



Analysis of Seasonal Variation of Some Physico-Chemical Parameters of Manas River, North-East India, to Assess Its Health

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ABSTRACT

The Manas River is a crucial tributary of the Brahmaputra River located in the North-Eastern region of India. It serves as a crucial source of water for irrigation, domestic use, and industrial activities (Sarma et al., 2019). To conduct a study on the physico-chemical parameters of the Manas River, water samples were collected from five different sampling sites, namely Mothanguri, B1, Narayanguri, B2, Bekipar, B3, Kalgachia, B4, Jogighopa, B5, at various times of the year between 2020(March) and 2023(February). Temperature is a crucial aspect to take into account when evaluating water quality as it can impact multiple parameters and modify the physical and chemical properties of water. Turbidity is a parameter that indicates the level of water clarity and how much suspended material in water reduces the transmission of light through it. Chloride is a crucial element for both aquatic and terrestrial organisms, serving as the primary extracellular anion in living organisms. The research conducted on the Manas River system unveiled considerable spatial and temporal fluctuations in its physicochemical parameters, which is a common occurrence in aquatic ecosystems.

Keywords: Phosphorus, Nitrogen, pH, aquatic, ecosystems, organisms

INTRODUCTION

The Manas River is a crucial tributary of the Brahmaputra River located in the North-Eastern region of India. It serves as a crucial source of water for irrigation, domestic use, and industrial activities (Sarma et al., 2019). The River Manas in Assam is a snow-fed river that is renowned for its fish diversity worldwide, housing both hill stream and plain water fish species. Originating outside the Great Himalayan range, the river drains approximately 41350 square

57816



**Priyam Sarmah**

kilometers in eastern Bhutan. The river enters India through the Manas National Park located at the foot of the Bhutan Himalayas in the Bodoland Territorial Area Districts (BTAD), Assam, and flows southwest before entering Bhutan again from the Kameng frontier region of India. The river bifurcates into two primary streams, with the upstream tributary known as Beki originating about 30 km downstream from the national park. In this context, the Manas River system refers to the junction of the Manas River and its tributary, the Beki River. The river flows through Bhutan for 272 km of its overall length of 376 km. In Assam, the River Manas stretches approximately 104 km, starting from its upstream origin at Mothanguri (located inside the Manas National Park) at an elevation of 87.5 m MSL, to its downstream confluence at Jogighopa at an elevation of 13.4 m MSL. The average width of the stream ranged from 175 to 310 meters. During the monsoon season, the stream was found to be quite swift, but it slowed down during dry seasons. The depth of the river ranged from 15.5 ± 7.19 m (Mothanguri) to 27.5 ± 14.11 m (Jogighopa) and was not uniform throughout. However, it was noted that the depth was lower upstream in comparison to downstream. The upstream river system has a 'V-shaped valley, clear water, fast flow, and a pebbly and rocky substratum. However, before merging with the Brahmaputra River, wide flood plains with low velocity could be observed in the downstream area. Unfortunately, the growing anthropogenic activities in the region have raised concerns regarding the quality of water in the Manas River. Activities such as urbanization, industrialization, agricultural activities, and deforestation have been identified as significant sources of pollution in the river (Devi et al., 2016). Such activities can severely impact the physicochemical properties of river water.

METHODS AND MATERIALS

To conduct a study on the physico-chemical parameters of the Manas River, water samples were collected from five different sampling sites, namely Mothanguri, B1, Narayanguri, B2, Bekipar, B3, Kalgachia, B4, Jogighopa, B5, at various times of the year between 2020(March) and 2023(February). The samples were collected during four seasons, namely pre-monsoon (March to May), monsoon (June to August), retreating monsoon (September to November), and winter (December to February), from to cover the variations in physico-chemical parameters. The distance between the sampling sites ranged from 22 to 28 km. Samples were collected randomly from all sampling sites in the morning of the first week of every month between 7 am and 10 am using Make-Tarson plastic bottles. Parameters such as Dissolved Oxygen (DO), temperature (WT), water velocity (WV), and Free CO₂ (FCO₂) were measured on the spot. The water samples were then analyzed in the laboratory for various parameters such as pH, total alkalinity, total hardness, total chloride (TC), turbidity, salinity, conductivity, and Total Dissolved Solids (TDS) using the methods of APHA (2005) and Trivedi and Goel (1986). The results were presented in a bar diagram, and the abbreviations used for the different seasons were PM, M, RM, and W for pre-monsoon, monsoon, retreating monsoon, and winter, respectively.

Physico-chemical parameters of water**Temperature (Water)**

Water temperature was measured using a centigrade thermometer with an accuracy of 0.1°C. The thermometer was immersed in the water for about 5 to 7 minutes and the temperature was recorded at the level where the mercury column becomes stable.

Turbidity

Turbidity was measured with the help of digital water analyzing kit (Make- Systronics). For this, a water sample was taken in a beaker and the cell was dipped into it. The terminals are connected to the sockets and the reading was recorded.

Water velocity

Surface water velocity or water current was measured by using a float, a measuring tape and a stopped clock. The particular distance covered by a pre-weighted drifted float at a particular time represents the velocity of running



**Priyam Sarmah**

water. The float is pre-weighted to get them submerged and to escape any wind effect. The water velocity was determined using the formula: $V = d/1.2t$ after Saha (2010).

Conductivity

Conductivity was estimated with the help of a digital water analysing kit (Make- Systronics) where sample water was taken in a beaker, terminals connected to the socket and reading was recorded.

Hydrogen Ion Concentration (pH)

pH of water samples at each sampling site was determined directly with the help of a digital pocket-sized pH meter (Model: HI-96107, HANNA Instrument). The instrument was calibrated for each measurement with a standard buffer solution having a pH value of 7.

Free CO₂ (FCO₂)

Chemical analysis was done on the spot following the method of Trivedi and Goel (1986) and APHA (2005). The calculation was done using the formula given below:

Dissolved Oxygen (DO)

The chemical estimation was done immediately after the collection of a sample by Modified Winkler's Method followed by Trivedi and Goel (1986) and APHA (2005).

Total Chloride (TC)

The chloride present in the sample water of each sampling site was estimated by Argentometric Method. The calculation was done by the following formula (Trivedi and Goel, 1986):

Hydrogen Ion Concentration (pH)

A digital pH meter (Make- Systronics) was used to determine the pH of soil water suspension followed by Das (2013). In a ratio of 1: 2, a 20 g soil sample was mixed in 40 ml distilled water. The suspension was stirred intermittently with a glass rod for 30 minutes and then left for an hour. The pH was recorded by dipping the electrode into the supernatant

Total Alkalinity (TA)

Total alkalinity was estimated by titrating the sample with a strong acid (HCl) using phenolphthalein and methyl orange indicators followed by Trivedi and Goel (1986).

Total Hardness (TH)

EDTA titrametric method (APHA, 2005) was employed to determine the total hardness of the water sample. The calculation of total hardness was done using the following formula:

Total Dissolved Solids (TDS)

The digital water analyzing kit (Make- Systronics) was used to estimate the Total Dissolved Solids (TDS). The cell was immersed into a beaker containing the sample water and the reading was recorded after the terminals were connected to the sockets.

Salinity

For salinity analysis too, the digital analyzing kit (Make- Systronics) was used. The water sample was taken in a beaker and the cell was dipped into it. The terminals were connected to the sockets and the reading was recorded.



**Priyam Sarmah****Sediment Quality Analysis**

Composite soil samples (sediment) were collected randomly from each survey station from 0 – 200 cm depth during the study period. After removing recognizable plant debris, these composite samples were dried under shade and finally powdered with a wooden pestle and mortar such that they easily can pass through a sieve (2 mm). These were then stored in plastic containers and used for physical and chemical analysis following Jhingran *et al.* (1969).

Organic Carbon (OC)

To estimate the quantity of organic carbon in the soil sample, the method of Walkey and Black (1934) described by Jackson (1967) was employed.

Available Nitrogen (N₂)

To estimate available nitrogen in the soil, the Kjeldahl method was employed

Available Phosphorus (P₂O₅)

The Stannous chloride method was employed to estimate the quantity of available phosphorus in the soil samples followed by Saha (2010).

RESULTS

Physico-chemical parameters influence both the horizontal and vertical migration of aquatic organisms. The distribution, diversity as well as feeding of aquatic organisms including fish is affected by these parameters. Therefore, it is of utmost importance to maintain and monitor the surrounding environmental parameters for suitable growth and development of aquatic flora and fauna

Temperature (Water)

Temperature is a crucial aspect to take into account when evaluating water quality as it can impact multiple parameters and modify the physical and chemical properties of water. Furthermore, water temperature has the potential to affect the metabolic rates and biological activity of aquatic organisms, thereby influencing their preferred habitats. The water temperature was found to fluctuate moderately among all the study sites and ranged from $8.0 \pm 0.182574^\circ\text{C}$ to $27. \pm 0.496655^\circ\text{C}$ highest recorded in monsoon season at B4 and lowest in winter at B1. Fig. 1 depicts the water temperature recorded during four seasons in the five sampling sites of Manas river system.

Turbidity

Turbidity is a parameter that indicates the level of water clarity and how much suspended material in water reduces the transmission of light through it. However, it does not provide a direct measurement of the overall suspended materials present in water. Turbidity is generally used as an indicator of changes in the concentration of Total Dissolved Solids (TDS) in water, but it does not provide an exact measurement of solids. In the present study, turbidity values ranged from 0.1 ± 0 to 121 ± 0.294392 NTU (fig2) lowest in B1 & B2 during winter and highest in B4 during monsoon season.

Water velocity

Water velocity is considered a very important parameter which affects the distribution of fish species and their abundance. The estimated values of water velocity were observed to vary (Fig. 3) from $0.3 \pm 0.08165\text{ms}^{-1}$ in pre monsoon in site- B5 to 1.2 ± 0.01 ms⁻¹ in monsoon season in site-B1.

Conductivity

Conductivity of water is a measure of the ability of water to conduct an electrical current. It is an important indicator in the measurement of water quality. The purer the water, the lower the conductivity.



**Priyam Sarmah**

On annual average basis, maximum ($463 \pm 2.44949 \mu\text{s}$) conductivity at site B4 in pre monsoon and minimum ($30 \pm 0.816497 \mu\text{s}$) at site B1 during retreating monsoon (Fig. 4) was observed.

Hydrogen Ion Concentration (pH)

To determine the acidity or alkalinity of a solution, the pH scale is used, which ranges from 0 to 14, with 7 being considered neutral. Solutions with a lower pH are considered acidic, while those with a higher pH are considered alkaline. In the context of water quality assessment, pH is a crucial factor as it can impact the productivity of water and the growth and reproduction of aquatic organisms. The value of pH was observed to be within the range of 5.73 ± 0.08165 (retreating monsoon at B2) and 8 ± 0.081649658 (pre monsoon at B1) and estimated to be slightly acidic in all the five sampling sites in retreating monsoon season (Fig. 5). However, it was estimated to be alkaline in sites – B3, B4 and B5 during pre- monsoon season.

Free CO₂ (FCO₂)

FCO₂, or free carbon dioxide, is a naturally occurring gas that can dissolve in water. It is essential for the process of photosynthesis in aquatic plants and is important for their growth and reproduction. However, excessive amounts of FCO₂ can be harmful to fish and other aquatic organisms. When the concentration of FCO₂ in water is too high, it can result in acidic water conditions, which can lower the pH and increase the corrosive effects of oxygen, leading to negative impacts on aquatic life. Therefore, maintaining a balanced level of FCO₂ in water is crucial for the health and well-being of aquatic ecosystems. Highest value of FCO₂ ($4.4 \pm 0.08165 \text{mgL}^{-1}$) was recorded at site B4 during retreating monsoon and lowest value ($0.8 \pm 0.082057 \text{mgL}^{-1}$) at site B1 during winter season (Fig. 6).

Dissolved Oxygen (DO)

The term DO stands for Dissolved Oxygen, which refers to the amount of oxygen that is freely available in water or other liquids. This parameter is crucial in evaluating water quality due to its impact on the survival of aquatic organisms that rely on DO for respiration. The concentration of DO varied from $14.55 \pm 0.008165 \text{mgL}^{-1}$ to $6.5 \pm 0.08165 \text{mgL}^{-1}$ highest recorded in winter from B1 and lowest recorded in retreating monsoon from B4 (Fig. 7).

Total chloride (TC)

Chloride is a crucial element for both aquatic and terrestrial organisms, serving as the primary extracellular anion in living organisms. However, the discharge of toxic chlorinated waste into water bodies can increase the chloride content of the water. While it is essential for maintaining normal physiological functions, elevated or fluctuating concentrations of chloride in water can be harmful to aquatic organisms as it can disrupt osmoregulation, leading to impaired growth and reproduction. The annual mean concentration of chloride was observed to fluctuate slightly within the five sampling sites during the four seasons (Fig. 8) within the range of 9.5mg L^{-1} and $15 \pm 0.820569 \text{mg L}^{-1}$ with highest value recorded in winter from site-B2 and lowest value observed in pre monsoon from site- B3

Total Alkalinity (TA)

Alkalinity is a characteristic of water that determines its capacity to resist changes in pH levels that would cause the water to become more acidic. It is determined by the concentration of carbonate and bicarbonate ions dissolved in the water, which contribute to the water's buffering capacity. The calculated alkalinity values in all sampling sites ranged from $75 \pm 0.182574 \text{mgL}^{-1}$ to $170 \pm 0.832666 \text{mgL}^{-1}$ throughout the annual cycle (Fig. 9). Highest value of alkalinity was recorded from B4 during the winter season and the lowest value was recorded from B5 during the premonsoon season.

Total Hardness (TH)

The term total hardness refers to the concentration of alkaline earth metals such as calcium and magnesium, in combination with weak and strong acids. Temporary hardness is typically associated with carbonates and bicarbonates, while permanent hardness is associated with sulfates and chlorides..



**Priyam Sarmah**

The annual range of total hardness in the entire sampling site varied from 40 ± 0.081649658 mg L⁻¹ to 210 ± 0.163299 mg L⁻¹ with lowest value recorded in retreating monsoon in site-B1 and highest value recorded in pre monsoon from site B5 (Fig. 10)

Total Dissolved Solids (TDS)

TDS refers to the total amount of dissolved inorganic and organic substances in a liquid, including molecules, ions, and micro-granules that are suspended in it. When it comes to clean water, TDS and salinity are nearly identical. However, in water with high TDS concentration, cells may shrink, which can affect the mobility of organisms in the water column, causing them to float or sink beyond their typical range. Values of TDS were found to fluctuate between 22.8 ± 0.08165 ppm (B1) and 270 ± 0.081649658 ppm (B1) during retreating monsoon and pre monsoon respectively which has been depicted in Fig. 11.

Salinity

The concentration of dissolved salt in a given volume of water is called salinity. Salinity is either expressed in grams of salt per kilogram of water, or in parts per thousand (ppt). Salinity values ranged from 0.05 ± 0.011547005 ppt to 1.85 ± 0.03 ppt with highest value recorded in pre monsoon at B4 and lowest value recorded in monsoon at B1 and was observed to be almost uniform throughout all sampling sites during all the four seasons (Fig. 12).

Sediment Quality

Organic carbon refers to the carbon stored in soil organic matter (SOM). It plays a crucial role in soil health, acting as a nutrient reservoir that helps reduce surface crusting and compaction while increasing water penetration into the soil. During the investigation period, the data recorded for organic carbon varied from $0.24\% \pm 0.018257419$ in pre monsoon at B1 to $1.24\% \pm 0.018257$ in monsoon season from B4 (Fig. 13).

Hydrogen ion concentration (pH)

Soil pH refers to the degree of acidity or alkalinity in soil, and it is a critical factor that affects a range of chemical processes within the soil. It is widely recognized as a master variable in soils that can help identify the chemical properties of the soil suspension. The pH values of sediment of Manas River revealed slightly acidic condition during winter season at all the five study sites. The site wise variation of soil pH in all the four seasons was presented in Fig. 14. The soil pH of the river recorded maximum (7.95 ± 0.08165) in retreating monsoon season at B3 and minimum (6.2 ± 0.08165) in winter season at B5.

Nitrogen (N₂)

The majority of nitrogen found in soil is in the form of organic matter, along with trace amounts of ammonia and nitrate. The nitrogen that is accessible to plants in the soil is referred to as available nitrogen. The quantity of available nitrogen in the soil is affected by environmental factors such as rainfall and temperature. The present study recorded a maximum of 67 ± 0.244949 Kg ha⁻¹ nitrogen in monsoon at site B3 and a minimum of 5 ± 0.08165 Kg ha⁻¹ during the winter season from site B3 (Fig. 15).

Phosphorus (P₂O₅)

Phosphorus is an essential element that has been suggested to be the limiting nutrient in primary production in freshwater and is sometimes referred to as a 'sub-optimal' element. It is required for various cellular processes such as metabolism, cell division, respiration, growth, and synthesis of proteins in all living tissues. The inorganic form of phosphorus is considered important for production. However, due to its reactivity, phosphorus occurs in soil in very low amounts. In the present investigation, the concentration of phosphorus in soil was observed to range between 1 ± 0.08165 Kg ha⁻¹ during winter at B3 and 6.7 ± 0.184097 Kg ha⁻¹ during monsoon at site B5. It was observed that its trend progressively decreased from monsoon to winter (Fig. 16).





Priyam Sarmah

DISCUSSION

Based on the study, the water temperature ranged from $8.0 \pm 0.182574^{\circ}\text{C}$ to $27. \pm 0.496655^{\circ}\text{C}$, with the highest temperature being recorded during the monsoon season at B4 and the lowest temperature during winter at B1. This variation could be attributed to the fact that site B1 is located in the upper reaches of the study area, while site B4 is situated in the lower reaches. A similar trend of temperature fluctuation was also observed in a headwater stream of Garhwal by Sharma et al. (2016). It is important to note that variation in water temperature due to seasonal changes is a common occurrence in aquatic ecosystems, as reported by Laal et al. (1988) and Nath (2001). The study revealed significant spatial and temporal variations in the physicochemical characteristics of the river water. Turbidity levels ranged from 0.1 ± 0 to 121 ± 0.294392 NTU, with the lowest readings in B1 and B2 during winter and the highest in B4 during the monsoon season. During the monsoon season, the turbidity values were the highest in all the sampling sites as compared to pre-monsoon, retreating monsoon, and winter. This increase in turbidity is attributed to heavy rainfall during the monsoon season, which leads to an increase in the turbidity of the sandy bottom of the sampling sites. Similar findings were reported by other researchers such as Banerjee et al. (1998), Singh et al. (1999), and Das (2013).

Water velocity values were observed to vary from $0.3 \pm 0.08165\text{ms}^{-1}$ in pre-monsoon at site-B5 to 1.2 ± 0.01 ms^{-1} in the monsoon season at site-B1, with higher values of water velocity observed in the monsoon season and lower values in the winter season in all five sampling sites. Basistha (2006) reported similar water velocity values ranging from 0.2 ms^{-1} to 1.3 ms^{-1} in this particular river system, while Singh et al. (2012) found similar results from the hill stream Sidzii, a tributary of the Doyang River. The study revealed significant spatial and temporal variability in the physicochemical parameters of the river water. Turbidity values ranged from 0.1 ± 0 to 121 ± 0.294392 NTU, with the lowest values recorded in B1 and B2 during winter and the highest value in B4 during the monsoon season. The highest water velocity values were observed in the monsoon season and the lowest in the winter season in all five sampling sites. The annual average basis conductivity values varied from a maximum of 463 ± 2.44949 μs at site B4 in pre-monsoon to a minimum of 30 ± 0.816497 μs at site B1 during retreating monsoon. While there is no set standard for the conductivity of water, it was observed that the conductivity values of the Manas River system were within the normal range of 100 – 2000 recorded highest in the upstream and lowest in the downstream part. Similar findings were reported by Basistha (2006) and Singh et al. (2012) in this particular river system and the hill stream Sidzii, a tributary of the Doyang River, respectively.

The pH values were found to fluctuate within different sampling sites during the four seasons of the year, indicating a slightly acidic to the alkaline condition of the water body. Although the optimal range of pH is between 6.5 and 8.5 (BIS, 1982), a pH range of 5.0 to 9.0 is not directly lethal to fish (Liong, 1984). FCO_2 concentration was found to be higher during monsoon and retreating monsoon seasons in the five study sites during the present investigation. A lower value was recorded during the winter season. An increase in the FCO_2 value during the rainy seasons may be attributed to the increase in the amount of decayed matter brought in by rainwater and flood. DO is one of the most important factors in the aquatic environment. In the present investigation, DO values fluctuated from 14.55 ± 0.008165 mgL^{-1} to 6.5 ± 0.08165 mgL^{-1} , with the highest recorded in winter from B1 and the lowest recorded in retreating monsoon from B4, which was well above the tolerance limit (5 mg^{-1}) prescribed by BIS. The average total chloride concentration in the Manas River system did not show significant variation across the five sampling sites during the four seasons and remained within the acceptable limit recommended by Talukdar (2016).

The alkalinity of freshwater ecosystems usually ranges from 20-200 mg/L due to the presence of carbonate and bicarbonate ions (Ishaq& Khan, 2013). In the present study, the total alkalinity of the water in the Manas River system was found to be within this range. The total hardness of the river water varied from 40 ± 0.081649658 mg/L to 210 ± 0.163299 mg/L across all sampling sites, with the lowest value recorded in retreating monsoon at site-B1 and the highest value recorded in pre-monsoon at site-B5. The water was observed to be relatively soft upstream and harder downstream, suggesting that it is suitable for sustaining a good fishery. The total dissolved solids (TDS)



**Priyam Sarmah**

values in the Manas River system fluctuated between 22.8 ± 0.08165 ppm and 270 ± 0.081649658 ppm during retreating monsoon and pre-monsoon, respectively. The lowest value was recorded at site-B1 and the highest value at site-B5. TDS values beyond 2000 mg/L can have toxic effects on fish and fish eggs (Hickin, 1995). In the present study, TDS values remained very low, which is characteristic of clean waters according to EPA (2012).

Salinity plays a crucial role in the physiological and reproductive activity of aquatic organisms (Karuppasamy & Perumal, 2000). The salinity values at site-B1 were relatively low, possibly due to the high DO concentration and water velocity. During the pre-monsoon season, the salinity values were higher and lower during the monsoon season, with the highest values recorded at site-B4. Evaporation can increase the concentration of ions and, consequently, the salinity values. Conversely, the rise of water level during the rainy season lowers the salinity concentration (Pattilo, 1994).

The sediment quality analysis conducted in the study area indicated that the organic carbon values fluctuated between $0.24\% \pm 0.018257419$ and $1.24\% \pm 0.018257$, which is consistent with the findings reported by Talukdar (2016) and Das (2013) from the sediments of Simsang River and Pagladia River, respectively. The sediment pH of the Manas River system ranged from slightly acidic to alkaline, with values ranging from 6.2 ± 0.08165 to 7.95 ± 0.08165 . Chaudhury (2002) reported a similar range of pH (6.0–7.5) from the sediments of rivers in Arunachal Pradesh, and Das (2013) reported a pH range (6.45–6.84) from the sediments of the Pagladia River that was similar to the present findings.

According to Gupta et al. (2006), the ideal nitrogen content in soil should range from 272–544 kg ha⁻¹. However, the present study recorded nitrogen values that ranged from 67 ± 0.244949 Kg ha⁻¹ to 5 ± 0.08165 Kg ha⁻¹. The lower values of nitrogen could be due to the low concentration of organic carbon, which contains nitrogen and nitrogen-fixing microorganisms in the soil, as suggested by Talukdar (2016). Additionally, the phosphorus content estimated in the present study (ranging from 1 ± 0.08165 Kg ha⁻¹ to 6.7 ± 0.184097 Kg ha⁻¹) was also below the standard value reported by Gupta et al. (2006), which is between 22.5 and 56 kg ha⁻¹. The low phosphate content in the soil may be due to the low organic carbon concentration in the soil or its presence in an insoluble state, as suggested by Rai et al. (2010).

CONCLUSION

The research conducted on the Manas River system unveiled considerable spatial and temporal fluctuations in its physicochemical parameters, which is a common occurrence in aquatic ecosystems. Among the parameters analyzed, water temperature, turbidity, water velocity, FCO₂ concentration, dissolved oxygen (DO), total chloride concentration, total alkalinity, and total hardness exhibited significant variations across different sampling sites and seasons. While the pH values were within the acceptable range, the total dissolved solids (TDS) values were low, indicating that the river water is suitable for supporting a healthy fishery. The outcomes of this investigation can provide valuable insights for the effective management and preservation of the Manas River ecosystem.

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Declaration of competing interest

None to declare





Priyam Sarmah

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Priyam Sarmah

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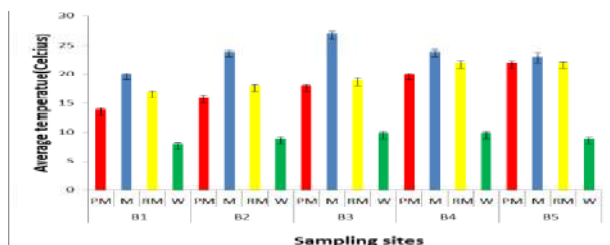


Fig. 1. Seasonal variation in water temperature values at different sampling sites of Manas river system (2020-2023).

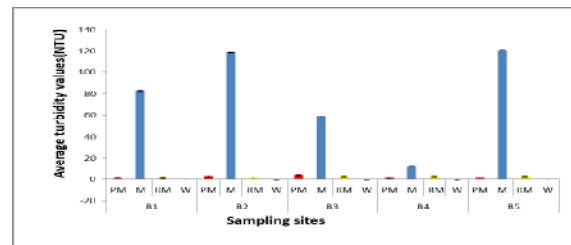


Fig. 2. Seasonal variation in turbidity values at different sampling sites of Manas river system (2020-2023).

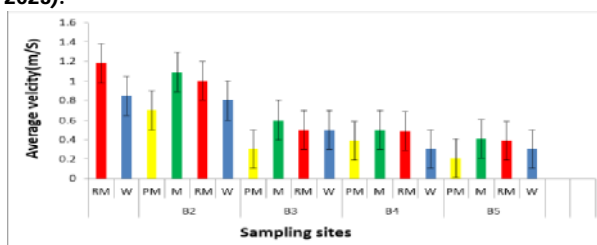


Fig. 3. Seasonal variation in water velocity values at different sampling sites of Manas river system (2020-2023).

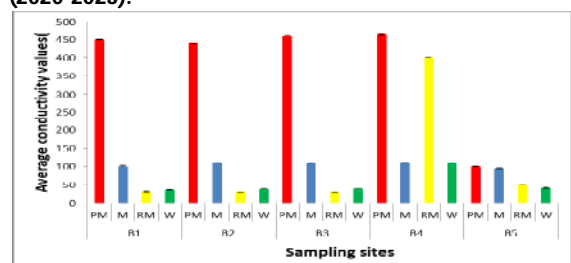


Fig. 4. Seasonal variation in conductivity values at different sampling sites of Manas river system (2020-2023).

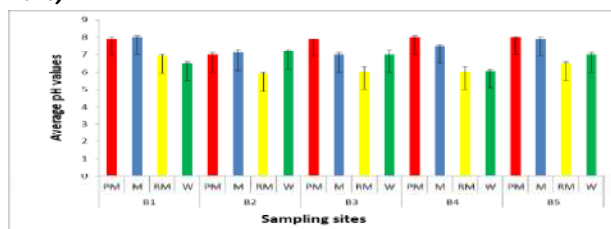


Fig. 5. Seasonal variation in water pH values at different sampling sites of Manas river system (2020-2023).

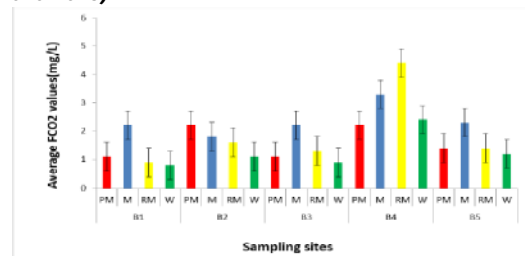


Fig. 6. Seasonal variation in FCO2 values at different sampling sites of Manas River (2020-2023).





Priyam Sarmah

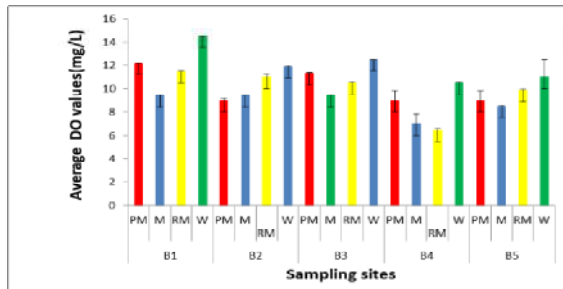


Fig. 7. Seasonal variation in Dissolved Oxygen (DO) values at different sampling sites of Manas river system (2020-2023).

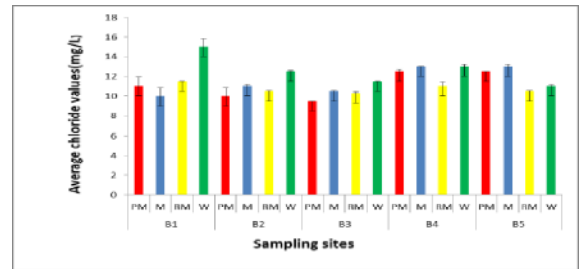


Fig. 8. Seasonal variation in Total Chloride (TC) values at different sampling sites of Manas river system (2020-2023).

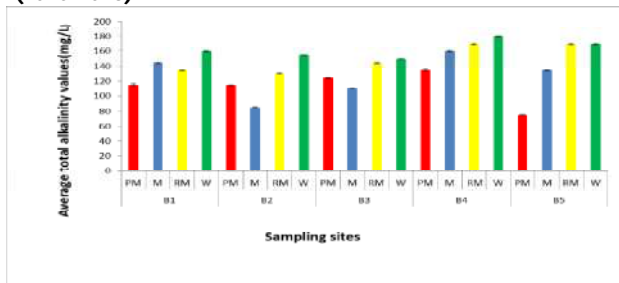


Fig. 9. Seasonal variation in Total Alkalinity (TA) values at different sampling sites of Manas river system (2020-2023)

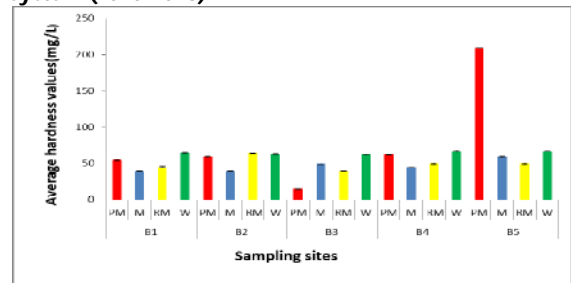


Fig. 10. Seasonal variation in Total hardness (TH) values at different sampling sites of Manas river system (2020-2023).

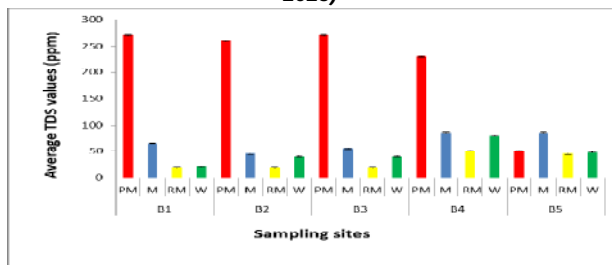


Fig. 11. Seasonal variation in TDS values at different sampling sites of Manas river system (2020-2023).

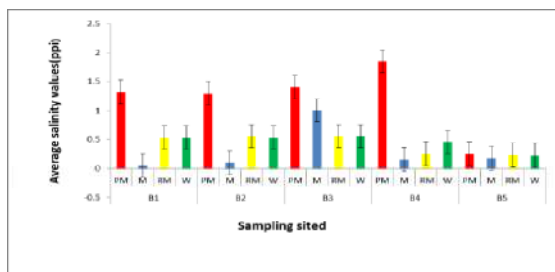


Fig. 12. Seasonal variation in salinity values at different sampling sites of Manas river system (2020-2023).

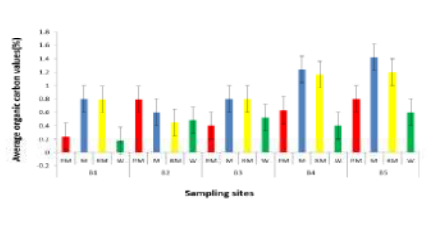


Fig.13. Average organic carbon values (%) at different sampling sites of Manas river system (2020-2023) during the four seasons.

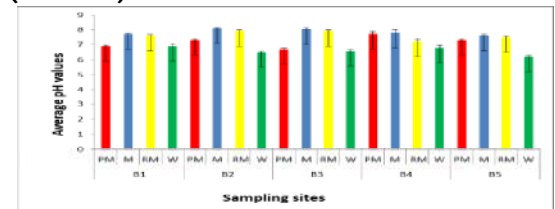


Fig.14. Seasonal variation in soil pH values at different sampling sites of Manas river system (2020-2023).





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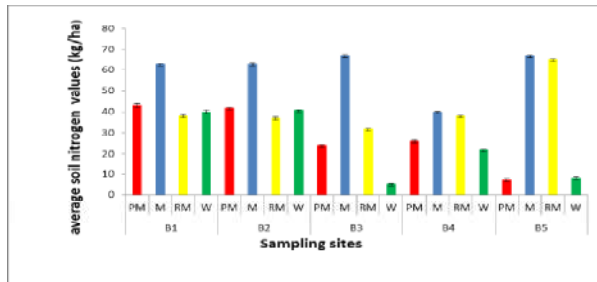


Fig. 15. Seasonal variation of soil nitrogen at different sampling sites of Manas river system (2020-2023)

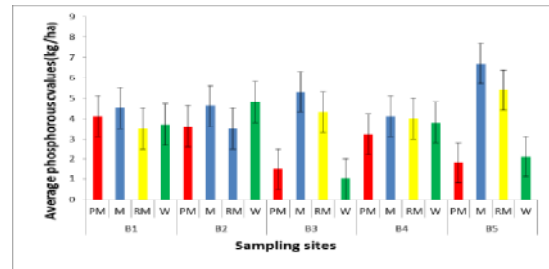


Figure 16. Seasonal variation of soil phosphorus at different sampling sites of Manas river system (2020-2023)





Fertility Enhancing Potential of Aerial Part of *Enhydra fluctuans* in Male Albino wistar Rats

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ABSTRACT

This investigation was designed to assess the pharmacognostical, antioxidant and fertility enhancing potential of ethanol extract of aerial part of *Enhydra fluctuans* in albino Wistar rats. The test extract was evaluated up to 2000 mg/kg body weight as safe for oral acute toxicity. The antioxidant potential was evaluated by DPPH radical scavenging activity. In accordance to determine the male-female fertility enhancing potentials the test sample were administered orally for 21 days at 100, 200 mg/kg body weight. After 27 days of experiment, rats were sacrificed. In male, the sperm count, sperm morphology, live and dead sperm count were evaluated. At 200 mg/kg body weight a significant rise in sperm count, live sperm percent which also accompanied by a decrease flattened head or dead sperm percent in comparisons to normal saline treated group with a level of significance ($P < 0.05$ and $P < 0.001$). The testes histopathology was also showing seminiferous tubules lining with germs cells containing luminal spermatozoa. In the male hormonal parameters were estimated from plasma serum which shows an increment in the testosterone, LH, FSH level in animals group treated with extract 200 mg/kg body weight. The gross morphology was also found to be improved in organs associated with reproductive system.

Keywords: *Enhydra fluctuans*, bioactive compounds, antioxidant, rat, male, fertility.





Moksood Ahmed Laskar and Mrinmoy Basak

INTRODUCTION

The use of herbs was been in practiced since the ancient times for the purpose of healthcare procurement throughout most human races Worldwide [1]. Fertility term refers to an organism for having the ability to reproduce itself whereas the inability of carry a pregnancy or to conceive is called as infertility. An estimation has reported that the prevalence of infertility is 10-15% married population across the globe [2]. Male infertility is the failure of causing pregnancy with a fertile female. This is attributed to few reproductive diseases which may include; poor sperm production and count, low quality sperms with functional defects, inadequate quality of semen which measures male fecundity[3].

Many approaches have been made for evaluation of fertility enhancing potential since long duration including chemical, hormonal and immunological approaches. The treatment with imported drugs and with advance technologies cannot be afforded by majority of couples having the problem infertility. Consequently, the uses of ethnomedicines remains and also will be remain for prolong as a chief sources and method towards health care ailment in most of developing countries. Moreover, many studies revealed the pro- fertility potential of various herbal drugs. However, no such investigation has been done on *Enhydra fluctuans* to the best of our knowledge.

Enhydra fluctuans is mostly abundant on marshy waste disposed areas and even on wet roadside canals so termed as hydrophytic plant and mostly grows in months of October to February. It is mostly found in China, Malaysia, Bangladesh, Tropical Africa and South East Asia. This plant is available predominantly in Assam and the North-Eastern region in India. *Enhydra fluctuans* has abundant applications in treating life threatening diseases like diabetes, cancer, liver problems and even has strong antioxidant, analgesic, fertility enhancement anti-inflammatory, anti-diarrhoeal and antimicrobial activity [4,5]. The various extracts of this plants reported with the absence or presence many chemical constituents such as alkaloids, carbohydrates, flavonoids, proteins, oils, tannins, phenolics, carbohydrates, isoflavone glycoside, and sesquiterpene lactones which justify its diverse medicinal value [6].

MATERIALS AND METHODS

Collection and authentication of plant materials: The fresh aerial parts of *Enhydra fluctuans* were collected from the locality of Bonda Amgaon of Kamrup (rural) district, Assam, India. The herbarium was prepared and authentication of plant species was done in Gauhati University, Assam, India.

Extraction: The extraction was done by the process of cold maceration using 100 grams of shed dried powder of plant extract with ethanol as a solvent. The obtained preparation was filtered and the filtrates are concentrated to sticky mass using Rota evaporator 3.42% was calculated as extractive value[7].

Pharmacognostic study: The morphology and microscopic observation was done. The preliminary test Phytochemical constituents such as test for alkaloids, glycosides, flavonoids, steroids, phenanthrene, phenolic compound and tannins were done [8].

Acute Toxicity Study: As per the OECD guidelines the oral acute toxicity study was carried out on the experimental rats.

Experimental animals: A sum of 24 Albino with an average weight of 190 gm-250gm of 3 months of age were acclimatized for 15 days in the animal housed facility of Assam down town University, Assam India. The animals were maintained 6 animals in each metabolic cage with average temperature 28-31°C, 12 hours dark and light with proper ventilation and supply of food pellets and water. Experiments was conducted in compliance with the protocols prescribed by OECD and CPCSEA guidelines. It was approved by the institutional animal ethics



**Moksood Ahmed Laskar and Mrinmoy Basak**

committee in accordance with the CPCSEA nominees with minimal animal suffering the approval no and date given as AdtU/IAEC/2022/08 on 24/09/2022. The rats are randomly divided into four different groups and the treatment was given orally for control group distilled water is administered as 1 mL/kg body weight, the ethanol extract of *Enhydra fluctuans* were administered as 100 and 200 mg/kg body weight and a standard drug treated group administered with 0.3 mg/kg of clomiphene citrate. The treatment was continued for 14 days the changes in body weight and total food consumption were recorded during the experimental days. At 15th day from the starting of treatment the animals were sacrificed with adequate euthanasia, blood sample were collected for biochemical estimation of reproductive hormones and other blood counts and lipid profile. The ventral prostrate were removed cleaning the attached fats and weighed. The epididymis, seminal vesicles and testis, were isolated, right testis were processed for histopathology whereas with epididymis and left testis are considered for sperm count and sperm morphology [9].

Gonadosomatic Index (GSI). The isolated epididymis and testes were weighed and recorded for all groups of animals and gonadosomatic index was determine using the formula as below:
{testes weight ÷ body weight} x 100 [10].

Sperm analysis: The scrotal incision was made to collect epididymis which is kept in petri-dish. Epididymis is weighed and recorded for all the groups of rats. The crushed and homogenized epididymis was transfer into another petri dish preloaded with 1 ml normal saline solution which then added to semen and mixed thoroughly with the aid of syringe to release and draw continuously to achieve adequate mixing. The mixture of semen was sucked up to 0.5 mark within the red blood cell pipette, addition of normal saline solution was done till 101 mark of the pipette and mixed, then the normal saline was discarded from stem of the pipette and the contents from bulb of the pipette was mixed thoroughly. One drop from the mixture was transferred to the neubauer chamber and spreaded through capillary action by placing a cover slip. The neubauer chamber was placed and viewed under 40X magnification in a slide stage microscope. The sperm cells were counted within the major five squares of neubauer chamber sliding the stage left and bottom to right and top. The counting of sperm was calculated as = $n \times 1 \times 10^6$ /ml of semen in rat [11].

Hormonal analysis: The collection of blood was done from tail vein of all the experimental animals after completion of the treatment. Centrifugation of blood samples was done for 10 minutes at 2500 rpm. The supernatant serum was withdrawn for estimation of reproductive hormones testosterone, luteinizing hormone (LH) and follicle- stimulating hormone (FSH). Serum FSH and LH was determined by a radioimmunoassay (RIA) kit, Board of Radiation and Isotope Technology, Mumbai, India); FSH level was measured by a microplate chemiluminescence immunoassay (CLIA) kit [12]. The testosterone concentration of serum was estimated by an enzyme-linked immunoassay method (Transasia Biomedicals Ltd., Bombay, India) following all the instructions and protocol designed in the commercial kit [13].

Histological analysis: The collected right testis was fixed for 24 hours in Bouin Fluid then it dehydrated using 70% alcohol. The dehydrated tissue again was washed through 80%,90% and absolute alcohol followed by treatment with xylene for several periods. It was finally fixed and infiltrated in paraffin wax keeping in oven at 65°C for 1 hour. The embedded tissue was sliced using hand rotary microtome with continuous thin sections of 5 microns. Sections of tissues were placed in slides preloaded with albumin and allowed to dry for 2 minutes using a hot plate. The tissue slides then treated with xylene for dewaxing and also treated with several alcohol concentration in descending order. Haematoxylin-eosin was used for staining the slides and finally it was mounted in DPX. It was observed under at a 100X magnification under Axio-Cam microscope [14].





Moksood Ahmed Laskar and Mrinmoy Basak

RESULT AND DISCUSSION:

Morphological parameters: Table.1: Morphological characters of leaf (*Enhydra fluctuans*)

Microscopic evaluation: The freshly collected aerial part transverse section was made and dried powder of the same was observed under microscope at 40x magnification shown in figure 2, and 3 respectively. Phytochemical Screening: The ethanol extract was processed for the Detection of alkaloids, glycosides, flavonoids, steroids, phenanthrene, phenolic compound and tannins obtained results shown in Table 2.

Acute Toxicity Study: The acute oral toxicity was of the ethanol extract was evaluated up to a dose of 2000 mg/kg body weight, where no sign of toxicity and mortality was observed so, the oral LD50 thus taken to be > 2000 mg/kg. Gonadosomatic Index: Effect of repeated daily oral treatments with 100-200 mg/kg/day of ethanol extract of *Enhydra fluctuans* (EEEF) on the average body weight on initial day and one day after the termination of experiments, testicular weight (TW) and gonadosomatic indices (GSI) and represented with a significant increase at $p < 0.05$, $p < 0.01$, and $P < 0.001$ respectively when compared with the normal saline treated groups as shown in the table 3 below.

Sperm analysis: The average sperm measured in the EEEF treated groups was found to increased as compared to the control group with a level of significantly ($P < 0.05$) however it was less than the standard drug clomiphene citrate treated group. Range of normal sperm and abnormal sperm percentage was found to be improved in comparison to the normal saline treated groups as shown below Table 5.

Hormonal analysis : The Serum levels of follicle stimulating hormone, luteinizing hormone and testosterone were measured using commercially available kits. According to the Table 6, the groups of animal with 100 mg/kg body weight and 200 mg/kg body weight of ethanol extract of *Enhydra fluctuans* treated were obtained with a certain rise in the hormonal concentration with a level of significance ($P < 0.01$) and ($P < 0.001$) respectively, whereas it was less when compared to the standard drug clomiphene citrate treated group as shown below.

Histopathology: The testicular sections of control group (a), 200 mg/kg ethanol extract of *Enhydra fluctuans* (b) and a standard drug clomiphene citrate treated group (c) photographs are being presented below in Table 5. In (b) the observation of spermatogenic series (SS) in seminiferous tubules, spermatozoa containing lumen (L), spermatogonium (SG), arrow marked represented spermatids and spermatozoa were improved compared to the normal saline treated group (a). However, the improvement was low in reference to the standard drugs treated group (c).

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Moksood Ahmed Laskar and Mrinmoy Basak

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Table.1: Morphological characters of leaf (*Enhydra fluctuans*)

Particulars	Observation
Colour	Green
Odour	No
Taste	No
Length	3.0-5.0cm.
Margin	Serrate/Crenate
Apex	Acute
Shape	Linear-oblong
Petioles	Absent
Surface	Glabrous-pubescent.

Table 2: Phytochemical screening of ethanol extract of *Enhydra fluctuans* (Aerial parts)

SI. No.	Constituents	Test	Methanolic Extract
1	Alkaloids	Mayer's reagent	++
		Dragendroff's reagent	++
		Hager's reagent	++
		Wagner's reagent	++
2	Flavonoids	Aqueous NaOH	++





Moksood Ahmed Laskar and Mrinmoy Basak

3	Glycosides	Borntrager's reagent	++
		Legal test	++
		Keller kiliani test	++
4	Phenols	Ferric chloride test	++
		Lead acetate test	++
5	Carbohydrate	Molisch's reagent	++
		Fehling's reagent	++
		Benedict reagent	++
		Seliwanoff's reagent	--
6	Saponin	Foam test	++

Table 3: Effect of ethanol extract of *Enhydra fluctuans*(EEEF) on rats GSI, TW

Treatment	Average body weight on Day-1(gm)	Average body weight on Day-15(gm)	Average testicular weight (gm)	Average gonadosomatic index (x10 ⁻²)
Control	225.40±12.16	226.20±13.16	03.46 ± 0.32	12.04 ± 0.16
100 mg/kg	227.80±12.95	228.40±12.95	03.50 ± 0.16	12.80 ± 0.42
200 mg/kg	230.40±13.37	232.80±13.16*	03.84 ± 0.43*	13.08 ± 0.81*
Clomiphene citrate 0.3 mg/kg	228.70±12.65	230.70±13.95	04.25 ± 0.32	13.60 ± 0.32

* Represent significant increases at p<0.05, p<0.01, and P<0.001 respectively when compared with the normal saline treated groups

Table 4: Effect of ethanol extract of *Enhydra fluctuans*(EEEF) on sperm parameters

Parameters	Control (Saline)	100 mg/kg EEEF	200 mg/kg EEEF	0.3 mg/kg Clomiphene citrate
Sperm count (x10 ⁶ /ml)	78.72 ± 0.16	80.54 ± 0.16	83.20 ± 0.01	85.66 ± 0.20
Abnormal sperm (%)	13.26 ± 1.04	12.85 ± 0.40	11.86 ± 0.32	11.05 ± 0.4
Normal sperm (%)	85.84 ± 0.32	86.15 ± 1.20	87.08 ± 1.02	88.95 ± 0.16

Values are expressed as Mean ± S.E.M; n = 6 in each group

Table 5: Effect of ethanol extract of *Enhydra fluctuans* (EEEF) on testosterone level, FSH and LH

Parameters	Control (Saline)	100 mg/kg EEEF	200 mg/kg EEEF	0.3 mg/kg Clomiphene citrate
Testosterone (ng/ml)	3.95 ± 0.27	4.10 ± 0.16	4.68 ± 0.20	4.95 ± 0.16
FSH (mIU/ml)	3.40 ± 0.20	3.85 ± 0.40	3.95 ± 0.18	4.14 ± 0.4
LH (mIU/ml)	30.16 ± 3.18	32.46 ± 1.40	34.12 ± 0.60	36.20 ± 0.12

Values are expressed as Mean ± S.E.M; n = 6 in each group





Moksood Ahmed Laskar and Mrinmoy Basak



Figure 1: *Enhydra fluctuans*

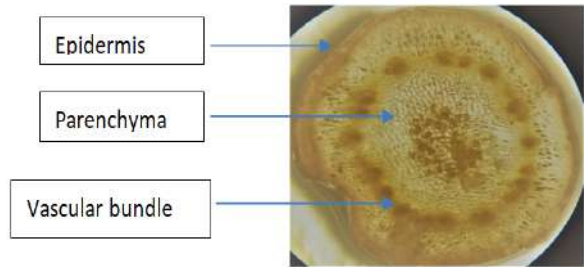


Figure 2: T. S of Aerial part of *Enhydra fluctuans*

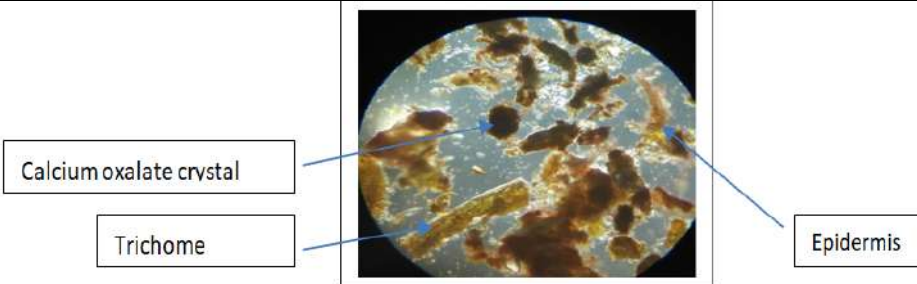


Figure 3: Powder microscopy of Aerial part of *Enhydra fluctuans*



Figure 4: Steps involved in extraction and phytochemical tests

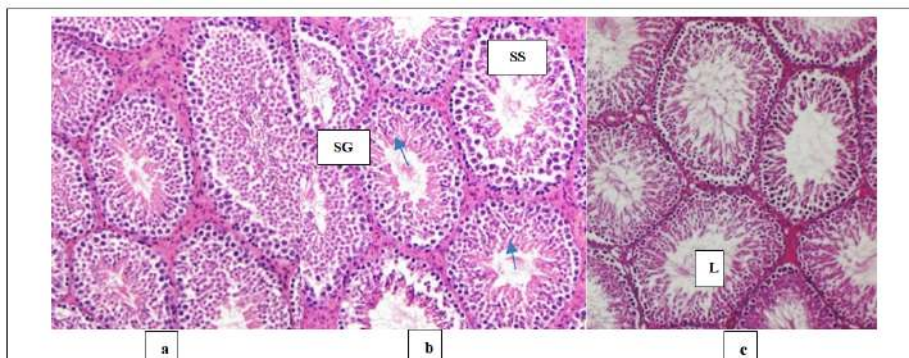


Figure 5: Histopathological Photomicrographs of rat testis





Summarize the Cumulative Rainfall Statistical Data using Five Number Summary, Outliers and Graphical Representation of Box Plot

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ABSTRACT

Engineering is a key instrument for issue solving in the modern environment. To come up with creative solutions, statistics is necessary. The employment of statistical techniques will improve comprehension and provide solutions. Making decisions is a crucial part of our life. We base our choices on the knowledge we possess, our attitudes, and our values. We can evaluate information using statistical approaches. Also, statistics can be utilised to help us decide when there are doubts. Using statistical approaches, we can make a conclusions about a bigger group of people or things based on data from a smaller collection of those things or people. Central to the study of statistics are methods for examining data as well as principles of inference. Boxplots are a helpful and popular graphical method for data exploration that helps us better grasp the data we are working with. Boxplots show the first, second, and third quartiles of a data collection together with the interquartile range and outliers. The boxplot's informational content and the majority of its variations are based on the data's median. Yet, the mean is frequently used in scientific applications to analyse and report data. In this study, we suggest a modification of the traditional boxplot that shows data surrounding the mean. Also, some information about the median is shown.

Keywords: Statistics, Data, Five Number Summary, Outliers, Box Plot, Graphs.

INTRODUCTION

The scientific method depends on having a solid understanding of datasets. Determining the significance of data by focusing just on its values is a difficult process, though. By summarising the distribution using a limited number of parameters, descriptive statistics offer a simple and clear way to identify the key features of a dataset. Often used for this purpose are the median, mode, mean and quantiles. The basic objective of descriptive statistics is to quickly

57835





Ravi Dhandhukiya and Aakash Gupta

characterise, using a condensed set of values, the features of the underlying distribution of a dataset. These factors frequently reveal information about the data that would otherwise be obscured. These data summaries also make it easier to compare different datasets. Data reporting using graphical techniques is advised. The purpose of graphs is to assist the researcher in identifying and reporting trends in the data, not to represent numbers with decimal places. In addition, studies on graphical methods indicate that graphs are more effective than tables at communicating comparisons between sets of data. The boxplot, one of the most often used graphical methods for data exploration, shows summary statistics centred on the median rather than the mean.

DATA

Data are the facts and figures collected, analyzed, and summarized for presentation and interpretation. Below data is based on rainfall of March 2023 in state Gujarat. In this research paper I am going to use Actual (mm) data This Cumulative Rainfall from 01-03-2023 to 27-03-2023 published by Government of India, Ministry of Earth Science, India Meteorological Department, Meteorological Centre, Ahmedabad 382475. Actual Source Link: https://mausam.imd.gov.in/ahmedabad/mcdata/rain_cum.pdf

Five Number Summary, IQR and Outliers

In a five-number summary, the following five numbers are used to summarize the data:

1. Smallest value Small value of the data considered as smallest value of the data.
2. First quartile (Q_1) Divide data into four parts, with each part containing approximately one-fourth, or 25% of the observations. **Table (1)** shows a data distribution divided into four parts. The division points are referred to as the quartiles and are defined as Q_1 , Q_2 and Q_3 .

Q_1 : first quartile, or 25th percentile.

Percentile is to be defined by index i .

$$i = \left(\frac{P}{100} \right) n;$$

Where, P = Percentile

n = Total number of data.

3. Median (Q_2) Q_2 : second quartile, or 50th percentile.
4. Third quartile (Q_3) Q_3 : third quartile, or 75th percentile.
5. Largest value Large value of the given data considered as largest value of the data.
6. Interquartile Range The interquartile range is known as IQR .
$$IQR = Q_3 - Q_1$$
7. Upper Limit and Lower Limit & Outliers The limits for the box plot are $1.5(IQR)$ below Q_1 and $1.5(IQR)$ above Q_3 .
Lower limit = $Q_1 - 1.5(IQR)$
Upper limit = $Q_3 + 1.5(IQR)$
Data outside these limits are considered outliers.
Outliers are denoted as dot.
8. Whiskers The dashed lines in Box plot are called whiskers. The whiskers are drawn from the ends of the box to the smallest and largest values inside the limits.

Ascending order is mandatory to calculate quartiles. According to **Table (1)** ascending order of the data will be 0,0.8,0.9,1.0,1.0,1.4,2.0,2.0,2.2,3.2,3.7,4.3,4.4,4.4,4.7,5.7,6.5,6.9,8.7,9.1,9.3,10.6,10.6,10.6,11.2,11.9,12.6,13.2,13.4,13.9,14.4,17.8,18.3,20.4,20.8,21.6,24.4,29.2,34.1.





Ravi Dhandhukiya and Aakash Gupta

1. Smallest value	0
2. First quartile (Q_1)	3.2
3. Median (Q_2)	9.1
4. Third quartile (Q_3)	13.9
5. Largest value	34.1
6. Interquartile Range	10.7
7. Upper Limit and Lower Limit	Lower limit = $Q_1 - 1.5(IQR) = 12.85$ Upper limit = $Q_3 + 1.5(IQR) = 29.95$ Outliers = 34.1

Box Plot

Graphical representation of calculative data known as Box plot. All the data has been mentioned in graphical way.

CONCLUSION

A common method for summarising the distribution of a dataset is the box plot. Understanding its design, history, and variations can aid in not just interpreting the information provided by the box plot but also in its development and use. Its use has become widespread in all fields of scientific enquiry. The clear illustration offers insights into a distribution's key features and allows for the addition of data that allows the box plot to be tailored to particular scenarios. Ultimately, the box plot is a beautiful way to portray scientific data because of how straightforward it is.

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Ravi Dhandhukiya and Aakash Gupta

Table 1. Cumulative Rainfall Data.

भारत सरकार
पृथ्वी विज्ञान मंत्रालय
भारत मौसम विज्ञान विभाग
मौसम केंद्र,
अहमदाबाद ३८२४७५.



Government of India
Ministry of Earth Science
India Meteorological Department
METEOROLOGICAL CENTRE,
AHMEDABAD 382475.

Cumulative Rainfall from 01-03-2023 to 27-03-2023				
Sr. No.	Name	Actual (mm)	Normal (mm)	DEP (%)
1.	D&NH AND DD(UT)	0.9	0	200
2.	GUJARAT	13.4	0.2	6585
3.	AHMEDABAD	10.6	0.4	2554
4.	ANAND	3.7	0.7	424
5.	ARAVALLI	21.6	0.3	7114
6.	BANASKANTHA	11.9	0.4	2873
7.	BHARUCH	3.2	0.2	1483
8.	CHHOTAUDEPUR	9.3	0	200
9.	DADARA & NAGARHAVELI	0	0	0
10.	DAHOD	12.6	0.2	6175
11.	DAMAN	1.0	0	200
12.	DANGS	34.1	0.7	4775
13.	GANDHINAGAR	11.2	0.3	3629
14.	KHEDA	4.4	0.3	1370
15.	MAHISAGAR	8.7	0.2	4233
16.	MEHSANA	10.6	0.1	10500
17.	NARMADA	13.9	0.4	3367
18.	NAVSARI	2.0	0.3	567
19.	PANCHMAHAL	6.9	0.1	6838
20.	PATAN	18.3	0.3	5983
21.	SABARKANTHA	20.4	0.3	6715
22.	SURAT	9.1	0.3	2917
23.	TAPI	5.7	0.3	1805
24.	VADODARA	2.2	0.2	975
25.	VALSAD	4.7	0.2	2245
26.	SUBDIVISIONRAINFALL	10.6	0.3	3435
27.	AMRELI	29.2	0.1	29067
28.	BHAVNAGAR	13.2	0.3	4292
29.	BOTAD	24.4	0.1	24267
30.	DEVBHOOMIDWARKA	1.0	0.3	240
31.	DIU	0.8	0.3	167
32.	GIRSOMNATH	4.3	0.1	4233
33.	JAMNAGAR	4.4	0.1	4257
34.	JUNAGADH	6.5	0.4	1523
35.	KUTCH	20.8	0.3	6818





Ravi Dhandhukiya and Aakash Gupta

36.	MORBI	2.0	0	200
37.	PORBANDAR	1.4	0.2	600
38.	RAJKOT	17.8	0.2	8781
39.	SURENDRANAGAR	14.4	0.1	14308

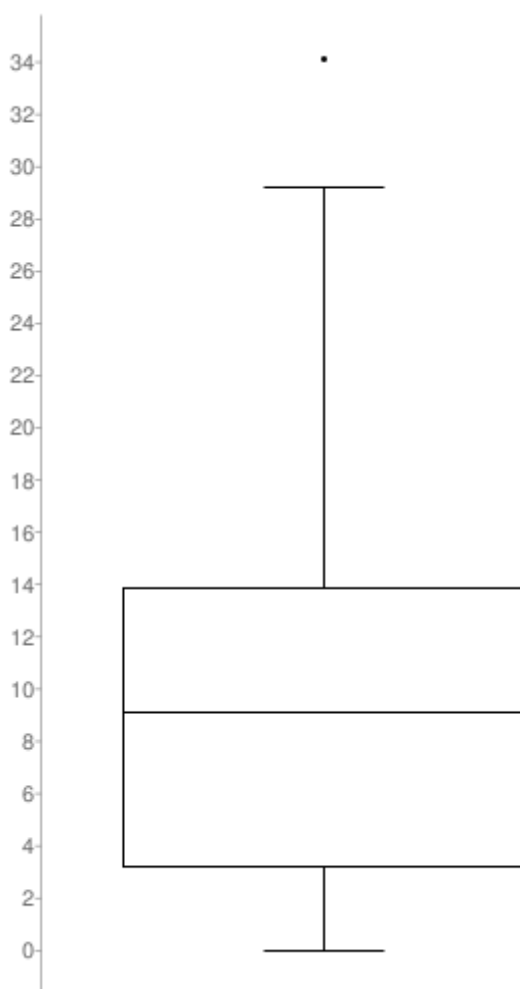


Fig. 1. Box Plot





Characterizations and Evaluation of Grain Amaranth Genotypes for Morphological and Seed Quality Traits

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ABSTRACT

The present investigation was carried out at the Research Block, Department of Crop Improvement and seed testing laboratory for thirty diverse germplasm line of grain amaranth including five check varieties *i.e.* PRA-1, PRA-2, PRA-3, Annapurna and Durga were evaluated in an augmented block design for access their performances. Among all the germplasm earliest flowering was recorded in IC-322201 and ES-223650 (41 days). IC-278922 (27.46 cm) has highest spikelet length and IC-278913 had largest mean stem thickness (13.67 mm). IC-279965 (120.40 cm²) has highest leaf area, earliest leaf breadth was noticed in IC-278921 (8.75 cm) and leaf length was noticed in IC-333211 (16.3 cm). IC-313269 showed highest 1000 seed weight (1.155 g) and maximum value seed yield/ plant was observed in IC-326896 (42.03 g). Highest germination percent was recorded for IC-278922 (91.00 %). While the lowest value for this character was noticed in IC-333211 (75.50 %) as compared to other germplasm line. Maximum value for root length was measured in IC-321281 (4.45 cm) and shoot length was observed in Durga (5.70 cm). The highest seedling fresh weight (0.775 g) and seedling dry weight (0.185 g) was found in Durga as compared to other germplasm line. The largest seedling length was measured for PRA-1 (20.34 cm). The maximum physical purity was noticed in IC-274451 (96.87%). The significantly maximum value of vigour index-I was observed for IC-313269 (785.50). It is significant to mention that the current study's findings have aided in the selection of



**Anita Trivedi et al.,**

improved germplasm in grain amaranth based on morphological and seed quality parameters. As a result, this germplasm can be used in breeding programs to develop high-yielding varieties.

Key words: Grain amaranth, seed quality, vigour and germplasm

INTRODUCTION

Amaranthus (*Amaranthus spp.*), popularly known as Chaulai. The genus *Amaranthus* contains 60 species that are cultivated for their leaves as well as their grains, with only a few wild species. Species like *A. tricolor*, *A. dubius*, *A. lividus*, *A. blitum*, *A. hypochondriacus*, *A. cruentus* and *A. edulis* are used for consume purpose whereas, *A. viridis*, *A. spinosus* and *A. retroflexus* are not safe to consume for either humans or livestock (Iftikhar and Khan, 2019). Vegetable type of leaf amaranth is *Amaranthus tricolor L.*, originated in south East Asia, particularly in India. (Rai and Yadav, 2005). Grain of the amaranth species is of high nutritional value and has higher protein than other cereal grains. It has significantly higher lysine content. Amaranth grain consists of 6 to 10% of oil, which is higher than most other cereals (Maurya and Arya, 2018).

The protein is of higher quality due to the presence of higher lysine content (5.0 to 6.0 %) and also rich in the sulphur-containing amino acids which confirms its high potential for use in both human and animal nutrition and also shows high promise for supplementing nutritive food and amelioration of protein deficiency strictly in the vegetarian diet people (Venkatesh *et al.* 2014). The production of *Amaranthus* (Ramdana) in Uttarakhand is cultivated under wide range of soils and diverse climate conditions. Grain amaranth is an important multifarious utility cash crop of the higher hills where, it is grown mainly as a pure crop. It occupies about 60-70% area under the crop in the higher hills. In low altitude areas it is grown mixed with other crops such as small millets and pulses. Grain amaranth remains a largely underexploited crop for grain purposes in the hills of Uttarakhand. Knowledge of genetic diversity and trait variations in populations is useful in plant breeding and for developing strategies to conserve the genetic resources [5] Insight into the genetic variation within and among the available amaranth genotypes in relation to the growth, yield and quality traits is necessary. Such empirical knowledge will facilitate strategic breeding program, as well as enhance effective genetic resources exploration, conservation, management, and utilization of *Amaranthus* species in future breeding programs [2]. Seed is an essential element in agriculture which is the part of success of any crop production programme. Seed quality testing has a great importance for the evaluation of varietal superiority in the environment (Kumar *et al.* 2015). The use of good quality seed is indispensable for the successful production of any crop (Manikandan *et al.* 2015). Therefore; the present study was to determine the different quality parameters of amaranth germplasm and identifies the desirable parents for an efficient breeding programme.

MATERIALS AND METHODS

Experimental site

The present investigation was carried out during *khari* season at the Research Block, Department of Crop Improvement for field experiment and further subsequent seed quality parameters were assessed in Seed Testing Laboratory of department of Seed Science and Technology, V.C.S.G. Uttarakhand University of Horticulture and Forestry, College of Forestry, Ranichauri, Tehri Garhwal.

Treatments details

The experiment comprises 30 diverse genotypes *viz.*, IC-258250, IC-274451, IC-274467, IC-274471, IC-278913, IC-278919, IC-278921, IC-278922, IC-279965, IC-279966, IC-279968, IC-313265, IC-313269, IC-313273, IC-321281,



**Anita Trivedi et al.,**

IC-322201, IC-326896, IC-326898, IC-329550, IC-329588, IC-333108, IC-333173, IC-333211, IC-341551, ES-223650 of amaranth including five checks viz., Annapurna, Durga, PRA-1, PRA-2 and PRA-3 used as treatments. The field experiment was laid out in augmented block design and laboratory experiment conducted in Complete Randomize Design with four replications. The seed material of genotypes including check Durga and Annapurna used in the experiment were obtained from Project Coordinator Unit of All India Coordinator Research Project on Under Utilized Crop, NBPGR, regional station Shimla while the check PRA-1, PRA-2 and PRA-3 were received from Department of Crop Improvement, Ranichauri.

Observations

The field parameter was conducted in an augmented block design with three replications there were two rows of each germplasm in each block with spacing 25×10cm. and observations was recorded on Days to first flowering, Days to 50% flowering, Plant height (cm), Inflorescence length (cm), No. of spikelet per plant, Spikelet length (cm), Stem thickness (mm), Leaf Area (cm²), Leaf Breadth (cm), Leaf Length (cm), No of branches, Petiole Length (cm), Days to maturity, 1000 seed weight (g) and Seed yield per plant (g) While, the laboratory experiment was conducted in Complete Randomized Block Design with four replications and observation was recorded on First count test, Standard germination (%), Root length (cm), Shoot length (cm), Seedling length (cm), Seedling fresh weight (g), Seedling dry weight (g), Moisture content (%), Physical Purity(%). The seedlings vigour index was calculated as per the methods given by Abdul Baki and Anderson (1973).

Statistical Analysis

The complete analysis of data has been processed by Windostat version 9.2 from indostat services Hyderabad.

RESULT AND DISCUSSION

The mean performance of 30 genotypes of Amaranth with respect to different morphological and seed quality parameters are discussed for assessment of germination and vigour parameters.

Morphological parameters

The means performances of thirty genotypes for various characters studied are given in Table 1. The maximum days to first flowering was recorded IC-258250(58 days) followed by IC-333108 (58 days), whereas, earliest flowering was observed in IC-313273(41 days) followed by ES-223650 (41 days).The range of days to 50 per cent flowering varied from 65.28 days (IC-313269 and IC-313273) to 78.08 (IC-274467) days with a general mean of 71.48 days. While, IC-274467 (78.08 days) followed by IC-274451 (77.08 days), IC-333211 (76.28 days), IC-279968, IC-333108 and IC- 333173 (75.28 days) took more time to flowering. A range of high variability in days to 50 % flowering is desirable for selecting the genotypes for earliness. A wide range of variability in days to 50 % flowering has also been reported by Kusuma *et al.* (2003), Akaneme and Ani [1] and Venkatesh *et al.* (2014) in amaranth. Significant highest plant height (122.39 cm) was found in IC-313269 followed by IC-313265 (120.79 cm), IC-313273 (117.39 cm), IC-279968 (116.59cm), IC-322201 (113.35 cm), IC-321281 (112.79 cm), IC-333108 (112.03) and IC-279966 (111.23 cm). However, minimum value was observed for IC-326898 (86.55 cm).

Plant height is usually a good index of plant vigour which may contribute towards productivity. The plant growth habit serves as a guide to determine the suitable planting distance for a crop/variety and the optimum plant population per unit area for harvesting maximum yields. Variation in plant height is attributed to inherent genetic difference of the crop/variety. Variability in plant height of amaranth has also been reported by Verma *et al.* (2001) Vujacic *et al.* (2005), Rana *et al.* (2005), Anuja [3], Haghghi *et al.* (2012) Chattopadhyay *et al.* [4], Venkatesh *et al.* (2014), Yadav *et al.* (2014) and Srivastava *et al.* (2015). The mean value of inflorescence length was ranged from 32.73 cm (IC-329550) to 67.81 cm (IC-278922) with an overall mean of 49.46 cm. Such a large extent of variability in inflorescence length might have also resulted due to diverse origin of accession coupled with environmental effect. Differences in inflorescence



**Anita Trivedi et al.,**

length of amaranth genotypes have also been expressed by Rana *et al.* (2005), Parveen *et al.* (2013) and Yadav *et al.* (2014).

The mean number of spikelets per plant range from 35.13 to 62.73 with an overall mean of 49.56. IC-278921 showed the highest mean value of number of spikelets per plant (62.73) followed by ES- 223650 (62.01), IC-329588 (61.09), IC-333108 (60.21). Lowest value for number of spikelets per plant was observed in IC- 279966 (35.13). Variability in amaranth genotypes was also reported by Erum *et al.* [6] a range of 1.0 to 19.6 spikelets per plant. Maximum number of leaves was observed for IC-322201 (93.60) which was significantly higher than other all genotypes. However, the significantly lowest value was recorded for IC-333211 (34.92). The general mean for this character was 67.78. The range of variability in number of leaves per plant was also observed by Chattopadhyay *et al.* [4] and Venkatesh *et al.* (2014) in amaranth. The maximum length of spikelet was recorded in IC-278922 (27.46 cm) which was significantly higher than in the rest of genotypes. Minimum spikelet length was observed in IC-333173 (11.14 cm) which were statistically at par. The overall mean for this character was 18.57 cm. Spikelet length is principal yield contributing character in grain amaranths. The spikelet length mainly governed by genetic constitution of the genotype but environmental effect is also supposed to play crucial role in increasing the length of spikelet. Spikelet length of grain amaranth genotypes have also been expressed by Yadav *et al.* (2014).

The range of stem thickness ranged from 6.41 mm to 13.67 mm. Genotype IC-278913 had largest mean stem thickness (13.67 mm) while genotype IC-341551 exhibited smallest stem thickness (6.41 mm). The general mean for this character was 9.46 mm. Stem thickness is a character expressing vigour of the genotype. This trait is also important in the view of selecting the population for resistance lodging. A wide range of variability among the genotypes included in this investigation could offer better opportunity of population improvement for this character through selection breeding. Sravanthi *et al.* (2012) have also observed a wide range of variability in stem thickness of grain amaranth genotypes rang 1.91 cm to 5.57 cm.

Leaf area ranged from 120.4 to 47.63 cm² with an overall mean of 84.98 cm². Maximum Leaf area 120.4 cm² was recorded in genotype IC-279965 whereas, Genotype IC-278919 (47.63 cm²) were noted for minimum Leaf area. Leaf Breadth ranged from 4.54 to 8.75 with an overall mean of 6.59 cm. The highest leaf Breadth 8.75 cm was recorded in genotype IC-341551 followed by PRA-3 whereas, the lowest leaf Breadth 4.54 cm was recorded in genotypes IC-333173. Leaf length varied from 10.02 to 16.3 with an overall mean of 12.94 cm. The highest leaf length 16.3 cm was recorded in genotype IC-333211 whereas, genotype IC-279966(10.02 cm) were noted for minimum leaf length. The IC-333108 showed the highest number of branches (5.35) while, lowest value for number of branches was observed in IC-326898 (2.16) with overall mean 3.7.

The range of petiole length lies from 3.34 to 8.13 with an overall mean of 4.77 cm. The highest petiole length 8.13 cm was recorded in genotype IC-274451, whereas Genotype PRA-3 (3.34 cm) was noted for minimum petiole length. The days to maturity ranged from 135.08 days (IC-279966) to 144.40 days (IC-322201) with a general mean of 139.48 days. The lowest value for days to maturity was found in IC-279966 (135.08 days) followed by IC-313269 (135.32 days), IC-329550 (135.80 days) Highest value for days to maturity was found in IC-322210 (144.40 days) followed by IC-258250 (144.12 days) On the basis of investigation some genotypes viz., IC- 279966, IC-313269, IC-329550, IC-274451 and IC- 313265 could be identified as early matured genotypes comparable to popular cultivar Annapurna and Durga. Delay maturity genotypes look 144.40 days. It indicated that these were only a difference between early and late maturity.

1000 seed weight of thirty amaranth genotypes including five checks ranged from 0.612 g to 1.155 g. Genotype IC-313269 showed highest 1000 seed weight (1.155 g) which was significantly higher than remaining other genotypes. Minimum 1000 seed weight was recorded in IC-278913 (0.612g). Overall mean for this character was 0.897 g. Range of variability in seed yield per plant was in the range of 7.10 g to 42.03 g (Table 4.1). Maximum value for this character was observed in IC-326896 (42.03 g) followed by IC-321281 (39.49 g), IC-278913 (39.41 g), IC-313273 (39.18g) Lowest value was observed for IC-274467 (7.10 g). The general means for this character was 23.51 g. Seed yield is the major determinant variable for selecting a particular crop for its commercialization and income generation capability. The above results



**Anita Trivedi et al.,**

indicated a wide range of variability in grain yield per plant across the genotypes and check varieties. Such a pronounced lead of variability could be used to improve the population of grain amaranth. Similar results also reported by Sravanthi *et al.* (2012), Parveen *et al.* (2013), Gimplinger *et al.* (2007) and Venkatesh *et al.* (2014) in grain amaranth.

Seed quality parameters

The mean value of various quality parameters for amaranth germplasm is given in Table 2. The highest value of first count (50%) was recorded for Durga-35407 with overall mean (41.33%). Significant differences for the standard germination per cent among various genotypes of amaranth ranged from 75.50 % to 91.00 %. Significantly highest germination per cent was recorded in IC-278922 (91.00 %). However, the lowest value for this character was noticed in IC-333211 (75.50 %) with overall mean 87.00 %. Similar results also reported by Kumar *et al.* (2015) in amaranth.

The variability range of the diverse germplasm for root length from 1.55 to 4.45 cm. statistically maximum value for root length was measured in IC-321281 (4.45 cm) and the minimum value for this character in IC-333211 (1.55 cm). The general mean was 2.89 cm for this character. Similar results were also observed by Gelinis *et al.* [7] in grain amaranth. The result of shoot length for divergence genotypes for amaranth was found significant. The value varied from 4.00 to 5.70 cm with an overall mean 4.47 cm. The significant greater value for this character was found in Durga35407 (5.70 cm) followed by IC-329588 (4.00 cm) which was statistically at par with other germplasm while minimum value for shoot length was observed in IC-329588 (4.00 cm). Similar result was reported by Krishnanappa *et al.* (2001) in finger millet. Seedling fresh weight varied significantly from 0.417 to 0.775 g. The maximum value (0.775 g) was recorded in Durga which was significantly higher among all the genotypes while minimum value (0.417 g) was observed in IC-274451. The general mean for this character was 0.519g. Similar finding was also reported by Tzortzakis (2009) and Kumar *et al.* (2015) in grain amaranth.

The range of seedling dry weight varied from 0.185 to 0.112 g for different genotypes of amaranth. The highest value was recorded in Durga (0.185 g) which is significantly superior then other genotypes. However the lowest value was recorded in IC-274451 (0.112 g) with overall 0.141 g. Corroborative results have also been given by Krishnanappa *et al.* (2001) in finger millet and Kumar *et al.* (2015) in grain amaranth. The largest seedling length was measured for PRA-1 (20.34 cm) followed by IC-279966 (18.26 cm) however, smallest seedling length recorded for IC-326898 (13.96cm) with general mean of 16.33 cm.

The perusal of results revealed significant variations among different genotypes for vigour index-I. The vigour index-I varied from 516.60 to 785.50. The highest value was observed 785.50 in IC-313269 which was significantly highest value while the lowest value was in IC-333173 (516.60). However, the general mean for this character was 642.45. Similar results were also reported by Kumar *et al.* (2015) in grain amaranth. The seedling vigour index-II showed range of variability for different genotypes of amaranth and value varied from 9.44 to 16.27. The highest value was observed in Durga-35407 (16.27). This is significantly higher than all the genotypes. However, the lowest value was recorded in IC-333211 (9.44). The overall mean was 12.36. Similar findings also reported by Krishnanappa *et al.* (2001) in finger millet and Kumar *et al.* (2015) in grain amaranth. (8.30%).

The higher value recorded for physical purity test in IC-274451 (96.87%) followed by IC-258250 (94.81%), IC-333173 and ES-223650 with overall mean 83.65%. The range of moisture content varied from 11.47 to 15.72 % for different genotype of amaranth. The highest value was recorded in IC-333211 (15.72%) which was significantly superior then other genotypes. However the lowest value was recorded in IC-329550 (11.47%). The overall mean for this character was (13.67%).

CONCLUSION

The morphological and seed quality parameters are crucial for success of any crop production programme by selection and identification of better genotype. It is concluded that the assessment of genetic diversity in genotype will help to increase economic trait by developing high yielding varieties in crop breeding. The performance of





Anita Trivedi et al.,

genotypes IC-278922, IC-321281, IC-313269 and Durga were found promising under mid hill condition, which can be utilize for crop improvement programme.

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Synthesis, Spectral and Thermal Studies of Mixed Ligand Yt (III) Complexes and their Biological Investigation

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ABSTRACT

The mixed ligand Yttrium(III) metal complexes are prepared from Cupron and amino acids like L-Valine, L-Glycine, L-Hydroxyproline, L-Threonine. All complexes are dark brown in colour and stable solids. The conductometry study reveals that the complexes are non-electrolyte in nature while magnetic susceptibility measurements shows that complexes are paramagnetic in nature. FTIR spectral analysis confirms the metal ligand bonding in the complexes through O-, N- donor atoms. The TG,DTA study confirms the presence of coordinated water molecules in the complexes. The high decomposition temperature of the complexes indicates the strong metal ligand bonding. UV-Visible spectroscopy clears the intra ligand and LCMT transitions in the complexes. Elemental analysis shows that complexes are in 1:2:1 ratio. Agar cup method and Tube dilution method are employed for antibacterial detection of Yttrium(III) metal complexes which indicates that complexes exhibit antibacterial activity against selected strains of bacterial.

Keywords: Amino acids, ligand, complexes, antibacterial activity.





INTRODUCTION

Yttrium is a rare earth metal that has been extensively studied in the field of chemistry for its unique properties and potential applications. One of the most interesting aspects of yttrium is its ability to form stable coordination complexes with a wide range of ligands. These complexes have attracted a great deal of attention due to their diverse structures and potential uses in fields such as catalysis, luminescence, and medical imaging. Yttrium complexes are characterized by their coordination number, which typically ranges from four to nine, and by the geometry of their coordination polyhedra. Yttrium complexes can be prepared using a variety of synthetic methods, including ligand exchange reactions, redox reactions, and reactions with organometallic reagents. This area of research continues to be an active and growing field, with new complexes and applications being developed regularly. Yttrium complexes have already found practical applications in fields such as magnetic resonance imaging (MRI), nuclear medicine, and organic synthesis. With ongoing research and development, it is likely that these complexes will continue to find new uses in the future [1].

Yttrium is a rare earth metal that has received increasing attention in the field of chemistry due to its unique properties and potential applications. The ability of yttrium to form stable coordination complexes with various ligands has made it a subject of interest in fields such as catalysis, luminescence, and medical imaging. Recent studies have shown that yttrium complexes exhibit remarkable catalytic activity in a wide range of organic transformations. For instance, several yttrium complexes have been found to be effective catalysts for the ring-opening polymerization of cyclic esters, which is an important process for the production of biodegradable polymers. Additionally, yttrium complexes have been used as catalysts for the synthesis of chiral compounds, which have important applications in pharmaceuticals and agrochemicals. Yttrium complexes have also shown promise in the field of luminescence. For example, researchers have developed yttrium-based phosphors that exhibit efficient luminescence properties, making them suitable for use in white light-emitting diodes (LEDs). In the field of medical imaging, yttrium has been used as a radiopharmaceutical agent for targeted radionuclide therapy. Yttrium-90-labeled complexes have been developed for the treatment of various types of cancer, including lymphoma and liver cancer. Overall, yttrium complexes continue to be an active area of research, with ongoing efforts to develop new complexes and applications. With the unique properties of yttrium, it is likely that yttrium complexes will continue to play an important role in various fields of chemistry and beyond [2].

EXPERIMENTAL MATERIALS

All the chemicals which are used in the synthesis of mixed ligand complexes were buy from E.Merck pharma. The yttrium chloride hexahydrate and the amino acids, L-glycine, L-alanine, L-valine, L-proline were used in the synthesis of metal complexes without purification as such. The primary ligand Cupron was also employed in the synthesis of complexes. The solvents like DMF, DMSO, Ethanol, Acetone were utilized for the research work by distillation and purification as per standard protocol In the synthesis of complexes, analytical balance, Borosil glassware's were used and standard protocols were followed to calibrate them [3].

Synthesis of Mixed Ligand Yttrium Complexes

To the aqueous solution of yttrium chloride hexahydrate (303 mg, 1mmol), 10 ml alcoholic solution of (2Z)-2- (N-hydroxyimino)-1,2-diphenylethan-1-ol (454 mg, 2 mmol) was added with constant stirring and reaction mixture was placed for heating in the water bath for 10-15 minutes. Then to this reaction mixture, aqueous solution of amino acids (1mmol) was added dropwise with constant stirring and whole reaction mass was again put into the boiling water bath for heating for 10 minutes. After heating, reaction mixture was kept on the asbestos sheet and dilute ammonia solution was added dropwise to same beaker. The formation of complex was observed when pH was increased due to addition of ammonia solution. Solution containing complex ppt was filtered through the Buchner funnel and solid complex was then washed by ethyl alcohol and then by water and dried in vaccum [4-7].



**Sunil. S. Patil et al.,****Instrumentation**

The percentage of C,H and N atoms in all the synthesized complexes was determined from elemental analysis by using Thermo Finnigan Elemental Analyzer. The presence of percentage of yttrium metal was confirmed by complexometric titration. The analysis was carried out at department of Chemistry, IIT, Mumbai. To find the electrolyte nature of complexes, the molar conductance of all complexes was measured by preparing 10^{-3} molar solutions of complexes in DMSO solvent by using Labtronics LT-26 Deluxe Conductivity Meter. UV-Visible spectra of complexes were recorded on Shimadzu UV/VIS-160 Spectrophotometer by employing 10^{-4} molar solutions of complexes in DMF solvent while the UV-Visible spectrophotometer was calibrated with 0.0098 % KMnO_4 [8]. Determination of the magnetic moment and magnetic nature of all synthesized complexes were done on the Gouy Balance. The calibrant used for the same was tetrathiocyanato-cobaltate (III). Effective magnetic moment was obtained by performing diamagnetic corrections. Spectral information of synthesized complexes were acquired by using Perkin-Elmer FTIR Spectrophotometer Model No. 1600 containing KBr disc. TG-DTA graphs of compounds were obtained from Perkin-Elmer Diamond TG-DTA instrument at Chemistry department, IIT Mumbai with heating rate of $10^\circ\text{C}/\text{minutes}$ in controlled nitrogen atmosphere. XRD study of decomposition product of the complexes was done at IIT Bombay, Mumbai. Scanning rate is $2\theta = 1^\circ/\text{min}$ with monochromatic X-ray beam having wavelength 0.15 nm [9-13].

BIOLOGICAL ACTIVITY**Agar Cup Method**

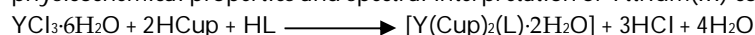
In this method, Mueller Hinton Agar (MHA) is prepared in 1000 ml distilled water. It is then sterilized at 121°C for 20 min. and then cooled down upto 40°C . All the glassware were sterilized. In the Mueller Hinton Agar, the 18 hrs. old bacterial culture of $10^6/\text{cm}^3$ density is incubated and 20 cm^3 of the agar is poured into the sterile plates. It is cooled and later allowed to solidified. Three wells of 8 mm diameter were punched in each plate. Tetracycline of 0.1 cm is used as control. The wells were filled with 0.1 cm^3 solution of complexes prepared in DMSO and labelled by the name of the sample. The sterile plates were incubated for 24 hours at 37°C . the zone of inhibition was later determined for the purpose of determination of antibacterial activity of all the complexes [14].

Tube Dilution Method

To find the MIC of the complexes, the tube dilution method was employed. For the same purpose the solution of all complexes in DMSO was prepared to get the stock solution of $1 \text{ mg}/\text{cm}^3$ and further dilutions were also made. The cultural stock of bacteria was diluted with sterile broth to get the concentration of $10^6/\text{cm}^3$. The four set of sterile tubes were taken to make a set of one type of bacteria and labelled with various concentrations of prepared complexes. The sterile tube was filled with 5 cm^3 of diluted solution of the yttrium complexes and also diluted culture of bacterial was added in each tube and then sealed and later kept for about 24 hours in the incubator. Tetracycline was used as standard. 5 cm^3 sterile Mueller Hinton Broth which was also incubated with bacterial cultural is a positive control. 5 cm^3 DMSO of 10^{-3} M dilution in three tubes were also kept for given bacterial strain in order to see the growth of bacteria. All the sterile tubes were maintained at 37°C for 24 hrs. The minimum inhibitory concentration was determined from the turbidity in the tubes. So, the no visible change in the turbidity will be considered as MIC of the complexes [15].

RESULTS AND DISCUSSION

This Chapter study mainly focused on the preparation of mixed ligand Yttrium complexes, study of their physicochemical properties and spectral interpretation of Yttrium(III) complexes.



Where,

HCup: Cupron

HL: Amino acid



**Sunil. S. Patil et al.,****Elemental Analysis**

The data obtained from elemental analysis suggest that the Yttrium chloride hexahydrate, (2-Hydroxy-1,2-diphenylethanone oxime), amino acids were reacted in 1:2:1 proportion during the formation of complex. The table No. 5 shows elemental analysis data. There for the general formula of all Yttrium complexes is 1:2:1 [16].

Molar Conductance

To measure the molar conductance of synthesized Yttrium complexes, each complex was dissolve in DMSO and 10^{-3} molar solution was prepared. The very low values of molar conductance of all complexes indicate that the complexes were non-electrolyte in nature. Table No. 6 shows the molar conductance values of all synthesized complexes [17].

Magnetic Susceptibility

Magnetic susceptibility of all the yttrium complexes has been measured. Specific magnetic susceptibility and molar magnetic susceptibility were determined by applying diamagnetic corrections. The negative values of specific magnetic susceptibility (χ_g) and molar magnetic susceptibility (χ_m) of all yttrium complexes suggests that the determination of effective magnetic moment is not possible which clears the diamagnetic nature of Yttrium complexes.

Electronic Absorption Spectra

the UV-Visible spectra of all Yttrium complexes recorded by preparing 10^{-4} molar solutions. The spectral nature of all the new formed Yttrium complexes is found to be similar to that of the ligands which signify that there is not too much variation in the structure of ligands when the complex formation has been takes place [18].

INFRARED SPECTRA

The infrared spectra of the all complexes recorded by using Perkin-Elmer FTIR spectrophotometer in the KBr disc of the range $4000-400\text{ cm}^{-1}$. The important bands are shown in the table. The spectral study of primary ligand 2-Hydroxy-1,2-diphenylethanone oxime, the secondary ligand amino acids indicates the strong band at $\sim 3440\text{ cm}^{-1}$ which is due to the presence of $-\text{OH}$ group in the compounds which are absent in the spectra of all complexes signifying the occurrence of bond between the Yttrium and ligands by the replacement of Hydrogen atom. The strong peak seen in the range of $1000-1010\text{ cm}^{-1}$ is due to the C-O stretching which was observed at 1120 cm^{-1} in the IR spectra of primary ligand 2-Hydroxy-1,2-diphenylethanone oxime. This shifting to lower wave number implying that the 2-Hydroxy-1,2-diphenylethanone oxime is bonded with Yttrium metal through the oxygen atom of $-\text{OH}$ group. The band due to the C=N stretching is seen in the range of 1405 to 1510 which is at higher wave number in the spectra of primary ligand showing that nitrogen of primary ligand 2-Hydroxy-1,2-diphenylethanone bonded with Yttrium metal in the complex. The bands seen in the spectrum of all yttrium complexes in the range of 3250-3290 are due to presence of free $-\text{OH}$ group in the complex which is from primary ligand 2-Hydroxy-1,2-diphenylethanone indicating the existence of primary ligand in the all yttrium complexes. The weak bands in the range of $750-840\text{ cm}^{-1}$ are may be due to the Metal-Nitrogen vibrations which clarify that the nitrogen atom of the primary ligand forms bond with the Yttrium metal during the formation of the complex [19]. The weak band arrived around 1310 cm^{-1} to 1370 cm^{-1} are due to the symmetric $-\text{COO}^-$ stretching vibrations while the bands seen around 1620 cm^{-1} to 1690 cm^{-1} are due to asymmetric $-\text{COO}^-$ stretching vibrations of acid group in the amino acids. Hence it can be confirmed that the Yttrium metal is coordinated with carboxylic acid through its oxygen atom in the all complexes [20]. Some the medium peaks obtained in the range of 3340 cm^{-1} - 3250 cm^{-1} and the weak band in the range of 1550 cm^{-1} – 1586 cm^{-1} may be assigned for $-\text{OH}$ asymmetric and $-\text{OH}$ symmetric vibrations respectively which indicates the presence of coordinated water molecules in the Yttrium complexes. The medium band around 700 cm^{-1} and around 750 cm^{-1} due to M-N vibrations and M-O vibrations signifying the bonding between metal ion and nitrogen and oxygen of the primary and secondary ligands.





Sunil. S. Patil et al.,

THERMAL STUDIES

Thermal study of the Yttrium complexes was done by TG and DTA techniques which was performed on a Perkin-Elmer Diamond TG-DTA Instrument in the presence of controlled nitrogen atmosphere. The heating was continued to 900°C with heating rate of 10°C min⁻¹. The gradual weight loss has been seen during thermal study for all complexes with rise in temperature confirming the thermal stability of all complexes. The three weight losses has been observed in the thermal study due to the decomposition of the complexes. The first loss in weight seen between 110°C – 170°C due to the loss of coordinated water molecules. The second weight loss occurred in the temperature between 237°C – 405°C is due to the loss of amino acid molecule from the complexes. The loss in the weight in the range of 625°C -828°C is seen due to the loss of two 2-Hydroxy-1,2-diphenylethanone (Cupron) molecules.

The constant plateau is observed after 860°C which signify that the decomposition of the Yttrium complexes has been completed. The thermal study of all complexes thus confirms the presence of two water molecules, one molecule of amino acid, two molecules of 2-Hydroxy-1,2-diphenylethanone which further indicating that the general formula of the complex is 1:2:1²¹. The XRD of the decomposition product obtained in the thermal study was taken which was compared with pure Yttrium oxide showing same bands as that were present in the pure Yttrium oxide. The XRD study thus reveals that the final decomposition product is Yttrium Oxide²²⁻²⁴.

CO-ORDINATION NUMBER

After studying all the physicochemical and spectral properties of the complexes it was concluded that the proposed coordination number of all the Yttrium (III) complexes is 8.

CONCLUSION

We have successfully prepared mixed ligand complexes of Yttrium(III) of type [YT(SO)₂(L).2H₂O] using N,O donor atom ligands. Complexes were dark brown colour and stable at room temperature. Very low molar conductance values of complexes clear the non-electrolyte nature of complexes. The Infrared spectroscopy study reveals that in the complexes, bonding of cerium metal ion take place through the N-and O-donor atoms of the primary and secondary ligands. Room temperature magnetic susceptibility study confirms the paramagnetic nature of the complexes. UV-Visible spectroscopy study signifies the intra ligand and charge transfer transitions in complexes. The complexes have high decomposition temperature values which shows that there was strong metal ligand bonding while DTA-TG study showing gradual weight loss in the complexes confirms the presence of the ligand moieties and two coordinated water molecules. So on the basis of all results, the proposed coordination number for cerium complexes is eight. Tube dilution and Agar cup method were employed to detect antibacterial activity of complexes which shows that complexes were more active against *S. aureus* and *S. typhi* as compared to *C. diphtheria* and *P. aeruginosa* microorganisms.

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PROPOSED STRUCTURES OF THE COMPLEXES

The physico-chemical and spectral studies of the all the Yttrium complexes helps to predict the proposed structures of the Yttrium (III) complexes. Following are the proposed structures of the complexes.





Sunil. S. Patil et al.,

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Table 1. Antibacterial Activity by Agar Cup Method

Sr. No.	Complex	Antibacterial Activity (mm)			
		<i>S. aureus</i>	<i>C. diphtheriae</i>	<i>S. typhi</i>	<i>P. aeruginosa</i>
1.	[Y(Cup) ₂ (Gly)·2H ₂ O]	14	11	10	12
2.	[Y(Cup) ₂ (Ala)·2H ₂ O]	16	13	8	9
3.	[Y(Cup) ₂ (Val)·2H ₂ O]	20	17	13	15
4.	[Y(Cup) ₂ (Pro)·2H ₂ O]	17	15	11	14
--	Tetracycline	30	23	25	16

Table 2. Data of Antibacterial Activity by Tube Dilution Method

Sr. No.	Complex	MIC (μg/cm ³)			
		<i>S. aureus</i>	<i>C. diphtheriae</i>	<i>S. typhi</i>	<i>P. aeruginosa</i>
1.	[Y(Cup) ₂ (Gly)·2H ₂ O]	65	66	100	115
2.	[Y(Cup) ₂ (Ala)·2H ₂ O]	70	75	100	117





Sunil. S. Patil et al.,

3.	[Y(Cup) ₂ (Val)·2H ₂ O]	82	70	120	105
4.	[Y(Cup) ₂ (Pro)·2H ₂ O]	80	82	118	100

Table 3. MIC of Metal Salts, Ligand and Tetracycline by Tube Dilution Method

Salt / Ligand/ Tetracycline	MIC (µg/cm ³)			
	<i>S. aureus</i>	<i>C. diphtheriae</i>	<i>S. typhi</i>	<i>P. aeruginosa</i>
Y.Cl ₃ .6H ₂ O	100	140	1450	180
Cupron	100	200	150	140
Tetracycline	1.5	2.0	1.5	7.0

Table 4. Empirical Formula, Molecular Weight and Colour of the Complexes

Sr. No.	Complex	Empirical Formula	Molecular Weight (gm mol ⁻¹)	Colour
1	[Y(Cup) ₂ (Gly)·2H ₂ O]	C ₃₀ H ₃₂ YN ₃ O ₈	651.50	White
2	[Y(Cup) ₂ (Ala)·2H ₂ O]	C ₃₁ H ₃₄ YN ₃ O ₈	665.53	White
3	[Y(Cup) ₂ (Val)·2H ₂ O]	C ₃₃ H ₃₈ YN ₃ O ₈	693.59	White
4	[Y(Cup) ₂ (Pro)·2H ₂ O]	C ₃₃ H ₃₆ YN ₃ O ₈	691.57	White

Table 5. Decomposition Temperature and pH of the Complexes

Sr. No.	Complex	Decomposition Temperature (°C)	pH
1	[Y(Cup) ₂ (Gly)·2H ₂ O]	265	7.02
2	[Y(Cup) ₂ (Ala)·2H ₂ O]	270	6.95
3	[Y(Cup) ₂ (Val)·2H ₂ O]	247	6.98
4	[Y(Cup) ₂ (Pro)·2H ₂ O]	254	7.00

Table 6. Elemental Analysis Data of the Complexes

Sr. No.	Complex	Elemental Analysis Found (Calculated)			
		% M	% C	% H	% N
1	[Y(Cup) ₂ (Gly)·2H ₂ O]	13.68 (13.65)	55.33 (55.31)	4.97 (4.95)	6.48 (6.45)
2	[Y(Cup) ₂ (Ala)·2H ₂ O]	13.39 (13.36)	55.92 (55.95)	5.18 (5.15)	6.33 (6.31)
3	[Y(Cup) ₂ (Val)·2H ₂ O]	12.81 (12.82)	57.17 (57.15)	5.50 (5.52)	6.10 (6.06)
4	[Y(Cup) ₂ (Pro)·2H ₂ O]	12.88 (12.86)	57.29 (57.31)	5.28 (5.25)	6.11 (6.08)

Table 7. Molar Conductance Data of the Complexes

Sr. No.	Complex	Conductance (Mhos cm ² mol ⁻¹)
1	[Y(Cup) ₂ (Gly)·2H ₂ O]	0.0020
2	[Y(Cup) ₂ (Ala)·2H ₂ O]	0.0016
3	[Y(Cup) ₂ (Val)·2H ₂ O]	0.0022
4	[Y(Cup) ₂ (Pro)·2H ₂ O]	0.0015

Table 8. Magnetic Susceptibility Data of the Complexes

Sr. No.	Complex	X _g (cgs units)	X _m (cgs units)	μ _{eff}
1	[Y(Cup) ₂ (Gly)·2H ₂ O]	- 1.03 x 10 ⁻⁶	- 7.83 x 10 ⁻⁴	Diamagnetic
2	[Y(Cup) ₂ (Ala)·2H ₂ O]	- 1.04 x 10 ⁻⁶	- 7.75 x 10 ⁻⁴	Diamagnetic
3	[Y(Cup) ₂ (Val)·2H ₂ O]	- 1.03 x 10 ⁻⁶	- 7.64 x 10 ⁻⁴	Diamagnetic
4	[Y(Cup) ₂ (Pro)·2H ₂ O]	- 1.00 x 10 ⁻⁶	- 7.33 x 10 ⁻⁴	Diamagnetic





Sunil. S. Patil et al.,

Table 9 Electronic Absorption Spectral Data of the Complexes

Sr. No.	Complex	λ (nm)	ν (cm ⁻¹)	Proposed Assignments
1	[Y(Cup) ₂ (Gly)·2H ₂ O]	260	38462	$\pi \rightarrow \pi^*$
		325	30769	$n \rightarrow \pi^*$
		379	26385	Charge-transfer
2	[Y(Cup) ₂ (Ala)·2H ₂ O]	264	37878	$\pi \rightarrow \pi^*$
		329	30395	$n \rightarrow \pi^*$
		375	26667	Charge-transfer
3	[Y(Cup) ₂ (Val)·2H ₂ O]	270	37037	$\pi \rightarrow \pi^*$
		330	30303	$n \rightarrow \pi^*$
		382	26178	Charge-transfer
4	[Y(Cup) ₂ (Pro)·2H ₂ O]	267	37453	$\pi \rightarrow \pi^*$
		327	30581	$n \rightarrow \pi^*$
		380	26315	Charge-transfer

Table 10. Thermal Data of the Complexes

Sr. No.	Complex	Temperature Range (°C)	Weight Loss Due to Loss of	% Weight Loss	
				Found	Calculated
1.	[Y(Cup) ₂ (Gly)·2H ₂ O]	110-164	Two water molecules	5.50	5.53
		237-397	One Amino acid molecule	11.42	11.37
		625-810	Two cupron molecules	69.42	69.46
2.	[Y(Cup) ₂ (Ala)·2H ₂ O]	125-170	Two water molecules	5.39	5.41
		243-400	One Amino acid molecule	13.25	13.24
		631-819	Two cupron molecules	68.03	68.00
3.	[Y(Cup) ₂ (Val)·2H ₂ O]	132-168	Two water molecules	5.18	5.19
		248-398	One Amino acid molecule	16.73	16.75
		635-828	Two cupron molecules	65.22	65.24
4.	[Y(Cup) ₂ (Pro)·2H ₂ O]	135-176	Two water molecules	5.21	5.20
		256-405	One Amino acid molecule	16.48	16.50
		632-816	Two cupron molecules	65.45	65.43





Sunil. S. Patil et al.,

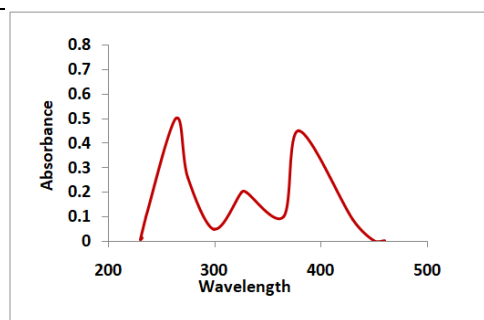


Figure 1. UV-Visible Spectra of $[Y(Cup)_2(Gly).2H_2O]$

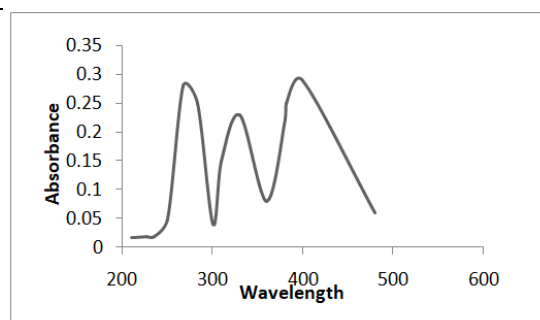


Figure 2. UV-Visible Spectra of $[Y(Cup)_2(Ala).2H_2O]$

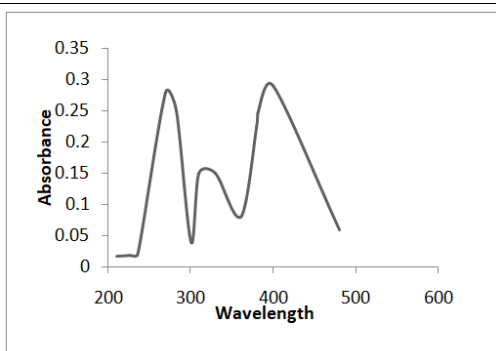


Figure 3. UV-Visible Spectra of $[Y(Cup)_2(Val).2H_2O]$

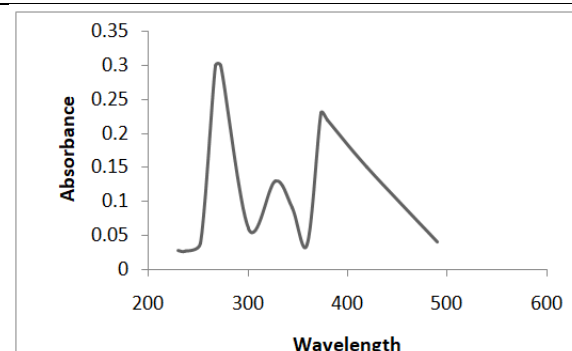


Figure 4. UV-Visible Spectra of $[Y(Cup)_2(Pro).2H_2O]$

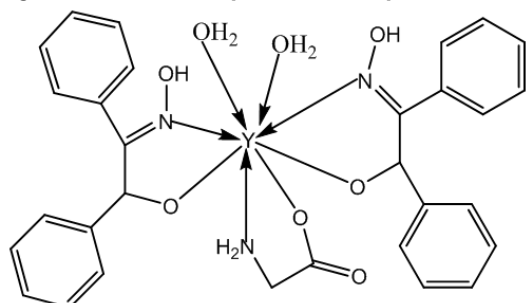


Figure 5. Proposed Structure of $[Y(Cup)_2(Gly).2H_2O]$

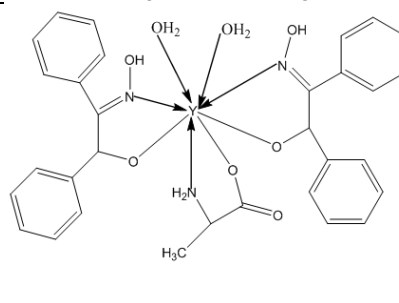


Figure 6. Proposed Structure of $[Y(Cup)_2(Ala).2H_2O]$

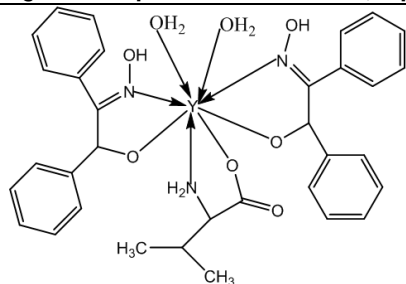


Figure 7. Proposed Structure of $[Y(Cup)_2(Val).2H_2O]$

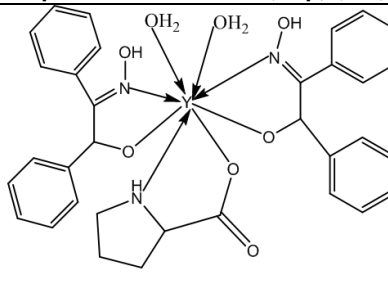


Figure 8. Proposed Structure of $[Y(Cup)_2(Pro).2H_2O]$





Antiplasmodial Potential of *Sesuvium portulacastrum*(L.) L.

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ABSTRACT

Halophytic flora is crucial for preserving ecological stability and safeguarding coastal ecosystems. Numerous secondary metabolites found in halophytes play an essential role in biological processes. *Sesuvium portulacastrum*(L.) L. is a herbaceous, eternal, dichotomous, culinary halophyte that grows quickly. It contains active phytochemical constituents such as alkaloids, saponins, tannins and terpenoids which are responsible for many biological activities. The leaves of this plant have been subjected to hot continuous extraction using the soxhlet method. From polar to non-polar, nine different solvent types were selected for crude extraction. The *Plasmodium falciparum* (3D7) strain is cultivated using the Trager and Jensen technique (1976). A polar solvent, ethanol, possess moderate activity with an inhibition percentage of $46.30 \pm 1.20 \mu\text{g/ml}$ compared with the other extracts among the nine solvents. From this study it is observed that the plant *S. portulacastrum* showed some moderate activity against *P. falciparum*. In higher concentration of the plant extract the inhibition percentage also increases.

Keywords: *S. portulacastrum*, *Plasmodium falciparum*, saponins, metabolites, solvent.



Deebika Kumar *et al.*,

INTRODUCTION

Halophytes are plants that thrive in a wide range of saline environments, including inland deserts, salt flats, steppes, coastal dunes, salt marshes, and mudflats (1). In addition to their salt tolerance thresholds, these plants exhibit a high degree of physiological adaptability depending on their origin climate zone (2). Due to their high polyphenol content, halophytes exhibit remarkable physiological flexibility (3, 4). Bioactive antiviral, antibacterial, and antifungal compounds are found in mangroves and their associates. Steroids, triterpenes, saponins, flavonoids, alkaloids, and tannins are abundant in them (5, 6, 7, 8). Aizoaceae family member *Sesuvium portulacastrum* (L.) is a significant halophyte in the group of "salt accumulator" plants, which amass high salt concentrations in their cells and tissues and avoid salt poisoning by generating succulence (9). It is considered a potential candidate for environmental conservation due to its capacity to endure under challenging environmental circumstances (10). Conventional medicine use this plant as a treatment for scurvy, renal issues, and fever (11). Five different single-cell, eukaryotic *Plasmodium* parasite species that are spread by the bite of Anopheles mosquitoes—primarily *Plasmodium falciparum* and *Plasmodium vivax*—cause malaria in humans. Worldwide, there were an anticipated 247 million malaria cases in 2021 in 84 malaria-endemic countries (including the territory of French Guiana), up from 245 million in 2020, with the majority of this rise coming from countries in the WHO African Area (12). Development of efficient antimalarial medications is hampered by the evolution of parasite strains that are resistant to treatments (13). This research revealed that there is a knowledge gap in this study since there is a paucity of data that is supported by evidence because this plant's ability to treat malaria has not been previously reported.

MATERIALS AND METHODS

Collection of Plant Material

The Plant materials (Leaves) were collected from Kodyamplayam (Latitude 11.3822° N and Longitude 79.8136° E), which is a portion of the Pichavaram mangrove cover, South East coast of India, Tamilnadu. The gathered plant material was taxonomically recognised and a voucher specimen was kept in the Herbarium of the Botany department at Annamalai University (Voucher No. 69). The collected plant materials are washed with tap water and then with distilled water to remove adhering salts and other associated animals. The plant materials are subjected to shade-dried for 2-3 weeks.

Extract preparation

Shade-dried leaves are made into a coarse powder (100g) using a mechanical blender and it is further subjected to hot continuous extraction by soxhlet apparatus (according to the boiling point of the solvent). The solvents chosen for the extraction process include n-hexane, Diethyl ether, Ethyl acetate, chloroform, dichloromethane, acetone, n-butanol, ethanol, and methanol (300ml).

In vitro culture of *Plasmodium falciparum*

CQ-sensitive strain 3D7 of *P. falciparum* was used for in vitro blood stage culture to test the antimalarial efficacy of different plant extracts. The strain 3D7 was obtained from Jawaharlal Nehru University, New Delhi. *Plasmodium falciparum* culture was maintained according to the candle jar method described by Trager and Jensen (1976), with minor modifications. For antimalarial activity evaluation, highly synchronous ring stage *P. falciparum* was used in each assay. The culture was maintained in fresh O⁺ve human erythrocytes suspended at 4% hematocrit in RPedMI 1640 (Himedia) containing 0.2% sodium bicarbonate, 0.5% albumax, 2 % glucose, 45 µg/L hypoxanthine, and 50 µg/L gentamicin (Himedia) and incubated at 37°C under a gas mixture of 5% O₂, 5% CO₂, and 90% N₂. Every day, infected erythrocytes were transferred into a fresh complete medium to propagate the culture.





Deebika Kumar et al.,

Antiplasmodial assay

Filter sterilized leaf extracts (200, 100, 50, 25, 12.5, 6.25 µg/mL) was incorporated in 96 well tissue culture plates containing 100 µL of *P. falciparum* culture with fresh red blood cells diluted to 2% hematocrit. Negative control was maintained with fresh red blood cells and 2% parasitized *P. falciparum* diluted to 2% hematocrit, and positive control was maintained with parasitized blood cells culture treated with chloroquine (14). Parasitaemia was evaluated after 48 h by Giemsa stain and the average percentage suppression of parasitaemia was calculated by the following formula:

$$\text{Average \% suppression of Parasitemia} = \frac{\text{No.of Infected RBC}}{\text{Total No.of RBC}} \times 100$$

Chemical injury to erythrocytes

To assess the chemical injury of the leaf extract on erythrocytes, 100 µL of erythrocytes were incubated with 200 µg/mL of the extract. The conditions of the experiment were maintained as in the case of the antiplasmodial assay. After 48 h of incubation, thin blood smears were stained with Giemsa stain and observed for morphological changes under high-power light microscope(15). The morphological findings were compared with those in erythrocytes that were uninfected and not exposed to the extract.

SYBR green assay: After 48 h of incubation, 100 µl of SYBR green dye was added to each well. 0.2 µl of SYBR green dye per ml of PBS lysis buffer and this experiment is carried out under a light-sensitive area (16). The reading was recorded in (excitation at 480 nm, and emission at 520 nm)

Antiplasmodial activity calculation and analysis

The antiplasmodial activity of mangrove leaf extracts was expressed by the inhibitory concentration 50 (IC₅₀), representing the concentration of drug that induced a 50% parasitaemia decrease compared to the positive control culture referred to as 100% parasitaemia (17).

Statistical analysis

The IC₅₀ values were calculated (concentration of extract in X axis and percentage of inhibition in Y axis) using Graph Pad Prism software with the linear regression equation.

RESULTS AND DISCUSSION

The antiplasmodial potential of *Sesuvium portulacastrum* is listed in Table No. 1. The Nine type of solvents were taken and screened against *Plasmodium falciparum*. The concentration of the plant crude extracts are 200 µg/ml, 100 µg/ml, 50 µg/ml, 25 µg/ml, 12.5 µg/ml, 6.25 µg/ml. Among all the extracts ethanol shows better activity with the inhibition percentage of 46.30±1.20 µg/ml towards chloroquinine sensitive 3D7 strain of *P. falciparum*. The positive control chloroquine showed 50 % inhibition with IC₅₀ value 41.89±1.89 µg/ml. Except positive control, all the other plant extracts showed IC₅₀ value greater than 200 µg/ml (IC₅₀ ≥ 200).

Traditional practitioners employ the entire plant for numerous diseases due to the presence of many bioactive components(18). This halophyte has been utilised for centuries as conventional healthcare to treat conditions including toothaches, leprosy, eye inflammation, dermatitis, haematuria, and conjunctivitis(19).Antibacterial, antifungal, and antioxidant properties were present in the essential oil extract of this plant(20).It contains phenol, which is an essential source of antioxidants(21). The MDA-MB-231, IMR-32, and HCT-116 cell lines were susceptible to the anticancer effects of *S. portulacastrum* diethyl ether extracts in a dose-dependent manner(22).The chemical components pyrrole derivatives, butanoic acid, ascorbic acid, octadecanoic acid, and hentriacontane, which act as antioxidants, antimicrobials, antiulcerogenic agents, and anticancer agents, were detected in the GC-MS analysis of the methanolic extracts of *S. portulacastrum* (23).





Deebika Kumar et al.,

CONCLUSION

The current investigation concluded that ethanolic extracts of *Sesuvium portulacastrum* have modest antiplasmodial action against the 3D7 strain of *Plasmodium falciparum*. The antiplasmodial action of *Sesuvium portulacastrum* has never been reported before. In higher concentrations of plant crude extracts, the inhibition percentage also increases with lower IC50 value.

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Deebika Kumar *et al.*,

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Table No. 1 Antiplasmodial Potential of *Sesuvium portulacastrum*

	6.25 µg/ml	12.50 µg/ml	25 µg/ml	50 µg/ml	100 µg/ml	200 µg/ml
Hexane	21.10±1.82	24.68±2.59	25.47±2.94	27.62±2.78	30.43±2.56	37.65±4.33
Diethyl ether	7.22±0.55	11.28±2.90	12.71±2.33	14.05±2.06	17.34±2.25	19.41±2.54
Ethyl acetate	21.33±0.59	25.46±1.09	26.16±1.00	27.51±1.07	29.29±1.61	35.97±0.81
Chloroform	11.29±2.22	14.41±1.90	17.52±2.28	19.97±1.91	22.30±1.61	25.68±0.82
Dichloromethane	18.32±1.84	21.42±1.97	23.30±0.90	24.14±1.12	25.07±0.73	25.26±0.67
Acetone	13.59±2.19	18.38±5.67	22.65±3.25	23.50±3.59	25.50±1.48	30.19±1.84
Ethanol	25.42±1.11	29.81±0.98	35.97±1.72	38.74±0.76	44.20±0.94	46.30±1.20
Methanol	13.71±0.57	16.97±2.14	23.07±1.68	28.10±2.56	36.73±0.63	41.24±1.62
Butanol	13.91±1.92	18.71±1.80	21.19±2.22	21.43±2.11	27.17±6.94	31.91±3.37





Human - Computer Interaction for Intelligent Women Safety and Security System

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ABSTRACT

Human-Computer Interaction (HCI) is a multiple disciplines scientific field concentrating on the design of computational power, specifically the communication between human users and computers. HCI scientists investigate how persons communicate directly with machines and create technologies that enable us to communicate with computers in new directions. Safety of women is a social problem, it needs to be resolved as soon as possible. Women constitute more than half of the population and suffer from physical, mental, and social deprivation. This work presents an intelligent women safety and security system which uses mechanisms such as Arduino, X-EYE Gender sensor, GPS, GSM, Buzzer, Pepper Spray Sensor and Shock Sensor with human computer interaction. Sometimes, user (women) may not be in the situation to activate the system. That time this system will help more. In this system, user (women) are not needed to give any input to activate the system. Automatically it gets activated while predicting the gender. And it helps the Police to identify the opponent easily while predicting the gender and age group. Hope, this work proposes a good women safety and security system without user (women) input and to protect herself with Human - Computer Interaction.

Keywords: Arduino, Human - Computer Interaction, Technology, Research, Women Safety, X-EYE Gender Sensor.





INTRODUCTION

In this world, women from all walks of life face threats in a variety of settings. In such a circumstance, several safety aids can be employed to notify the women's family members or other authorities in order to reduce female harassment. [1] and [2]. Women are vulnerable to violence in both the public and private domains, in and around the house, in communities, and at the city level. Risk is determined by urban design choices as well as the organization of public services, such as transportation and energy. Women have a higher level of insecurity than men. Domestic violence affects many women and girls not only in their homes, but also in public spaces, due to poor urban planning and management. In practise, this might refer to issues like poor street lighting, dangerous underpasses, inefficient community policing, and a lack of rehabilitation programmes for people who engage in antisocial behaviour in public settings. Those elements can become more prominent during times of conflict or societal upheaval. Those variables can heighten the danger of gender-based violence during times of conflict or societal instability [3]. Women's safety is a social issue that needs to be resolved as soon as possible. Women make up more than half of the population and face physical, mental, and social challenges. This is an obstacle to the country's development and progress [4]. Humans and computers connect in many different ways, and the interface between the two is demanding to make that connection possible [3].

HCI is more of an academic area than a practical one, focusing on study and empirical understanding of how humans use and are affected by technology. The study of human-computer interaction (HCI) is becoming increasingly relevant as humans engage with technology in more and more parts of their daily routines. This paper includes Section II is a review of existing systems, Section III is design and implementation and Section IV is conclusion.

REVIEW OF EXISTING SYSTEMS

This section discusses some existing devices for women safety implemented in Human – Computer Interaction. The work [4] discusses "Smart Foot devices for women safety". If a woman feels unsafe in this system, she employs a mechanism such as putting one foot four times behind the other. Bluetooth notifications are dispatched to ask for assistance with its place and lesser energy correspondence. The results analyzed using Naive Bayes classifier with accuracy of 97.5%. The work [5] discusses "A smart watch for women security based on IOT Concept 'Watch Me' ". Here, the system is used some technologies such as sensor, GSM/GPS, Temperature sensor and Motion sensor. When a women wear this watch, the sensor detects the heart rate of the user. When the heart rate increases at the moment, system gets activated. Instantly alerts nearby people and automatically calls registered emergency contacts and the nearest police station via GSM/GPS. Then police will take necessary actions to save that women while using GPS.

The work [6] discusses "Smart alarm system for women's security". System proposed with Arduino micro controller to control the overall system. When the user presses the digital switch, loud alarm sound imposed for self-defence, sms sent to the emergency contacts by using GSM, and location shared by using GPS. The work [7] deals with 'smart bags for women's safety'. The bag consists of a voice sensor, emergency switch, GSM module, Arduino board and actuators. The system is activated by picking up a woman's voice or an emergency call switch. When the system is instantly activated by a high-intensity flash of light, a siren produces a high-pitched alarm, sprays pepper, and delivers a very high-voltage shock to injure the attacker. Also, the message is sent to emergency contacts. An emergency contact will take the necessary steps to rescue the women.

The work [8] discusses "Designing handbags for women's safety". The bag includes a wireless bug killer, Arduino Uno micro-controller, electric shock torch, pepper spray, ESP 32 camera, GSM, and GPS. If the user (women) encounters a problem, she can immediately press the switch to wake up the system. GSM sends an emergency message to the family with a photo of the attacker. She can attack opponents with electric shocks and pepper spray. GPS gives the family the exact location of the victim. This is how women are saved.



**Rajayogeswari and KarthickAnand Babu**

The work [9] discusses "Smart security device for women based on IOT using Raspberry Pi". A Raspberry Pi, flex sensor, buzzer, camera, GSM, and GPS are all elements of the system. When a woman feels uncomfortable, she presses a switch to activate the system. The camera records a photo or video of the victim's current location and uploads it to the server. GSM is used to send messages to emergency contacts, and GPS is used to pinpoint the victim's exact location. The emergency contact rescues the woman while obtaining evidence from the victim.

Hence, this paper has to be designed comparatively with a unique safety and security system that uses number of electronic units are placed to give the protection against women. In this proposed system, women are not needed to give any input to activate the system. When someone comes closer in front of the women, immediately it finds the gender of that particular person whether the person is male or female and predict the age group. If the sensor predicts the mentioned person is male and age group, then the system gets activated automatically. Then siren, pepper spray, and shock will be triggered to attack the opponent for self-defence. In between, call and sms will be sent to the emergency contacts and nearby police station while sharing the location through GSM and GPS. The main advantage of this system is that there is no need to trigger any input from the user (women) and no need of any internet connection to activate the system.

DESIGN AND IMPLEMENTATION

The proposed system comprises of X-eye Gender Sensor, Arduino Uno micro controller, GSM, GPS, Shock switch, pepper spray and sound module.

X – EYE Gender Sensor

Nexmosphere's X-Eye gender sensor finds the gender of the person in front of the sensor and also provides an estimated age for that person. X-Eye Gender is a fully self-contained embedded sensor and it does not require internet access [14].

Arduino

The Arduino Uno board is based on ATmega328P micro-controller (datasheet). It encompasses everything a user requires to be get started with the device, such as an Usb port for integrating to a computer and an Ac to dc adapter or battery for energy [10].

GSM

The Global System for Mobile Communication (GSM) is a cellular mobile digitization that allows mobile voice and data services to be uploaded. GSM automates and compresses the data before sending it to the medium [15, 16].

GPS

The United States Space Force manages and controls the Global Positioning System "GPS" (which used to be known as Navstar GPS). "GNSS" continues to stand for Global Navigation Satellite System. It propagates location data and time data to any GPS receiver with a spectacular views of four or more GPS satellites. [17].

Shock Sensor

The shock sensor module is used to detect shocks, as its name suggests. A vibration sensor is another name for it. When someone touches, hits, moves, or jolts something equipped with a shock sensor module, the sensor sends a signal to their brain or controller, indicating the severity of the hit, move, or touch. Similarly, the brain or controller sends a logic high signal to a buzzer, beep, or sound system, depending on the intensity [12].

Big Sound Sensor

This noise detector generates both electronic signals. This signal can be used, for example, to turn a light switch on and off. With a relay module this sensor is very useful [13].



**Rajayogeswari and KarthickAnand Babu****Pepper Spray**

When a person's eyes are sprayed with pepper spray, they immediately close, causing incredibly painful eye and temporary paralysis. Some report a high pressure or boiling sensation, as well as an extreme pain. Pepper spray can also produce a dry cough or wheeze. This is done in order to protect the women from the assailant [18].

Working Mechanism

In the proposed system, when a person comes closer in front of the women, automatically the sensor finds the gender and age group of a person. When the sensor predicts the particular person is male and age group, then immediately Arduino micro controller gets activated. During location information sharing, emergency contacts and nearby police stations are notified by phone or SMS. In between that girl tackles the opponent while giving a shock, buzzer for asking help from other people and spraying pepper spray to close the opponent's eyes for some of few minutes. Police will track the location and save that girl. Also, Police can easily find out the opponent with the help of age prediction.

The proposed system consists of three important module.

- i) X-EYE Gender sensor module
- ii) Self-defence module
- iii) Rescue module

X-EYE Gender Sensor Module:

The optical lens of Nexmosphere's X-Eye gender sensor captures a visual image of the person standing in front of it. The sensor analyzes this image in real time and provides the results (gender and age) at the output of the sensor. The sensor does not save any visual picture or video data, nor can it be used to retrieve a live video feed.

Functionalities and API commands:

The following features are available with the X-Eye Gender sensors:
Gender detection determines whether an individual is female or male.
Age estimation is a method of estimating an individual's age range.
1. Gender detection - detect if a person is male or female
2. Estimated Age - Provides an measure of an individual's age range

X001B [PGCACG] P=People Detected 0=No People, 1=People Detected G=gender detection M=male, F=female, U=unknown C= confidence in gender X=very low, L=low, H=high A = estimated age range from 0 to 7 years
C = Confidence Age L = Low, H = High, X = Very Low

Gender Detection

When a person is detected, the sensor determines in real time whether the person is male or female. At the same time, the confidence level of the detected gender is displayed. Example API trigger commands are presented on the right.

Age Estimation

When a person is detected, the sensor evaluates the person's age range in real time. He has seven different age groups with the following default her mappings.

- Value 0 = Age from 00 to 11
- Value 1 = Age from 12 to 17
- Value 2 = Age from 18 to 24
- Value 3 = Age from 25 to 34
- Value 4 = Age from 35 to 44
- Value 5 = Age from 45 to 54
- Value 6 = Age from 55 to 64
- Value 7 = Age from 65 and more.



**Rajayogeswari and KarthickAnand Babu****Viewing angle and detection area:**

When installing the sensor, consider the viewing angle to ensure that people in front can be detected.

Self-defense module

The women use a shock sensor, a buzzer, and pepper spray to fight back against the attacker in this module. Meanwhile, emergency contacts and the local police station received text messages and phone calls.

iii) Rescue module

By tracking the location of the women using GSM and GPS, women can be saved in right time and easily catch the opponent by the Police hopefully.

CONCLUSION

This work aimed to develop an intelligent safety and security system without user (women) input for women safety. Sometimes, the women may not be in the situation of giving input to activate and protect herself. This system automatically activates when the attacker comes closer in front of the women unnecessarily even though there is no internet connection while predicting the gender. It makes the women feels safe and prevent her from anything which happens before unwanted. The Police can save the women in right time and also can find the opponent easily with the help of age prediction.

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Rajayogeswari and KarthickAnand Babu

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Table 1: Shows field of view angle and detection area

	XY-510	XY-520
viewing Angle	90°	50°
Minimum detection distance	15cm	35cm
Maximum detection distance	120cm	250cm

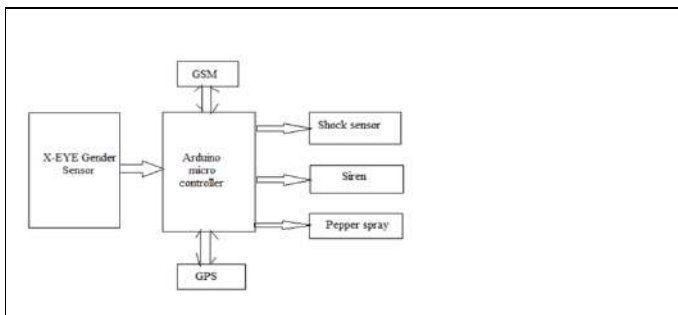


Fig 1: System Architecture

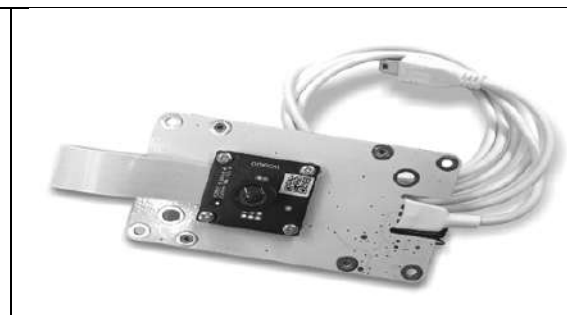


Fig 2: X – EYE Gender sensor

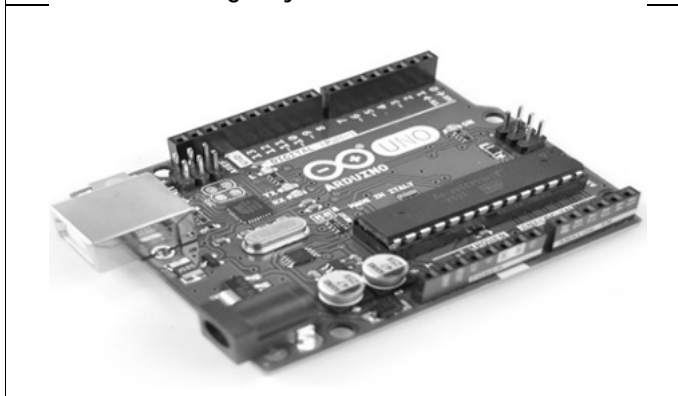


Fig 3: Arduino UNO



Fig 4: GSM module

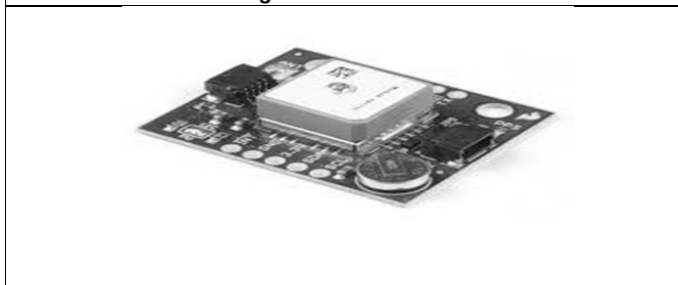


Fig 5: GPS module



Fig 6: Shock sensor





Fig 7: Big Sound sensor

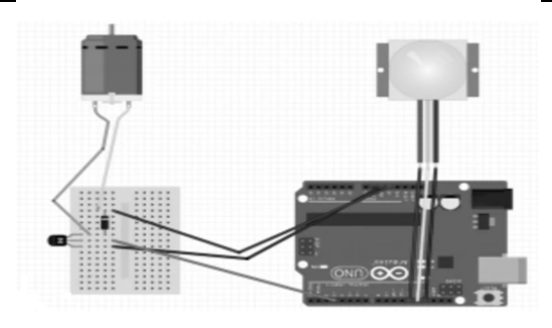


Fig 8: Pepper Spray sensor

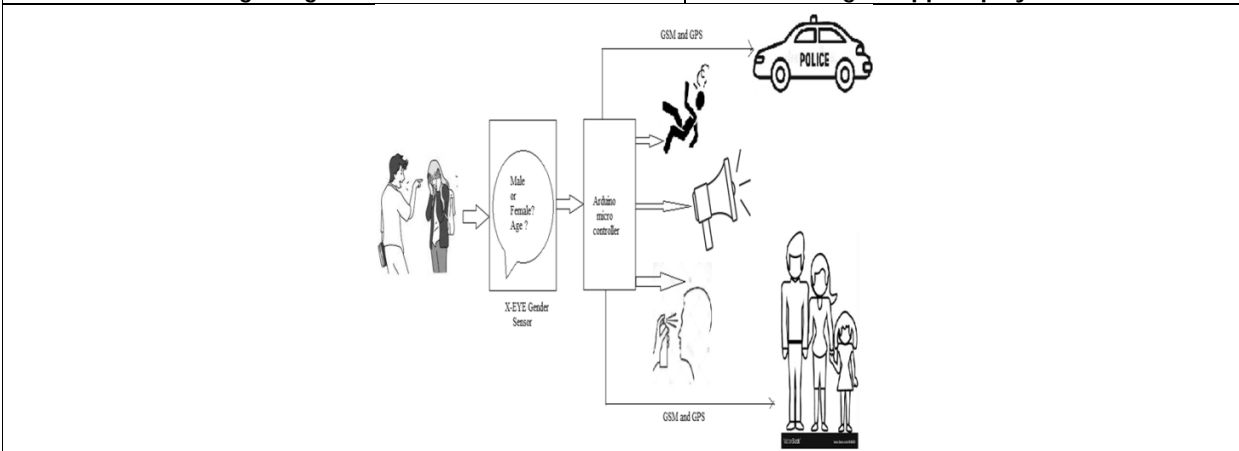


Fig 9: Working mechanism





The Impact of Air Pollution on Solar Energy Generation in the Panvel - Navi Mumbai Region

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ABSTRACT

In recent years, the high concentration of particulate matter in the air has greatly reduced the amount of solar radiation that can reach the earth due to the continuous increase in environmental pollution. This decrease has an immediate impact on the use of solar energy. Real-time data collected from Panvel, Navi Mumbai from January 2022 to December 2022 is used to investigate the correlation between solar energy production and the air quality index. According to the findings of the analysis, higher air quality indexes result in lower clearness indexes, and bright days have a faster-decreasing rate than cloudy days. This study examines the effects of air pollution and photovoltaic soiling on solar resources and photovoltaic system techno-economic performance.

Keywords: Renewable Energy Source, Solar Panel, Air Quality, photovoltaic Cell.





INTRODUCTION

Traditional fossil energy has become insufficient to meet people's living needs as the global population continues to grow. It is critical to promote the use of renewable energy in order to achieve sustainable development [1-3]. Solar energy has become a popular renewable energy for building applications because of its benefits such as wide distribution, large reservation, and lack of pollution [4]. It has piqued the interest of many researchers worldwide who are studying the transmission, conversion, and utilization of solar energy [1,5]. According to the "Renewables Energy 2018 - Global Status Report," the global capacity of solar power reached 402 GW in 2018 [6]. Solar energy utilization has advanced rapidly over the last two decades, and more attention has been paid to solar energy conversion efficiency, including electrical efficiency, thermal efficiency, and exergy efficiency [7,8]. Many factors have been identified as influential in solar energy system conversion efficiency, including photovoltaic module temperature [9], dust accumulation [10], ambient temperature, and wind speed [11]. The amount of solar radiation that reaches the photovoltaic surface has a significant impact on the power generated by solar photovoltaic modules [12]. However, air pollution and dust are prevalent throughout the world, particularly in regions with rapidly growing solar photovoltaic markets, such as China and India, where solar photovoltaic power generation is significantly reduced. [13]. Pollutants in the atmosphere have the potential to reduce solar radiation reaching the photovoltaic surface via reflection, scattering, and absorption, posing a threat to solar power production. Furthermore, soiling of photovoltaic modules caused by contaminant deposition (e.g., dust, industry emissions, and engine exhausts) on the photovoltaic surface is a significant challenge, particularly in arid and semi-arid regions with high concentrations of airborne dust, such as the Arabian Peninsula and northern Africa. [14-17]. Soiling, as a barrier between photovoltaic modules and solar radiation, can reduce solar transmittance through photovoltaic covers, resulting in a significant decrease in photovoltaic generation efficiency. Overall, both air pollution and soiling have a significant impact on the generation of solar photovoltaic power. Previous research on the soiling of solar photovoltaic modules has been reviewed; for example, Ilse et al. [14] provided an overview of soiling processes on photovoltaic modules at the microscopic and macroscopic levels.

METHODOLOGY

Panvel, near Navi Mumbai's industrial area, has been chosen to collect air quality index data. Data on solar power generation is gathered from solar panels installed on the roof of Changu Kana Thakur College in New Panvel-Navi Mumbai (Fig. 1). In this section, we interpret some key short points that will aid in data analysis. The Maharashtra Pollution Control Board provided data on Panvel's Air Quality Index from January 2022 to December 2022. Trackso, an IoT-based energy management platform, was used to collect data on the electricity generated by the solar panels in order to track performance.

RESULTS AND DISCUSSION

Data Analysis

It is observed that the amount of solar energy generated using photovoltaic cells depends on the intensity of solar radiations reaching the surface of the Solar Panels. Higher value of AQI (Air pollution) reduces the intensity of radiation reaching the solar photovoltaic cells and hence affects the electricity generation from the panels (Fig.2). In addition to reducing air pollution, the airborne dust and grime deposited on the front surface of photovoltaic modules, known as 'soiling,' is an unavoidable environmental hazard that results in a significant reduction in photovoltaic power generation. Solar power systems may be less efficient as a result of reduced solar radiation transmission caused by increased air pollution. To measure the effect of air pollution on solar radiation attenuation, data from the Panvel region from January 2022 to December 2022 is used to discuss the relationship between solar radiation and air pollution and to assess solar radiation attenuation caused by air pollution (Fig. 3). This study provides a thorough examination of the negative effects of air pollution and soiling on solar photovoltaic power





Pawar et al.,

generation. Air pollution reduces solar power generation by attenuating solar radiation reaching the photovoltaic surface via reflection, scattering, and absorption, whereas soiling reduces solar transmittance through photovoltaic module covers and reduces solar power generation efficiency. The elimination of air pollution through governmental policies and measures benefits the increase of surface solar radiation and, as a result, the power generation of photovoltaic modules. Furthermore, reducing air pollution, particularly particulate matter concentrations, would reduce soiling of photovoltaic modules.

CONCLUSION

Increased air pollution would reduce solar radiation transmission and thus the performance of solar energy systems. The type of air pollutants, mass concentration, and particle size are all important factors in determining the attenuation coefficient. The elimination of air pollution through governmental policies and measures benefits the increase of surface solar radiation and, as a result, the power generation of photovoltaic modules. Furthermore, reducing air pollution, particularly particulate matter concentrations, would reduce soiling of photovoltaic modules.

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Fig. 1 Photograph of solar panels

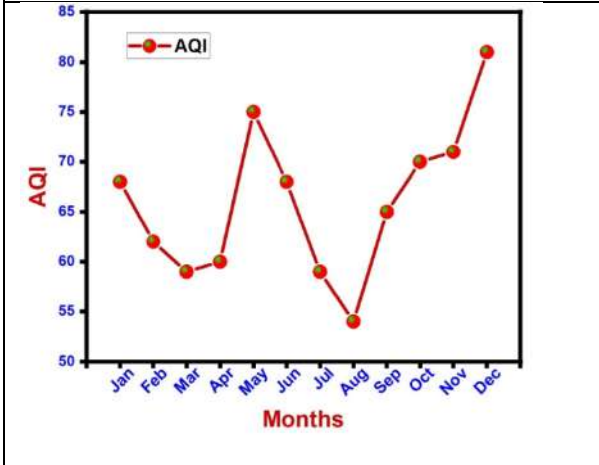


Fig.2. Air Quality Index (AQI) of January 2022-December 2022

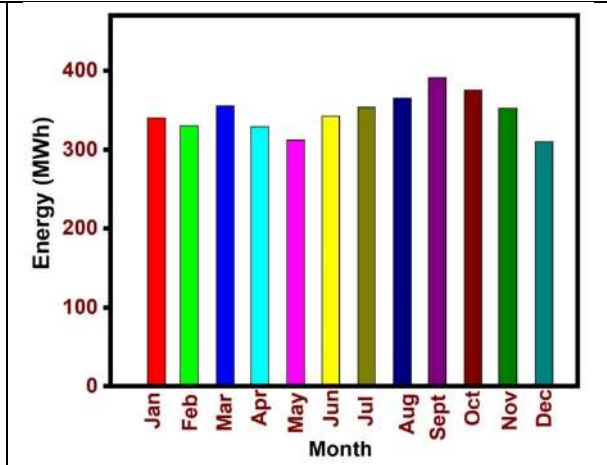


Fig. 3. Solar cell energy of January 2022-December 2022





Phyto-Constitutes Profiling by using LC-MS and GC-MS analysis and Antioxidant Activities of of *Phyllanthus maderaspatensis* L.

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ABSTRACT

Plants of *Phyllanthus* genus were medicinally useful for curing various diseases. *Phyllanthus emblica*, *P. fraternus*, *P. reticulatus* and *P. nururi* are common plants in Gujarat. Previous studies show *Phyllanthus maderaspatensis* is helpful in hepatoprotective activity, anti-inflammatory activity, skin disease, and anti-analgesic activity. The present work shows the phytochemical profiling of bioactive compounds in methanol and hexane extract, which is done by using liquid chromatography hyphenated with quadrupole time-of-flight mass spectrometer (LC-ESI-QTOF-MS) & gas chromatography (GC-MS) respectively. *Phyllanthus* genus rich source of phenol, flavonoid, and terpene components. However, the isolation of this bioactive compound will be useful for novel drug discovery. DPPH, ABTS, PMA, CUPRAC, and H₂O₂ radical scavenging assays were performed in the different extracts of leaves and fruit of *Phyllanthus maderaspatensis*.

Keywords: *Phyllanthus maderaspatensis*, GC-MS and LC-MS, Anti-oxidant assays

INTRODUCTION

Plants have been used for medicinal purpose since ancient time due to their specific chemical component which is helpful for curing various disease (Aboelsoud, 2010). *Phyllanthus* is one of the biggest genera of the *Phyllanthaceae* family with 11 subgenera, and more than 700 plant species spread worldwide (Mao et al., 2016). The purpose of the

57872



**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

present work is to screen the bioactive compound through GC-MS and LC-MS with the help of the NIST library. In GC-MS analysis total of 12 compounds in hexane extract and 7 compounds in methanolic extract of leaves was identified. The LC-MS analysis shows one bioactive compound was identified in leaf extract. The anti-oxidant assays were done in four different extracts of leaves and fruit of *Phyllanthus maderaspatensis* L. Free radicals are produced during many physiological processes of living organisms, and it is harmful to plants and animals. Plants have many chemical compounds which are scavenging this free radicle or reactive oxygen species (ROS) it is called an antioxidant agent and is known as radicle scavenging activity (Zheng and Wang, 2001; Kumaran and Karunakaran, 2007).

MATERIAL AND METHODS

Sample Collection

The plants were collected in December 2022 from Kumarkhan town of Ahmedabad district, Gujarat, India. The location stands between (Latitude 22.917715° N and longitude 72.01959° E). The plant herbarium is authenticated by the Department of Botany, Gujarat University. The voucher specimen was deposited at the herbarium of the Botany department, at Gujarat University.

Extract preparation

The collected leaves and fruit were washed with distilled water and were dried at $50 \pm 1^\circ\text{C}$ in the oven. The dried leaves & fruit were later powdered with the help of a grinder. The Soxhlet extraction method was followed to prepare extracts in 4 solvents, methanol, ethanol, acetone & aqueous. 10 g of powder was extracted in 100 ml of solvent (1:10 g/ml solid to solvent ratio) according to the boiling point of solvent with the help of a Soxhlet extractor. After that, it was filtered with Whatman No. 1 filter paper and allowed to dry in Petri plates for 24 hours.

GC-MS analysis

GC-MS analysis of methanolic and hexane extract of *Phyllanthus maderaspatensis* was performed using a PerkinElmer Clarus 680 system with a Gas chromatograph interfaced to a mass spectrometer equipped with an Elite 5 MS fused a capillary column (30 m×0.25 mm I.D×0.25 μm). For the detection of compound uses the electron ionization system was operated in electron impact mode with an ionization energy of 70 eV. Helium gas was used as carrier gas at a constant flow rate of 1 ml/min and injected volume of 1 μl was employed. The injector temperature was maintained at 250 °C but the initial temperature is 60 °C for 1 min. further gradually increase the temperature 10 °C / min and reach 150 °C than hold for 2 min and after that increae 10 °C/min up to 200 °C, in last phase 250 °C hold for 2 min. Mass spectra were taken at 70 eV. The solvent delay was 0 to 4 min, and the total GC-MS running time was 29 min. The scan interval is 0.5 seconds and the fragment is 50 to 6000 Da mass. The relative percentage amount of each component was calculated by comparing its average peak area to the total area. Here, 3 fraction of Hexane extract is separately analyzed. This fraction was separated in the ratio of (7:3) Hexane: Ethyl acetate through column chromatography. Column pack with silica (mesh size 60-120μm), the Flow rate is 1 drop /2 seconds. Methanol extract is used from the stock solution of 1 mg/ml.

Identification of phytochemical constituents

The mass detector used in this analysis was PerkinElmer Clarus SQ 8C. National Institute Standard and Technology (NIST library). The mass spectrum of the unknown components was compared with the spectrum of known components.

LC-MS analysis

LC-MS analysis was carried out using an Agilent HPLC interfaced with an Agilent 6200 quadrupole time of flight mass spectrometer (Agilent Technologies, USA). Chromatographic separation was performed using thermoBetasil C₁₈ column operate at 25 °C employing gradient elution using 0.1% formic acid in water (A) and 0.1% formic acid in methanol (B) as mobile phase at a flow rate of 0.4 ml/min The elution consisted of a gradient of 35-90% for 0-7 min,



**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

90-90% for 7-25 min, 90-35% for 25-35 min and initial condition nominated for 5 min. The sample injection volume is 2 μ L (Methanol extract is used from the stock solution of 1 mg/ml). Nitrogen was used as drying, nebulizing, and collision gas. The drying gas flow rate was 12L/min. The accurate mass data of the molecular ions were processed through the Mass Hunter workstation software.

Anti-oxidant Assay:**DPPH radical scavenging assay**

The DPPH (1,1 Diphenyl 2 Picrylhydrazyl) radicle scavenging activity was estimated by the standard method of Brand-Williams *et al.*, 1995 with minor modification. The stock solution of DPPH was freshly prepared (4 mg in 100 ml methanol) and kept in dark for 30 min. Plant extract and standard Ascorbic acid (0-100 μ l from stock 1 mg/ml) were taken into a test tube and made the final volume of 1 ml with the help of methanol. 3 ml of DPPH mixed with test tube solution and shaken vigorously then kept for 30 min in a dark condition. The absorption of the mixture was read at 517 nm using (Shimadzu UV-1800 Shimadzu corporation, Kyoto Japan) against a blank of absolute methanol without DPPH. The results were expressed as percentage inhibition of DPPH according to the following formula: $I\% = (A_{\text{control}} - A_{\text{sample}}) / (A_{\text{control}}) * 100$

Where A_{control} = absorbance of the DPPH solution without extract; A_{sample} = absorbance of the DPPH solution with plant extract.

ABTS radical scavenging assay

The ABTS [2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)] radicle scavenging activity was measured by Patel and Ghane, 2022. Plant extract (0-200 μ g/ml) and standard Trolox (0-200 μ l from stock 4 mg/ml) were taken into a test tube and made the final volume of 1 ml with the help of methanol. 3 ml ABTS reagent was added and then the mixture was incubated for 30 min. The absorption was taken at 730 nm against the blank (methanol without ABTS reagent). The results were expressed as a percentage of ABTS^{•+} scavenging according to the following formula: $I\% = (A_{\text{control}} - A_{\text{sample}}) / (A_{\text{control}}) * 100$

Where A_{control} = absorbance of the ABTS solution without extract; A_{sample} = absorbance of the ABTS solution with plant extract.

CUPRAC assay

The Cupric Reducing Antioxidant Capacity assay was performed using the method of Sethi *et al.*, 2020. For the assay, 0.2 ml sample extract or standard Trolox (0.125-1 ml) and made the final volume up to 1 ml by adding methanol, and then mixed with 3 ml of CUPRAC reagent (copper chloride, neocuproine, and ammonium acetate buffer (pH 7) solution in 1:1:1 ratio) to get total reaction mixture of 4 ml. After 30 minutes of incubation at room temperature, take the absorbance at 450 nm. Results were expressed as mg Trolox equivalents (TE)/g extract.

Phosphomolybdenum assay (PMA)

The Phosphomolybdenum assay was done by the method of Prieto *et al.*, 1999. Here the method was slightly modified. In this assay, 0.2 ml of plant extract (1 mg/ml stock) or standard ascorbic acid (0.2-1 ml) was mixed with phosphomolybdate reagent (0.6 M sulphuric acid, 28 mM sodium phosphate, 4 mM ammonium molybdate). Then the reaction mixture was incubated in the water bath for 60 min. Cooled at room temperature and absorbance was measured at 695 nm. The antioxidant capacity was expressed as mg of ascorbic acid equivalents (AAE)/g extract.

Hydrogen peroxide (H₂O₂) radicle scavenging activity:

Hydrogen peroxide radicle scavenging activity assay was performed as per the standard method of Baydar *et al.*, 2007 with slight modification. For this assay, a 2 mM solution of hydrogen peroxide was prepared in methanol. The series of concentrations used in this assay is (0- 200 μ g/ml) and the final volume of 1 ml was made by adding methanol. 2 ml of H₂O₂ solution was added and incubated for 10 min. After incubation absorbance was measured at 230 nm against the blank solution containing methanol without H₂O₂ solution. The results were expressed as a percentage of H₂O₂ scavenging according to the following formula:



**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

$$I\% = (A_{\text{control}} - A_{\text{sample}}) / (A_{\text{control}}) * 100$$

Where A_{control} is the absorbance of the H_2O_2 solution without extract and A_{sample} is the absorbance of the H_2O_2 solution with plant extract.

Statistical Analysis

Experimental results were analyzed as mean \pm S.D. of three independent replicates for biochemical assay. Statistical analysis was carried out using Microsoft® Office Excel (Microsoft® U.S.A). Principle component analysis (PCA) was also performed using Minitab ver.18.

RESULTS AND DISCUSSION

GC-MS analysis

The study shows the list of bioactive compounds which are analyzed through GC-MS and LC-MS with the help of the NIST library. In GC-MS analysis total of 12 compounds in hexane and 7 compounds was identified in methanolic extract of leaves. Tables 1-4 and Fig. 1-4 show the chromatogram and identified compound by GC-MS analysis. Twelve compounds namely, Octasiloxane, Cyclonasiloxane, 5 α -Pregnane-3-20 α -diol, Dodecane, 3,7,11,15 tetramethyl-2 hexadecane, Pentadecanoic acid, n-Hexadecanoic acid, 1-Hexadecanol, Heptadecane, Neophytadiene, Eicosane-2-methyl, Squalene and 7 compounds of methanolic extract is n-Hexadecanoic acid, 1,1 Bicyclopropyl-2-octanoic acid, 9,12,15 Octadecatrienoic acid, 3,7,11,15 tetramethyl-2 hexadecane, Heptadecane, Eicosane-2-methyl, Squalene.

Mamza et al., 2012 analyzed nine bioactive compounds from the ethanolic extract of *P. amaru*, Where Elangovan et al., 2015 identified 16 phytochemical constituents in the petroleum ether extract of *Phyllanthus emblica* and Phatak et al., 2016 find that 11 biomolecules in *Phyllanthus acidus* by the help of GC-MS.

LC-MS analysis

The results of the LC-MS analysis was shown in Table 5 and the chromatogram of the sample is present in Fig. 5 and the peak of Rutin is shown in Figure 6. In LC-MS analysis one bioactive compound (Rutin) was identified in the leaves extract of *Phyllanthus maderaspatensis*. Retention time, difference, molecular formula, abundance, and compound name are shown in Table 5. Ilyas et al., 2022 Optimization of rutin, catechin, gallic acid, ellagic acid, quercetin, and kaempferol with the help of HPTLC in the hydroalcoholic extract of *Phyllanthus maderaspatensis*. A total of 51 compounds is identified and characterization with the help of HPLC-ESI-QTOF-MS/MS of ethanolic extract of *Phyllanthus emblica*, *P. fraternus*, *P. amarus* and *P. nururi* (Kumar & Kumar, 2017).

Antioxidant activity

The antioxidant capacity of plant parts was measured by different assays of antioxidants. Table 6 and Graph 1-5 shows the antioxidant properties in the different solvent extracts of leaves and fruits. The radical scavenging activity (antioxidant potential) was calculated in the equivalent of Ascorbic acid and Trolox according to assays. Graph 1-5 shows the comparisons of leaves and fruit extract in different assays of Antioxidant such as 1,1 Diphenyl 2 Picrylhydrazyl (DPPH) radical scavenging activity, The Cupric Reducing Antioxidant Capacity, [2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)] radical scavenging activity, Hydrogen peroxide radical scavenging activity & Phosphomolybdenum assay.

The Ascorbic acid equivalent values ranged between 164.42 ± 8.24 to 461.08 ± 20.88 mg AAE/g for the Phosphomolybdenum assay, whereas in DPPH antioxidant capacity equivalent to Ascorbic acid ranged between 23.87 ± 2.7 to $88.54 \pm 0.85\%$ and 2.09 ± 0.4 to $11.02 \pm 0.67\%$ for H_2O_2 . Trolox equivalent values ranged between 136.16 ± 14.71 to 710.28 ± 66.23 mg TE/g extract for CUPRAC assay, and 71.32 ± 29.04 to $93.08 \pm 0.74\%$ for ABTS assay. A



**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

previous study has reported that the antioxidant capacity of *Phyllanthus maderaspatensis* was 274 ± 22.6 mg AAE/g extract (Kumaran and Karunakaran, 2007). The significant value of antioxidant (radical scavenging) activity is shown in the acetone extraction of leaves. This research is further used for the quality control of the drug and to provide a suitable extraction solvent for natural antioxidants.

Principal component analysis

PCA is a statistical technique which used for decreasing the dimensionality of the dataset. This is performed by linearly transformed data in to new coordinate system and the variation in data expressed with fewer dimension than the initial data (Jolliffe and George, 2016).

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Hitesh R. Kumarkhaniya and Bharat B. Maitreya

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Table 1: Phytoconstituents of Hexane leaves extract (fraction 1) of *Phyllanthus maderaspatensis*

Peak No	RT (min)	Scan	Area (%)	Match	R.Match	Formula	Compound Name
2	13.767	2343	1.782	455	560	O ₇ Si ₈	Octasiloxane
4	16.731	3054	3.009	750	771	O ₉ Si ₉	Cyclononasiloxane
7	16.981	3114	3.762	430	442	C ₂₁ H ₃₆ O ₂	5a-Pregnane-3, 20 a-diol

(RT: Retainment Time, Match Factor score: >900 is an excellent match; 800-900 is good match; 700-800 is far match; <600 is poor match, R.Match: Reverse Match)

Table 2: Phytoconstituents of Hexane leaves extract (fraction 2) of *Phyllanthus maderaspatensis*

Peak No	RT (min)	Scan	Area (%)	Match	R.Match	Formula	Compound Name
1	8.285	1028	2.230	874	878	C ₁₂ H ₂₆	Dodecane
3	17.840	3320	35.749	899	910	C ₂₀ H ₄₀ O	3,7,11,15 tetramethyl-2 hexadecane
7	19.240	3656	1.849	847	859	C ₁₅ H ₃₀ O ₂	Pentadecanoic acid
8	19.949	3826	3.601	783	798	C ₁₆ H ₃₂ O ₂	n-Hexadecanoic acid
9	20.274	3904	1.671	785	872	C ₁₆ H ₃₄ O	1-Hexadecanol
10	20.362	3925	1.917	845	868	C ₁₇ H ₃₆	Heptadecane

(RT: Retainment Time, Match Factor score: >900 is an excellent match; 800-900 is good match; 700-800 is far match; <600 is poor match, R.Match: Reverse Match)

Table 3: Phytoconstituents of Hexane leaves extract (fraction 3) of *Phyllanthus maderaspatensis*

Peak No	RT (min)	Scan	Area (%)	Match	R.Match	Formula	Compound Name
5	17.819	3315	4.984	891	917	C ₂₀ H ₃₈	Neophytadiene
6	18.457	3468	2.070	894	919	C ₂₀ H ₄₀ O	3,7,11,15 tetramethyl-2 hexadecane
7	19.932	3822	1.849	753	868	C ₂₁ H ₄₄	Eicosane-2-methyl
8	24.452	5621	23.524	896	897	C ₃₀ H ₅₀	Squalene
10	27.636	5670	2.069	720	791	C ₁₇ H ₃₆	Heptadecane

(RT: Retainment Time, Match Factor score: >900 is an excellent match; 800-900 is good match; 700-800 is far match; <600 is poor match, R.Match: Reverse Match)

Table 4: Phytoconstituents of methanol leaves extract of *Phyllanthus maderaspatensis*

Peak No	RT (min)	Scan	Area (%)	Match	R.Match	Formula	Compound Name
1	19.895	3813	10.499	862	863	C ₁₆ H ₃₂ O ₂	n-Hexadecanoic acid
2	20.266	20.266	2.997	575	599	C ₁₄ H ₂₄ O ₂	1,1 Bicyclopropyl-2-octanoic acid





Hitesh R. Kumarkhaniya and Bharat B. Maitreya

3	21.667	4238	1.599	847	848	C ₁₆ H ₃₀ O ₂	9,12,15 Octadecatrienoic acid
4	21.825	4276	1.665	864	892	C ₂₀ H ₄₀ O	3,7,11,15 tetramethyl-2 hexadecane
7	24.205	4847	1.095	715	787	C ₁₇ H ₃₆	Heptadecane
8	24.439	4903	37.004	910	910	C ₃₀ H ₅₀	Squalene
10	27.436	5622	12.622	877	899	C ₂₁ H ₄₄	Eicosane-2-methyl

(RT: Retainment Time, Match Factor score: >900 is an excellent match; 800-900 is good match; 700-800 is far match; <600 is poor match, R.Match: Reverse Match)

Table 5: Phytoconstituents of Methnol leaves extract of *Phyllanthus maderaspatensis* (LC-MS analysis).

Peak No	RT (min)	Observed m/z	Difference (ppm)	Score (DB)	Abund (%)	Formula	Compound
3	4.884-5.084 min	611.16	0.69	99.04	64.13	C ₂₇₂ H ₃₀ O ₁₆	Rutin

Table 6: Antioxidant Assays of *Phyllanthus maderaspatensis* Leaf Extracts (n=3 ± S.D).

Sr. No.	Solvent	Plant part	DPPH (% RSA)	ABTS (% RSA)	H ₂ O ₂ (% RSA)	CUPRAC (mg TE/g)	PMA (mg AAE/g)
1.	Methanol	Leaves	54.18 ± 2.7	91.34 ± 0.28	3.06 ± 0.4	417.86 ± 10.45	333.79 ± 9.3
		Fruit	88.54 ± 0.85	71.32 ± 29.04	2.71 ± 0.4	710.28 ± 66.23	461.08 ± 20.88
2.	Ethanol	Leaves	23.87 ± 2.7	80.59 ± 1.87	7.20 ± 1.21	277.09 ± 20.3	293.1 ± 25.53
		Fruit	88.11 ± 0.46	91.68 ± 0.79	3.49 ± 3.68	527.41 ± 14.34	338.56 ± 7.04
3.	Acetone	Leaves	64.7 ± 2.37	93.08 ± 0.74	8.49 ± 0.54	617.08 ± 13.51	333.24 ± 25.11
		Fruit	81.99 ± 3.04	78.52 ± 0.24	11.02 ± 0.67	530.52 ± 72.23	435.7 ± 45.23
4.	Aqueous	Leaves	71.26 ± 4.06	81.19 ± 2.72	2.09 ± 0.4	136.16 ± 14.71	164.42 ± 8.24
		Fruit	54.67 ± 1.72	85.39 ± 1.48	3.67 ± 0.54	516.69 ± 9.55	244.05 ± 4.50

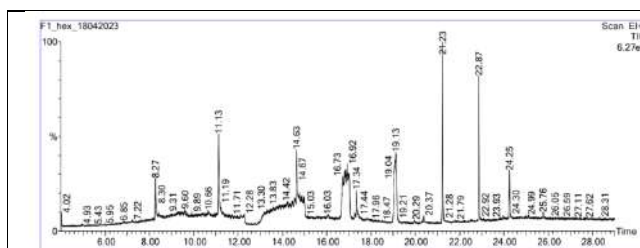


Fig.1 GC-MS Chromatogram obtained from the Hexane leaves extract (fraction 1) of *Phyllanthus maderaspatensis*

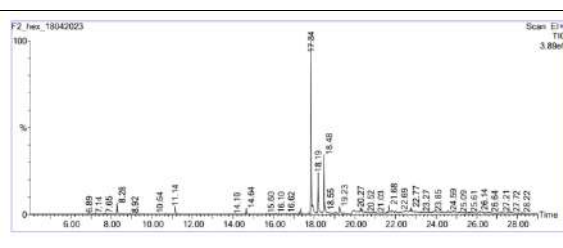


Fig.2 GC-MS Chromatogram obtained from the Hexane leaves extract (fraction 2) of *Phyllanthus maderaspatensis*

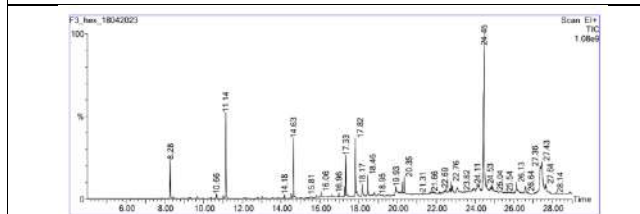


Fig.3 GC-MS Chromatogram obtained from the Hexane leaves extract (fraction 3) of *Phyllanthus maderaspatensis*

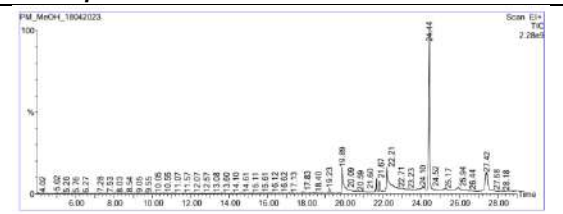


Fig.4 GC-MS Chromatogram obtained from the Methanol leaves extract of *Phyllanthus maderaspatensis*





Hitesh R. Kumarkhaniya and Bharat B. Maitreya

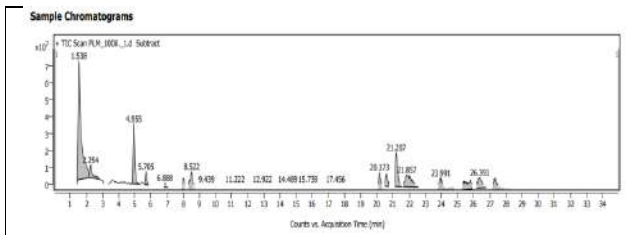


Fig.5 LC-MS Q-TOF base peak of chromatogram obtained from the Methanol leaves extract of *Phyllanthus maderaspatensis*

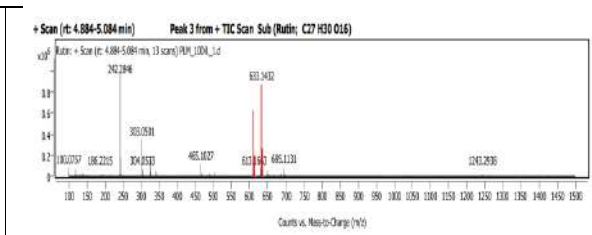


Fig.6 LC-MS/Q-TOF Chromatogram of Rutin obtained from the Methanol leaves extract of *Phyllanthus maderaspatensis*

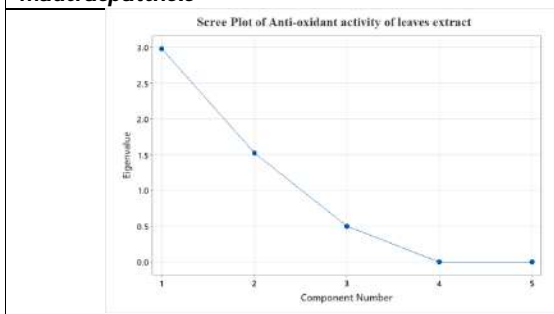


Fig.7 Scree plot

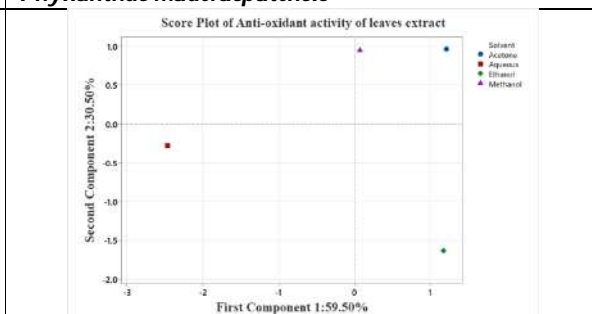


Fig. 8 Score plot

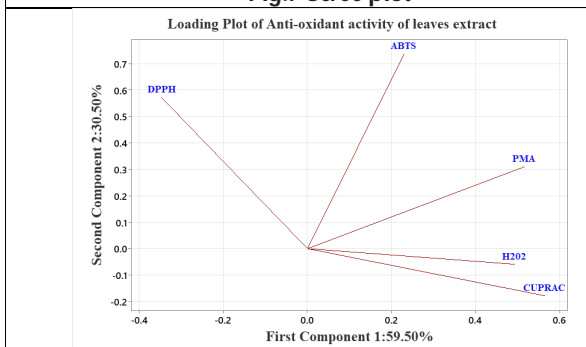


Fig. 9 Loading plot

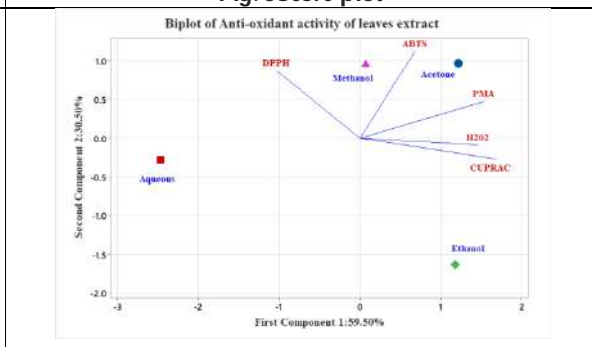


Fig. 10 Biplot

Fig.10: Principal component analysis (Scree plot, Biplot- Score and Loading plot) based on antioxidant activities (DPPH, ABTS, H₂O₂, CUPRAC, and PMA) in four different leaves extract of *Phyllanthus maderaspatensis*L.

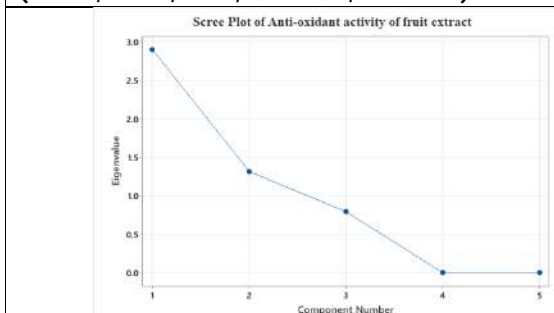


Fig.11 Scree plot

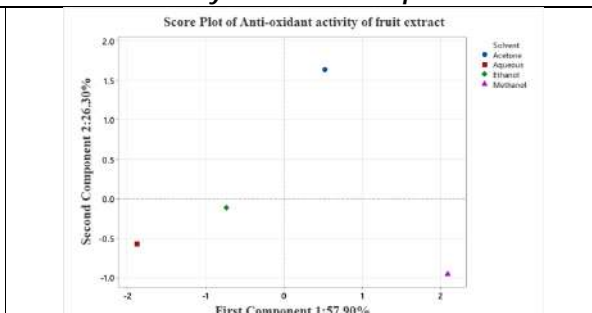


Fig. 12 Score plot





Hitesh R. Kumarkhaniya and Bharat B. Maitreya

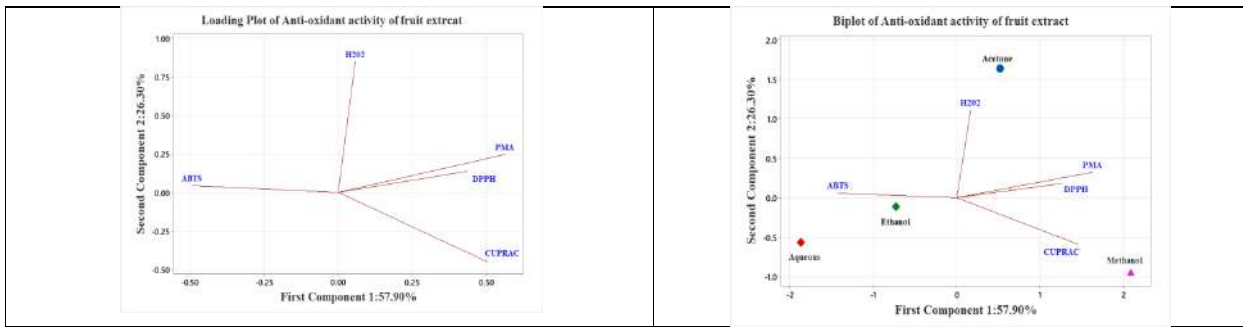
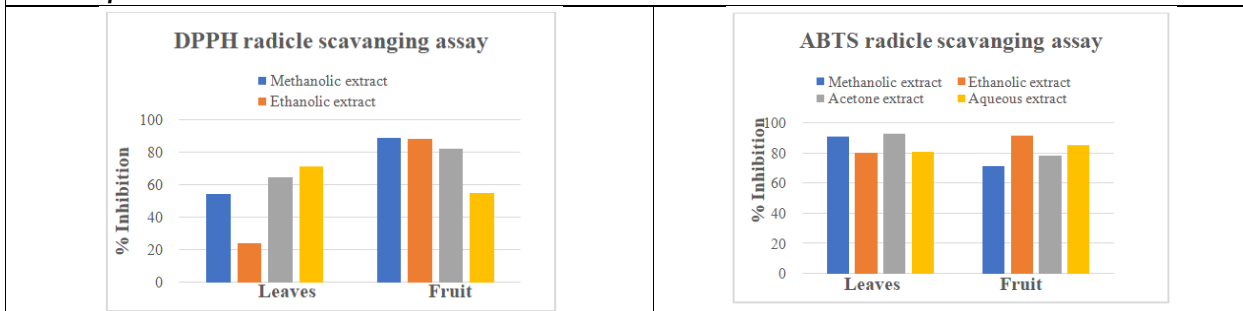


Fig. 13 Loading plot

Fig. 14 Biplot

Fig. 11-14: Principal component analysis (Scree plot, Biplot- Score and Loading plot) based on antioxidant activities (DPPH, ABTS, H₂O₂, CUPRAC, and PMA) in four different fruit extract of *Phyllanthus maderaspatensis*.



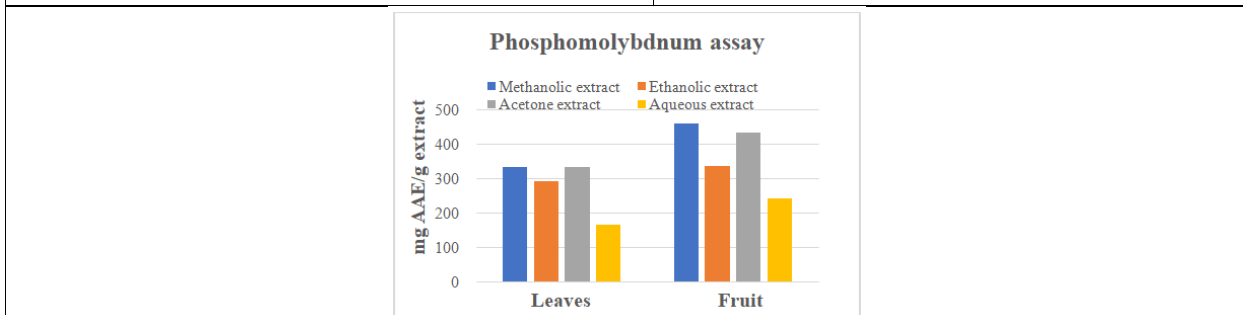
Graph.1 % Inhibition of DPPH of Leaves and Fruit Extract in different solvents

Graph.2 % Inhibition of ABTS of Leaves and Fruit Extract in different solvents



Graph.3 % Inhibition of H₂O₂ of Leaves and Fruit Extract in different solvents

Graph.4 mM TE/g of CUPRAC values of Leaves and Fruit Extract in different solvents



Graph. 5 mM AAE/g of PMA values of Leaves and Fruit Extract in different solvents





An Umbrella Review of Pulsatile Drug Delivery System on Benefits and Importance in the Treatment of Various Diseases

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ABSTRACT

In the present era, pulsatile drug delivery systems (PDDS) have emerged as time-controlled drug delivery systems that can generate lag time independently of external factors such as pH, enzymes, and gastrointestinal motility. While most medications are designed to release immediately or over time, PDDS has gained significant attention lately due to its ability to synchronize drug release with the body's natural circadian rhythm. Pulsatile drug release, where the drug is rapidly delivered after a specific lag time, can be particularly beneficial for conditions such as asthma, peptic ulcer, cardiovascular disease, arthritis, attention deficit disorder in children, and hypercholesterolemia. This drug delivery system has been developed to work in harmony with the biological clock, and the pulse must be carefully designed to achieve complete and rapid drug release following the lag time. Consequently, PDDS offers great potential for the treatment of patients with chronic conditions by delivering drugs at the right time, location, and in the correct quantities.

Keywords: Time controlling, Lag time, Pulsatile drug release, circadian rhythm.

INTRODUCTION

Traditionally, drug distribution is from injection site. The goal is to sustain drug concentration within the therapeutic window for an extended period, typically through sustained-release formulations in oral controlled-release systems, to ensure a sustained therapeutic effect. Second - generation drug delivery helps some bioactive chemicals at a continuous, consistent pace that aligns with the resonant dynamic circadian cycle of living organisms. This approach



**Earva Sravani et al.,**

recognizes that the need for or response to medications in living beings is not a "zero-order" process. Instead, organisms have a predictable circadian rhythm that can optimize the desired pharmacological effects while minimizing adverse effects [1,2]. A pulsatile drug delivery system (PDDS) is defined as a drug delivery system that releases a particular amount of drug fast and easy under lag time. This type of systems are used in different cases where the drug should release at perfect site to show its effect. PDDS has been expanded in medical field such as hypertension, arthritis, asthma, and peptic ulcers. The ability of PDDS to release the drug in a pulsatile manner, minimizing adverse effects [3,4]. Pulsatile drug delivery systems has been divided by two release phases. In first phase, a little portion of drug is released then in second whole drug is released after lag time in less time. Most PDDSs drug is stored in barrier polymeric layer. After break down of the polymeric layer after the lag time the drug is released . A quick-release core tablet is typically enclosed in a barrier layer created through press coating, liquid coating, or a combination of the two [5,6,7].

BENEFIT OF PDDS

1. The pulsatile measurement structure has many advantages over the conventional dosage structure.
2. Reduces the medication's dosage without reducing its therapeutic impact.
3. Reducing the negative impact.
4. Patients' consistency has improved.
5. Chronotherapy modified delayed discharge provides the best possible illness treatment.
6. Pulse discharge enables different dosages in a single dose form.
7. Increased nighttime or daytime activities [8].
8. Drugs are tailored to the body's circadian cycles[9].
9. Protects mucosa from drugs that aggravate it.
10. The first-pass metabolism prevents medication loss[10].

ADVANTAGES

1. Prolonged afternoon or evening activities
2. Less consequences
3. Reduces short time dosing
4. A tiny size
5. best for the patient
6. costs low[11]

LIMITATIONS

1. A multiparticulate pulsatile drug delivery device with many production processes.
2. Minimum drug use.
3. Inadequate release.
4. The single unit pulsatile drug delivery system's in vivo variability. [12]

DISEASES REQUIRING PULSATILE DRUG DELIVERY

Few of the drugs shows special effect when taken during specific time compared to other drugs at the same time. For example, the antihypertensive drug nifedipine has more effect during day time when compared with night [13].

A few diseases are needed to be formulated as PDDS.

1. A PDDS can be helpful for treating asthma.
2. For several functions of the cardiovascular system, including blood pressure, pulse, stroke volume, cardiac output, and blood flow
3. Maintains blood pressure peaks during day and nights
4. Used in treatment of lung failure
5. Maintains body glucose level in diabetes[14].





Earva Sravani et al.,

Capsule based systems

Pulisincap device is used to make capsules. Single-unit capsular pulsatile drug delivery are many based on present method. They consist of a plug and an insoluble capsule body a medication. A predefined amount of time passes before the plug is removed as a result of enlargement, erosion, or disintegration.

1. One such system is the Pulsincap® system, which consists of a water-insoluble capsule body that is filled with a medication formulation. A hydrogel plug with the ability to swell closes the body's open end.
2. There were no reports of gastrointestinal damage and these formulations were well tolerated by both healthy people and animals. Nevertheless, enteric coating the system to only enable its disintegration in the higher pH area of the small intestine solved the potential issue of varying stomach residence duration [16][17].

Capsular System Based on Osmosis

The Port® System Drug Release Mechanism from PORT System has semi permeable membrane coats the gelatin capsule has insoluble plug and an osmotically active . Water diffuses through the semi permeable membrane as it comes into touch with the aqueous medium, leads to rise in internal pressure that eventually causes the plug to eject. Coating thickness regulates the lag time [18].

System based on expandable orifice

An capsular system which is osmotically determined was developed to release liquid drug.. In this system, the liquid medication is absorbed into highly porous particles that, after the hindrance layer is out, release the medication through a space in a semipermeable capsule supports by an expanding osmotic layer [19].

Pulsatile system with erodible or soluble barrier coating

Time clock system

The mostly pulsatile drug delivery systems has barrier-coated reservoir devices. At a specific lag time barrier break down and the medicine is then quickly released. The thickness of the coating layer affects the lag time. The hydrophobic film redispersion did not seem to be impacted by the presence of intestinal enzymes, mechanical action of the stomach, or gastro-intestinal pH, according to a research with human volunteers. This system's main benefit is that it is simple to manufacture without the need for specialised machinery [20] [21]

The Chronotropic® system

This has core which is coated with swellable hydrophilic hydroxypropylmethyl cellulose, which helps in slow drug release. Moreover, by using an outer gastric-resistant enteric film, it is possible to circumvent the variability in stomach emptying time and achieve a colon-specific release by relying on the relatively repeatability of small intestine transit time. The HPMC's is thick and viscos that explains the lag time. Both *in-vitro* and *in-vivo* lag times connected with hydrophilic retarding polymer. The both tablets and capsules can be prepared by this system.[22][23]

Multilayered Tablet

A three-layered tablet with two drug-containing layers and a drug-free gellable polymeric barrier layer produced a release pattern with two pulses. This three-layered tablet was impermeably coated on three sides with ethyl cellulose, leaving the top uncoated. The first dosage that was integrated into the top layer was quickly released from the noncoated surface upon contact with the dissolving media. The space at which the barrier layer is gelling or dissolving determines how quickly the second pulse appears. The coating materials include ethyl cellulose, cellulose-acetatepropionate, methacrylic polymers, acrylic and methacrylic co polymers, and polyalcohols. [24] [25]

Pulsatile system with Rupturable coating:

The release of the medication is based on disintegrants as opposed to swellable or erodible coating systems. Effervescent excipients, swellers, or osmotic pressure can all help to provide the pressure required for the coating to rupture. After rupturing the drug is released intermittently as a consequence of the carbon dioxide that formed as a result of water entering the. A capsule-based system containing a medication, swelling agent, and rupturable

57883



**Earva Sravani et al.,**

polymer layer was created using the extremely swellable agents, also known as super disintegrants. The polymers swells, that leads to complete film rupture and quick drug release. The lag time is affected by the outer polymer layer's The decrease in lag time by adding on hydrophilic polymers like HPMC. The distribution of both solid and liquid medication formulations is possible with the device. Drugs that display considerable first-pass metabolism were intended to be delivered using a reservoir system with a semipermeable covering [26][27].

Pulsatile system with rupturable coating:

For the release of the medication, these methods depends on the coating disintegrating. Effervescent excipients, swellers, or osmotic pressure can all help to provide the pressure required for the coating to rupture. A tablet core covered with ethyl cellulose contained an effervescent blend of citric acid and sodium bicarbonate. Once the coating ruptured, the medication was released intermittently as a consequence of the carbon dioxide that formed as a result of water entering the core. The mechanical characteristics of the coating layer may affect the release [28].

Pulsatile system based on rupturable coating

E.g. Time –controlled Explosion system (fig. 1.)

Osmotic based rupturable coating system

The entry of this system combines swelling and osmotic actions. A core containing the medication, a disintegrant, and a low bulk density solid and/or liquid lipid substance (such as mineral oil) was created. Then cellulose acetate was added to this core. Water permeates the core when submerged in an aqueous media, dislodging the lipid material. As lipid material is exhausted, internal pressure builds up until a critical stress is achieved, which causes the coating to burst [29].

Pulsatile delivery by change in membrane permeability

Different counter-ions in the media can have an effect on the permeability and water absorption of acrylic polymers having quaternary ammonium groups. [44] This ion interaction has served as the foundation for several delivery methods. According to reports, the polymer of choice for this use is eudragit RS 30D. It frequently has a positively polarised quaternary ammonium group in the polymer side chain, which is invariably followed by counterions that are negatively charged with hydrochloride. Because the ammonium group is hydrophilic, it helps the polymer interact with water, modifying its permeability and enabling water to infiltrate the active core in a regulated way [30].

Stimuli-induced pulsatile drug delivery

Systems used to deliver medications based on stimuli release the drug as a result of changes came about by the biological environment. The drug's entry in light of those frameworks arises from advancements that have prompted modifications in the gels or micelles, which may expand or erode as a result of certain stimuli. These methods involves intake of drug only after being stimulated by a biological component, such as temperature, or another chemical stimulus [31].

Thermoresponsive pulsatile releases

Thermosensitive gels are hydrogels that has reversible volume changes as a output of temperature variations. In order to increase the responsiveness of medicine administration, thermo sensitive hydrogels have been investigated as potential drug carriers. Cross-linked collections of organic, synthetic, or partially designed polymers are known as hydrogels. These gels deform at a progress temperature that corresponds to the lower fundamental arrangement temperature of the pure polymer used to create the gel. The inclusion of hydrophobic groups, such as methyl, ethyl, and propyl groups, is one of the typical characteristics of temperature-sensitive polymers. PINPA cross-connected gels have exhibited thermoresponsive, erratic phases of swelling and shrinking, for example, increasing at temperatures below 32°C and contracting above this level [32].





Earva Sravani et al.,

Externally regulated systems

Another way for pulsatile drug release is through externally regulated systems, in which external stimuli involves magnetic, ultrasound, electrical effect, and radiation are used to control drug release. Magnetic beads are contained in the implant of the magnetically controlled system. The reason for using magnetic beads, drug release happens when a magnetic field is applied [33].

CONCLUSION

The review is evaluation for this formulation strongly urges that novel delivery mechanisms be developed so that patients can receive more therapeutic advantages. Pulsatile medication delivery is one such method that holds hope for treating patients with long-duration conditions including arthritis, asthma, hypertension, etc. by administering a medicine at the proper time, location, and dosage. In treating disorders, particularly those with chronological pathophysiology, where pulsatile drug administration is advantageous, extended release formulations and quick release formulations are ineffective. Pulsatile release systems should be promising in the future since the medicine is delivered in this system when its real concentration is required according to chronological necessity.

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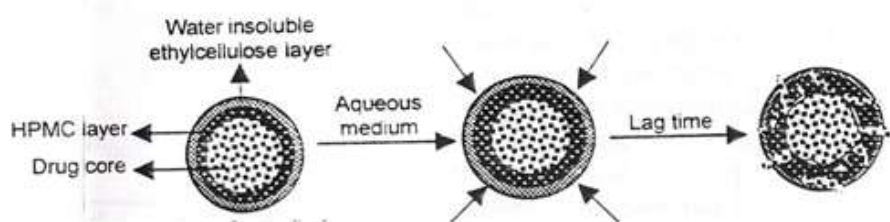


Fig.1: Time –controlled Explosion system (TCES)





Pharmacognostic Standardization and Phytochemical Evaluation of *Phyllanthus maderaspatensis* L.

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ABSTRACT

Phyllanthus maderaspatensis, is a traditional herbaceous plant belonging to the Euphorbiaceae family. Many plants of the *Phyllanthus* genus were used for herbal formulation. It has various bio-active constituents that play important roles in the hepatoprotective activity, antioxidant activity & anti-microbial activity. Adulteration is one of the major problems in herbal medicine. To prevent market adulteration, we evaluate some pharmacognostic characters & identification markers such as the study of macroscopic & microscopic characteristics of powder, physio-chemical values, and TLC profile of extract. The present study evaluates the pharmacognostic characteristic and Phytochemical analysis like screening of secondary metabolites & quantification of total phenol (TPC), flavonoid (TFC), an alkaloid (TAC), tannin (TTC), terpenoid (TTEC) and glycosides content. The fresh leaves are used for the estimation of primary metabolites such as starch and reducing sugar.

Keywords: *Phyllanthus maderaspatensis*, Pharmacognostic Evaluation, Phytochemical & Biochemical assays, TLC & Quantitative assessment.



**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

INTRODUCTION

India is one of the most diverse countries in the case of medicinal plants. More than 1000 plant species belong to the *Phyllanthus* genus, and they used as ayurvedic medicinal plants from ancient times (Webster, 1994; Sarin *et al.*, 2014). *Phyllanthus maderaspatensis* distributed in India, Shri-Lanka, and China. It is commonly called Daniyu in Gujarati, Nila-Nelli in Tamil, and Hajarmani in Hindi (Leelaprasad *et al.*, 2011). In Gujarat, 11 species of *Phyllanthus* were found commonly. *Phyllanthus nururi* and *Phyllanthus maderaspatensis* one of the most dominant herbaceous plants. The plants of the *Phyllanthus* genus are used for the treatment of skin disease, Hepatoprotective activity, anti-inflammatory, anti-analgesic, anti-diabetes, and kidney-related disease (Kamruzzaman *et al.*, 2016; Saha *et al.*, 2007; Adeneye *et al.*, 2008; Khatoun *et al.*, 2006).

Pharmacognostic characteristic is a basic key to the identification of the plant. Physio-chemical parameter, organoleptic, macroscopic & microscopic characteristic, also the HPLC, TLC, & HPTLC fingerprint profile was examined, and developed the monograph for identification (Pharmacopeia, 2007). Biochemical & phytochemical analysis proved that the higher the amounts of secondary metabolites show the maximum antioxidant activity. *Phyllanthus maderaspatensis* was useful for curing ophthalmia, cancer, bronchitis, & teeth disease, Anti-microbial, and Anti-hepatotoxic (Asha *et al.*, 2004; Rani & Raju, 2014; Bommuet *et al.*, 2008; Kanthale & Biradar, 2012). The present study aims at evaluating the pharmacognostic characteristics, phytochemical analysis, and quantification of the bioactive components such as total phenol (TPC), flavonoid (TFC), an alkaloid (TAC), tannin (TTC), terpenoid (TTEC) and glycosides content. Furthermore, develop the TLC profile and biochemical assays.

MATERIAL AND METHODS

Sample Collection

The plants were collected in December 2022 from Kumarkhan town of Ahmedabad district, Gujarat, India. The location stands between (Latitude 22.917715° N and longitude 72.01959° E). The plant herbarium is authenticated by the Department of Botany, Gujarat University. The voucher specimen was deposited at the herbarium of the Botany department, at Gujarat University, Ahmedabad.

Habit and Habitat

Native of *Phyllanthus* in Africa, Asia, and Europe. The *Phyllanthus maderaspatensis* is a perennial erect herb. It's commonly seen in wild areas & farms as a weed. Stem is branched, glabrous, greenish, and square at the top position, becomes a secondary growth it would be the erect woody stem. Leaves are obovate & smooth; the leaf base is cuneate and the leaf apex is mucronate. Unisexual or bisexual cyme type of flowers & disc is six lobed. The fruit is round smooth greenish to yellowish, and the seed is brown (Alekyat *et al.*, 2020)

Organoleptic Characteristic

According to Indian Pharmacopeia 2007 the powder characteristic is very helpful for the identification of plant species. Odor, texture, taste, and color were important parameters.

Physicochemical parameter

Extraction Procedure and Yield

The collected leaves and fruit were washed twice with distilled water and were air-dried at room temperature (25 ± 1°C). The dried leaves & fruit were later powdered with the help of a grinder. The Soxhlet extraction method was followed to prepare extracts in 6 solvents, Methanol, Ethanol, Acetone, Water, Chloroform & Hexane. 10 g of powder was extracted in 100 ml of solvent (1:10 g/ml solid to solvent ratio) according to the boiling point of solvent with the help of a Soxhlet extractor. Later it was filtered with Whatman No. 1 filter paper and allowed to dry in Petri plates for 24 hours. The extraction yield was calculated by the following formula (Herodez *et al.*, 2003).



**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

Yield (%) = $m_{\text{extract}}/m_{\text{raw material}} * 100$

Total Ash

2 gm of drug powder was taken in a silica crucible & weighed with a crucible weight. The crucible was put into a muffle furnace for 5-6 hours at 500°C until free from carbon, cooled & reweighed the crucible (Akhtar *et al.*, 2019).

Total ash content calculated by the following formula:

Ash Content = Weight of Ash / Weight of sample*100

Moisture Content

The moisture content estimated by the standard method of AOAC, 1990. First of all, weigh the petri dish (A_1). 2 gm of fresh plant part (A_2) is taken into the petri dish and then dry at 65°C in a hot air oven. After drying weigh the petri dish with sample (A_3). The moisture content is calculated by the following formula:

Moisture content = $(A_1 - A_3) / (A_2) * 100$

Biochemical Assay

The biochemical test of the fresh plant was determined by different standard methods like an estimation of protein was performed using the standard protocol of Bradford, 1976; phenol determines by Bray *et al.*, 1954. total sugar by the standard method of Nelson, 1944; Reducing sugar was estimated by the method of Somogay, 1952; and starch was determined by Hodge *et al.*, 1962. The absorption of the sample & standard was taken by using UV-Vis Spectrophotometer (Shimadzu UV-1800, Shimadzu Corporation, Kyoto, Japan).

Phytochemical Screening

The qualitative analysis of different secondary metabolites such as alkaloids, carbohydrates, glycosides, saponin, phytosterols, phenols, tannins, flavonoids, proteins, amino acids, diterpenes, triterpenes, steroids, lactones, and flavanols glucosides are tested by using the standard method of Harborne, 1998; Shaikh & Patil, 2020.

Thin Layer Chromatography

Thin Layer Chromatography of various extracts of the drug, such as methanolic, ethanolic & acetone extract run on pre-coated aluminum TLC plates (Silica gel 60 F₂₅₄, 0.25 mm thickening of the layer) of MERCK Life Science Private Limited was used. All three extract of leaves and fruit were run in 4 different solvent system which is used as the mobile phase. Toluene: Ethyl acetate: Formic acid (5:5:1), Toluene: Ethyl acetate: Formic acid (6:4:1), Toluene: Ethyl acetate: Formic acid (7:3:0.5) and Toluene: Ethyl acetate: Formic acid (5:4:1.5). After the finalized of solvent system develop the TLC plated & derivatization of different reagents. After spraying the TLC plates were observed under the UV short wavelength (245 nm) and UV Long wavelength (365 nm). The R_f values of spots were calculated by following this formula (Akhtar *et al.*, 2019). R_f values: Distance travel by spot/Distance travel by solvent.

Quantitative Evaluation

Secondary metabolites play important role in the protection of plants and enhance their life. It is helpful for protection, pollination, and play important role in many physiological processes such as Anti-oxidant activity, due to the presence of poly-Phenol, Flavonoid, and Tannin are the key components of secondary metabolites (Ali and Neda, 2011).

Determination of Total Flavonoid Content (TFC)

The total flavonoid content was estimated by using the standard method of Kamtekar *et al.*, 2014. Plant extract (200 µg/ml) and standard Quercetin (0-1000 µg/ml in Ethanol) were introduced into the test tube. 4 ml water was added and treated with 0.3 ml (5% w/v of NaNO₂), After 5 min 0.3 ml (10% w/v AlCl₃) and 2 ml (1M NaOH) were added and made the final volume of 10 ml by the help of distilled water. The absorbance of standard & samples for flavonoid was recorded at 510 nm using UV-Vis Spectrophotometer (Shimadzu UV-1800, Shimadzu Corporation, Kyoto Japan). The results of TFC results are expressed as mg of Quercetin equivalents per gram (mg QE/g) extract.





Hitesh R. Kumarkhaniya and Bharat B. Maitreya

Determination of Total Phenolic Content (TPC)

The total phenolic content (TPC) of each extract was determined by Folin ciocalteu's method. Plant extract (20 μ l from stock 10 mg/ml) and standard Gallic acid (0-1000 μ g/ml in distilled water) were mixed with 0.5 ml 1N F.C reagent. After 5 min 1.5 ml 20% (w/v) sodium carbonate was added & made the final volume up to 10 ml using distilled water. The absorbance of standard and samples for phenol was recorded at 750 nm using UV-Vis Spectrophotometer (Shimadzu UV-1800, Shimadzu Corporation, Kyoto Japan). The results of TPC are expressed as mg of Gallic acid equivalents per gram (mg GAE/g) extract (Singleton *et al.*, 1965).

Determination of Total Tannins Content (TTC)

Total tannin content measured by the standard method of folindenis. Plant sample (200 μ l from stock 1 mg/ml) and series of standard Tannic acid (0-1000 μ l from stock 1 mg/ml in ethanol) made 1 ml final volume using methanol. 0.1 ml Folin denis reagent was mixed with extract, here folindenis reagent was diluted with water in a ratio of (1:10). After the addition of water 7.5% (w/v) sodium carbonate was added & made final volume up to 3 ml using distilled water. The absorbance of standard and samples for tannin was recorded at 700 nm using UV-Vis Spectrophotometer (Shimadzu UV-1800, Shimadzu Corporation, Kyoto Japan). The results of TPC are expressed as mg of Tannic acid equivalents per gram (mg GAE/g) extract (Vala & Maitreya, 2019).

Determination of Total Terpenoid Content (TTEC)

Estimation of total terpenoid content is followed by the method of Patel *et al.*, 2021 with minor modification. Plant sample 10 μ l (from the stock solution 1mg/ml) and standard ursolic acid (0-40 μ g) were taken in a test tube. 150 μ l acidic vanillin reagent (5g in 100 ml GAA) was mixed with the sample. 500 μ l perchloric acid was added to the reaction mixture & after that heated in a water bath for 15 min at 60°C. This reaction was kept in an ice bath & at room temperature. After that add 2.25ml GAA and take the absorption at 548 nm. Results were expressed in an Ursolic acid equivalent (UAE/g) extract.

Determination of Total Alkaloid Content (TAC)

For the determination of alkaloid content use the method of Ghaneet *et al.*, 2018. Briefly, 69.8 mg bromocresol green was dissolved in 3 ml of 2N sodium hydroxide & 5 ml distilled water. After that heat and diluted up to 1000 ml by adding distilled water. 1 ml plant extract (stock solution 1mg/ml) and standard Galanthamine (0-1000 μ l) were taken in the test tube. 1 ml bromocresol green and 1 ml sodium phosphate buffer were added. Then the 2 ml chloroform was used for extraction of the reaction mixture, taking the absorption of this chloroform layer at 470 nm. TAC was expressed as mg Galanthamine equivalent (GE/g) extract.

Determination of Glycoside

1 ml plant extract and 1 ml freshly prepared baljet's reagent (95 ml 1% picric acid and 5 ml 10% sodium hydroxide) are mixed & kept for 1 hour at room temperature. Add 2 ml of distilled water & take the absorption at 495 nm against the blank (Snehalatha & Rasmi, 2021).

Statistical Analysis

Experimental results were analyzed as mean \pm S.D. of three independent replicates for biochemical assay. Statistical analysis was carried out using Microsoft® office excel (Microsoft® U.S.A).

RESULTS

Macroscopic character

Observation of macroscopic characters describe in figure 1.





Hitesh R. Kumarkhaniya and Bharat B. Maitreya

Microscopic Characters

Root: Cork is varied in 2-4 layer of cells, the single-layered epidermis is just below the cork, then 2-3 layer of hypodermis is present. The root of *Phyllanthus maderaspatensis* has a minute pith and a large area of xylem and medullary rays. Phloem is seen at the upper side of the xylem in the 4-5 layers of cells.

Stem: The stem has a large pith cavity; the cortex area is small and many other parenchymatous cells are present in the hypodermis layer. The size of the xylem and phloem is depended on the secondary growth of the stem.

Leaves: The T.S of leaves without stain, showing Upper epidermis (UE), Collenchyma (Co), Sclerenchyma (Scl), Vascular bundle (VB), Palisade parenchyma (PP), Parenchyma (Pa), the Lower epidermis (LE) and also showing Anisocytic types of stomata present in leaves of *Phyllanthus maderaspatensis* L.

Biochemical assay

Many Biochemical assays perform for the estimation of various primary and secondary metabolites from the fresh plant material. Figure 6 represents the biochemical analysis of freshly collected leaves of *Phyllanthus maderaspatensis* L. which was performed by taking 3 individual samples and it shows that the total protein content in leaves is higher and starch content is least. The protein content recorded in leaves is 1.77 ± 0.033 mg/ml which follows total sugar, 1.094 ± 0.01 mg/ml, phenol recorded is 0.751 ± 0.39 mg/ml, reducing sugar is 0.193 ± 0.012 mg/ml and starch is 0.081 ± 0.007 mg/ml.

Phytochemical Screening

Qualitative analysis of phytochemicals was performed to check the presence of certain Phytochemical constituents in leaves of *Phyllanthus maderaspatensis* L. The table 3 represents the presence of alkaloids, glycoside, phenol, flavonoid, and lactones in all extracts of *Phyllanthus maderaspatensis* L. leaves; carbohydrates, protein, saponins, and tannin were present in methanolic, ethanolic and acetone extracts; Flavanol glucoside, steroid, amino acid and phytosterol not present in any extract; where diterpene and triterpene have seen in only methanolic and ethanolic extract.

Thin Layer Chromatography

Thin layer chromatography was performed to examine the flavonoid and also present another chemical along with flavonoids. Quercetin use as standard for flavonoid. The number of spots and Rf value of *Phyllanthus maderaspatensis* L. leaves and fruit in two different solvents viz., Methanol, Acetone.

Quantification of Secondary Metabolites

Phenol, flavonoid,terpene, tannin, alkaloid and glycosides are secondary metabolites which are helpful for various physiological process of the plant. It acts as an anti-oxidant agent, role in pigmentation, helps in pollination and protects against herbivory (Anokwuru *et al.*, 2011). Table 5 shows, TPC, TFC, TTC, TTRC, TAC and Glycoside from four extracts of leaves and fruits. The highest TPC was seen in the Acetone extract of fruit (221.08 ± 6.59 mg GAE/g extract), whereas the lowest TPC was recorded in the methanolic extract of leaves (13.75 ± 0.05 mg GAE/g extract). The highest amount of TFC was present in the methanolic extract of leaves (82.59 ± 1.77 mg QE/g extract) and lowest in the ethanolic extract of leaves (4.38 ± 4.62 mg QE/g extract). Maximum TTC was found in ethanolic extract of fruit (450.84 ± 36.47 mg TAE/g extract) and minimum in fruit extract of aqueous (33.76 ± 31.8 mg TAE/g extract). TTEC and TAC highest in ethanolic extract of leaves and lowest in aqueous fruit extract. In case of glycoside acetone leaves and fruit has highest amount such as 656.39 ± 5.74 and 615.14 ± 24.38 mg/g extract respectively.

DISCUSSION

According to results, various morphological and anatomical parameters were observed by Khatoon, 2006. Lilyas *et al.*, 2022 show the ethanolic and Aqueous extract yield was 15.18 and 15.48 respectively. Quantification of secondary metabolites with reference of Rutin, Quercetin and Gallic acid is 100-1600 ng, 10-160 ng and 100-5000 ng respectively.



**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

Akhtar *et al.*, 2019 measure the moisture content of seed is 6.77% and TLC was performed in n-Butanol: Acetic acid: water (5:1:4) solvent system, that gives 0.59 and 0.82 Rf values. Alkaloids, carbohydrates, glycoside, flavonoids, tannin, protein, and steroids are the present aqueous extract of *Phyllanthus maderaspatensis* (Leelaprakash, 2011). Carbohydrates, triterpene, and tannins were seen in both hexane and methanolic extract where protein and flavonoids were only present in the methanolic extract of *Phyllanthus maderaspatensis* (Ravichandran *et al.*, 2012). Very few studies available on determination of secondary metabolites of *Phyllanthus maderaspatensis* L. like previous study of Kumaran & Kurunakaran, 2007 got the methanolic extract yield 7.79%, TPC value 230 ± 10.7 mg GAE/g extract & TFC value was 57.5 ± 4.7 mg RE/g extract.

The present study provides the standard parameter for the identification of plants such as morphology, powder macroscopy, microscopy, physicochemical parameter, preliminary screening, and TLC reported here. Primary metabolites were determined from the fresh leaves by the help of biochemical assay and secondary metabolites such as TPC, TFC, TTC, TTEC, TAC and Glycoside was estimated in different extracts of leaves and fruit. The plant extract shows the different bands in TLC plates that are compared with the quercetin (flavonoid standard). This research is further used for the quality control of the drug and to provide a suitable extraction solvent for secondary metabolites and natural antioxidants.

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**Hitesh R. Kumarkhaniya and Bharat B. Maitreya**

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Hitesh R. Kumarkhaniya and Bharat B. Maitreya

Table 1: characteristic of plant powder or organoleptic characters

Sr. No	Parameter	Leaves	Stem	Root	Fruit
1.	Color	Dark Green	Light Brown	Dark Brown	Yellowish Brown
2.	Taste	Bitter	Bitter	Bitter	Bitter
3.	Odor	Heena Mehdi	Indistinct	Pungent	Coffee
4.	Texture	Smooth	Rough	Rough	Slightly Rough

Table 2: Physicochemical parameter

Sr. No	Parameter	Results		
		Solvent system	Leaves (%)	Fruit (%)
1.	Extraction Yields	Methanol	6.76	8.33
		Ethanol	9	13.5
		Acetone	7.4	7.66
		Aqueous	5	6.33
2.	Moisture Content		19.83 ± 0.76	35.66 ± 8.14
3.	Total ash	Plant part	Ash Content	
		Leaves	15.85 ± 0.05	
		Stem	19.34 ± 0.12	
		Root	20 ± 0.08	
		Fruit	18.46 ± 0.45	

Table 3: Preliminary Screening of Phytochemicals

Sr. No.	Phytochemicals	Test	Methanol Extract	Ethanol extract	Acetone Extract	Hexane Extract
1.	Alkaloids	Mayer	++	+	-	-
		Wagner	+	+	+	+++
		Dragendorff	-	-	+	+
		Hager	-	-	-	-
2.	Carbohydrates	Molisch	-	-	+	-
		Benedict	++	+	-	-
		Fehling	++	++	+	-
3.	Glycosides	Modified Borntrager	-	-	+	-
		Legal	+	++	+	+
		Keller Killiani	-	+	-	-
		NaOH Reagent	+	-	-	-
4.	Saponins	Froth	++	+	+	-
		Foam	++	+	-	-
5.	Phytosterols	Salkowski	-	-	-	-
		Liebermann Burchard	-	-	-	-
6.	Phenols	Ferric Chloride	++	+	+	-
		Lead Acetate	++	+	++	+
7.	Tannins	Gelatin	+	+	+	-
8.	Flavonoids	Alkaline Reagent	++	+	++	+
		Lead Acetate	+	+	+	+
9.	Proteins	Xanthoproteic	+	+	+	-
		Million	-	-	-	-





Hitesh R. Kumarkhaniya and Bharat B. Maitreya

		Biuret	+	+	-	-
10.	Amino Acids	Ninhydrin	-	-	-	-
11.	Diterpenes	Copper Acetate	-	-	+	+
12.	Triterpenes	Salkowski	++	+	-	-
		Tschugergen	+	+	-	-
13.	Steroids	Salkowski	-	-	-	-
		Liebermann Burchard	-	-	-	-
14.	Lactones	Legal	+	+	+	+
		Baljit	+	+	+	+
15.	Flavanol Glucosides	Mg and HCl Reduction	-	-	-	-

(sign + shown the presence of chemical, ++ for high amount of chemical and – shown the absence of chemical)

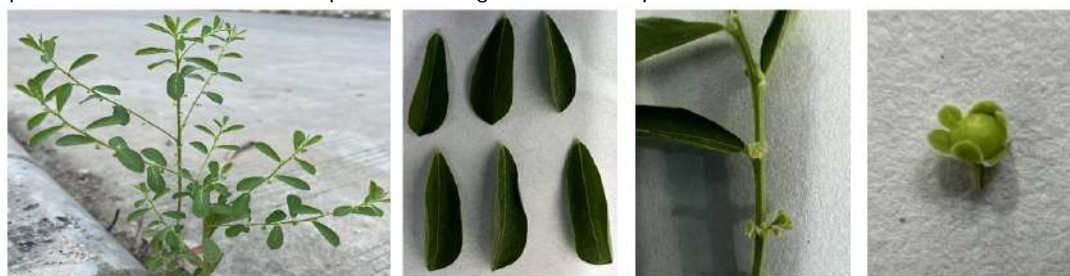
Table 4: Rf Value and No. of Spots Observed in this Solvent Systems:

Sr. No.	Extract	Solvent System	No. of Spots	Rf Value
1.	Leaf Methanol	Toluene: Ethyl acetate: Formic acid (7:3:0.5)	7	0.451, 0.516, 0.58, 0.79, 0.838, 0.919, 0.951
2.	Fruit Methanol		8	0.21, 0.3, 0.49, 0.5, 0.61, 0.78, 0.9, 0.93
3.	Leaf Acetone		9	0.272, 0.4, 0.472, 0.5, 0.545, 0.633, 0.890, 0.927, 0.963
4.	Fruit Acetone		7	0.5, 0.6, 0.63, 0.73, 0.79, 0.92, 0.95

Table 5: Total Phenolic, Flavonoid, Tannin, Terpenoid, Alkaloid and Glycoside Content of *Phyllanthus maderaspatensis* Leaf and Fruit extracts (n=3 ± S.D).

Sr. No.	Solvent	Plant part	TPC (mgGAE/g)	TFC (mg QE/g)	TTC (mg TAE/g)	TTEC (mg UAE/g)	TAC (mg GE/g)	Glycoside
1.	Methanol	Leaves	13.75±0.05	82.59±1.77	107.69±20.14	253.57±63.24	36.18±11.6	11.59±2.66
		Fruit	162.89±1.06	60.76±2.5	317.94±38.52	251.12±75.94	20.79±11.32	11.92±0.82
2.	Ethanol	Leaves	68.19±1.71	4.38±4.62	131.63±50.54	468.01±29.66	264.85±40.15	11.48±2.94
		Fruit	218.05±5.77	20.83±0.95	450.84±36.47	514.71±69.27	81.18±11.14	29.82±4.28
3.	Acetone	Leaves	117.49±7.31	6.94±4.33	134.18±70.76	311.73±59.92	100.5±25.54	656.39±5.74
		Fruit	221.08±6.59	59.84±3.92	438.46±48.36	282.45±58.18	34.84±8.06	615.14±24.38
4.	Aqueous	Leaves	18.48±1.38	70.54±0.83	190.59±44.89	337.75±48.43	27.48±40.15	79.92±41.35
		Fruit	42.19±0.68	19.93±0.82	33.76±31.82	102.42±74.86	18.28±12.43	21.31±10.21

mg: milligram, g: gram, TPC: total phenol content, TFC: total flavonoid content, TTEC: total terpenoid content, TTC: total tannin content, TAC: total alkaloid content, GAE: gallic acid equivalent, QE: quercetin equivalent, TAE: tannic acid equivalent, UAE: urosolic acid equivalent, GE: galanthamine equivalent

Fig:1 (A) *Phyllanthus maderaspatensis* L.

(B) Leaves

(C) Flower

(D) Fruit



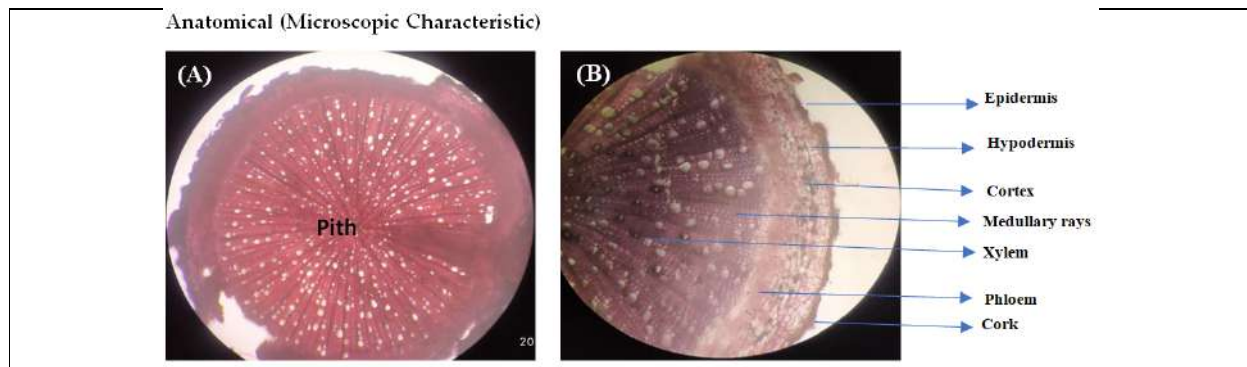


Fig: 2 Section A and B Showing the T.S of *Phyllanthus mederaspatensis*- ROOT

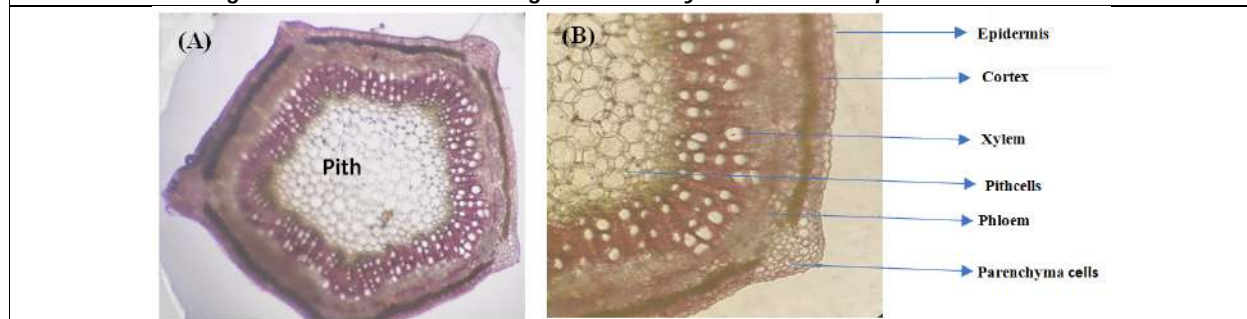


Fig: 3 Section A and B Showing the T.S of *Phyllanthus mederaspatensis*- STEM

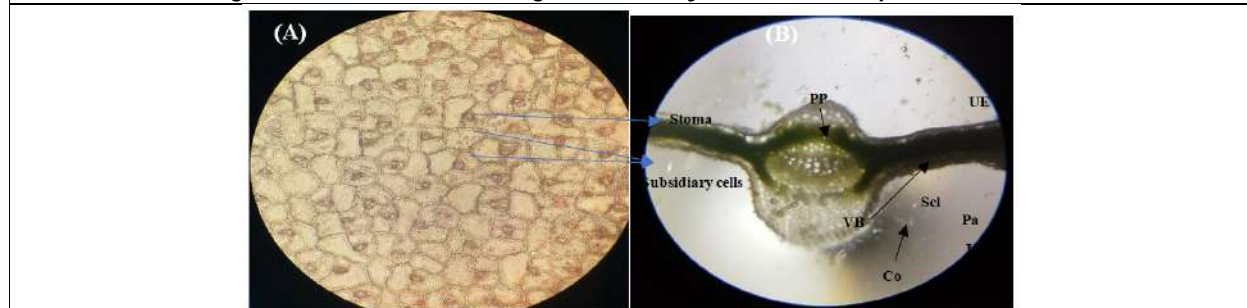


Fig: 4 Section A Shows the Anisocytic type of Stomata in leaves and Section B shows the T.S of leaves without stain, showing Upper epidermis (UE), Collenchyma (Co), Sclerenchyma (Scl), Vascular bundle (VB), Palisade parenchyma (PP), Parenchyma (Pa), Lower epidermis (LE)



Fig 5 Powder characteristic of (A) Leaves

(B) Stem

(C) Root

(D) Fruit





Hitesh R. Kumarkhaniya and Bharat B. Maitreya

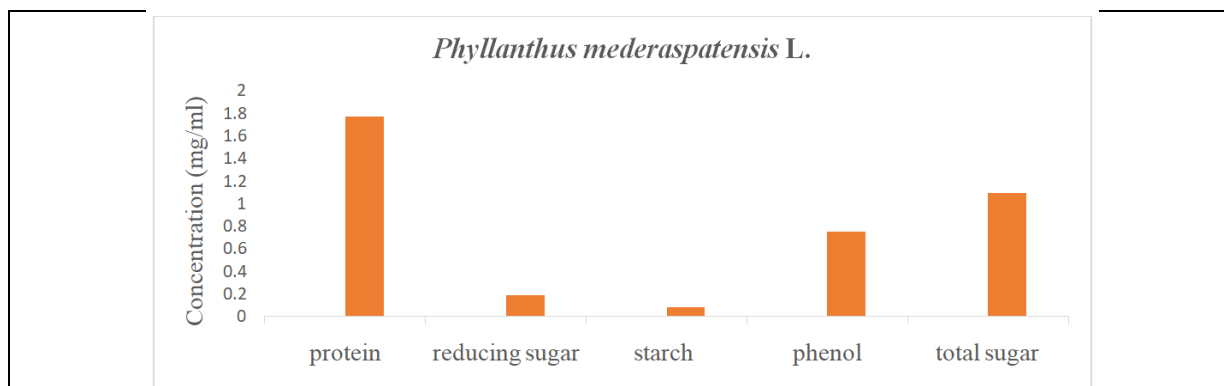


Fig. 6: Biochemical Analysis of *Phyllanthus mederaspatensis* L. Fresh Leaves (n=20)

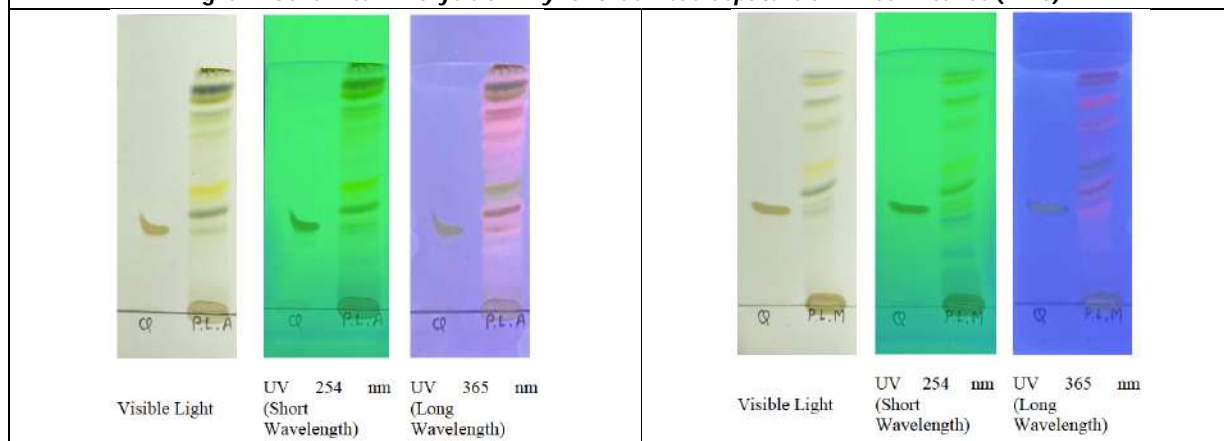


Fig. 7 Acetone Extract and Quercetin TLC Images of *Phyllanthus mederaspatensis* L. Leaves in Visible Light, Short Wavelength and Long Wavelength of UV

Fig. 8 Methanolic Extract and Quercetin TLC Images of *Phyllanthus mederaspatensis* L. Leaves in Visible Light, Short Wavelength and Long Wavelength of UV.

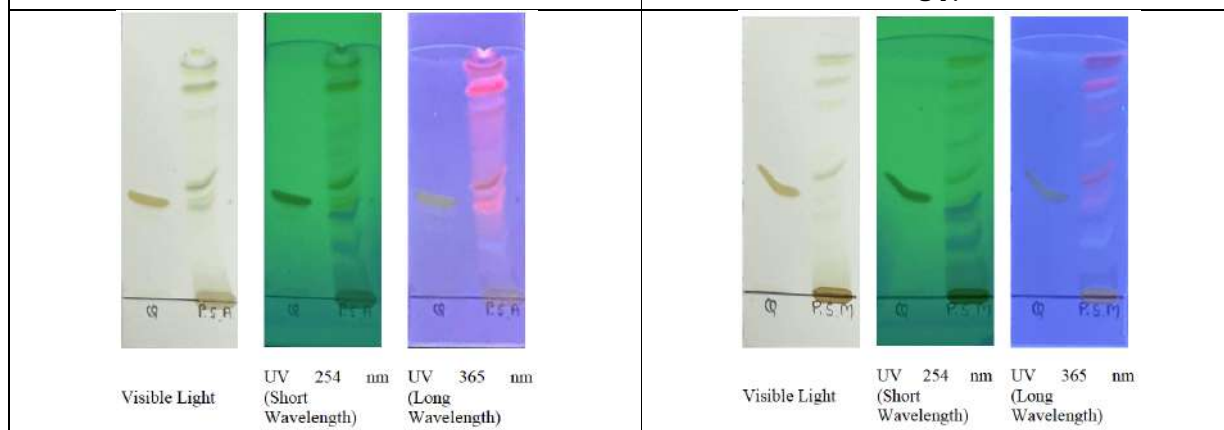


Fig. 9 Acetone Extract and Quercetin TLC Images of *Phyllanthus mederaspatensis* L. Fruit in Visible Light, Short Wavelength and Long Wavelength of UV.

Fig. 10 Methanolic Extract and Quercetin TLC Images of *Phyllanthus mederaspatensis* L. Fruit in Visible Light, Short Wavelength and Long Wavelength of UV.





A Brief Review of Regulatory Requirements and Outcomes for Continuous Manufacturing in Pharmaceuticals

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ABSTRACT

Continuous manufacturing (CM) is the process by which pharmaceutical products are formulated from end-to-end on a single, uninterrupted production line for improved product quality, better adherence to process, eliminating hold times, also for less energy consumption and many more. The aim of this article is to provide a concise overview of the regulatory requirements and outcomes associated with the implementation of continuous manufacturing in the pharmaceutical industry. The review will focus on the advantages, challenges, and potential regulatory obstacles of adopting continuous manufacturing, as well as its effects on product quality, efficiency, and cost-effectiveness. There are some challenges like moving from outdated batch equipment to new technology, upgrading industrial infrastructure, etc. the recent regulatory updates suggested that the transition from traditional batch manufacturing to novel CM has several advantages like less product failure, Quality by process optimization rather than at the end product testing and early access to the market. Several Global regulatory bodies are in support of this transition for CM such as the US FDA's CDER OPQ, the PAT team of EMA, innovative manufacturing technology of Japan's PMDA and ICH. These regulatory bodies have released guidelines for the CM-related regulatory aspects, including process description, control strategies, process validation and key GMP requirements. The outcomes of self-audit include, there was no substantial barriers identified for CM applications related to manufacturing process changes or pre-approval inspection, it even has a shorter time for approval and market entry early revenue benefits.

Keywords: Continuous manufacturing, Regulations, Development Considerations, Drug Product, Pharmaceuticals, Audit.



**Abhishek Kumar Sharma et al.,**

INTRODUCTION

The transition from batch manufacturing to continuous manufacturing is gaining momentum in the fine chemical and pharmaceutical industries. The benefits of continuous manufacturing include improved product quality and safety due to ongoing automated process monitoring, decreased environmental impact by decreasing waste due to a high rate of reaction efficiency, and space savings due to the compact size of the equipment. These benefits are made possible by the unit operations interconnection that enhances automation. The pharmaceutical sector is still attempting to make the transition from batch to continuous manufacturing. This is because the batch methods can guarantee adequate revenues in the high value-added pharmaceuticals domain, mitigating the need to switch, which would necessitate additional capital investment, provided there are no issues with the product's quality or the manufacturing process. Since the pharmaceutical industry is heavily regulated, many businesses are concerned that any considerable revisions to current production procedures may result in regulatory delays. A "business as usual" mentality that results in the slow adoption of continuous processes has been further influenced by this perceived uncertainty. Furthermore, even though continuous manufacturing closely adheres to ICH and FDA regulations, pharmaceutical manufacturing is a multinational endeavor, requiring businesses to obtain regulatory clearance for their goods in numerous nations, each with their own regulatory bodies. Although the FDA has expressed support for continuous manufacturing, not all international regulatory organisations may be equally able or willing to examine and approve a continuous procedure for use. It's probable that more effort will be needed to solve the problems with regulatory harmonization.

The objectives of this article is to provide a concise overview of the regulatory requirements and outcomes associated with the implementation of continuous manufacturing in the pharmaceutical industry. The review will focus on the advantages, challenges, and potential regulatory obstacles of adopting continuous manufacturing, as well as its effects on product quality, efficiency, and cost-effectiveness. The review also attempts to compare batch and continuous manufacturing process. At last, we want to shed light on how continuous manufacturing can serve as a viable alternative to conventional batch manufacturing methods in the pharmaceutical sector(1).

DISCUSSION

Continuous Manufacturing

Process manufacturing, also referred to as continuous manufacturing, is a flow production technique in which factories operate constantly creating items and supplies. Each component of the product moves seamlessly from one machine to the next during the many manufacturing phases in this sort of production system.

Continuous Manufacturing in Pharmaceuticals

Continuous manufacturing processes enable the continuous intake of raw materials and the continuous discharge of finished goods from the system. Batch production is a tedious and disjointed process that lacks the responsiveness, agility, and flexibility which are necessary for adapting to emergent changes in supply and demand. Compared to batch manufacturing, CM type of procedure has a number of benefits, including the ability to adjust quickly to changes in supply or demand. Rapid increases in output volume, the elimination of scaling-up barriers, and process streamlining are all possible with continuous manufacturing. In comparison to conventional batch techniques, it is more effective, dependable, and cost-efficient, leading to substantial long-term cost savings. Additionally, it produces a smaller environmental impact and lowers the possibility of poor product quality. Continuous manufacturing offers the chance to implement cutting-edge manufacturing controls and generate consistently high-quality products with less trash (2).





Abhishek Kumar Sharma et al.,

Each or all of the unit processes in a manufacturing process can use CM. A manufacturing strategy in which some element processes run in a batch approach while others are combined and run in a continuous mode Example of CM mode includes:

- A production strategy in which all unit activities of a manufacturing process for a drug constituent or drug product are combined and run continuously.
- A manufacturing strategy where drug constituent and drug product element activities are combined across the line separating the two to create a solitary CM process (i.e., the Drug product is constantly created by forming and processing drug substance through packed unit operations.)⁽³⁾.

Batch vs. Continuous Manufacturing

There are several distinct phases involved in batch production. Production usually stops at each stage of the procedure so samples may be examined offline for quality. The material may occasionally be held in containers or transported to different sites throughout the world during these "hold periods" between phases to finish the production process. This can extend processing time by weeks or even months. It might also increase the danger of deterioration for some active compounds that are susceptible to environmental factors. Additionally, if demand for a particular medicine increase, greater manufacturing can call for more sophisticated machinery. This equipment scaling up demands more room, a larger footprint, more work, and more money ⁽⁴⁾. Contrarily, drugs produced by continuous manufacturing are continuously transferred across the same facility, reducing wait periods in between phases. An assembly line comprising completely integrated components is fed with material. This process is quicker, less prone to human error, and better able to adapt to changes in the market. Continuous production may operate for extended periods of time to accommodate increasing demand, potentially lowering the chance of medicine shortages. The same quality control requirements apply to both batch and continuous production, however continuous manufacturing facilities prefer to automate monitoring, which is done more often than in batch manufacturing. Continuous production equipment can deteriorate with time, just like any other piece of technology, but automated monitoring can spot problems far in advance of a failure. In order to do better preventative maintenance, such monitoring can also assist in estimating the life expectancy of a piece of equipment⁽⁵⁾ figure 1

Finally, continuous manufacturing can make monitoring and tracing more flexible, which would be helpful if a product failed. For instance, in batch production, the size of the machinery used to generate a given amount (or batch) of a medicine defines that quantity. A time stamp, the amount of medicine produced, or the number of raw materials used can all be used to identify a quantity (or batch) in continuous production. In the case of a production failure, these tracking techniques enable the producer to isolate a smaller amount of damaged material, resulting in less waste and a lower likelihood of a shortage⁽⁶⁾. Table 1

The Advantages of Continuous Production

Continuous Manufacturing has many advantages that are used to produce large scales of goods. Some of the benefits of continuous manufacturing include:

- **Consistency:** By maintaining an uninterrupted process, manufacturers are less likely to experience human mistake, which ultimately lowers waste and machine downtime.
- **Increasing production rate:** Nonstop manufacturing occurs all the time. In order to fulfil the rising demand from market, manufacturers will be able to produce vast numbers of items in a shorter period.
- **Stronger quality control:** Since continuous manufacturing involves few changes, firms have better quality control, which reduces the possibility that human mistake may affect the final product.
- **Low labour costs:** Once the engineers and operators create a flow for continuous manufacturing, less servicing is required. There are no interruptions to the machines' operations. This enables businesses to spend less on staff and more on cutting-edge technology.⁽⁷⁾





Abhishek Kumar Sharma et al.,

Fda's effort in modernizing pharmaceutical manufacturing

The Center for Drug Evaluation and Research (CDER) is in charge of a number of programs that guarantee patients will always have access to high-quality medications and support the development of the pharmaceutical industry. A modern, science- and risk-based pharmaceutical quality assessment system should be implemented, according to the Pharmaceutical cGMPs for the 21st Century initiative, which the FDA launched in 2002. FDA regularly inspects pharmaceutical manufacturing facilities to verify compliance with cGMP regulations. In order to incorporate the principles of quality by design (QbD) into future regulatory guidelines, the FDA has taken action. Quality cannot be tested into products; rather, it should be incorporated as a fundamental component of the product's design, according to the systematic science- and risk-based strategy known as Quality by Design (QbD). The FDA has collaborated with other top regulatory organisations to harmonise and standardise its technological and scientific principles, including QbD, with the regulatory organisations of the European Union and Japan.

The pharmaceutical sector is being urged to develop and adopt new technologies, including those pertaining to continuous manufacturing, by OPQ. In order to facilitate the adoption of new technologies, OPQ has established an emerging technology team (ETT) that will improve communication with sponsors, guarantee consistency, continuity, and predictability in review and inspection, identify and assess regulatory barriers, and establish standards and policies for review and inspection(8,9)

A Transition That Is Difficult but Worthwhile

A number of sectors, like the chemical and Pharmaceuticals, have already evolved their production processes and employ effective continuous technologies to manufacture goods in a secure manner. However, the move to continuous production is still in its early stages for the pharmaceutical sector for a number of reasons. First, such a move might have expensive start-up expenditures. It is expensive to replace outdated batch equipment, buy new technology and train workers on how to use it, and upgrade industrial infrastructure; this calls for a major investment from a medication company. Nevertheless, economic evaluations have revealed the possibility of considerable long-term savings. Additionally, certain technologies need time to develop before they can be used commercially.

It's possible that the technology to manufacture some pharmaceuticals continuously, like biological goods, is still under development. To address these issues as well as others, research is being done. Additionally, when a new production technique is adopted, medication manufacturers continue to regard regulatory uncertainty as a potential factor in product clearance delays. The FDA is offering tools and information to aid with the transition while the industry explores how to make the change. To assist fund and promote research in this field, for instance, the agency is collaborating with the Biomedical Advanced Research and Development Authority, a programme of the U.S. Department of Health and Human Services. In order to evaluate relevant technologies more accurately, we are also educating our review team and doing internal research on risk areas connected to continuous manufacturing (10).

Regulatory Aspects of Continuous Manufacturing's International Acceptance

Continuous manufacturing is being used in the pharmaceutical sector, But in the future, continuous manufacturing should not be limited to these dosage forms. The majority of the current experience is based on Oral Solid Dose (OSD) initiatives. there are many Case studies are available to demonstrate how continuous manufacturing has received regulatory approval to produce pharmaceuticals in various locations, including the "Rest Of the World" (ROW). (i.e., authorities in jurisdictions except the US, EU, Japan, and Canada).Continuous manufacturing provides better process understanding and oversight as well as improved tracking capabilities throughout production when compared to earlier manufacturing methodologies. Real-time release testing (RTRT) and components for process metrics could also be included in the continuous production process. This state-of-the-art technology can therefore improve the flexibility and effectiveness of the manufacturing process. Because continuous manufacturing speeds up research times and increases supply chain flexibility, several pharmaceutical businesses are especially keen to use it. Given the innovation of modern manufacturing techniques, there can be a perceived regulatory risk when these new techniques, such continuous production, are used to newly produced chemical entities (NCEs) or already-



**Abhishek Kumar Sharma et al.,**

commercialized goods. The use of modern manufacturing techniques is encouraged by regulatory organization like the US, Europe, Japan, and many other locations, according to discussions with these organisation the previous ten years. This has been seen during site inspections by regulators and official and informal discussions with several regulatory authorities across the world. Furthermore, data given at several conferences, seminars, and other scientific gatherings have emphasised reliable production techniques and greater quality assurance made possible by the implementation of continuous manufacturing. Through a variety of conferences sponsored by organisations like ISPE, the Product Quality Research Institute, the American Institute of Chemical Engineers, the Massachusetts Institute of Technology and the Manufacturing and Crystallization Consortium, the International Foundation-Process Analytical Chemistry, and the American Association of Pharmaceutical Sciences, the value of continuous manufacturing has garnered recognition throughout the industry, academia, and regulatory agencies(11).

Continuous manufacturing is compatible with the current regulatory framework, according to an analysis of the regulatory guidance documents currently available like, GMPs, quality systems, scientific publications, and various mechanisms for regulatory interactions. This compatibility is also highlighted by the growing number of regulatory approvals for continuous manufacturing. Pharmaceutical firms can interface with regulators through the Emerging Technology Team (ETT) of the US Food and Drug Administration (US FDA), the Process Analytical Technology (PAT) team of the EMA, and the Innovative Manufacturing Technology Working Group of the Japanese Pharmaceuticals and Medical Devices Agency (PMDA) (IMT-WG). FDA established ETT in 2015 to promote discussions on all novel technologies. The FDA supported using the ETT mechanism to talk about ideas for creating and promoting applications for continuous manufacturing. When the EMA PAT team was created in 2006, continuous manufacturing issues were taken into consideration for discussion. The IMT-WG of the PMDA was established in 2016 to hold discussions on a range of cutting-edge technologies, including continuous manufacturing(12)

In addition, recently released regulatory guidance documents for the support of continuous manufacturing. They consist of:

- The FDA's draught "Quality Considerations for Continuous Manufacturing" industry guidelines from 2019.
- "PMDA Views on Applying Continuous Manufacturing to Pharmaceutical Products for Industry," a preliminary draught statement from the PDMA published in 2018.
- The National Institute of Health Sciences of Japan's "Points to Contemplate Regarding Continuous Manufacturing"
- "State of Control in Continuous Pharmaceutical Production," another publication from the Japanese National Institute of Health Sciences
- The 2017 edition of EMA's "Guideline on Manufacture of the Finished Dosage Form" (EMA/CHMP/QWP/245074/2015), a general guideline manual that specifies requirements for situations in which the manufacturing processes are CM.
- ICH Q13, "Continuous Manufacturing of Drug Substances and Drug Products" (13,14)

Development Considerations for Continuous Manufacturing**Process Development**

When creating continuous processes for the production of drug substances and drug products, pharmaceutical businesses might employ a range of manufacturing methodologies. Like traditional/batch manufacturing processes, continuous manufacturing methods would be sufficiently explained in regulatory submissions by highlighting important design and control characteristics. A brief summary of the entire production plan could be included in the regulatory submission. This broad description could include a concise summary of each unit operation and its mode of operation (e.g., batch or continuous), as well as interfaces between unit operations, the material movement, the proposed flow rate, and the overall time required to finish the process. Information on important process factors, their limits, and IPC points may also be included. Details about the development and modelling of a continuous procedure may be included in the pharmaceutical development part of the regulatory submission. These





Abhishek Kumar Sharma et al.,

components could include information on model setup, maintenance, and development, system dynamics, the spread of disturbances, and residence time distributions.

For the continuous production process, other factors to take into account are as follows:

- The rate at which material moves through the process.
- Elements that affect the "scale" of the continuous manufacturing process. For instance, "scaling out" plans, flow rate ranges, and operating time ranges, when several lines running simultaneously are regarded as one lot.
- In-process control (IPC) indices.
- The control strategy requires control systems. For instance, automated valves used to divert non-conformance materials and reject items deemed to be out of specification. (13–15)

Control Strategy

A CM process's control approach is intended to guarantee that the output materials produced over time are of the desired quality. The dossier should outline the pertinent operational features (such as material diversion) and controls that are applied during production. Below is a discussion of a few aspects of the control strategy.

Raw materials and intermediates

If more than one batch of a raw material is used in a continuous manufacturing batch, further raw material management may be necessary. The use of PAT tools is one of several possible control strategies that should be based on knowledge of the product and process. Due to the few sampling ports and high sample frequencies in a continuous process, it may be more challenging to determine the properties of an intermediate product that may or may not be isolated. Raw material and excipient quality characteristics ought to be related to the product's CQAs and the process' requirements.

Equipment

For continuous processes, it is crucial to take equipment control aspects into account. Extruders, twin screw blenders, chemical reactors, loss in weight feeders, tablet presses, and other machinery may need to operate continuously for extended periods of time, necessitating specialised maintenance in the form of calibration and frequent inspection. Although the equipment requirements for continuous manufacturing can change based on the precise product being produced, there are a few standard parts that are frequently used. These consist of:

1. Feeders and blenders: They are employed to regulate the flow of raw materials and guarantee that they are thoroughly mixed prior to joining the process.
2. Continuous reactors: These reactors are made to run continually, producing a constant amount of product. They can be set up in a variety of methods, such as stirred tanks, plug flow reactors, and microfluidic reactors.
3. Separation and purification tools: These might be chromatography, filtering, or crystallization processes.
4. Drying and milling apparatus: This can include milling tools, fluidized bed dryers, and spray dryers.
5. Control systems: To ensure that the product is reliably made at the desired quality level, continuous production requires accurate monitoring of the process parameters. It includes Sensors, automated feedback circuits, and computerized process control systems.
6. Cleaning and sterilization equipment: To avoid contamination and guarantee product quality, continuous production equipment needs to be cleaned and sterilized on a frequent basis. This may involve tools like steam generators, sterilization chambers, and CIP (clean-in-place) devices(16).

Quality product characteristics and uniformity

To determine whether the manufactured product is of uniform quality and character, it is necessary to establish the system's capacity to identify nonconforming products as well as the process's resilience to generate the desired quality of the product even in the presence of variability.(17)





Abhishek Kumar Sharma et al.,

Product collection or rejection

Although it is anticipated that the continuous process would retain a state of control, there may be brief process upsets or disturbances throughout the entire operation period. In some cases, the product created during the disruption may be eliminated while the remaining product is kept. Instead, than rejecting a portion of a batch, other circumstances can call for the entire batch to be rejected. The required quality and consistency of the collected product can be ensured by establishing a priori criteria, based on the amount of risk, for product collection, product rejection, and batch rejection, as well as specifying how or who takes such decisions. It's important to have a plan for disposing of products acquired during startup and shutdown.

Traceability

It is important to comprehend and record the traceability of incoming ingredients to the finished product. Data on system dynamics, including distributions of residence times, can be used to support traceability. It's also important to think about planned interruptions like feeder refills and how they affect the system as a whole.

Process monitoring and sampling

Managing planned changes and responding to unanticipated disturbances are the two main goals of the monitoring system. Material distribution, system dynamics, and dose unit should all be taken into consideration when determining the measurement interval or sample acquisition time. Samples, whether extracted or analysed in-line, should be representative. The possible modes of failure for any sample devices used must be understood. The way in which feedback and feed forward control are implemented, as well as how quality is evaluated at any phase (unprocessed material attributes, IPCs, end quality), relies on the flow rate, sampling rate, time constants, and residence time distributions. In situations where there is a higher risk of variability, such as after the addition of a new batch of input materials or after process parameter changes based on feed-forward/feed-back loops, consideration can be given to defining a flexible tracking frequency where more tracking is anticipated.

Risk assessment and failure modes

In order for a continuous process to run reliably, which in turn helps to guarantee that the end result is always of the same calibre, process reliability is a crucial component. A thorough understanding of the risks and failure modes of the process and its associated estimation and control mechanisms paves the way for the advancement of efficient risk mitigation strategies as well as the aid of manufacturing: changes and process enhancements that may occur over the course of a product's lifecycle. Making risk-based decisions requires knowledge of the risks and possible failure mechanisms.

Specifications

As a part of the control plan, specifications will be required. Although conventional testing of the final product on off-line specimens is possible, continuous methods can include an RTRT method for particular quality aspects. For RTRT methodologies, a more complex sampling plan and a larger sample size may be required in contrast to conventional release testing.

Stability Considerations for Continuous Manufacturing

There are no differences between batch process and continuous process in the regulatory criteria for having acceptable stability data. When designing the stability protocol, a few distinctions should be considered.

State of Control: final Product Collection, in-Process Sampling

As per ICH Q10, a condition of control offers the assurance of ongoing process performance and product quality. To make sure that all of the information up for a release decision complies with the relevant specifications, acceptance criteria based on monitoring at an appropriate frequency might be set. Reliable data and a thorough understanding of the dynamics of the process should be the basis for any decisions to divert or reject material that does not fulfil the requirements for acceptance. It should be confirmed that the system can consistently create a product over an extended period of operation. It should also be understood how potential failure mechanisms and performance

57904





Abhishek Kumar Sharma et al.,

degradation can occur, as well as how to identify them. To guarantee that any impact on product quality is recognised and adequately managed across all operational states, even during routine operations, risk analysis techniques, including practical testing and/or modelling tools, can be used. The process residence time and resident time distribution are often measured at startup, normal operation, shutdown conditions, and other conditions in order to determine the period of product collection. Understanding and quantifying the residence time distribution in particular can be utilised to identify the products that are under the purview of any investigation or disposition choice and which materials may have been impacted by a change in process circumstances (18).

In certain situations, monitoring product qualities, process parameters, and equipment capacity may be used to determine the process's maximum run time rather than confirming a single fixed run time. To find and discard products that don't satisfy specifications, it is frequently necessary to use sampling, testing, quality control techniques, and equipment mechanisms. In order to guarantee that a process variable or product characteristic cannot move outside the initially defined acceptable method window or acceptable range without being detected, it is imperative to make sure the control and tracking system can take measurements at a rate that is appropriate to the dynamic response time of the parameter or attribute. While selecting measurement frequency, it is crucial to take into account the intrinsic process risk (for example, greater risk at reduced API dose), known process variability, and required residence time in the equipment to complete transformation. (For instance, more danger at higher throughput)(19).

Traceability of Materials in Continuous Production

Any precise percentage of a product formulated in a continuous manufacturing process that is distributed to the market should be promptly and precisely linked to the relevant process data, as well as the numerous inputs from which it was produced. This usually entails being aware of residence time and RTD at relevant flow rates and working parameters. Making decisions about later release while taking into consideration variables like diverting unsuitable product during the process can offer a suitably precise and prompt link between pertinent product quality information and any specifically designated product. Other monitoring considerations include the general movement of materials through the system or each of its component parts, as well as the ability to account for material that may be intentionally detached from the system for screening or accidentally lost due to unforeseen circumstances or redirecting.

Raw Material, in-Process Material Handling

Due to equipment and material behaviours, such as starting materials in hoppers or process intermediates that develop gradually over time but are difficult to see during batch processing or quick test runs, continuous processing may provide difficulties. The operating and flow characteristics of the materials that will be processed should be considered early on to greatly aid in the construction of the process instrument. Care should be taken when using transport methods because they may transform materials to some extent (such as segregating and/or attriting powders). Risk analysis, real-world tests, and modelling methods should all be considered in order to identify and estimate any possible challenges associated with upholding stable process circumstances throughout the operation of a continuous production for the entire production run. Considerations for undesirable material accumulation brought on by chemical and physical processes, the stability of raw ingredients, or intermediates stored in shield containers, should all be made (20)

Detection and Treatment for Non-Conformity

Handling nonconformities and/or deviations is a crucial factor in any quality system. Unexpected inconsistencies will surely happen throughout the product lifetime, despite the importance of understanding processes and products. The comprehension of the current process and the resulting product may be called into doubt as a result of these problems, necessitating further process development. The improvement of products and processes requires a strong Corrective Action and Preventive Action (CAPA) framework. The methodology can help with process and product improvement as well as better understanding of those areas. A continuous manufacturing process should take into account a few important factors. The process management system must be sufficiently sophisticated to be





Abhishek Kumar Sharma et al.,

able to recognize a typical process and recognize when data are sufficiently differing to indicate a deviation that may have an immediate effect. In these circumstances, the product must be redirected somewhere else for additional analysis and possible refusal or waste. Therefore, it's possible that the final item that will be put on the market won't contain all of the components that were initially fed into the procedure as part of the initial single production order. Along with more complex IPCs and monitoring, continuous manufacturing might also be subject to unintended failure modes. When building a trustworthy control system, these failure types should be considered. Continuous and batch manufacturing usually handle non-conformities in the same way. Some important differences that should be considered are covered in the sections under Personnel Operations and Training, Carry-Over of Materials, Material Diversion, Product Observation on the Manufacturing Floor, and Distribution System Uncertainty.

Personnel Procedures and Training

It is critical to evaluate whether emerging technologies, such as automated manufacturing and PAT techniques, will have any negative impacts on present technology, manufacturing, and quality approaches. methods that stipulate who is in charge of stopping and starting activities, how deviations are recorded, looking into inconsistencies, and captivating corrective action may need to be altered depending on the latest innovation. Novel processes and/or revisions typically necessitate extra staff training.

Material Carry-Over

It's crucial to make sure that inquiries are correctly stretched to later batches of similar pharmaceutical products as needed. In order to ensure that the inquiry is appropriately expanded to respective batches, it is essential to understand how the facility describes a batch. The permitted carryover amount must be evaluated.

Material Diversion

It is crucial to establish detailed protocols for handling non-conformances, such as data that are out of specification or out of trend and need diverting the product stream during manufacturing. In advance of an event of non-compliance, procedures defining when the flow of product is to be redirected and when collection is to be restarted should be created. Non-conforming material should be redirected at the following suitable point if it is found. Before deciding how to dispose of the batch, the diverted material should be investigated if the in-process analysis indicates that a specific amount of material has to be redirected.

Production Floor Product Monitoring

On the production floor, continuous manufacturing processes are more likely to be implemented using process analytical technology instruments (in-line, at-line, or on-line). Like conventional manufacturing, any variation found on the production floor should be investigated before the material is disposed of. For instance, if in-line evaluation results indicate a failure is likely, final product testing is inadequate to allow the release of related material, and a related inquiry should be conducted. Failure of the monitoring equipment should also be evaluated. In circumstances of equipment failure, a method can frequently be devised for the adoption of alternate testing or inspection techniques. Utilizing testing of the final product or other alternatives while retaining a respectable degree of quality could be the alternative strategy.

Raw Material Variability

When conducting an inquiry for continuous production methods, it is crucial to take initial material inconsistency into account as a potential source of failure. Various starting material batches are frequently blended at the beginning of production in a batch method. In continuous production, when various quantities of raw materials can be employed throughout the production operation, this might not be the case. Despite possibly meeting specifications, using many initial material lots in a single product batch could result in variations in the final product(3)



**Abhishek Kumar Sharma et al.,****The regulatory outcome for CM compared to Traditional batch**

A self-audit of approved U.S. regulatory submissions that use CM in contrast to conventional batch procedures was carried out by CDER's Office of Pharmaceutical Quality (OPQ). CM is an advanced manufacturing technique that continuously and directly moves materials created during each process stage to the next for additional processing. Pre-approval inspections, manufacturing-related post-approval application supplements, annual reports reporting modifications to the manufacturing process, and OPQ time to approval and market entry. Six applications were authorised at the beginning of 2022 to use CM for finished solid oral drug products. OPQ compared various subsets of this dataset using 134 approved comparator products that were produced in batch processes and met specific requirements (21)

Time to approval and market entry

This self-audit revealed that using CM sped up approvals and market entrance. The applications that used CM were accepted in the first review session without Complete Response letters being sent out, and they were accepted before the User Fee goal date. The designation of Breakthrough Therapy was given to four of the six accepted CM applications, prompting the review process. When compared to batch applications, the goods using CM went on sale twelve months and three months sooner after regulatory submission. Patients are given earlier access to products through CM operations, which has a positive economic effect for the sponsors and requires fewer process and equipment considerations when scaling up operations. All of the CM applicants included in this investigation participated in the CDER's Emerging Technology Program (ETT), which could have assisted with first-cycle approvals.

Manufacturing process changes reported in annual reports

For the purpose of evaluating manufacturing changes mentioned in annual reports, OPQ searched annual reports for the term "manufacturing process change." This term was not mentioned in any of the five applications for goods manufactured only using CM, but it was mentioned five times in the application for a product created using both batch and CM. The 114 batch applications contained 33 mentions, and 21 of these annual reports contained changes to the drug product procedure. As a batch procedure developed, mentions decreased over time.

Number of post-approval application supplements

When OPQ examined post-approval application supplements for CM products, it discovered that 30% of them had to do with the manufacturing procedure. However, there were no adjustments made to the machinery, operating procedures, or batch sizes in supplements for CM applications, demonstrating the intrinsic adaptability of CM processes.

Pre-approval inspections

The majority of batch products and almost all CM products had their pre-approval inspection records manually checked by OPQ. More process-related problems were found during the inspection of CM applications than batch applications, which may be a sign that CM processes are more focused on inspection than batch processes. Overall, the results of this self-audit show that CM applications do not present greater risks to regulatory reports or results than batch applications. Applications utilizing CM may benefit from regulatory benefits like better manufacturing agility and scale-up flexibility, as well as financial benefits for sponsors and manufacturers. In addition to providing patients with early access to medications, CM implementation has the potential to decrease or mitigate drug shortages and improve product availability.(21)Table 2

CONCLUSION

In conclusion, this review has highlighted the continuous manufacturing process and batch manufacturing process, its pros and cons and the regulatory requirements. The later article focused on the FDA's role and regulations on continuous manufacturing. Regulatory aspects of international acceptance are demonstrated in this by using the case



**Abhishek Kumar Sharma et al.,**

study and guidance documents published by various governing bodies all over the world. In this, we tried to focus on the development consideration for the continuous manufacturing of drug products mainly in the area of process development, control strategy, materials, equipment quality, traceability, monitoring, specifications, and many more. Lastly, we have shown the regulatory outcomes for the CM process compared to the traditional batch through a self-audit carried out by the US FDA's CDER Office of Pharmaceutical Quality (OPQ) and have found out the time for approval and market entry was found to be faster. On comparison of manufacturing process changes reported in the annual report it was found that CM has 5 times lesser process changes than batch process, they were no machine adjustments, operating procedures, or batch size in post-approval application supplements. In pre-approval inspection which was manually done by OPQ found that they do not possess greater risk in the regulatory report than batch.

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Table 1: Comparative Process of Batch and Continuous manufacturing

	Batch Manufacturing	Continuous Production
Raw material feeding /product output	The process operation involves the periodic injection of raw materials, and when it is complete, the product (or output material) is immediately released.	Continuous injections of raw materials into the process operation result in the continuous and sequential release of the product (product material) after a predetermined amount of time.





Abhishek Kumar Sharma et al.,

production techniques	Operator handling repeatedly starts and stops each process.	Through connected unit operations, automation, and a lack of operator supervision, production is continuous.
Production facility area	Big Area considered necessary	Space saving
Scaling-up	At the development and validation stages, specific verification procedures and equipment are required for each scale, and distinct equipment is required for commercial manufacturing.	By simply modifying the manufacturing schedule, it is possible to make the transition to commercial production quickly, and the development-related machinery can be built with real-world production in mind.

Table 2: Patents on Continuous Manufacturing

Patent Publication Number	Name	Country	Publication date	ref
WO/2021/126829	Continuous Processes for Manufacturing Impregnated Porous Carriers and For Manufacturing Pharmaceuticals Containing Impregnated Porous Carriers	New jersey, US	24.06.2021	(22)
KR102357760	Dry Molding Machine for Manufacturing In-Line Type Continuous Coating Oral Disintegrating Film	Republic of Korea	08.02.2022	(23)
WO2019241163	System For Molding and Coating of Pharmaceutical Tablets	Massachusetts US	19.12.2019	(24)
WO2012078677A2	Continuous Processing Methods for Biological Products	Massachusetts US	2012-08-02	(25)
US20170218012A1	Integrated Continuous Manufacturing of Therapeutic Protein Drug Substances	US	2020-07-14	(26)

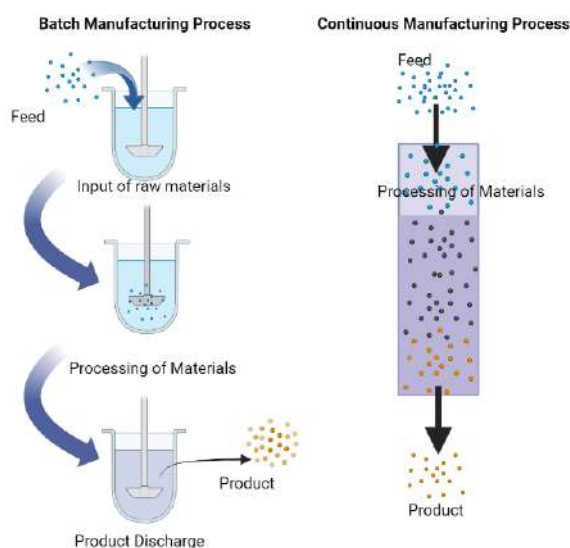


Fig. 1 Comparison of Batch Manufacturing and Continuous Manufacturing





Prediction of Financial Time Series using Deep Learning Hybrid Model Techniques

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ABSTRACT

Financial Time Series are dynamic and difficult to predict because of their chaotic structure. Periodically examples indicate of financial variables make up a FTS. This study makes use of a new hybrid model that combines LSTM, Polynomial Regression, and Chaos Theory to make predictions about FTS. First and foremost, In this hybrid, the FTS is put to the test for pandemonium. Later, the time series is simulated using Chaos Theory to account for the presence of chaos. As a starting point, LSTM will be used to forecast using the model's time series. Error predictions can be made using LSTM forecasts based on the sequence of errors. The final hybrid model projections are the result of applying error predictions and original model forecasts. Nine data sets are used to examine the performance of the hybrid model using two new hybrid models namely Chaos +LSTM and Chaos+LSTM+PR. According to MSE, MAPE, Dstat, and Theil's U, the hybrid model presented in this paper outperforms specific models as ARIMA, CART, Random Forest, CNN, LSTM,PROPHET as well as CART with Chaos, and Chaos with Random Forest as a whole. While using hybrid model, a better forecast may be made, and it has been proven using a variety of FTS, including such foreign exchange rates.

Keywords: Chaos, Polynomial Regression, Deep Learning, Time Series Prediction, Exchange rate.



**Krishna Mohan et al.,**

INTRODUCTION

Day-to-day exchange rates, financial exchange rates, and product costs are often available on a regular basis in the form of a Financial Time Series [1]. Fluctuating and transient, in general, are the characteristics of the FTS. A chaotic time series is sensitive, authoritative, as well as nonlinear from the outset [2]. As a result, FTS is raucous, with shifting numerical highlights. This characteristic makes the figure impossible [3,4]. To obtain nonlinearity in a time series, a valid forecast model is often difficult to construct. This makes FTS determination difficult and dynamic. Time series or half-and-half time series models have been shown by numerous scientists to be preferred to single-time series models when it comes to ready use [5-7]. An obstacle framework's hidden non-straight powerful way of behaving by a given scalar FTS can be demonstrated using boundaries, such as the slack as well as mix consolidating in their individual stage spaces, where coordination aspect and delay implies the quantity of factors fundamental for the non-linear elements in disarray [8,9]. More precise expectations can be achieved by the application of advanced neural network techniques [10,11]. A hazardous and indirect aspect will be built into the ANNs to guide yield from information sources [12]. As a result, a hybrid technique like LSTM is used to address the issues in this area, which is often overlooked [13]. The FTS is examined in detail by the LSTM, a type of Recurrent Neural Network. Long Short-term Memory Network in a chain can be learned, and as a result, it notices time series non-linearity as great, resulting in more robust hypotheses than straight anticipating models such as ARIMA, Prophet, CART etc., [14,15].

Objectives of the research

1. Chaos with Long Short Term Memory and Polynomial Regression is expected for FTS's new Chaos-based Hybrids..
2. Predicted trade rates and stock market indexes, Forex, and Commodities are among the topics covered in this research.
3. CART, Random Forest, ARIMA, CNN, LSTM, Prophet, Chaos + CART, Chaos + RF, and Chaos + LSTM as well as expectation models are all compared to see how they stack up against each other.

REVIEW OF LITERATURE

In order to replicate the volatility of three different US Dollar trading rates, Jonatan Henrquez et al [16] proposed a mixture model. There have been previous studies that used information obtained and assess time-series noise or to silence time-series clamour in order to gather useful elements. For the EUR/USD conversion scale returns, ANN was proposed by Alejandro Parot et al [17]. The prompts should include a variety of methods for enhancing the ability of each model to make inferences. Using the benchmark model which reduces RMSE by 19.3%, the suggested model received a 32.5-percent score, and the best mixture was found. Lei Ruan et al [18] proposed that the monetary company focus on the monetary organisations and the updating of clever monetary configurations in order to satisfy customers' expectations on a larger and more consistent level. There are advantages to the ANN strategy in dealing with the current economic scenario. R. Hafeziet al [19] provided the basis of ANNs for the smart model in order to forecast the future costs of gold. Bat calculations, a meta-heuristic method for identifying vacillations, use the required brain organisation. For the purpose of gauging the model's accuracy, the Root Mean Squared Error was used. Results showed that the suggested Recurrent Neural Network beat both traditional and innovative gauges (RNN). M. Durairaj et al [20] conducted a systematic study of various crossover expectancy models between 1999 and 2019. Over the past two decades, 34 distinct FTS halves have been seen that focus on deep learning. The hybrid model arrangement that coordinates an LSTM with a GARCH model of one or three, was advocated by Ha Young Kim et al [21].

It was hypothesised by Yujin Baek et al [22] in the ModAugNet framework that the LSTM aversion covering module and the LSTM expectation module might be used to increase the data in securities exchange records. The proposed approach has been tested and yielded two separate agent market data sets. The findings demonstrated the model's amazing consistency. EMD-LSTM and CEEDMAN-LSTM are two crossover expectation models presented by Cao et al. [23]. Rather of using a static LSTM model, this strategy takes advantage of the possibilities of a composite





Krishna Mohan et al.,

framework. Past arrangements have been a little different than this one. By integrating nonlinear and straight models, Ümit Üvüç Büyükaşahin and colleagues were able to improve their findings [24]. It's possible that under certain circumstances, these current approaches may not be as effective as they may be. According to Chen, J. et al. [25]. Using RVFL-GMDH and chaotic time series analysis, a decisive moment forecast approach for stock costs is proposed. [26]. Stock value is determined by the fractal normal of an odd attractor with an infinite self-comparative structure in this model. Deterministic expectation and span forecasting can be achieved using a sophisticated decay determination troupe anticipating framework presented by Jiang et al. [27]. One of the most recent studies, by Beeram S R and Kuchibotla S, looks at cutting-edge time series forecast models, such as irregular strolls and ARIMA as well as a number of other models, including ANN and SVR [28]. According to Gunho Jung and Sun-Yong Choi, it is possible to predict FX instability exactly by combining a variety of deep learning models[29]. It is possible to accurately predict trade rates using the FSPSOSVR method, which incorporates PSO (molecular swarm enhancement), arbitrary woodland highlight determination, and SVR [30,31]. "Long momentary memory" (LSTM), a famous profound learning apparatus that is proven of being incredibly powerful in several FTS concerns, has been used to make course expectations in Forex , Profound learning can be used for conversion scale predictions, according to Dautel et al. [32].

RESEARCH METHODOLOGY

Because of the uncertainty in predicting financial rate time series, the proposed cross-breed technique is designed to smooth out the fluctuations. This is done using the Lyapunov type. The scalar time series' stage space is then generated using Chaos Theory. Layered values for slack and mix are critical to the construction of stage space. Slack from time series can be selected using the Akaike Knowledge Criteria (AIC). In order to attain the best implantation aspect feasible, Cao's technique is utilised. Chaos theory is able to replicate the stage area prior to perfect postponement and assimilation of parts. Thereafter, the conjectures are recalculated by using the polynomial regression method.

This portrays the proposed cross breed arrangement. In FTS estimates limiting the normal conjecture error is vital. Let $Y = \{y_1, y_2, \dots, y_k, y_{(k+1)}, \dots, y_N\}$, be a period series with N arrangement of time series, with $t = \{1, 2, 3, \dots, k, k+1, \dots, N\}$. Then it be done to following:

1. Examine Y for signs of chaos. Whenever chaos exists, recreate phase space from Y using the shortest lag (h), as well as the smallest embedding dimension (m).
2. Chaotic Modeled partitioned Y into $Y_{Train} = \{y_t; t = h m_1 + 1, h m_1 + 2, \dots, k\}$ and $Y_{Test} = \{y_t; t = k + 1, k + 2, \dots, N\}$.

Stage-2: Applying the LSTM

- i) Use the Y_{Train} training set to train LSTM
- ii) Use Eq. (1) to get initial predictions and Eq. (2) to get matching errors

$$\hat{y}_t = g_1(y_{t-l_1}, y_{t-2l_1}, \dots, y_{t-m_1 l_1}) \quad t = l_1 m_1 + 1, l_1 m_1 + 2, \dots, k \quad \dots (1)$$

$$e_t = y_t - \hat{y}_t \quad t = l_1 m_1 + 1, l_1 m_1 + 2, \dots, k \quad \dots (2)$$

Stage-3: Using PR Model

- i) Apply Polynomial Regression (PR), $g_2(x)$ to the functional form. $Y_{out} = \beta_0 + \beta_1 X + \beta_2 X^2 + \dots + \beta_n X^n$ in order to obtain e' as in Eq.3

$$\hat{e}_t = g_2(e_t) \quad t = l_1 m_1 + 1, l_1 m_1 + 2, \dots, k \quad \dots (3)$$

- ii) Using Eq. 3, At the end of Level 2, obtain final training fixed predictions.





Krishna Mohan et al.,

$$\hat{y}_t = \hat{y}_t + \hat{e}_t \quad t=l_1m_1 + 1, l_1m_1 + 2, \dots, k \quad \dots (4)$$

Phase 2: **Testing:** After passing through the two steps, acquire test set predictions by substituting the observations with $t = k + 1, k+2, \dots, N$ in equations 1,2,3, and 4 respectively.

Hybrid Model (Chaos+LSTM+PR)

Three stages will be involved in the construction of the hybrid Model. As part of this Hybrid, Chaos Principle is utilized in the first stage to construct a phase area based on the financial period series, followed by LSTM in the second stage, and PR in the third stage. Here, PR is used to obtain e^t .

Design of experiment

According to this study's exploratory design, several datasets were used, assignments were given to models and devices, and a model assessment was carried out to show how this strategy may be implemented.

Datasets for the Study

With the usage of a variety of datasets, the proposed blend is shown to be beneficial. From the US Federal Reserve, the Indian Rupee/USD, Singapore Dollar/USD, and Japanese Yen/USD trading rates are gathered. Three product costs in US Dollars are gathered from Investing.com. S&P 500, Nifty 50, and Shanghai Composite List are three of Investing.com's protective values. There are nine sets of data in table 1, each with the appropriate dates and some comments. There is also an initial preparation and a final test set. The FTS problem has been proved to be a learning problem. Informational indexes are separated into a preparation set (80%) and a test group (20%). This wealth of informational resources confirms and locates each dataset's disorder. The ideal delay as well as connection point for each informational collection are then re-created in the space of time.

Testing the model

MSE, MAPE, Dstat, and Theil's U are examples of objective capacities that achieve the optimum arrangement, where the MSE/MAPE esteem as well as the standard deviation are both as low as they may be. It has been tested using Theil's Inequality Coefficient, Mean Squared Error, as well as Directional Change Statistics to see if this proposed model is useful. This half-and-half model has really been tested for accuracy and vulnerability. Both of these estimates were returned to the creators when they had the chance to explore the time-series features of inaccuracies in figures.

Square Mean Method

Error Squared of Mean MSE/MAPE calculates the usual squares of errors to see how reliably the model suggests the outcome. The test set tests the model boundaries after the model has been set up to determine the next term's value. This is what we mean when we say "beginning with differential structure. Both the train selection and the MSE/MAPE test error are under investigation. It is possible to learn a great deal from scientists who have made huge mistakes that have had far-reaching ramifications for society at large. The closer an MSE/MAPE is to zero, the more accurate it is.

$$MSE = \frac{\sum_{t=1}^N (y_t - \hat{y}_t)^2}{N} \quad (1.5)$$

$$MAPE = \frac{1}{N} \sum_{t=1}^N \left| \frac{y_t - \hat{y}_t}{y_t} \right| \quad (1.6)$$

Where N is the series of number as well as the predicted values are noted at time t . In the result section, Tables shows the comparative results.





Krishna Mohan et al.,

Change in Statistical Directionals

The direction of movement in a time series can be determined using Dstat. The suitable matching number of predicted and actual endlessly values is evaluated by taking into account all parameters of the testing range. Sign measurements can be expressed in terms of,

$$Dstat = \frac{1}{N} \sum_{t=1}^N a_t * 100\% \tag{1.7}$$

$$a_t = \begin{cases} 1, & \text{if } (y_{t+1} - y_t) * (\hat{y}_{t+1} - y_t) \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Better time-series developments are discovered by the model with a higher Dstat score. The normalised mean square blunders only establish prediction uniquely as far as levels with the aim that these series are attractive. As a result, a person's ability to foretell the future it is possible to be judged by the precision of their angle (Dstat) predictions and the advancements in sign.

Theil's Inequality Coefficient

The Inequality coefficient of Theil alluded to be U, decides how much nearer an estimate time series is to the ongoing time series. The U worth by and large ranges from 0 to 1. A worth of zero is joined with an ideal expectation, (e.g.) implying that U=0 fits well with all perceptions. Also, a worth of one is related with a figure that on normal has a similar blunder as a "gullible" no change gauge (i.e.) U=1 demonstrates the outcome is low.

$$U = \frac{\sqrt{\frac{1}{N} \sum_{t=1}^N (y_t - \hat{y}_t)^2}}{\sqrt{\frac{1}{N} \sum_{t=1}^N (y_t)^2 + \frac{1}{N} \sum_{t=1}^N (\hat{y}_t)^2}} \tag{1.8}$$

EXPERIMENTATION AND RESULTS DISCUSSION

The informative collections are used in conjunction with each other when trying out different things in different situations. In this case, the LSTM technology employed contains a 50-hub thick layer with each hub powered by the ReLU initiating feature. For the past 500 years, the adam analyzer has been used as a misfortune task for the LSTM. Scaled values using Min Max Scaler are used to place Chaos+LSTM+PR. Second-degree polynomial relapse is the strategy used when PR displays mistakes. The results of each dataset are listed here.

Crude oil

Table 2- Values obtained from the crude oil test set
 Fig. 3- Crude oil test predictions using the suggested hybrid

Gold Price (USD)

Test set results are shown in Table 3 for the Gold Price in US Dollars. Chaos+LSTM+PR outperforms ARIMA (2,1,1), Prophet, LSTM and CART in the table in terms of mse and mape, dstat and theil's U in terms of mse, dstat and theil's U. It demonstrates that the forecasts are more accurate. Figure 4 also shows this. The anticipated values of LSTM as well as Chaos+LSTM are also shown in the graphic. In terms of MSE and MAPE, Chaos+LSTM did not do as well as Chaos+CART, Chaos+RF, CART, RF, as well as LSTM.

Soyabean price

In the Soyabeans Price US Dollar Test Set, the findings are shown in Table 4. Chaos+LSTM+PR is clearly superior to ARIMA (0,1,0), Prophet, LSTM and CART in terms of the mse and mape, as well as in terms of theil's U, compared to ARIMA (0,1,0), CART, and Chaos+LSTM. It demonstrates that the forecasts are more accurate. Figure 4 depicts this as well. In terms of MSE and MAPE, Chaos+LSTM did not perform as well as Chaos+CART, Chaos+RF, CART, RF, or LSTM.





Krishna Mohan et al.,

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Results are shown in Table 5. The proposed hybrid (Chaos+LSTM+ PR) surpasses ARIMA (3,1,3), Prophet, LSTM, CART, RF, Chaos+ CART, Chaos+RF, as well as Chaos+LSTM in the table in terms of mse, mape, dstat, and theil's U. It demonstrates that the forecasts are more accurate. Figure 6 depicts this as well. In terms of MSE and MAPE, Chaos+LSTM did not do as well as Chaos+CART, Chaos+RF, CART, RF, or LSTM.

Nifty 50 stock index

The findings are shown in Table 6. Chaos+LSTM+PR surpasses ARIMA (0,1,1), Prophet, LSTM and CART as well as the proposed hybrid (Chaos+LSTM+PR) in the table in terms of mse, mape, dstat and theil's U. It demonstrates that the forecasts are more accurate. Figure 5 also depicts this. According to MSE and MAPE, Chaos+LSTM did not perform as well as Chaos+CART, Chaos+RF, RF, CART, LSTM, and LSTM were compared.

S&p 500 stock index

The test results for the S& P 500 Stock Index are shown in Table 7 MSE, MAPE, Dstat, and Theil's U. Compared to Chaos+CART and Chaos+RF, the proposed hybrids Chaos+LSTM and Chaos+CNN can outperform Chaos+LSTM and Chaos+CNN in MSE, MAPE, Dstat, and Theil's U. CNN outperforms all other ARIMA, Prophet, CART, RF and LSTM models when it comes to MSE, MAPE, and Theil's U. It demonstrates that the forecasts are more accurate than the actual numbers. Figure 8 depicts this as well. It's worth noting that the prophet performed the worst of all the techniques in presented the table. The predictions of both proposed methodologies versus actual test set values are shown in Figure 4.7. Both approaches anticipate significantly different values from the actual test set values, as seen in the graph. The accompanying table displays the test set's INR/USD results. Chaos+LSTM+PR outperforms ARIMA (3,1,2), Prophet (LSTM), RF (Chaos+CART), Chaos+LSTM, and Chaos+LSTM in the table in terms of mse, mape, dstat, and theil's U. It serves as evidence that the projections are more accurate than previously believed to be the case. This is shown in Figure 9 as well. If you're looking for the best MSE and MAPE, Chaos+LSTM isn't the best option.

JPY/USD

The findings of the JPY/USD test set are shown in Table 9 MSE, MAPE, Dstat, and Theil's U. A couple of proposed hybrid algorithms, Chaos+LSTM and Chaos+CNN, may perform better than Chaos+CART and Chaos+RF on MSE, MAPE, and Dstat, as well as Theil's U. CNN, might outperform all other ARIMA, Prophet, CART, RF, and CNN models. It's worth noting that the prophet performed the worst of all the techniques in presented the table. The predictions of both proposed methodologies versus actual test set values are shown in Figure 10 Both approaches anticipate significantly different values from the actual test set values, as seen in the graph

SGD/USD

The results of the JPY/USD test set are shown in the table above. Chaos+LSTM+PR is clearly superior to ARIMA (0,1,0), Prophet, LSTM and CART as well as Chaos+ RF and Chaos+ LSTM in the table of performance metrics. It reveals that the forecasts are closer to the actual values than previously thought. In terms of MSE and MAPE, Chaos+ LSTM was not as accurate as CART, RF, CART, LSTM, and LSTM. Above table shows the results of test set of SGD/USD. From the table, In terms of mse, mape, dstat, and theil's U, the suggested hybrid (Chaos+LSTM+PR) clearly out- performs ARIMA (1,0,0), Prophet, LSTM, CART, RF, Chaos+CART, Chaos+RF, and Chaos+LSTM, as shown in the table. It shows the predictions are strongly correlated in comparison to the actual values shown in Figure 11.

CONCLUSION

FTS forecasts can be made using a variety of methods. But productivity is hampered, as well as a compelling business arrangement that can be used to anticipate the greatest results. Chaos+LSTM+PR, a hybrid model, was tested in order to expose the problem of FTS expectations. First, the FTS is put to the test for the crossover's heavy





Krishna Mohan et al.,

emphasis on violence. Next, it was shown that the time series exhibited chaotic behaviour in accordance with the Chaos Theory. The AIC is used to get the best time series slack. Cao's approach is used to provide the best estimates of combination. The stage area was reproduced till the optimal deferral and incorporation aspect were gained from time series based on the notion of upheaval. For the initial figures, the model time series was fed into an LSTM. PR can use the LSTM prediction error grouping to meet blunder expectations. Polynomial relapse is used to alter expectations. Mistake expectancies and unique LSTM forecasts are used to arrive at final values for the half-breed model. The crossover model is evaluated using FTS, which are unknown monetary standards. A final half-breed model that excels in a variety of monetary time series applications is Chaos+LSTM+PR.

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Krishna Mohan et al.,

Table .1-Datasets Used for the Study

Data Set	Dates	Count	Training Set	Test Set
Crude Oil Price (USD)	02-Jan-1990 to 29-Jan-2021	7890	6312	1578
Gold Price (USD)	02-Jan-1990 to 29-Jan-2021	7907	6326	1581
Soybeans Price (USD)	02-Jan-1990 to 31-Jan-2021	8063	6451	1612
Nifty 50 Stock Price	06-Nov-1995 to 29-Jan-2021	6281	5025	1256
Shanghai composite Index	20-Dec-1990 to 29-Jan-2021	7362	5890	1472
S&P 500 Stock Index	02-Jan-1990 to 29-Jan-2021	7831	6265	1566
INR/USD	02-Jan-1990 to 29-Jan-2021	8093	6475	1618
JPY/USD	02-Jan-1990 to 29-Jan-2021	8101	6481	1620
SGD/USD	02-Jan-1990 to 29-Jan-2021	8101	6481	1620

Table 2- Values obtained from the crude oil test set

ForecastingModel	MSE	MAPE	DStat	Theil'sU
ARIMA	122.17013	15.629139	52.758402	0.0226266
Prophet	2079.5150	43.669223	50.158528	0.1817419
CART	5.9811462	3.4417719	48.680405	0.0011074
RF	5.9069172	3.4390847	48.826886	0.0007223
LSTM	5.7178772	3.30012595	49.587824	0.000727
CNN	4.923178	3.212694251	50.22194039	0.000761211
Chaos+CART	5.8593575	3.4006169	51.616994	0.0010846
Chaos+RF	5.02599745	5.489568998	50.34876347	0.001882526
Chaos+LSTM	4.433305	2.5539713	55.694990	0.0009945
Chaos+LSTM+PR	2.55E-07	1.0007893	80	2.87E-11

Table 3- Gold Pricing of Test set Results

ForecastingModel	MSE	MAPE	DStat	TheilU
ARIMA	27802.054680	9.048922	51.7088607	0.006927380
Prophet	67822.883460	15.076782	50.569626	0.0152807
CART	2650.180641	1.867481	50.037974	0.08067199
RF	1389.3705806	1.2799911	51.4556962	0.09035156
LSTM	190.32789	1.0266208	56.5822784	0.00670003
CNN	204.4298704	1.031466741	47.4683544	0.100102128
Chaos+CART	200.907862	1.8883911	57.341772	0.0016747
Chaos+RF	185.644763	1.32960359	50.506329	0.090387
Chaos+LSTM	167.047461	1.00946563	59.2025316	0.0001080
Chaos+LSTM+PR	0.0031655	0.0040988	87.456	0.009462e-10





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Table 4-Results of test set of Soya beans Price

ForecastingModel	MSE	MAPE	DStat	TheilU
ARIMA	36277.433250	15.161464	50.775915	0.016791
Prophet	317374.435389	36.564604	50.900062	0.099628
CART	492.448338	1.732297	55.307262	0.000268
RF	186.908517	1.072228	51.707014	0.000101
LSTM	124.167554	0.817279	51.024208	0.779597e-05
CNN	110.1634494	0.69731048	53.0726257	0.89e-05
Chaos+CART	105.229258	1.730958	55.493482	0.0002632
Chaos+RF	99.237605	1.065448	54.203600	0.0001015
Chaos+LSTM	97.197407	0.2306449	58.893234	0.000890
Chaos+LSTM+PR	2.43608e-05	0.000306	93.785	0.0028e-12

Table 5- Test set results of Shanghai Composite Index

ForecastingModel	MSE	MAPE	DStat	TheilU
ARIMA	668777.360368	19.1875061	53.840924	0.02724
Prophet	2265404.326675	87.2517349	51.597552	0.17262
CART	8076.550985	1.950799	53.8409245	0.000397
RF	3623.417136	1.256007	49.4901427	0.000178
LSTM	2956.134975	1.1817620	55.130523	0.000146
CNN	1915.863751	1.147577864	57.65465	0.000190
Chaos+CART	1433.170556	11.0793280	59.268524	0.00365
Chaos+RF	1359.312050	1.0246783	69.5581237	0.00176
Chaos+LSTM	1254.767975	1.007058429	73.6940856	0.0017
Chaos+LSTM+PR	1.76715	1.00342	88.567	0.000129e-09

Table 6- Results of test set of Nifty 50 Index

ForecastingModel	MSE	MAPE	DStat	TheilU
ARIMA	3400655.7030	17.260416	55.139442	0.018258
Prophet	849534.677585	6.739681	52.270916	0.00393
CART	451114.427545	19.200982	87.808764	0.02473
RF	418860.943174	18.087281	88.808764	0.022805
LSTM	16129.754511	10.850068	88.836653	0.499417
CNN	6957.30123	9.946663737	89.03187251	0.0328
Chaos+CART	4510.369836	8.194321	90.569721	0.0247330
Chaos+RF	4232.770306	8.0233875	92.888446	0.02306
Chaos+LSTM	1560.525616	7.837223	95.677290	0.00803
Chaos+LSTM+PR	43.639324	1.2165	94.456	0.002894e-08





Krishna Mohan et al.,

Table 7: S&P 500 Stock Index test results using proposed two-stage hybrids

Forecasting Model	MSE	MAPE	DStat	Theil U
ARIMA	246490.773162	15.918238	57.444089	0.020656
Prophet	645978.130974	11.909248	54.376996	0.011875
CART	524902.738023	27.451097	96.549520	0.047702
RF	531831.296643	27.811611	95.846645	0.048434
LSTM	841.164380	10.803366	97.437699	0.114755e-05
CNN	353.6204	9.837133625	98.47923323	0.002729612
Chaos+CART	252.627397	7.453308	98.613418	0.047702
Chaos+RF	151.715480	6.905680	98.846645	0.048624
Chaos+LSTM	70.470136	5.690652	99.309904	5.137796e-05
Chaos+LSTM+PR	1.47217	1.0049732	92.5632	0.0051e-09

Table 8 : The Results of the INR/USD Test Set

Forecasting Model	MSE	MAPE	DStat	TheilU
ARIMA	24.682253	5.644728	50.587507	1.000507
Prophet	19.351410	4.903262	52.690166	0.001971
CART	18.622667	4.976640	91.774891	0.002088
RF	18.081244	4.503860	74.582560	0.002023
LSTM	10.059231	2.260106	94.969078	0.353172
CNN	9.406507115	1.415129313	95.64007421	0.000153046
Chaos+CART	8.243653	1.208711	97.661719	0.002264
Chaos+RF	8.119208	1.499516	98.902288	0.002028
Chaos+LSTM	6.625058	0.893032	99.834879	0.718151
Chaos+LSTM+PR	2.4521e-08	1.039854	100	0.005e-12

Table 9 : The Results of the JPY/USD Test Set

Mode Prediction	MSE	MAPE	DStat	TheilU
ARIMA	20.522047	3.029495	50.833848	1.000817
Prophet	123.833278	8.199826	49.289684	1.005242
CART	0.903238	0.635285	51.760345	1.629257e-05
RF	0.464442	0.441553	49.845583	1.865966e-05
LSTM	0.859494	0.174147	68.054354	0.0443902e-05
CNN	0.34434871	0.194904509	69.66028413	0.41e-05
Chaos+CART	0.892972	0.133950	75.895614	0.587788e-05
Chaos+RF	0.464889	0.1445031	78.857319	0.867801e-05
Chaos+LSTM	0.361535	0.0375804	88.424953	0.451573e-05
Chaos+LSTM+PR	1.312878e-08	1.003427	98.5667	0.274069e-13





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Table 10 : The Results of the SGD/USD Test Set

Forecasting Model	MSE	MAPE	D Stat	Theil U
ARIMA	20.024654	12.260339	51.822112	0.007313
Prophet	10.049610	19.039075	51.142680	0.015482
CART	4.499225e-05	10.384234	55.095738	0.198772e-05
RF	2.754348e-05	9.291158	48.857319	0.339461e-06
LSTM	2.378308e-05	4.270992	69.833848	0.345399e-06
CNN	2.66E-05	6.28453484	58.78381717	0.08E-06
Chaos+CART	4.544950e-05	0.381212	76.948733	0.210897e-05
Chaos+RF	2.695724e-05	0.287179	79.351451	0.183174e-06
Chaos+LSTM	1.842131e-05	0.339434	85.216182	0.023645e-05
Chaos+LSTM+PR	1.175296e-12	0.09046	100.0	0.459333e-9

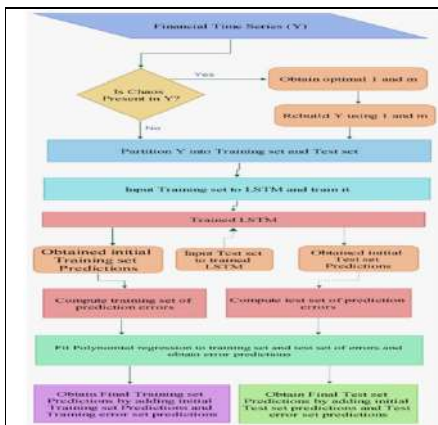


Fig. 1. Proposed Approach

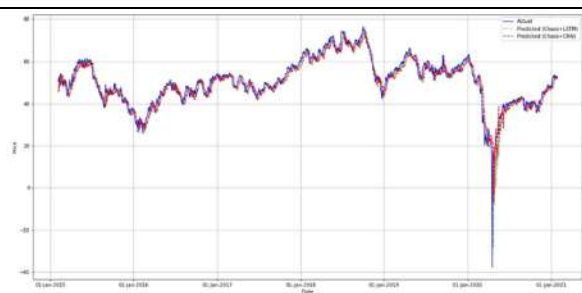


Fig. 2. Crude oil test predictions using the suggested hybrid

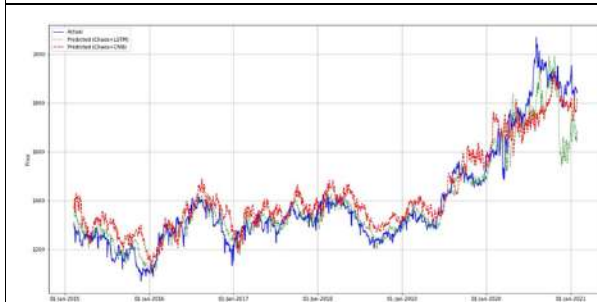


Fig. 3. Test set predictions of Gold Price using Proposed hybrid

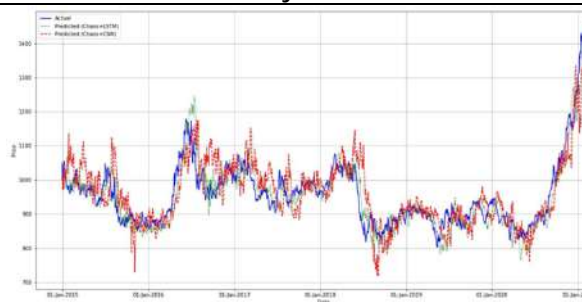


Fig. 4 Predictions of Test set of US Soybeans using Proposed hybrid





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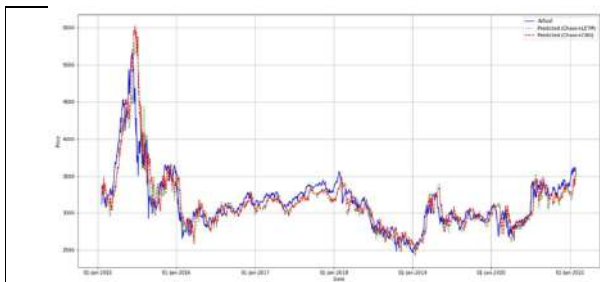


Fig. 5- Proposed Hybrid Test Index Predictions of Shanghai Test Set

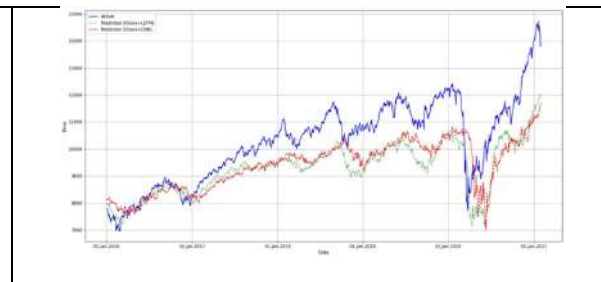


Fig. 6 Predictions of Test set of Nifty 50 Stock Index.

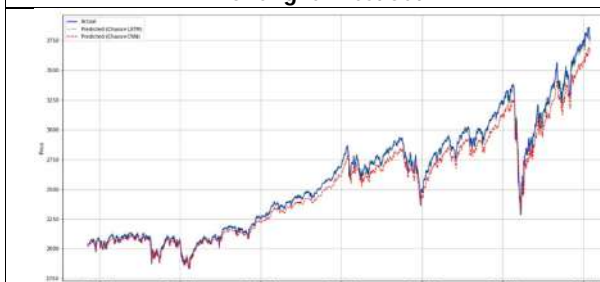


Fig. 7. A two-stage hybrid model for the S&P500 test set

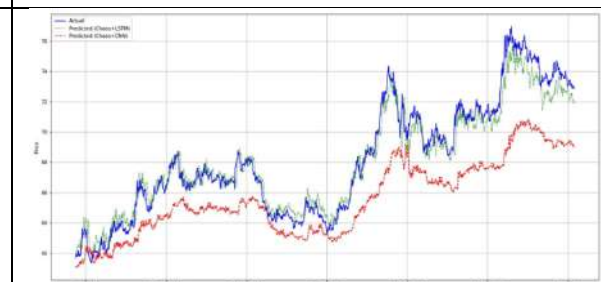


Fig.8 Prediction of INR/USD Testset Using the Hybrid Model

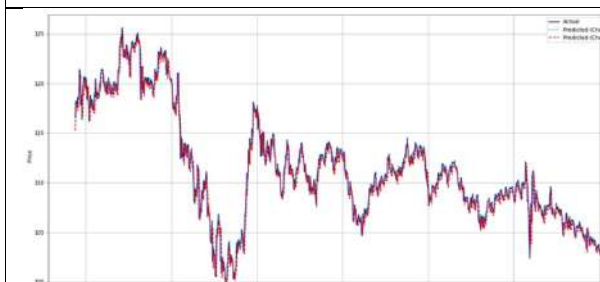


Fig.9. Proposed Hybrid Test set Predictions of JPY/USD

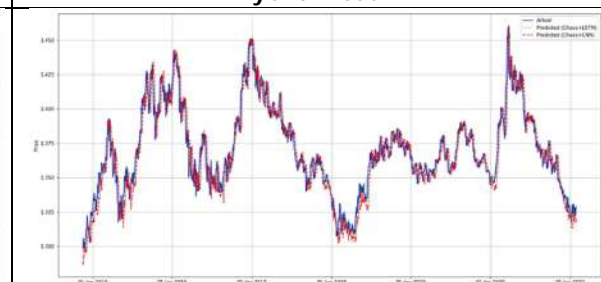


Fig. 10. Prediction of SGD/USD Testset Using the Hybrid Model





Design of an IoT based Electric Vehicle Charging Station

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ABSTRACT

The main theme is to provide create more hospitable social and environmental situations. For this system, the IoT-based electric car charging station system is created. The prebuilt software and hardware system of charging stations is a revolution that is currently sweeping various sectors that contributes to a significant rise in the number of electric vehicles. Three distinct instances are taken into account in this dissertation to test the system under various circumstances. In order to check many factors, including available balance, port preference, and time preference for charging the vehicle, QR codes are employed. The Internet of Things underpins the entire system.

Keywords: EVCS-Electric Vehicle Charging Station, Arduino Uno, Relay, LCD Display, ESP-01 ESP8266 WIFI Transceiver Module and Power supply.

INTRODUCTION

The electronics and IT industries produce solutions on a daily basis to meet human and environmental needs. Therefore, as engineers, we constantly consider societal needs and work to satisfy them. In light of these needs, one system—an IoT-based electric charging system—is shown here. Additionally, this technology aids in protecting the environment from several aspects such as a drop in fuel use and fewer pollutants. The issue of electrical vehicles is currently quite popular and is also developing into a significant element of this intelligent future. The limited range of electric vehicles is one drawback. Therefore, vehicles need constant recharging. The goal of developing this system



**Murali et al.,**

goes beyond EV alone; it also has positive effects on population growth. According to the info we now own, there is a limited source of petroleum on earth, thus the situation is crucial that we discover alternate solutions. Electricity is one such possibility. The network of charging stations is being made available to consumers by several EV manufacturers, including Tata EVs and other EVs. The intricate software and hardware design of the charging station, however, prevents hundreds of EV manufacturing startup firms (both small- and large-scale) from offering charging stations to their clients. This project aims to provide EV manufacturers with a prebuilt software and hardware architecture of intelligent charging stations that incorporates free charging to its customers for the first year of ownership as well as a hassle-free charging and payment experience after one year of ownership, which will ultimately motivate customers to buy an EV and will contribute to environmental preservation. The producers have put in place a specific strategy to draw in additional customers. One key tactic is to offer free charging at charging stations for a set amount of time after the vehicle is purchased.

IOT BASED EV CHARGING STATION

The IoT-based EVCS setup makes use of the components listed below, each with its own procedural circuit and pin diagram. The ESP-01 ESP8266 Serial WIFI Transceiver Module, the Power Supply, the Relay, the LCD Display, and the Arduino UNO. The process that the IoT-based EVCS goes through to function with each component is depicted in the above Figure 2. Relay automatically switches between Grid and Power supply when the QR get scanned. Figure 1 depicts the schematic for the EVCS. The EV owners must scan a QR code that is located above the relevant port in order to select a charging port. Additionally, the proposed work will check the amount of money left in the user's wallet (bank account) and, in light of that information, will recommend a timeout for EV charging. Users of EVs needed an Android application for that purpose, and other programming languages including Java and XML were used in its development. The communication wire will then make it simple to determine if the EV user and charging station belong to the same firm or whether there are various EV users present. This will assist determine whether we should provide free charging in accordance with the EV user's purchase date. Charging begins when this procedure is complete.

EXPERIMENTAL SETUP

Arduino UNO

Arduino Uno is a microcontroller board, based on the 8-bit ATmega328P microprocessor. Voltage regulator, serial communication, and crystal oscillator are the other parts to assist the microcontroller. Six analogue input pins, a USB connection, a Power barrel connector, an ICSP header, and a reset button are all topographies of the Arduino Uno. It also contains 14 digital input/output pins. Using the pinMode(), digitalRead(), and digitalWrite() methods in Arduino programming, the 14 numerical in/out pins are utilised as input or output pins. Each pin functions at 5 volts and covers an inherent pull-up resistor of 20 to 50 kilo ohms that is unconnected by default. It can deliver an extreme of 40 mA of current. There are 14 total pins, several of which have unique uses. Arduino may interact, with a computer, another Arduino board, or other microcontrollers. Utilizing digital pins 0 (Rx) and 1, the ATmega328P microcontroller suggests UART TTL (5V). sequential communication (Tx). The board's ATmega16U2 stations this sequential connection finished USB and presents a virtual com port to computer applications. No additional driver is required because the ATmega16U2 usages the built-in USB COM drivers. A.inf file is necessary on Windows, though. Simple text data may be transmitted to and received from the Arduino board using the serial monitor found in the Arduino software. To communicate data, USB-to-serial chip and a USB connection are used and two RX and TX LEDs are present in the Arduino board that blink when this happens. Any of the Uno's digital pins may be used for serial communication thanks to a software serial library. SPI and I2C (TWI) communication are also supported by the ATmega328P. For easier I2C bus use, the Arduino software comes with the Wire library.



**Murali et al.,****PIN DESCRIPTION****Relay Module**

Relays are switches that run on electricity. A usual of operative interaction stations and a usual of input terminals for one or more control signals make up the device. Any number of connections, including make contacts and break contacts, may be present on the switch. Relays are employed when a circuit has to be controlled by a separate, low-power signal or when several circuits need to be controlled by a single signal. Relays were initially utilised as signal repeaters in long-distance telegraph lines; they retransmit the signal coming in from one circuit on another. Early computers and telephone exchanges both made heavy use of relays to carry out logical processes. The contacts of a relay are typically closed or opened by an electromagnet, although different operating theories have been developed, such as solid-state relays, which employ semiconductor features to regulate without using moving parts. Electrical circuits are protected from overload or defects by protective relays, which are still employed in current electric power systems. These relays have calibrated working characteristics and may have numerous operational coils.

ESP8266 MODULE

The ESP8266 is a low-cost, extremely user-friendly gadget that connects to the internet. The module can purpose as both a position and an access point, enabling it to connect to Wi-Fi and simply collect and post data to the internet, making the Internet of Things as modest as possible. This project strength admission any info that is obtainable on the internet by using APIs, making it keener. It can also get data from the internet. Arduino IDE is programmed using this module, which importantly recovers its use, is additional intriguing feature. However, this version of the module only has 2 GPIO pins (you may hack it to utilise up to 4), thus you must use it in conjunction with another microcontroller like Arduino; alternatively, you can check into the more independent ESP- 12 or ESP-32 variants. Although there are other techniques and IDEs for using ESP modules, the Arduino IDE is the one that is most frequently used. So let's stick to talking about that in the section below. Be careful while designing your circuits since the ESP8266 module can only operate at 3.3V; at 3.7V or more, the module would be destroyed. Ground is Connected to the ground of the circuit, To upload a programme, TX is a GPIO - 1 connected to the programmer's Rx pin,GPIO-2 General intent Pin for input/output, A Chip Enable Active high is CH EN, GPIO-0 generally use the input/output pin, resetting the module using Reset, A general-purpose input/output pin is RX GPIO-3,Vcc Connect only to +3.3V.

LCD DISPLAY

It is a type of flat panel display that operates primarily using liquid crystals. It syndicates the possessions of two different conditions of matter: solid and liquid. The viewable picture on an LCD is created by a liquid crystal.LCD technologies enable screens to be significantly smaller when compared to cathode ray tube (CRT) technology. In an LCD television, the pixels are electrically turned on or off when polarised light is rotated by liquid crystals. A varied variety of devices, together with LCD televisions, computer monitors, instrument panels, cockpit displays for aeroplanes, and interior and outdoor signs, employ LCDs. Liquid crystal displays, or LCDs, are utilised in embedded system applications to show different system data and statuses. The LCD 16x2 is a 16-pin device with two rows that can each hold 16 characters. Both 4-bit and 8-bit modes are supported by LCD 16x2. Custom characters may also be produced. It contains 3 control lines that may be utilised for control and 8 data lines for data transmission. Refer to the subject LCD 16x2 module in the section on sensors and modules for further details on LCD 16x2 and its application.

RESULTS AND DISCUSSION

The QR code is displayed in Fig. 8.1. With the use of an EV application, charging orders may be initiated by scanning these QR codes. Figure 5.2 depicts the procedure after scanning the QR code, concluding the payment process, and starting the billing for the chosen time slot in accordance with the payment.





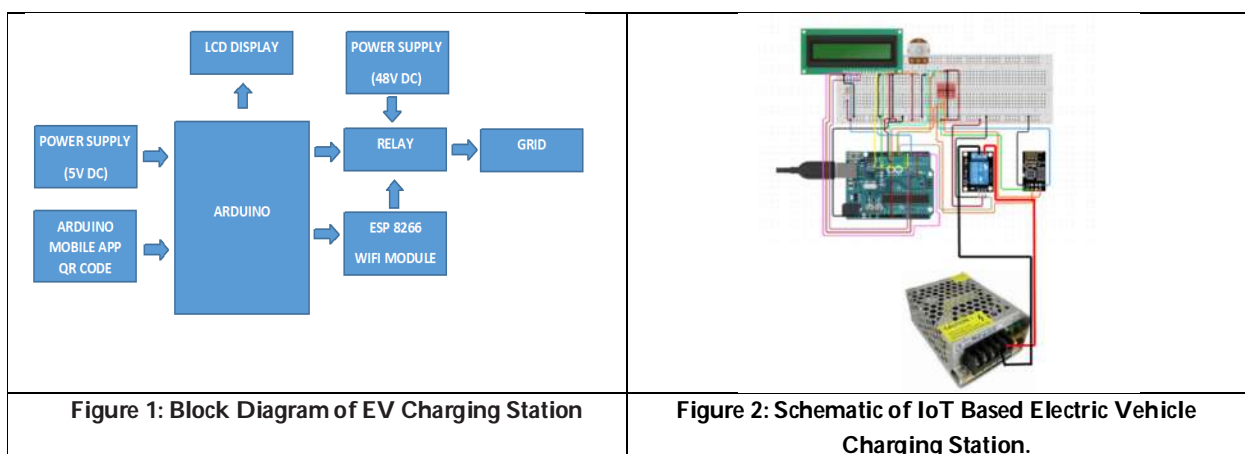
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CONCLUSION

An efficient solution to the problems with the infrastructure for charging electric vehicles is an IoT-based charging station that uses Arduino, LCD display, relay, power supply, Arduino mobile app QR code, and ESP8266 module technology. The system has a number of advantages over conventional charging methods, including improved safety, less energy use, and better resource use. It has the ability to regulate the charging pace, keep an eye on the charging process, and give the user real-time updates on the charging state. The charging process may be remotely monitored and managed thanks to the usage of IoT technologies, improving user experience and boosting system effectiveness overall. Due to its ability to address one of the main issues with electric vehicles, the development of this smart charging system has the potential to be extremely beneficial to the industry. The demand for smarter and more efficient charging systems will only grow as the use of electric vehicles continues to rise. The suggested approach provides a realistic and efficient response to this problem.


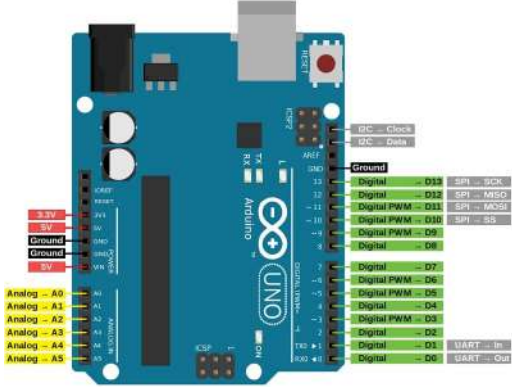
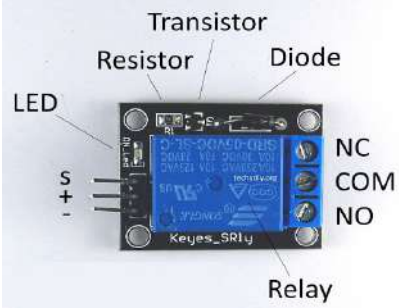
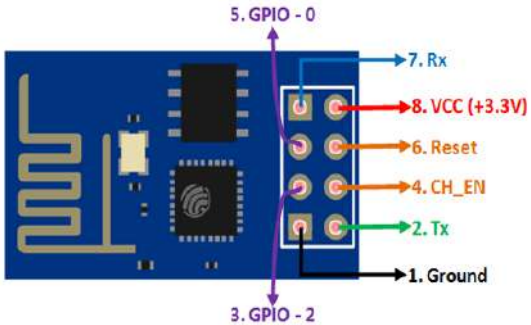
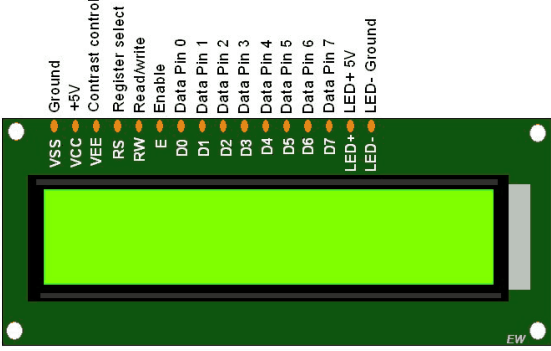
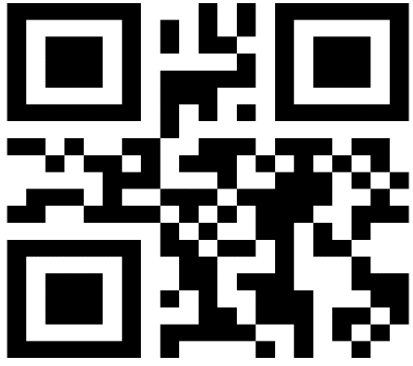
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Murali et al.,

	
<p style="text-align: center;">Figure 3: Arduino UNO</p>	<p style="text-align: center;">Figure 4: Arduino UNO Pin Description</p>
	
<p style="text-align: center;">Figure 5:Block diagram of Relaymodule</p>	<p style="text-align: center;">Figure 6: Block Diagram of Esp8266</p>
	
<p style="text-align: center;">Figure 7: Block Diagram of LCD Display</p>	<p style="text-align: center;">Figure 8. QR code</p>





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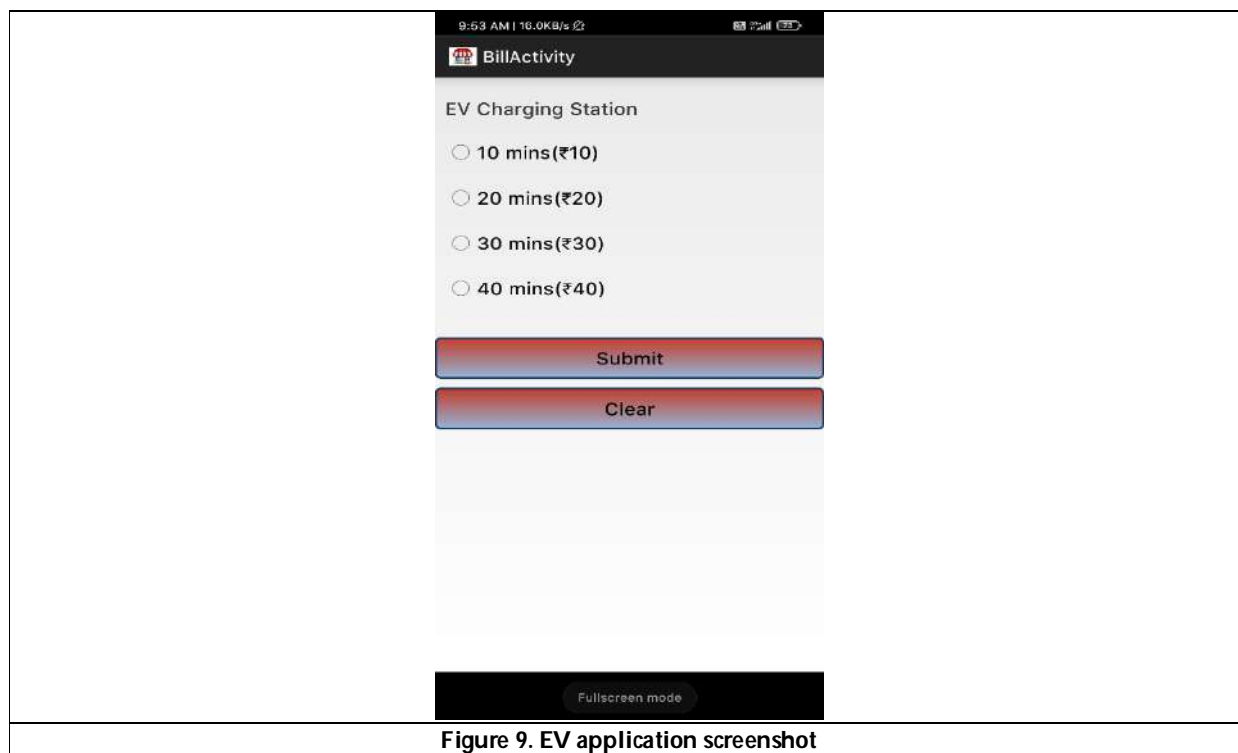


Figure 9. EV application screenshot





A Comparative Study of Bone Fracture Detection Techniques: Convolutional Neural Networks' Outperformance

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ABSTRACT

This paper evaluates the use of deep learning techniques in bone fracture diagnosis, specifically focusing on the effectiveness of Convolutional neural networks (CNNs). Traditional diagnostic techniques are tedious as well as error prone, making machine learning approaches an impressive alternative. We analyze four recent studies that detected bone fractures using deep learning methods and find that CNN is the most effective and widely applied classifier in these studies. The studies reported high accuracy rates ranging from 90.11% to 98.39%, and CNN consistently outperformed other classifiers such as KNN, SVM, and ANN. Our research concludes that CNN is a reliable and effective classifier for predicting bone fractures using deep learning methods.

Keywords : Bone fracture, CNN, ANN

INTRODUCTION

One of the most frequent injuries seen among individuals of all ages is a fractured bone. For efficient treatment and recovery, fractures must be accurately detected and diagnosed. Traditional fracture detection techniques, including X-rays, CT or MRI can be expensive and time-consuming. Artificial intelligence and machine learning methods for automated fracture detection have gained a lot of attention lately because they have the potential to increase diagnosis accuracy and speed while lowering expenses.



**Aleena Thankachan and John T Abraham**

OVERVIEW

Bone fractures are a common injury that need to be properly diagnosed and treated right away. In recent years, bone fracture detection using medical imaging has shown promising results when applying deep learning techniques, especially Convolutional neural networks (CNNs). In this paper, we provide an overview of the current literature on bone fracture detection using deep learning techniques, with a focus on comparing different classifiers used in these studies. We analysed and compared the findings of four recent surveys that used deep learning methods to detect bone fractures. A number of datasets, ranging from 100 to 1052 X-Ray images, and evaluation criteria, such as accuracy, precision, recall, F1-score, specificity, etc., were applied in the experiments.

According to our research, CNN is the most effective and widely applied classifier in these studies. In three of the four studies, CNN served as the classifier, and in the fourth, a two-stage system with a crack-sensitive CNN for fracture detection was used. The studies used a variety of evaluation metrics and obtained high accuracy rates, ranging from 90.11% to 98.39%. Furthermore, in research that evaluated different classifiers, CNN consistently outperformed others, including KNN, SVM, and ANN. As per our research, CNN is a trustworthy and effective classifier for identifying bone fractures using deep learning methods.

However, more study is needed to see how effectively CNN functions in large datasets as well as in other circumstances. The application of deep learning techniques, in particular CNN, has the ability to improve the detection of bone fractures and help to make precise and timely diagnosis, thereby improving patient outcomes.

OBJECTIVES

1. This paper's goal is to compare several methods for detecting bone fractures, with an emphasis on convolutional neural networks (CNNs).
2. The purpose of the paper is to show that CNNs outperform other methods in terms of accuracy and productivity.
3. The paper's overall goals are to show the capability of CNNs in this area of knowledge on bone fracture diagnosis.
4. This paper may encourage additional research and development in this field by demonstrating the advantages of employing CNNs for bone fracture detection, ultimately resulting in more precise and effective bone fracture diagnosis and treatment

ANALYSIS AND DISCUSSION

Traditional Approaches to Bone Fracture Detection

In accordance with traditional systems, radiologists or other medical experts must manually examine X-ray images to detect bone fractures, which takes time and requires specialized knowledge. Although these conventional methods are still regarded as the gold standard for fracture identification, they have scaling and human error risk concerns. Other conventional methods might utilise specialized imaging methods that provide greater resolution images, including CT or MRI.

Although traditional methods of fracture identification are still quite successful, they have several drawbacks, such as the requirement for specialist knowledge and the possibility of human error. In recent years, there has been an increase in interest in developing automated fracture detection methods that can assist radiologists and other medical professionals in identifying fractures while reducing the possibility of human error.



**Aleena Thankachan and John T Abraham****Machine Learning Techniques for Bone Fracture Detection**

A promising method for automating bone fracture identification using X-ray pictures is machine learning algorithms. Utilizing these techniques, a computer algorithm is trained to identify patterns and features from a large dataset of X-ray images that have been labelled with fracture data. Once trained, the system can identify fractures in fresh X-ray images automatically. There are several machine learning techniques that have been used for bone fracture detection, including:

Convolutional Neural Networks (CNNs)

CNNs are deep learning models that do well at a number of image classification tasks, including the detection of bone fractures. CNNs are created with numerous layers of convolution, pooling, and fully linked layers to learn features from images.

Support Vector Machines (SVMs)

Among the supervised learning algorithms, SVMs are useful for classification applications. In applications like bone fracture diagnosis where the data may be represented as a set of features, SVMs are an excellent choice because they are especially helpful when the data is linearly separable.

Decision Trees

Decision trees are a sort of supervised learning method that may be applied to classification and regression applications. Using different features taken from X-ray pictures, decision trees can be used to identify bone fractures.

Random Forests

Random forests are a supervised learning technique that combines various decision trees to increase the model's accuracy and reliability. By mixing several decision trees trained on various subsets of the data, random forests have been successfully used for bone fracture detection.

Deep Learning Techniques

For the diagnosis of bone fractures, deep learning approaches like recurrent neural networks (RNNs) and CNNs have shown promising results. Deep learning algorithms can pick up on tiny details that conventional machine learning algorithms might miss because they are built to learn complex representations of images. Overall, using X-ray images to automatically diagnose bone fractures is a promising method of machine learning techniques. To get the best results, these algorithms need large annotated datasets for training and validation, and careful attention must be given to the selection of the right features and parameter modification.

LITERATURE REVIEW

The literature review on bone fracture detection using deep learning approaches is as follows:

1. "Bone Fracture Detection & Classification Using Deep Learning Approach" (2020) by D P Yadav and Sandeep Rathor: In this study, the authors collected a dataset of 100 images, which was augmented to 4000 images. A deep CNN algorithm was used for this model, and 3 experiments were performed for model evaluation. The highest accuracy achieved was 95% on a test set of 10% of the dataset.
2. "Bone fracture detection through 2 stage system of Crack-Sensitive Convolutional Neural Network" (2021) by Yangling Ma and Yixin Luo: In this study, the authors used CrackNet, which is sensitive fracture lines, for bone fracture detection. They used a dataset of 1052 images, out of which 526 were fractured. The accuracy achieved was 90.11% with an F-measure of 90.14%.
3. "Efficient Bone fracture detection & classification using ML approaches" (2022) by Tabassum Nahid Sultana and Asma Parveen: In this study, the authors used different classifiers for classification and compared their accuracies to find the best one. They used a dataset of 300 X-rays for training and achieved a classification



**Aleena Thankachan and John T Abraham**

accuracy of 98.39%. CNN classifier was found to be superior among the classifiers used, including KNN, SVM, ANN, and CNN.

4. "Bone fracture detection using Convolutional neural networks" (2022) by Kallimpudi Bhaskara sai kiran and B Satyasaivani: In this study, the authors compared three types of CNN classifiers, ConvNet/CNN, VGG16, and R-CNN, for bone fracture detection. They used a dataset of 221 images for both training and testing. The highest accuracy achieved was 86.32% with R-CNN classifier.

In summary, these studies show that deep learning approaches can be effective in bone fracture detection. The use of CNN classifiers has been proven to be effective, and some studies have used techniques like augmentation and crack-sensitive CNN to improve accuracy. However, further research is needed to validate these techniques in clinical settings and to develop more reliable and accurate models.

Limitations and Future Directions**Limitations**

1. The availability and quality of the dataset used could have an impact on the findings of the study. The performance of CNN in detecting bone fractures may need to be further validated using a bigger and more varied dataset.
2. The study might only be applicable to the particular fracture types and images present in the dataset. Future research should assess how well CNN performs in identifying a wider variety of fracture types and images.

Future Directions

1. Future studies should look into how CNN may be used to automatically classify the seriousness of bone fractures. Diagnosing patients and choosing the best course of treatment may benefit from this.
2. Future studies should evaluate how well CNN models perform in identifying bone fractures using various imaging modalities, including MRI and ultrasound.
3. It should also look into recently added CNN variations and try to find the best out of it.

CONCLUSION

In conclusion, it has been proven that using CNN as a classifier for bone fracture diagnosis yields better results than using traditional techniques and other machine learning classifiers. There is evidence from numerous studies to support the use of CNN in enhancing the speed and accuracy of bone fracture detection, which again will increase patient satisfaction and lower healthcare costs. The potential of CNN in automated fracture severity classification, using other types of images for detection etc. presents interesting options for future research despite the limitations of the current study. In summary, the use of CNN as a classifier for bone fracture detection is a promising area of research that has the potential to significantly improve patient outcomes and healthcare delivery. To fully realise CNN's Potential for detecting bone fractures and overcome the current research's limitations, further study is required.

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Aleena Thankachan and John T Abraham

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Facial Expression Recognition Analysis Applying Deep Learning Technique based on Convolutional Neural Network Architectures

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ABSTRACT

In the field of Artificial Intelligence and Computer Vision, Facial Expression Recognition (FER) helps in understanding different emotions and has become an active area of research in human-computer interactions. Real-world applications include commercial call centers, screening emotions during interview, screening behavior of students in classroom, game development, e-learning-video conference. In recent years several Deep Learning research papers are proposed based on Convolutional Neural Network (CNN) for Facial Expression Recognition. Deep Learning techniques improve the performance and robustness of the system on large amount of datasets. Deep Convolutional Neural is found to be more advantageous over traditional methods of FER. In this research paper steps involved in CNN, Comparative study of various methods using CNN- image type, dataset used and emotion types are discussed. The test results accuracy obtained from different CNN architectures for different emotions through Facial Expression Recognition are analyzed. This study helps us to understand and improve the Facial Expression Recognition using different CNN architectures for training and testing on different datasets using images.

Keywords: CNN-Convolutional Neural Network, FER-Facial Expression Recognition, SWIFT-Swift-Invariant Feature Transform, HOG-Histogram of Oriented Gradients, LBP-Local Binary Pattern





Nancy Sopana N S and Radhakrishnan

INTRODUCTION

Emotions are considered to be psychological state of human beings. Due to its variety of applications, these are applied in various fields like psychology, education, computer science, medicine, etc. In the beginning emotion classification started with the Darwin study in the book "The Expressions of Emotions in Man and Animals" in 1899. In his book he has stated about how human beings live in different cultures and develop different emotions. After this many research papers are published studying people's behavior related to specific emotions. Traditional approaches include Scale-Invariant Feature Transform (SIFT), Histogram of Oriented Gradients (HOG), Local Binary Pattern (LBP) followed by a classifier which are trained on database of images or videos. In recent trends deep learning models are proposed.

II. FACIAL EXPRESSION RECOGNITION

Verbal and vocal methods convey up to 45% of information whereas non-verbal method convey up to 55% of information. Facial Expression Recognition is considered as non-verbal communication. Applications of Facial Expression Recognition include Gaming platform, safe driving, lie detector, recommendations, auxiliary medical care and mood based learning for students. Traditional Facial Feature Extraction methods that use machine learning algorithms are Active Shape Model (ASM), Active Appearance Models (AAM), Local Binary Patterns (LBP). For facial expression recognition or facial emotion recognition the system could be developed for two types still images and for videos-sequence of images.

Facial Expression Recognition includes three steps

1. To detect face in an image.
2. To preprocess the image, to obtain visible face features and extract them
3. Emotion classification includes to train and test the image.

CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Network (CNN) is based on deep artificial neural networks that help in finding out visual patterns from the given input images. CNN requires minimum preprocessing of images when compared to other image classification algorithms. CNN helps in considering global information, local information and color information. Convolutional Neural Network (CNN) is applied in many fields in image analysis, visual recognition, feature learning. Several advantages of Convolutional Neural Network are parallel data processing, weight sharing which helps in reduction of parameter between layers and helps in prevention of overfitting of the model. The concept of local connection helps in reduction of the size of the neural networks. There are different CNN architectures like AlexNet, VGG-16, Inception-V1, Inception-V3, ResNet-50, Xception, Inception-V4, Inception-ResNets, ResNeXt-50.

The Different layers in Convolutional Neural Network are

Convolution Layer

The Convolution layer helps in finding out set of features in the image. It just drag a window which represents the feature on the image and finds out the convolution product between the feature and each portion of the scanned image. A feature is then referred as filter.

Pooling Layer

The pooling layer helps in reducing the size of the image, at the same time maintaining their important characteristics. It calculates maximum or average of a region. It includes different pooling methods like Max pooling, average pooling, Global pooling, sum pooling.

Fully Connected Layer

Fully connected layer is also known as hidden layer, consisting of multiple layers based on the depth that we are going to classify the model. In fully connected layer, it just takes the output of the previous layer then flattens and





Nancy Sopana N S and Radhakrishnan

takes that as a single vector, it then applies weight to predict the correct label. The output gives the final probability for each label.

Dropout Functions

Dropout helps to prevent model from overfitting. This ignores randomly selected neurons during training. It also avoids testing errors.

Activation Function

It replaces all negative values received as inputs by zeros. There are different activation functions ReLu correction layer, Linear activation function, Non-linear activation function, sigmoid activation function, Hyperbolic tangent activation function. In CNN optimizer technique is used which is mainly helpful in changing the characteristics of neural networks like weights, learning rate and helps in minimizing loss. There are different optimizers like ADAM, RMSProb, AdaDelta, AdaGrad, SGD.

DIFFERENT CNN ARCHITECTURES

FACIAL EMOTION RECOGNITION USING CNN (2021)

This method does both feature extraction and expression classification done simultaneously. It includes Convolutional Neural Network with 20 layers and consists of different parts. In the first part CNN is used for background removal-edge detector, circle detector and corner detector filters are applied at the start of the convolution layers. The second part CNN filters is used for facial features extraction like eyes, nose, ears, lips and cheeks which consists of 3 x 3 kernel. The Third part is classification and the last part is emotion prediction. In this paper the type of testing is done both with Offline and Real-time testing. The authors future work is to optimize the structure of CNN for more speed and for accuracy and improve performance by trying with different feature extraction methods with powerful machines and with increased size of the image[1]

CHILDREN'S EMOTION RECOGNITION BASED ON CONVOLUTIONAL NEURAL NETWORK (2020)

This method includes children's emotional interaction and helps in understanding children's easy and effective learning. It combines both feature extraction and classifier which further helps in facial expression recognition in children. In this paper the CNN includes multiple filters and classifier. The first convolutional layer is of size 1*1 and convolution kernel is 32. It helps to increase data dimension and fitting ability. The second convolutional layer is of 5*5 size. It helps in quick contour feature extraction and increase in the depth of the model. The third and fourth convolutional layer size is 5*5. This layer helps in abstraction process from low order features to high order features. The model uses pooling layer of size 2*2. It also includes two dropout layers in full connection layer to avoid over fitting and improvement in generalization of the model. Here offline testing is done. The authors future work is to increase in Learner's emotion types, Increase and expand learners emotion database, Improvement in learner's recognition accuracy and efficiency[2]

FACIAL EXPRESSION RECOGNITION USING CNN WITH KERAS (2021)

In this paper the CNN model includes four convolution layer, two fully connected layers, six activation layer. ReLu function is used for non-linearity in images. Max pooling is used for reduction in image dimension. Dropout function (and normalization) is used to avoid overfitting while training images. Flatten to convert image in to 1Dimensional array, these are input for fully connected layers and finally the Output layer includes dense and softmax layer. Deep Convolutional Neural Network using tf.keras is developed to detect correct facial expression. The future work of the authors is to use this model for Kathak Navras facial expression dataset.[3]





Nancy Sopana N S and Radhakrishnan

FACIAL EMOTION RECOGNITION USING CONVOLUTIONAL NEURAL NETWORK(2021)

Both feature extraction and classification are done automatically in this model and in specific deep feature extraction is done. It consists of VGG19 based CNN Architecture- It includes 19 layers (16 convolution layers, 3 fully connected layers, 5 Maxpool layers and 1 Softmax layer) and also tested with five optimizers ADAM, AdaDelta, RMSProb, AdaGrad and SGD. The type of testing done is offline testing. The future work of the author is to increase the accuracy of this model by using transfer learning and complex feature extraction techniques.[4]

FACIAL EMOTION RECOGNITION OF STUDENTS USING CONVOLUTIONAL NEURAL NETWORK(2019)

This method includes three phases-face detection using Haar Cascade method, Normalization and emotion recognition using CNN method. The model includes 4 Convolution layers, 4 max pooling layers and 2 fully connected layers. To provide non-linearity in CNN model ReLU function, batch normalisation, softmax activation functions are applied. The future work of the authors is to apply CNN model on 3D students image for extracting emotions. CNN model using Tensorflow,keras API is built.[5]

AN IMPROVED FACIAL EMOTION RECOGNITION SYSTEM USING THE OPTIMIZED CONVOLUTIONAL NEURAL NETWORK MODEL WITH DROPOUT (2021)

The proposed model by the authors includes convolution layer, batch normalization layer and a Max pooling layer forms a fully connected layer and the output of this fully connected layer is given as input to the dropout layer and flattening operation is performed. After flattening operation ReLU function is used, followed by dropout layer and the dense layer and finally the output is obtained. Softmax layer is used for classifying output in the final dense layer. The future work is to study trade-off between overfitting and under fitting for FER.[6]

DEEP-EMOTION: FACIAL EXPRESSION RECOGNITION USING ATTENTIONAL CONVOLUTIONAL NETWORK(2021)

This paper is based on attentional convolutional network, which mainly focuses on feature rich areas. It used less than 10 layers. It also used visualization method for highlighting salient regions of facial images. The feature extraction includes four convolutional layers, for every two it is followed by max pooling layer and ReLU layers (Rectified Linear unit) activation function and dropout layer and two fully connected layers.[7]

FACIAL EMOTION RECOGNITION WITH CONVOLUTIONAL NEURAL NETWORK BASED ARCHITECTURE(2021)

The architecture of the proposed model consists of ten layers, after each CNN layer, batch normalization is used and additional operations like max pooling and dropout are also applied and finally includes fully connected layers, for implementation Google Colab is used. Happiness and sadness are correctly labeled. The future work of the authors is to work with real-time application of emotion recognition and to combine both speech emotion and face emotion together.[8]

EXPERIMENTAL RESULTS AND DISCUSSIONS

S.N O	PAPER NAME	IMAGE TYPE	DATASET	ACCURACY	PRE-PROCESSING	EMOTIONS ANALYZED
1.	Facial Emotion Recognition using CNN	Raw grayscale image(48*48)	Kaggle Facial Expression Recognition dataset	Accuracy-61.8%	Data Augmentation methods	1.Angry 2.Fear 3.Happy 4.Neutral 5.Sad 6.Surprise





Nancy Sopana N S and Radhakrishnan

2.	Children's Emotion Recognition based on Convolutional Neural Network	327 video sequences from 118 subjects are selected and are labelled with seven basic expressions. jpg format image through the screenshot program	1.General facial database ck+ 2.Self built database	Accuracy-97% and 1% higher than other mainstream CNN models	Here combination of both face feature point extraction and face contour rotation are done	1.Happiness 2.Concentration 3.Panic 4.Boredom
3	Facial Expression Recognition Using CNN with Keras	Camera captures images(48*48) grey scale image	Kaggle's-ICMP2013-Facial Expression Recognition (FER) Dataset	Accuracy-66.7%	Data Augmentation method	1.Surprise 2.Happy 3.Neutral 4.Angry 5.Sad 6.Disgust 7.Fear
4	Facial Emotion Recognition using Convolutional Neural Network	Image(48*48*1)	FER2013-CSV file	VGG19 gained highest accuracy when compared with ALEXNET Accuracy-88% , when compared with other research works its accuracy is 91.89504%	Data Normalization and Data Augmentation (Rotation, shift, zoom, shear)	1.Anger 2.Fear 3.Happy 4.Sad 5.Surprise 6.Neutral
5	Facial Emotion Recognition of Students using Convolutional Neural Network	live frames from web camera 48*48 size image	FER2013 database	Accuracy-70%	Image Augmentation method is applied like rotation, shift, shear, zoom and flip	1.Anger 2.Happiness 3.Sadness 4.Disgust 5.Surprise 6.Neutral 7.Fear
6	An Improved Facial Emotion Recognition System using the Optimized Convolutional Neural Network Model with Dropout	for own dataset the images and videos are taken from web resources videos are converted in to frames and preprocessed manually gray scale image 48*48	AFEE, CK48, FER2013, RVDSR, CREMAD and a self prepared dataset of 36,153 facial images	Accuracies FER2013-92.33% RVDSR-96.80% CREMA-D-97.78% CK-48-99.44% JAFEE-98.68%	Preprocessing done manually	1.Happy, 2.Angry 3.Sad 4.Surprise 5.Neutral, 6.Disgust 7.Fear
7	Deep-Emotion: Facial Expression	wild setting (48*48) resolution	FER2013, CK+, FER2013, JAFFE	Classification Accuracy FER2013-70.02%,	Data augmentation methods (flip, small rotation,	1.Happiness 2.Sadness 3.Anger 4.Fear





Nancy Sopana N S and Radhakrishnan

	Recognition Using Attentional Convolutional Network			FERG-99.3%, JAFEE-92.8%, CK+-98%	small distortion)	5.Disgust 6.Surprise 7.Neutral
8	Facial Emotion Recognition with Convolutional Neural Network Based Architecture	Gray-scale image(48*48)	FER2013	Accuracy-70%	No preprocessing	1.Anger 2.Disgust 3.Fear 4.Happiness 5.Sadness 6.Surprise 7.Neutral

In the first paper the resolution of the dataset used is low, but the proposed CNN model helps in finding out the correct emotions. In the second paper the method used gives high accuracy and robustness when compared to the traditional methods. It helps in children effective learning especially in the kinder garden teaching activities. In the third paper the designed CNN model is found to give accurate results for happy, sad, surprise emotions for kathak facial expression recognition (Navras) dataset. In the fourth paper the model proposed is found to give 17% more accuracy when compared with other past models. The metrics used also produced satisfactory results over performance. In the fifth paper the proposed model is good in predicting happy and surprise face however it produced poor results in predicting fear faces and got confused with sad faces. This model can help the teacher to understand students listening during presentation. In the sixth paper the usage of dropout is found to gain 3.09% gain in test accuracy. In the seventh paper gives attention to special regions by reducing the dense of neural networks. In the eighth paper accuracy for happiness and surprise emotions are 90.37% and 83.52% whereas for fear, anger and disgust emotions are found to be low when compared with other emotions and the proposed CNN model the hyper-parameters are tuned for achieving more accurate results.

CONCLUSION

Convolutional Neural Networks plays an important role in facial expression recognition in recent trends. The development of CNN from novel to different algorithms has made its greatest impact particularly in the field of deep learning. This paper is mainly focused on the capability of Convolutional Neural Network for facial expression classification. The analysis of CNN architectures on different datasets of different papers are done. Each methods has its own advantages and disadvantages. The accuracy results of different algorithms based on CNN helps in understanding and improvement for Facial Expression Recognition. Since most authors have considered images and image frames from videos, real time performance could be considered. Improvement in the CNN model can lead to accurate finding of emotions and more metrics could be considered, which would help in better performance of the algorithm.

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***In-silico* Study for Potential Inhibitors of HSP70 Proteins in the Treatment of Breast Cancer**

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ABSTRACT

This study aimed to explore the potential of inhibiting Hsp70 as a treatment strategy for breast cancer. Hsp70 is over expressed in many breast cancer cells and is critical in diverse biological processes. In this study, the Hsp70 C-terminal domain was docked with its inhibitor analogues of novobiocin, co-chaperones, and anti-cancer drugs with the help of Hex 6.3 docking software. According to the findings, Hsp70 had a high affinity for binding to Kar2. A wide variety of anticancer drugs (ligands) were chosen and docked by Hex 6.3 while maintaining ATP as the control in order to inhibit Hsp70. Among the anticancer drugs tested, Vincristine demonstrated the highest level of inhibition with a binding energy of -321.48 kcal/mol. Novobiocin was modified into fifteen analogues to improve its solubility and cytotoxicity, and Analogue 2 was found to be the most effective Hsp70 C-terminal domain inhibitor with a binding energy of -345.05 kcal/mol. These findings suggest that inhibiting Hsp70 with specific small molecule inhibitors such as Analogue 2 of Novobiocin may be a promising therapeutic approach for breast cancer treatment.

Keywords: Breast Cancer, Anti-Cancer, Hsp70, Heat Shock Protein, Inhibitors, Molecular Docking, Computational approach, Drug Designing, Hex, Co-Chaperones





INTRODUCTION

Cancer of the breast is a kind of cancer that begins in the cells of the breast and is the most commonly diagnosed cancer in women worldwide and the second most prevailing cancer overall [1]. Breast cancer is a growing health concern in India. Breast cancer is the predominant form of cancer among women in India, comprising approximately 27% of all cancers in this demographic, as per the Indian Council of Medical Research (ICMR). The National Cancer Registry Programme (NCRP) reported that around 170,000 new cases of breast cancer were detected in India during the year 2020 [2]. Breast cancer incidence rates are increasing in India, particularly among younger women. Studies suggest that this may be due to changes in reproductive patterns, such as delaying pregnancy and having fewer children. Breast cancer mortality rates are also high in India, with an estimated 87,090 deaths due to breast cancer in 2020 [3,4]. The incidence of cancer cases continues to rise, leading scientists and patients alike to search for safe anti-cancer medications. One approach to finding new anti-cancer drugs is through drug repurposing, which involves identifying existing drugs that may have the potential for new therapeutic uses. *In-silico* studies, which use computational methods to screen existing drugs for anti-cancer properties, are being extensively carried out [5]. The technique of molecular docking is commonly employed in drug repurposing as it enables researchers to make predictions about the affinity of binding between a protein and a ligand. Drug repurposing has several advantages over traditional drug development, as it is a faster, more cost-effective approach [6]. Furthermore, repurposing existing drugs reduces the risks associated with developing new drugs, as the safety profiles of these drugs are already known [7][8].

Heat shock proteins are a protein class that are important for the physiological response to stress and protect cells from a variety of stressful conditions. These proteins are commonly referred to by their acronym HSP. They are categorised into different families depending on the molecular weight of their constituent proteins, and the HSP70 family is one of the most researched HSP families [9][10]. HSP70 is a crucial molecular chaperone that performs various significant functions such as ensuring proper protein folding, maintaining protein balance, and preventing protein clumping. In addition, it assists in the viability and multiplication of tumor cells [11]. The N-terminal nucleotide-binding domain (NBD) and the C-terminal substrate binding domain (SBD) are the two crucial components of HSP70 and are linked by a linker region. The C-terminal substrate binding domain (SBD) is made up of a 15-kilodalton sandwich subdomain and a 10-kilodalton subdomain, whereas the N-terminal nucleotide-binding domain (NBD) is made up of two subdomains. These subdomains are found in the C-terminal substrate-binding domain [9][10]. This structural organization allows HSP70 to function as a molecular chaperone, assisting in proper protein folding and preventing protein aggregation. The binding of the polypeptide to the C-terminal substrate binding domain (SBD) of HSP70 is highly dependent on the state of the N-terminal nucleotide-binding domain (NBD). Research suggests that when the NBD is bound to ADP, the SBD assumes a closed conformation, where SBD α forms a lid over SBD β . This particular conformation promotes strong and precise binding of the SBD to polypeptides [12][13].

HSP70 has been identified as a significant biomarker for inhibiting HSP90 due to its high upregulation in cancer cells. Recent studies have shown that blocking HSP70, is necessary to eradicate cancer cells while leaving healthy cells unaffected [14][15]. This inhibition also leads to the degradation of HSP90 client proteins through the proteasome pathway, making HSP70 a promising target for cancer therapy. Despite its potential, there is a shortage of inhibitors available for HSP70[16]. Molecular docking is a popular technique used for drug discovery, which can help identify new inhibitors for HSP70 [17]. With the help of *In-silico* studies, scientists can identify the binding affinity between the protein and ligand, which can be used to design more effective therapeutic interventions for cancer treatment. Herein highlights the use of various bioinformatics tools and databases in docking studies. These tools have proven to be essential in obtaining 3D structures of proteins, searching for ligands and docking simulations. The results of this study may aid further research on the Hsp70 protein and its potential inhibition.





Yunus et al.,

MATERIALS AND METHODS

Online software tools and databases

Computational approaches have revolutionized drug discovery processes, providing efficient and cost-effective methods for identifying new therapeutic agents. In this study, we utilized various computational tools and databases to analyze the interaction between small ligand molecules and the HSP70 C-terminal domain [18]. These databases and software are PubChem, NCBI, Swiss-Prot, BLAST, Phyre 2 server, PDB, UCSF Chimera, Open Babel GUI software, ChemBioDraw Ultra 13.0, and Hex 6.3. The RCSB Protein Data Bank is a reliable source for obtaining the 3D structures of protein. The structure of human Heat shock HSP70 (PDB ID-1S3X) was acquired from this database in the PDB file format [19] [20] [21]. The three-dimensional structure of the protein was then modeled and obtained using the PHYRE server.

Choice of ligand

As part of the study, several chemical compounds or ligands and small molecule inhibitors from different pharmacological categories were screened for their ability to inhibit HSP70 activity. The pharmacological properties and long-term stability of these substances were taken into account during the evaluation.

Ligand and protein preparations

Initially, a comprehensive investigation was carried out to identify potential target proteins of human HSP70 or HSP70 C-Terminal, along with potential ligands or small molecules. A variety of ligands and chemical compounds were chosen based on their pharmacological properties, including PES (2-phenylethanesulfonamide or pifithrin- μ), Vinblastine, Vincristine, Epigallocatechin-3-Gallate (EGCG), Apoptozole, Artesunate, Aromatase (AI), Letrozole, Novobiocin, Quercetin, Triptolide, and ATP. These drugs and ligands were obtained from the PubChem database and their chemical structures were acquired in SDF format [22]. However, this format was incompatible with the Hex 6.3 tool, so Open Babel GUI, a free online toolbox [23], was used to convert them to the required PDB format. After the conversion of SDF format to PDB format, the ligand structure was modified by ChemBioDraw software for better solubility. Firstly, the software window was opened, and the ligand file was retrieved in .pdb format. To increase the solubility of the ligand, functional group additions and deletions were made using the software tools. These modifications resulted in the creation of newly discovered molecules with improved solubility. The modified molecules were then archived in .pdb format for further use. Overall, the ChemBioDraw software provides a user-friendly interface for modifying ligand structures and can be an important tool in drug design and discovery. All of the converted drugs were saved in a directory to be utilized in subsequent docking procedures [24][25].

Molecular docking

There are two types of molecular docking methods: rigid docking and flexible docking. Rigid docking is the preferred method because it does not allow the molecule to move during docking with the protein. Molecular docking software such as Autodock and Hex are commonly used and have been shown to produce reliable docking results [25]. The choice between Autodock and Hex would depend on the specific requirements of the study. Autodock is known for its ability to perform flexible docking, which allows for the flexibility of the ligand molecule during docking. This can be particularly useful in cases where the binding site is unknown or flexible, or when the ligand is relatively flexible. Autodock is also capable of handling large datasets, which can be beneficial when screening multiple ligands [25][26]. On the other hand, Hex is a fast and efficient docking tool that performs rigid-body docking, which is useful when the docking molecules are relatively rigid and there is prior knowledge of the binding site. Hex also has the ability to handle protein-DNA complexes in addition to protein-ligand complexes, making it a versatile tool for structural biology studies.

In this research, only rigid molecular docking was performed using HEX 6.3 tools. The protein structures were validated before the docking process using a curation process. After the validation, the prepared structures were used for the docking analysis [25]. To perform molecular docking using Hex software, a manual Hex window was



Yunus *et al.*,

opened and the defined path location was used to open each receptor and ligand separately from the file. The docking option was selected and turned on using the option control. The software then performed the docking process, resulting in the creation of a binding energy value (E) for each docking complex [27]. The binding energy values were properly stored for further analysis. The entire docking process has been done in a sequential manner, in which Hsp70 docked with its co-chaperones (p23, kar2, Dnak, Dnaj, Grp78, ML346, Hf1). First, the N-terminal domain of Hsp70 was used for docking. Then, the middle domain and finally, the entire length of Hsp70 protein were used. The docked results are shown in table 1 given below. Then HSP70 docked with selected ligands. The results of docking all the chosen ligands with Hsp70 are presented in table 2. And after that selected ligand was docked with HSP70 C-terminal. The results of docking all the selected ligands with the Hsp70 C-terminal domain are presented in table 3. all the docking complexes were saved as a .pdb file to use in future studies. This saved file can be used for further analysis and optimization of the ligand-receptor interaction. Once the docking result was obtained, the most favorable results were selected for subsequent analysis. These results comprised the top five binding affinities, which were expressed as negative values to indicate exothermic reactions, with greater negative values indicating better results. Figure 1 depicts the complete workflow of this process.

RESULTS AND DISCUSSION

Docking energy calculation with proposed inhibitors/ ligand

During the docking process, the ligand interactions and orientations were meticulously examined. Table 2 presents the binding affinities of the selected ligands with heat shock proteins HSP70 (PDB ID-1S3X). As per table 2, Vincristine displayed the highest binding affinity (-321.48 Kcal/mol), followed by Vinblastine (-321.06 Kcal/mol), while Letrozole (-215.18 Kcal/mol) also exhibited good scores. Hence, Vincristine is likely to be an effective inhibitor of hsp70 overexpression.

Inhibition of Hsp70 C-Terminal domain

The results of docking all the selected ligand with the Hsp70 C-terminal domain are presented in Table 3. The interactions and orientations of the ligands as well as their docking were closely monitored. As can be seen in Table 3, vinblastine and Novobiocin have binding affinities of -321.06 and -314.86 kcal/mol, respectively, with vincristine having the highest binding affinity (-321.48 kcal/mol). The ATP molecule, which was used as a control to narrow the analysis, had a lower binding affinity than any of the ligands, apart from Artesunate and KBK437. As a result, these ligands, which have a higher affinity than ATP, can be used as inhibitors of the Hsp70 C-terminal domain. Because the ligands are more capable than ATP molecules, when they enter the cytosol, they may take the place of ATP and bind to the Hsp70 catalytic site, disrupting its chaperoning function even more.

Now, the outcome demonstrated that Novobiocin is an effective inhibitor that was consistent with previous research. According to the research on Novobiocin, the drug's low solubility and toxicity prevented it from participating in clinical trials. The solubility could be the reason. as we know water-soluble substances dissolve easily in the cytosol of animal cells, whereas water-insoluble forms precipitate because animal cells are more aqueous. Additionally, cell toxicity is caused by any extra substance in the cytosol. As a result, every research effort is focused on altering the structure of Novobiocin to improve its solubility. We were motivated to work on modifying the structure of Novobiocin by this idea. Therefore, twelve analogues were produced using ChemBioDraw Ultra 13.0 with the intention of increasing solubility. Here the functional groups that enhance solubility are illustrated in figure 2. Additionally, the functional groups increase electro negativity, which will aid in the formation of hydrogen bonds. As a result, changes were made at random using a hit-and-run and functional group approach at the various positions (Figures 3, 4, and 5).

HEX 6.3 was used to perform the Docking, and the results of the calculation were tabulated in Table 4. Some of these findings also show similarities with novobiocin analogues (Figure 3, 4, and 5). Hex docking analogue 2 scored





Yunus et al.,

higher, i.e., -345.05 Kcal/mol, which means higher affinity than others. Other analogue controls refer to the ATP molecule, scoring higher. Except for analogues 4 and 9, all analogues showed good affinity towards ATP molecules.

The impact of inhibition on the binding affinity between the c-terminal domain of hsp70 and a novobiocin analogue.

In the past, the results demonstrated a strong affinity between the chaperoning complex-functioning Hsp70 C-terminal Domain, vincristine, and novobiocin and its analogues. As a result, inhibition studies have been conducted, and the best literature and some suitable inhibitors have been identified. In order to examine the effects, the Hsp70 C-terminal domain was docked with specific inhibitors. The only docking energy calculation used in these studies was hex. All docking calculations between the Hsp70 C-terminal domain, Vincristine, which most effectively inhibits the ligands' C-terminal, and Novobiocin and its different analogues, are compiled in Table 5. Table 5 indicates that Novobiocin's analogues are superior inhibitors to Novobiocin. The energy value was reduced to a negative number due to docking. As previously stated, the complex is more stable the more negative the e-value. The docking result of the C-terminal domain of Hsp70 with distinct inhibitors is different because there must have been some exchange of energy between them when the domain docked with them.

CONCLUSIONS

The Food and Drug Administration (FDA) has approved the use of tamoxifen (Nolvadex, Soltamox) in the treatment of breast cancer (1978) [28]. Since a synthetic derivative of spergualine from *Bacillus sp.* 15-deoxyspergualine was discovered. Since 15-deoxyspergualine was the first drug identified to alter the ATPase activity of Hsp70-1 and it showed considerable anticancer activity against leukemia (L1210) cells in mice. Given these results, researchers have taken a keen interest in Hsp70 inhibitors for the treatment of cancer and neurological diseases. There are several different classes of Hsp70 inhibitors, each with its own unique inhibition mechanism and slightly a variety of biological repercussions. A number of these inhibitors have been tested in clinical trials for a variety of cancer types. However, the findings of these studies have been less than positive. The findings of these trials demonstrate how important it is to have a complete understanding of the biology of the target, the interactions between the molecular chaperone and various types of inhibitors, and the effect that cellular environments have on the outcomes of treatment.

There are a few ways to address the known problems caused by Hsp70 interruption. To begin with, inhibitors of the C-terminal domain still have anti-proliferative effects even though they do not activate the heat shock response. It is expected that no problems with dosage and schedule associated with N-terminal inhibitors will occur with this class of compound. Second, it is possible that Hsp70 inhibition would be less affected by isoform-selective inhibitors. Pan-inhibition, or the ability to simultaneously inhibit all four human isoforms, is demonstrated by all known Hsp70 inhibitors. Not only would an isoform-selective inhibitor aid in defining the roles played by each isoform, but it may also prove more effective therapeutically. For instance, co-chaperone disrupts offer a different way to block only a subgroup of the Hsp70 protein substrate. These disruptors may also have fewer undesirable consequences than other types of inhibitors. In conclusion, Hsp70 continues to be an appealing therapeutic target; However, new inhibition techniques are needed to overcome the therapeutic drawbacks seen with specific N-terminal inhibitors.

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Yunus et al.,

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Yunus *et al.*,

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Table 1:Hsp70 docking calculation with its co-chaperon byHex6.3software.

Protein	Co-chaperones	Energy(Kcal/mol)
Hsp70	P23	-632.38
	Kar2	-718.07
	Dnak	-481.13
	Dnaj	-412.39
	Grp78	-702.49
	MI346	-180.00
	Hf1	-319.10

Table 2: Calculation of the targeted Hsp70 docking energy by Hex 6.3

Chaperone	Ligand Molecules	E-Value(Kcal/mol)
Hsp70	Letrozole	-215.18
	PES	-162.46
	Quercetin	-208.08
	Triptolide	-205.70
	Vincristine	-321.48*
	Vinblastine	-321.06

Table 3: Study of the directed docking energy on the targeting C-terminal domain of Hsp70 executed by Hex 6.3

Chaperone	Ligand Molecule	E-value(Kcal/mol)
Hsp70C-terminal	ATP	-241.63
	Aromatase	-262.86
	Artesunate	-221.95
	Apoptozole	-286.58
	EGCG	-291.00
	ERK1	-298.25
	KBK437	-182.83
	Novobiocin	-314.86
	VER-155008	-284.47
	Vinblastine	-321.06
	Vincristine	-321.48 *





Table 4: Novobiocin Analogues Docking Energy Calculations by Hex 6.3

Chaperone	Novobiocin Analogues	E-Value
Hsp70C-terminal	Analogue1	-322.64
	Analogue2	-345.05 *
	Analogue3	-319.28
	Analogue4	-196.65
	Analogue5	-299.29
	Analogue6	-310.20
	Analogue7	-342.64
	Analogue8	-329.21
	Analogue 9	-178.33
	Analogue10	-339.40
	Analogue11	-321.38
	Analogue12	-297.87
	ATP	-241.63

Table5: Docking analysis of the C-terminal domain of Hsp70 with Vincristine, Novobiocin, and its Analogues.

Chaperone	Ligands	E-Value(Kcal/mol)
Hsp70C-terminal	Analogue 2	-345.05
	Analogue 7	-342.64
	Analogue 10	-339.40
	Vincristine	-321.48
	Novobiocin	-314.48

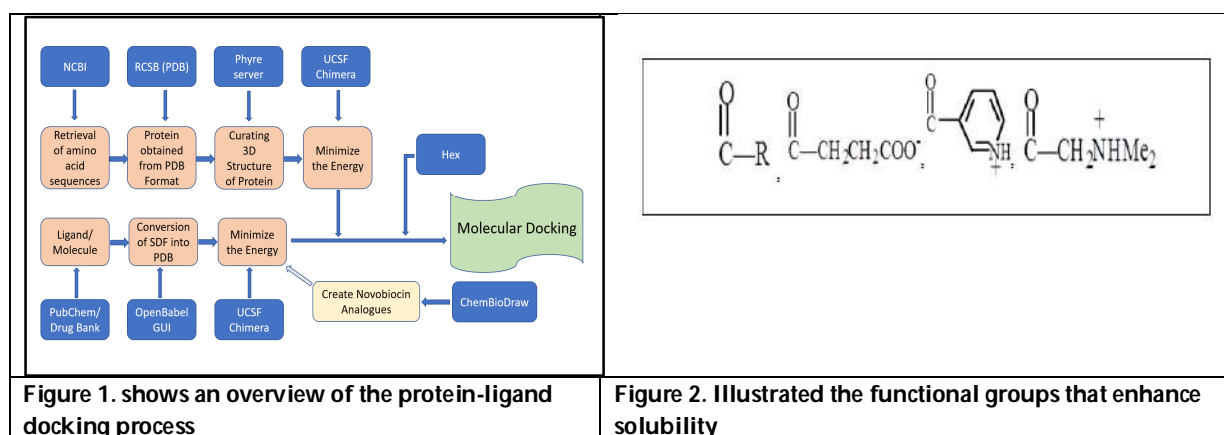


Figure 1. shows an overview of the protein-ligand docking process

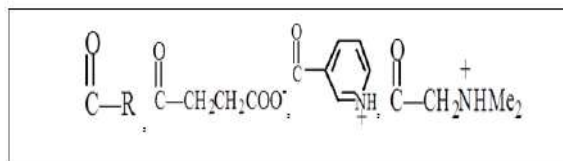


Figure 2. Illustrated the functional groups that enhance solubility





Yunus et al.,

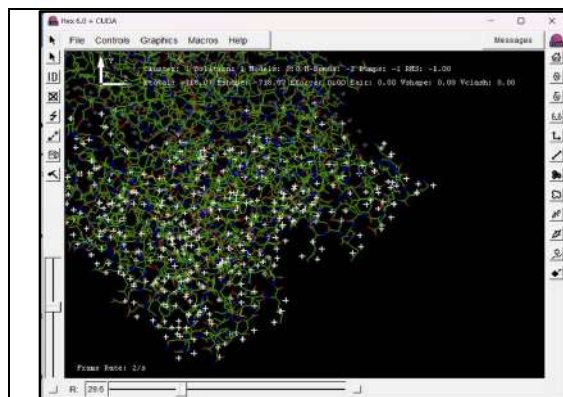


Figure: 3 Docking of HSP70 with Kar2 Co-chaperon by Hex 6.3

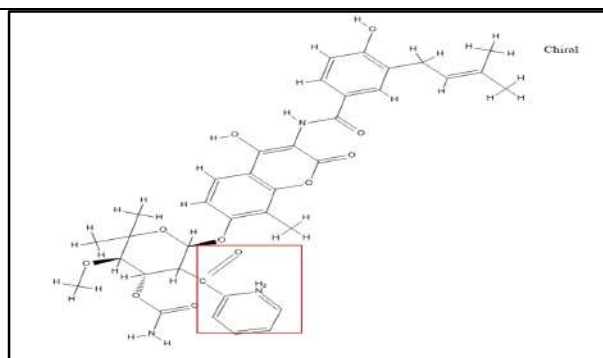


Figure: 4: Analogue -2 (addition of functional group Aniline on 7th position of oxygen in Novobiocin)

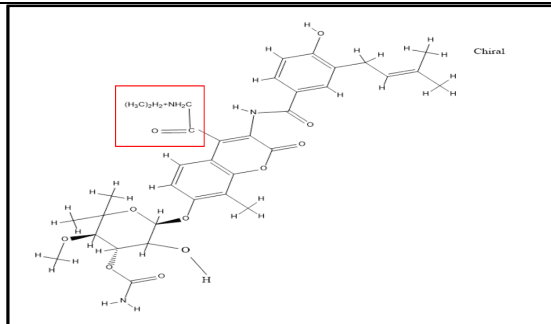


Figure: 5: Analogue - 7 (addition of functional group on 8th position of oxygen in Novobiocin)

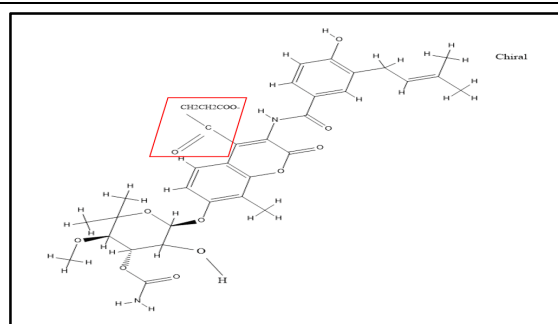


Figure: 6: Analogue - 10 (addition of functional group on 8th position of oxygen in Novobiocin)





A Comparative Study on the Spectral Response of a $p^+ n n^+$ Structured Back- Surface - Field Silicon Solar Cell with $p^+ n$ Junction Solar Cell

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ABSTRACT

Though lot of research work has been done on the $n^+ p p^+$ solar cell, not much work has been done on the $p^+ n n^+$ solar cell. In this paper a $p^+ n n^+$ back surface field silicon solar cell has been considered and based on the analytical derivations the spectral response contributions from the front layer, the base layer and the depletion layer of the solar cell have been obtained and shown graphically. Spectral response of an ordinary $p^+ n$ solar cell has also been plotted for different back surface recombination velocities. It is observed that spectral response of the considered back- surface- field (BSF) silicon solar cell is significantly higher than normal $p^+ n$ junction solar cell. Also dependence of the spectral response on the device parameters like impurity concentration, the front and back surface recombination velocities has been discussed correspondingly.

Keywords: spectral response; absorption coefficient; impurity concentration; recombination velocity; solar cells.

INTRODUCTION

Lot of research work has been done on silicon solar cells during the last few decades [1-6], and various new designs have been developed to increase their efficiency. The $n^+ p p^+$ back- surface-field silicon solar cell is one such device that gave much higher efficiency than that of the conventional n on p solar cell. A back- surface- field (BSF) silicon solar cell showing much improved efficiency over the conventional solar cells was first reported by Mandelkorn et al.





Ashim Kumar Biswas

[7]. In the BSF solar cells a heavily doped layer was incorporated at the back of the normal solar cell, which led to much higher efficiency. Though most of the research work has been done on the $n^+ p^+ n^+$ BSF solar cells, only a few papers has been reported on the $p^+ n^+ n^+$ BSF solar cells [8-10]. Recently an analytical study on the injected dark current in solar cell has been performed by the author et al [11], taking into account the effect of heavy doping. In addition to this another analytical study has been carried out on the photocurrent of solar cell considering the effect of high-low junction at the front surface as well as at the back surface of the device [12]. In our present work, a $p^+ n^+ n^+$ BSF silicon solar cell has been selected and especially spectral response of the device has been studied, and the results obtained from this have been explained analytically and also compared with the results obtained from the normal $p^+ n^+$ junction solar cell.

ANALYSIS

The diagram of the solar cell and its assumed dimensions considered in this present work are shown in Fig. 1. Analytical expressions for the spectral response in the front layer, depletion region and base region of the $p^+ n^+ n^+$ BSF solar cell have been obtained here following the method described by Hovel [13] and Sze [14], in which they have studied an $n^+ p$ junction solar cell.

The contribution of the spectral response front the front region is given by the authors [15]

$$SR_1 = \left| \frac{J_n}{qF(1-R)} \right| = \left[\frac{\alpha L_n}{\alpha^2 L_n^2 - 1} \right] \times \left[\frac{\left(\frac{S_n L_n}{D_n} + \alpha L_n \right) - \exp(-\alpha x_j) \left(\frac{S_n L_n}{D_n} \cosh\left(\frac{x_j}{L_n}\right) + \sinh\left(\frac{x_j}{L_n}\right) \right)}{\frac{S_n L_n}{D_n} \sinh\left(\frac{x_j}{L_n}\right) + \cosh\left(\frac{x_j}{L_n}\right)} - \alpha L_n \exp(-\alpha x_j) \right] \quad (1)$$

The contribution of the spectral response from the depletion region is obtained as [13]

$$SR_2 = \left| \frac{J_{dr}}{qF(1-R)} \right| = \exp(-\alpha x_j) [1 - \exp(-\alpha W)] \quad (2)$$

The spectral response contribution from the base of the cell is given by [16]

$$SR_3 = \left| \frac{J_p}{qF(1-R)} \right| = \left[\frac{\alpha L_p}{(\alpha^2 L_p^2 - 1)} \right] \left[\exp\{-\alpha(x_j + W)\} \right] \times \left[\frac{\alpha L_p - \frac{S_p L_p}{D_p} \left\{ \cosh\left(\frac{H}{L_p}\right) - \exp(-\alpha H) \right\} + \sinh\left(\frac{H}{L_p}\right) + \alpha L_p \exp(-\alpha H)}{\frac{S_p L_p}{D_p} \sinh\left(\frac{H}{L_p}\right) + \cosh\left(\frac{H}{L_p}\right)} \right] \quad (3)$$

where $H' = H - (x_j + W)$, is the base thickness of the cell.

Hence the total spectral response contributed from the above mentioned three different regions is obtained by adding the equations (1), (2) and (3)

$$SR = SR_1 + SR_2 + SR_3 \quad (4)$$

The doping dependent life time, mobility and diffusion coefficient for the minority carriers have been calculated from the published literature [17] and [18]. If the value of back surface recombination velocity (S_p) is taken as 0, the concerned $p^+ n^+$ junction solar cell can be treated as an idealised $p^+ n^+ n^+$ BSF solar cell. Based on this approximation numerical calculation has been carried out and the corresponding computer simulated results have been obtained and explained.

RESULTS AND DISCUSSION

The nature of the spectral response contribution from the front layer, depletion layer and base layer can be interpreted considering different parameter such as impurity concentrations, absorption coefficient, depletion width and recombination velocity. Spectral response contribution from the front region with acceptor concentration for different values of front surface recombination velocity is shown in Fig. 2. Spectral response remarkably decreases as



**Ashim Kumar Biswas**

front surface recombination velocity increases. This is expected because at high recombination, minority carrier lost becomes higher, indicating low spectral response. On the other hand as the acceptor concentration is increased gradually, spectral response primarily remains nearly constant and after a certain value of the acceptor concentration it drops down because of the high doping. In Fig. 3 spectral response contribution from depletion region with absorption coefficient has been plotted for different values of depletion width. It is observed that for a particular value of depletion width as the value of absorption coefficient increases, spectral response reaches its maximum value and after that it decreases if the value of absorption coefficient is further increased. This is because that silicon device is highly active up to $\alpha = 10^4 \text{ cm}^{-1}$ and over this value it shows little sensitive. Again, when depletion width increases, spectral response corresponding to a certain value of the absorption coefficient increases because of more and more carriers generation taking place in the increased width of the depletion region.

Spectral response contribution from the base region against donor concentration for different values of back surface recombination velocity is shown in Fig. 4. When the value of donor concentration increases, spectral response for a particular value of back surface recombination velocity remains nearly constant up to certain value of the donor concentration, after that it drops down as the value of donor concentration is further increased. On the other hand spectral response significantly increases as the back surface recombination velocity decreases, and it reaches a maximum value as the back surface recombination velocity reduces to zero ($S_p = 0 \text{ cm/s}$). This implies the case of a BSF solar cell. Resultant spectral response contributed from different region with absorption coefficient for BSF solar cell and normal p⁺ n junction solar cell is highlighted in Fig. 5. It is observed that as the value of the absorption coefficient gradually increases, spectral response corresponding to BSF cell is significantly greater than that of a normal solar cell.

CONCLUSION

In this paper, mainly spectral response contribution from different regions of a p⁺ n n⁺ BSF and p⁺ n ordinary silicon solar cell has been studied analytically. It is observed that spectral response strongly depends on front and surface recombination velocity, depletion width, impurity concentrations as well as absorption coefficient. This is also observed that spectral response and hence efficiency of the considered p⁺ n n⁺ BSF solar cell is tremendously higher than that of the p⁺ n normal solar cell.

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Ashim Kumar Biswas

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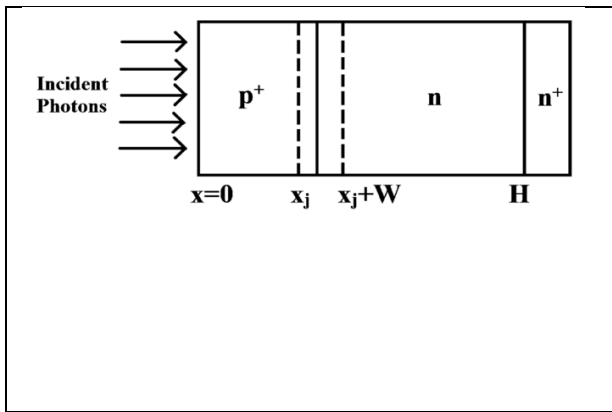


Fig. 1. A p+n n+ structured solar cell.

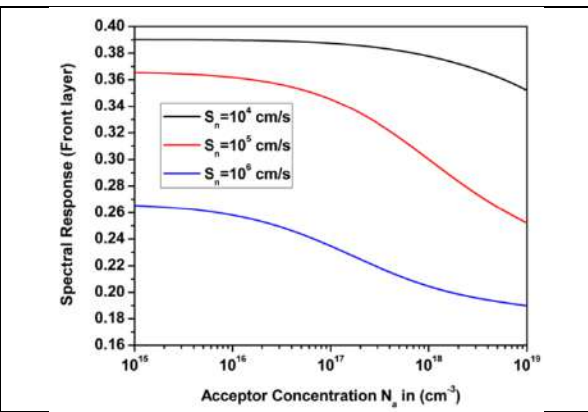


Fig. 2. Spectral response versus acceptor concentration for different values of front surface recombination velocity.





Ashim Kumar Biswas

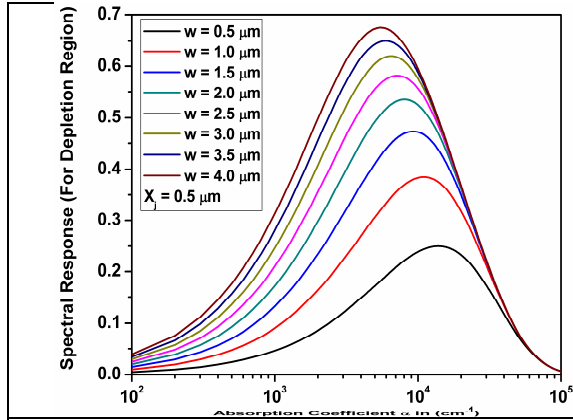


Fig. 3. Spectral response versus absorption coefficient for various values of depletion width.

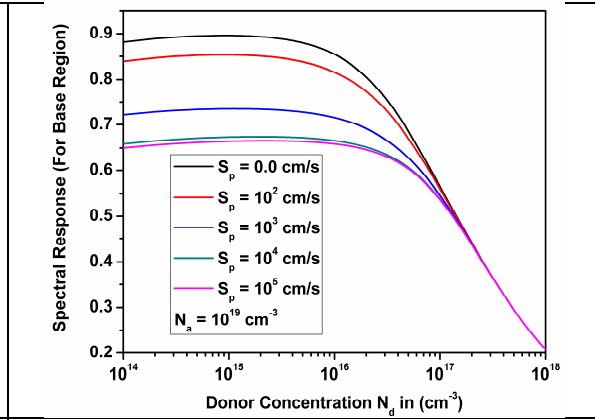


Fig. 4. Spectral response versus donor concentration for different values of back surface recombination velocity.

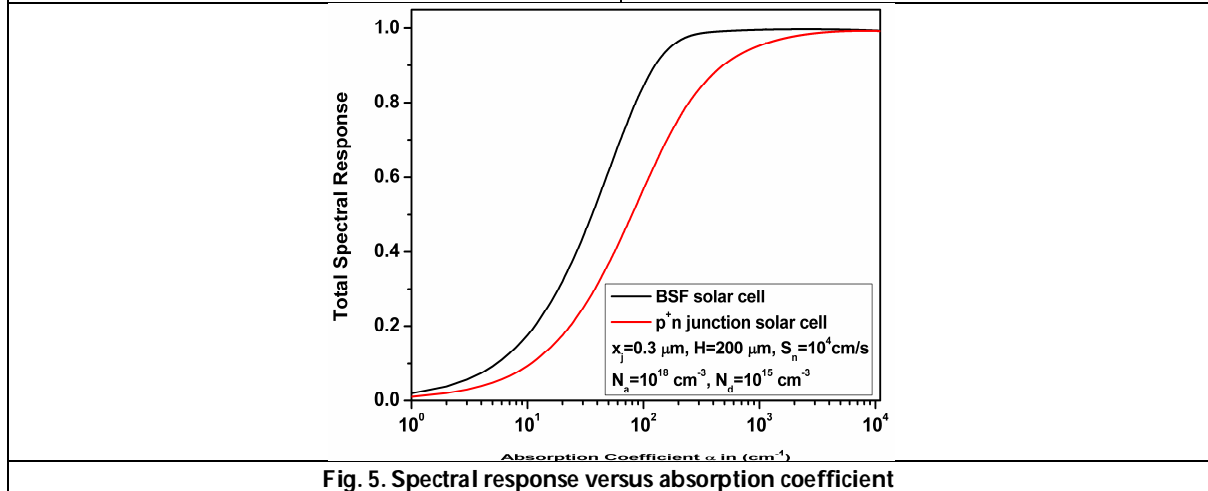


Fig. 5. Spectral response versus absorption coefficient





Antioxidant and Hepatoprotective Activity of *Scoparia dulcis* via NF κ B Activation on Exposure to Chronic Noise Stress

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ABSTRACT

Loud noise is progressively becoming the most prevalent environmental pollution. In addition to the auditory organs, it can cause damages to other system via the HPA/ SAM axis stimulation. The aim of this study is to determine the detrimental effect of chronic noise exposure on the hepatic system. The experimental animals were exposed to 100 db/hrs of noise for 30 days and later treated with *S. dulcis* aqueous extract 200mg/kg.bw. Upsurge generation of ROS/RNS and altered antioxidant status was observed on exposure to 30 days of noise stress. These increased enzymatic and non-enzymatic antioxidant enzymes can be related due to increase free radical generation. This imbalance in the redox cell status could have caused fatty degeneration via lipid peroxidation of the hepatocytes in the hepatic sinusoid. Elevated AST by 38.08% and ALT by 10.57% in the noise stressed group when compared to control might have resulted due to increased permeability of cells usually characterized by lipid peroxidation mediated hepatocellular injury. The hepatoprotective properties of the *S. dulcis* treated group could alleviate hepatic enzymes induced by noise stress via NF κ B regulation. The free antioxidant and hepatoprotective role were evident, as *S. dulcis* extract could restore the redox imbalance and hepatic enzymes in the stress animals.

Keywords: Noise, Free radicals, Antioxidants, Nuclear Factor-KappaB, and *Scoparia dulcis*.





Wankupar Wankhar

INTRODUCTION

With increasing industrialization and urbanization, exposure to loud noise is progressively becoming the most prevalent environmental pollution. Exposure to noise (100 decibel/4 hours/day) can generate unwarranted free radicals [1], and this can lead to several illnesses affecting neurological, endocrine, and cardiovascular systems [2, 3]. In response to stress, activation of the hypothalamic-pituitary-adrenal axis and sympathetic adrenal medullary system (HPA/SAM) axis triggers the elevation of glucocorticoids and activates hepatic gluconeogenesis to provide energy. However, this can also lead to pathophysiological consequences if exposure to stress is persistent [4]. It is crucial to note that oxidative stress can regulate normal biological activities and it can also initiate hepatic damage by inducing irreversible alteration of proteins, DNA and lipid peroxidation [5]. A redox-sensitive transcriptional factor, NFκB, plays an important role in determining the oxidative stress and it activates numerous stress response genes like the antioxidant enzymes [6]. The liver exhibits the highest antioxidant enzyme capacity in the body. Asghar et al. [7] reported that noise is toxic and elevated level of MDA in liver tissue. Determining the hepatic redox status and markers for hepatocellular injury can help us analyze the degree of hepatic dysfunction in the liver when exposed to noise.

Scoparia dulcis a known folk-medicinal plant possesses several therapeutic benefits claimed by traditional practitioners. The extracts of *S. dulcis* have been used in diabetes, toothache, and stomach-related issue [8] anti-viral [9], analgesic, anti-inflammatory [10, 11], anti-hypertensive [12], anti-hyperglycemia effects [13], hepatoprotective activity [14,15], antioxidant, antiapoptotic and cytoprotective action [16] antioxidant activity, [17]. The plant contains steroids, diterpenoids, triterpenoids, flavonoids, and benzenoids [18]. The hepatoprotective activity of *this plant* have been reported in numerous literature, but the mechanism of action is unknown.

MATERIALS AND METHODS

Chemicals

Chemicals of analytical grade was purchased from SRL, Mumbai, India and Sigma-Aldrich were used for this study. The secondary antibodies and primary antibodies were acquired from Merck milipore and Sigma Aldrich respectively (3,3'-Diaminobenzidine) DAB reagent was purchased from Pierce, USA.

Identification and extraction of plant extract

The plant specimen Reg no NIS/MB/62/2012 have been authenticated and deposited at the Herbarium of National institute of Siddha. The leaf was ground into powder using grinder and 100 grams of the grinded leaves was extracted with 300 mL of sterile distilled water using the Soxhlet apparatus at 60°C and was later freeze dried and stored at 4°C for investigation.

Animals

Ethical clearance was obtained from the Institutional Animal Ethical Committee (IAEC no. 01/20/2013 dated 20/02/2013). For this study, healthy Wistar albino adult male rats weighing 180–220 g was chosen. 2 animals were housed in each cage, with ad libitum food and water.

Noise stress induction procedure

Loudspeakers (15W each) powered by a white-noise generator (0–26 kHz) were placed 30 cm above the cage. 100 dB noise was uniformly generated and monitored by a sound level meter (S.NO-F02199; Cygnet Systems, Gurgaon, Haryana, India).

Experimental groups

The experimental animal was separated into 4 group consisting of 6 animals each. For 48 days, Group I animals received (0.9%) normal saline orally. For 30 days, Group II animals were exposed to noise (100 dB/4 hr). *S. dulcis*

57957



**Wankupar Wankhar**

aqueous extract was administered to Group III animals according to Latha et al. [13] for 48 days. In Group IV animals were exposed to 100 dB/hr for 30 days and later administered with *S. dulcis* extract (200 mg/kg.b.w) till the 48 days. All experiments were done between 8 and 10 am to eliminate variation caused by their circadian rhythm.

Determination of free radicals generated

H₂O₂ levels were calculated in accordance with Pick and Keisari, [20], and nitric oxide (NO) levels as per method of Moshage et al. [19] using the Griess reagent

Determination of enzymatic and non-enzymatic antioxidants

Estimation of catalase (CAT) and superoxide dismutase (SOD) was done in accordance with Sinha [22] and Marklund and Marklund [21], respectively. The methods of Rotruck et al. [23] were used to measure the activity of glutathione peroxidase (GPx) and Habig et al. [24] and for glutathione-S-transferase (GST). Horn and Burns method [25] were used to measure glutathione reductase (GR), which utilized NADPH to convert oxidized glutathione (GSSG) to reduced form. The method developed by Moron et al. [26] was used to determine reduced glutathione (GSH).

Determination of stress markers

Lipid peroxidation (LPO) estimation according to Ohkawa et al. [27] and protein thiol estimation according to Sedlack and Lindsay [28].

Determination of liver enzymes

Estimation of γ -Glutamyl transpeptidase (γ -GT) as per Orłowski and Meister, [29], alkaline phosphatase (ALP) was assayed as per Bergmeyer, [30], aspartate aminotransferase (AST) and alanine aminotransferase (ALT) as per King, [31].

Histology

Animals were given 90/50 mg/kg.b.w. of ketamine and xylazine to cause complete anaesthesia. After that, phosphate-buffered saline and 10% buffered formalin were transcardially infused into the rats. The animal was dissected in ice cold environment and liver was taken and stored in 10% buffered formalin. Liver was then rinsed in running water to remove the formalin pigments followed with progressively stronger alcohol dehydrate the tissue. The paraffin blocks were created by paraffin wax impregnation [32]. Using a Spencer Lens rotatory microtome (model no. 820, New York, USA), the block were sections with 6 μ m thickness before being stained with H&E.

Immunohistochemistry

Immunohistochemistry was performed in accordance with Bancroft and Cook's [32] using the DAB universal staining kit. Xylene was used to deparaffinize sections followed by dehydration with ethanol. Slides were cleaned with PBS before being treated with 3% H₂O₂ for 15 minutes at room temperature to quench endogenous peroxidase activity. The slides were treated with blocking solution (10% normal goat serum) for 5 min at room temperature following antigen retrieval (15 min at 90 °C in 10 mM citrate buffer, pH 6.0). After that, a primary antibody was incubated on the sections for an entire night. The sections were then rinsed with PBS, reacted with secondary antibody for 30 minutes at 37 °C, and then incubated with HRP secondary link antibody for 30 minutes at 37 °C. Following that, DAB chromogen was applied to the parts for 15 minutes. The sections were then mounted after being counter stained with hematoxylin and rinsed with deionized water.

Statistical analysis

The SPSS statistical tool, version 17.0, was used for statistical analysis. Significance at p0.05 was set. The findings are shown as mean standard deviation (SD), and the data were subjected to ANOVA, followed by Turkey's multiple comparison tests when the 'F' test ratio was significant.





Wankupar Wankhar

RESULT AND DISCUSSION

Antioxidant status on liver

Reactive species are involved in oxidative/nitrosative stress, a common mechanism by which several environmental pollutants have an imperative role in mediating the pathogenesis of disease. Free radical generation via excessive stimulation of the HPA/ SAM axis is among the most common mechanism by which noise stress can induced illness in various system of our body. In comparison to control and *S. dulcis* treated groups, exposure to noise for 30 days (4 h/day) resulted in a significant increase in H₂O₂ and NO levels in the liver tissue Table: 1. To counteract this upsurged ROS / RNS generation, our body contain several endogenous enzymatic and non-enzymatic antioxidants. The enzyme SOD is generally considered the first-line defense catalyzing the dismutation of superoxide radicals to H₂O₂ and O₂, thereby reducing cellular damage [33]. This increase in superoxide (O₂⁻) formation could be the prime factor regarding increased SOD activity in this study (Table: 2). The second line of defence is made up of CAT and GPx, which break down H₂O₂ and protects the tissue from the reactive hydroxyl radical (OH·). In addition to reducing H₂O₂, GPx also reduces the oxidation of GSH. From these findings, it is evident that the elevated level of SOD, GPx, and CAT on 30 days of noise exposure could serve as an adaptive response of the liver to noise stress (Table: 2). However, the experimental group clearly shows that the animal's antioxidant status was severely impacted. Alleviated enzymatic activity in the *S. dulcis*-treated noise-exposed group indicates the therapeutic efficacy of the plant as a free radical scavenger. On the contrary, decrease protein thiol (Table: 3) levels was justified by the decreased thiol GSH (Table: 2). In addition, the alteration of antioxidant activities during stress is often associated with the reduction of GSH and an increase in LPO (Table: 3). Furthermore, decreased GSH levels and a rise in lipid peroxidation are frequently linked to the alteration of the antioxidant system during stress (Table 3). Since GSH serves as the substrate for GST's enzymatic process, a drop in GSH content with an increase in GST activity. All these factors can cause oxidative damage and the development of cell death might result [34]. Phytocompounds like terpenoids, flavonoids, stilbenes, phenolic compounds, and proanthocyanidins are present in the plant [35]. These polyphenols act as a scavenger by breaking the chain reaction and suppressing generation of radicals by the regulation of enzyme activity or by chelating metal ions.

Oxidative/nitrosative stress on hepatic enzymes:

Alterations in hepatic enzymes like AST, ALT, ALP, and g-GT were observed on exposure to noise when compared to control. Data summarized in **Table 4** suggest that noise stress could mediate mild hepatic damage. An increase in hepatocellular injury markers like serum ALT and AST indicates that the hepatic enzymes may have escaped into the circulation [36]. Elevated AST by 38.08% and ALT by 10.57% in the noise-exposed group when compared with control could have resulted due to increased permeability of cells usually characterized by lipid peroxidation mediated hepatocellular injury. The hepatoprotective properties of the *S. dulcis* treated group could alleviate hepatic enzyme. In addition, an increased ALP by 2.01% and a decrease in g-GT by -0.89% were observed in a noise-exposed group, compared to the control. However, no significant changes observed in all the experimental groups. To further support our finding Tsai et al. [15] stated the hepatoprotective effect of *S. dulcis* on CCl₄ induced liver injury in mice

Redox regulation of NF-κB hepatoprotective activity

Under the neuroendocrine stress, antioxidant enzymes are regulated by interplay of glucocorticoids (GCs) signals via glucocorticoids receptor (GR) and signals from NFκB pathway [37]. Immunohistochemical expression of NFκB in noise stress group could attenuate free radical generation and this might have been to the adaptive response of the animal to noise stress (Fig. 1). Altering the cellular antioxidant enzyme levels and modulation of NF-κB target gene products promote survival [38]. To corroborate our study, Oliveira-Marques et al. [39] reported that free radical, may act as a modulator for the NF-κB pathway and inhibition of NF-κB activation can increase TNFα induced ROS generation, LPO and oxidation of protein [40]. It is also important to note that rat liver histoarchitecture showed normal arrangement of hepatocytes, hepatic cord rays and portal areas (Fig. 2) in all the group except the noise exposed animals. The therapeutic nature of *S. dulcis* is due to the synergistic effect of the compounds for their antioxidant and hepatoprotective activity mediated via NF-κB regulation.



**Wankupar Wankhar**

CONCLUSION

Noise is a definite stressor and it can affect the liver through multiple pathways. The most common being the redox imbalance. ROS/NO-mediated lipid peroxidation can disrupt the hepatocytes. Damage to the hepatocytes could increase cell permeability and leakage of hepatic enzymes like AST and ALT. However, the *S. dulcis* treated group displayed a creditable therapeutic efficiency via its antioxidant and hepatoprotective activity. Understanding the interplay between modulation of NF- κ B signaling and oxidative stress can help develop newer therapeutic strategies.

Conflict of interest statement

We declare that we have no conflict of interest.

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Wankupar Wankhar

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Table: 1 Effect of noise stress on free radical generation

	Control	Noise	SD Alone	Noise+ SD
Hydrogen peroxide (H₂O₂) generation (μmoles/unit/mg protein)	3.96±0.101	6.31±0.98*	3.86±0.14#	5.01±0.71*#
Nitric Oxide (NO) generation (μmoles/unit/mg protein)	3.14±0.31	5.57± 0.89*	3.04±0.32#	3.59±0.34*#

Values are expressed as Mean ± SD, N=6 and significance at p<0.05. ** Compared with saline control and # Compared with noise stress.

Table: 2 Effect of noise stress on enzymatic antioxidant and non-enzymatic antioxidant

	Control	Noise	SD Alone	Noise+ SD
Superoxide dismutase (units/mg protein)	2.43±0.14	3.45±0.28*	2.31±0.16#	2.59±0.30#
Catalase (μm H₂O₂utilised/mg protein)	7.46±0.54	12.96±1.44*	7.75±0.47#	10.06±0.84*#
Glutathione peroxidase (μg GSH utilized/mg protein)	10.94±0.54	15.93±0.86*	10.09±0.48#	13.16±1.40*#
Glutathione-S-Transferease (GST) (μmoles of CDNB utilized/min/mg of protein)	3.06±0.49	5.05±1.00*	2.95±0.37#	3.59±0.34*#
Reduced glutathione (GSH) (μg of GSH/mg of protein).	7.61±1.06	4.91±0.55*	7.41±0.76#	6.78±0.75*#

Values are expressed as Mean ± SD, N=6 and significance at p<0.05. ** Compared with saline control and # Compared with noise stress.

Table: 3 Effect of noise stress on bio markers of stress

	Control	Noise	SD Alone	Noise+ SD
Lipid peroxidation (nm MDA/mg protein)	2.96±0.22	5.84±0.56*	2.91±0.04#	3.51±0.30*#
Protein thiols (μg/mg protein)	10.69±1.64	6.07±1.02*	9.98±1.04#	8.10±1.05

Values are expressed as Mean ± SD, N=6 and significance at p<0.05. ** Compared with saline control and # Compared with noise stress.





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Table: 4 Effect of noise stress on liver enzyme

	Control	Noise	SD Alone	Noise+ SD
ALT (μmoles of pyruvate liberated / mg protein/min)	23.28±2.88	34.05±3.98*	26.27±2.11#	29.14±1.52
AST (μmoles of pyruvate liberated / mg protein/min)	22.97±2.86	25.40±1.86*	19.48±3.15#	22.29±2.60#
ALP (μmoles of phenol liberated / mg protein/min)	105.43±5.08	107.55±4.11	103.25±6.30	109.02±5.59
γ-GT (nmoles of p-nitro aniline formed / mg protein/min)	4.47±0.18	4.32±0.36	4.51±0.16	4.98±0.14

Values are expressed as Mean ± SD, N=6 and significance at p<0.05. "*" Compared with saline control and "#" Compared with noise stress.

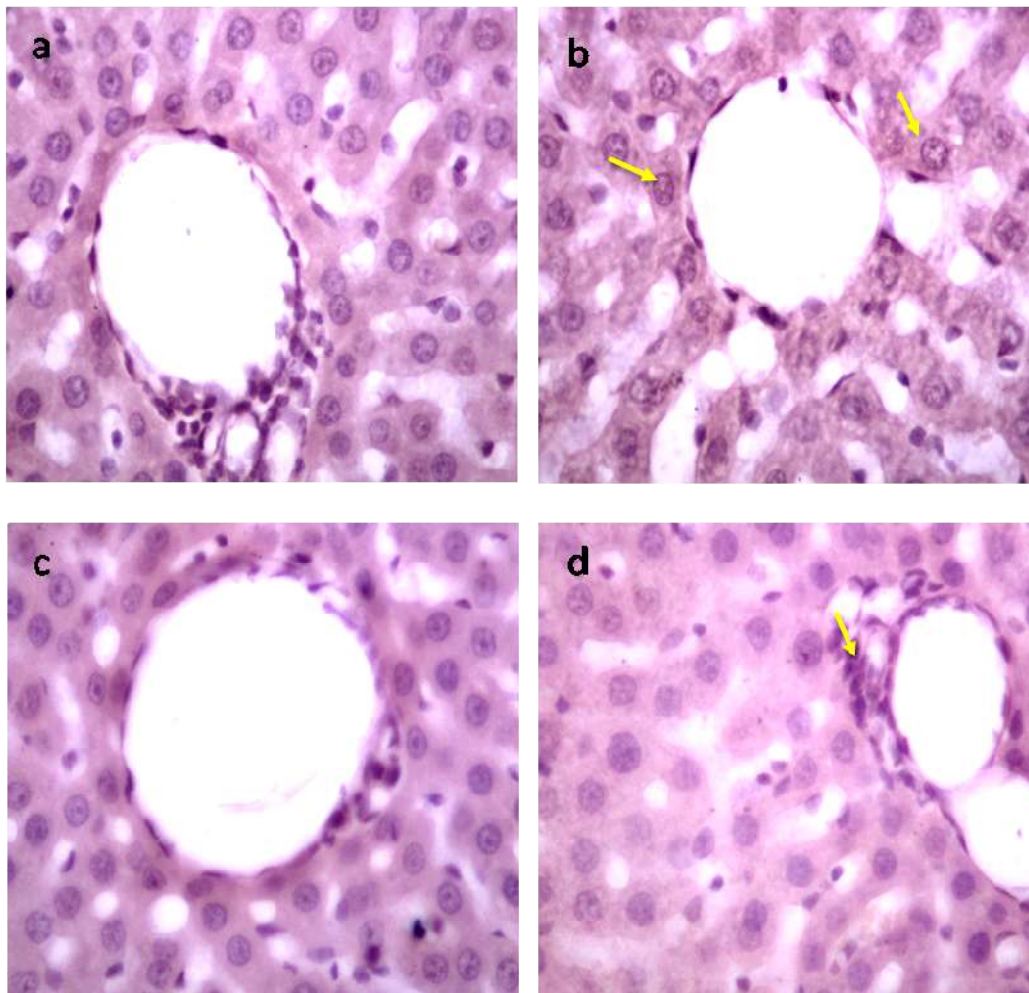


Fig.1. Illustrates IHC of NFκB: parenchymal cell and sinusoidal pattern of liver in different experimental groups at 10x (a) Control rat liver cell morphology, (b) exposed to noise-stress for 30 days (4 hours/day) (c) treatment with *S. dulcis* extract (d) *S. dulcis* extract treated noise exposed group. Arrow indicates a positive cell



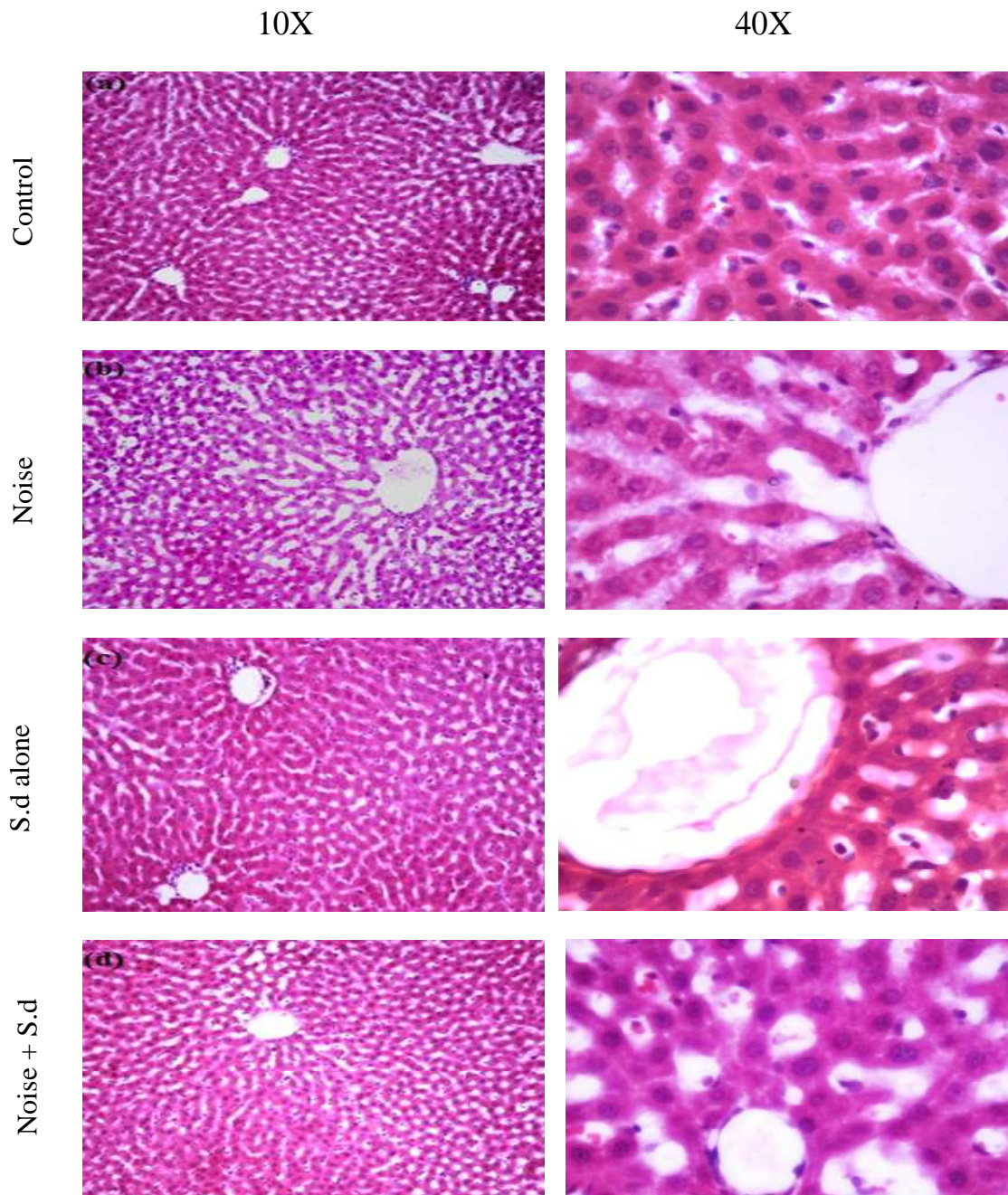


Fig.2. Illustrates H&Estained parenchymal cell and sinusoidal pattern of liver in different experimental groups. (a) Control rat liver cell morphology, (b) exposed to noise-stress for 30 days (4 hours/day) (c) treatment administrated with *S. dulcis* extract (d) *S. dulcis* extract treated noise exposed group.





Maternal Experiences of Caring for a Child with Autism : A Narrative Review of Qualitative Studies

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ABSTRACT

Autism is a development disability that impedes the social communication and interactional capabilities of the affected. As a pervasive disorder, it requires constant caregiving. Although there are studies on autism that focus on the affected individuals, there is a paucity of research on the maternal experiences of taking care of a child with autism. This study is intended to enhance the understanding of maternal experiences of caregiving their child with autism by providing an overview of the current literature. A narrative review of qualitative papers published in the last ten years (2013-2023) was conducted. Two databases of research papers were searched, and a total of 17 qualitative papers across the world were found that reflected the maternal experiences. The study identified three main themes- issues with diagnosis, attempts at coping, and experiences of stigma. The findings reveal the relevance of understanding the maternal experiences of caregiving their child with autism in order to realize the wider challenges they encounter.

Keywords: Maternal Experiences, Caregiving, Autism, Narrative Review, Qualitative.



**Akhila Johnson and Sampath Kumar**

INTRODUCTION

Autism can be defined as a complex pervasive neurodevelopmental disorder characterized by deficits in social communication and interaction, and display of stereotyped, repetitive behaviours. According to the American Psychiatric Association's Diagnostic and Statistical Manual Fifth Edition (DSM-5), these symptoms of autism will be present in the early years of an individual's development and can cause clinically significant impairments in social, occupational, or other relevant areas of functioning (American Psychiatric Association, 2013). The idea of autism has evolved over years. The term 'autism' was originally coined by Eugen Bleuler in 1910 who thought of it as a form of childhood schizophrenia. Later, Leo Kanner in 1943 defined autism as a neurodevelopmental disorder distinct from schizophrenia. This caught the attention of psychologists such as Bruno Bettelheim who came up with the controversial 'Refrigerator mother theory' during 1950s which attributed child's autism to emotionally cold, dismissive mothers. This theory was later disproved as research showed that causes of autism were mostly biological. Gradually, autism began to be considered as a spectrum condition, taking into consideration the different symptoms experienced by different people of autism. It is to be understood that manifestation of autism is different for every single person with autism, with some requiring more support than others.

Autism can also be called as a social disability as the affected ones may have difficulties in establishing and maintaining relationships with others because of the lack of communicational and interactional capabilities. It is also an invisible disorder as there are no apparent signs that show that a person is affected. As a result, it can be challenging for the individuals with autism and their caregivers to access public places as people around them may not even understand why the affected individual behaves inappropriately. This can result in caregivers being socially withdrawn due to the fear of unsolicited stares and advices from the public. Therefore, parenting a child with autism can present immense challenges. When compared to fathers, it is the mothers who experience immense challenges as they have to take care of their child with autism, compromising one's own priorities.

Research shows that mothers of children with autism experience heightened psychological distress, caregiving burden (Estes *et al.*, 2013), lower resilience levels (Ilias *et al.*, 2019), and health-related issues (Fairthorne *et al.*, 2015). Parenting stress and depressed moods are significantly higher in mothers of children with autism (Ingersoll *et al.*, 2011). A recent study showed that about 50% of all mothers of children with autism had high levels of depressive symptoms (Roubinov *et al.*, 2022). In India, mothers of children with autism are found to have depressive and anxiety symptoms (Selvakumar & Panicker, 2020). Having a child with autism can also increase rates of divorce (Hartley *et al.*, 2010). As mothers are evidently affected in numerous ways due to giving care to their child with autism, examining the maternal experiences is integral.

MATERIALS AND METHODS

The articles for this study were gathered from the published research papers in research databases namely, Google Scholar and PubMed. Only papers published in the time period of 2013 to 2023 were collected and screened based on certain inclusion and exclusion criteria determined for the study. The inclusion criteria for the selection of articles were:

1. Language of the published papers must be English.
2. Peer-reviewed articles indexed in PubMed and Google Scholar.
3. Original research articles.

The exclusion criteria for the collection of articles for this review study were:

1. Non-English publications
2. Articles that are not peer-reviewed.
3. Review articles
4. Gray literature
5. Website sources





Screening and Selection

Only limited literature was found published in relation with the maternal experiences of taking care of a child with autism in the time period between 2013 and 2023. Those articles published within the last ten years were considered. The combined search terms used were maternal experiences, child(ren) with autism, and qualitative study. Based on the topic of study, 17 articles were selected after considering the inclusion and exclusion criteria. The flowchart that depicts the screening of the articles is given below in Fig. 1.

RESULTS

Of the 17 studies included, 9 articles examined the general lived experiences of mothers caring for a child with autism (Papadopoulos, 2021; Acharya & Sharma, 2021; Nicholas *et al.*, 2020; Lovelace *et al.*, 2018; Manor-Binyamini & Shoshana, 2018; Gobrial, 2018; Ilias *et al.*, 2017; Ijalba, 2016; Heydari *et al.*, 2015). Eight articles examined maternal experiences in the context of their spirituality (Salkas *et al.*, 2016), child's socio-sexual needs (Pryde & Jahoda, 2018), mother-daughter relationship (Navot *et al.*, 2017), resilience (Santoso *et al.*, 2016), online emotional and informational support (Reinke & Solheim, 2015), difficulties in the access of autism diagnosis and resources (Johnson *et al.*, 2020; Munroe *et al.*, 2016), and access to support via mental health services (Jackson *et al.*, 2020). The majority of the selected studies were conducted in the United States (n= 7) and the United Kingdom (n=4) and represented a variety of settings including African American families, Latino and Hispanic immigrant mothers. The setting of other articles were Greece, Nepal, Malaysia, Indonesia, Canada, Iran, Israel, and Egypt. Eight studies used interpretative phenomenological analysis; four studies used thematic analysis etc. Sample size ranged from three to eighty-five. Three themes emerged from the review of the nineteen articles. They are:

Theme I: Issues with Diagnosis

Ten articles reported issues with diagnosis as a key concept. Mothers experienced skepticism regarding their child's development (Acharya & Sharma, 2021; Ilias *et al.*, 2017; Navot *et al.*, 2017) and were either struggling to obtain or resisting a diagnosis (Nicholas *et al.*, 2020) and had guilt and grief upon delayed diagnosis (Johnson *et al.*, 2020; Navot *et al.*, 2017). Disbelief from others of child's diagnosis, and lack of information regarding autism were challenging for them. For mothers of adolescent girls and boys, concerns about sexuality and vulnerability in future relationships, worries about abuse (Pryde & Jahoda, 2018), future functioning, and dealing with child's puberty were evident (Navot *et al.*, 2017). The mothers had preconceptions about autism (Acharya & Sharma, 2021; Ijalba, 2016), and tried to modify their parenting styles upon advices from doctors. The lack of service availability or accessibility despite the need for services was encountered by them (Nicholas *et al.*, 2020). They had negative experience accessing mental health services as they faced rejection, and fought in order to be heard. They also had breakdown in relationships with professionals due to their feelings of being blamed, and a lack of trust in them (Jackson *et al.*, 2019).

The mothers were in need of more support from government in terms of more special schools, therapeutic services, financial help, and employment opportunities (Ilias *et al.*, 2017). They had negative experiences with educational professionals too (Johnson *et al.*, 2020; Ilias *et al.*, 2017). They also encountered physical, emotional (Munroe *et al.*, 2016), economic and social problems (Acharya & Sharma, 2021; Gobrial, 2018). Feelings of vulnerability and frustration about child's future, and reactions to child's diagnosis caused them emotional burden. The changes in relationship with spouse (Johnson *et al.*, 2020) due to their low involvement in caregiving (Ilias *et al.*, 2017) along with family finances resulted in family burden, and the stigma of autism, and the lack of social life due to caregiving caused social burden among the mothers (Papadopoulos, 2021). They also felt alone, and guilty due to child's autism, and experienced vicarious traumatization that impacted them psychologically (Jackson *et al.*, 2019).

Theme II- Attempts at Coping

Seven articles had coping as an important component. Mothers of children with autism tried to adapt coping strategies such as respite care, religious coping, positive coping, and problem focused strategies (Acharya & Sharma, 2021). Sharing of information on the resources and strategies, along with prayer also were coping mechanisms for them (Johnson *et al.*, 2020). Among mothers from Latino families, child with autism was seen as a positive sign from



**Akhila Johnson and Sampath Kumar**

God, and was thought to be a blessing and a part of God's plan. They believed that special children were given to special parents, although there were negative cultural attributions about children with autism (Salkas *et al.*, 2016). This interest in spirituality and ascribing child's autism to God's plan can also be seen as a coping strategy.

Online engagements with other parents of children with autism were also seen as a measure by these mothers as other parents shared their reality and could relate to their feelings and experiences. This engagement was reciprocal and they received support from others and provided them support too (Reinke & Solheim, 2015). The mothers employed various strategies in finding solutions to their problems that eventually enhanced their resources of resilience in dealing with child care, that included participation in spiritual activities, using external resources, sharing problem solving techniques with other mothers of children with autism, and creating household management systems (Santoso *et al.*, 2016). Mothers also had coping strategies such as, change in attitudes, acceptance of child's autism, shifting expectations about child, and fostering spiritual beliefs (Ilias *et al.*, 2017). Many mothers were pessimistic about their child and resorted to crying and worrying but turning to spirituality helped them manage their challenges (Heydari *et al.*, 2015).

Theme III- Experiences of Stigma

Five articles dealt with the theme of stigma. Mothers of children with autism experienced social isolation and stigmatization. Lack of understanding and awareness on autism among these mothers, their families and communities were evident. Mothers often avoided social situations due to the problematic behaviours of their child. Nevertheless, these mothers desired for acceptance among people (Ijalba, 2016). They encountered negative attitudes and responses from the public which frustrated them. Blaming the child's disability over 'poor parenting' was one of the accusations faced by the mothers that sometimes resulted in internalisation of imposed stigma, although they tried avoiding such instances (Nicholas *et al.*, 2020).

For African immigrant mothers in UK, experiences of rejection from family, church, local African community, and unwelcome responses and judgments from public stemmed from the belief that it was the mothers who were to be blamed for their child's autism. This particularly impacted upon their identities, and they felt the pressure for their child with autism to meet the expectations from others. Though they experienced stigma from all societal groups, they encountered it mostly from the African community within the UK and Africa. Lack of acceptance among people and their judgemental attitudes made these mothers isolate themselves, leading to alienation. They also appeared to internalise others' judgments, that impacted on their maternal identity, forming feelings of guilt and shame. For few, this had led to decide not to have another child (Munroe *et al.*, 2016). African American mothers had experiences of racial discrimination too (Lovelace *et al.*, 2018). Bedouin mothers from Israel had encountered marginalization within their community and exclusion within exclusion which was inherent within the family structure, society, and in all aspects of everyday life. They lacked the ability to participate in any decision-making and in other areas of daily life. They also lacked social support as they experienced isolation in socio-cultural context. There was also social stigma surrounding their child as husbands blamed the mothers for child's autism (Manor-Binyamini & Shoshana, 2018).

DISCUSSION AND CONCLUSION

Although the study articles included in the study had participants from diverse countries having different socio-cultural backgrounds, all of the mothers were found to have common experiences of parenting their child with autism that came with a lot of implications. This review has identified the major aspects of their caregiving experiences that shed light on why these mothers deserve scholarly attention. The themes identified within the study provide insights into the various issues that are associated with caring for a child with autism. Only those studies that discussed the caregiving experiences of mothers raising a child with autism were included. Though there is a growing literature on autism that specifically focusses on the prevalence rates, studies within the maternal contexts are very limited. Future studies should focus on the parental contexts in association with caregiving, with emphasis on the maternal experiences, as they are the ones who are mostly involved in the caregiving process. This review





Akhila Johnson and Sampath Kumar

was limited to only qualitative studies that helped in understanding the deep, lived experiences of the mothers in raising a child with autism. Since the word 'experiences' was included in the search strategy for this review study, few studies were also excluded. This study followed a more targeted search strategy that aimed at unearthing the problems specific to maternal caregivers of children with autism.

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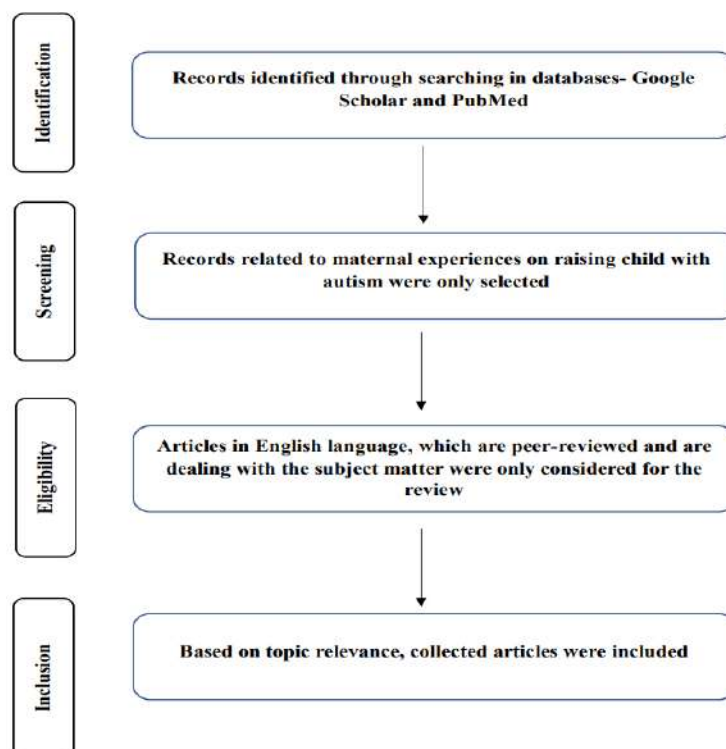




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Fig. 1. Flowchart of the Screening Process





Assessment of the Impact of Geospatial Sensitivity on Meteorological Parameters at Ahmedabad, India, using the WRF Model

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ABSTRACT

Numerical modeling depends heavily on the accuracy of the model. Qualitative model outputs (such as wind direction, relative humidity, temperature, etc.) may differ significantly from current data. The present work evaluated the effectiveness of the WRF model over the semi-arid Indian city of Ahmedabad (23.04 N, 72.56 E). The main goal of this research is to examine the performance of the model using different spatial model resolutions on a selected grid domain located in Jaipur region. A fine physical parameterization method was applied to execute the model with spatial variations and model resolution. With different combinations of model resolution, model performance varies. The model run for 24 km model resolution shows promising and improved numerical results.

Keywords : Numerical model, physical parameterization, WRF model, model resolution.

INTRODUCTION

In the proposed investigation, authors simulated the weather data gathered from on-site observations over Ahmedabad (23.04 N, 72.56 E), India, using the WRF model version 4.2 and investigated the sensitivity of various utilizing various horizontal model resolutions for the better parameterization scheme as mentioned by Soni et al., 2014 [1] within that area. The multiple microphysics (MP) and cumulus parameterization (CP) methodologies was examined to determine how effectively this work when simulating an extreme rainfall event over the Indian subcontinent [2], [3], [4], [5], [6]. For each and every meteorological phenomenon, the following three variables are essential: wind speed (WS), relative humidity (RH) and air temperature (T). To comprehend the tendencies and



**Hiren S. Lekhadiya and Ravi R. Dhandhukiya**

variation of the atmosphere, these variables are investigated. The effect of thermodynamic parameters (humidity and temperature) retrieved from Indian National Satellite-3D (INSAT-3D) on WRF model forecast is also researched and addressed [7], [8]. Acknowledging a location's elevation by its local weather patterns depends on knowing the numerical model's selection of specific geographical resolution. To find the optimum resolution for dynamically downscaling, it is also essential to determine the horizontal resolution of the model [9].

METHODOLOGY**Model Configuration**

The WRF regional climate model, which can run regardless of nesting, serves as the basis for the study. In conjunction with numerous organizations, including the NCEP, the NOAA, and many others, the model is mainly designed by the NCAR. A limited-area, non-hydrostatic primitive equation model with various extensions for different physical parameterization processes is indeed the WRF [10]. The numerical parameters are preserved while the model follows the terrain [11], [12].

The model includes a wide range of thermodynamics parameters which can be selected according to circumstances. To find the ideal combination for a specific site, it is essential to run various simulation studies. The model's physical parameterization choices include Surface Layer, Cumulus Parameterization, Planetary Boundary Layer, Microphysics, Land Surface and multiple radiative methods for boundary layer soil activity [13]. In the current study, its standard WRF model design is applied to each experimental setup in accordance with the best physical parameterization scheme as recommended by Soni et al., 2014 [1]. Soni et al., 2016 [13] found that using the microphysics scheme from Lin et al., 1983 [14] over the studied area produced good quantitative measurements. The QNSE, which is typically used for locations with stable stratification, is the surface and planetary boundary scheme.

Design of Experiments

All studies are using the NCEP Reanalysis FNL dataset with beginning and lateral boundary conditions of $1^\circ \times 1^\circ$ every 6 hours. The model integration is performed over the chosen domain ($18^\circ\text{N} - 28^\circ\text{N}$, $68^\circ\text{E} - 78^\circ\text{E}$) for 72 hours with incorporation occurring every hour. Non-hydrostatic movements have been selected for computation, and the Mercator projection has been selected for the entire experiment

Simulation Period

All experiments run between February 17 to February 23, 2021, for a week. The absolute minimum for the spring of 2020 - 2021 is demonstrated through Wunderground (<http://www.wunderground.com>) measurements over the Ahmedabad between February 20 - 23, 2021. Being the coldest phase during the entire year 2021, a thorough examination of the model's predicted results was performed during the time period stated earlier, with an emphasis on the timeframe from 0:00 UTC on February 20 to 0:00 UTC on February 23.

For Ahmedabad, we collected surface observations through Wunderground, which we used as validation data to confirm model predictions at the station level. This website instantly collects weather data from meteorological departments around the world. In some cases, international airports also own this weather data, which is maintained by various government organizations. Pressure, direction, wind speed, relative humidity and temperature are provided every 30 to 60 minutes for surface variables. We collect data every hour so we can compare it with the model results.

The NMSE and Correlation graphs for T and RH are shown in Figures 2 and 3, respectively. Temperature performed better with simulations of 24km and 48km accuracy. The 54km and 60km simulation resolutions beat previous model solutions for RH. Tables 1, 2, and 3 show the overall results of the comprehensive statistical analysis for T, RH, WS, etc. A perfect model output will have a minimum NMSE value of 0, a maximum COR value of 1, an FB close to 0 (either negative or positive), and an FA2 percentage value close to 100. For NMSE and FB, the tables were arranged in



**Hiren S. Lekhadiya and Ravi R. Dhandhukiya**

ascending order; For COR and FA2, they were arranged in descending order. According to statistical research, it can be found that 24 and 6 km resolution performs better for temperature, 24 and 60 km resolution performs better for relative humidity, and 42 km and 18 km resolution perform better for wind speed.

The output of the simulation for temperature and relative humidity for ranges of 6 km and 24 km is shown in Figure 5. The figure shows that while 24 km performed better than 6 km for relative humidity, 6 km was able to provide output that was closer to observations for temperature. According to observations, the wind generally blows from south to north. Both 6 km and 24 km successfully simulate the observed wind direction, but not the wind speed. Correlation, including NMSE, FA2 and FB, 24km is overall better than 6km. The 24km model resolution outperforms other geospatial resolutions in terms of performance statistics.

CONCLUSION

The present research examines how responsive various model resolutions are to weather phenomena. Ten alternative model resolutions were taken into consideration utilizing the same utilizing the identical initial and lateral boundary conditions as the NCAR/NCEP reanalysis to assess the sensitivity of the model resolutions. In all experiments, it is found that the WRF model faithfully reproduces the observed fluctuations in meteorological variables. Research shows that 24 km spatial resolution provides minimal biases over the research area and improved statistical results, both of which are essential for regional simulations.

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Hiren S. Lekhadiya and Ravi R. Dhandhukiya

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Table 1. Temperature Statistics

TEMPERATURE STATISTICS				
	NMSE	COR	FB	FA2
6km	0.04	0.85	0.14	98.00
12km	0.04	0.86	0.12	98.00
18km	0.04	0.84	0.13	97.00
24km	0.04	0.85	0.11	97.00
30km	0.05	0.85	0.15	96.05
36km	0.05	0.84	0.15	98.00
42km	0.06	0.84	0.16	97.00
48km	0.07	0.86	0.17	85.12
54km	0.08	0.86	0.21	83.36
60km	0.08	0.86	0.23	83.36

Table 2. Relative Humidity Statistics

RELATIVE HUMIDITY STATISTICS				
	NMSE	COR	FB	FA2
6km	0.08	0.75	-0.07	96.36
12km	0.07	0.77	-0.14	96.36
18km	0.07	0.77	-0.14	96.36
24km	0.07	0.78	-0.10	95.27
30km	0.08	0.78	-0.19	95.27
36km	0.08	0.79	-0.15	95.14
42km	0.07	0.78	0.02	95.27
48km	0.07	0.82	-0.10	95.27
54km	0.07	0.83	-0.12	95.14
60km	0.07	0.83	0.01	95.14

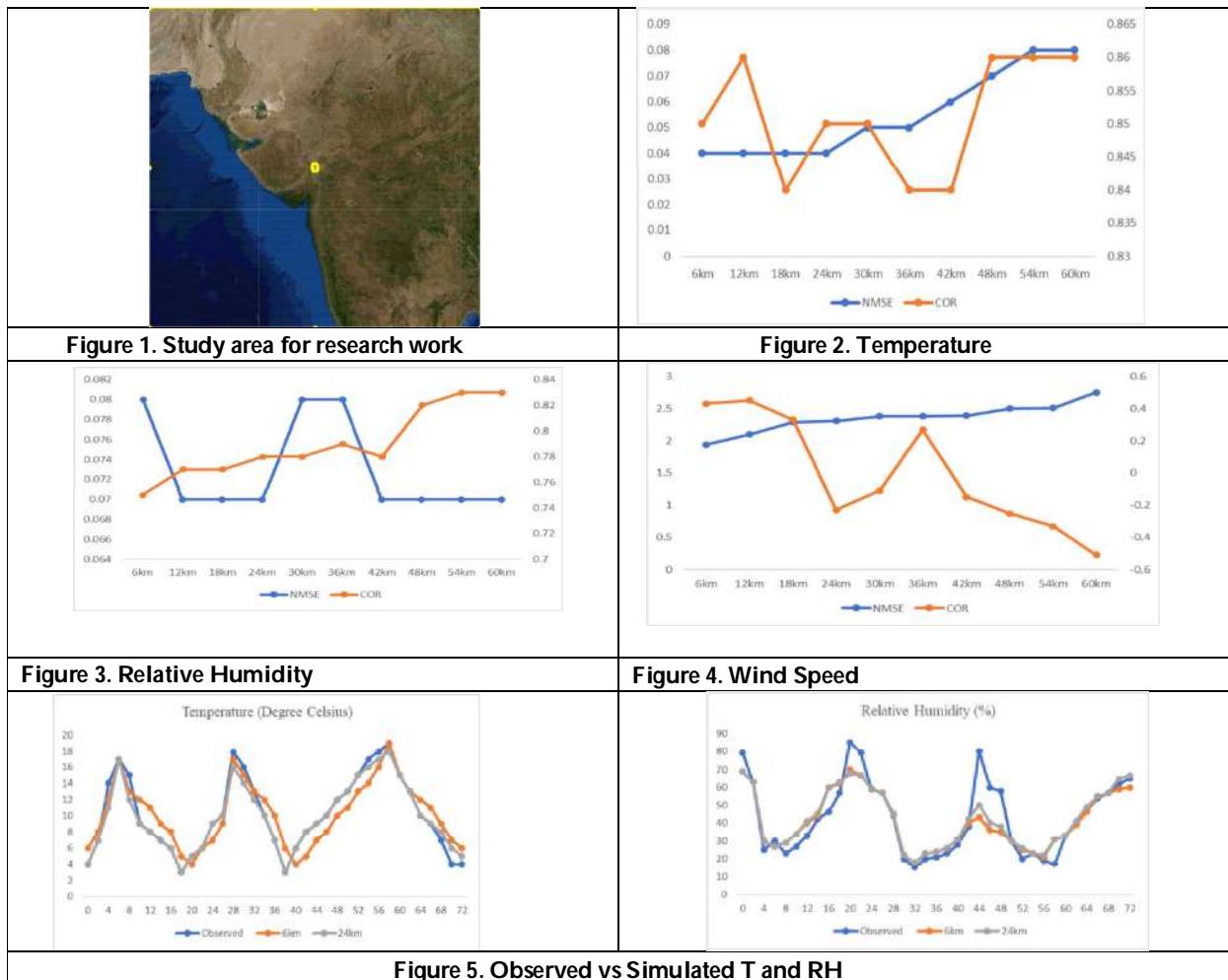




Hiren S. Lekhadiya and Ravi R. Dhandhukiya

Table 3. Wind Speed Statistics

	WIND SPEED STATISTICS			
	NMSE	COR	FB	FA2
6km	1.94	0.43	-0.76	26.14
12km	2.1	0.45	-0.86	24.36
18km	2.29	0.33	-0.85	23.60
24km	2.31	-0.23	-0.66	23.60
30km	2.38	-0.11	-0.78	26.72
36km	2.38	0.27	-0.89	23.60
42km	2.39	-0.15	-0.7	23.60
48km	2.5	-0.25	-0.71	26.70
54km	2.51	-0.33	-0.69	23.60
60km	2.75	-0.51	-0.63	18.47





Resident Perceptions toward Cultural Heritage Tourism in Jammu and Kashmir : An Empirical Study

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ABSTRACT

This research is being conducted with the aim of gaining insights of the inhabitants' support perceptions concerning the growth of cultural heritage tourism in Jammu and Kashmir, India. The research also attempts to explore perceptual differences which may exist in the demographic characteristics of the locals with regard to their support for cultural heritage tourism. The demographic characteristics employed include populations' gender, occupation, education, age, length of residence, income. The current research used a quantitative approach, making use of a self-administered survey, to gather 485 samples from local residents of chosen cultural heritage locations across Jammu and Kashmir. The analysis was conducted using descriptive approaches, such as estimation of mean as well as frequency, and statistical methods, such as the t-test, ANOVA, including post hoc tests. The result shows that residents in their respective communities support CHT development. Additionally, findings found significant difference across residents' gender, age, education and occupation and no statistically significant difference among the mean value of residents from various income groups and length of residency with respect to their support towards cultural heritage tourism. This investigation can help tourism authorities establish both operational and strategic decisions concerning the growth of CH tourism.

Keywords: Residents' support, Tourism development, Demographics, cultural heritage tourism, Jammu and Kashmir





INTRODUCTION

Since the time of the Romans, humans frequently travelled for cultural tourism purposes, visiting historical sites, landmarks, and monuments as well as participating in festivals and special events and going to museums. The whole tourist experience includes all of these different kinds of activities (McKercher & Cros, 2002). In the 1970s, scholars realised that several tourists visited particularly to understand about as well as experiencing a particular culture and heritage, and they started to consider this type of tourism as a distinct market segment. According to Richards, (2001), Cultural heritage tourism is experiential travel that combines a desire for or sense of belonging to the history and culture of the area with curiosity about or knowledge of places that represent people from the past and present. The tangible cultural heritage consists of places, landmarks, literature, artifacts, and buildings whereas languages, rituals, mythology, and expertise are all components of intangible culture. Natural heritage includes notable landforms and ecosystem as well as biodiversity (Richards, 2001). Over the last several years, there has been an increase in tourists seeking for cultural heritage destinations as a result of the expanding global interests for heritage. It caters to a certain group of people who were well educated and interested in experiencing something different from the typical vacation. Since the tourism sector plays such a significant part in reshaping the economic, social, and cultural outlook of an area, countries throughout the globe are striving to develop innovative unique selling propositions (USPs) for the purpose of marketing tourism using an integrated strategy. Cultural-heritage tourism seems to be a solution to the number of countries attempting to provide something distinctive to visitors. Cultural tourism flourished mostly in 1990s, becoming a "highprofile, massmarket activity" McKercher & Cros, (2002). There were increasingly more locations throughout the globe are being marketed as cultural heritage places because of the commodity's attractiveness. However, the developed nations, especially Europe and North America, have long recognised the benefits of cultural heritage tourism and actively promoted the sector (Graham et al., 2000; Poria et al., 2001). In addition to this, cultural heritage tourism has attained greater significance in less developed nations, particularly in the Southeast Asian regions (McKercher et al., 2004).

As a result, the continuous growth of tourism at a variety of places results in a wide range of both favourable and unfavourable tourism effects, which in turn have an effect on the way a large majority of local communities live their lives. Not only may the consequences have immediate consequences for the communities, in addition they have the potential to directly change the community's level of support towards the expansion of tourism (Ko and Stewart, 2002; Dyer, et al., 2007). Considering possible alterations introduced by tourism in the respective communities, researchers argue that tourism developers should carefully include local peoples' perspectives as a component of the tourism planning procedure. As stated by Gursoy et al., (2002), it is highly important to take into consideration the opinions and attitudes of inhabitants of the region if tourism is to be appreciated and supported by locals. If local inhabitants are displeased with tourism growth or visitor behaviour, unfavourable encounters between visitors and locals may occur. As a result, high levels of visitor satisfaction have been connected to favourable attitudes held by hosts regarding tourism (Andriotis & Vaughan, 2003). Therefore, considering the lack of empirical investigation on residents' opinions in the region, it is necessary to investigate their' perspectives towards cultural heritage tourism, in order to ensure that the findings of this research provide tourism developers as well as policy-makers with valuable information to find solutions to challenges, as well as to come up with effective strategies for the growth of cultural heritage tourism. In this sense, the study's primary goal would be to evaluate the attitudes of inhabitants regarding their support for the development of cultural heritage tourism in Jammu and Kashmir.

The Indian territory of Jammu and Kashmir is a globally renowned tourism destination with immense tourism prospects that attracts all types of travellers. The diversity of ethnicities existing in the region has resulted in the development of diverse knowledge, disciplines, such as archaeological sites, arts and crafts, customs, music, literature, dance, that portray a vivid heritage as well as a blend of different cultures. The culture of Jammu and Kashmir reflects the impression of multiple ancient civilisations which have at distinct periods inhabited the region. Each of these civilizations has contributed something unique towards the cultural heritage of the territory. The region has abundance of historical literature, languages, religions, arts, handicraft, dances, and music,



**Nassar Ahmed and Shahnawaz Ahmad Dar**

among other things. Moreover, it should be remembered that cultural heritage tourism has just beginning to expand in the area; hence it is necessary to investigate local's perspectives towards the CHT industry.

REVIEW OF LITERATURE

Prior studies that investigated locals' views toward tourism have shown that due to similar cultural background and social environment, resident's perception or attitudes towards tourism are homogeneous within communities. Later scholars recognized that this notion is incorrect, since investigations have shown differences in resident opinions and attitudes within communities. According to Haralambopoulos and Pizam (1996), "research on this field is not universal due to factors such as the 'type of tourism at the destination', 'community's characteristics', and 'residents' demographic structure', that potentially influence residents' perception of tourism impacts". Hence, it is essential to discover the demographic aspects of tourist attractions in order to get a deeper comprehension of how locals feel about the expansion of tourism (Sinclair-Maragh et al., 2015). Many such demographic traits have been shown to have an influence on how locals perceive the growth of the tourist industry (Almeida-García et al. 2016). As a result, it is essential to examine the demographic characteristics of inhabitants in order to identify their perspective regarding tourism, especially their support towards its growth. Gursoy et al., (2010) asserts that the individualistic attitude of people makes it difficult for tourist planners to create a growth strategy that would please everyone. Accordingly, it is vital to comprehend locals' viewpoints in relation to their demographic characteristics mostly in planning phase and management of destinations and requires increasing emphasis throughout tourism planning as well as execution strategies in order to strengthen the link among the opinions of local inhabitants and the growth of the tourism industry (Sinclair-Maragh, 2017; Almeida-Garca et al., 2016).

Gender is an important demographic factor that significantly influences locals' attitudes towards tourism (Nunkoo and Gursoy, 2012). Prior investigations have shown that gender has an insignificant impact on people' attitudes (Rasoolimanesh et al., 2015; Mensah, 2012). Age is another demographic characteristic of inhabitants that has been shown to affect how people perceive tourism (Bagri and Kala, 2016; Látková and Vogt, 2012) and was identified as a major determinant of locals' attitudes regarding tourism (Huh & Vogt, 2008). Education level is another major socio-demographic factor that was discovered to be crucial in determining people's support towards tourism development (Sharma and Dyer, 2009; Muresan et al., 2016). Moreover, studies revealed that income has no effect on communities' attitudes regarding tourism (Hao et al., 2011), however few demonstrates that wealthy people have more favourable opinions about tourism development (Haralambopoulos & Pizam, 1996). Review of existing literature on tourism reveals those locals who are economically reliant on the travel and tourism sector, appear to possess a favourable perception regarding tourism development (Deccio & Baloglu, 2002; Lankford & Howard, 1994), because they recognize greater economic advantages from tourism expansion. Moreover, many with occupations outside the tourism industry perceive tourism as a source of environmental and economic problems encountered (Kuvan & Akan, 2005). Previous literature has attempted to determine the length of locals' residency and their opinions regarding tourism however the results have been contradictory (Látková and Vogt, 2012; Almeida-García et al., 2016). Haley et al., (2005) found that inhabitants who have just shifted in a city had more favourable attitudes about tourism than those who have lived there over a longer period of time. Some studies have shown a weaker and inconsistent association among tourism development and duration of residence (McGehee & Andereck, 2004; Lankford & Howard, 1994).

RESEARCH HYPOTHESIS

- H1: The support towards cultural heritage tourism differs significantly across males and females.
- H2: The support towards cultural heritage tourism differs significantly across different age groups.
- H3: The support towards cultural heritage tourism differs significantly across different education level.
- H4: The support towards cultural heritage tourism differs significantly across different income groups.





H5: The support towards cultural heritage tourism differs significantly across different occupational groups.

H6: The support towards cultural heritage tourism differs significantly across length of residence.

RESEARCH METHODS

The quantitative technique was used in this research to investigate the attitudes of inhabitants regarding their support for the development of cultural heritage tourism. A descriptive research approach was used for this study. Field survey method was employed to collect primary data from the target respondents with the help of a structured questionnaire which was developed after reviewing relevant literature. In order to measure resident support, five statements were adapted from previous tourism support studies (e.g. McGehee & Andereck, 2004; Andereck & Vogt, 2000; Latkova & Vogt, 2012; Styliadis & Quintero, 2022; Lwoga, 2019). In the end, participants were provided a “five-point Likert scale with 1 being strongly disagree and 5 being strongly agree” on the basis of which they were instructed to rate how much they agreed or disagreed with each statement. The survey took place at the selected cultural heritage destinations of Jammu and Kashmir. Using a systematic sampling approach with an initial random position, researchers remained stationed at specific locations to intercept any fourth adult who passed by. This conforms to the data collecting technique adopted by (Ouyang et al., 2017; Wang et al., 2020; Tam et al., 2022) given the absence of explicit sample frame. The survey is composed of two sections. The respondents' demographic information was presented in the first section, while questions about local support were presented in the second section. During the data collecting phase that lasted for three months (May through August 2022), 650 people were approached and requested to take part in the study. Among those 485 individuals filled the questionnaire, which resulted around an 84.7% response percentage. Mean, frequency, as well as statistical procedures that include the “t-test and one-way ANOVA” were employed to conduct the study's statistical analysis.

RESULTS

Demographic data

Out of the four hundred eighty-five individuals who gave the gender details (table, 1), 311 (64.1% of the total) were males, while 174 (35.9%) were women. The most important age range for inhabitants is between the ages of 18 – 24 (24.5%) or rather 25 - 34 (18.8%). According to respondents' educational qualifications, most of the survey participants held a college 23.7% and high school degree 21.0%. In terms of the respondents' employment (table 4.5), the significant portion of participants (29.3%) are either self employed or whose occupation or income is directly or indirectly associated with tourism (27.0%). Further highest proportion of study participants (35.7%) earnings recorded between Rs. 10, 000 - Rs. 49, 999, followed by (29.1%) between Rs. 50,000 – Rs. 89999. Finally, significant portion of participants had been residing in their respective areas for longer than 11 years, accounting for (45.4%) of the study population. The next largest category (31.8%) had resided in their respective localities for 6 to 10 years.

Local Community Support for CH Tourism

The level of support that inhabitants of Jammu and Kashmir had for the expansion of cultural heritage tourism was evaluated by using five statements that functioned as measures of the latent variable in the research. Each statement was rated by participants using a Likert scale, where a value of 1 means strong disagreement and a value of five signify a strong agreement. The average values for these five questions were over 3.75, which is an obvious sign that respondents agreed with these statements, according to the replies shown in (table, 2). Survey participants explicitly agreed on the fact that the sheer volume of people visiting Jammu and Kashmir should increase “mean value” (3.76); cultural heritage tourism should be further developed in Jammu and Kashmir “mean value” (3.77), it is critical to create plans to regulate historical site conservation and the expansion of cultural heritage tourism “mean value” (3.76). Further residents support current cultural heritage tourism developments “mean value” (3.73) and finally, “local governments should fund the development of cultural heritage tourism in Jammu and Kashmir” mean value (3.76). In general, from the results it became clear that the respondents have strong beliefs on support for cultural heritage tourism development in Jammu and Kashmir.



**Nassar Ahmed and Shahnawaz Ahmad Dar****Demographic characteristics and Community perceptions**

This section of the study provides additional examination of the data that was obtained in order to investigate any perceptual differences which may exist in the demographic characteristics of the locals with regard to their support for cultural heritage tourism. The demographic characteristics employed include populations' age, occupation, gender, income, length of residence, education. The data have been subjected to comparative statistics employing the t-test as well as ANOVA. A t-test was conducted on demographic factors comprising two sample categories and for a number of groups exceeding two samples ANOVA and Tukey's Post Hoc analysis (HSD) was employed. The t-test analysis (table, 3) demonstrates a statistically significant ($p < 0.05$) difference across the gender categories of residents in terms of their support towards cultural heritage tourism. Further the (ANOVA) findings demonstrates a statistically significant exists difference across the resident's age categories, $F = 3.561$, $p = .004$ (table, 4a) educational groups, $F = 4.490$, $p = .001$ (table, 5a) and occupational groups, $F = 4.324$, $p = .002$ (table, 7a) with respect to their degree of support for cultural heritage tourism. As a result, (H1, H2, H3 and H5) was supported. However there exists no statistically significant difference among the mean value of residents from various income groups (table, 6) and length of residency (table, 8) regarding their support towards cultural heritage tourism ($p > 0.05$). Hence, (H4 and H6) was not supported. Findings demonstrate a statistically significant difference exists across the resident's gender, age, educational groups and occupational groups with respect to their degree of support for cultural heritage tourism. The post hoc analysis reveals that there exists a statistically significant difference among resident age groups of 18-24 and above 65 years (table, 4b), across educational groups with no formal education and less than high school; no formal education and high school; no formal education and college; no formal education and university graduates (table, 5b) and across the occupational groups with public/private sector employees and direct/indirect tourism employees (table, 7b).

DISCUSSION

The study's primary goal would be to evaluate the attitudes of inhabitants regarding their support for the development of cultural heritage tourism in the "Indian Union territory of Jammu and Kashmir". In order to carry out this study, a comprehensive review led to the formulation of six hypotheses, which were then verified through surveys with locals from J&K. In general, considering the research result obtained, it may be inferred that residents strongly support cultural heritage tourism development and want to see the increased number of tourists while stressing on the plans for promotion and conservation of cultural heritage tourism in Jammu and Kashmir. If properly promoted and developed cultural heritage tourism act as an important economic development option in the region. The study findings also exhibited that males had a higher percentage than females to be in favour of CH tourism growth in J&K. As a result, males are more supportive than females towards cultural heritage tourism development. The outcomes of this investigation were in accordance with those found in previously published studies (Jani, 2018; Nunkoo and Gursoy 2012; Papastathopoulos et al., 2020). Study results likewise indicate that the age group ranging from 18 to 25 had the largest percentage of respondents who expressed strong support for cultural heritage tourism. As a result, (younger people) showed greater support for cultural heritage tourism, in contrast to (older people), who expressed lesser support for the sector.

The outcomes of this investigation were in accordance with those found in previously published studies (McGehee & Andereck, 2004; Haralambopoulos & Pizam, 1996; Sinclair-Maragh, 2017) who likewise discovered that younger peoples had a more favourable attitude regarding the tourism industry's growth than older ones. A high mean value is reported for the participants who had graduated or post-graduated from a reputed university, whereas a low mean value is reported for the participants with no formal education. Therefore the group of participants who supported the development of cultural heritage tourism had graduated or post-graduated from a reputed university or college. These results are consistent with those found in earlier studies who concluded that individuals with a greater degree of education had more favourable perception of tourism opposed to those who have relatively low level of education (Sinclair-Maragh, 2017; Almeida-García et al. 2016; Alrwajfah et al., 2019). Further, analyses indicate that inhabitants whose occupation or income are directly or indirectly associated with tourism are indeed



**Nassar Ahmed and Shahnawaz Ahmad Dar**

the major occupational group with highest level of support towards cultural heritage tourism development. The results, however, are consistent with those of other research that have shown a favourable association among residents' employment sector/economic dependency and their opinions of tourism (Kim, 2018; Woo et al., 2018; Muresan et al., 2016). Finally, there exists no statistically significant difference among the mean value of residents from various income groups and length of residency regarding their support towards cultural heritage tourism.

CONCLUSION

These findings should not be ignored and needs to be accordingly considered when making decisions regarding tourism policy and regional planning. Given that male inhabitants are more inclined to be in favour of CHT, the possible reason could be that they were more engaged in the tourism sector than female inhabitants. As a result, those in charge of making plans for CH tourism need to continue providing more opportunities for entrepreneurial investments and employment to male residents. Also, authorities throughout the area should help in promoting cultural events and activities for visitors and offer women's the incentive to take part in community arts and crafts, attempting to take advantage of people's strong desire to share their culture. Furthermore, the authorities may also encourage CHT-related educational programmes for community members with lower educational attainment, emphasising the socio - economic advantage of CHT to enhance locals' support for the sector. Training and educating community members in order to work with in tourism sector is a vital tool for community empowerment (Nunkoo and So, 2016). In a similar vein, administrative authorities should focus their attention on younger community members, and should additionally make an attempt to encourage elders by increasing the number of awareness programmes and introducing initiatives that boost community participation. The local planning and development authorities should organise an informational campaign for community members among diverse set of occupational groups in an effort to increase the literacy and educational level of the local population regarding the advantages of CHT. Further, informing locals regarding the various aspects and major priorities of tourism industry and provide details regarding the tourism related ventures already underway in the area will be beneficial in the long run. Hence, by identifying the multiple demographic features of community members, local authorities will indeed be able to incorporate initiatives that appeal to various demographics. As a result of this, those in charge of the planning of tourism should begin to place a greater emphasis on providing for the requirements of the locals. More importantly the results of the research add to the literature regarding the evaluation of community support towards cultural heritage areas especially in developing economies. Furthermore current research does have certain limitations. First and foremost, the present investigation is based on the quantitative (close-ended) methodology for data collection hence; future researchers should use mixed method (qualitative and quantitative) approach for resident's opinions. In addition, this research was cross-sectional, therefore longitudinal studies are recommended to evaluate potential changes in inhabitants' support behaviour. Lastly, the study examined only resident's attitude so it is recommended that perception of other stakeholders participating in cultural heritage tourism should be studied in future studies.

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Nassar Ahmed and Shahnawaz Ahmad Dar

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Table 1. Respondents' Demographic Characteristics

Demographic	Frequency	%	Demographic	Frequency	%
Age (n=485)			Employment (n=485)		
18-24	119	24.5	Unemployed	66	13.6
25-34	91	18.8	Student	40	8.2
35-44	65	13.4	Self employed	142	29.3
45-54	44	9.1	Public/private	106	21.9
55-64	90	18.6	Direct/indirect tourism	131	27.0
65 above	76	15.7	Income (n=485)		
Gender (n=485)			Less than 9999	14	2.9
Male	328	67.6	Rs. 10,000 - Rs. 49,999	173	35.7
Female	157	32.4	Rs. 50,000 - Rs. 89,999	141	29.1
Education level (n=485)			Rs. 90,000 - Rs. 1,29,999	125	25.8
No formal education	97	20.0	Rs. 1,30,000 - Rs. 1,69,000	32	6.6
Less than high school	71	14.6	Length of residence (n=485)		
High school	102	21.0	Less than a year		
College degree	115	23.7	1-5 years	22	4.5
university degree	100	20.6	6-10 years	89	18.4
			More than 11 years	154	31.8
				220	45.4





Nassar Ahmed and Shah Nawaz Ahmad Dar

Table 2. Support for cultural heritage tourism

	Mean	Std. Deviation
Support	4.269	.479
Increase in the volume of tourists	3.76	1.27
Cultural heritage tourism should be further developed	3.77	1.23
It is critical to create plans to regulate historical site conservation and the expansion of cultural heritage tourism.	3.76	1.28
I support current cultural heritage tourism developments in Jammu and Kashmir	3.73	1.26
Public funding for CH tourism promotion	3.76	1.30

Table 3. Results of t-test for gender

Construct Variables	Gender	Mean	Std. Deviation	Levene's test for equality of variances		t	Sig. (2-tailed)
				F	Sig.		
	Male	3.8088	.45490	4.061	0.44	3.687	.000
	Female	3.6395	.51001				

Table 4a. Results of ANOVA by age

Construct	Age	Mean	Std. Deviation	F-value	df	Sig.
	18-24	3.8654	.41381	3.561	5	.004
	25-34	3.7237	.56448			
	35-44	3.8308	.43703			
	45-54	3.6555	.45955			
	55-64	3.7530	.51063			
	65 above	3.6081	.43150			

Table 4b. Results of Tukey's HSD post hoc by age

Construct	(I) Age	(J) Age	Mean Difference (I-J)	Sig.
	18-24	25-34	.14163	.267
		35-44	.03457	.997
		45-54	.20993	.122
		55-64	.11236	.529
		65 above	.25733	.003
	25-34	35-44	-.10707	.733
		45-54	.06829	.970
		55-64	-.02927	.998
		65 above	.11569	.619
	35-44	45-54	.17536	.405
		55-64	.07780	.914
		65 above	.22276	.061
	45-54	55-64	.09757	.872
		65 above	-.04740	.995
	55-64	65 above	-.14496	.361





Nassar Ahmed and Shahnawaz Ahmad Dar

Table 5a. Results of ANOVA by education

Construct	Education	Mean	Std. Deviation	F-value	df	Sig.
	No formal education	3.5738	.48178	4.490	4	.001
	Less than high school	3.8162	.49842			
	High school	3.8109	.48785			
	College	3.7805	.48452			
	University and above	3.7962	.41198			

Table 5b. Results of Tukey's HSD post hoc by education

Construct	(I) Highest Education	(J) Highest Education	Mean Difference (I-J)	Sig.
	No formal education	Less than high school	-.24243*	.010
		High school	-.23711*	.004
		College	-.20667*	.014
		University	-.22241*	.009
	Less than high school	High school	.00533	1.000
		College	.03576	.987
		University	.02002	.999
	High school	College	.03043	.990
		University	.01469	.999
	College	University	-.01574	.999

Table 6. Results of ANOVA by income

Construct	Income	Mean	Std. Deviation	F-value	df	Sig.
	Less than Rs. 9999	3.7174	.34489	.485	4	.747
	Rs. 10,000 - Rs. 49,999	3.7514	.46762			
	Rs. 50,000 – Rs. 89999	3.7965	.51734			
	Rs. 90000- Rs. 129999	3.7267	.45173			
	Rs. 130000 or more	3.7039	.53613			

Table 7a. Results of ANOVA by occupation

Construct	Occupation	Mean	Std. Deviation	F-value	df	Sig.
	Unemployed	3.6555	.45308	4.324	4	.002
	Student	3.7172	.41018			
	Self employed	3.7481	.50120			
	public/private	3.6694	.50207			
	direct/indirect tourism	3.8897	.44399			

Table 7b. Results of Tukey's HSD post hoc by occupation

Construct	(I) Occupation	(J) Occupation	Mean Difference (I-J)	Sig.
	Unemployed	Student	-.06172	.966
		Self employed	-.09263	.682
		public/private	-.01396	1.000
		direct/indirect tourism	-.23425*	.010
	Student	Self employed	-.03092	.996
		public/private	.04775	.983
		direct/indirect tourism	-.17253	.258





Nassar Ahmed and Shahnawaz Ahmad Dar

	Self employed	public/private	.07867	.694
		direct/indirect tourism	-.14162	.099
	public/private	direct/indirect tourism	-.22029	.004

Table 8. Results of ANOVA by length of residence

Construct	Length of residence	Mean	Std. Deviation	F-value	df	Sig.
	Less than a year	3.6855	.43022	.508	3	.677
	1–5 years	3.7460	.46251			
	6–10 years	3.7304	.50006			
	More than 11 years	3.7807	.47767			





Knowledge Attitude and Practices of Covid Appropriate Behavior- A Cross Sectional Dipstick Study of People in Jaipur, Rajasthan

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ABSTRACT

All stakeholders agree, post-pandemic, that humanity must learn to live with it rather than try to live without it. Even with vaccinations, COVID-19 must be managed carefully. This research explores public knowledge, attitudes, and practices (KAP) associated to Covid Appropriate Behaviours (CAB). Data was collected over 15 days after the current increase in Covid instances from December 10-25, 2022, through Google forms. Participants were from Jaipur, Rajasthan, and WhatsApp contact lists of two undergraduate and two postgraduate hospital administration [1] students were utilized to reach responses. 232 subjects were included in the statistical data analysis. Most participants know the acronym of CAB (96.6%) and the toll-free number (75%). Only 39% of respondents remembered how many CABs are advised, and only 46% knew that 6 feet was the acceptable social distance. Male and female KAP differed in travel, social media, toll-free numbers, distance, and psychological support. ANOVA found age-related differences in respiratory hygiene, physical distance, discrimination towards Covid-positive patients, and psychological support. Knowledge has a negative connection with practice, whereas attitude has a favourable association. Health specialists and policymakers must convey

57987



**Shanmugapriya et al.,**

knowledge and about CAB to increase its popularity. 'Person-centered' initiatives and policies that welcome disadvantaged people are needed in future, and to overcome the CAB knowledge-practice gap.

Keywords: Attitudes, CAB, knowledge, practice, Jaipur.

INTRODUCTION

COVID 19 outbreak brought unanticipated challenges that can only be overcome with everyone's participation and following Covid appropriate behaviours in the interest of greater common good. Central and state governments are doing a good job stopping the spread of Novel Corona Virus (COVID 19), but they must emphasize preventative measures and practices to successfully deal with the disease over the long run. The Indian Ministry of Health and Family Welfare produced a guide on COVID-appropriate behaviours. This guide offers 15 ways to avoid the deadly infection. We must make 15 promises as part of COVID Appropriate Behaviours.[1]. People learnt to respect nature after experiencing its curative benefits for the first time owing to a lack of human play. While attention is now focused on responding to the pandemic and adjusting to its immediate effects, an enabling environment is required to encourage and sustain COVID-19-appropriate behaviours. The bimodal distribution of COVID-19 and the imminent approach of the following wave make proper behaviour very essential [2].

In light of the recent worldwide increase in occurrences of chronic obstructive pulmonary disease (COPD), the Indian Medical Association is sounding an urgent call for the public to adopt COVID Appropriate Behavior. The health minister Mandaviya, at his online meeting with IMA,[3] appealed to follow Covid-appropriate behaviour this holiday season to keep variants away. Doctors advise against self-medication, adhering to isolation and quarantine measures, and immunisation in order to decrease adding to the numbers.[4].It's especially important to follow Covid customs throughout the holidays and wedding season. The consequences of being uninterested might be severe. Covid-appropriate behaviours like as social distance, mask wearing, and hand washing, especially during celebrations, were taught to us after the second lethal wave and must be practised indefinitely. Vaccinated people must also adhere to the rules.[5].As the Christmas season approaches, the government has warned of a likely spike in coronavirus infections and urged immunization.It is important to follow CAB, less travel and responsible festivities are advised [6]. To defeat the new coronavirus, we must employ preventative measures like immunisation and practise Covid-appropriate behaviours like using masks, keeping distance from others, and washing hands often. [7]. Because the surge is poised to make another appearance, it is imperative that we continue to exhibit Covid appropriate behaviors. Therefore, the purpose of the research is to determine the level of knowledge, attitudes, and actual practices shown by individuals throughout this critical period.

REVIEW OF LITERATURE

Following the completion of the requisite literature search for this specific study, it was discovered that just a small number of research were concentrating on the subject at hand. To the best of our knowledge, this investigation will be the pioneering effort of its kind to be carried out in the state of Rajasthan. With the aid of the findings that are derived from this research, we will be able to determine the actual characteristics of the COVID suitable practices that are used by the citizens of Jaipur.

According to media, social media, government websites, and personal networks, the best way to limit the COVID-19 virus is to isolate and treat afflicted persons. Awareness correlates with education and employment. The great majority of participants supported the government's attempts to limit COVID-19 and acted responsibly during the quarantine. Most responders avoided crowded areas and used masks and gloves when outdoors [8]. CAB Knowledge influences attitudes (including risk and optimism) and behaviours (e.g., personal hygiene practices and



**Shanmugapriya et al.,**

social distancing). Efficacy belief was the most influential and significant COVID-19 practice component. It connected knowledge to three preventive behaviours (wearing facial masks, practicing hand hygiene, and avoiding crowded places). Demographics affected knowledge. Women and the educated were influencing more [9]. There was no statistically significant difference in knowledge of symptoms and disease transmission by type of Health Care Worker, however the majority understood both. Most participants considered lockdowns, infection control programmes, and continual education of healthcare staff were effective approaches to restrict COVID-19's spread. Taking all safety procedures when handling PPE was the sole practice connected with qualification. Competence, optimism, and professionalism are high in CAB [10].

It was not enough for participants to simply be aware of COVID-19; rather, they needed to have a constructive emotional outlook on the topic. Preventive behaviours were more common among older individuals, and they were more likely to adopt epidemic prevention hygiene practises, reduce public activities, and assist others avoid the epidemic, whereas younger participants were less likely to adopt these behaviours [11]. In one study of sick female healthcare workers at south region medical college hospital, 63.7% wore masks as instructed, 68% washed their hands properly, and 63.3% were not worried about the illness. 82.4 percent of people choose felt masks. 86% said hand washing was effective, and 58.8% said masking and social distance prevent a second illness. In comparison research, HCWs over 20 had a favourable attitude about face masks, social distance, and hand washing and considered CAB is more beneficial in reducing infection [12]. Age was related to CAB knowledge, but not attitudes. Covid-19 suitable behaviours and age are not statistically significant, and general population covid-19 knowledge scores are adequate with their demographic factors. Only around 50% of participants followed preventive behaviours and held COVID-19-appropriate attitudes. And a gap was discovered between Covid knowledge and practice [13]. Most research participants reported staying home in recent days, not attending parties, funerals, or public locations, and changing daily routines owing to COVID-19. Most participants preferred health professional-sent COVID-19 information. TV, radio, and newspapers were used to spread COVID-19 news. Knowledge of participants affects COVID-19 prevention and control [14].

RESEARCH METHODOLOGY

Research question

What is the status of knowledge, attitude and practices among the people of Jaipur towards the COVID appropriate behaviors?

Research objectives

The study's objectives have been established to address the research question.

1. To find out the status of people's knowledge, attitudes and practices on various information regarding COVID practices
2. To assess the difference between KAP – CAB between male and female respondents
3. To examine the difference between KAP – CAB among various age groups
4. To discover the association between Knowledge on CAB and Practice of CAB
5. To find the association between attitude on CAB and Practice of CAB

Research hypotheses

- H1o: There is no difference between male and female KAP on CAB
H1a: There are differences between male and female KAP on CAB
H2o: There is no differences between the people of diverse age groups' KAP on CAB
H2a: There are differences between the people of diverse age groups' KAP on CAB
H3o: There is no association between Knowledge on CAB and practice of CAB
H3a: There is an association between Knowledge on CAB and practice of CAB
H4o: There is no association between Attitude on CAB and practice of CAB



**Shanmugapriya et al.,**

H4a: There is an association between Attitude on CAB and practice of CAB

Population, sampling and data collection

This research used a cross-sectional, analytical study design. People who are now residing in Jaipur city were considered for data collection. After some preliminary testing, the questionnaire was refined and made available to a wide audience via the format of a Google form. For this research, convenience sampling method was adopted.

Study tool/ questionnaire

The Ministry of Health and Family Welfare published an illustrated guide on 15 Covid-appropriate behaviours. This manual presents 15 strategies for avoiding exposure to the fatal virus. These 15 procedures were recast as knowledge, together with supporting information for the respondents (e.g., the CAB acronym and its extended form, how many behaviours, the respondents' preferred types of masks, the required distance in feet, and the specifics of a toll-free number). Variables for attitudes and practices were established in accordance with the 15 exemplar Covid actions measured through the Likert scale.

RESULTS AND ANALYSIS

The reliability statistic shows that the 49-item KAP-CAB scale's Cronbach alpha is 0.702, as per the table. It is preferable if the reliability coefficient approaches 1.0. The internal consistency reliability of the measures employed in this study having a value larger than 0.7 is considered to be good.

Objective No. 1: To find out the people's knowledge on various information regarding COVID practices.

Objective no.2: To assess the difference between KAP – CAB between male and female respondents and testing of Hypothesis 1

H1o: There is no difference between male and female KAP on CAB

H1a: There are differences between male and female KAP on CAB

The results of the T-test shows that the difference of means for males and females on knowledge, attitudes and practices of Covid appropriate behavior are significant. Thus reject the null hypothesis and accepting the alternate hypothesis i.e.H1a: There are differences between male and female KAP on CAB.

Objective no. 3: To examine the difference between KAP – CAB among various age groups and testing of hypothesis 2

H2o: There is no differences between the people of diverse age groups' KAP on CAB

H2a: There are differences between the people of diverse age groups' KAP on CAB

The indicated F values relevant with the significant p values (< 0.005) shows that there are differences between the multiple age group in knowledge, attitudes and practice of Covid appropriate behavior. Thus, rejecting the null hypothesis and accepting the alternate hypothesis i.e H2a: There are differences between the people of diverse age groups' KAP on CAB. The regression coefficient Beta value(-.264) indicates that the negative association between knowledge and practice of CAB. Hence it can be deduced there is a significant inverse association between knowledge and practice of CAB. So, the alternative hypothesis H3a: There is an association between Knowledge on CAB and practice of CAB is accepted.

Objective no 4: To discover the association between Knowledge on CAB and Practice of CAB and testing of Hypothesis 3

H3o: There is no association between Knowledge on CAB and practice of CAB

H3a: There is an association between Knowledge on CAB and practice of CAB



**Shanmugapriya et al.,**

Objective no.5: To find the association between attitude on CAB and Practice of CAB and testing of hypothesis 4

H4o: There is no association between Attitude on CAB and practice of CAB

H4a: There is an association between Attitude on CAB and practice of CAB

The regression coefficient Beta value (0.505) indicates the positive association between attitude and practice of CAB. Hence it can be deduced there is a significant association between knowledge and practice of CAB. So, the alternative hypothesis H3a: There is an association between attitude on CAB and practice of CAB is accepted.

DISCUSSION AND CONCLUSION

It is encouraging to learn that 96.6% of people are aware of the CAB and its expansion, and that 72.0% of respondents are acquainted of the CAB's promises and the Ministry of Health and Family Welfare's illustrated guide. However, 39% of individuals are only conscious of the number of necessary actions, which include mask use, hand washing, no travel, social isolation, no gatherings rather than respiratory cleanliness, prejudice against Covid users, and psychological assistance. In addition, although everyone is conscious that a certain distance must be maintained, only 46% of respondents provided the right reply of 6 feet. The majority of responders favour disposable masks (56%), while some choose for reusable or handcrafted options or both. It's encouraging to discover that 75% of respondents were aware of the covid emergency toll-free number 1075. Males are aware that unnecessary travel should be avoided, surface cleaning is essential, unpleasant social media messages should not be shared, and credible information sources should be relied upon. In addition, male respondents are aware of the toll-free number to contact in the event of a covid emergency. However, females are more aware of the restriction against spitting in public places than males. Compared to men, females are more averse to physical greetings and more inclined to preserve social distance. Males are more likely than females to conduct respiratory hygiene, maintain physical distance, wash their hands, dial a helpline number, and seek psychological help.

Knowledge of respiratory hygiene is strong among those aged 41 to 50 but learnt discrimination against Covid people among those aged 41 to 50 and older. Elderly persons have a favorable attitude toward physical distance, not touching the ears, nose, and eyes, and seeking psychological assistance. Younger age groups are more likely to dial a toll-free number in an emergency and to view reliable sources as trustworthy than older age groups. Young age groups are more likely to keep physical distance, use masks, and dial toll-free numbers. In addition, age group 41-50 is the only age group that does not seek psychological support when compared to other age groups. The results of the regression analysis showed that there is a negative association between knowledge and practice. This finding prompted the researchers to draw the conclusion that even if individuals have knowledge of CAB, they are not practicing it correctly. In addition, attitude has a positive association with practice, which indicates that a more favorable attitude toward the right behaviours for the COVID context leads to better practices.

During a global pandemic, the people must always take precautions to contain it. This study finds that knowledge is an essential predictor of attitudes and behaviours, which helps advance intervention techniques to encourage and sustain cautious public behaviour during the COVID-19 pandemic. The study reveals that the general people have enough understanding of CAB but do not practice to desired extent. Knowledge drives attitudes and practices. When educating people, the government and relevant agencies should also consider how to move the public from "empty talk" to "do it now." We advise that relevant authorities or education departments produce morality- or social-cohesion-based propaganda or educational interventions to increase people's desire to adopt preventative steps in the future. Our study found that inconsistent knowledge, attitudes, and practises, along with a lack of access to health care and pre-existing health conditions, may prevent some people from engaging in healthy behaviours. This research shows how the government and public health organisations plan and implement policies and treatments that don't ignore critical cases.





Shanmugapriya et al.,

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Shanmugapriya et al.,

Cronbach's Alpha	N of Items
.702	49

Table 2: Knowledge regarding various information

S.no	Knowledge regarding various information	Percentage
1	Knowing full form for the acronym CAB	96.6%
2	Awareness about CAB – Released by Ministry of Health and family welfare, India.	72%
3	Knowledge about number of Covid Appropriate Behaviors	39%
4	Knowing the information regarding maintaining 6 feet physical distance	46%
5	Preference of the type of masks by study respondents	56%
6	Knowledge of people – known about 1075 Toll free number for Covid emergency.	75%

Table 3: Differences between male and female in KAP- CAB as per the t-tests

VARIABLE	GENDER	MEAN	SIGNIFICANCE	INFERENCE
KNOWLEDGE				
No unnecessary travel	Male	1.0000	.000	More Male respondents said 'Yes' to No travel than females
	Female	1.1409		
Surface cleaning frequently	Male	1.0361	.000	Knowledge of surface cleaning is more for male than females
	Female	1.1342		
Spit in open places	Male	1.0361	.000	Female knowledge on not spitting in open space is more than male
	Female	1.1745		
Should not encourage negative social media posts and spreading	Male	1.1084	.000	Males having knowledge on, not encouraging negative social media posts rather than female.
	Female	1.2284		
Getting information only from credible sources	Male	1.0241	.000	Males have more knowledge on getting information from credible sources than female
	Female	1.2282		
Aware about the availability of Toll-free number for COVID	Male	1.0843	.000	Males are aware about Toll free number than females
	Female	1.3020		
ATTITUDE				
Physical contact	Male	4.6386	0.001	Greeting without physical contact is preferred more by female than male
	Female	4.3289		
Physical distance	Male	4.5783	0.005	Maintaining physical distance is more preferred by female than males
	Female	4.7181		
PRACTICE				
Respiratory hygiene	Male	4.8554	0.000	Respiratory hygiene is more maintained by male than female
	Female	4.6376		





Shanmugapriya et al.,

Handwash	Male	4.2048	0.000	Washing hands thoroughly by males than female
	Female	3.3624		
Discrimination	Male	4.3855	0.004	Females are discriminating the COVID sufferers than males
	Female	3.9799		
Calling Toll free number	Male	4.0120	0.001	Males are frequently calling Toll free number than females
	Female	3.6779		
Psychological support	Male	4.3133	0.000	Males are seeking for more psychological support than females

Table 4: Differences between age groups as per the ANOVA results

VARIABLE	SIGNIFICANT	F-VALUE	Differences as per post-hoc test
KNOWLEDGE			
Respiratory hygiene	0.000	7.803	41-50 age group don't know the concept of respiratory hygiene, when compared to the other age groups
Discrimination	0.002	4.380	41-50 and 50 above people said Yes, for discriminating people with COVID
ATTITUDE			
Physical distance	0.000	7.881	The attitude of maintaining physical distance is more among 31-40, 41-50 and above 50. But less for young age 15-20 and 21-30.
Touching nose, ears	0.000	8.908	Young age group (15-30) differs from higher age group (31-50 and above) in the attitude of avoiding touch of eyes, ears and nose.
Toll free no	0.003	4.204	Attitude of calling toll free numbers among young and middle age group is high when compared to elders (41-50 and 50 above)
Credible sources	0.000	8.565	The attitude of seeking information through credible sources is very high among young age group and 50 years above when compared to middle age group.
Psychological support	0.004	3.983	Attitude of seeking psychological support is high among elder group than middle and young age.
PRACTICE			
Physical distance	0.005	3.771	Maintaining physical distance low among young age group and elders when compared to middle age group
Mask	0.000	5.272	Wearing mask all the time is practiced among young and middle age group, but not elder group
Toll free no	0.000	6.492	Calling toll-free number 1075 is frequent among young age group rather than middle age and aged people
Psychological support	0.000	11.170	41-50 age group seeking psychological support is very less, when compared to other groups





Shanmugapriya et al.,

Table 5: Relationship between Knowledge and Practices of CAB as per the regression analysis

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	64.837	2.015		32.169	.000
	Knowledge	-.428	.103	-.264	-4.143	.000

a. Dependent Variable: Practice

Table 6: Relationship between Attitudes and Practices of CAB as per the regression analysis

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	25.116	3.569		7.038	.000
	Attitude	.467	.053	.505	8.883	.000

a. Dependent Variable: Practice





Deep Learning - based Dynamic Music Recommendation System based on Human Emotions

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ABSTRACT

Facial features play a big role in predicting human behaviours. A digital camera is mostly used to capture the feelings of people. The basic objective of numerous programmes being created is to identify human emotions. Only a few motion detection packages include capabilities like e-cognition, criminal activity detection, mental disease and depression diagnosis, and business notification advice. For this suggested gadget, we develop a dynamic music recommendation machine model based on human emotions. The songs are performed for all emotions in line with whatever patterns one tries to notice. The corresponding tunes are sung when the mode is determined from the input image for a surefire way to instruct customers. By using this technique, the programme is linked to human emotions, enabling customised application. In order to develop music games based on human emotions, our project's objective is to understand those emotions. To do this, we use computer vision and device mastery approaches. For motion detection and tweaking recommendations for our experimental effects, we use open CV.

Keywords: mental, disease, human, behaviours, music, games.



Sanjay *et al.*,

INTRODUCTION

In general, people have a tendency to convey their emotions, particularly through their faces. It is common knowledge that music frequently alters a person's mood. It is possible to calm the customer's thoughts more and more and frequently end up with a pleasing outcome by capturing and identifying the sentiments that they are emitting and by delivering appropriate music that suit their moods. The goal of the design is to capture a person's facial expressions of emotion. On computer systems, there is a song player for capturing human emotions via camera interfaces. The programme captures a picture of the user, extracts the character's facial features using photo segmentation and image processing algorithms, and tries to determine what emotion the character is conveying. The project's goal is to make the user happy by playing gambling music that satisfy their needs and photographing their picture. Facial recognition evolved from the high-quality face analysis that identified persons in the past. Individuals frequently evaluate or make assumptions about the thoughts, sentiments, or emotions that others are trying to portray through their facial expressions. It can also aid in the treatment of disorders like stress and depression in some unique ways. Several fitness hazards may be avoided by parsing expressions, and actions can be done to enhance the user experience.

PROPOSED ALGORITHMS

CNN ALGORITHM

One of the main kinds of neural networks for picture type and photo identification is convolutional. Face popularity, object detection, scene recognition, and many others. Convolutional neural networks are widely employed in a select few fields. Roncus takes an entry photo that is evaluated according to a specific kind and manipulates it to look like a dog, cat, lion, tiger, etc. The laptop interprets the image as a collection of components and bases its interpretation on the image's choice. Depending on how the image is decided, it will look to be $h*w*d$, where h stands for the top, w for the width, and d for the size. A matrix of $6*6*3$ represents an RGB image, whereas a matrix of $4*4*1$ represents a grayscale image. Each input image in CNN will travel through a series of convolutional layers that include collates, layers, and filters (also called kernels). The soft-max function is then used to demonstrate that the object is likely to have values between 0 and 1.

LITERATURE SURVEY

Smart Music Player Integrating Face Emotion Recognition

Music have always been a popular method for expressing human emotions. Our suggested array structure is used to build a real-time device vision system that simultaneously conducts face recognition and emotion classification in a single step, allowing us to evaluate our models. Strong motion-based class hierarchies can get a long way towards making movement easier. Studies on music classes that are centred on emotions, however, have not produced the best results. In this essay, we offer an emotive EMP move-platform music player that, in real time, plays music according on the user's ideas. In our adaptive tune advise gadget, EMP offers clever, mode-based track tips that integrate movement-based reasoning skills. Three components make up our music participant: the integration module, the music module, and the animation module. The emotion module utilises the user's photo as input and deep learning algorithms to accurately predict the user's mood with 90.23% of the time.

Mode primarily based song recommendation machine

The sensitive expression can be used to gauge a person's mood or emotion. You may get these expressions from the stay feed using the camera system. In computer vision and machine learning (ML), where machines are trained to detect certain human gestures or patterns, significant research is being done. Machine mastery offers a variety of methods for spotting human movements. In this manner, MobileNet is used with the Keras model to provide a trained version with a short length that is simple to connect with Android-ML. Music is a fantastic website. We are united by our businesses, ages, origins, languages, tastes, political beliefs, and economic stages. As these applications may be used anytime, anywhere, and may be connected to daily sports, tours, sports, and other activities, they are in high demand. Tune has gone digital due of the rapid advancement of mobile networks and digital media



**Sanjay et al.,**

technologies. the main subject matter that many younger people are looking for. People frequently turn to music as a coping method, particularly to change a bad mood, gain strength, or relieve stress. Also, listening to the right music might improve intellectual wellness. Thus, singing and human emotions are closely related. Our suggested gadget develops a music player that gauges mood in real time and plays songs mostly depending on the mood detection. This adds a new feature to the standard music apps that are already installed on our cell phones. Customer satisfaction is one of the comprehensive detection method's main benefits. This device's function is to analyse the user's image, forecast their facial traits, and automatically choose music that go with it..

A Motion-Based Private Music Recommendation System Using Convolutional Neural Networks Approach

A approach to improve the user's listening experience is to provide music recommendations in their song selections. It might be challenging to make the connection between personal data about an individual (such as location, time of day, musical preferences, movements, etc.) and musical compositions. In this article, we suggest the usage of an emotion-based entirely persona song recommendation system (EPMRS) to identify relationships between user data and tracks. We use two event approaches—a weighted feature extraction (WFE) method and a deep convolutional neural community (DNN) technique—to achieve this connection. Using music recordings, such as auditory cues and associated information, the DNN approach extracts latent capacities for type. To extract the difference between the user facts and the tune data, we create an implicit user score for the song using the WFE approach. The Term-Frequency and Inverse Document Frequency (TF-IDF) method is used in the WFE technique to produce implicit listener evaluations for songs. Subsequently, depending on the user's implied track score, EPMRS suggests music to the user. To instruct EPMRS, we make use of the Million Song Dataset (MSD). We use the Electroencephalography Feedback-based fully Personalized Music Recommender System (PMRSE) and the Content Similarity Music Recommendation System (CSMRS) as our basic systems for the assessment. According to the results of the experiments, EPMRS offers greater song suggestion accuracy than CSMRS and PMRSE. We are also expanding our Android and iOS apps to provide useful analytics on user interaction with EPMRS. A collection of anonymous customers' reviews demonstrates that EPMRS accurately represents their musical preferences.

Real-time motion detection the usage of camera and facial expressions.

There are a lot of practical uses for emotion recognition in daily life. In this essay, we offer a technique for detecting human emotion in the present. To anticipate human moods, we extract the matching facial characteristics for each face that is detected by the camera and look at distinctive feature patterns and styles. Tests show that our suggested device reliably identifies human movements in real time with an average accuracy of about 70.6 percent.

Deep Learning in Music Recommender Systems

Deep learning (DL), as in many other study fields, is being practised in music recommendation systems (MRS). In this field, deep neural networks are employed primarily to extract hidden musical aspects from audio tracks or metadata and to analyse the ensuing musical elements (tracks or artists) from playing music or listening sessions. In content filters and hybrid MRS, hidden item features are typically incorporated, and track series advice, including car-continuing plays, uses song item series styles. The characteristics of the field of track advances in MS research are discussed in this article. It is shown on the country of the artwork that develops track guidelines using in-depth knowledge. The conversation is set up in accordance with the size of the neural network type, input, and guidance technique (contentious filtering, collaborative filtering, or both) (fashionable or sequential music recommendation). Also, we discuss the major obstacles MRS students face, particularly in the context of developing in-depth research expertise.

Music player assessment based totally on seems

They frequently convey emotions by hand gestures, facial expressions, and voice tones during spoken interactions with others. The face is a vital part of the human body and plays a crucial role in establishing a character's behaviour and emotional condition. The way someone is looking gives away their current state of mind. It takes a lot of work and time to plan outstanding performances and choose tunes for those performances. So, it may be advantageous if





Sanjay et al.,

the tune performer herself chose music that suited the person's contemporary mood. It may be incredibly laborious, time-consuming, in-depth, and unsustainable effort to manually filter through a list of related music and develop a universal story line that is backed by employing personal sentiments. As a result, the programme may be created for these extensive narrative management activities. Nevertheless, the currently suggested techniques are computationally laborious and only moderately accurate. This suggested system would automatically produce the participant based entirely on the extracted face expression, reducing the time and work required for the guide rendering approach. A digital camera that is integrated into the device transmits facial emotions. The camera takes a picture, and this picture is then put through a number of processes to ascertain the user's mood or feeling. We'll learn how to identify a user's mode in an instant and present them with songs about the modern mode. For face identification and motion detection, the study suggested the Viola-Jones method and multi-class SVM (Support Vector Machine).

The pain of the track participant is based on the popularity of facial actions

Science has proven that music has a mystical quality. People are continually drawn to music that is entirely focused on emotional experiences. Music is regarded as a stress-reliever. Paying attention to track can help you handle many mental conditions very well. Our musical system-based interest is expanding. With the use of the digital camera, the facial image is caught, and the emotions are produced. A number of classifiers are used to do classification. To determine the movement of a recorded facial image, a neural network model is trained and employed. According to the user's perspective, PyQt5 is used to construct the sport play within the musical games.

Music player primarily based on Android movement

Music plays a significant part in people's daily lives and in the contemporary, advanced period. Usually, the person is given the task of manually picking chosen tunes on the device. In order to create a game that is mostly focused on the user's behaviour and emotional state, we have here offered an effective and realistic version. Current techniques for automating playlist production are slower, less accurate, and may necessitate the use of additional systems like EEG or sensors. Speech is the oldest and most natural way to convey emotions, sensations, and anger, yet its production requires great calculations, time, and financial costs. In order to automatically build a storyboard, this project tool is entirely dependent on collecting facial expressions from videos in real time as well as extracting audio notes from songs to denote a certain mood. As a result, computing costs are incredibly minimal.

EXISTING SYSTEM

According to Nikhil et al., facial expressions can reveal what a person is thinking. Individuals regularly display their emotions by hand gestures, heightened voices, and their faces, but they mainly show their sentiments through their faces. Person complexity is decreased by a movement-based fully track player. On stage, there are often a lot of chants. For the user, playing music in a random order is insufficient. The songs can be played automatically in accordance with the user's mode thanks to this method. The webcam records pictures of the subject, which are then saved. The photographs had first undergone an RGB to binary conversion. A characteristic point detection system is the name of this records presenting method. This method works just as well with the Open CV-based Haar Cascade generation. The sophisticated song participant makes use of Java software. organises the database and plays the music in accordance with the preferences of the user.

PROPOSED SYSTEM

The suggested machine can recognise a customer's facial expressions and, based on those expressions, extract facial functions, which may then be used to attribute a user's positive sentiment. Songs that fit the customer's feeling may be suggested when they specify an emotion. We develop a dynamic song recommendation version that is based mostly on human emotions in our suggested device. The songs are done for every feeling with each sample that is attempted to be listened to. Moves are identified from a real face using integrated function extraction and machine learning capabilities, and when the mode is learned from the input photo, the associated songs are played for a specific way to instruct users. The usefulness is connected to human emotions via this method, which draws on personal experience. Hence, utilising computer vision and machine learning techniques, our project aims to identify



**Sanjay et al.,**

human emotions in order to expand emotion-based entirely music games. We utilise openCV for motion detection and track tips for experimental results.

SYSTEM ARCHITECTURE**SYSTEM REQUIREMENTS****HARDWARE REQUIREMENTS**

System - Pentium-IV

Speed - 2.4GHZ

Hard disk - 40GB

Monitor - 15VGA color

RAM - 512MB

SOFTWARE REQUIREMENTS

Operating System - Windows XP

Coding language - Python

SOFTWARE ENVIRONMENT**Python**

Python is an object-oriented, high-level, interpretive, interactive, and literal language. Python is intended to be simple to analyse. It usually uses English key phrases instead of punctuation, has fewer syntactic structures than other languages, and regularly uses English key phrases.

- **Python is interpreted** —during runtime, an interpreter is used to process Python. The programme does not have to be finished before execution may start. The same may be said for PHP and PERL
- **Python is interactive** -you can sit down at the command line and start writing your packages using the interpreter right away.
- **Python is item-orientated** -Python enables encapsulating code in items in an item-oriented approach or programming style.
- **Python is a language for beginners.** For novice programmers, Python is a superb language that enables the creation of a broad range of programmes, from basic word processors to web browsers and games.

MODULES

- Data Collection Module
- Emotion Extraction Module
- Audio Extraction Module
- Emotion - Audio Integration Module

MODULE DESCRIPTION**Data Collection Module**

here are three requirements for users to proceed: 1. Which songs do they enjoy listening to most while they are joyful? 2. Which songs do they prefer to listen to when they're feeling down? Three. What music they enjoy listening to while they're angry.

Emotion Extraction Module

An electronic camera or webcam was used to record the user's image. In order to improve the classifier that is used to identify the person in the photograph after the photo has been taken, the webcam image's body is converted to a grayscale image. After the transformation is complete, the image is submitted to the classifier set of rules, which may extract the face from the webcam's frame by using feature extraction techniques. Functions are collected from the extracted facial information and sent to a network that has been trained to represent the user's reported mood. These images will be used to train the classifier so that, when it is presented with a very different and unfamiliar collection of images, it can extract face position barriers from those images entirely on the basis of the knowledge it has

58000





Sanjay et al.,

previously acquired from education and education. Barriers exist in returning the coordinates of the recently seen face. The network has expertise over a huge data-set. This is used to gauge the consumer's level of passion.

Audio Extraction Module

Following the receipt of the user's emotions, a list of songs based on the user's emotions is presented, the user's music/audio based on the feelings uploaded by the user is displayed, and the user can listen to whatever song he chooses. The songs are shown in the order in which the customer has listened to them.

Emotion - Audio Integration Module

Songs that are proved to evoke certain feelings are kept for tune selections, and they are posted on the website. For instance, the customer is presented with music from the happiness database if an emotion or facial trait is utilised to represent happiness.

RESULTS AND DISCUSSION

This analysis was done in order to pinpoint how the human face and music reacted to modern user preferences. A camera is excited about images of a human face. When the picture is taken, it is converted to a grayscale image to be corrected by the classifier. The corrected image is then sent to the classifier's set of rules, where human emotions are extracted from the face. Classifying a lot of performers can help their investigation. Following the detection and recognition of appropriate facial patterns, clever remarks will assist the user in improving their behaviour.

CONCLUSION

In this paper, we described how our suggested machine uses algorithms for system learning to recommend music based on facial expressions. The suggested gadget may be scaled to provide face expression suggestion using submit-information gathering methods. The gadget no longer uses a sophisticated song recommendation algorithm that corresponds to the data of the existing device. The suggested approach provides faster and more accurate results than the current device. With this approach, we employ machine learning techniques to provide tune recommendations entirely based on in-the-moment facial expressions. The suggested device uses PythonScript's machine learning module. To expand this electronic gadget, we utilised OpenCv, Tensorflow, Keras, WebBrowser, and of course Python scripting. This method is also set up to make consumers' lives simpler and for their convenience. As a result, the character will eventually get calm and acknowledge his excellent decision, allowing you to assist him in enhancing his temper. With the help of their advanced notation, students will be able to enjoy listening to the songs afterwards. The songs will be played on YouTube together with the distinctive animation of the games.

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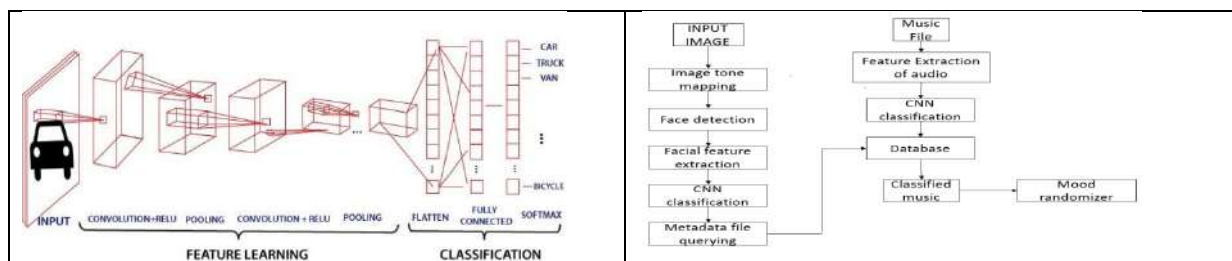


Fig. 1. Feature Learning

Fig2. System Architecture

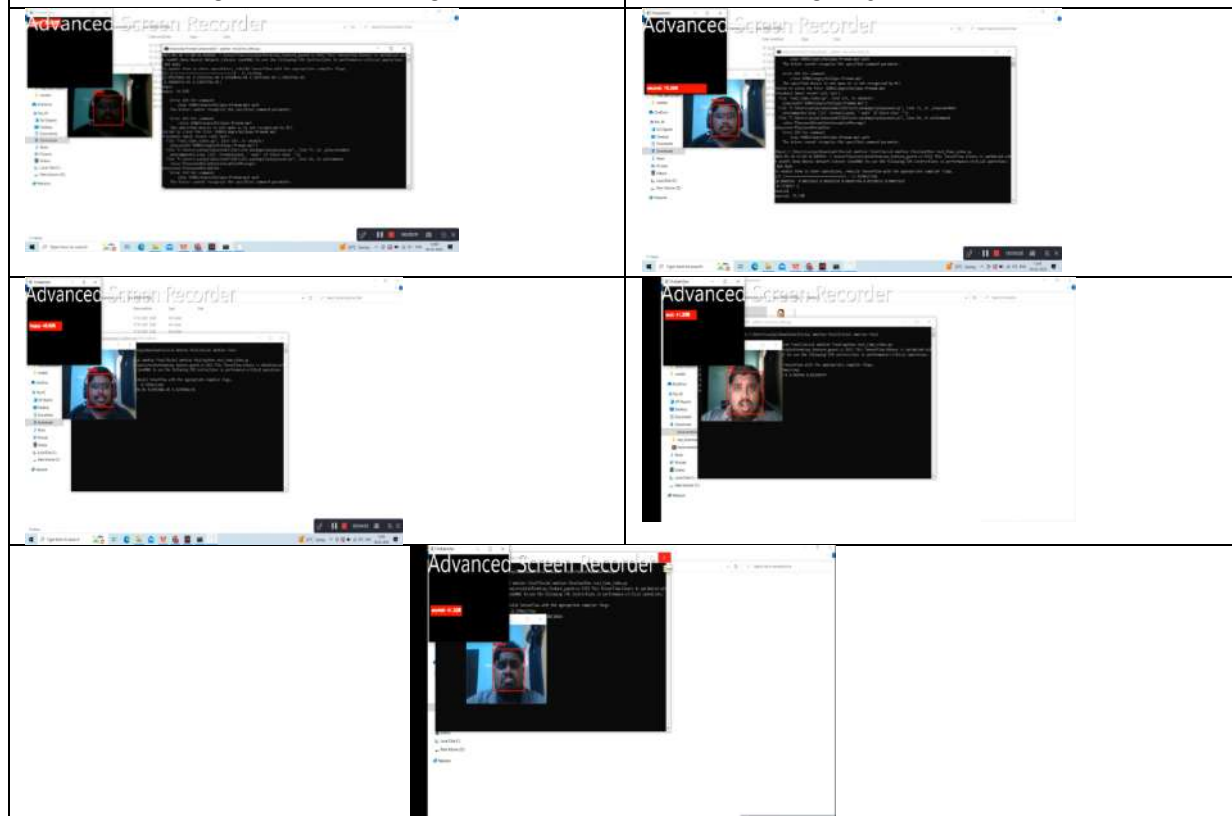


Fig. 3 .Advanced Screen Recorder





Ground Water Exploration using Remote Sensing and GIS in Zawlnuam Rural Development Block, Mizoram, India

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ABSTRACT

Growth of human population, climate change, soil contamination and rapid urbanization increase the demand for water supply. Surface water resource is often inadequate to meet this ever-increasing demand. Consequently, ground water resources need to be explored and harnessed not only for domestic purposes, but also for irrigation and industrial purposes. Advent of scientific techniques for identifying ground water prospective areas for large scale exploration enables us to save time and money. Zawlnuam rural development block in Mamit district of Mizoram, India is endowed with abundant rainfall and number of perennial streams. However, rapid growth of population leads to insufficiency of water resources within the area. Ground water resources may solve this chronic crisis for water scarcity. The present study makes use of geographic information systems (GIS) and remote sensing data to identify the potential locations for ground water availability. Important geospatial aspects which are responsible for the presence of ground water within the district were identified. Accordingly, three thematic layers viz., geomorphology, lithology, geological structures like faults and lineaments were generated. These thematic layers were then combined to form the hydrogeomorphic units which are treated as the aquifers. The final maps show the ground water conditions of the area in terms of prospect. The final output can be utilized for exploration, development and management of ground water resources.

Keywords: GIS, Ground water, Remote Sensing, Zawlnuam block.





Lalbiakmawia et al.,

INTRODUCTION

Ground water is the largest reachable source of fresh water and one of the most important natural resources for supplying the ever-increasing demand caused urbanization and growth of population (Sharma and Kujur, 2012; Neelakantan and Yuvaraj, 2012; Kumar, 2013; Choudhary et al., 1996). Therefore, finding ground water potential areas, monitoring and conserving ground water has become highly necessary (Rokade et. al., 2004; Kumar and Kumar, 2011). The North-Eastern Locale (NER) of India comprises an interesting agglomeration, with a broadened geographical set-up. The marvelous physiographic set up incorporates the dazzling Himalayan Mountain belt within the North, Shillong Region within the south, the Indo-Myanmar Run within the east and the compelling Brahmaputra River, shaping the broad Assam geology. The differing lithologic and structural gathering calls for coordinates geo scientific ponders to distinguish and layout target zones relating to pattern information era, mineral asset assessment, relief of common risks, natural issues and water asset advancement ventures. The rocks uncovered in the North Eastern Region (NER) run in age from Precambrian to Recent. Geologically and geomorphically, the Mizoram state shapes one of the easternmost parts of India, bordered by Bangladesh to the west and south-west, Tripura to the west, Assam to the north, Manipur to the northeast and Burma to the east and southeast. It possesses an area of 23,980 sq.km and the landscape is exceptionally rough and topographically youthful. It is connected with Assam and rest of the nation through the adjoining Cachar area of Assam lying to its north. The landscape characteristic showed an extremely youthful geology. In Mizoram, the geography and physiographic expression of the state is bestowed by around N-S trending steep, generally anticlinal, parallel to sub-parallel slope ranges and narrow connecting synclinal valleys with series of parallel hummocks or topographic highs. In general, the western limbs of the anticlines are steeper than the eastern limbs. Faulting in numerous areas have produced steep fault scarps, especially along the steep-dipping fault planes. The other geomorphic components are the exceedingly dissected ridges with the arrangement of profound gorges which has developed due to intensive erosion in many areas. The contrast of rise between valley floors and slope tops varies significantly from western to eastern areas of Mizoram and ranges from 200 m - 600 m. The steep slope ranges occur are more towards the east part of the state. Mizoram is blessed with high amount of annual rainfall. However, geology of the state comprises ridges with steep slopes and narrow intervening synclinal valleys, faulting in many areas have also produced steep fault scarps (GSI, 2011). Hence, most of the water available is lost as surface runoff. Therefore, majority of the population suffered shortage of water especially in the post-monsoon season. The age-old method of fetching water from springs is still prevalent within the state. Springs, the main sources of water also get depleted during the post monsoon period (Central Ground Water Board, 2007).

Zawlnuam block of Mamit district also experienced acute shortage of water. Therefore, ground water prospective areas have to be identified so as to adopt proper measures for its development. Groundwater is an essential source of water for all people. Although it is submerged beneath the surface of the planet, groundwater contributes significantly to the water cycle and accounts for 99% of the earth's liquid fresh water. The groundwater reservoir feeds rivers, lakes, and wetlands when they are in need of water and drains some of the flow when there is excessive surface water present. Rivers, lakes, and wetlands are surface manifestations of groundwater. Across the world. Up to 50% of the world's population receives all or a portion of their drinking water from groundwater, which also supplies 43% of the water used for cultivation. For their essential daily water needs, 2.5 billion people rely only on groundwater supplies in different parts of the world. The ability of humans to produce enough food without contaminating the soil, water, or climate will be a challenge. The biggest problem that humanity has ever faced has been described as this. The key to the problem is the management of groundwater sustainably. It is crucial to have a scientific understanding of groundwater management because, with careful use and replenishment, groundwater may help solve problems for the future. Although it is submerged beneath the surface of the planet, groundwater contributes significantly to the water cycle and accounts for 99% of the earth's liquid fresh water. The groundwater reservoir feeds rivers, lakes, and wetlands when they are in need of water and drains some of the flow when there is excessive surface water present. Rivers, lakes, and wetlands are surface manifestations of groundwater. Many of the world's largest aquifers (groundwater reserves) are being depleted, according to current scientific measurements.



**Lalbiakmawia et al.,**

A decrease in the stream flow, drying out of springs or wetlands, loss of vegetation, drops in well water levels and soil subsidence can all result from such depletion. Pollution brought on by anthropogenic activities produces chemicals and wastes that have seeped into the earth, this is yet another risk for the groundwater. Groundwater quality is deteriorated by pollution, endangering both human and the ecological health. More demands will be made on the groundwater, a massive but limited resource as the human population grows. Recognizing, understanding our groundwater systems and carefully regulating them within the constraints of the hydrologic cycle will be more important than ever. Few efforts were made to study ground water prospect zones within the state of Mizoram using geospatial technology. These include mapping of groundwater potential zones in Serchhip district (Lalbiakmawia and Lalruatkima, 2014) and mapping of groundwater potential zones in Aizawl district (Lalbiakmawia, 2015).

Spatial technology like application of Remote Sensing and GIS techniques allow swift and cost-effective survey and for management of natural resources (Ramakrishna et. al., 2013). Hence, these techniques have wide-range applications in the field of geo-sciences including ground water prospecting (Jeganathan and Chauniyal, 2002; Anirudh, 2013). Interpretation of satellite data in combination with adequate ground truth information makes it possible to identify and outline various ground features such as geological structures, geomorphic features and their hydraulic characteristics that may serve as indicators of the presence of ground water (Raju et al., 2013). Therefore, many researchers have utilized these techniques successfully in ground water studies (Gustafsson, 1993; Saraf and Jain, 1994; Krishnamurthy and Srinivas 1995, Krishnamurthy et. al., 2000). The same techniques have been proved to be of immense value not only in the field of hydrogeology but also in water resources development as well. (Saraf and Choudhury, 1999; Sharma and Kujur, 2012). The main purpose of the present study is to make use of geo-spatial layers in delineating ground water prospective areas in Zawlnuam block, to create vital database for future development and management of ground water within the rural development block.

STUDY AREA

Zawlnuam block is located in the north western part of Mizoram between 23° 40.648' to 24°15.210' N Latitudes and 92°15.503' to 92°33.000' E Longitudes. It is bounded to the north by Assam state, on the south by Mamit RD block, on the east by Kolasib district and to the west by Bangladesh. The total geographical area of Zawlnuam block is approximately 1170 sq. km and it falls in the Survey of India Topo sheet Nos. 83D/7, 83 D/8, 83 D/11, 83 D/12, 84 A/5, 84 A/6 and 84 A/9. The study area enjoys a moderate climate owing to its tropical location. It is neither very hot nor too cold throughout the year. The average annual rainfall is 2806.47mm (Lalzarliana, 2017).

MATERIALS AND METHODS**Data used**

Indian Remote Sensing Satellite (IRS-P6) LISS III data having spatial resolution of 23.5m and Cartosat-I stereo-paired data having spatial resolution of 2.5m were used as the main data. SOI topographical maps and various ancillary data were also referred in the study.

Thematic layers

Thematic layers generated using remote sensing data like geomorphology, geology and lineaments can be integrated in a Geographic Information System (GIS) environment and can be utilized for delineating ground water potential zones (Chaudary et al., 1996; Kumar and Kumar, 2011). The present study utilized three thematic layers to identify ground water potential zones of the study area. The different layers are as follows-

Geomorphology

Geomorphology is one of the most important features in evaluating the ground water potential and prospect. It can also be utilized in managing ground water resources and highly helpful for selecting the artificial recharge sites as well (Kumar and Kumar 2011; Valliammai et al., 2013, Raju et al., 2013; Ghayoumian et al., 2007). The study area comprises geomorphic units like intermontane valley, alluvial plain, fractured valley, less dissected structural hill,



**Lalbiakmawia et al.,**

moderately dissected structural hill and highly dissected structural hill. All the geomorphic units occurring in the study area are mapped as polygon features. While demarcating the geomorphic units, top sheets were consulted to comprehend the relief variations and other topographic features. The geomorphologic map showing assemblage of different landforms is prepared based on the lithological map so that each rock type is classified into different geomorphic units. Apart from dissection in the hills, slope-form also plays an important role in ground water occurrence and flow in the hilly/ mountainous terrain (RGNDWM, 2008). Geomorphological map of the study area is shown in Figure 2.

Lithology

Detailed knowledge of lithology is an important factor in ground water exploration and in particular, the features to be considered are geological boundaries, porosity, etc., (CGWB 2000; Al-Bakri1 and Al-Jahmany, 2013). All the rock formations occurring in the study area are mapped as a layer. Existing geological and literature are consulted which helps in knowing general geological setting of the area and different rocks types that occur or likely to occur in the area (RGNDWM, 2008). Lithology of Mizoram comprises great flysch facies of rocks made up of monotonous sequences of shale and sandstone (La Touche, 1891). The study area lies over rocks of Middle Bhuban, Upper Bhuban and Bokabil formations of Surma Group along with Tipam group of Tertiary age. Recent unconsolidated sedimentary materials are also found in the low-lying areas. Middle Bhuban and Bokabil formations consist mainly of argillaceous rocks while Upper Bhuban formation and Tipam group comprises mainly of arenaceous rocks (GSI, 2011). The lithostratigraphic map of the study area is given in Figure 3

Geological Structure

Lineaments like faults, fractures and joints can be delineate and analyse using Remote sensing data (Kanungo et al., 1995). They are the most obvious structural features that are important from the ground water point of view (Bhatnagar and Goyal, 2012). The geological structures occurring in the area are treated as conduits for the movement of ground water and provide potential for ground water recharge (CGWB, 2000; Sankar, 2002; Sharma and Kujur, 2012). It was observed that the rocks exposed within the study area were traversed by several faults and fractures of varying magnitude and length (MIRSAC, 2006). The geological structures are mapped as line features.

DATA ANALYSIS

In order to delineate the aquifers, the lithological, geomorphological and structural maps are subjected to overlay analysis by superimposing the layers one over the other in GIS environment. The information present in the layers as the attribute data is also subjected to analysis. During the process of integration, the geomorphic units and rock types are made co-terminus by adjusting the boundaries. As a result of the integration, the areas having unique lithology, landform and structure are delineated. There by the primary porosity and permeability of the rock formations and the secondary porosity and permeability developed due to structural deformation and geomorphic process / landform genesis are taken in to account. These integrated lithological-structural-geomorphic units are considered as aquifers. The features generated are annotated with alphanumeric codes wherein the alphabetic code represents the geomorphic content and the numeric code represents the lithological content. The line features are annotated with different colours as indicated in the classification systems.

The different types of aquifers identified within the study area are unconsolidated sediments represented by alluvial and flood plains, Permeable Rocks which are the semi-consolidated sediments having primary porosity and permeability, and Fractured Rocks which generally acts as conduits for movement of ground water.(RGNDWM, 2008).



**Lalbiakmawia et al.,**

RESULTS

The lithological, geomorphological and structural layers are subjected to overlay analysis by superimposing the layers one over the other in GIS environment in order to delineate the aquifers. Subsequently, different types of aquifers were identified depending on the various combinations of the geological materials. The different types of aquifers were classified into 12 categories based on their geomorphic classes and lithological units. This classification is done in accordance to their assumed or expected importance based on the *a priori* knowledge of the experts (Neelakantan and Yuvaraj, 2012; Krishna Murthy and Renuka Prasad, 2014). The final output is ground water potential map along with an expressive legend. The map legend shows the geomorphic units, rock types, aquifer materials and ground water prospect classes.

CONCLUSION

The present study has proven that geo-environmental factors like geomorphology, lithology and geological structure are directly associated with the occurrence of ground water, and form vital parameters for selecting suitable areas for ground water exploitation. The study also shows that remote sensing and GIS techniques can be utilized as vital tools in delineating ground water potential zones. The final map prepared through the present study shows detailed idea about ground water potentiality of the area. This, can therefore, forms an important database for developmental activities, and also for identifying critical areas for implementing ground development and management programme.

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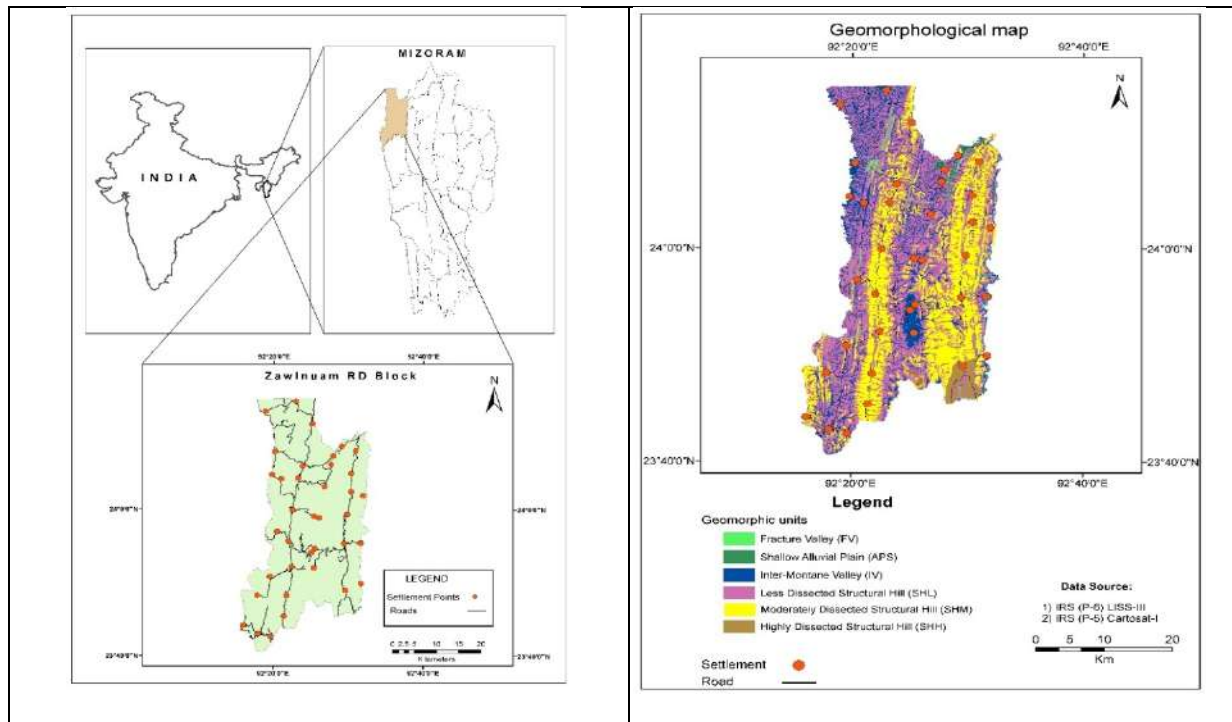


Figure 1: Location map of the study area

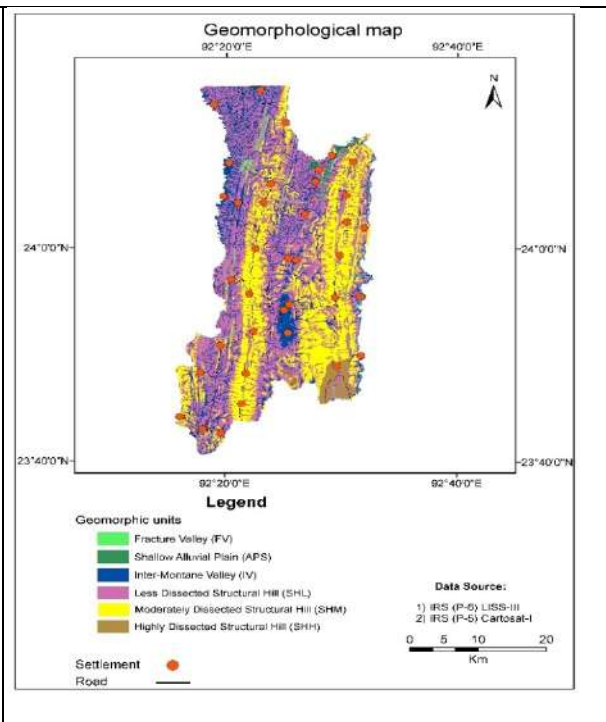


Figure 2: Geomorphological map of the study area

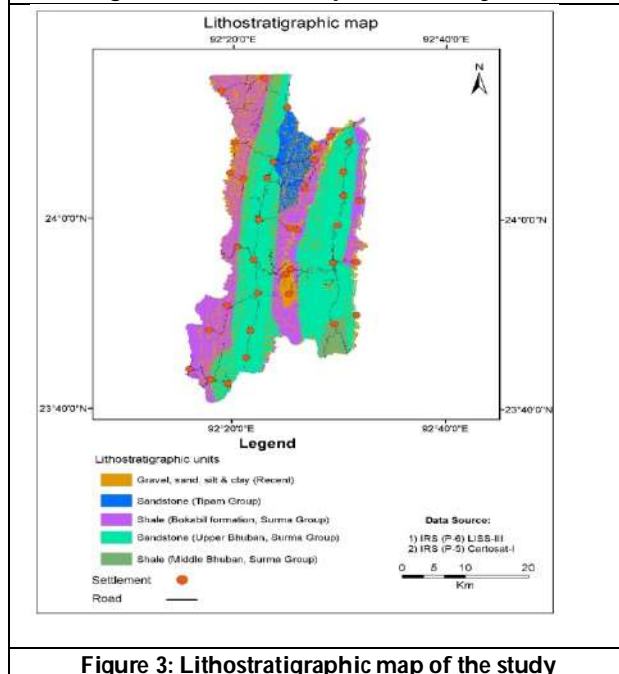


Figure 3: Lithostratigraphic map of the study

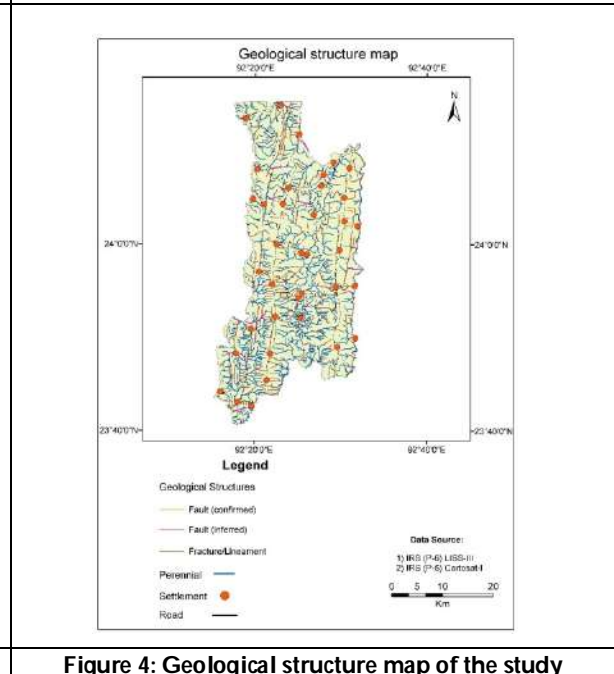


Figure 4: Geological structure map of the study





Lalbiakmawia et al.,

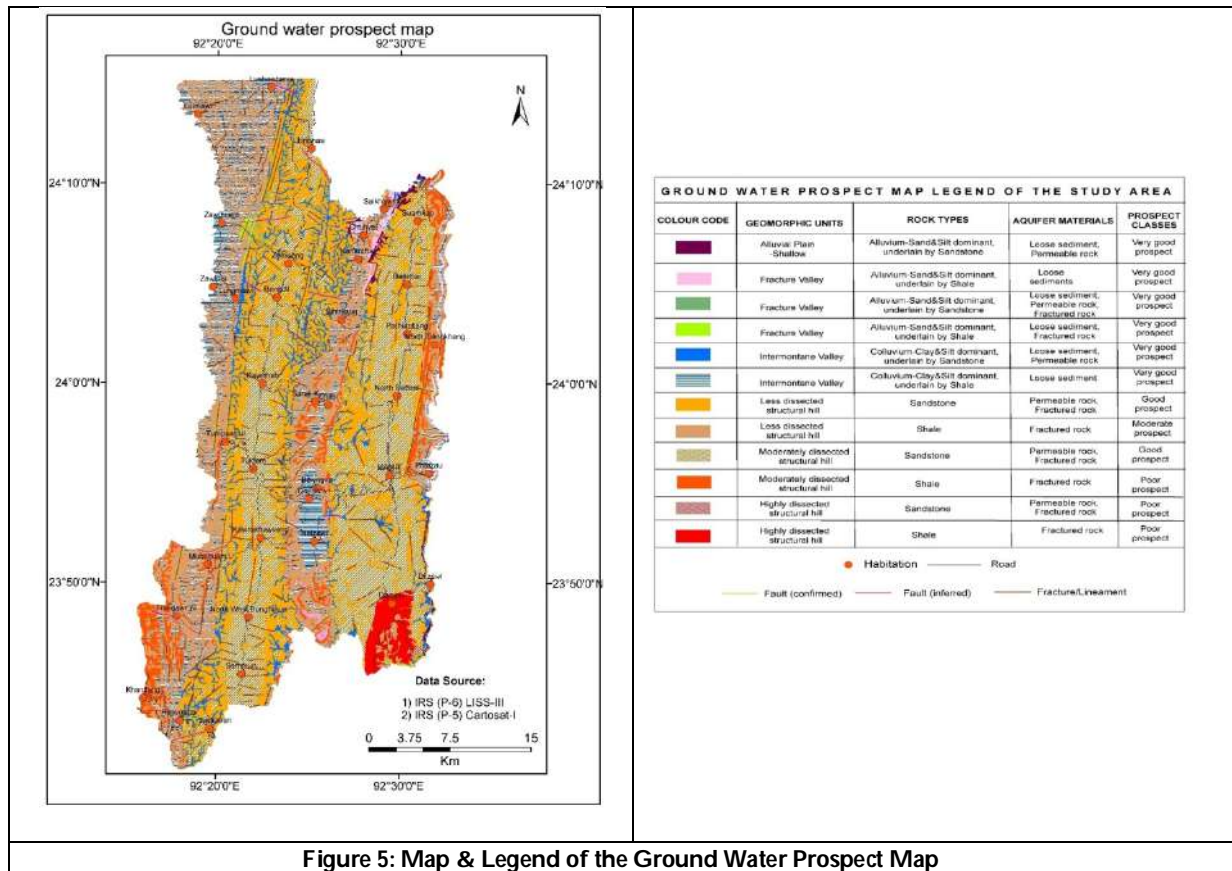


Figure 5: Map & Legend of the Ground Water Prospect Map





Studies on Impacts of Organic Farming on Soil Quality and its Fertility - a Review

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ABSTRACT

Organic farming has numerous definitions and meanings, but they all point to a system that relies on ecosystem management instead of foreign agricultural inputs. By excluding synthetic input like artificial fertilizers, pesticides, animal medications, genetically modified plants and varieties, preservatives, and the process begins to consider possible social and environmental consequences. Organic agriculture is indeed a farming approach that provides food with as little impact on ecosystems, wildlife, or mankind as possible. Biological nitrogen fixation, mixed cropping, crop wastes, bio-pesticides, biogas slurry, or other vital components are all part of organic farming. Vermicomposting has become an important component in organic farming due to its exceptional performance in enhancing crop and soil fertility growth in a sustainable way. Organic farming has a significant influence on human health, economic growth, and climate change globally. Increasing soil organic matter and tilth improves the soil's ability to retain plant-available moisture and absorb more water without becoming saturated or anaerobic. Organic farming increased organic matter content, nutrient labile status, and soil physicochemical qualities. The use of Farm Yard Manure (FYM) in combination with rhizobium, as well as the co-inoculation of Phosphate Solubilizing Bacteria (PSB) with rhizobium, increased yield. The protection of soil fertility and soil quality is seen as a core component for attaining desired production in organic agriculture.

Keywords: Organic farming, Benefits of organic farming, Soil quality, Benefits on soil quality



**Akshay Kiran et al.,**

INTRODUCTION

Organic agriculture is a farming approach that provides food with as little impact on environments, animals, or mankind as necessary [1]. Organic agriculture, in accordance with its core ideology, involves not only ecologically sound management approaches, but also a socially appropriate and economically accountable agricultural system. As per the explanation of the United States Department of Agriculture (USDA) study, "organic farming is a method which tries to avoid or tends to ignore the use of synthetic inputs (such as synthetic fertilizers, pesticides, hormones, growth regulators, etc) and to the greatest extent viable rely on such crop rotations, crop residue, animal manures, off-farm organic waste, mineral grade rock ingredients but also biological system of nutrient management as well as plant protection".

Organic fertilisers have the advantages of being cheap, improving the soil structure, and aeration, enhancing water retention capacity, and encouraging healthy root growth. Organic fertiliser is obtained from different sources, includes minerals, animal manure, sewage sludge, including plants. Vegetables, animals, and leftover substances all contributed to increasing the organic matter content of the soil. As a result, it would be suggested that integrated nutrient management be said to improve the soil efficiency over time besides making proper use out of organic fertilisers (including animal manure, plant residue, and sewage sludge) but also scientifically organising them for enhanced optimum crop production, yield, and quality. Organic fertilisers increase soil texture and water penetration by diversifying the soil. Organic farmers with higher nutritional retention considerably reduce the risk of groundwater pollution. By isolating carbon within the soil, organic agriculture contributes to reducing the global warming and greenhouse gas emissions. Many organic agriculture management practises encourage carbon transfer to the soil, which increases productivity while favouring carbon storage. Plant-animal hybrids boost agricultural production through improving the nutrient and energy cycles. The existence of structures that provide nourishment and shelter, as well as the lack of pesticides, attract prospective or recolonizing species, comprising natural flora and fauna (e.g., birds) and organisms that assist the organic system, including such pollinators and bug predators [2].

The transition from ploughing to less tillage and the addition of composted manure raised Soil Organic Carbon (SOC) by 6% compared to the pure slurry application, with no influence on soil microorganisms, and that these modifications induced a shift in microbial populations [3]. The 15 year analysis also found a 25% rise in topsoil SOC, a 32% increase in microbial biomass and activity, and a change in microbial communities. Organic farming was also found to increase soil structure by increasing organic matter concentrations and soil aggregation [3]. Organic farming is being embraced in around over 186 countries [4], with the total area being 72.3 million hectares worldwide [5]. Oceania has (35.9 million hectares, 50%) and Europe has (16.5 million hectares, 23%) have the most organic agricultural land in the globe, as illustrated in (Fig.01). South America has the most (8.3 million hectares, 11%), followed by Asia with (5.9 million hectares, 8%), North America with (3.6 million hectares, 5%), and Africa with (2 million hectares, 3%). [5].

Components of organic farming

Organic farming includes symbiotic nitrogen fixation, crop rotation, crop leftovers, bio-pesticides, biogas slurry, and other important components. Vermicomposting has grown in importance in organic farming due to its efficacy in enhancing crop and soil fertility production in an efficient manner. When compared to conventional management, long-term organic management, includes the application of cover crops also with composting, resulted in a dramatic shift in the chemical and biological qualities of the soils. Thus, organic farming may give a feasible alternative to develop sustainable agricultural systems by enhancing soil quality [6]. In general, a rise in soil organic carbon content (Fig.2) is predicted following the application of organic matter additives, with a proportionate response related to the amount that is applied [7]. However, the link between organic matter application rates and increases in SOC content is not as straightforward [8, 9]. SOC increases range from 24 to 92% as a result of long-term application of many organic materials, including Municipal Solid Waste (MSW) compost, FYM, organic manure, composted farmyard manure, and cow dung and slurry [10].



**Akshay Kiran et al.,**

Crop rotation: Crop rotation within the same land over two years more than is advised in sustainable agriculture for keeping soil quality and managing insects, weeds, and diseases. Including legumes in rotations, for example, enhances soil fertility. Crop rotation can also aid in the control of weeds, pests, and diseases [11]. Crop rotation with care may be an effective technique for improving short-term Soil Organic Matter (SOM) and maintaining soils that are fertile, healthy and productive. The amount of post-harvest crop leftovers in organic the plant production systems varies significantly depending on the crop diversity and the intensity that it is picked. Small grain crops harvested for seed, such as barley, wheat, oats, rye, or triticale, usually provides 8,000 to 10,000 pounds of dry matter per acre to the soil following harvest. A producer can reduce the occurrence of numerous potentially destructive vegetable crop soil illnesses and aid with nematode problems by utilizing these products in agriculture rotation. Crop rotation can also aid in the control of weeds, pests, and diseases [11]. Crop leftovers can provide significant nutrients to later crops. Crop leftovers replenish macro and micronutrients taken from the soil by crop production. The quantity and quality of agricultural residues will definitely impact the soil organic matter buildup, in addition to the subsequent availability and timings of nutrients delivery to crop production [11]. Crop wastes also offer the carbonaceous biomass needed by soil soil biota (e.g., earthworms and beetles) and microorganisms [12].

Crop Residue: Soil is improved by adding agricultural waste using fungus organisms, physicochemical parameters and crop yields. Cover cropping (known as green manuring) is commonly regarded as a key component of Management of soil quality in organic agriculture across California. Cover crops can provide organic matter, enhance soil quality, minimize weed growth, attract pollinating insects, spiders, and predatory mites, and decrease nitrate leaching losses to groundwater among crops. Crop yields also may seriously restrict a grower's options for harvesting and planting alternative main cash crops, and, guess it depends on the cropping scenario, the use of crop varieties may have possibly adverse implications such as soil water decrease, temporary inactivation of plant nutrients, increased pest infestation, and enhanced management and costs associated [65]. When compared to conventional management, long-term organic management, includes the application of cover crops and also compost, results in a dramatic shift in the chemical and biological features of soil. Thus, organic farming may give a feasible alternative to develop sustainable agricultural systems by enhancing soil quality [6].

Organic manure: Organic manure are from natural source (plant, animal and human residues). Organic manure promotes crop development directly with Improving humic substance absorption and, therefore, the accessibility of both major and minor fertilisers via soil microorganisms [63].

Bulky organic manure: Bulky organic manure, such as composted, Farm yard manure, and green manure, contains fewer nutrition than tightly packed organic manure.

FYM: FYM is a thoroughly decomposed mix of manure, urine, agricultural waste, and waste materials (roughages or fodder).

Compost: Compost is useful for controlling plant nematodes and moderating pesticide effects via sorption, the most critical interaction between organic material and pesticide that limits its breakdown and transport in soil [64]. Composting takes a very long time and results in significant loss of the organic compounds as CO₂ or does not add to the organic pool [13]. The application of compost elevated soil pH from 6.0 without composting to 6.5 with compost and reduced broadleaf weed population by 29% and grassy weed population by 78% [14].

Vermicompost: Vermicompost is a type of organic manure or compost produced by earthworms, which dwell in soil and ingest organic waste until excreting them digested. They contain a large proportion of macronutrients and micronutrients, vitamin, growth promoters, and immobilised microorganisms, each of which is required for plant growth.

Green Manuring: Green manuring is a technique of adding the soil's organic matter by ploughing and integrating decomposed organic green plant tissues in into soil to strengthen the structural properties and the soil's nutritional



**Akshay Kiran et al.,**

value. Green manure (legume crop) offers both organic matter and additional nitrogen. Sun hemp, Dhaincha, Cowpea, Cluster Beans, Senji, Berseem, as well as other organic manures crops are popular [63].

Concentrated Organic Manure: Oilcakes, meat meals, horn and hoof meals, blood meals, and fishmeal which are organic in nature and made from raw materials of animal or plant origin and contains a higher percentage of vital plant nutrients like nitrogen, phosphorous, and potash than bulk organic manures [63].

Biofertilizers: Biofertilizers are the microorganisms which are capable of boosting soil fertility, for example, by fixing the atmospheric nitrogen and through mycorrhizal fungus and phosphate solubilizers, they are environmentally acceptable and sustainable methods of obtaining soil fertility. Biofertilizers are biological nitrogen-fixing microorganisms that lead to the development and expansion of agricultural vegetation and trees, as well as the production of biomass and crop yields.

Bio-pesticide: Plant-based biopesticides comprises alkaloid, polyphenolic compounds, terpenoids, as well as some secondary chemicals. They influence the actions and physiology of bugs, fungus, and nematode through various biological effects. Insecticides that are often used include Pyrethrum, Nicotine, Neem, Margosa, Rotenone, and others [63].

Analysis of the environmental benefits of organic farming

Organic agriculture has a huge influence on the humans health, economic progress, and global climatic change. Organic agriculture is a developing economic industry. Various studies have proved that the benefits of organic farming in environment preservation. Organic agricultural systems provide a variety of advantages, each with its own set of environmental advantages. Cover cropping enhances soil quality, decreases soil erosion, and increases soil nutrients (table.1).

Organic matter is soil and its properties

In a review of 14 long-term animal manure experiments, the manured soil had greater organic material levels, lesser bulk density, porosities and hydraulic properties, and stronger accumulated stability than traditionally treated soils [15]. All these soils quality indicators will benefit crop development if they are improved [16,17]. As a result, one among the most important advantages of manure as organicfertiliser source is its ability to maintain and enhance the soil organic matter levels. Organic methods include organic matter applications and prolonged, more diverse crop rotations including cover and catch crop production can help reduce soil erosion and nutritional degradation [18,19] Increasing soil organic matter and tilth improves the soil's ability to hold plant usable moisture and absorb more water without being waterlogged or anaerobic. A network of big and tiny pores exposed to the soil surface and extending into the soil profile improves moisture uptake and storage after rainfall, allowing crops to draw on existing moisture stores during dry periods and require less frequent. Cover cropping, organic inputs, and little tillage all contribute to the soil's ability to absorb and retain rainfall for crop use while minimising runoff.

During decomposition, organic matter releases macro- and micronutrients into the soil suspension, which become accessible to the plants, resulting in greater absorption. Organic farming proved capable of preserving better By altering soil characteristics, crop yield can be increased while soil quantity and productivity are improved over time [20]. After four years, organic and low-input farming approaches increased organic carbon, exchangeable potassium, soluble phosphorus, and pH, as well as the reserves pool of stored nutrients are maintained at a relatively steady EC level [21].

Organic production systems and soil physical parameters

Organic fertility inputs also enhance soil physical qualities by reducing bulk density, increasing water-holding capacity, and boosting infiltration rates [22]. Lower bulk density means more pore space and better aeration, which creates a more suitable environment for biological activity [23]. Adding compost to soil reduced bulk density while increasing soil water content (table.2) [24]. Organic matter is the most important component in the production and



**Akshay Kiran et al.,**

stability of granular and crumb aggregates [25]. Organic farming also reduced bulk density by 2.3% while increasing water holding capacity and soil porosity by 28.4% and 16.5%, respectively, over conventional farming [26]. The inclusion of agricultural wastes lowered the bulk density, improved the pore space, water holding capacity, aggregate stability, and accessible water [27]. The surface layer of soil that was continually supplemented with organic manures was darker than the surface layer of soil that was not supplemented with organics [28].

Organic production systems and soil chemical properties

Organic farming supplies all crop nutrients through organic manures, which include a high concentration of organic carbon [29]. Organic farming improves the level of SOM and humic compounds in the soil [30, 31, 32]. Most soils exhibit a moderate but constant rise in SOM throughout the transition years from conventional to organic systems [33, 34] argued that the quality of SOM in agricultural systems that utilise cover crops and other organic inputs and those that do not discovered that SOM levels in the 0-30 cm depth had risen by 19% in the organic and low-input treatments after four years of organic operation. A link between SOM content and accessible Ca, K, Mg, Na, and P was discovered [35]. (table.2) Because of the varied nature of manure production and storage, the N, P, and K contents of fresh FYM range from 0.01 to 1.9% on a dry weight basis [36, 37]. On an average, well-rotted FYM includes 0.5 percent N, 0.2 percent P₂O₅, and 0.5 percent K₂O on average [38]. In a 25 t ha⁻¹ land application of well-rotted FYM can contribute 112 kg N, 56 kg P₂O₅, and 112 kg K₂O ha⁻¹[39]. Several studies from all over the world had proved that Farmyard manure treatments has a profound impact on soil parameters and agricultural production [40]. Crop straw is commonly used as livestock feed or fodder by farmers. Straw is a typical bedding material used to capture urine and increase Nitrogen cycle. Wet straw and organic manure from animal shelters are collected daily and kept or composted mostly on farmer's land.

The 6-year research found that organic farming increased soil organic carbon and accessible Zn content whereas conventional farming increased pH and exchangeable salt in Central India [41]. The use of FYM and green manure kept Fe, Zn, Cu, and Mn levels in the rice-wheat rotation high [42]. Organic agriculture increased organic matter content and the nutrient labile status, as well as soil physicochemical qualities [43]. The addition of carbonaceous materials such as straw, wood, bark, sawdust, or maize cobs improved a manure's composting properties. (table.2) These polymers lowered water content while increasing the C:N ratio.

Organic production systems and soil-biological properties

Organic agriculture, according to scientific evidence, enhances the density and diversity of soil life. Organic approaches encourage soil flora and fauna as well as soil structure and reconditioning and biogeochemical cycles. Organic additions are quickly colonised by microorganisms and improve other soil qualities, hence preserving fertility stability. Soil microbial activity and biological processes are more active in organically maintained soil [44, 45, 46]. Although enzymes amendments frequently include organic, the increase in activity of soils supplemented with organic residues is more likely attributable to microbial stimulation than to the direct addition of enzymes from the organic sources [47].

Compost comprises bacterium, actinomycetes, and fungi; hence, a new supply of humic material may not only contributed but also had promoted microorganisms [48, 49]. Furthermore, compost performed an essential function in the control of plant nematodes and in the sorption of pesticides. Sorption is one the most critical interaction among soil/ organic matter and pesticides, limiting both degradation as well as movement in soil. Pesticides attached to organic materials in the soil or clay particles are less mobile and bioavailable, but also less accessible to microbial breakdown and hence more persistent [50, 51] Composting material increased the activity of heterotrophic fungus and bacteria in soil, in addition to the performance of soil organisms which convert inaccessible nutrients to usable forms (table.2). The use of FYM in association with rhizobium, in addition to the co-inoculation of PSB with rhizobium, boosted soybean yield [52].

A "good" soil structure, in terms of agronomy, demonstrates the qualities listed below: optimal soil force and aggregate stability, which provide resistance to system disturbances, such as capping crusting, slaking, and erosion; optimal bulk density, which promotes root development and affects other soil physical parameters like air and water



**Akshay Kiran et al.,**

moves within in the soil; and optimised moisture potential and flow of water penetration [53]. In contract, the addition of decomposed or composted materials, such as manure or compost, leads to a more slowly but lasting increase of aggregate stability because, in this case, the organic matter is rich in humic acids, which represent relatively stable binding agents [54]. Therefore, a combination of green manures and decomposed or composted materials provides optimum performance [55,56].

Soil fertility

Agricultural soils are subject to a variety of anthropogenic stresses, such as SOC loss, nitrogen reduction, increased soil, and heavy metal deposits [57]. High SOC concentration promotes soil structure, aeration, moisture capacity, chemical buffering ability, microbial soil activities, plant root growth, and ongoing mineralization of plant nutrients. A global assessment found that soils in organic farming systems have substantially higher levels of SOC than soils in conventional farming systems [58]. Longer cropping systems with forage legume in organic systems, increased external carbon input, and the recycling of organic matter are additional potential solutions. Increased agricultural residue absorption into soils as a result of higher yields raises SOC level [59]. Increasing the use of fertilizers to enhance yields reduces the risk of soil nutrient depletion. Building and maintaining soil quality is essential for organic agricultural success [60]. Soil quality, which comprises the inherent natural features of soils as well as dynamic qualities that fluctuate based on usage, is an essential indication of the soil's sensitivity to natural or human forces. The notion of soil quality is mostly employed for crop productivity and environment protection in agricultural ecosystems and land use regions such as forest and pasture [61]. Soil quality and soil health are phrases that characterise the soil's capacity to execute these vital duties. The cornerstone of effective organic vegetable crop production methods is often regarded as soil quality or health. Organic farmers usually identify long-term soil quality maintenance and improvement as their key management goals [62].

CONCLUSION

The preservation of soil fertility and soil quality is seen as a fundamental condition for achieving targeted production in sustainable agriculture. In conclusion, the data reviewed demonstrates that organic management preserves and enhances soil quality. The benefits of organic farming discussed in this article are typically trustworthy, despite the fact that there is significant diversity within organic farming based on farm style and production intensity. Nonetheless, organic farming is the only agricultural method that is legally regulated and where farmers' compliance with laws is rigorously monitored. As a result, the benefits inherent in organic farming are, to some extent, assured. Organic farming procedures may be effectively employed in rich soils where the nutrient supply capacity is great and there are no substantial difficulties with their original soil features; nevertheless, organic farming practices in infertile soil conditions require a number of changes.

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Table.1: Organic farming practices and their benefits (Erik, 2000)

Organic Farming Practices	Environmental Benefits
Crop rotation	Improves soil quality, disrupts the life cycles of weeds, insects, and diseases, traps carbon and nitrogen, and diversifies production (can have market benefits)
Manure, compost, green manure use	Improves soil quality, binds carbon and nitrogen, and boosts output
Cover cropping	Improves soil quality, lessens erosion, traps carbon and nitrogen, prevents dust (protects the quality of the air), increases soil nutrients, and boosts production
Avoiding synthetic fertilisers	Minimises salinization, improves soil quality, increases carbon sequestration, prevents contamination of surface and ground waters, and (in many cases)
Avoiding of synthetic pesticides	Promotes soil quality, biodiversity, water quality, and pest management effectiveness. It also prevents pollinator disruption and lowers the cost of chemical inputs.
Planting habitat corridors, borders, and/or insectaries	Provides habitat for wildlife, aids biological pest management, and increases biodiversity.
Buffer areas	Improves biodiversity, raises water quality, and reduces wind erosion

Table.2: Physical, Chemical and Biological Properties of Soil

Physical properties	Chemical properties	Biological properties
Bulk density	pH	Microbial biomass carbon
rooting depth	Electrical conductivity	Microbial biomass nitrogen
Water infiltration rate	Cation-exchange capacity	Earthworms
Water-holding capacity	Organic matter	Enzymes
Aggregate stability	Mineralizable nitrogen	Disease suppressiveness





Akshay Kiran et al.,

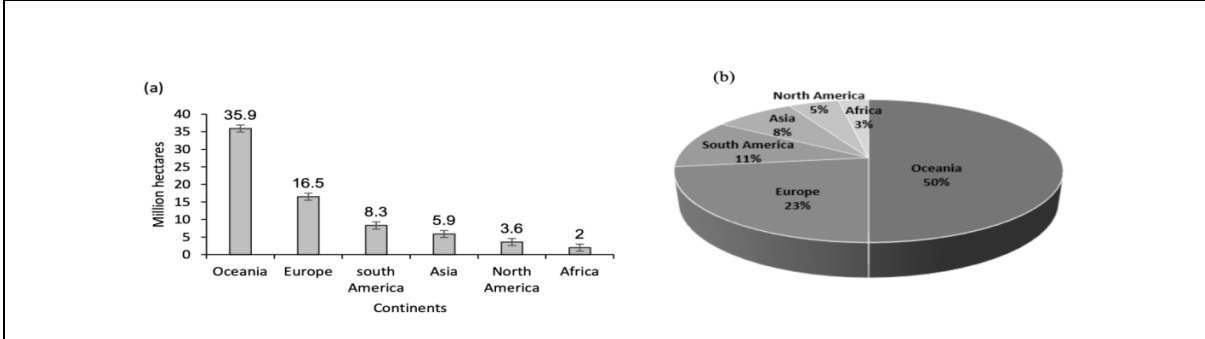


Figure.1. Organic agricultural land areas around the world depending on (a) the Million hectares and (b) percentage in 2019 (Willer et al., 2021).

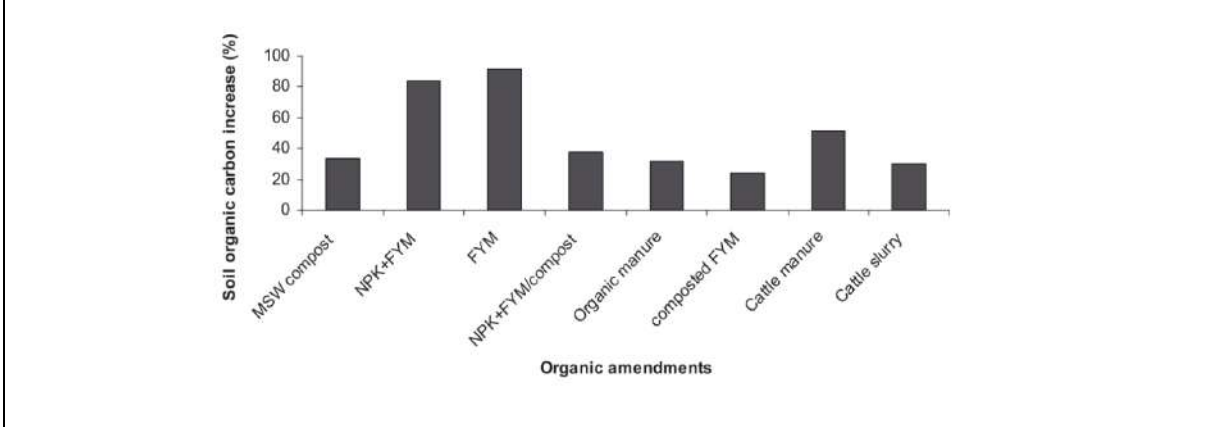


Figure.2. Increase in SOC after different longterm organic amendments. (Diacono & Montemurro, 2010).





A PSO based MPPT in a Standalone PV System to Tackle Steady State and Dynamic Climatic Conditions

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ABSTRACT

In this paper, a particle swarm optimization (PSO) based MPPT is proposed for a PV system to improve the tracking accuracy under steady state and dynamically varying climatic conditions. Since the solar irradiation is varying with time, PSO is well suitable for maximum power point(MPP) tracking in PV systems. The optimum number of particles, W1, C1 and C2 parameters are selected to minimize the power loss in the tracking. Simulation work is carried out using Matlab/Simulink software. Simulation results show the superiority of PSO based MPPT with minimum power loss.

Keywords: Particle swarm optimization (PSO), Maximum power point tracking (MPPT), Photovoltaic (PV) system, Global maximum.

INTRODUCTION

Renewable energy sources are being eco-friendly and non-pollutant, and meet the demands of the power supply of the growing population. Due to globalization and industrialization, the energy requirement is increasing rapidly. By implementing new technologies in the renewable energy field, maximum energy from the sun can be extracted with the minimum loss [1-2]. Among various types of renewable energy systems, solar PV has become the most important source of renewable energy. Because of easy maintenance, being widely distributed, and pollution-free, PV array is used in utility grids and many industrial applications. PV technology has become a well-known technology for electric power generation. However, the generation cost of the PV power is high and the conversion efficiency of the





Uma Maheswari

PV cell is low [3-9]. The photovoltaic effect is used for the direct conversion of solar energy into electrical energy. Grid-connected and stand-alone energy systems are the two types of combinations of PV applications. The main task is to locate the global maximum in the PV characteristic curve. Once the global maximum is identified, maximum power point tracking is easy with minimum tracking error. Many MPPT algorithms are discussed in literature such as perturb and observe (P&O), incremental conductance (INC), fuzzy based, artificial neural network (ANN), adaptive neuro fuzzy inference system (ANFIS) etc. The P&O and INC methods are simple however, they are less efficient. P&O algorithm perturbs around MPP and becomes slow in tracking. For the fuzzy based system, human expertise is required and the selection of membership functions plays a key role in the performance of the system. ANN and ANFIS methods are widely used in motor control applications and optimization problems[2]. Since they require huge data set for training and testing the networks, they are complex and require high memory.

In this work, the performance analysis of the stand-alone PV system under steady state and rapidly changing climatic conditions is discussed. This paper aims to discuss the implementation of the PSO algorithm in the PV system to minimize error in MPPT. Section 2 of this paper addresses the implementation of the PSO control algorithm. Section 3 presents the design of the boost converter. Simulation results and conclusions are presented in section 4 and section 5 respectively.

PROPOSED PSO BASED MPPT METHOD

Figure 2 shows the flowchart of the PSO algorithm. The first step is to set PSO parameters. After that, the algorithm is used to search the best duty cycle of the boost converter corresponding to i th particle gbest position. With help of measured PV voltage and current, PV power is calculated and it is nominated as P_{best} . If this value is better than the previous, one the algorithm updates this value. A comparison between the obtained power value and the global best power value is carried out by this algorithm. Updating of the Gbest value is continued till all the particles are tested. The position and velocity of each particle is changed as per the algorithm as shown in Figure 2

MODELING OF THE BOOST CONVERTER

The duty cycle of the boost converter is written as

$$D = 1 - \left(\frac{V_i}{V_o}\right) \eta \quad (1)$$

The formula for calculating inductor value is expressed as

$$L \geq \frac{V_s(\min)D}{f_s \Delta i_L} \quad (2)$$

where f_s - Switching Frequency

D -Duty Cycle

Δi_L - Ripple current (20–40% of i_L).

Input and output capacitor values are selected from the following expressions

$$C_i \geq \frac{I_{om}D^2}{0.02(1-D)V_i f_s} \quad (3)$$

$$C_{out} \geq \frac{I_{om}D}{f_s \Delta V_c} \quad (4)$$





Uma Maheswari

RESULTS AND DISCUSSION

The simulation diagram of the proposed method is depicted in Figure 3. Various irradiance and temperature profiles are used in the simulation study to prove the improvement in the performance of the system. The PV array output is boosted to a higher level by a DC-DC boost converter to supply a resistive load. The duty cycle of the boost converter is controlled by an effective PSO based MPPT algorithm which is explained in the previous section. The simulation parameters are listed in Tables 1 and 2. Characteristics of 500W PV array under various irradiance and temperature levels are shown in Figure 4. The temperature has a direct impact on the output power. An increase in temperature level decreases the power at MPP. A detailed simulation study is carried out using Matlab/Simulink software and results are shown in Figure 5. Output voltage current and power waveforms are shown for both steady state and under varying climatic conditions. For the simulation study of dynamic conditions, the irradiance level is initially maintained at 1000W/m² and at t=0.4 s, it is decreased to 250 W/m². At t= 1s the irradiance level is again set to 1000W/m². The output power, voltage and current values are changed with respect to the irradiance level as shown in Figure 5.

Simulation results are shown for steady state (Figure 5a) and dynamic conditions (Figure 5b) separately. Both the simulation results show better tracking speed and minimum ripples in the output of the PV system. Table 3 shows the superiority of the proposed method over other methods in the literature. Because of its high adaptive nature and minimum power loss, PSO based MPPT is preferred for the standalone PV system.

CONCLUSION

In this paper, the duty cycle of the boost converter is controlled exactly by the proposed PSO based MPPT algorithm. Simulation results reveal the good tracking speed and minimum oscillations at MPP. A comparison between the proposed method and other MPPT methods is also tabulated. It shows that the proposed method is fast and efficient and does not perturb around MPP. This proposed method is suitable for small and isolated applications.

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Uma Maheswari

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Table1. Simulation parameters

Parameter	Value
PV array: 500W	
No of modules in series	2
Open circuit voltage (Voc)	37.3 V
Maximum voltage (Vm)	30.7 V
Short circuit current (Isc)	8.66 A
Maximum current (Im)	8.15 A
Maximum power (Pm)	250 W
No of cells per module	60
Boost Converter:	
Inductance	6.1 mH
Input Capacitance	250 μF
Output Capacitance	670 μF
Switching frequency	5kHz

Table2. PSO parameters

W1	0.9
C1	1.4
C2	1.8

Table 3 Comparison between PSO and other MPPT methods

Parameter	PSO	INC[3]	P&O[1]
Convergence Speed	High	Low	Low
Power loss at MPP	Minimum	High	High
Simplicity	High	Low	High
Cost	High	High	Medium
Adaptation in rapidly changing climatic condition	High	Medium	Low





Uma Maheswari

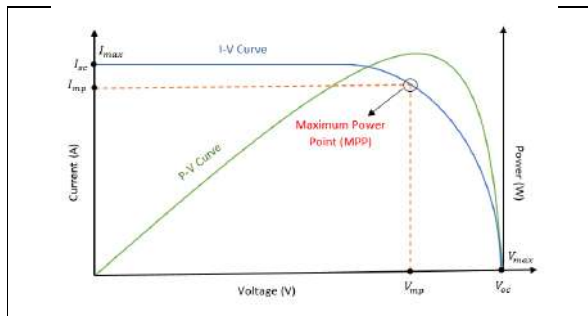


Fig.1 PV and IV characteristics with MPP

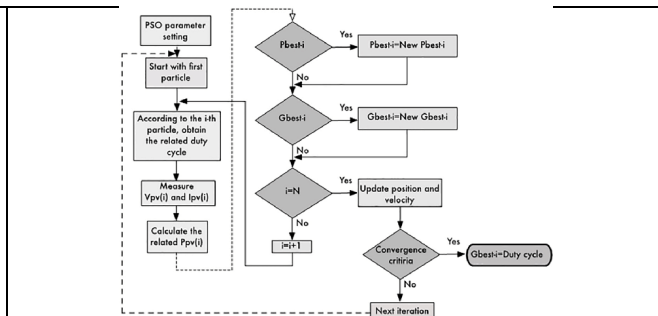


Fig.2 PSO based MPPT algorithm

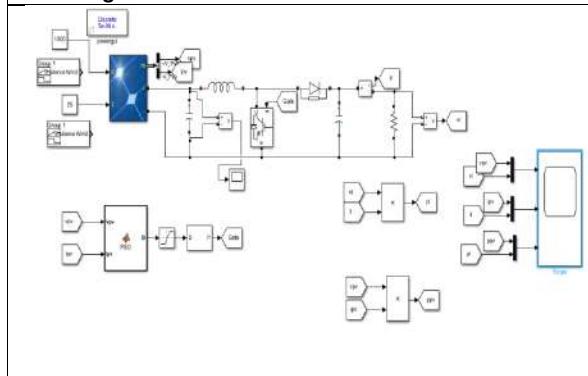


Fig.3 PSO based isolated PV system

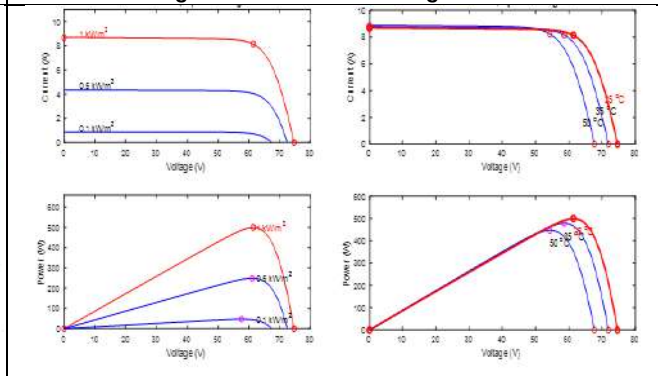


Fig.4. Characteristics of PV system at various irradiance and temperature levels

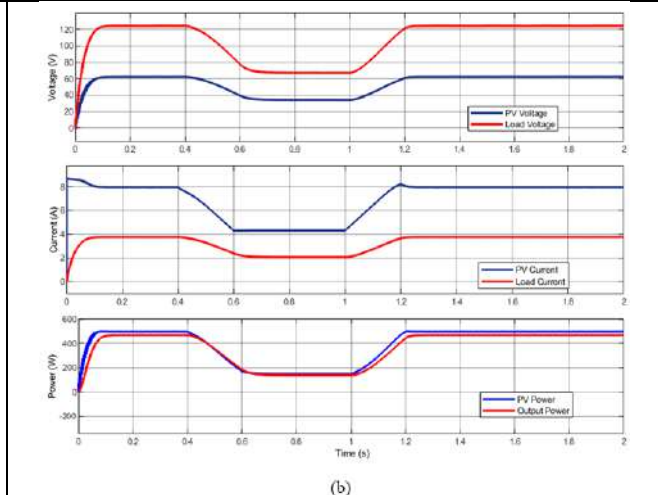
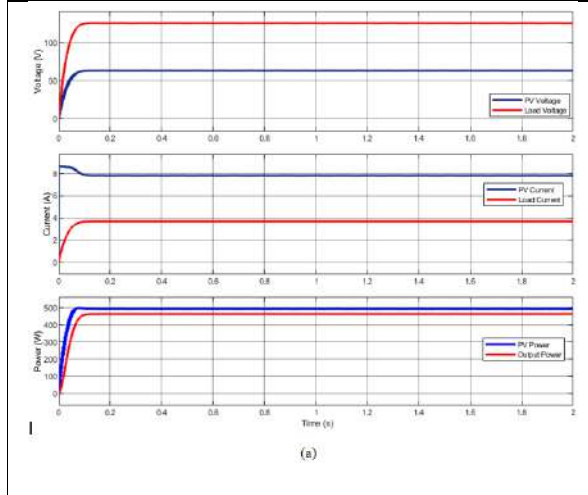


Fig.5 Simulation results of PSO based system (a) steady state (b) dynamic condition





Maximum Power Point Techniques with High Step-up DC-DC Converter

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ABSTRACT

This paper proposes a solar irradiation modeling based maximum power point tracking (MPPT) algorithm for photovoltaic (PV) system with a high step-up converter design. The proposed algorithm aims to overcome the confusion in the direction of tracking during rapidly changing solar irradiance using half sine wave modeling of solar irradiation and the results are compared with classical perturb and observe (P&O) method and dP perturb and observe (dP P&O) method. Also, to improve the voltage rating, a new high step-up dc to dc converter is proposed and the results are validated with a boost converter. The performance of the proposed algorithm is verified for different insulation levels during a day in a specific area.

Keywords: DC-DC Converter, Maximum power point tracking, Photovoltaic system, Solar irradiation

INTRODUCTION

Around the globe, significance and usage of solar energy are seeking priority among alternate energy resources due to its eco-friendly nature and salient features [1]. The fuel is free, and no pollution is created from operating PV systems. Thus, PV systems are considered to be from the future trendsetters for securing eco-friendly, sustainable and albeit inexpensive electricity. PV panels generate specific power at certain operation conditions. The PV output voltage and current vary with environmental effects such as the solar irradiation, the ambient temperature, the



**Ganga and Deeparani**

pollution of the PV module surface, shadowing etc. As it is known, environmental conditions vary seasonally and on a daily basis. If these parameters change, also the amount of produced power changes, therefore the PV output parameters, according to the changing environmental conditions, must be continuously monitored. In addition, the generated power from a PV module is also related with the load level. Consequently, the PV module has a nonlinear power versus voltage (P VsV) and current versus voltage (I VsV) characteristics and there is a unique operation point on these characteristics that provide the possible maximum power. This point is called as maximum power point (MPP) [2,3].

When PV system is operated at Maximum Power Point (MPP) maximum efficiency is expected from the system [4]. There are many MPPT algorithms like Perturb & Observe (P &O) method [5], Incremental Conductance (INC) method [6], Hill Climbing method [7], Fractional Open Circuit Voltage (FOCV) method [8], Fractional Short Circuit Current (FSCC) method [9], Artificial Intelligence based on Fuzzy logic controller [10], Neural Network [11,12] and Genetic Algorithm [13] and also different combinational techniques to increase the tracking speed and to reduce the oscillations in the P & O method [14]. P&O algorithm is the commonly used MPPT technique because it is simple and easy to implement [15]. This method is performed by observing the operating voltage from PV array and perturb in a given direction. When the power output from the PV increases, then the operating point is moved to a maximum power point or else the direction has to be reversed. Incremental Conductance (INC) method normally uses fixed iteration step size, which produces accurate and fast tracking of maximum power point. This technique is used to track the maximum power by measuring the ratio between instantaneous conductance and incremental conductance values from the PV system [16].

The maximum power point based operating voltage of PV system is very less and not suitable for the high-voltage applications. To overcome the problem, the DC-DC converter topology is used to boost the voltage from low to a high level based on the load condition. DC-DC converter topologies namely boost converter, buck-boost converter, Single Ended Primary Inductance Converter (SEPIC), Cuk converter, a double boost converter, a flyback converter, push-pull converter, interleaved boost converter was extensively used by various researchers [17–19]. Conventional boost converters are commonly used for energy conversion for the PV system [20–22]. Moreover, it is well known that in conventional DC to DC boost converters, increasing duty cycle decreases the stability and increases the control difficulty. Therefore, while the output voltage of boost converter increases exponentially with duty cycle, in practice the voltage conversion ratio between output and input voltage of the converter is recommended to be selected as a maximum four [23]. Although another alternative to increasing the conversion ratio is using the isolated DC to DC converter topology, this structure causes some problems such as cost, complexity, etc. [24]. Different DC to DC converter topology with high voltage step-up capability has been investigated. The combination of the conventional boost converter with switched capacitors has been proposed to provide high conversion ranges. In this system, the output voltage level is related to the number of capacitors used in the circuit. However, voltage regulation action decreases the efficiency of the converter dramatically. Therefore, this topology is suitable and provides high efficiency, if an additional converter is used for voltage regulation [25].

Isolated converters [26]–[28] can attain high voltage gain by adjusting the turn's ratio of the transformer. However, for higher voltage gain, it requires large turn's ratio. It also suffers from high voltage stress on output rectifier diodes. In high power applications, current fed converters are a good alternative over voltage fed converters. Here, boost-type input inductor helps to increase the voltage gain without large turn's ratio of the transformer. However, additional inductor along with isolation transformer increases the weight and volume of these converters. In addition, active or passive snubber circuit is necessary to overcome the voltage spikes due to the leakage inductor. It is well known that conventional boost converter cannot be used for the high step-up application. It is due to the reverse recovery problem of the output diode, increased conduction loss at large duty ratio operation, and the high voltage stress on MOSFET switch [29]. The quadratic boost converter is another choice for high-gain applications [30], [31].





Ganga and Deeparani

In this paper, efforts have made to develop a soft switching, high gain and high efficient converter with reduced voltage stress on the switch. Coupled inductor-based switched capacitor converter in conjunction with passive clamp circuit is proposed for this purpose. Proposed converter can achieve high voltage gain with reduced voltage stress on switch and output diode. Fig. 1, shows the overall PV system with MPPT techniques and DC-DC converter. The voltage and current from PV system are taken as input for the MPPT techniques to track the maximum point and it generates the duty cycle to the converter. The converters will boost the voltage according to the generation of the pulse from the MPPT. In this paper, solar irradiation modeling based MPPT algorithm is proposed to track the maximum power point from the PV panel and compared the results with classical P&O and dP P&O MPPT techniques. The performance of the proposed MPPT algorithm along with the converter is analyzed and validated with the boost converter topology as well as with different MPPT techniques.

MATERIALS AND METHODS

Energy conversion efficiency of solar PV is quite low. Therefore, it is essential to use a highly efficient power conversion system to utilize the PV generated power to the maximum. The converter is used to convert the low voltage obtained from PV to high voltage as per the load requirement. In this paper, the proposed high step-up dc to dc converters are utilized to generate the high voltage gain from the PV system and described below.

Boost Converter

The boost converter operates under the step up mode and uses single switch for its operation. Boost converter or step up converter consists of an inductor, diode, capacitor, and a switch as shown in fig. 1. The circuit for the step-up boost converter operates by varying the amount of time in which inductor receives energy from the source. When the switch is ON state, the inductor output is connected to ground and the voltage V_{in} is placed across it. The inductor current increases at a rate equal to V_{in}/L . When the switch is OFF state, the voltage across the inductor changes and is equal to $V_{out}-V_{in}$. Current that was flowing in the inductor decays at a rate equal to $(V_{out}-V_{in})/L$. Boost converter switch take long time to turn ON due to that long duty cycle is used which increases the switching losses. The switch stress and flow of inrush current is also high in the conventional boost converter.

Proposed Converter

Proposed converter can achieve high voltage gain with reduced voltage stress on switch and output diode. The derivation of the proposed converter is shown in Fig. 2.

The voltage gain of coupled-inductor with a boost converter [14] is given by:

$$\frac{V_o}{V_{in}} = \frac{1+ND}{1-D} \quad (1)$$

Where D is the duty cycle of the main switch S, and N ($N=n_2/n_1$) is the turns ratio of the coupled-inductor. From equation (1), it is clear that a higher voltage gain than that of the conventional boost converter is achieved by introducing the coupled inductor. The coupled inductor is modeled as a magnetizing inductor L_m , a leakage inductor L_{lk} , and an ideal transformer with a turn ratio N. However, the voltage stress of the output diode D_o is much higher than its output voltage when switch S is in the on a state.

A rectifier composed of a diode D_r and a capacitor C_r is included to reduce the voltage stress of the output diode D_o as shown in Fig. 2(b). Therefore, low-voltage-rated diodes can be adopted for a reduction of the conduction losses, and a higher efficiency can be achieved than the circuit shown in Fig. 2(a). Finally, in order to make the main switch S work under the soft switching condition, a passive clamp network composed of a clamp diode D_c and a clamp capacitor C_c is adopted, as shown in Fig. 2(c). The equivalent circuit of the converter is shown in Fig. 3.

In order to perform a mode analysis of the proposed converter, several assumptions are made as follows.





Ganga and Deeparani

Mode 1 [t₀–t₁]: Before t₁, the switch S is ON condition the output diode D_o and rectifier diode D_r are reversed-biased. The magnetizing inductor L_m and leakage inductor L_{Lk} are connected in series and charged by the input voltage V_{in}. Therefore, the currents through them are equal and increase gradually in a linear way. The clamp capacitor voltage V_{Cc} and rectifier capacitor voltage V_{Cr} are unchanged. The load current is provided solely by the output capacitor C_o. the magnetizing inductor current i_{Lm} and that of the leakage inductor current i_{Lk} are given by:

$$\frac{di_{Lm}}{dt} = \frac{di_{Lk}}{dt} = \frac{V_{in}}{L_m + L_{Lk}} \quad (2)$$

Mode 2 [t₁–t₂]: At t₁, the main switch S turns off. Then, the parallel capacitor C_s is charged by the magnetizing current. Since C_s is small and L_m is relatively large, the drain-source voltage of the switch S increases. The turn-off losses of the main switch S are reduced due to the existence of the parallel capacitor C_s. The increasing rate of the drain-source voltage v_s can be derived by:

$$\frac{dv_s}{dt} = \frac{I_{Lm}(t_1)}{C_s} \quad (3)$$

In this stage, the antiparallel diode D_c is forced to conduct. Since the clamp capacitor C_c is much larger than C_s. Thus, the ZVS turn-on condition is achieved.

Mode 3 [t₂–t₃]: At t₂, the rectifier diode D_r and output diode D_o are forced to conduct. The magnetizing inductor L_m and leakage inductor L_{Lk} are discharged by the voltages of –V_{Cr}/N and V_{in}+ V_{Cr}/N–V_{Cc}, respectively. Since L_{Lk} is much smaller than L_m, the decreasing rate of i_{Lk} is much greater than that of i_{Lm}. Since the output capacitor C_o is relatively large when compared with the clamp capacitor C_c, the current through the output rectifier diode i_{Do} is approximately equal to i_{Lk}. The current through the rectifier diode i_{Dr} increases linearly from zero, and the increasing rate is given by (3).

$$\frac{di_{Lm}}{dt} = -\frac{V_{Cr}}{NL_m} \quad (4)$$

$$\begin{aligned} \frac{di_{Dr}}{dt} &= \frac{\frac{di_{Lm}}{dt} - \frac{di_{Lk}}{dt} i_{Do}}{N} \\ &= \frac{(V_{Cc} - V_{in})}{NL_{Lk}} - \frac{V_{Cr}}{N^2} \left(\frac{1}{L_{Lk}} + \frac{1}{L_m} \right) \end{aligned} \quad (5)$$

Mode 4 [t₃–t₄]: At t₄, the current through the output diode D_o decreases linearly to zero and D_o turn off. The leakage inductor current i_{Lk} begins to change its direction and it increases linearly in the reverse direction. The magnetizing inductor current i_{Lm} continues to decrease linearly and the current through the rectifier diode i_{Dr} continues to increase linearly. The change rates of i_{Lk}, i_{Lm} and i_{Dr} are the same as the ones in the previous stage. Mode 5 [t₄–t₀]: At t₄, the turn-on signal is applied to the main switch S when its antiparallel diode is in the ON state. Therefore, the main switch S turns ON with ZVS. At t₀, the leakage inductor current i_{Lk} increases to be equal to the magnetizing inductor current i_{Lm}, the current through the rectifier diode i_{Dr} drops to zero, and D_r turns off. After that, the magnetizing inductor L_m and leakage inductor L_{Lk} are connected in series and charged by the input voltage V_{in} again. Then, a new switching period begins.

The 4 modes of operation are as shown in fig 4. The sum of diode voltages and switch voltage is equal to the capacitor voltage V_{CM}. The input current is equal to the average of inductor L₁ current, and the output current is equal to the average of inductor L₂ current. The design equations used for boost, SEPIC, and modified SEPIC converter are tabulated in Table 1. By using the expressions, the parameters are computed and used for conversion of the PV low voltage to high step-up the voltage with high static gain for required applications.



**Ganga and Deeparani****RESULTS AND DISCUSSION**

In this section, the implementation of the PV system is described. P&O, dP P&O and improved dP P&O based MPPT techniques have been designed and simulated using MATLAB/Simulink software. The specification of the PV panel under standard test condition (STC) used in this system is listed in Table 2. The boost and modified BOOST converter was implemented using parameters listed in Table 2. The improved dP P&O MPPT algorithm is implemented based on solar irradiation modeling. One day solar irradiation data at specified location are given to the input of the system. This input solar irradiation samples (from 6 AM to 6 PM) are obtained from Centre for Research on Alternate Energy laboratory at our institution. There are 24 samples are chosen as the input of these systems (1 sample per 30 minutes) as shown in Fig.5. The performance of the three MPPT techniques based on the converter was designed and compared.

The power output of the boost converter based PV system is shown in Fig. 6(a) and (b) with P&O, dP P&O and improved dP P&O based MPPT techniques. Among the various MPPT methods, improved dP P&O MPPT algorithm outperforms the other two algorithms by providing high power output and fast tracking of MPP. The power output for modified BOOST based PV system using the above-mentioned three MPPT methods are shown in Fig. It can be again observed that the improved dP P&O based MPPT algorithm produces a high power output in this system. The output power of the modified BOOST converter performed by improved dP P&O can produce upto 177.6W and boost converter produces 161.4 W. Hence, it is concluded that the combination of improved dP P&O based MPPT and modified BOOST converter for PV system generate better power output compared with boost converter system. This topology also operates with zero voltage switching. Due to this, the conduction loss is reduced and high static gain is achieved in modified BOOST based improved dP P&O MPPT technique for PV system.

CONCLUSION

This paper proposes a solar irradiation modeling based maximum power point tracking (MPPT) algorithm for photovoltaic (PV) system with a high step-up converter design. The improved dP perturb and observe maximum power point tracking technique to overcome the confusion in the direction of tracking during rapidly changing solar irradiance using half sine wave modeling of solar irradiation. The proposed system results are compared with classical perturb and observe (P&O) method and dP perturb and observe (dP P&O) method. The proposed maximum power point tracking technique is implemented with a new high step-up dc to dc converter. The proposed dP P&O based MPPT algorithm produces a high power output. The output power of the modified BOOST converter performed by improved dP P&O can produce upto 177.6W and boost converter produces 161.4 W. Hence, it is concluded that the combination of improved dP P&O based MPPT and modified BOOST converter for PV system generate better power output compared with boost converter system.

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Ganga and Deeparani

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Table 1: Specification of PV module at STC (25 C and 1000 W/m2)

Parameter	Value
Maximum Power (W)	$P_{max} = 200W (+10\%/-5\%)$
Voltage at MPP (V)	$V_{mpp} = 26.3V$
Current at MPP (A)	$I_{mp} = 7.61A$
Open Circuit Voltage (V)	$V_{oc} = 32.9V$
Temp. Coefficient I_{sc} , αI_{sc}	$+3.18 \text{ mA}/^\circ\text{C}$
Temp. Coefficient Open Circuit, βV_{oc}	$-123 \text{ mV}/^\circ\text{C}$
Number of cells in series (Ns)	54

Table 2: Converter parameters

Parameter	Value
Input voltage (V_{in})	$V_{in} = 105 \text{ V}$
Output voltage (V_{out})	$V_{out} = 320 \text{ V}$
Switching frequency (f_s)	$f_s = 25 \text{ kHz}$
Output voltage ripple ($\Delta V_o/V_o$)	1%
Load (R_L)	$R_L = 128 \Omega$
Inductance (L)	$L = 230 \mu\text{H}$
Input capacitance (C_1)	$C_1 = 300 \mu\text{F}$
Output capacitance (C_2)	$C_2 = 30 \mu\text{F}$
Input voltage (V_{in})	$V_{in} = 105 \text{ V}$

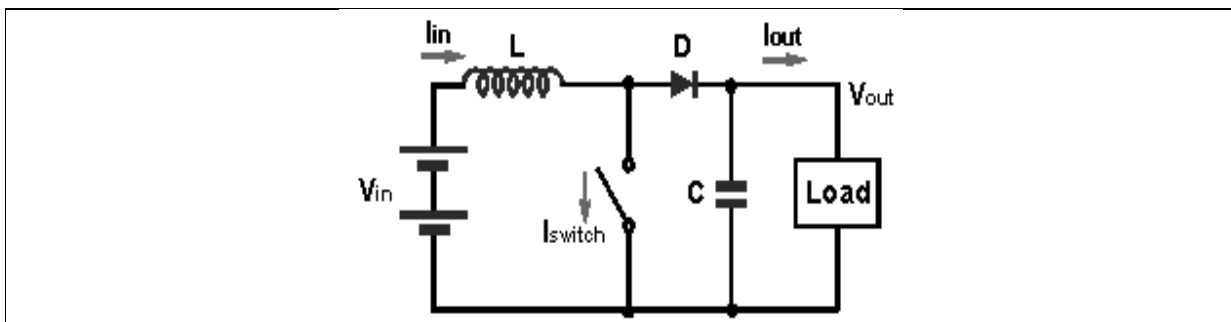


Fig.1. Boost converter circuit





Ganga and Deeparani

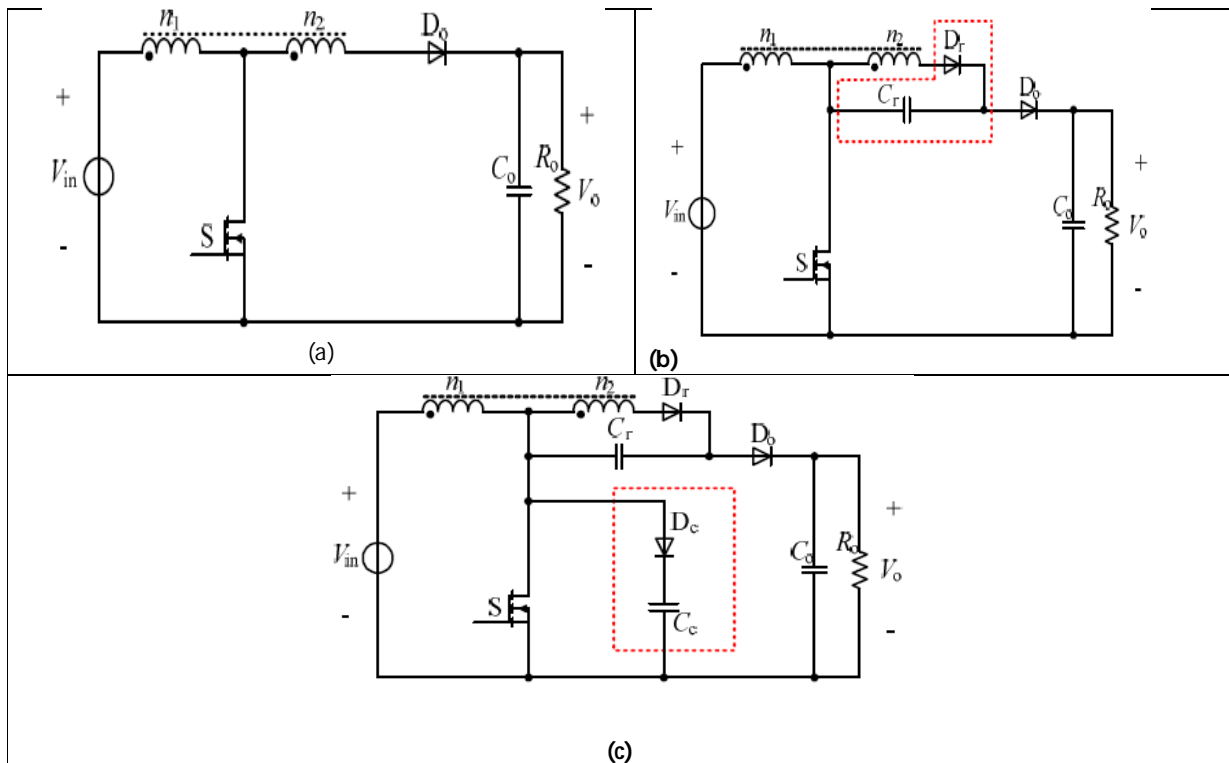


Fig.2. The derivation of the proposed converter. (a) The coupled-inductor based boost converter presented in [12]. (b) A capacitor and a diode are added as a rectifier. (c) The passive clamp circuit is included.

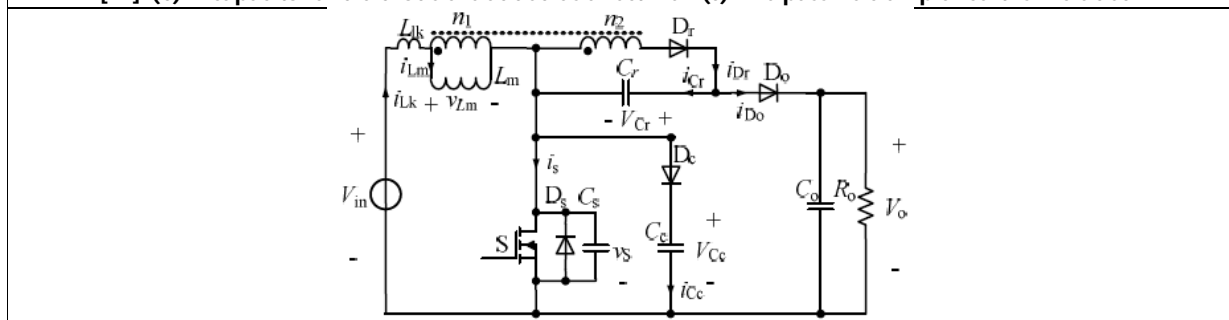
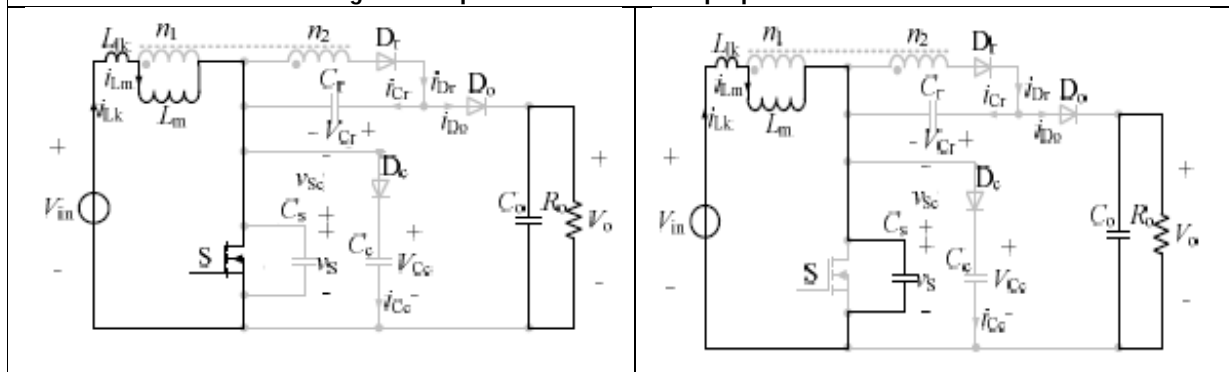


Fig.3. The equivalent circuit of the proposed converter





Ganga and Deeparani

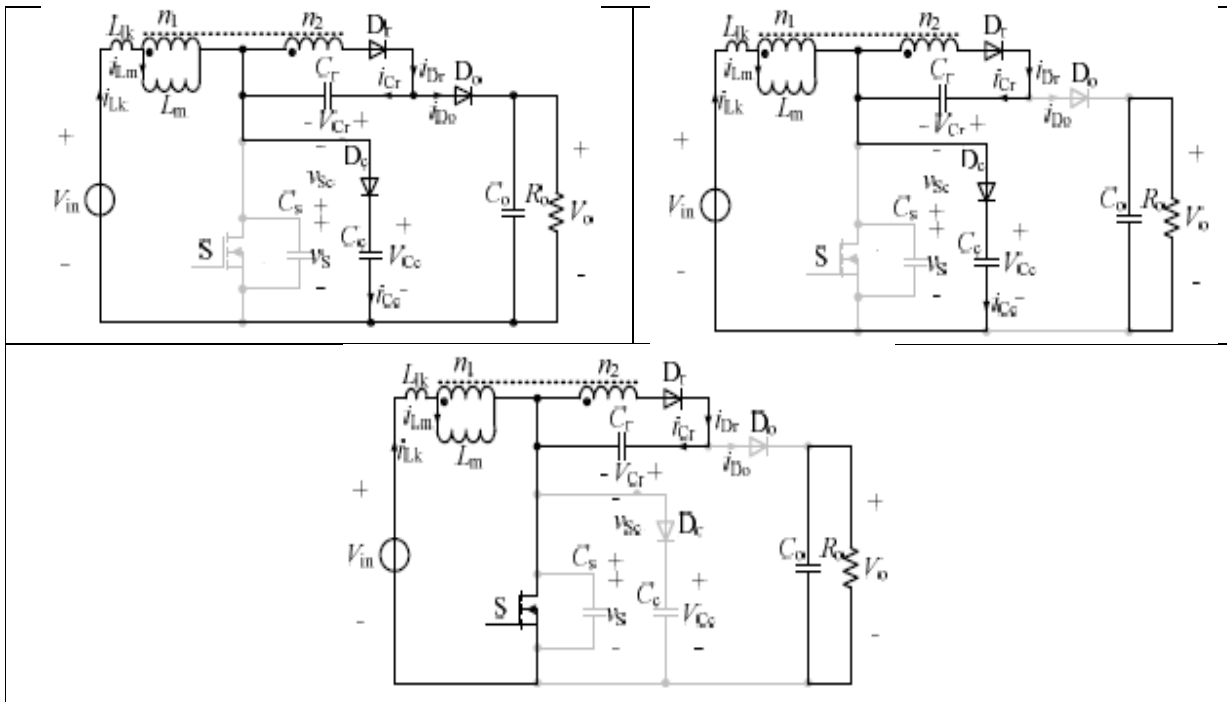


Fig.4. Modes of operation of the proposed converter.

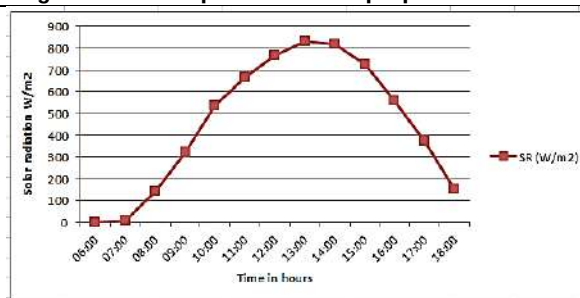
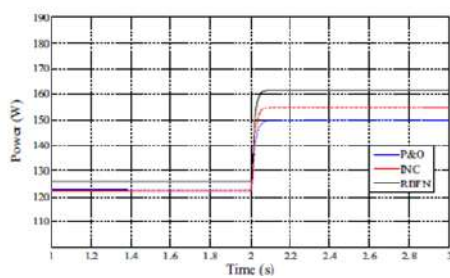
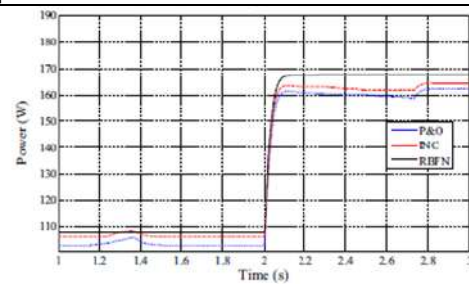


Fig.5. Input samples



(a)



(b)

Fig. 6(a) and (b) with P&O, dP P&O and improved dP P&O based MPPT techniques





Various Patterns of Spinal Muscle Imbalances in Shoulder Joint Dysfunction - A Systematic Review

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ABSTRACT

Shoulder dysfunction has a wide range of underlying musculoskeletal reasons. It also seen that along with shoulder joint dysfunction there is involvement of spinal muscle imbalances as both are the part of kinetic chain and also core acts as a primary source of force transmission to the upper extremity movements. We carried out a systematic review for different types of spinal muscle imbalances in shoulder joint dysfunction. Based on the authors' experience, knowledge, and reflective practise, articles were chosen. In order to conduct the review, PUBMED, PEDRO, MEDLINE, CINHALL, and their databases up to January 2023 were searched electronically for relevant papers, Where in MeSH search terms and free words were used. In addition to the electronic search, articles were searched manually for relevant studies. Articles were selected based on authors expertise, self- knowledge and reflective practice. The current study included 17 articles that fulfilled the inclusion criteria suggesting that shoulder joint dysfunction not only affect the shoulder joint but also spinal muscles causing weakness of trunk extensors as well as trunk flexors and up to some extent it also affects trunk lateral rotators of affected side. This review spoke about the shoulder joint dysfunction and its rising consequences and also about the assessment methods, treatment approaches available in treating and minimizing the symptoms of this dysfunction. Further research is required over what more preventive strategies can be adopted in case of the shoulder joint dysfunction using spinal muscle strengthening as an equally important part of treatment.

Keywords: shoulder dysfunction, core, scapular dyskinesia, kinetic chain.





INTRODUCTION

Shoulder dysfunction has a wide range of underlying musculoskeletal reasons. They include shoulder impingement syndrome, glenohumeral osteoarthritis, avascular necrosis, tendinopathy, bursitis, rotator cuff tears, adhesive capsulitis, and trauma from accident. A number of deficits, including discomfort, stiffness, weakness, postural deviations, and altered glenohumeral rhythm, are brought on by shoulder dysfunction. The limitations resulting from these impairments include those related to reaching, lifting, overhead movements, carrying, pushing, pulling, grooming, and sleeping. Shoulder dysfunction, which affects 16% to 21% of the population, is the second most frequent musculoskeletal issue addressed in physical therapy [1,2]. Scapular dyskinesia is also one of the problem that is seen in shoulder dysfunction which is defined as altered movement or position of the scapula. When the scapular musculature is weak or dysfunctional, normal scapular posture and mechanics can be disrupted. Increased protraction, anterior tilt, and inadequate acromioclavicular elevation have been found as features of the scapula in people with scapular dyskinesia. Shoulder complex function is inefficient when the scapula fails to perform its stabilising role, which can lead to poorer neuromuscular performance as well as a higher risk of gleno-humeral joint damage [2,3,4]

Painful shoulder conditions such labral pathologies, arthrosis, or instability, as well as skeletal (such as a clavicular fracture), neurological (such as long thoracic or auxiliary nerve palsy), and muscle dysfunction, all affect or impair the majority of muscles (e.g., soft tissue inflexibility, muscle weakness, inhibition, or imbalance) [5]. Similar to the core, the scapula serves as a pivot for moving strong forces and energy from the legs and trunk, which are the primary contributors of this energy and force, towards the upper extremity, which are the main transfer mechanisms of this energy and force [5]. For the scapula to work optimally overall, the scapular muscles must contract appropriately. The existence of strong scapular muscles is one of the most crucial conditions for optimal scapulothoracic joint stability and effective movement [6,7]. The following effects of the consequent altered biomechanics are possible: 1) abnormal stresses on the shoulder's anterior capsular components; 2) increased rotator cuff compression; and 3) diminished shoulder complex neuromuscular function. 4) A decline in the spinal muscles' strength 5) a decline in the general functioning of the muscles [6,8]. A change in scapular position has been associated to a number of shoulder and neck disorders, including discomfort and soreness in the neck. The scapula is an essential part of the gleno-humeral rhythm and a critical link in the kinematic chain of the upper extremities. Complex shoulder kinematics must be sustained and coordinated by the scapula [7]. The scapula produces synchronous scapular rotation and acts as a kinetic chain link during humeral motion. If the scapular position is disturbed, forces generated by the lower body and trunk will not be efficiently transmitted to the upper extremity [8,9].

The loss of link function alters the biomechanics of the scapula. Changes in scapula-thoracic muscular strength might extend mechanical load on pain-sensitive cervical spine tissues because the scapula and the cervical spine have shared muscle attachments. The highest attachments of the scapula-thoracic muscles, the levator scapulae and Trapezius, transmit loads from the shoulder girdle to the cervical tissues. Failure of the scapular muscles can put tension on the cervical regions and create or sustain biomechanical instability in the cervical spine, both of which can result in the beginning, continuation, or recurrence of neck discomfort [8,10]. The intrinsic core stabilising musculature, notably the multifidi, internal obliques, transverse abdominus, diaphragm, and pelvic floor muscles, are responsible for trunk stability. Increased intra-abdominal pressure is caused by the structural organization of these muscles and their adequate activation, resulting in a hard cylinder in the trunk. Whenever these muscles are working appropriately, they help to stabilise the trunk before moving the upper limbs [9,10]. Basic reasons of upper extremity dysfunction include inadequate hind-foot stability, a lack of hip range of motion, hip extensor and abductor stiffness and/or weakness, decreased spinal mobility, restricted pelvic motion and/or strength, and inadequate scapular control [11]. The proximal segments of the scapula must work properly in order to provide proximal stability for upper extremity distal mobility because they act as a link in the kinetic chain, acting as a funnel for the flow of forces and energy from the lower limbs and core to the upper limbs. Proper trunk, pelvic, hip, and leg





Sakshi P. Shah and Sandeep B. Shinde

strength, stability, and mobility are required for this [11,12,13]. The core is crucial for maintaining stability for upper and lower limb motion in a variety of sports, including badminton and basketball, as well as in daily activities. Because it enhances overall body stability and performance, spinal stability is crucial in the setting of scapular dyskinesis [14].

METHODOLOGY

We carried out a systematic review for different types of spinal muscle imbalances in I shoulder joint dysfunction. Based on the authors' experience, knowledge, and reflective practise, articles were chosen. In order to conduct the review, PUBMED, PEDRO, MEDLINE, CINHALL, and their databases up to January 2023 were searched electronically for relevant papers. Retrieved articles were manually searched for relevant research in addition to being subjected to computerised search. We searched for the terms "scapular dyskinesis," "spinal instability," "kinetic chain," and "shoulder dysfunction." Further to an electronic search, publications were manually searched for selected studies. The selection of articles was based on the knowledge, self-awareness, and reflective practise of the authors.

Study selection

A systematic review was undertaken. We included studies published in English up to January 2023 which are focused on spinal muscle impairments in shoulder joint dysfunction, factors contributing to shoulder dysfunction, correlation between shoulder dysfunction and spinal musculature, kinetic chain between shoulder and spinal muscle.

Data extraction

The inclusion criteria were checked at every stage of the study selection process. The evaluation of the selection and extraction procedure included every phase. The references' headings and abstracts were scrutinised. After reviewing the full texts of relevant publications, those that matched the criteria for inclusion were included. When data met inclusion requirements, the researcher incorporated it in the database. The database of randomised clinical trials, randomised control trials, comparative studies, and cross-sectional research was the criterion for study inclusion. These studies also included studies with shoulder joint problems and various spinal muscle imbalances. The research examined for this study covered a wide range of topics, including the link between spinal instability and shoulder joint dysfunction symptoms and physiotherapy treatment options. After that, researchers examined over, analysed, and discussed these databases. Following that, the researcher read and reviewed.

Research	Author	Findings	Conclusion
Integrating Shoulder and Core Exercises when Rehabilitating Athletes Performing Overhead Activities [36]	Brumitt J, Dale RB	The study findings suggested that early rehabilitation should include core muscle activation along with shoulder muscle rehabilitation.	The study concluded that Exercises for the core and shoulders that are incorporated may assist minimize the gap between early functional rehabilitation activities and later rehabilitation exercises.
Is there a relation between shoulder dysfunction and core instability? ²⁵	Radwan A, Francis J, Green A, Kahl E, Maciurzynski D	The study found out that experimental group has significantly reduced balance than control group, also there is positive correlation between double leg lowering test and Functional questionnaires.	The study concluded that It was discovered that athletes with shoulder dysfunction have poor balance. Also there is a link between a greater balance and stability deficit and a greater degree of shoulder dysfunction. The rehabilitation of athletes with shoulder dysfunction should





Sakshi P. Shah and Sandeep B. Shinde

			include balance training as a crucial part of core stability, according to therapists and trainers.
Invited clinical commentary the role of the scapula ⁶	Russ Paine, Michael L. Voight	This study focuses on the identification of dysfunction and retraining of the scapular musculature, as well as the anatomy and biomechanics of the scapula and accompanying musculature.	According to the study's findings, the glenohumeral joint and the scapula certainly cannot function independently. The proper operation of the scapula and surrounding muscles is necessary for the glenohumeral joint to operate normally.
Are chronic neck pain, scapular dyskinesia and altered scapula-thoracic muscle activity interrelated?: A case-control study with surface and fine-wire EMG ¹¹	Birgit Castelein, Ann Cools, Thierry Parlevliet, Barbara Cagnie.	The group with neck pain and scapular dyskinesia had less activity in the Middle Trapezius and more activity in the Pectoralis Minor when compared to the healthy group with scapular dyskinesia.	The study found that scapular dyskinesia had minimal to no effect on the activation of the scapula-thoracic muscles.
Scapular Dyskinesia and the Kinetic Chain: Recognizing Dysfunction and Treating Injury in the Tennis Athlete ¹²	Sundeep S. Saini, Sarav S. Shah, Alan S. Curtis.	For the purpose of converting potential energy produced in the lower extremities into kinetic energy in the upper extremities during a tennis serve, the study discovered that the scapula must function as a force transducer in the kinetic chain. Every modification in the force coupling raises the risk of harm.	According to the study, Scapular dyskinesia—which concerns the scapula's mobility and positioning—is a frequent site at which the kinetic chain breaks, and it has been linked to the long-term damage of distal structures through compensatory mechanisms. To determine potential places of failure along the kinetic chain, a thorough assessment of the individual tennis nodes should be performed.
Clinical Tests of Lumbo-Pelvic-Hip Complex Function in Individuals with and without Scapular Dyskinesia: Implications for Identifying Individuals at Risk for Upper Extremity Injury. ¹³	Lisa Eve Henning	The greatest trunk, pelvic, hip, and knee movement deviations were compared in order to investigate the relationship between scapular dyskinesia and kinematics during the SLS and SLDL.	According to the study, the dyskinesia group's knee valgus, hip rotation, and trunk rotation during the single-leg squat were all considerably higher than those in the control group.





Sakshi P. Shah and Sandeep B. Shinde

Correlation between scapular muscle endurance and core muscle endurance in subject with chronic shoulder pain. ¹⁴	Reem M. Atta, Hanaa K. Ata, Yasser M. Aneis, et al.	The modified Sorensen, trunk flexor endurance, lateral endurance test on the affected side, and pain level all had a positive link with the results of the scapular muscular endurance test. The scapular muscle endurance test and the lateral endurance test for the unaffected side did not significantly correlate.	The study indicated that patients with sub-acromial impingement syndrome have impairments in their scapular and core endurance. All core tests, with the exception of the non-affected lateral core endurance test, appear to be correlated with scapular muscular endurance.
correlation between core stability and scapulohumeral rhythm in badminton player- An observational study ¹⁵	Dr. Basavraj Motimath, Manjiri V Mahajan and Dr. Dhaval Chivate	The study's findings revealed a positive correlation between core stability and scapula-humeral rhythm in the outcome measures of scapula-humeral rhythm, lateral scapular slide test, Functional throwing performance index, close kinetic chain upper extremity test, and scapular muscle strength testing.	According to the study, scapula-humeral rhythm and core stability are related, and if one is disturbed, the other would be as well.
The relationship between scapular and core muscle endurance in professional athletes ¹⁶	Gamze Cobanoglu, Sinem Suner Keklik, Ali Zorlular, Elif Aygun Polat, et al.	The results of this study's Spearman correlation analysis revealed a positive moderate connection between the prone bridge test and the scapular endurance test as well as the Sorensen test and the scapular endurance test have positive relations.	This study found that scapular muscular endurance in athletes' increases at the same time as core muscular endurance. This implies that developing scapular and core muscle endurance in athletes is essential for performance and injury prevention.
Relationship between scapular muscle and core endurance in healthy subjects ¹⁷	Zeynep Hazar Kanik, Omer Osman Pala, Gurkan Gunaydin, et al.	The results of the side bridge test in this study had a positive association with the results of the scapular muscular endurance test ($r = 0.414$; $p = 0.003$). The results of the scapular muscular endurance test did not significantly correlate with the results of the other core endurance tests ($p > 0.05$).	According to the study's findings, in healthy subjects, there might be an association between lateral core muscles and scapular muscle endurance.
Effects of lower extremity and trunk muscles recruitment on serratus anterior muscle activation in healthy male adults ¹⁸	Navpreet Kaur, Kunal Bhanot, Lori Thein Brody, et al.	The serratus anterior (SA) revealed considerably higher EMG activity during the FPP with contralateral closed chain leg extension (CCLE), ipsilateral closed chain leg extension (ICLE), closed chain serape effect (CS), and open chain serape effect (OS) than the FPP.	The study came to the conclusion that the SA muscle is activated more during the FPP exercise when the lower extremities and trunk muscles are simultaneously recruited.
The effects of trunk stabilization on shoulder pain secondary to scapular dyskinesia ¹⁹	Kelly Kika	The study findings showed that Decreases in rib flare during shoulder flexion and trunk rotation during stability tests and these were indicators of improvements in trunk stabilisation. Normalization of scapular mechanics and Gleno-humeral static alignment were also observed.	According to the study, shoulder pain and trunk stability have a positive relationship. Shoulder pain reduced and scapular mechanics improved as the patient's coordination, strength, and endurance for trunk stabilisation improved.





Sakshi P. Shah and Sandeep B. Shinde

Analysis of the kinetic chain in asymptomatic individuals with and without scapular dyskinesia. ²⁰	Elisa Doria Pires, Paula Rezende Camargo. M	In this study, the group with scapular dyskinesia revealed moderate strength and endurance for the trunk flexors, hip extensors, and scapula-thoracic muscles, compared to the group without dyskinesia.	The study found that scapular dyskinesia in non-athletes without shoulder pain may be influenced by the strength of the hip extensors and trunk flexors as well as the endurance of the scapulothoracic muscles.
Influence of scapular position on the core musculature activation in the prone plank exercise. ²¹	Juan M. Cortell-Tormo, Miguel García-Jaén, Iván Chulvi-Medrano, et al.	In this study, EMG was used to assess how the positioning of the scapulae affected the core muscles during a prone plank. Comparatively to scapular abduction and anterior pelvic tilt and scapular adduction and posterior pelvic tilt, scapular adduction and posterior pelvic tilt displayed higher overall EMG activity.	According to the study, the core muscle groups made a greater contribution to the postural sustaining demands during posterior pelvic tilt positions, especially when the scapulae are in adduction. This was demonstrated by the influence of the scapular and pelvic position on the EMG response of the core muscle groups.
Rehabilitation of scapular dyskinesia: from the office worker to the elite overhead athlete. ²²	Ann M J Cools, Filip Struyf, Krist of De Mey, et al.	Strength deficits or neuromuscular deficits (a deficit of co-contraction and force couple activity) are two categories of impairments with muscle performance. Serratus anterior, middle, and lower trapezius have all been discovered to be weak in the latter, although upper trapezius frequently exhibits hyperactivity.	The study came to the conclusion that there is indications of scapular kinematic changes connected to shoulder and neck pain. Moreover, there is evidence of changed scapular muscle recruitment patterns in these individuals, as seen in changes to the adjacent muscles' strength, flexibility, motor control, and rhythm.
Scapulohumeral rhythm and associated spinal motion ²³	Jack Crosbie, Sharon L. Kilbreath, et al	In both unilateral and bilateral arm movement, scapular upward rotation is significantly greater on the non-dominant side than the dominant. Bilateral and unilateral arm movements result in significantly diverse spinal motion patterns and scapular external rotation ranges.	The study concluded that the shoulder girdle and the thoracic spine are significantly affected by any elevation of the arm, regardless of the plane of motion. Thoracic spine examination should be a part of clinical shoulder evaluation.
Activation of scapular and lumbopelvic muscles during core exercises executed on whole-body wobble board ²⁴	Andrea Biscarini, Samuele Contemori, Giuditta Grolla.	Comparing the same exercises carried out on the ground to those done on the WWB revealed considerably increased EMG activity in the serratus anterior and anterolateral abdominal muscles. On the other hand, during the bird dog exercise, lower-back muscle activation was noticeably higher on the ground.	Compared to exercising on the ground, using a WWB is a simple and efficient way to improve the activity level of the core muscles that control transverse-plane lumbopelvic and trunk stability. External overload is not necessary.





RESULTS

The searches identified 17 relevant studies; these showed clinical manifestation of scapular dyskinesia and its association with kinetic chain. There is positive correlation between scapular dyskinesia and spinal muscle endurance. A study regarding scapulohumeral rhythm and spinal motion by Jack Crosbie, Sharon L. Kilbreath examined how the humeral, scapular, and thoracolumbar spine motions coordinated during a variety of unilateral and bilateral upper limb movements under various movement situations. On three different planes—sagittal, coronal, and scapular—thirty-two healthy women elevated their arms unilaterally and bilaterally. Using a multi-sensor, 6-degree-of-freedom electromagnetic tracking system, the scapular, humeral, and spinal orientations were measured at 100 Hz. The study reached the conclusion that the shoulder girdle and the thoracic spine are significantly affected when the arm is elevated, regardless of the plane of motion, and that the thoracic spine should be taken into account while evaluating the shoulder clinically [23].

A study by Andrea Biscarini et al. examined changes in core-muscle activation during core-stability activities performed on the ground, in stable condition, and on the whole-body wobble board (WWB) in order to determine the impact of using this newly constructed whole-body wobble board. In this study to encourage proactive and reactive activation of the core muscles with a transverse or diagonal line of action, which offer trunk and pelvic stability with modest spine compression forces, WWB was permitted to roll in the plane perpendicular to its longitudinal axis in this study. After doing core-stability exercises on the WWB (in an unstable condition) and on the ground, the electromyography (EMG) activity of the lumbo-pelvic and scapular muscles was monitored (stable condition). The average and maximum EMG activity in stable and unstable conditions were compared. According to the study's findings, performing core-stability exercises on a weighted platform (WWB) is an easy and effective way to raise the activity level of the core muscles that control transverse-plane lumbopelvic and trunk stability without the use of external overload [24].

A study kinetic chain revisited: New concepts on throwing mechanics and injury by Samule k. Chu, Prakash Jayabalan, et al and Burkhart SS et al, and Kibler WB said that proper mechanics of the overhead throwing motion and the role of kinetic chain in throwing is important when evaluating the overhead throwing athlete. An examination should include glenohumeral range of motion, rotator cuff strength testing, and assessment of scapular dyskinesia [25,26,27].

DISCUSSION

This systematic review emphasises the relationship between different spinal muscle imbalances and shoulder problems. Since the scapula is a crucial link in the kinetic chain, persons with scapular dyskinesia may experience core muscle weakness as a result of the musculoskeletal system's tendency to develop improper movement patterns in order to preserve function. The proximal segments' capacity to provide proximal stability for distal motion of the upper extremity is crucial. The trunk, pelvis, hips, and legs must be strong, stable, and mobile enough to accomplish this. The core stability and scapulohumeral rhythm of badminton players were correlated in a study by Dr. Basavraj Motimath, Manjiri V Mahajan, et al. A total of 40 badminton players were chosen at random for the study. To evaluate the core stability, tests for strength and stability of the core were conducted. Scapulohumeral rhythm was evaluated using an inclinometer. The participants underwent the functional throwing performance index, the close kinetic chain upper extremity test, and the lateral scapular slide test. The findings revealed a strong relationship between core stability and scapulohumeral rhythm.²⁹The impact of scapular position on the core muscles during a prone plank was also examined in a study by Juan M. Cortell-Tormo et al. In specifically, when the scapulae are in adduction, the research examined the extent to which the core and scapular muscles contribute to the postural stabilising needs during posterior pelvic tilt postures [30].



**Sakshi P. Shah and Sandeep B. Shinde**

According to research, the lumbar pelvic hip complex (LPHC) serves as the kinetic chain's functional centre and provides a stable proximal base for the effective functioning and movement of the distal extremities. LPHC stability refers to the LPHC's capacity to regulate the trunk's posture and motion over the pelvis and leg to promote the best possible distribution of forces and energy along the kinetic chain. Moreover, during functional and athletic movements, the gluteus maximus and gluteus medius assist in controlling the torso, pelvis, and legs. The proximal and distal parts of the kinetic chain have both been linked to dysfunction by decreasing or failure to activate these muscles properly [13].

To determine the association between scapular and core muscular endurance in professional athletes, Gamze Cobanoglu et al. conducted a study. According to the study's findings, the Scapular Endurance Test and the Sorensen Test have a strong relationship. The conclusion drawn from this is that Muscular endurance in the scapula and the core is essential for performance and assessing injury risk. It is clear that in athletes, scapular muscular endurance improves along with core muscle endurance. This implies that developing scapular and core muscle endurance in athletes is essential for performance and injury prevention [16]. Regarding the treatment regimen, a study by Tuçe zekli Msrlolu et al. examined the immediate impact of core muscles-activated posture on shoulder maximal voluntary isometric contraction (MVIC) strength as well as the impact of core stability exercises. The participants were given core stabilisation exercises for six weeks, including abdominal drawing-in, abdominal drawing-in with alternating upper extremity movement, abdominal drawing-in with alternating lower extremity movement, abdominal drawing-in with alternating upper and lower extremity movement, opposite arm leg raises in prone position, pelvic tilt while standing, and forward lunge. After a home-based fitness regimen, the MVIC readings considerably increased. The study found that a six-week programme of core stability exercises significantly improved shoulder MVIC strength. This finding might support the use of exercises that strengthen the core during the initial stages of shoulder rehabilitation, when shoulder muscle strengthening exercises are painful [31].

Another case study by Kelly Kika examined the effects of trunk stabilisation as a primary physical therapy treatment for shoulder pain caused on by Scapular Dyskinesia and Subacromial Impingement Syndrome. The patient showed improvements in trunk stabilisation and less shoulder pain after ten physical therapy sessions. Reduced rib flare during shoulder flexion and reduced trunk rotation during stability tests were indicators of improvements in trunk stabilisation. Moreover, scapular mechanics as well as glenohumeral and scapular static posture were adjusted. By the conclusion of the therapy, improvements in shoulder and scapular strength were also observed [19].

CONCLUSION

The above review regarding the shoulder joint dysfunction and various patterns of spinal muscle imbalances stated that shoulder joint dysfunctions not only affect the shoulder joint but also spinal muscles causing weakness of trunk extensors as well as trunk flexors and up to some extent it also affects trunk lateral rotators of affected side. It is very crucial that while screening for shoulder joint dysfunction we need to do thorough assessment of spinal muscles as they both are included in the kinetic chain of the body. In any cases of shoulder dysfunction, compensation of spinal muscles is seen due to adaptation. Treatment of the shoulder dysfunction needs to include complete rehabilitation of kinetic chain as it will give great stability, balance and fine control of movements. Integrated training including core stabilization, rotator cuff strengthening and scapular stabilization all should be given equal important during rehabilitation. These are the prime aspect of treating shoulder dysfunction as it will help in early recovery.

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**Statement conflict of interest**

The authors claimed that there are no conflict of interest concerning the content of present study.

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**Sakshi P. Shah and Sandeep B. Shinde**

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Sakshi P. Shah and Sandeep B. Shinde

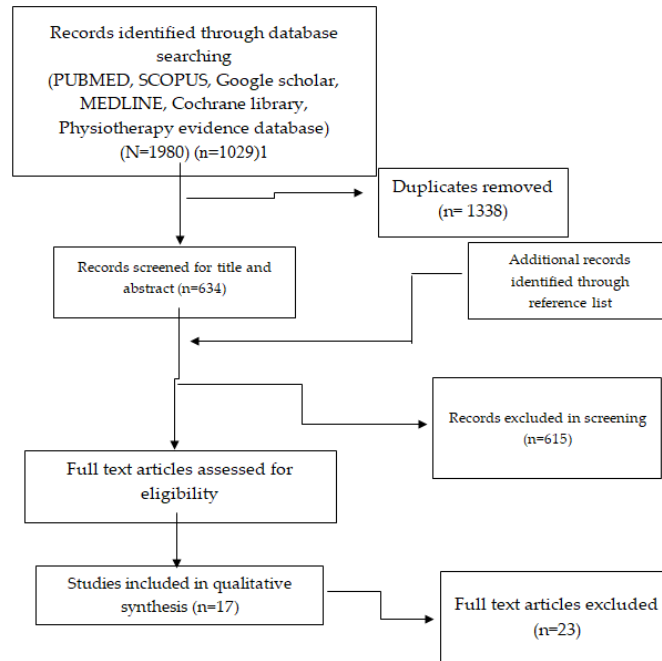


Fig.1. Flow Chart





A Study of NGOs in Jammu and Kashmir Working with Inclusive Perspective of Education for Beneficiaries' Capacity Building

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ABSTRACT

Education is an influential tool for the individual welfare, bringing in the equality and social Justice, and also to pace up national development. India, being the second most populous country of the world, having a population of about a billion and a quarter out of which the number of people with disabilities in the country is 26 million, or roughly 2.1% of the total population (Census, 2011). Thus, to facilitate the capacity building of all through education requires additional dedicated mechanisms besides the government facilitations and provisions. Hence, NGOs have a big role to play in to improve the access and quality of education and consequent welfare of the people belonging to the marginalised sections. NGOs functions like an extended mechanism of support in capacity building and initiating welfare to the sections where government (due to different reasons) has limited/no reach. These are capable of working at grass root level Jammu and Kashmir, by virtue of remaining a special state until recent, grossly remained an unexplored terrain as far as the availability of statistics in different areas are concerned, examples are many and here the most relevant to quote is the availability of data on growth and matters related to functioning of NGOs. In this backdrop, the proposed study targets to explore the domains of functioning of NGOs and the kind of obstructions, issues and challenges imposed as perceived by the NGOs on their functioning.

Keywords: NGOs, diversities, differences, inclusive perspective, capacity building empowerment.



**Monika and Kiran**

INTRODUCTION

Inclusion is seen as a universal human right. The aim of inclusion is to embrace all people irrespective of race, gender, disability, medical or other (Singhal, 2005; 2006; Kallangur 2008). It is about giving equal access and opportunities and getting rid of discrimination and intolerance (removal of barriers). It affects all aspects of public life. With respect to diversity, inclusion means different things to different people, but various studies have shown that teaching mixed classes can be challenging for teachers as well as for students, especially students with disabilities. Thus, while having a look on the policies and literary review in the field of inclusive and special education, it can be asserted that although policies are in plenty, constitutional provisions with new amendments (like the RTE Act, 2009, Article 21A, are there, strongest laws are in place, efforts of governments and NGOs and other stakeholders are there as per guidelines of international agencies, but still the result of inclusion are very low, even after the 25 years of India signing the Salamanca statement. India, being the second most populous country of the world, having a population of about a billion and a quarter out of which the number of people with disabilities in the country is 26 million, or roughly 2.1% of the total population (Census, 2011). Thus, to facilitate the capacity building of all through education requires additional dedicated mechanisms (Non-governmental organizations) besides the government facilitations and provisions.

Role of NGO's and reflection on their importance

NGOs are continuously playing an important role for the creation, implementation and enforcement of different policies as well programs for the upliftment of the society. The main activities undertaken by NGOs are:

- Raising awareness about the prevalent issues among the people through various campaigns
- NGOs are working as an agent (brokerage) between a variety of groups and sectors
- NGOs are playing an active role in capacity building among different organizations such as providing free education, medical camps, training programs, distribution and delivery of essential humanitarian and other social services.

Status of NGOs in India

To check the action of the NGOs in order to filling the gaps in the governmental welfare system, NGOs conduct research-based advocacy for the analysis of various government projects and adopt right-based approach and with power NGOs network is devoted to develop ideal medium between government and society for the participation and exchange of trusted and accurate source of quality information. Thereby, the Central Statistical Institute of India 2009 that there were 3.3 million NGOs registered in India. In 2020, Guide stars India (GSI) had more than 10,000 verified NGOs and more than 1,600 certified NGOs on its portal. There are also 100,873 NGOs registered on the 'NGO DARPAN' portal of Nitti Aayog (ICNL, 10 Nov 2021) so, the NGO in India are playing a major role for the upliftment of deprived people in the society. It is also performing worthy job in this direction and it has undertaken various projects like abolition of poverty and are working upon various social evils. The functions of NGO are setting an example for serving the humanity.

Status of NGOs in J&K

In Union Territory of Jammu & Kashmir, many Non-Government Organisations are working for social development and welfare of the rural and urban communities. Many NGOs are working at the grassroots level to improve the educational and living standards of disabled person as well as for other social aspects. They are also generating awareness about the value of education in the remote areas and for the upliftment of the weaker and the underprivileged sections of the society. They have been working hard since independence in strengthening the education system in India so that more children reach school and remain there. Currently, total 1566 registered NGOs are working in Jammu and Kashmir (DARPAN, NITI Aayog, Government of India). All these NGOs are working in different domains such as child welfare, Women development, Child education, Women empowerment, Social awareness, Rights of person with disabilities, development of physically and mentally challenged, Betterment of backward and deprived communities etc.



**Monika and Kiran****Need and Significance of study**

Education is an influential tool for the individual welfare, bringing in the equality and social justice, and also to pace up national development. Therefore, all across the globe, education is recognised as the human right. Due to the potency and established importance of the education as a tool, the quality in education becomes really a matter of concern. And, therefore it is the shared responsibility of the national functionaries and the civil society to provide good quality education to all including those belonging to various disadvantaged sections. India, being the second most populous country of the world, having a population of about a billion and a quarter out of which the number of people with disabilities in the country is 26 million, or roughly 2.1% of the total population (Census, 2011). As a result, in addition to government facilitations and provisions, extra specific mechanisms are required to assist the capacity building in education. Hence, NGOs have a big role to play in to improve the access and quality of education and consequent welfare of the people belonging to the marginalised sections. Through a preliminary survey of the population, total 1566 registered NGOs working in the UT Jammu and Kashmir have been identified (web sources: DARPAN, NITI Aayog, Government of India). The broader areas of the functioning of these 1566 registered NGOs are found to be ranging across child welfare, Women development, Child education, Women empowerment, Social awareness, Rights of person with disabilities, development of physically and mentally challenged, Betterment of backward and deprived communities etc. The present study attempts to examine the status, function and the different domains of inclusive NGOs working in Jammu and Kashmir. The study proposes to do detailed case studies of the sampled NGOs (from both Jammu and Kashmir Divisions respectively) for addressing the research questions mentioned below.

Research Question

1. What is the magnitude of NGOs working with inclusive perspective of education for beneficiaries' capacity building?
2. What are the obstructions, issues and challenges as perceived by the NGOs working with inclusive perspective of education in functioning effectively?

Objectives of the study

1. To find the magnitude of NGOs working with inclusive perspective of education for beneficiaries' capacity building.
2. To study the obstructions, issues and challenges as perceived by the NGOs working with inclusive perspective of education in functioning effectively

Delimitation of the Study

The study was geographically delimited to Jammu and Kashmir division only.

METHODOLOGY**Population**

The population of the study constituted all the NGO's working in the Jammu & Kashmir provinces with more than one group of beneficiaries from the total number of 1566 NGOs (www.darpanportal.com).

Sampling**Sampling Technique**

It was not possible for the investigator to collect the data from all the NGOs. Thus, the purposive sampling technique was used for the selection of the sample.



**Monika and Kiran****Criteria for sample selection**

NGOs working with inclusive orientation and working for more than one group of beneficiaries as well as focusing on welfare and education of multiple groups that represented in the total sample were taken for the collection of data.

Sampling Frame

In the following tables of sampling frame and NGOs which fulfilled the pre-determined selections criteria have been depicted-

Sample selection and Size

The detailed description of the sample selected for the present research work as follow:

Final Sample comprised of six inclusive NGOs, of which four NGOs were chosen from Jammu division and two from Kashmir division who were approachable and consented to be the part of the study as mentioned in the Table no.2

Process of Sample Selection

The researcher visited the websites of NGOs for identification of the above-mentioned criteria in Table no.1 and also taken the email IDs and contact number. The researcher than make contact with the NGOs for seeking permission to be the part of study. The researcher got consent from six NGOs for preceding the research work.

Tool used for study

Tool: In the present study the researcher has used self-constructed Semi – structured thematic interview tool for collection of the data on the basis of themes.

Themes Explored

The tool was constructed on the basis of the following themes depending on the nature of the study i.e.,1) Exploration of profile 2) Goal orientations informing the practices of NGOs 3) Status of affairs (physical and human resources) 4) Issues and challenges faced by the NGOs 5) Suggestions for improvement.

Tool Construction (Identification of Themes)

For the construction of the tool the researcher has reviewed the related literature and on the basis of review different themes has been identified. After the identification of themes, the researcher discussed it with the supervisor and frame the questions based on the themes. Preliminary inquiry from the NGOs was also done.

Analysis and interpretation of data

In order to gain the information regarding the services provided by the NGOs, telephonic interviews had been conducted in which the questions related to the area of functioning, physical and human resources, funding facilities, beneficiaries, inspiration and motto behind the establishment and the various challenges faced by them and their suggestions are addressed. The data was analyzed by manifested content analysis of the interview data taken from the administrators of different NGOs as well as quantification of data by using frequencies & percentage. The analysis of the study has been described in thematic way as under:

Thematic Analysis

Table 3 .reflection on profile depicts that majority of the NGOs are working in the field of education and disability. In which few NGOs was working in the ground of social welfare and rehabilitation rest other working with Gender issues /Employment and caste on the basis of many studies Signal (2007) and Abusrour (2017), it was found that, undeniably NGOs are giving their best at their level but still we are lacking in improving the status of education of the disadvantaged sections. The probable reason for the popularity of these two areas could be the scope provided in the area for marking the performance and promotion of chances to get easy and good amount of grants and financial support if any NGO has either of the area in its functional profile.





Monika and Kiran

Table 4. depicts that the majority of the NGOs inspired by the social well-being and some are influenced by individual will/self-motivated as well as others were inspired by their values to give equal opportunities in an inclusive environment for nurturing and developing a sense of being an important part of the society. During interview one of the respondents said:

“विकलांगहोनेकेअपनेअनुभवोंनेमुझेएकऐसामंचस्थापितकरनेकेलिएप्रेरितकिया

जहांमेंअपनेअनुभवसाझाकरसकूँऔरविकलांगबच्चोंकेलिएभीकामकरसकूँताकिउन्हेंभीसमानशिक्षाप्राप्तहोसके।”

Translation: On the basis of my own experiences as being disabled that I had gone through the life till now, motivated me to setup a platform where I can share my own experiences and also work for the disabled children so that they can get access to all equal educational opportunities and enjoy equal rights.

Empathy and contribution to the betterment of society as a part of social responsibility have still not been able to get their due place as reflected in the exploration of the ground inspiration or motto directing functioning of majority of NGOs under consideration. Sense of charity and outsiders are still a dominating sense by which majority of the NGO's are operating.

Table 5. Shows that the majority of the NGOs were lacking sufficient suitable infrastructure and few NGOs admitted that, they had sufficient funds and availing the grants from different ministries such as Ministry of social justice empowerment, Ministry of education, Ministry of women and child development etc. Majority of NGOs reported to have multiple sources of funding i.e., government grants and donation money etc. But, the crunch of financial resources to fund the basic operations of sampled NGOs had been reported as major issue by all. Because of insufficient funds from available resources, it was reported that NGOs were needed to look for alternate fund sources and face lots of hardships consequently. The version of one of the respondents is worth to be quoted below for highlighting the nature of hardship NGOs faced while generating the financial resources.

“हमफंडिंगकेलिएघर-घरजातेहैं।

Table 6. revealed that majority of the NGOs reported they were facing problem related unavailability of trained teacher, field workers as well as lack of trained administration and management committee. Because of insufficient human resources it was reported that NGOs were facing the problems related recruiting the trained teachers and management committee. The findings of the present study found similar to the study conducted by Ferguson (2009) and Lekorwe & Mpabanga (2007) revealed that scarcity of Human resources, such as lack of trained staff, lack of parental involvement and absence of networking etc. The problem highlighted by the sampled NGOs which effects the functioning and quality of education provided to their beneficiaries. Due to shortage of funds, NGOs were unable to hire trained teachers and staff. One of the responded acknowledged as:

“हमारेपासफंडिंगकमहोनेकेकारणहमकुशलटीचररिक्रूटनहींकरपाते”

Translation: Due to the lack of funding, we are not able to recruit trained teachers.

Table 7. highlights various issues and challenges faced by the NGOs in which, majority of the NGOs reported unavailability of sufficient funding. Reporting of issues such as; untrained staff, teachers, unavailability of resource persons etc. It has become evident that the issues pertaining to functioning of NGOs revolve around primary requisites for effective functioning of any organizations. The situation gets intensified negatively by way most of the NGOs are working (as reported). These organizations lack networking, strategic planning, and long-term vision, consequently, they are unable to get into alternative resolutions on their own. Rather, they keep on looking for external support and help mainly from government.

Table 8. reflects the suggestions proposed by the NGOs in which majority of the NGOs were in favour of capacity building of the teachers and staff. Most of the NGOs given the suggestions related with polices and their





Monika and Kiran

implementations. In which, some shows their concerns towards inclusion and role of society. One of the participants responded

“नीतियांबनातेसमय, विकलांगोंकेहितोंऔरअधिकारोंकेलिएभीउचितध्यानदियाजानाचाहिए।”

Translation: While formulating the policies, due consideration should also be paid for the interests and rights of disabled

Majority of the sampled NGOs were in the favour to strengthen policies and their implementations at grassroot level. For the growth and development of the NGOs it was reported there is need to prepare the competent teachers and staff for improving the quality of education.

Major findings of the Study

- Majority of the NGOs in Jammu and Kashmir are working in the field of education and disability sector, where the main focus is to ensure the educational rights of the people from different marginalized sections especially focusing on the PWDs while as some NGOs are dealing with social welfare and rehabilitation and rest others are working with gender issues, employment and caste.
- Majority of the NGOs were inspired by the social well-being and some are influenced by individual will/self-motivated as well as others were inspired by their values to give equal opportunities in an inclusive environment for nurturing and developing a sense of being an important part of the society.
- Majority of the NGOs were lacking sufficient suitable infrastructure and trained human resource as they depend on the public for funding because they were not funded by the government properly.
- As far as the human resources are concerned, majority of the NGOs admitted that they had insufficient human resources and also lack of trained administration and management committee.
- Majority of NGOs were facing the problem of unavailability of trained teachers and field workers
- Majority of the NGOs were dissatisfied by the unavailability of funds. Most of them showed that they were facing the problems related to academic issues such as; untrained staff, teachers, unavailability of resource persons etc. Most of the NGOs were dissatisfied because of rejection of person with disabilities and unawareness of parents about their rights in the society.
- Majority of the NGOs are in favor of capacity building of the teachers and staff and provided the suggestions related to policy and their implementations mainly showing their concerns towards inclusion and role of society.

CONCLUSION

NGOs are also playing an essential role in monitoring and evaluation because they act as an overseer or independent assessor of government performances and also check their accountability. As per the findings of the study role of government was missing, if government takes steps on fake organizations and genuine organizations it will get sufficient funds through generating, organizing and raising their funds through various activities for instance; getting grants from funding agencies through various projects, government schemes, and funds can be generated by availing the benefits from student and child scholarship programs along with creating a social media group for effective networking, organizing different awareness events and cultural events as well as organizing small raising funds in that way, they can help in the development of NGOs in Jammu and Kashmir. For the betterment, Liaoning of NGOs to different agencies is very necessary because the greatest challenge for NGOs in the education sector is to recruit, train and retain the professionally trained teachers. Due to the shortage of untrained teachers, NGOs are facing many problems for that the Government should devote or locate more resources for the capacity building of the teachers, who could serve and provide quality services to the clients. For their appropriate excellence and expansion, NGOs' officials should be aware about the specific training programs that are run by various professional agencies, and it should be made compulsory for them to join such programs enabling them to learn how they can run their NGOs professionally. Undoubtedly NGOs a boon to any developing country, but only if they are audited and





Monika and Kiran

supervised by Govt. The functions of NGO are setting an example for serving the humanity. It is performing worthy job in this direction and it has undertaken various projects like abolition of poverty and are working upon various social evils.

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Table 1 Sampling Frame

	Jammu	Kashmir	Total
No. of NGOs	254	1,312	1,566
No. of NGOs Working with Multiple Groups	70	143	213
NGOs working on education along with welfare	25	35	60

Table 2. Sample selection and size

Province	NGOs	Total
Jammu	1. Jammu Institute of General Education & Rehabilitation (JIGER)	4
	2. Samaj Kalyan Kendra (Jammu),	
	3. Home for Handicapped (Jammu)	
	4. Red cross home for handicapped (Jammu)	
Kashmir	1. Humanity welfare organisation helpline (Anantnag Kashmir)	2
	2. Hope Disability Centre (Ganderbal Kashmir)	
Total		6

Table.3. Reflection on profile

S. No.	Theme	Frequency	Percentage
1.1	Establishment:		
	• 1975-1985	2	33.33
	• 1985-1995.	-	-
	• 1995-2005	2	33.33
	• 2005-2015	1	16.66
1.2	• 2015 & Ahead	1	16.66
	Status of registration		
	• Registered	6	100
	• Not registered	-	-





Monika and Kiran

1.3	Area of Operation • Whole J&K • One Province only • District only	5 1 -	83.33 16.66 --
1.4	Area of functioning • Education • Social Welfare • Rehabilitation • Gender issues/Empowerment • Disability • Caste	6 4 4 1 6 1	100 66.66 66.66 16.66 100 16.66

Table. 4- Identification of the Inspiration/Motto of sampled NGOs

1.1	Inspiration /motto	Frequency	Percentage
1.2	Individual will	3	50
1.3	Social welfare	4	66.66
1.4	Values	2	33.33

Table 5. Availability of Resources and facilities

S. No	Theme	Frequency	Percentage
1	Suitable infrastructure		
1.1	• Available and Sufficient	-	---
1.2	• Insufficient Availability	----	---
1.3	• Not Available	6	100
2	Financial Resources		
2.1	Availability of funds		
2.2	• Yes	3	50
2.3	• No	3	50
3	Sources of funding		
3.1	• Government sources	5	83.33
3.2	• Public sources	6	100

Table 6. Human Resources

S.No.	Theme	Frequency	Percentage
1.	Management & administrative Availability		
	• Yes	4	66.66
	• No	2	33.33
1.1	Sufficiency		
	• Yes	2	33.33
	• No	4	66.66
1.2	Traning		
	• Yes	2	33.33





Monika and Kiran

	• No	4	66.66
2.	Teachers/trainers /field workers availability		
	• Yes	5	83.33
	• No	1	16.33
2.1	Sufficiency		
	• Yes	–	–
	• No	6	100
2.3	Suitable training/Education		
	• Yes	2	33.33
	• No	4	66.66

Table 7- Issues and challenges

S. No.	Issues and challenges	Frequency	Percentage
1.	Availability of finance	6	100
2.	Proper Administration	4	66.66
3.	Proper Academic facilities	5	83.33
4.	Social Acceptance of disables	4	66.66
5.	Lack of awareness amongst parents	4	66.66

Table 8- Suggestions provided

S. No	Suggestions	Frequency	Percentage
1.	Strengthening the existing polices & framing new polices	3	50
2.	Inculcation of respect for diversity and promotion of Inclusion through provision of equal opportunities	3	50
3.	Bringing awareness about disability and sensitising people	2	33.33
4.	Capacity building of teachers	4	66.66
5.	Bringing the understanding of proactive role of society towards deprived section	2	33.33





Evaluation of Chest X-Ray on Covid-19 Patients : A Review

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ABSTRACT

In month of December 2019 Wuhan, City in China, has reported the 1st case of covid-19. Cases have been suddenly increases and gave enormous stress on healthcare system. It was marked as pandemic by WHO on 11th March 2020 (Litmanovich et al. 2020; Rousan et al. 2020; Sohrabi et al. 2020; Chamorro et al. 2020). It mainly responsible for respiratory illness and highly transmissible disease caused by a Novel Strain family corona viridae, a pathogen. By knowing the consequences and the type where it belongs to which category SARS-COV-2 was labelled as covid-19 by the International Classification of Diseases (ICD). Molecular test such as RT-PCR or Imaging test of chest can be used for the diagnosing of the disease. Also it plays an major role for planning of the treatment and management of affected individuals based on the severity. Fever, cough, Dyspnea, Fatigue are most common symptoms noted and very less symptoms are sputum, haemoptysis, headache noted (Rousan et al. 2020). It was thought important to understand which pathology is most commonly found in chest X-ray of covid-19 patients.

Conclusion: By referring many published articles it is concluded that the common findings in chest x-ray of covid-19 patients noted as Ground Glass Opacity (GGO) and consolidation including Bilateral, peripheral, middle and lower zones distribution. Chest x-ray can be used for covid-19 affected individuals for diagnosis and follow up in patients.

Keywords: Ground Glass Opacity, Consolidation, SARS-COV-2, Chest X-ray





INTRODUCTION

In December 2019 first case of corona virus (covid -19) was reported. Later it rapidly spread to the whole world. Also it affects the economical, financial and health conditions of the people as well. By October 2020 planetary- covid-19 cases spread out to 46 million and mortality rate exceeded up to 1,140,000 (Hopkins, J. 2020; Guan et al. 2020). Enormous rise in number of cases due to the absence of particular drug, vaccine or treatment, thus entire world was facing the challenges of Healthcare and financial system. Generally this infection occurs within 14 days of exposure to an infected environment, frequently less than 4-5 days. This infection can occur at any stage of age group because it is getting transmitted via coming in contact via droplets of secretion from covid-19 individuals (Heymann, D. L and Shindo, N. 2020). With the help of Imaging and molecular test diagnosis of this disease can be done. In symptomatic and asymptomatic individuals diagnosis can be done by molecular test by identifying the viral RNA in RT-PCR. Due to its speciality of short reporting time and also less reaction time laboratory tests were in fully demand but also it is still challenged by risk of contamination and substantial amount of false negatives (Radiology, A. C. O. 2020; XU et al. 2011; Kanne et al. 2021).

In clinically suspected covid-19 patients having negative RT-PCR report, imaging tests help to detect the signs of pneumonia which will help to take immediate decision of treatment and also management of patient health condition. Imaging tests were more preferable for those patients who are having moderate to severe features of covid-19 pneumonia instead of RT-PCR test (Kanne et al. 2021; Hjouj et al. 2021). To determine the level of severity of the disease, when the RT-PCR is unavailable, when the results are negative with symptomatic patients or the results of RT-PCR test are delayed, chest imaging was most implemented diagnostic tool for asymptomatic to extremely infected patients. Due to its better diagnostic features, sensitivity and specificity the chest X-ray and CT-scan are more preferable as imaging modalities but the choice is still a matter of discussion with respect to various literatures (Fang et al. 2020; Sverzellati et al. 2021).

Chest X-Ray

The most commonly imaging test performed as chest x-ray on suspected cases of covid-19 individuals (WHO 2020; Hussain et al. 2021). Mostly chest x-rays were used instead of CT due to its quick results and easy procedure (Guan et al. 2020; Wong et al. 2020; Weinstock et al. 2020; Cozzi et al. 2020; Ippolito et al. 2020; Schiaffino et al. 2020; Hare et al. 2020). Simple internationally recognised reporting template of chest x-ray developed by the British Society of Thoracic Imaging (BSTI) has been included into an National Health Services England (NHSE) radiology tool for diagnosis of suspected covid-19 cases (Hare et al. 2020; NHS England Speciality Guides 2020).

Typical Related to Covid-19 Findings

It shows reticular pattern GGO, Consolidations with rounded, patchy appearance especially distribution noted in Peripheral, Bilateral and in Lower lung areas (Phan et al. 2020).

Intermediate Related to Covid-19 Findings

In this pneumonia can be noted. It may be due to a consolidation/ GGO with peripheral and lower lung field distribution.

Atypical Related to Covid-19 Findings

Pleural effusion, lobar consolidation, millitary patterns and cavitations are reported hardly in 3% of covid -19 individuals. Common findings in infected individuals are multifocal airspace opacities, GGO and consolidation also other findings are pleural effusion, Lymphadenopathy, bronchieactasis, Septal thickening



**Vashist Baburao Mhalsekar and Adithya G Rao**

and cavitation are rarely noted (Guan et al. 2020; Cozzi et al. 2020; Ippolito et al. 2020; Schiaffino et al. 2020; Ai et al. 2020).

Consolidation

It is an particular area of alveolar air spaces are filled with fluid, Inflammatory cells or other material. Due to an pneumonia a complete consolidation is seen which spreads out through lobes via pores of Kohn between alveoli's. In plane chest radiograph features of consolidation includes air space opacification obscure the pulmonary vessels and air bronchograms (Occurance of Air filled bronchi) (Hacking C. et al. 2020).

Ground Glass Opacities

It is an area of highly attenuation in lung with conserved vascular and bronchial markings. It is non-specific signs with etiology such as partial lung filling of air spaces, edema, inflammation, partial lung filling of alveoli, interstitial thickening, inflammation. Often it is used to refer to fairly diffuse region of hazy lung radio-opacity in which edges of pulmonary vessels are difficult to recognize. It contains three different morphological forms they are focal Ground Glass Opacification (includes Ground Glass nodules), Diffuse Ground Glass Opacification (includes Diffuse Ground Glass nodules) and Isolated diffuse ground Glass Opacification (Shivananda A. And Amini B. et al. 2008).

Septal Thickening

It can be having different types of interlobular or septal thickening such as nodular, irregular and reticular. After GGO and consolidation the most common pathology seen in chest x-ray findings of covid-19 individuals are reticular pattern interlobular septal thickening which includes the radiographic features are Kerley a lines with 2-6cm long lines directed towards hilum and Kerley B lines about 2cm tiny line directed perpendicular to the pleura (Wu et al. 2020; Shi et al. 2020; Song et al. 2020).

DISCUSSION

An early diagnosis is important not only for confirmation of disease but it plays an important role to show the severity of the disease and also it helps to take action for management and treatment of the patients. For the diagnosis of covid-19 on chest x-ray findings many literatures have been published. Results of Liq .A.Rousan. et al. (2020) Peripheral GGO striking the lower lobes. As the development of illness exceeds, the GGO proceed into an consolidations around 6-11 days (GGO 70%, Consolidation 30%). Later stage of illness at (12-17 days) the consolidations reverts into the GGO (GGO 80%, Consolidation 10%). The study concludes that the peripheral GGO affecting the lower lobes were common findings found in chest X-ray of covid-19 individuals. A study performed by Asraf Hussain et al. (2021) Shows findings of chest x-ray on covid 19 individuals were (91%) shows peripheral lung involvement, 83% were having lower and middle zone involvement and 89.8% shows bilateral GGO/ Consolidations. Later they concluded in study Bilateral lower zone consolidation is most frequently finding in chest x-ray of covid 19 patients which is almost similar to the results of E Martinez. Chamorro et al. (2021).

In the study of David L. Smith et al. (2020) Covid 19 patients chest x-ray findings are consolidations band like GGO, patchy/ confluent in middle to lower and also at peripheral zone distribution were noted. The study done by Abdelwahed Abougazia et al. (2021) in Qatar on covid 19 patients their chest X-ray findings are in a small number of cases pleural effusions (2.4%) were noted. Maximum number of cases were having air space opacities mainly distributed in peripheral lung zones (69.5%) and at lower (87.1%) higher number have been noted, also large count of bilateral involvement were found (74%). Another study by Misbah Durrani et al. (2021) On chest x-ray findings of covid-19 patients noted in peripheral, lower, middle and bilateral lung zones shows clearly a spectrum of mixed Ground Glass Opacities, pure Ground Glass





Vashist Baburao Mhalsekar and Adithya G Rao

opacities to consolidation. As the results shown in many literatures of covid-19 GGO and consolidation including the bilateral distribution, peripheral, middle and lower lung areas were the common radiographic findings of covid-19.

CONCLUSION

To access the severity of this disease for better diagnosis chest x-ray with RT-PCR test can be useful which might help in reducing mortality rate and improving life expectancy. Most common findings of chest x-ray in Covid-19 patients are consolidations and GGO including bilateral with peripheral middle and lower lobe distributions.

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Evaluation of the Water Quality in the Eastern Parts of Nandurbar District, Maharashtra, India

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ABSTRACT

The present study aimed to assess the water quality index of water samples collected from eastern part of Nandurbar District, Maharashtra. The qualitative assessment of water is an integral step in sustainable development of the region. The area representative fortyfive samples were collected in month of March 2020 and were analysed for major physico-chemical parameter. The results were matched with World Health Organization (WHO, 2017) standards, Hydro-chemical analysis shows that the quality of water is tented towards alkaline with hard to very hard water types. The contamination and domestic water aptness were evaluated by calculating water quality index (WQI). WQI classification revealed that 16% samples fallen under good class while 78% samples are in the poor class, 4% samples are in the very poor class and only 2% of the samples fall into unsuitable water quality.

Keywords: Water, WQI, Nandurbar District, India





INTRODUCTION

Water is one of the most important elements in human life for its survival. Out of that the subsurface water resources such as bore well, dug well and hand pumps are main sources of water for ingestion and agronomic as well as industrial activity. The increase of agriculture related activity results into change in land use pattern and population growth all around the world (Ganaie et al., 2021; Brontowiyono et al., 2022; Gbedzi et al., 2022; Chavhan et al., 2022). The increasing in the anthropogenic activities in semi-arid and arid area, where the freshwater resources is already present in scare amount creates pressure on freshwater results into increasing the pollution of the water resources around the world (Okello et al., 2015; Chen et al., 2021; Goswami et al., 2022; El-Anwar and Salman, 2022). Water shortage was experienced by almost every country in the world at certain times of the year. In view of this, sub surface water resources studies are getting most significant for the use in domiciliary, commercial and farming actions in different parts of the biosphere (Gleeson et al., 2020). Several studies have focused on surface and ground water quality assessment and its appropriateness for consumption for household use and farming practices in the last ten years (Ram et al., 2021; Mallick et al., 2021; Adeyemiet al., 2022; Tarki et al., 2022). The potential contaminants in ground water are immeasurable; they are different type biological and mineral, organic, biological. Now a days in sub-continent of Asia, subsurface water resources pollution from numerous element constituents is studied for different lithological and hydrological condition by many researchers by comparing with WHO (Adimalla 2019; Rakib et al., 2020; Zong et al., 2022). In current scenario, the contaminants like fluoride and nitrate have widely pollute subsurface water resources mainly due to anthropogenic influence and caused the cancercausing health effect (Kadam et al., 2022; Su et al., 2021; Adimalla et al., 2022; Mukherjee et al., 2022; Xiao et al., 2022; Gugulothu et al., 2022). Many different localities such as Nandurbar, Jalgaon, Aurangabad, and Nanded are having high nitrate and fluoride related health problems (Kadam et al., 2020; Yeole et al., 2020; Mukate et al., 2022; Reddy et al., 2022; Cui et al., 2022). The potential causes of fluoride and nitrate in these areas are extensive use of fertilizers for cultivation lands and leaching fluoride having minerals from granitic exposures in a semi-arid condition with alkaline waters (Toolabi et al., 2021; Marghade et al., 2021; Senarathne et al., 2021). Hence, it is a critical assignment for hydrogeologist and aquatic researchers to identify the genesis along with existence of fluoride and nitrate in terms of their probable health effects for capable water resource management.

The Shahada Tehsil located in the eastern region of Nandurbar District, belongs to alluvium plain of Tapi on northern part and western part is hard rock terrain of Maharashtra, India. Very less studies has been done this area mainly water pollution, quality assessment and its danger linked health hazard to human beings in that area. The main influencing parameter for groundwater contamination is agriculture practices as well as enrichment of major elements results into health risk. Normally, in the northern deep alluvium plain, the surface water bearing zones are extra susceptible to change than the deeper basaltic aquifers due to high permeability and penetrability of the soil. This study primarily emphasizes on the physio-chemical processes which affect the chemical composition of subsurface water changes with respect to time and space. In view of this, the main objectives of study are to evaluation quality of water using WQI in the study area. In totality, the results of the study will give the scientific output for sink and origin for surface and groundwater pollutants in the study area. Also, help to governing bodies, water planners and resource managers to develop effective basin management plans in semi-arid western parts of the Deccan Volcanic Province (DVP).

STUDY AREA

Shahada is a Tehsil in Nandurbar District of Maharashtra State, India. It's situated in north eastern region of Nandurbar District (Fig.1). Shahada tehsil is hub for many renown organisations working in economical, industrial and educational sectors in the North Maharashtra region. Shahada Tehsil has mostly scheduled tribe population lives about 88 percent of the total population. Total population of Shahada Tehsil is 335,346 living in 63,120 Houses, spread across total 207 villages and 147 panchayats. The microclimate of the area is categorized by a warm summer and overall aridness through the year expect during rainy season month, i.e., June to September. The temperature





fluctuates dramatically throughout the year, with the lowest temperature around 15°C and the highest temperature reaching 42°C. The average annual precipitation in the study region is around 650mm. The groundwater level in the research region varies between 5 and 10 m bgl in the pre-monsoon season and 10 to 20 m bgl in the post-monsoon season.

Geological outline of study area

The majority of the study region is comprised of basaltic terrain that is covered with alluvium deposits that date back to the Cretaceous to Eocene and are found in the Deccan Traps (Fig.2.) At the end of the Mesozoic epoch (70Ma), volcanic eruptions of the fissure-type produced the trappean rocks that are found today in western, central, and southern India (Vaidyanadhan and Ramakrishnan, 2008). Two major rivers Tapi and Narmada drain the district. The drainage network of Tapi includes number of tributaries like Nagan, Shivan, Gomai, Dehali etc while tributaries like Katri, Devnadi, Udai etc form the drainage network of Narmada River. About 30% area forms shallow alluvium deposits of recent period. Significant geological formation of intratrappean Lameta bed is observed in Akkalkuwa tehsil, at Northwest tip of the district.

METHODOLOGY

The area considered for the research located in the survey of India (SOI), toposheets of 1:50,000 scales, which further used to prepare the base map to outline the boundary, road, major streams, major cities and also marking of collected sampling location. The random sampling was done for groundwater availability, total the forty-five subsurface water samples in the year of March 2020 with reference different land use type, geology, geomorphology. The samples were collected in pre cleaned plastic bottle of one litter volume, after its collection, it is stored below 4°C temperature in the laboratory to avoid further reaction. During sampling the latitude and longitude, groundwater level, elevation of sampling point is recorded to prepare the sampling points map. The parameter such pH, electrical conductivity (EC) and total dissolved solid (TDS) were checked on site only using the calibrated HANNA digital meters. The major cations and anions such as calcium (Ca^{2+}), magnesium (Mg^{2+}), bicarbonates (HCO_3^-), and chlorides (Cl^-) were studied by standard titrimetric methods. Sodium (Na^+) and potassium (K^+) ions were assessed by flame photometric method (ELICO CL 3610). The fluoride (F^-) was investigated by SPANDS method. Also, nitrate (NO_3^-) and sulphate (SO_4^{2-}) were measured by spectrophotometer (Shimadzu UV-800) by following the APHA 2005 of water sample analysis. The charge balance errors (CBE) was calculated and which is observed within $\pm 10\%$ error. (Berner and Berner, 1987). Further, the results were comparing with WHO 2017 standards permissible and desirable limit for household purpose. These results were also used for calculation of quality of water using WQI by comparing with standard limit. The open sources GIS based spatial analysis tool for preparation of spatial variation map.

Computation of Water Quality Index (WQI)

WQI is extensively used method to classify the subsurface water sample into various classes' domestic and drinking purpose. This is arithmetic based process is mainly depends on the assigned rank and weights given to the analysed elements and this is most trust worthy method for evaluation groundwater quality. Complete evaluation of subsurface water eminence and aptness, the water analysed parameters such as pH, EC, TDS, Ca^{++} , Mg^{++} , TH, Na^+ , K^+ , HCO_3^- , Cl^- , SO_4^{2-} , NO_3^- and F^- were taken in account.

The WQI measured by the stages are given below:

The weighted arithmetic WQI method (Yisa et. al., 2010; Tyagi et. al., 2014) was applied to assess water suitability for drinking purposes. In this method, water quality rating scale, relative weight, and overall WQI were calculated by the following formulae:

$$q_i = (C_i/S_i) \times 100$$





Patil et al.,

where q_i , C_i , and S_i indicated quality rating scale, concentration of i parameter, and standard value of i parameter, respectively.

Relative weight was calculated by

$$w_i = 1/S_i,$$

where the standard value of the i parameter is inversely proportional to the relative weight.

Finally, overall WQI was calculated according to the following expression:

$$WQI = \frac{\sum q_i w_i}{\sum W_i}$$

RESULTS AND DISCUSSION

WQI is an extensively used method to classify the water superiority for domestic and household purpose (Wagh et al., 2019; Suvarna et al., 2022). In the area under study, bore well generally deliver water for local and farming purpose; hence, the groundwater eminence is closely related with local residents. Thus, regular checking and aptness evaluation of groundwater eminence is a vital to evade further humanoid well-being deterioration in part of study region having higher contamination values. Physico-chemical analysis is essential to know the mechanism of natural and manmade processes related to the change of subsurface quality. Percolated rejuvenated water react with topsoil by biogeochemical process results into change of its chemical constitutes. WQI was further categorized into four groups (Fig.3.): the WQI value less than 100 is termed as good water quality, in study area (16% sample) shows this type water quality; if the WQI values are between 100 to 200 represents poor, in study area (78% sample) shows this type water quality. The WQI values between 200 to 300 shows the very poor water quality, in study area sample (4% sample) shows this type water quality. The unsuitable water quality represents, when WQI values above 300. In the area under study, a sample no. 5 (2%) has categorised in the unsuitable water quality mainly settlement found to be more as compare with other area (Graph no.9). The calculated WQI values are ranges from 85.12 to 313.79 (table 3), showing that subsurface water quality is poor to Unsuitable water quality for domestic as well as household purpose. These changes are primarily occurring due to anthropogenic influence caused by household activity and/or farming process like spraying of fertiliser, insecticides also probably due to farming return flow results into upsurge in nitrate.

CONCLUSION

The present study aimed to assess the water quality index of water samples collected from eastern part of Nandurbar District, Maharashtra. Hydro-chemical analysis shows that the quality of water is tented towards alkaline with hard to very hard water types. The major parameters mentioned in WHO drinking standards such as, Ca^{2+} , HCO_3^- , Na^+ , K^+ , Cl^- , SO_4^{2-} and are within permissible limits. On the other hand, pH, NO_3^- , EC, TDS, TH exceed the permissible limits, respectively. Due to the accumulation of salt, there was a high concentration of EC and TDS in the study area's downstream region. The application of fertilisers, agricultural runoff, excessive use of herbicides, and the presence of chicken manure in the basin are all contributing factors to the enrichment of NO_3^- level in groundwater. The semi-arid environment, which boosted F ion leaching from the host lithology, is to blame for the excessive F. Additionally, the main causes of F ion leaching into groundwater include minerals like fluorite, muscovite, biotite, etc. Furthermore, the fluorite mineral dissolves more readily in groundwater due to its mild alkaline nature. Only 2% of samples are classified as having inappropriate water quality by the WQI, whereas 78% of samples are classified as having poor water quality. To promote public health, it is necessary to raise household levels of awareness about the chemicals present in water.





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Table 1: Physicochemical parameters of water sample

Sr No	pH	EC μS/cm	TDS Mg/l	TH Mg/l	Ca Mg/l	Mg Mg/l	Na Mg/l	K Mg/l	HCO ₃ Mg/l	SO ₄ Mg/l	Cl Mg/l	NO ₃ Mg/l	F Mg/l
1	10.27	12.65	11.80	44.70	5.33	6.40	2.40	1.20	3.36	8.40	0.55	6.67	11.00
2	9.33	47.17	44.00	55.40	7.79	6.13	3.60	1.04	6.72	16.80	0.64	20.00	9.00
3	9.33	12.44	11.60	39.40	4.80	5.47	1.68	0.52	3.36	8.40	2.39	9.33	6.00
4	10.13	21.01	19.60	45.20	5.60	6.13	2.52	0.40	8.00	20.00	2.40	6.22	12.00
5	10.40	43.57	40.64	109.30	14.72	13.07	7.84	1.34	9.79	24.48	3.32	19.33	16.00
6	9.33	10.72	10.00	30.70	4.00	3.87	1.60	0.58	3.52	8.80	2.20	4.67	1.00
7	9.33	17.15	16.00	39.30	5.23	4.80	2.60	0.46	3.52	8.80	1.20	11.33	1.00
8	9.33	17.15	16.00	39.90	5.44	4.67	3.12	0.78	2.72	6.80	2.40	4.22	1.00
9	9.33	23.16	21.60	44.10	5.81	5.47	2.36	0.76	4.70	11.76	2.40	13.56	1.00
10	9.33	19.30	18.00	41.90	5.87	4.67	3.36	0.68	4.80	12.00	0.60	7.56	1.00
11	9.33	15.01	14.00	37.00	4.75	4.80	2.56	0.62	4.00	10.00	2.07	15.33	1.00
12	9.33	15.01	14.00	35.50	4.43	4.80	2.44	0.50	3.17	7.92	1.98	11.33	1.00
13	9.33	22.55	21.04	46.30	5.76	6.27	3.04	0.76	4.96	12.40	2.64	10.73	1.00
14	9.33	26.16	24.40	49.30	5.07	8.27	2.64	0.72	5.92	14.80	0.68	4.44	1.00
15	9.33	13.94	13.00	39.30	4.69	5.60	2.00	1.00	3.36	8.40	1.68	2.66	1.00
16	9.33	12.44	11.60	30.80	3.41	4.80	2.00	1.20	1.60	4.00	0.68	2.26	1.00
17	9.60	15.54	14.50	39.50	4.21	6.40	1.92	0.78	4.16	10.40	0.68	3.03	1.00
18	9.33	19.30	18.00	43.10	5.87	5.07	2.72	0.68	5.82	14.56	0.36	1.86	8.00
19	9.73	21.44	20.00	45.10	5.49	6.27	2.84	0.76	5.92	14.80	0.48	9.11	1.20
20	9.33	34.30	32.00	45.30	5.97	5.60	2.40	0.78	5.28	13.20	0.19	2.06	1.00
21	9.47	20.86	19.46	28.70	3.31	4.27	1.80	0.72	1.92	4.80	0.67	2.62	3.50
22	10.13	12.44	11.60	32.80	3.84	4.80	1.52	0.78	2.40	6.00	0.44	2.14	7.00
23	9.33	19.30	18.00	42.70	4.80	6.53	2.40	0.42	5.60	14.00	0.24	1.82	4.00
24	9.33	12.48	11.64	34.40	4.27	4.67	1.80	0.64	2.24	5.60	1.02	5.78	1.00
25	9.33	28.73	26.80	27.30	3.20	4.00	1.60	0.42	2.08	5.20	1.97	5.33	3.00
26	9.87	48.37	45.12	38.90	4.80	5.33	2.08	1.20	3.58	8.96	1.24	11.11	1.00
27	9.33	40.74	38.00	95.10	15.04	8.00	7.60	1.04	9.92	24.80	0.68	12.67	16.00
28	9.47	30.38	28.34	46.50	5.44	6.80	2.56	0.64	5.60	14.00	1.04	11.11	1.00
29	9.87	19.02	17.74	43.70	5.12	6.40	1.60	0.66	5.22	13.04	1.52	6.89	3.30
30	9.47	19.30	18.00	39.80	4.80	5.60	2.88	0.42	4.80	12.00	1.16	3.78	1.00
31	9.33	12.86	12.00	31.50	3.20	5.33	1.44	0.40	2.08	5.20	0.76	3.56	3.00
32	9.47	21.57	20.12	71.00	9.71	8.27	3.60	0.96	7.36	18.40	0.97	13.11	12.00
33	9.47	15.01	14.00	41.90	4.91	6.13	2.04	0.64	3.36	8.40	0.60	13.56	1.00
34	9.33	17.15	16.00	30.30	3.31	4.80	1.28	0.32	1.92	4.80	0.56	1.00	6.00
35	9.60	12.86	12.00	42.20	4.80	6.40	2.20	0.42	3.52	8.80	1.97	7.89	1.00
36	9.33	44.02	41.06	40.90	4.69	6.13	2.24	0.42	3.84	9.60	0.60	4.89	3.00
37	9.33	25.08	23.40	43.80	5.23	6.27	2.48	0.84	5.44	13.60	1.68	10.67	6.00
38	9.33	31.09	29.00	41.50	4.91	6.00	2.80	0.72	4.80	12.00	0.64	8.67	3.00





Patil et al.,

39	9.33	25.73	24.00	46.30	6.19	5.60	2.52	0.76	7.20	18.00	0.27	11.56	11.00
40	9.33	21.23	19.80	41.90	5.44	5.33	2.08	0.66	3.36	8.40	1.44	5.11	1.00
41	9.33	27.87	26.00	46.20	5.65	6.40	2.72	0.80	5.92	14.80	1.24	12.44	2.00
42	9.33	17.15	16.00	42.40	5.28	5.73	2.60	0.52	5.12	12.80	0.47	8.89	4.00
43	9.33	11.79	11.00	41.90	5.44	5.33	1.44	0.56	2.56	6.40	1.56	1.01	1.00
44	9.60	15.01	14.00	42.50	5.12	6.00	2.48	0.76	3.52	8.80	1.68	9.11	3.00
45	9.60	28.39	26.48	46.00	5.87	6.00	2.48	0.80	5.79	14.48	0.42	11.11	2.00

Table 2: Allotted weights and Relative weights of physiochemical parameters

Parameter	Standard value	Allotted weight (wi)	Relative weight (Wi)
pH	7.5	5	0.100
EC	500	4	0.080
TDS	500	5	0.100
TH	100	5	0.100
Ca ²⁺	75	2	0.040
Mg ²⁺	50	2	0.040
Na ⁺	200	4	0.080
K ⁺	10	1	0.020
Cl ⁻	250	4	0.080
HCO ₃ ⁻	500	3	0.060
SO ₄ ⁻	250	5	0.100
NO ₃ ⁻	45	5	0.100
F ⁻	1	5	0.100
Sum (Σ)		50	1.00

Table 3: Classification of water sample based on WQI

Sample No.	Σ WQI	WQS	Sample No.	Σ WQI	WQS
1	124.72	Poor	24	94.86	Good
2	227.62	Very poor	25	118.96	Poor
3	114.71	Poor	26	181.56	Poor
4	159.21	Poor	27	278.91	Very poor
5	313.79	Unsuitable water quality	28	162.87	Poor
6	90.98	Good	29	134.06	Poor
7	120.72	Poor	30	123	Poor
8	113.53	Poor	31	90.66	Good
9	146	Poor	32	196.52	Poor
10	129.05	Poor	33	121	Poor
11	120.47	Poor	34	96.76	Good
12	111.41	Poor	35	113.66	Poor
13	146.78	Poor	36	170.72	Poor
14	152.72	Poor	37	153.81	Poor
15	105.95	Poor	38	154.45	Poor





Patil et al.,

16	85.12	Good	39	168.45	Poor
17	111.72	Poor	40	125.08	Poor
18	134.66	Poor	41	161.38	Poor
19	143.14	Poor	42	130.30	Poor
20	157.42	Poor	43	99.33	Good
21	102.09	Poor	44	121.57	Poor
22	95.89	Good	45	159.41	Poor
23	129.14	Poor	---	---	---

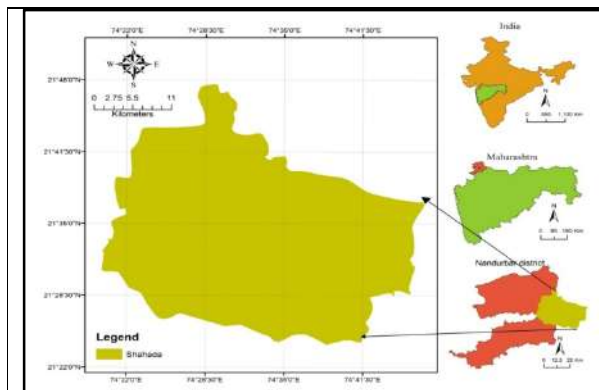


Fig 1. Administrative map of the study area

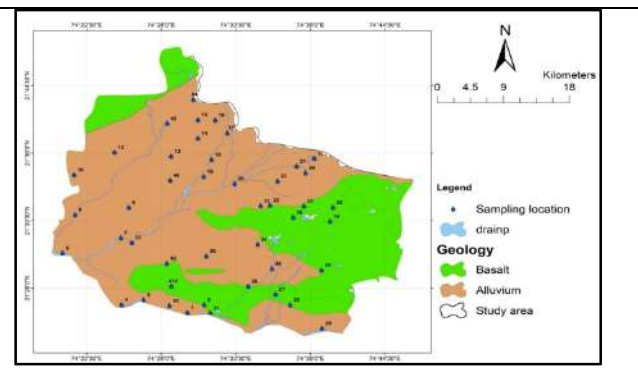


Fig 2: Geology and sample locations of study area

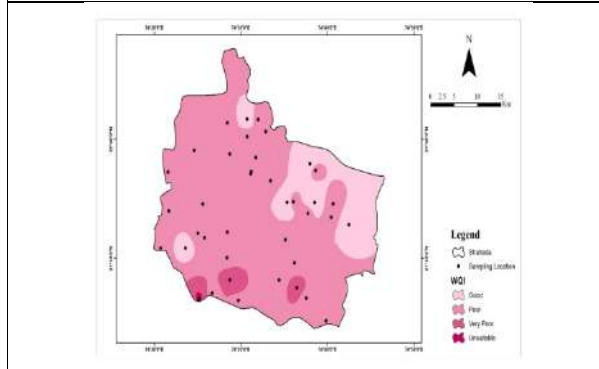
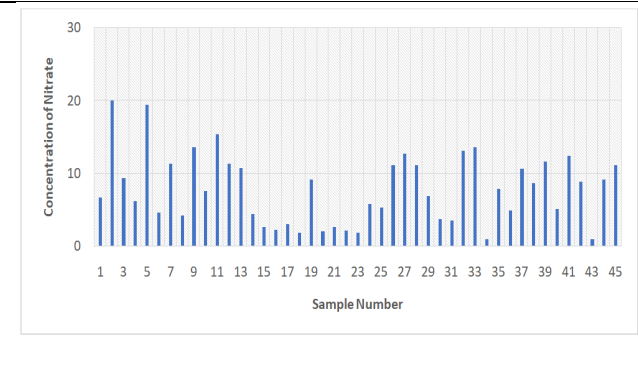
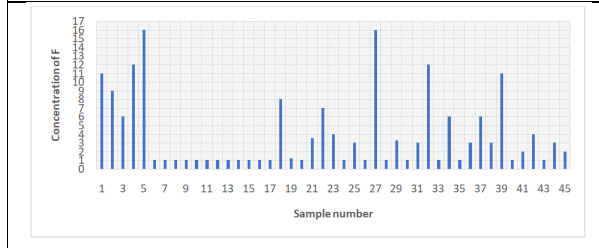


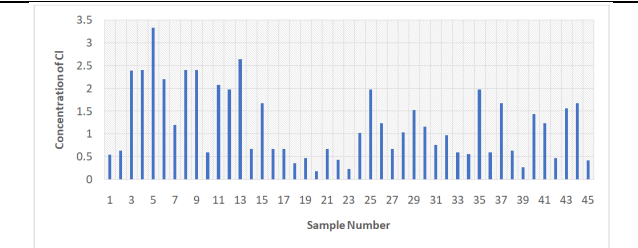
Fig 3: Water Quality Index map for area under study



Graph no. 1 Concentration of nitrate in water sample collected from study area



Graph no. 2 Concentration of F in water sample collected from study area

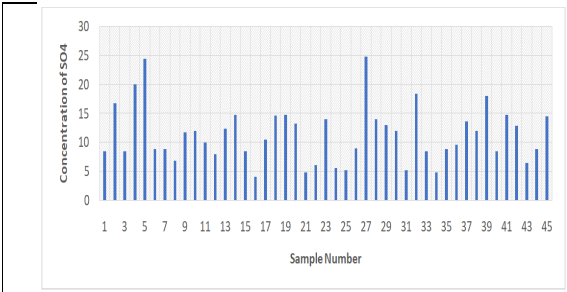


Graph no. 3 Concentration of Cl in water sample collected from study area

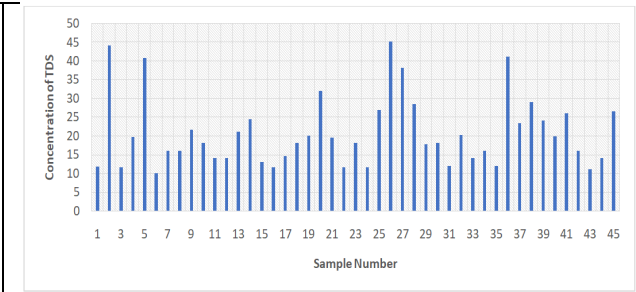




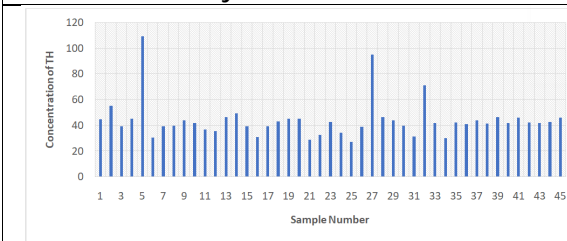
Patil et al.,



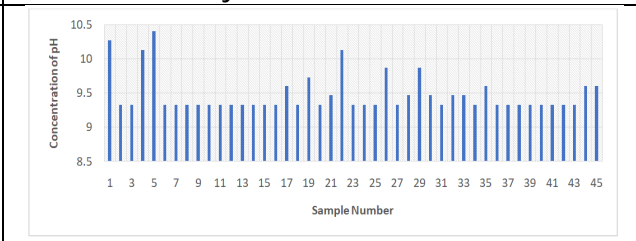
Graph no. 4 Concentration of SO₄ in water sample collected from study area



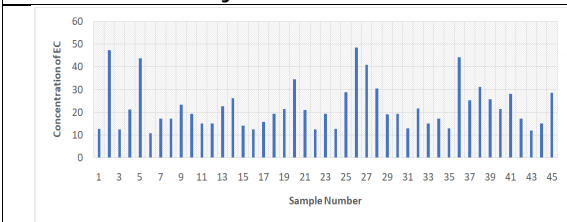
Graph no. 5 Concentration of TDS in water sample collected from study area



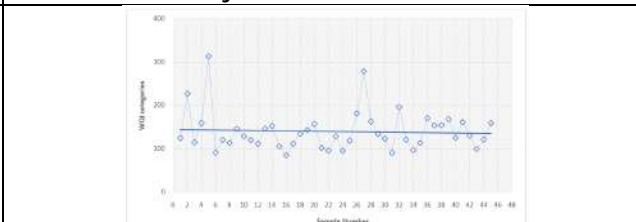
Graph no. 6 Concentration of TH in water sample collected from study area



Graph no. 7 Concentration of pH in water sample collected from study area



Graph no. 8 Concentration of EC in water sample collected from study area



Graph no. 9 WQI Graph for study area





Optimizing Economic order Quantity through Geometric programming with Fuzzification of Inventory Parameters

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ABSTRACT

The economic order quantity (EOQ) model is a well-known inventory management model that identifies the ideal quantity of products to order in order to reduce inventory expenses. Traditional EOQ models, on the other hand, rely on predictable demand, constant ordering and holding expenses, and unbounded storage space. These presumptions might not hold true in real-world circumstances, necessitating the inclusion of uncertainty and restrictions in EOQ models. In order to maintain optimal inventory levels while cutting costs, supply chain management must include inventory management.

Keywords: Geometric programming, inventory, fuzzy sets, hexagonal fuzzy numbers.

INTRODUCTION

In order to overcome these problems, this literature review focuses on the application of geometric programming (GP) and fuzzy logic in EOQ models. The conventional EOQ model makes the following assumptions: deterministic demand, constant ordering costs, and no storage space restrictions. Yet, demand may be erratic and storage space may be limited in real-world settings. Hence, in order to make the conventional EOQ model more suitable to real-





Mary Henrietta et al.,

world circumstances, scholars have suggested different expansions and adjustments to it. This study of the literature looks at current developments in EOQ models and geometric programming-based optimization of those models. In mathematics, geometric programming (GP) is a method applied in solving nonlinear optimization problems that may be converted into a certain form known as a posynomial form. Duffin, Peterson, and Zener developed GP for the first time in 1967 (5), and it has since been widely used to solve many other optimization issues, including inventory models. GP has been found to outperform conventional techniques like the Lagrangian and Kuhn-Tucker methods in solving EOQ models with nonlinear constraints and goal functions (11). A thorough introduction of applied GP, including its applicability to inventory models, is given by Beightler and Philips (1). With the help of GP, Kochenberger (12) solves a variety of inventory models, including EOQ models with erratic demand and storage capacity restrictions. Comparable to this, Jefferson and Scott (9) talk about several methods for using GP to apply to inventory models and give several instances.

Applying fuzzy logic, decision-making systems may deal with ambiguity and imprecision. Fuzzy logic, which was first introduced by Zadeh (21) in 1965, is frequently used in many industries, including inventory management. Models for uncertain demand, ambiguous input parameters, and subjective standards can be handled using fuzzy logic (16). In order to accommodate fuzzy demand and cost factors, Park (15) suggests a fuzzy set-based interpretation of EOQ, which expands on the conventional EOQ paradigm. A fuzzy EOQ model with demand-dependent unit costs and constrained storage is presented by Roy and Maiti (17). Fuzzy logic is used by Hsieh (8) to enhance manufacturing inventory models.

In order to solve EOQ models, fuzzy logic has also been integrated with GP. A GP-based method is suggested by Mahapatra, Mandal, and Samanta (14) to solve an EOQ model with fuzzy coefficients of objective and constraints. The effectiveness of a fuzzy logic-based EOQ model is compared with Lagrangian and Kuhn-Tucker approaches by Kalaiarasi et al. (10) in their study. Incorporating sustainability factors into inventory management models has gained popularity recently. Wang and Ye (18) evaluate carbon emissions using just-in-time and EOQ models. A sustainable EOQ model that takes into account carbon emissions and warehouse capacity restrictions is examined by Widodo and Utama (3). In order to optimise EOQ models with various fuzzy numbers while taking into account both environmental and economic goals, Kalaiarasi et al. (11) present a GP-based method.

The application of GP and fuzzy logic in EOQ models to handle uncertainty and restrictions is highlighted in this literature review's conclusion. While fuzzy logic manages imprecision and uncertainty in decision-making processes, GP is useful for tackling nonlinear optimization problems. Many EOQ models, including ones with variable demand, storage capacity restrictions, and sustainability considerations, have been subjected to these methodologies. Future studies might investigate how GP and fuzzy logic might be included into EOQ models to solve complex, multi-objective inventory management issues.

PRELIMINARIES

Definition: Fuzzy Set [19]

Let X be a space of points (objects). A fuzzy set A in X is an object of the form $F = \{(x, \mu_F(x): x \in X\}$ where $\mu_F: X \rightarrow [0,1]$

INVENTORY MODEL - GEOMETRIC PROGRAMMING

Notations

F - demand

q - total delivery quantity

B_T - unit's delivery transportation cost

B_H - inventory cost of per unit of product

μ - carbon emission for unit product in inventory per year

δ - carbon emissions for unit product transportation

α - tax rate





Mary Henrietta et al.,

Duffin's [5] proposed method of employing GPP to solve problems and provide geometric formulations is used to reduce overall costs [3].

$$\begin{aligned} \text{Total cost} &= \frac{FB_T}{q} + \frac{qB_H}{2} + \alpha \left(\frac{F\delta}{q} + \frac{q\mu}{2} \right) \\ TC &= \frac{FB_T}{q} + \frac{qB_H}{2} + \frac{\alpha F\delta}{q} + \frac{\alpha q\mu}{2} \end{aligned}$$

The primal solution is

$$\min TC = \frac{F(B_T + \alpha\delta)}{q} + \frac{q(B_H + \alpha\mu)}{2}$$

subject to the constraints,

$$\begin{aligned} \frac{F(B_T + \alpha\delta)}{q} &\leq 1 \\ \frac{q(B_H + \alpha\mu)}{2} &\leq 1 \end{aligned} \quad - (1)$$

The dual problem is taken as

$$\text{Max } d(\beta) = \left(\frac{F(B_T + \alpha\delta)}{q} \right)^{\beta_1} \left(\frac{B_H + \alpha\mu}{2\beta_2} \right)^{\beta_2} \left(\frac{F(B_T + \alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H + \alpha\mu}{2M_2 \beta_4} \right)^{\beta_4} \quad - (2)$$

with

$$\begin{aligned} \beta_1 + \beta_2 &= 1 \\ -\beta_1 + \beta_2 - \beta_3 + \beta_4 &= 0 \end{aligned}$$

The degree of difficulty for the problem is $4 - 1 - 1 = 2$ which will result in having an infinite number of solutions.

$$\begin{aligned} \beta_2 &= 1 - \beta_1 \\ -\beta_1 + (1 - \beta_1) - \beta_3 + \beta_4 &= 0 \end{aligned}$$

solving, we get $\beta_1 = \frac{1 + \beta_4 - \beta_3}{2}$ and $\beta_2 = \frac{1 - \beta_4 + \beta_3}{2} \beta_1$ and β_2 substituting for in equation (2), the dual function gets transformed into,

$$d(\beta_3, \beta_4) = \left(\frac{2F(B_T + \alpha\delta)}{1 + \beta_4 - \beta_3} \right)^{\frac{1 + \beta_4 - \beta_3}{2}} \left(\frac{B_H + \alpha\mu}{1 - \beta_4 + \beta_3} \right)^{\frac{1 - \beta_4 + \beta_3}{2}} \left(\frac{F(B_T + \alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H + \alpha\mu}{2M_2 \beta_4} \right)^{\beta_4}$$

by taking log on both sides of the above equation, we maximize $d(\beta_3, \beta_4)$ to find the values of β_3 and β_4

$$\begin{aligned} \log d(\beta_3, \beta_4) &= \frac{1 + \beta_4 - \beta_3}{2} [\log(2F(B_T + \alpha\delta)) - \log(1 + \beta_4 - \beta_3)] + \frac{1 - \beta_4 + \beta_3}{2} [\log(B_H + \alpha\mu) - \log(1 - \beta_4 + \beta_3)] \\ &\quad + \beta_3 \left[\log \left(\frac{F(B_T + \alpha\delta)}{M_1} \right) - \log \beta_3 \right] + \beta_4 \left[\log \left(\frac{B_H + \alpha\mu}{2M_2} \right) - \log \beta_4 \right] \end{aligned}$$

partially differentiating w.r.t β_3 and β_4 and equating to zero,

$$\text{i.e., } \frac{d(\log d(\beta_3, \beta_4))}{d\beta_3} = 0 \quad \& \quad \frac{d(\log d(\beta_3, \beta_4))}{d\beta_4} = 0$$

$$\begin{aligned} \Rightarrow -\frac{1}{2} [\log(2F(B_T + \alpha\delta)) - \log(1 + \beta_4 - \beta_3)] + \frac{1}{2} + \frac{1}{2} [\log(B_H + \alpha\mu) - \log(1 - \beta_4 + \beta_3)] \\ - \frac{1}{2} \left[\log \left(\frac{F(B_T + \alpha\delta)}{M_1} \right) - \log \beta_3 \right] - 1 = 0 \end{aligned}$$

$$\begin{aligned} \Rightarrow \frac{1}{2} [\log(2F(B_T + \alpha\delta)) - \log(1 + \beta_4 - \beta_3)] - \frac{1}{2} - \frac{1}{2} [\log(B_H + \alpha\mu) - \log(1 - \beta_4 + \beta_3)] + \frac{1}{2} \left[\log \left(\frac{B_H + \alpha\mu}{2M_2} \right) - \log \beta_4 \right] - 1 \\ = 0 \end{aligned}$$

$$\left(\frac{F(B_T + \alpha\delta)}{M_1} \right) \left(\frac{1}{\beta_3} \right) \left(\frac{B_H + \alpha\mu}{2F(B_T + \alpha\delta)} \right)^{1/2} \left(\frac{1 - \beta_4 + \beta_3}{1 + \beta_4 - \beta_3} \right)^{1/2} = e$$

$$\left(\frac{B_H + \alpha\mu}{2M_2} \right) \left(\frac{1}{\beta_4} \right) \left(\frac{2F(B_T + \alpha\delta)}{B_H + \alpha\mu} \right)^{1/2} \left(\frac{1 + \beta_4 - \beta_3}{1 - \beta_4 + \beta_3} \right)^{1/2} = e$$

$$\frac{F(B_T + \alpha\delta)(B_H + \alpha\mu)}{2M_1 M_2 \beta_3 \beta_4} = e^2$$

$$\Rightarrow \beta_3 \beta_4 = \frac{F(B_T + \alpha\delta)(B_H + \alpha\mu)}{2M_1 M_2 e^2}$$

$$\frac{F(B_T + \alpha\delta)}{q} = \beta_1^* d^*(\beta)$$





Mary Henrietta et al.,

$$\begin{aligned} \frac{q(B_H + \alpha\mu)}{2} &= \beta_2 d^*(\beta) \\ \frac{F(B_T + \alpha\delta)}{q} &= \beta_1 d(\beta) \\ \frac{q(B_H + \alpha\mu)}{2} &= \beta_2 d(\beta) \\ q &= \sqrt{\frac{2F(B_T + \alpha\delta)\beta_2}{(B_H + \alpha\mu)\beta_1}} \\ TC &= \sqrt{\frac{[F(B_T + \alpha\delta)][B_H + \alpha\mu]}{2\beta_1\beta_2}} \end{aligned}$$

when $M_1 \rightarrow \infty$ and $M_2 \rightarrow \infty$ we see that $\beta_3 = 0$ and $\beta_4 = 0$, henceforth as per conditions of the geometric programming we see that $\beta_1 + \beta_2 = 1$. i.e., $\beta_1 = \frac{1}{2}$ and $\beta_2 = \frac{1}{2}$

$$\begin{aligned} q &= \sqrt{\frac{2F(B_T + \alpha\delta)}{(B_H + \alpha\mu)}} \\ \min TC &= \sqrt{\frac{[F(B_T + \alpha\delta)][B_H + \alpha\mu]}{0.5}} \end{aligned}$$

FUZZIFICATION OF THE INVENTORY MODEL

The crisp value of the total cost is fuzzified using hexagonal numbers with different defuzzification methods as below.

Process (i)

Fuzzy methodology using ranking-based defuzzification and hexagonal fuzzy integers. The primary solution's parameter demand F is fuzzified using hexagonal numbers, then defuzzified using the ranking approach.

$$\begin{aligned} \min TC &= \frac{\tilde{F}(B_T + \alpha\delta)}{q} + \frac{q(B_H + \alpha\mu)}{2} \\ \text{subject to the constraints,} \\ \frac{\tilde{F}(B_T + \alpha\delta)}{q} &\leq 1 \\ \frac{q(B_H + \alpha\mu)}{2} &\leq 1 \end{aligned}$$

The duality of equation 2 becomes,

$$\text{Max } d(w) = \left(\frac{(F_1+F_2+F_3+F_4+F_5+F_6)(B_T + \alpha\delta)}{q} \right)^{\beta_1} \left(\frac{B_H + \alpha\mu}{2\beta_2} \right)^{\beta_2} \left(\frac{(F_1+F_2+F_3+F_4+F_5+F_6)(B_T + \alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H + \alpha\mu}{2M_2\beta_4} \right)^{\beta_4}$$

with

$$\begin{aligned} \beta_1 + \beta_2 &= 1 \\ -\beta_1 + \beta_2 - \beta_3 + \beta_4 &= 0 \end{aligned}$$

$$\begin{aligned} d(\beta_3, \beta_4) &= \left(\frac{2 \left(\frac{F_1+F_2+F_3+F_4+F_5+F_6}{6} \right) (B_T + \alpha\delta)}{1 + \beta_4 - \beta_3} \right)^{\frac{1+\beta_4-\beta_3}{2}} \left(\frac{B_H + \alpha\mu}{1 - \beta_4 + \beta_3} \right)^{\frac{1-\beta_4+\beta_3}{2}} \left(\frac{(F_1+F_2+F_3+F_4+F_5+F_6)(B_T + \alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H + \alpha\mu}{2M_2\beta_4} \right)^{\beta_4} \\ q &= \sqrt{\frac{2 \left(\frac{F_1+F_2+F_3+F_4+F_5+F_6}{6} \right) (B_T + \alpha\delta)}{(B_H + \alpha\mu)}} \\ \min TC &= \sqrt{\frac{\left(\frac{F_1+F_2+F_3+F_4+F_5+F_6}{6} \right) [(B_T + \alpha\delta)][B_H + \alpha\mu]}{0.5}} \end{aligned}$$





Mary Henrietta et al.,

Process (ii)

Fuzzy technique using hexagonal fuzzy numbers and signed-distance defuzzification were used

$$\min TC = \frac{\tilde{F}(B_T + \alpha\delta)}{q} + \frac{q(B_H + \alpha\mu)}{2}$$

subject to the constraints,

$$\frac{\tilde{F}(B_T + \alpha\delta)}{q} \leq 1$$

$$\frac{q(B_H + \alpha\mu)}{2} \leq 1$$

The duality of equation (2) becomes,

$$\text{Max } d(w) = \left(\frac{(F_1+2F_2+F_3+F_4+2F_5+F_6)(B_T+\alpha\delta)}{8q} \right)^{\beta_1} \left(\frac{B_H+\alpha\mu}{2\beta_2} \right)^{\beta_2} \left(\frac{(F_1+2F_2+F_3+F_4+2F_5+F_6)(B_T+\alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H+\alpha\mu}{2M_2\beta_4} \right)^{\beta_4}$$

with

$$\beta_1 + \beta_2 = 1$$

$$-\beta_1 + \beta_2 - \beta_3 + \beta_4 = 0$$

$$d(\beta_3, \beta_4) = \left(\frac{2 \left(\frac{F_1+2F_2+F_3+F_4+2F_5+F_6}{8} \right) (B_T + \alpha\delta)}{1 + \beta_4 - \beta_3} \right)^{\frac{1+\beta_4-\beta_3}{2}} \left(\frac{B_H + \alpha\mu}{1 - \beta_4 + \beta_3} \right)^{\frac{1-\beta_4+\beta_3}{2}} \left(\frac{(F_1+2F_2+F_3+F_4+2F_5+F_6)(B_T + \alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H + \alpha\mu}{2M_2\beta_4} \right)^{\beta_4}$$

$$= \sqrt{\frac{2 \left(\frac{F_1+2F_2+F_3+F_4+2F_5+F_6}{12} \right) (B_T + \alpha\delta)}{(B_H + \alpha\mu)}}$$

$$\min TC = \sqrt{\frac{(F_1+2F_2+F_3+F_4+2F_5+F_6)}{8} [(B_T + \alpha\delta)][B_H + \alpha\mu]}{0.5}}$$

Process (iii)

Hexagonal fuzzy numbers were used as the fuzzy technique, and the graded mean integration representation method was used for defuzzification.

$$\min TC = \frac{\tilde{F}(B_T + \alpha\delta)}{q} + \frac{q(B_H + \alpha\mu)}{2}$$

subject to the constraints,

$$\frac{\tilde{F}(B_T + \alpha\delta)}{q} \leq 1$$

$$\frac{q(B_H + \alpha\mu)}{2} \leq 1$$

The duality of equation (2) becomes,

$$\text{Max } d(w) = \left(\frac{(F_1+3F_2+2F_3+2F_4+3F_5+F_6)(B_T+\alpha\delta)}{12q} \right)^{\beta_1} \left(\frac{B_H+\alpha\mu}{2\beta_2} \right)^{\beta_2} \left(\frac{(F_1+3F_2+2F_3+2F_4+3F_5+F_6)(B_T+\alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H+\alpha\mu}{2M_2\beta_4} \right)^{\beta_4}$$

with

$$\beta_1 + \beta_2 = 1$$

$$-\beta_1 + \beta_2 - \beta_3 + \beta_4 = 0$$

$$d(\beta_3, \beta_4) = \left(\frac{2 \left(\frac{F_1+3F_2+2F_3+2F_4+3F_5+F_6}{12} \right) (B_T + \alpha\delta)}{1 + \beta_4 - \beta_3} \right)^{\frac{1+\beta_4-\beta_3}{2}} \left(\frac{B_H + \alpha\mu}{1 - \beta_4 + \beta_3} \right)^{\frac{1-\beta_4+\beta_3}{2}} \left(\frac{(F_1+3F_2+2F_3+2F_4+3F_5+F_6)(B_T + \alpha\delta)}{\beta_3 M_1} \right)^{\beta_3} \left(\frac{B_H + \alpha\mu}{2M_2\beta_4} \right)^{\beta_4}$$

$$q = \sqrt{\frac{2 \left(\frac{F_1+3F_2+2F_3+2F_4+3F_5+F_6}{12} \right) (B_T + \alpha\delta)}{(B_H + \alpha\mu)}}$$

min





Mary Henrietta et al.,

$$TC = \sqrt{\frac{(F_1+3F_2+2F_3+2F_4+3F_5+F_6)}{12}[(B_T+\alpha\delta)][B_H+\alpha\mu]}{0.5}}$$

IMPLEMENTATIONS OF PYTHON

Using Python programming, the numerical computations of EOQ in both crisp and fuzzy are computed. All of the factors necessary to determine the total cost are inputted into the software, which then computes the hexagonal fuzzy numbers using three distinct defuzzification techniques and tabulates the results. Python 3.7.5 [MSC v.1916 64 bit (AMD64)] on win32 was the version used.

NUMERICAL DISCUSSIONS

Wang and Ye (2018) provided the parameters' crisp values, which were fuzzified using hexagonal fuzzy numbers and then defuzzified in three different scenarios using a sensitivity analysis.

$F = 5000$, $B_T = \$1000$ /delivery, $B_H = \$5$ /unit/year, $\alpha = \$30$ /ton, $\delta = 0.4$ ton/delivery, $\mu = 0.04$ ton/unit/year. The estimated crisp value $q = 1277.59$ and $TC = 7921.11$ and compared with the fuzzified values.

CONCLUSION

The geometric programming approach is applied to minimise the overall total cost by evaluating the economic order quantity in crisp sense and hexagonal fuzzy numbers with three different defuzzification methods were applied to compare the optimal order in fuzzy sense. The ranking method, signed-distance method, and graded-mean representation method using Python programming were developed for an easy and effective derivations. Numerically comparing the fuzzy and crisp forms in a non-linear programming problem revealed that all the values are exactly equal.

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Mary Henrietta et al.,

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Table 1. Sensitivity Analysis

Variations	Values	Hexagonal Fuzzy Numbers	Output in Crisp		Ranking method		Signed-distance		Graded-mean	
			Q	TC	q	TC	Q	TC	q	TC
- 50%	2500	(2350,2400,2450, 2550,2600,2650)	903.398	5601.071	903.398	5601.071	903.398	5601.071	903.398	5601.071
- 25%	3750	(3450,3550,3650, 3850,3950,4050)	1106.432	6859.883	1106.432	6859.883	1106.432	6859.883	1106.432	6859.883
- 10%	4500	(4200,4300,4400, 4600,4700,4800)	1212.036	7514.625	1212.036	7514.625	1212.036	7514.625	1212.036	7514.625
No	5000	(4700,4800,4900, 5100,5200,5300)	1277.598	7921.111	1277.598	7921.111	1277.598	7921.111	1277.598	7921.111
+ 10%	5500	(5200,5300,5400, 5600,5700,5800)	1339.956	8307.731	1339.956	8307.731	1339.956	8307.731	1339.956	8307.731
+ 25%	6250	(6100,6150,6200, 6300,6350,6400)	1428.398	8856.071	1428.398	8856.071	1428.398	8856.071	1428.398	8856.071
+ 50%	7500	(7200,7300,7400, 7600,7700,7800)	1564.732	9701.34	1564.732	9701.34	1564.732	9701.34	1564.732	9701.34





Mary Henrietta et al.,

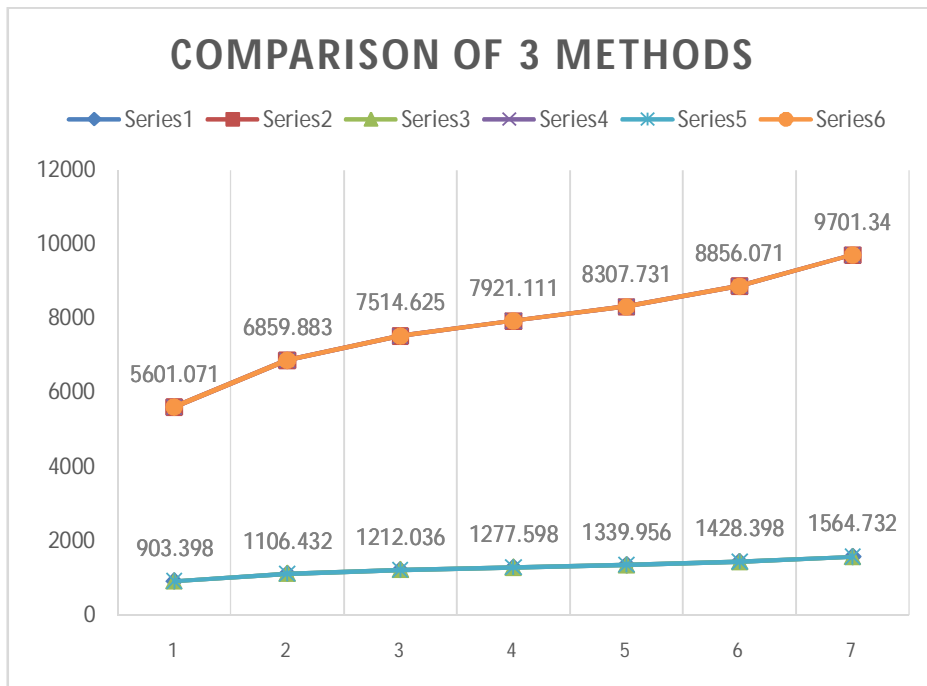


Figure 1. Comparison of 3 Methods





Predictive Model for Placement Assurance in Management Institution using Machine Learning Algorithms

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ABSTRACT

Training and placement management are only two examples of the many manual tasks that must be completed at a school. The present college system is manual, therefore it requires a lot of time and effort. Databases useful to both academics and companies may be produced using this strategy. You can get to it from anywhere on campus so long as you have your login details. The information stored in the system is safe because of how it was constructed. One of the aims of this project is to create a placement predictor that, given a student's credentials and the requirements of a certain company, can provide an estimate of the student's chance of being placed there. To that end, we want to use Machine Learning to develop more precise prediction models, such as Logistic Regression, Decision Tree Classifier, and Unsupervised learning. This, in turn, should lead to an ever-increasing degree of precision in our forecasts.

Keywords: Decision Tree Classifier, Machine Learning, Logistic Regression, Unsupervised Learning.

INTRODUCTION

The groundwork for an Outcomes-Based Education program is established, allowing students to gain insight into the intended outcomes of the curriculum, the tutoring strategies employed, and the criteria for achieving a graduate degree. That settled the issue, When all of your needs are met, your education will be finished. That is to say, we ended up passing the class. Present day businesses in India are embracing a result-based Planning strategy for

58079



**Ankit Maurya and Abhay Dwivedi**

employee training. Educating with the end result in mind, or a curriculum created with the students in mind. Implementation with verified outcomes, such as data acquired, capabilities, etc., disproved conventional and long-held opinions. The store management has the option of determining the competition scoring system. There has not yet been effective implementation and meticulous funding schemes put in place to guarantee that this level of planning will be maintained in Indian education, despite the fact that the assembly of an A on the OBE in an affiliation arrangement marks the beginning of serious education. Thus, it could be beneficial to give performance-based awards more or less weight. appointments to academic positions that follow accepted practices. Each and every one of a school's pupils contributes significantly to its overall performance. raises the bar for everyone else by contributing to their own success The ways in which students are asked to present their work and participate in academic performances are highly influential on their development. To be successful in their fields, students at lower educational levels honed skills like critical thinking, honesty, effort, collaboration, and performance; students at higher educational levels honed these skills and many more. Because it sets the foundation for each student's educational experience, the placement process is fundamental to every educational institution. The campus is the primary indicator of the school's success. places for students Every student submits applications to schools after learning what percentage of applicants are accepted. The training procedure is facilitated by the placement administration system. qualifications for each firm might differ widely, so it's important to have guidance counselors on hand to help candidates stay positive during the placement process, which can be draining for both parties. Its major function is software resource optimization, but it also has hardware applications. Administrators utilize Kmeans clustering to help them divide up students into groups based on their designated majors. The finished product is a rapid, reliable, and user-friendly management system. The placement officer is capable of handling all operations independently. The college may save money, time, and trees by switching to an electronic filing system for its records. While many colleges and universities provide on-campus work experience to their students, many only maintain records on paper or in Excel, making it impossible to do more thorough statistical analyses when needed.

LITERATURE REVIEW

Recent studies (Liu, Yang, et al., 2018) have focused on a student-tracking system that schools employ to maintain tabs on their students' personal details. Students' performance suffered as a result of the use of ineffective data premanagement strategies, including the computation and implementation of flawed decision trees and the evaluation of flawed association rules. Relevant information was selected from the acquired pool using the include confirmation technique. The study included an examination of attendance and circulation records, grade point averages, and the results of a battery of cognitive tests, among other things. By using the protocols of the mental state assessment model, we were able to identify students with physical disorders, and by calculating the mean phenotypic value, we were able to determine the underlying causes of poor physical appearance. The exhibit's titles recognize both well-known and obscure people, rich and poor alike. Within this organized framework, the analytical results from the data mining algorithms were presented in a logical fashion.

Consistent with the findings of Ishizue and coworkers (2018) This article shows how AI evaluations may be used to analyze student performance based on factors including cognitive ability, programming tasks, and self-administered questionnaires, even in the absence of traditional testing. Decision tree models with 9 illustrative components have an F-degree of 0.912.1. The top ranking model according to the support vector machine has 20 predictable components and a limited cumulative rise in standard deviation of 0.962. In order to reference: (Ahmed S., et al., 2018) In this article, we will focus on how DM methods may be applied to the world of coaching. To aid in finding competent interns for the ground campaign, a TPO board was established. Using help students, we used a C4.5 decision tree computation to data from the previous academic year and the organization's current requirements. Eligible newcomers may use this example to see whether they have what it takes to succeed in the position. If we could do this, we'd have a far better chance of being on time for the grounds drive.



**Ankit Maurya and Abhay Dwivedi**

GPA, maximum potential score, programming skill, correspondence supremacy, logical fitness, and inquisitiveness were all taken into account while evaluating applications. According to Nichat et al. (2017), the author of this work employed a decision tree classifier in the model-building process to predict how well an undergraduate will do on an assessment. A demand technique was used to evaluate the restrictions, and several factors associated with the study's execution and students' participation were taken into account. Excellent judgment and the findings may help you avoid academic failure. The results may also predict where you need to focus your efforts to improve. The student receives suggestions on how to most effectively devote their time and energy as part of this process.

Indeed, evidence supports this hypothesis. In order to design and execute hypothesis-testing ground placements, the author of this research (Patel T., et al., 2017) conducted an in-depth analysis of the WEKA software package, in addition to other data-mining frameworks. Academic performance is only one indicator of a student's overall success. Some of these include their background and upbringing, their personal limitations, their abilities, and their efforts. The results of the models were evaluated using a variety of methods, such as the clear k-mean, the Farthest-first convergence, the segregated assembly, and the moderate grouping. Clear k-mean, Farthest-first intersection point, and bound gathering took only 0.02 seconds to create, whereas varied evened-out squeezing took 0.09 seconds and thickness-based gathering took 0.08 seconds.

This has been proven true throughout several research efforts (Raut. A. B. et al., 2017). This study shows how students may use data mining to forecast how they will do on an exam using a C4.5 decision tree. It was also stressed that students need the assistance of teachers so that they may use their common sense in their studies and avoid making silly blunders. There is evidence from recent studies (Goyal, J., et al., 2017) that show that the author of this work relied on an evaluation from information mining to develop a premise that is really remarkable. The established model was used to determine the probability of events and to estimate the understudy's probable success in social settings. In this investigation, we looked at both the Naive Bayes and the Improved Naive Bayes methods. For this data analysis task, we utilized the software packages WEKA and NetBeans. The accuracy of the improved version of this technique (with the same 560 models) was much greater than that of Naive Bayes (80.96 percent). Research by R. Sumitha and colleagues (2016) The author of this study utilized a dataset collected by high school students to build a data model meant to promote harmony among young spectators. We employed the J48 calculation, and we double-checked the results of the model using a wide variety of data mining metrics. Accuracy-wise, the J48 evaluation outperformed other methods such as Naive Bayes (87.92%) and multi-layer perceptron (94.94%). We paid special attention to GPA, payments, interest, PUC scores, requirements for Engineering and Medium, board size, and board type. No discrepancies were found in the evidence collected at the time of the murder.

METHODOLOGY

DATASET

This analysis made use of data available on Kaggle (Moitra, 2022). Before using the data, the researcher verified its veracity and secured permission from the original dataset's developer. Since the students' identifying information had been scrubbed from the dataset, it was useless for identifying purposes. The data set was compiled from the results of a campus placement exam taken by graduating students across 20 different disciplines. The dataset did not contain any demographic information. Campus placement exams are distinct from traditional academic performance evaluations due to their employment-focused nature.

PREDICTION SYSTEM

In this study, we apply a wide variety of machine learning techniques to the issue of class placement, using data from the applicants' profiles. In a similar vein, we can project the future number of students placed by looking at the pattern over the last several years.



**Ankit Maurya and Abhay Dwivedi**

To produce our forecasts, we used SVM, Logistic Regression, a Random Forest Classifier, and an XGBoost Classifier. T&P serves as the primary information hub for the preprocessing stage. After that, another another round of processing was performed on the preprocessed data to enable accurate prediction. Data was split into training and test sets after the models were trained and evaluated.

LOGISTIC REGRESSION

Logistic regression is a machine learning model used for binary classification issues, such as determining whether a student will be placed or if he has to make significant improvements in a certain area. It takes input various factors and bound to give binary output between 0 and 1.

Logistic function = $1/(1+e^x)$

This is the logistic equation in which x is the input variable after processing it will give binary output.

DECISION TREE CLASSIFIER

This model may be used to address both regression and classification issues; it is a supervised learning model. The classifier is structured like a tree, with the inner hubs dealing with the subset of the dataset, the branches handling the options, and the outside hubs providing the verdict. It the just similar to the tree where the process starts with the root and finishes in the leaf based on the decisions taken and dividing the tree into sub-trees.

XGBOOST CLASSIFIER

Machine learning library XGBoost is a gradient-boosted decision tree that can scale over a network. This is useful for solving issues involving regression, classification, and ranking. The purpose of this technique is to identify a training pattern from a fresh dataset and make predictions about the labels of its features.

RANDOM FOREST

To do both classification and regression, the random forest model (a supervised machine learning technique) is used. To improve performance, this technique may pool the resources of numerous classifiers to address a complex issue. This model is comprised of many decision trees, each of which was trained on a separate subset of the dataset and then used to predict a normal distribution across the yield. Instead of depending only on decision trees, it takes the most popular forecast from each tree and utilizes it as the final result.

SUPPORT VECTOR MACHINE

Classification issues are the most common applications for this supervised learning model. In order to quickly place forthcoming data into the appropriate category, this algorithm makes use of a decision boundary that divides n-dimensional space into categories. The model is trained by using labeled data. The output is predicted because the model is used for prediction.

LINEAR REGRESSION

This machine learning model is based on supervised learning and used for regression task. This predicts the output based on the values of independent variables. It finds the relationship between variable and output.

The output of the targeted prediction is completely dependent on the number of independent variables and relationships between them.

Linear Equation = $Y = a + bX$

Where,

Y = dependent variable

X = Explanatory variable

This all are the models which we implemented in this paper and worked on to get various prediction scores and future total number of students getting placed in the upcoming years.



**Ankit Maurya and Abhay Dwivedi**

This hybrid project is very rare in which both the MIS along with machine learning prediction model is been implemented for proper understanding of the statistics of the individual as well as organizational growth in terms of placement and understanding the barrier which is affecting the student placements.

RESULTS

This project is completely made in python language and Django as a web framework used to design the front end and linking to the back end. For the database SQLite is used which is default in the Django setup. Along with the Management Information System the prediction part is also done with the help of python, csv format dataset, sklearn library for machine learning models. The datasets is real dataset of our college placement of various batches that took part into campus or of campus placements.

CONCLUSIONS

Training and Placement management with prediction system is unique method of implementing a dynamic Management information system into any technology. This can work as recording data, registrations, authentication, dynamically performing all the task that a T&P cell of a university requires. As of previous studies and paper they have implemented both of the work separately and none of the paper implemented both the methods together which we implemented. As of the prediction part we had the real dataset of placement in our college of which we had implemented supervised machine learning models like Logistic regression, Random Forest, Support vector machine, Decision tree classifier, XGBoost classifier in which the best score provided was by XGBoost and Decision tree classifier model. The least accuracy score in our case was given by Support vector machine model. As the data goes on increasing into the management system the prediction models will be trained with more precession for growth in accuracy score as it is providing now. In the Student Training and Placement management system we can modify according to the needs of the administration.

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Ankit Maurya and Abhay Dwivedi

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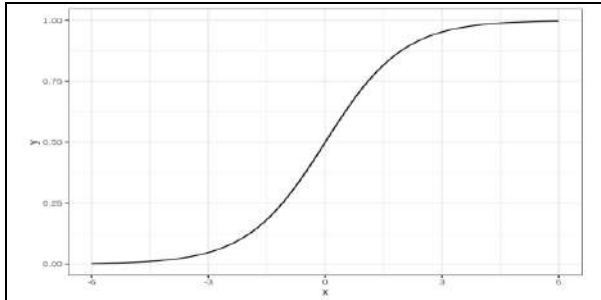


Figure 1 Logistic regression

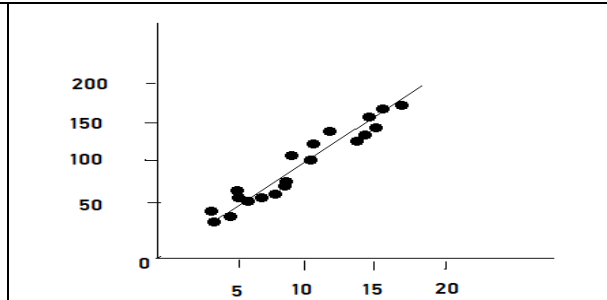


Figure 2 Linear regression





Maya's Psychological Issues in Anita Desai's Cry, the Peacock: a Brief Analysis"

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ABSTRACT

This paper will examine the phenomenal strength of Maya's psychological problems in Anita Desai's Cry, The Peacock. The sensibility of feminism found in every work of Anita Desai forms the first novel Cry, The Peacock, published in 1963. The main concept of the novel is to describe the situation of married women in Indian society. The uniqueness of her feminine sensibility makes her a versatile literary personality. Her works also show the lack of liveliness in the relations between husband and wife and the violence of non-communication in family and society. The victimization of women in the family and in society is illustrated by Anita Desai's protagonists. Mrs. Desai's Cry, The Peacock is a manifesto of the psychological problems of Maya. The essence of post-feminism is palpable from the beginning of the novel as Maya establishes herself as an individual rather than a creation of someone. This paper, therefore, explores the life of the married Maya and her psychological problems in the novel Cry, The Peacock.

Keywords: insanity, marriage, non-communication, sensibility, society, psychological predicament.

INTRODUCTION

Anita Desai is one of the outstanding and creative novelists of Indian English. Her feminist approach is not of the strenuous, fearsome, demanding kind, but depicts the portrayal of intellectually sensitive women married to dutiful,

58085



**Gangeshwaran Raj and Chelliah**

tender, but insensitive men. Reality forces the women of Desai to reluctantly adapt. They innovate their surroundings and live in an alienated world of fantasy dreams that isolate them from the outside world. Projecting the fate of married women in Indian society is considered Desai's main concern. As a feminist and psychological novelist, her works often deal with the inner struggle, isolation, marital discord and violence of non-communication in women's married life, which completely unsettles them. Desai portrays the female characters as unhappy, dissatisfied, unmotivated and frustrated. In general, she succeeds in addressing the natural longings and desires of people, especially women. Such feelings cannot be neglected as they have a great impact on daily life. Desai deliberately makes her character her spokesperson to highlight her concern about married women in Indian society. In the novel *Cry, The Peacock*, Maya's psychological views are analyzed and explored. Desai has succeeded in bringing out Maya's frustration and claustrophobia.

Anita Desai was born in 1937 in Missouri, Uttar Pradesh, to a Bengali father and a German mother. She studied in Delhi. She learned English, Hindi, Bengali and the German language. She chose English for her fiction and secured a place among other intellectual Indian writers like RK Narayan, Mulk Raj Anand, Manohar Malgonkar, Raja Rao, Kamala Das, Khushwant Singh, Dr Pramilla Kapur and Sasi Bhadra. She was considered a successful author of seven novels and a considerable number of short stories. She published several reviews, articles on various disciplines of human experience and such notable novels as *Cry, The Peacock* (1963), *Voice in the City* (1965), *Bye Bye Blackbird* (1971), *The Peacock Garden* (1974), *Where Shall we go this Summer?* (1975), *Fire on the Mountain* (1977), and *Clear Light of Day* (1980). She was awarded the Sahitya Academy Award for her novel *Fire on the Mountain*.

Maya's traits in the novel *Cry, The Peacock*

The novel *Cry, The Peacock* is about a frustrated woman, Maya, who belongs to a rich orthodox family and is married to a gentle, dutiful man, Gautama. The conflict in Maya towards her husband's character is expressed from the beginning of the novel. Mrs. Desai portrays Maya as an introvert and neurotic character. She mentions Maya's life from two perspectives, life before marriage and life after marriage. Before marriage, when she was still under the guidance of her father, she enjoyed life to the fullest. From the novel, we learn that Maya's mother is no more and her brother has moved to the US to strengthen his destiny for a secure future. The only person who cares for her is her father. There are no obstacles for her in her parents' home. She is very lovable and is pampered by her father and spends most of her time with him. Maya exclaims that no one in this world loves her as much as her father. The excess of love she received from her father later destroys her married life and later her own life. Due to her father's love, she has created her own world full of love and affection. This has given her the impression that the whole world is just a toy in her hands and that she has full freedom to change it to her liking.

Maya's married life was different. Maya expected the same love from her husband, but he did not live up to her expectations. She desires a carefree and cheerful life after marriage. She dreams of her husband showing her the same love that her father showed before marriage. Her husband was a contrast to her father. Gautama was a respected lawyer who went about his work. Her marriage to him was not one of love and affection, but of expediency. Desai has accurately identified the psychological problems of Indian married women and exposed them through her fictional character Maya. She has described Maya's insecurity, strange behaviour and fear. Maya inwardly thinks of madness and insanity. Desai's concern for Maya's childhood prophecy is a common thread throughout the novel. Maya shares Gautama's disappointment with traditional rituals regarding the death of people. Desai exacerbates Maya's character through the lack of communication between husband and wife.

The mind of Maya trusts in astrology. She believes in an astrologer's prediction of death that one of the couple will die in an unusual and unnatural way. The astrologer confessed to Maya the prophecy that an unusual death will occur when the marriage enters its fourth year. The death will be either herself or Gautama. Maya's obsession with the astrologer's prophecy is a common thread throughout the novel and causes her to fall into insanity. The fear of her future haunts her daily life. Desai illustrates Maya's inner fear and mentions her psychological problem with the world of superstition. Maya's father does not take the prophecy seriously and calls it a false belief. Maya cannot separate herself from the prophecy. She is haunted by the dreams that obsess her. Maya's complete isolation and



**Gangeshwaran Raj and Chelliah**

longing cause her to trust the astrologer's prophecy. She entangles her inner fear and superstition to such an extreme that in the end there is a terrible explosion. Maya's isolation is expressed after the death of her pet Toto at the beginning of the novel. The husband's reaction to the pet's death has left Maya dissatisfied. This led her to make a comparison between her father and Gautama. As a result, her married life is destroyed in the fourth year. The repercussions of these incidents create feelings of revenge in Maya's heart. A marital bond creates a bond between the couple. There is a lack of affection between them. Apart from the marital bond, there is nothing to hold them together. Maya wants to escape the life of marriage. She develops her own world of sensible fantasy and imagination as married life has completely broken down. The change in life takes place when she enters the life of Gautama. He is a man of facts who gives importance to rational things. They both have different views. Gautama is callous and always busy with his duties instead of showing Maya the love and affection that she expects from him. Their parallel lives fail to meet under the right circumstances, but never fail to construct a rift between them. Since they have different ways of thinking, their married life cannot be satisfactory.

Maya's Psychological and Environmental Issues:

Maya is in a psychological quandary throughout the novel. She wants someone to express the inner conflict she is struggling with. She wants help from her father, with whom she was very happy as a child. From the beginning of the novel, she expresses her madness. The thought of alienation has improved her thinking to create her fantasy world. Maya wishes for someone to take her out of her psychological predicament. The suffering and pain she has experienced in her married life has made her very suspicious and insecure. Maya rejects the melancholy and pensiveness that surrounds her. She tries to be psychologically comforted, but she disappears into her fantasy dream. Maya longs for a married life like that of Sita and Rama. She longs for a real marriage where one body and one soul unite. Gautama does not care about her inner feelings, he rationally goes about his work. He rejects Maya's thought in many situations in the novel. She feels alienated from the entire house of Gautama. Since they belong to the orthodox, they are not in a position to approve of Maya's feelings as her husband Gautama does. The illness in Maya became worse day by day and she lived with a complete obsession with the psychological problems she had in her married life. As a result, she becomes moody and ignorant. When Gautama sees her discontent, he urges Maya, but she becomes neurotic.

Mrs. Desai is deeply concerned with the lack of liveliness in the marital relationship and the brutality of non-understanding. This sense of beauty is reflected in the novel *Cry, the Peacock* as Desai looks at the predicament of torture imposed by the passive indifference and unconcern of men. It is at this level that Desai is concerned with female emancipation and the emancipation of the spirit that can flower within the bounds of matrimony and turn your bog into a meadow. Significantly, Maya is a childless woman who has no career and is married to ordinary, egocentric man. The Indian husband's complete concentration on himself and his depiction is a central point that the wife orbits, expunging her completely as she ministers to his needs. This characteristic of women has society's sanction. Desai depicts Maya's need to be understood, as she dwells not only on the plane of the recent but also on the plane of imaginary excursion and shares her thoughts. In the novel *Voices in the City*, Monisha is even more pitiful in her Ipea of privacy: a room of her own to read a little money she can give to her brother a little dignity; an urge to be respected as a person in her own right within the Indian context; the meaning and purpose of life which women seek to realise for themselves.

Through Maya in *Cry, The Peacock* Desai probes into the usefulness of living in a world that rejects to grant human beings the worth they deserve. Maya expresses Gautama's regret for post-independent India, which is much more materialistic and corrupt than pre-independent India. Desai is ruthless in eliminating some established values that tend to fetter the independence of women in her fictional realm. Marriage is no longer God's gift to women. To get rejected in the quest for norms is a fate worse than death. Satyenarain Swigh observes: To Maya a woman's role circumscribe by domesticity also can sink to such debts. It is the spiritual companionship and the sharing of consciousness that gives meaning to life. (P43)



**Gangeshwaran Raj and Chelliah**

The predicament of educated Indian women is accentuated through the tragedy of Maya. All Indian women have feelings within them that they exhibit and yearn for but that their partners do not share. The interior passion is communicated in contrasting ways. Mrs. Desai portrays the situation that echoes the inner mode of the character as the storm in *Cry, The Peacock*, which buffets Maya within its fury, commenting on these techniques and their contextual utility. Singh says: "Using these varied techniques Mrs. Desai has carefully delineated the inner world of women. It is not to establish equality but a right to be herself the right to give her inclination full sway and a right to impinge her full personality on her husband's consciousness as he does on her" (P32).

CONCLUSION

Anita Desai does not justify the activities of Maya but only grants her the right to act. This is an important claim, and one should not be denied the right to decide because it may be incorrect. In *Cry, The Peacock* Maya firmly presses her claims. The sensibility of the Indian wife, the victim of society's malicious traditions, is significantly emphasized through Maya's character in *Cry, the Peacock*. By expressing the story of Maya's mental disintegration and the varied responses to Gautama's death, Desai compulsively illustrates the sensibility. The exploration of psychological sensibilities evokes the sympathy of the readers. *Cry the Peacock* is undoubtedly a Fictional Forte of Maya's psychological issues.

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A Review of Nano Capsule

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ABSTRACT

In a vesicular device known as a nano capsule, the drug is contained within a cavity made up of an inner liquid centre encased in a polymeric membrane. The study of tiny is known as nanotechnology. Nano is derived from "Nano," a Greek word that signifies "dwarf size." Two different kinds of polymers can be used in the creation of the nano capsules that are 1) natural polymer 2) synthetic polymer. There are several ways to make nano capsules, including a) solvent evaporation, b) nano precipitation, c) solvent diffusion d) salting out e) dialysis f) supercritical fluid technology. To achieve regulated the release and effecting drug targeting, dispersed polymer nano capsules can be used as anno sized drug carriers. Nano capsules are extremely small particles that vary in size from 10 to 100nm.

Keywords: Nano capsules, Nanotechnology, Drug release, Drug targeting, bio availability.

INTRODUCTION

The study of incredibly small structures is called Nanotechnology. The Greek term for the prefix is "Nano." Nano refers to tiny or minuscule size (1). Development in Nanotechnology, often between 0.1 and 100nm. In the disciplines of biomedicine, pharmaceuticals, electronics, and molecular diagnostics, Nano materials have numerous significant applications. In vesicular devices known as Nano capsules, the medication contained within a cavity made up of a polymeric membrane with an inner liquid core. (2). The desired ingredient can be inserted inside a hollow, spherical



**Rajavel et al.,**

Nano capsule with a diameter of less than 200 NM. They can be filled with polar or nonpolar solvents (3). Drug delivery systems using Nanoparticles are typically designed technologies that utilize them for controlled drug release and targeted drug delivery (4).

Advantage

Greater protection from degradation during storage. 2)Increased dosage loading decreased irritation of the medication at the administration site. 3)Action that is site specific. 4)Improve medication absorption by Keeping the drug's release under control and maintain it at the localization location). 5) Various administration techniques, including intra-ocular, parenteral, nasal, and oral, can be used with the system (5).

Disadvantages

Productivity is difficult; a very expensive formulation has low yield. 2)Technology transfer to commercial manufacturing is highly challenging for industrial applications. 3) Lowered ability for dosage adjustment. Highly evolved technology. 4) Requires expertise to produce. 5)Due to its Nano size, stability of dosage forms is a significant problem. 6)Recycling is also very expensive (6).

Polymer

Natural and synthetic polymers are two types of polymers commonly used in the preparation of a Nano capsule. Polymers are made up of large of molecules of repetitive chemical units. A mer is the smallest repeating unit. The word "polymer" comes from the Greek word "polymers," which means "many parts"(7).

Natural polymer

The natural polymers that are successfully used in the formulation of a variety of medicinal products include enzymes, muscle fibers, proteins, polysaccharides, and gummy exudates. Agar, shellac, acacia, guar gum, Chitosan, carrageenan, gelatin, and gum karaya are well-known natural polymers used in pharmacy and other industries (8). These natural polymers are highly suited for the creation of pharmaceutical and cosmetic products and are frequently employed in the pharmaceutical industry as adjuvants, emulsifiers, and packaging adhesives. By treating seaweed to an alkaline solution, alginic acid 6, a naturally occurring polymer made up of beta-1, 4-linked-D-Mannuronic acid and alpha-1, 4-linked L-guluronic acid molecules, is produced. When added before to compression, it works fantastically as an extra granular disintegrate (9).

Synthetic polymer

The only polymers made by humans are synthetic ones. Thermoplastics, thermosets, elastomers, and synthetic fibers are the four primary groups that they fall under from the standpoint of utility. They are frequently discovered in a wide range of consumer goods, including money, "super glue", etc. There are numerous synthetic polymers with different main chains and side chains available. While heterocyclic polymers like polysulfides, polycarbonates, polyester, polyamide, polyurethanes, and have other elements(such as Sulphur, oxygen, and nitrogen) inserted along the backbone, common synthetic polymers like polythene, polystyrene, and poly acrylates have backbones made of carbon-carbon bonds (10).

Properties of polymeric capsules

1.Polymeric Nano capsules can be produced in various size, shape, quantities. 2. Different mechanisms can be developed to make Nano capsules function. 3. They can be produced as monodisperse particles and have precisely defined biochemical, electrical, optical, and magnetic properties. 4.They can be altered to meet the intricacy of any application for which they are intended; for instance, targeted medication delivery systems can cause the contents to release in response to a particular bimolecular triggering mechanism (3).





CHARACTERISTICS OF NANO CAPSULES

Particle size

The particle size and size distribution in Nano capsule systems control the in vivo distribution, bioavailability, toxicity, and targeting properties of nanoparticle systems. Moreover, it typically affects the stability of nanoparticle systems as well as the capacity for drug loading and release. The majority of therapeutic agents associated with or located at the surface of the smaller particles have a bigger surface area, resulting in immediate drug release, whereas the larger particles with their massive core surfaces gradually diffuse away. To determine the particle size, photon correlation spectroscopy or dynamic light scattering are used (11).

Determination of pH of a Nano capsule

During the formulation of Nano capsules earlier, pH was evaluated at temperature using a digital pH meter. The pH range for dispersion in Nano capsules is 3.0 to 7.5. (12).

Determination of drug content

By combining precisely weighed manufactured Nano capsules with an appropriate organic solvent, the drug content can be ascertained. The appropriate amount of material was then run through the HPLC at the compound's maximal wavelength or the UV Spectrophotometer. Following that, each sample's absorbance must be measured and compared to the reference value (13).

In-vitro drug release

USP type 11 dissolution equipment was used for in-vitro dissolution research. The experiment was conducted in 100 ml of the buffer (PH 3.0). The dissolving medium, which was kept inert thermostatically at $37\pm 0.50C$, was dipped into the suspension of the capsule in the dialysis membrane. At 100 rpm, the stirring rate was held constant. Five milliliters of the sample were taken out at predefined intervals and spectrophotometrically tested for drug releases. Each withdrawal was followed by the addition of 5 ml of fresh dissolving medium to the dissolution jar (14).

Zeta potential

The zeta potential is the electric potential at the interface between the liquid layer and the dispersed particle layer that surrounds it. By moving the particle towards the electrode with the opposing charge at a rate proportional to the size of the zeta potentials, electrophoretic light scattering can be used to measure it. Given that the strong electrostatic repulsion forces are what prevent the particle aggregation phenomenon from occurring, the stability is +30 (or -30) (15).

Nano capsules Encapsulation efficacy

By ultracentrifugation at about "10,000" RPM for one hour, the drug Nano capsules were separated from the drug dispersion. The Nano capsules then settled at the bottom in pellet form. While the liquid supernatant still contains free medication. Efficiency of entrapment as determined by the following equation (16).

Encapsulation efficiency (EE%) = (Total drug-free drug / Total drug) x 100.

MORPHOLOGY

Numerous microscopy techniques can be used to determine the average size elemental content and state of aggregation in addition to studying the Nano capsule form and structure. scanning electron microscopy (SEM) and transmission electron microscopy (TEM) are the two most popular techniques (17).



**Rajavel et al.,****EVALUATION STUDIES OF NANO CAPSULE****X-Ray diffraction study**

Using a Rigaku D/max-2000 diffractometer at 250 milliampere and 50 kV, powder X-ray diffraction with monochromator graphite is used to identify the phase of the materials. The XRD pattern shows the phase makeup of the manufactured items (18).

Differential scanning calorimetry

DSC analysis is performed on both closed (with a lid) and open (without a cover) samples. The observations reveal similar heat activity for both strategies (19).

Scanning electron microscopy

Small, vast, and enormous clusters and branches may arise at different sizes in the structure of clustered aggregates with branches made up of Nano capsules, proving the structure's self-similar features. By utilizing a PhilipsXL-30 scanning electron microscope, which exhibits the transparent shape of small clusters at high magnification, it can be identified. Tiny particles that stick together to form a flocculent arrangement. It is possible to see a low-magnification SEM image of a coral-like structure with branched features and the axial and direction in longitudinal (20).

Transmission electron microscopy studies [TEM]

TEM studies can be used to determine how a well oral administration of specially insulin-loaded Nano capsules crosses the epithelium after the rats are used in in-vitro and in-vivo experiments. According to TEM findings, biodegradable Nano capsules are absorbed in the gut and carry insulin across the mucosa of the epithelium (21).

High-resolution TEM

The core/shell structure of matching Nano capsules is readily visible in their precise morphology, which was investigated using high-resolution transmission electron microscopy (22).

Multi angle laser scattering

Vaults are made of a big internal hollow and a very thin outer shell (2 Nanometer) that resembles a capsule. The chemical encapsulation, preservation, and transportation capability of the vault particle in a Nano capsule is astounding (18). By employing multi angle light scattering to probe the vault conformation in solution, the interconversion of open and closed conformations is examined. These findings make it possible to regulate how encapsulating materials are trapped and released. In both environmental and medical detoxification, vaults harboring hazardous metal binding sites are crucial (23).

Squid

Quantum Design of MPMS-7s (or) MPMS-5s SQUID devices are used to measure the Nano capsules magnetic properties. SQUID devices have a wide range of possible applications and more sensitive detector for detecting even a small change in multi flux (24).

FT-IR analysis

In order to confirm the presence of discrete peaks, FTIR analysis is employed. The peaks correspond to the distinctive functional elements of the compound (25-26).

METHODS AND MATERIALS**The Methods of preparation****Interfacial method**

Condensation polymers can be bulk polymerized at low temperatures instead of at high temperatures via interfacial polymerization. It is made up of two immiscible solvents, and depending on how quickly the reaction happens, one





Rajavel et al.,

solvent of the monomer solution reacts with another solvent of monomer solution to form a high molecular weight monomer. The aqueous core containing oligonucleotides of iso-butyl cyanoacrylate. This aqueous core can be used to formulate the Nano capsule. An ultra-centrifugation method used to purify the resulting Nano capsule followed by resuspending in water to achieve aqueous core dispersion.

Oils, the drug molecule, polymers and solvents (ethanol, acetone, and hexane) are all present in solvent phase. On the other hand, the non-solvent phase may be one solvent (or) a mixture of solvent. The non-solvent phase has polymer with the surfactant. The aqueous phase is introduced in the organic phase with stirring to form colloidal form. Finally, solvent displacement method used to formulate the Nano capsule. Poly-ε-caprolactone (PCL) is a popular biodegradable polymer used in the Solvent displacement process (27).

Polymerization method

In this process, monomers are polymerized in an aqueous solution to create Nanoparticles. After polymerization is complete, the drug either adsorbs to the Nanoparticles or dissolves in the polymerization media. By ultra-centrifuging the Nanoparticle solution, various stabilizers and surfactants used for polymerization are subsequently removed, and the particles are then resuspended in isotonic surfactant-free media. Making poly (butyl cyanoacrylate) or poly (alkyl cyanoacrylate) Nanoparticles using this method has been documented. The concentration of surfactants and stabilizers utilized determines the production of Nano capsules and their particle size (28).

Emulsion polymerization

Here, an example of pre-emulsion preparation for one of the Nano capsules (M-6) is given [15]. Two portions were combined to create the pre-emulsion: Part I have 40 g of styrene, 0.8 g of divinyl-benzene, 0.82 g of 2,2'-azo bis (iso butyl nitrile) , and 40 g of Des mourn BL3175A; and Part II comprised 1.71 g of sodium dodecyl sulphate, 1.63 g of Ige pal CO-887, and 220 g of water. In separate containers, Parts I and II were magnetically combined for ten minutes. Then, under mechanical agitation, Part II was added to Part I, and the mixture was agitated at "1,800" rpm for 30 minutes. Before utilizing a Misonicator 3000 to achieve a particle size of 250 NM, the resulting pre-emulsion was cooled to 5. The pre-formulation was transferred to a three-necked round bottom flask that had been degassed for 30 minutes and had a mechanical stirrer, a reflux condenser, and a nitrogen inlet. To finish the polymerization, the temperature was raised to 70 and maintained there for eight hours (29).

Solvent evaporation

The first technique for establishing Nanoparticles was solvent evaporation; in this method, polymer solutions 20 were formed in volatile solvents, and dichloromethane and chloroform were used to create emulsions 21. However, ethyl acetate has since replaced this technique because it has a much better toxicological profile and can produce polymeric particles smaller than 500 NM. After the solvent has evaporated during preparation, the emulsion transforms into a suspension of Nanoparticles, and the solution is then allowed to diffuse into the continuous phase of the emulsion to carry out conventional techniques. Such procedures include high-speed homogenization or ultrasonication, solvent evaporation by a continuous magnetic stirring at room temperature or under reduced pressure, resulting in the formation of solidified Nanosized particles collected by ultracentrifugation, washing to remove surfactants, and lyophilizing the finished product (30).

ARC discharge method

ARC discharge method has been modified as a contemporary method of synthesising aggregates using modified techniques, adding GdAl₂ (gadolinium aluminium alloy) ingot as an anode. Arc-discharge technology has been used to create the accumulation of self-system. A different type of magnetic Nano capsule with GdAl₂ as the inner metallic element and amorphous Al₂O₃ (aluminium oxide) as the shell has been created. By altering the amount of materials in the anode, it can potentially expanding the family of magnetic Nano capsules based on their vaporization pressures. Nano capsules are self-built to create frequently arranged 3D macroaggregates in an arc discharge technique without using a catalyst (or) template (31).



**Emulsion coacervation method**

Chitosan, a di-block copolymer of ethylene oxide or propylene oxide (PEO-PPO), and poly sodium tri polyphosphate are the two aqueous phases that are mixed together in the procedure. In this procedure, the positively charged chitosan amino group combines with the negatively charged tri polyphosphate to generate coacervates that are in the Nanometer range in size (32).

Double emulsion method

Double emulsions, also known as "emulsions of emulsions," are sophisticated disperse systems that fall into one of two categories (33).

1) W/O/W (water-in-oil emulsion)

2) O/W/O (oil-in-water) (34).

Emulsion Diffusion method

The water immiscible solvent and a little amount of the water immiscible organic solvent are utilized as the oil phase in this procedure. Biodegradable polyesters, particularly PCL, PLA are frequently used polymers. Another option is poly (hydroxy butyrate - co hydroxy valerate, or PHBHV) (35).

Layer by layer

"Polycations" such as polylysine, chitosan, gelatin B, poly(allylamine), amino dextran, and protamine sulphate are employed in the layer-by-layer technique. Polystyrene sulfonate (PSS), sodium alginate, poly-acrylic acid, dextran sulphate, carboxymethyl cellulose, hyaluronic acid, gelatin A, chondroitin, and heparin are among the poly-anions employed (36).

APPLICATION OF NANO CAPSULES**Nano capsules as a drug delivery system**

Polymer dispersed to achieve controlled release and effective therapeutic targeting. The type of surfactant and the characteristics of the outer coating mostly influence dispersion stability and the primary physiological reaction. The structure and chemistry of the capsule walls have a significant impact on the release and degradation properties of these substances. The most crucial capsule characteristics are the distribution of the capsule's radius, its surface, the thickness and permeability of its membrane and its thermal and chemical degradation, are reviewed (3).

Australian scientists developed the Nano capsule with the goal of directing anti-cancer drugs toward tumours while minimizing adverse effects on healthy tissue. The width of the capsules range between 1 micron to 1,000 millimetres, it contains an antibody for tumour transferred via the blood stream. The capsules can quickly shatter and discharge their contents when they enter the tumour without harming the skin-penetrating lasers that emit near infrared radiation (37).

New cancer weapon-nuclear Nano capsules

Astatine is a radioactive substance that emits alpha particles with high velocity through a process known as radioactive decay. These particles decay at a rate that is roughly 4,000 times faster than the emitted electrons' beta decay, and they are most frequently used to treat cancer. The alpha particle is unusual for targeting tumors at the single cellular level because of its combination of poor penetrating strength and big particle size (38).

Hormone dependent breast cancer treatment

According to the study, complex small interfering RNA enclosed in Nanoparticles can be used to specifically target the estrogen receptor alpha (ER). These Nano capsules were intravenously injected into estradiol-stimulated MCF-7 cell xenografts, which drastically reduced tumor formation and ER expression in cancer cells. It suggests that a novel method for the treatment of a hormone-dependent breast tumor that depends on ER siRNA delivery may be created (39).



**Rajavel et al.,****Nano capsules against melanoma**

Cancerous melanoma tumors are incredibly aggressive and have a dismal prognosis, especially when they have spread. Contrary to significant efforts to improve adjuvant therapies, this produces a better response than the commonly used FDA-approved medication imidazole carboxamide which is less than 16%. To specifically target a cancer cell, the following actions should be taken: (40).

- 1) The size, structure, and form characteristics of the Nano capsules passively increased permeability retention.
- 2) Active targeting is made possible via antibody coupling (41).

Nano capsules for oral delivery of peptides and proteins

Peptides and proteins are administered orally using Nano capsules, notably biodegradable poly (iso butyl cyanoacrylate) Nano capsules. However, because of these compounds' typical bioavailability, developing appropriate carriers continues to be a difficult method. Following the oral administration of the loaded insulin Nanoparticles, the effect has been seen in "diabetic rats". The process of encapsulation that protects the bioactive molecules from enzymatic and hydrolytic breakdown. Bioactive peptides can be trapped inside the Nano capsules (42).

Self-assembled DNA Nano capsules for drug delivery

Researchers studying Nanotechnology now use DNA as a fundamental component. The molecular self-assembly of basic DNA is used to create a tetrahedron and a cube octahedron through the process of Nanofabrication. These molecules create proteins that can bind to these structures on their outer surfaces and encapsulating within DNA polyhedral. Then, it is investigated how these therapeutic molecules are delivered to diverse tissues or cells (43).

Nano capsules for self-healing materials

Damages in polymer coating materials, adhesive component parts, microelectronics, and structural composites can last for longer periods of time. Polymer microcapsules containing the healing agent have been used to create the novel self-healing technique. Additionally, it is strong enough, has a long shelf life, and binds to the host material quite well. Nano capsules have grown in favors as a means of advancing the future with miniature tools that will ultimately lead to unique therapeutic applications in the study of medicine and technology. These capsules may generate and accept nanometer-sized items thanks to functionalized surface regions and their walls (44).

Nano capsule bandages to fight against infection

If the skin becomes contaminated, conventional dressings must be taken off, which slows recovery and may be upsetting for the youngster. This cutting-edge dressing will expedite treatment because it automatically releases antibiotics only when the wound becomes infected. As a result, the dressing won't need to be removed, improving the likelihood that the wound will heal without leaving a scar. The color shift serves as an early indicator of infection, allowing us to treat it more quickly and lessen the shock to the child by shortening their stay in the hospital. This Nano capsule bandages could also be utilized by the military on the battlefield treating ulcers and other types of wounds (3).

Liposomal Nano capsules in agriculture and food sciences

The microscopic bilayer vesicles known as liposomes are created when polar lipids are dispersed in hydrophilic liquids. By preserving the most reactive and sensitive molecules before release, they can serve as effective medication delivery systems. The stabilization of encapsulated therapeutic materials against a variety of chemical and environmental alterations, including their enzymatic and chemical modifications, as well as changes in buffering against high pH, temperature, and ionic strength, has been made possible via liposomal entrapment (45).



**Rajavel et al.,****The future application of Nano capsules**

Genetic engineering, adhesive, Agrochemicals, wastewater treatment, cleaning goods, and cosmetics component applications are some areas where Nano capsules may find use. They can be used to encapsulate biological cells, enzymes, catalysts, oils, adhesives, polymers, latex particles, and inorganic micro- and Nanoparticles (2).

CONCLUSION

Nano capsules contribute to a methodological development for formulation using a variety of techniques, primarily interfacial Nano-deposition and polymerization. Additionally, they are capable of being released as monodisperse particles with distinct electrical, biological, optical, and magnetic properties. They are constrained in medication delivery systems because they are designed to produce the contents in response to a certain bimolecular triggering action mechanism. Nano pills have effective uses in a variety of industries, including agrochemicals, wastewater treatment, genetic engineering, cosmetics, cleaning supplies, and adhesive components. Enzymes, adhesives, catalysts, polymers, oils, inorganic micro- and Nanoparticles, latex particles, and even living cells are all encapsulated using them. Finally, they can be applied to delivery. They can be utilized to distribute active medicinal substances, to sum up (APIs). They offer cutting-edge, efficient drug delivery technologies for the foreseeable future (46).

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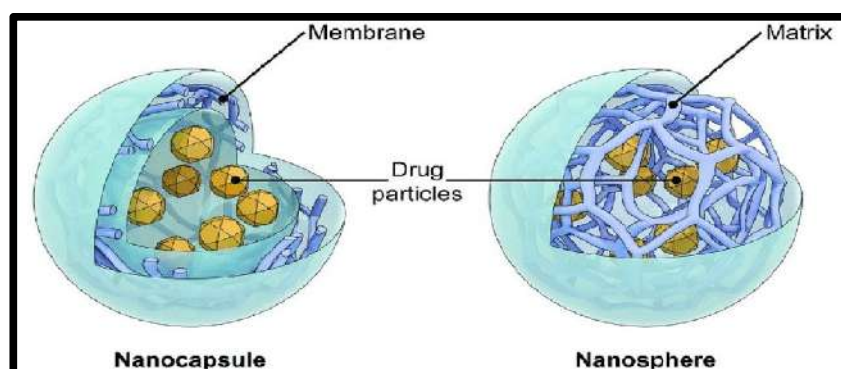


Fig 1: Structures of nano capsule





Health-Related Quality of Life in Overweight and Obese Adolescents: A Systematic Review

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ABSTRACT

Adolescence is a time in a person's life when many physical and biological changes take place. Adolescents who are overweight or obese can develop poor self-esteem and a lack of self-confidence. The goal of this systematic review was to summarize the HRQoL (health-related quality of life) of obese and overweight adolescents, find the most common tools used to estimate HRQoL in obese and overweight adolescents, and report the HRQoL results in overweight and obese adolescents. Method: We investigated articles indexed in the Web of Science, PubMed, PsycINFO, and CINAHL databases, utilizing several expressions together such as " HRQoL " and "overweight" or "obesity." Results: Our research is supported by five empirical studies. A variety of tools are used to assess the HRQoL of obese or overweight adolescents. Obese adolescents had significantly lower average HRQoL compared to underweight (83.5 14) in the areas of school functioning (55.0 20.8; $p = 0.05$), psychological ($p = .002$), and parental well-being ($p = .036$). Conclusions: This study points out that obesity harms adolescents' quality of life in terms of psychological and physical well-being, social, and peer support, autonomy, and the school environment. Obesity was linked to a decline in HRQoL across the domains of mental and physical health. There is an urgent need for comprehensive public health responses, such as nutritional

58099



Saritha *et al.*,

education, growth monitoring, exercise programs, and the promotion of physical education in schools and communities, to tackle the growing adolescent health threat in India.

Keywords: Health-related quality of life, Over-Weight, Obesity, Adolescents.

INTRODUCTION

Adolescence is a period of human development characterized by various physical and biochemical changes. The changes involve increased fat, muscle mass, height, weight, and menarche for girls. Children who are overweight are more likely to have social problems like social stigma and prejudice, which can hurt their health. Teenagers who are overweight or obese may have low self-esteem, lack of confidence, and biochemical changes in their bodies. Increased fat, greater development in height and weight, increased muscle mass, and the beginning of girls' menarche are among those changes. Obesity in teens is exacerbated by a lack of community areas for adequate physical activity, a healthy food shortage, an inadequate intake of vegetables and fruits, and excessive time spent in "sedentary activities," including television and video games. (Lubna Mohammed Thaher *et al.*, 2018) The disease's or health's impact on mental, physical, and social well-being from the perspective of the patient is known as HRQoL. In obese individuals, "weight-related HRQoL" may be used to evaluate "disease-specific HRQoL" and is also more susceptible to the psychological and physical impacts of obesity and can be more sensitive to weight loss after strict lifestyle control, as shown by the previous research. Meeke Hoedjes and colleagues (2018) A WHO study found that obesity has almost tripled worldwide since 1975. In a 2016 WHO survey, more than 1.9 million adults aged 18 and up were reported to be overweight. More than 650 million were overweight or obese, and more than 340 million children and youth from 5 to 19 years of age were obese or overweight. According to gloomy estimates based on previous secular trends, almost 85 percent of adults in the US are estimated to be overweight or obese by 2030. (Man Jula Uppal and Karamjeet Kaur, 2020) Overweight and obesity among adolescents have been linked with major HRQoL impairments and declining HRQoL in the physical, social, academic, and emotional fields (Wendy L. Ward *et al.*, 2012).

Review Objectives

This study explores the HRQoL of obese and overweight adolescents. So, the key goal of the review was to (1) summarize the HRQoL for overweight and obese adolescents. (2) Name the tools that are most often used to measure the HRQoL of obese and overweight teens. (3) To report HRQoL outcomes for obese and overweight adolescents.

MATERIAL AND METHOD

"An extensive search of electronic databases, such as PubMed, PsycINFO, the CINAHL database, and Web of Science," has been carried out as part of a systematic review to examine the HRQoL results of obese or overweight adolescents. All database searches were conducted with the following combination of free-text terms: " HRQoL " AND "overweight" OR "obesity" AND "adolescents." In the first step, duplicates were eliminated, and pertinent article reference lists were analyzed to find further research fulfilling inclusion criteria. Reviewers scrutinized titles and abstracts for inclusion after the first literature search.

Eligibility Criteria

The research involved in this evaluation met the following criteria: (1) HRQoL among obese or overweight adolescents; (2) An intervention analysis was carried out on the HRQoL of obese or overweight adolescents. (3) Non-intervention or a pre-post comparison group was used in quantitative research to examine HRQoL in obese or overweight adolescents. (4) The research paper was published in peer-reviewed journals. The paper was not included if: (1) there were no overweight or obese adolescents; (2) the studies were qualitative review papers, case series, or case reports; and (3) They had never been published in English.



Saritha *et al.*,

Data Extraction

The relevant studies' data were recorded systematically using an extraction tool. (1) Study characteristics, study design, author, country, and year of data collection, (2) Characteristics of adolescents: adolescents' number and mean age, (3) Tools utilized to measure HRQoL (4) Findings

Quality Assessment of the Study

The studies' quality was assessed by the "STROBE Reporting Guidelines for observational research and the Critical Review Form for quantitative studies". Every question can be answered completely (score = 2), partially (score = 1), or vaguely (score = 0). The total score for every study was determined. Depending on the derived scores, the studies were classified as poor (total score less than 12 points), fair (between 13 to 24 points), good (between 25 to 30 points), and excellent (between 30 to 36 points). A third reviewer rated the study independently.

RESULTS

Our method of research led to 349 studies: 140 from PubMed, 103 from the Web of Science, 79 from PsycINFO, and 27 from CINAHL. Once duplicate publications were excluded, we identified 248 possible articles. The titles and abstracts of all identified research were reviewed throughout the selection phase. Consequently, 189 analyses were eliminated as they were not considered appropriate for this review. Therefore, 59 studies were selected for the eligibility stage. Among them, 54 studies did not match the selection criteria and were therefore excluded. In conclusion, five empirical studies proved pertinent to our research (Table 1).

Study Quality

Four studies reported "poor" HRQoL (**Rashmi Ronghe, Nirja Joshi, and Tushar Sathe (2019); Lara Meixner *et al.* (2020); A. Fagbohun *et al.* (2021); J. Felix *et al.* (2020);** and "good" in the latest study by **Varghese C. Antony and Kaukab Azeem (2019)**).

Study Characteristics

Table 1 is a summary of the most important methodological and general aspects of each of the analyses that were looked at. Four studies are cross-sectional studies (**A. Fagbohun *et al.*, 2021; Lara Meixner *et al.*, 2020; Varghese C. Antony and Kaukab Azeem (2019); and Rashmi Ronghe, Nirja Joshi, and Tushar Sathe (2019)**). Only one study consists of a cohort study (**J. Felix *et al.*, 2020**). There were no interventional studies or randomized controlled trials in terms of research methodology. All the research was published between 2019 and 2021. The studies included studies from southwestern Nigeria, Germany, Saudi Arabia, and India.

Characteristics of Children and Mothers

There were 2300 adolescents in those five studies. They were between 13 and 17 years old.

HRQoL

This review of health-related measurements of quality of life revealed **A. Fagbohun *et al.* (2021)** used the "Pediatric Quality of Life Inventory questionnaire," and **J. Felix *et al.* (2020)** adopted the EuroQol five-dimensional questionnaire (EQ-5D-3L), the DISABKIDS generic module (DCGM-31), and the KINDLE obesity module. **Lara Meixner *et al.* (2020)** reported on the KIDSCREEN-27 questionnaire. **Varghese C. Antony and Kaukab Azeem (2019)** administered the Health Quality of Life Scale (HRQoL-14). **Rachmi Ronghe, Nirja Joshi, and Tushar Sathe (2019)** adopted the Kidsscreen-27 questionnaire.

Outcomes of HRQoL Among Overweight and Obese Adolescents

A. Fagbohun *et al.* (2021) noticed that the mean BMI and total HRQoL score of the participants were 19.0 [+ or -] 3.0 kg/m² and 73.7 [+ or -] 11.7, respectively. 6.9% of the population was underweight, 2.3% were overweight, and 0.6% was obese.±





Saritha et al.,

Females (72.3 [or -] 12.2) had an average HRQoL score significantly below that of males (75.0 [or -] 11.1), $P = 0.048$. Obese adolescents had a considerably lower average HRQoL in school performance (55.0 ± 20.8) than underweight adolescents (83.5 ± 14) and participants with a normal BMI (81.3 ± 16.3) ($P < 0.05$). Significant variations were observed between the four BMI categories in terms of HRQoL only in the area of school functions ($F = 4.298$; $P = 0.005$). Post hoc analysis of HRQoL in the school functioning domain by BMI category revealed that obese participants had significantly lower HRQoL than underweight participants (mean difference = -28.5% ; $P = 0.005$) and those with a normal BMI (mean difference = -26.3% ; $P = 0.008$). In a cohort study, **J. Felix et al. (2020)** showed that the HRQoL of adolescents in all OGGs was significantly lower than the non-obese adolescent's reference value. After adjustments for age and gender, the HRQoL of adolescents was significantly impaired in OGG III than in OGG-I. OGG III adolescents were 2.15 times more likely than OGG I adolescents to report mobility issues on the EQ-5D-3L. The average difference between OGG III and I was reported to be 9.7 and 6.6 points for the DCGM-31 and KINDL, resp., and 5.1 points for the DCGM-31 between OGG II and I. The inclusion of additional variables in the regression models revealed that the HRQoL evaluated by the DCGM-31 differed considerably among the OGGs. Apart from males, female sex and daily screen time of more than 4 hours were linked with lower HRQoL, as determined by the KINDL and DCGM-31. **Lara Meixner et al. (2020)** reported 8.0% as obese and 18.7% of children and adolescents as overweight. After adjusting for potential confounding factors, obesity and overweight were strongly linked to poorer physical health in both sexes when compared to normal weight. Overweight boys: standardized beta = .14, standard error [SE] = .03, $p < .001$, and obesity $\beta = .16$, SE = .03, $p < .001$. overweight girls: ($\beta = .09$, SE = .04, $p = .011$," and obese: ($\beta = .11$, SE = .03, $p = .003$ "). In addition, obese boys had lower psychological ($= 0.10$, SE = 0.04, $p = 0.002$) and parental ($= 0.08$, SE = 0.04, $p = 0.036$) well-being than their normal-weight peers. **Varghese C. Antony and Kaukab Azeem (2019)** reported good health for "94% of normal weight", 87% of underweight students, 73% of overweight students, and 57% of obese students. Obese and obese Category III subjects showed a higher frequency of restricted activity days and expressed sleep deprivation, anxiety, and depression. Students in the low-weight and obesity categories showed less energy. HRQoL was lower among obese and obese class III students. Students showed better SRH gut in the normal weight category. Obese people experienced more unhealthy days associated with mental and physical problems and noticed more days of reduced activity because of depression, pain, and lack of sleep. Overweight students had higher emotional impairments. **Rashmi, Nirja Joshi, and Tushar Sathe (2019)** demonstrated that 52 were of normal weight and 31 were overweight. Of the 84 teens aged 16 and older, 51 were of normal weight and 33 were overweight. 48 adolescents aged 17, including 24 overweight and 24 normal weights. Obesity has a negative influence on the HRQoL of adolescents between the ages of 15 and 17 in the dimensions of psychological and physical well-being, social and peer support, autonomy with parents, and school environment.

DISCUSSION

This review was primarily intended to explore the HRQoL of obese and overweight adolescents. The evaluation of the article's quality revealed that most of the essential criteria, including the relevance of the topic, methodological quality, result analysis, and impacts, were acceptable. **A. Fagbohun et al. (2021)** reported that obese adolescents' mean HRQoL in the school functioning range of 55.0 to 20.8 was considerably less compared with underweight adolescents (83.5 ± 14) and a normal BMI of 81.3 to 16.3 ($p < 0.05$). This study was supported by **S. Petersen et al. (2014)**; **Anangamanjari D. Pedapudi et al. (2020)**; **Papiya Roy, Premananda Bharati, and Suman Chakravarty (2019)**; and **Ying-Ping Chen et al. (2015)**. The results showed that adolescents aged 12 to 14 years had improved HRQoL due to improved social and academic functioning and well-being. Among young obese people between the ages of 15 and 18, HRQoL is poor in emotional, physical, social functioning and well-being. In addition, adolescents with an overweight or obese BMI observed a marginally lower HRQoL than children with a normal BMI. Despite being statistically significant, the magnitude of this change was negligible at $p < 0.05$. In addition, a cohort study showed that adolescents in obesity grade III (OGG-III) groups were 2.15 times more likely to report mobility problems on the EQ-5D-3L than adolescents in OGG-I. For DCGM-31, a mean difference of 9.7 and 6 points were noted from OGG III and I-31 and KINDL, while 5.1 points were noted between OGG II and I for DCGM-31. Similarly, **Jagdish P. Goyal et al. (2011)**; **Xiu Yun Wu et al. (2019)**; **Anil P. Kumar and G. D. Faisal (2015)**; **Adekunle Sanyaolu et al. (2019)**;



**Saritha et al.,**

Jayalakshmi Mohan *et al.* (2018); and Chinwendu E., Chukwunonso E.C.C. Ejike, Ikwuegu, and Ruth C. Abalogue (2015) described eating while watching television as being 1.81 times linked with the risk of being obese and overweight (OR: 1.81; 95% CI = 1.192.79) While watching television or computer games over 3 hours has been associated with an increased risk of being obese and overweight, the odds have increased by 1.84 (OR: 1.84; 95% CI = 1.192.84) and 5.4-fold (OR: 5.4; 95% CI = 2.7710.54), respectively. If the children do not play an outdoor game or only play a weekly game, the risk of obesity and overweight increases 4.29-fold (OR: 4.29; CI = 2,467.47) and 2.93-fold (OR: 2.93; 95% CI = 1.784.84). Transportation to school by bus or automobile was also linked with 2.81 (OR: 2.81; 95% CI = 1, 415, 61), which increased the risk of being obese and overweight. In our research, Lara Meixner *et al.* (2020) and Rashmi Ronghe, Nirja Joshi, and Tushar Sathe (2019) indicated that psychological ($\beta=0.10$, $ES=0.04$, $p=0.002$) and parental ($\beta=0.08$, $ES=0.04$, $p=0.036$) well-being was lower in obese males than in normal-weight males. Obesity has a negative influence on the HRQoL of adolescents between 15 to 17 years of age in the dimensions of physical well-being, psychological well-being, social, peer support, autonomy with parents, and school environment. It was supported by Dinesh Kamaraj *et al.*, (2016); MD Tsiros *et al.*, (2009); Nora Wille *et al.*, (2010); Praween Agrawal *et al.*, (2015); Francesca Mastorci *et al.*, (2021) Arun Kumar, Chitwan Bhasin, and Udai Prakash Verma (2020). The results showed that the mean psychosocial score was 21.53 with a 3.053 SD. Higher scores were noticed in the 10, 12, and 18 age groups, while adolescents reported the lowest scores in the 14 and 16 age groups. The score difference among all age groups was statistically significant statistically ($P<0.000$). In our review study, Varghese C. Antony and Kaukab Azeem (2019) reported that self-rated health was good in around 87% of underweight, 94% of normal-weight, 73% of obese and only 57% of obese-III undergraduate students. There was a considerable difference in $p<0.002$. Supportively, Syed Arshaduddin Ahmed and Syed Atiq ur Rahman (2016); Parekh Alok, Parekh Malay, and Vadasmiya Divyeshkumar (2012); G. Chaitali *et al.* (2014); Catherine L. Keating *et al.*, (2011); Dagna Lek *et al.* (2021); and Gayathri D. Syamily and Kulandaivel (2020) showed that the % of overweight adolescents was greatest at 40.5% in elementary school, followed by 33.3% in high school; and obesity was highest at $P<0.01$ in elementary school, with a prevalence of 35% in high school. The percentage of obesity and overweight was higher for male adolescents at 65.8% and 54.4% than for adolescent girls at 34.2% and 45.6% at $P<0.01$. Finally, our study reveals the dearth of published studies on HRQoL among overweight and obese adolescents. This can be a fruitful area for further studies to find out whether HRQoL varies according to age in adolescents. There is also a lack of data on monitoring measures and the transfer and generalization of the effects of being overweight or obese on HRQoL in adolescents. We didn't include qualitative work, even though it adds a lot to the research in this area, because its results can't be extrapolated to large populations as reliably as those of quantitative analyses.

CONCLUSION

Our study found that obese and overweight adolescents have a lesser HRQoL. Overall, this evidence showed that overweight adolescents between 15 and 17 years of age have a detrimental influence on their HRQoL in the aspects of physical well-being, psychological well-being, social and peer support, autonomy, parental involvement, and school environment. A rise in "poor health" is related to a higher BMI. Obesity was related to reduce HRQoL in the areas of physical and mental health. To tackle this new danger to adolescent health in India, comprehensive public health interventions such as nutrition education, growth monitoring, and promotion of exercise programs and physical education in schools and communities are crucial.

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Table1: Participant Characteristics

Author (year)	Type of study design (nation)	Number of adolescents (n)	The age of adolescents	Measuring scale	Findings
A. Fagbohun <i>et al.</i> (2021)	A cross-sectional study (Southwestern Nigeria)	650	14.1 ±2.1 years	Pediatric Quality of Life Inventory questionnaire	At p 0.05, "obese adolescents had a significantly lesser mean HRQoL in the school functioning range of 55.0–20.8 compared to underweight adolescents" (83.5–14) and a normal BMI of 81.3–16.3 at p<0.05.
J. Felix <i>et al.</i> (2020)	Cohort study (Germany)	352	16.7 +/- 2.4 years	The EuroQol five-dimensional (EQ-5D-3L) questionnaire, the DISABKIDS chronic generic module (DCGM-	Adolescents in the OGG III (obesity category) groups were "2.15 times more likely to report mobility"





Saritha et al.,

				31), and the KINDLE obesity module were all used.	difficulties on the EQ-5D-3L compared to adolescents in the OGG groups. The mean differences for OGG III and I-31 and KINDL for DCGM-31 were 9.7 and 6 points, respectively, and for OGG II and I, they were 5.1 points.
Lara Meixner et al. (2020)	cross-sectional study (Germany)	1770	11 to 17 Years	KIDSCREEN-27 questionnaire	Boys with obesity had lower psychological ($\beta=0.10$, SE =0.04, p = 0.002") and parental well-being ($\beta=0.08$, SE =0.04, p = 0.036") than their peers of the same weight.
Varghese C. Antony and Kaukab Azeem (2019)	Cross-sectional study (Saudi Arabia)	140	19 ±0.70 years	CDC HRQoL-14	For 87 percent of underweight, 94 percent of normal weight, 73 percent of obese, and just 57 percent of obese-III individuals, health status has been rated as satisfactory. At p = 0.002, the difference was statistically significant.
Rashmi Ronghe, Nirja Joshi, and Tushar Sathe (2019)	Cross-sectional Study (India)	203	15 to 17 years	KIDSCREEN-27 questionnaire.	Obesity hurts the HRQoL of 15- to 17-year-olds in the areas of physical and





Saritha et al.,

					mental health, independence from parents, social support from peers, and the school environment.
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Effect of Fortified Organic Manures and Micronutrient Fertilization on the Soil Properties and Yield of Sesame in Coastal Saline Soil (*Typic ustifluvent*)

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ABSTRACT

Coastal saline soils are well known for the deficiency of both macro and micronutrients. Growing of oilseeds in coastal saline soil is a common practice in India especially in Tamilnadu. Due to poor nutrient status and leaching of applied nutrients in the sandy nature coastal soil, the productivity of sesame is very low. In order to enhance the soil fertility and improve the sesame productivity, an experiment was carried to study the influence of micronutrients fortified organic manures on the soil properties and yield of sesame in coastal saline soil in the farmer's field at Perampattu coastal village in Cuddalore district of Tamilnadu during March–June, 2021 using sesame variety TMV 4 as test crop. The texture of the soil was sandy loam with pH- 8.39, EC-4.11 dS m⁻¹ and low organic carbon status of 2.27 g kg⁻¹. The soil had low (139.50 kg ha⁻¹), low (9.30 kg ha⁻¹) and medium (162.31 kg ha⁻¹) status of alkaline KMnO₄- N, Olsen- P and NH₄OAc- K, respectively. The available zinc (0.71 mg kg⁻¹) and manganese (0.92 mg kg⁻¹) were below the critical level. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The various treatments imposed in the study were T₁–Control (RDF/100% NPK alone), T₂–RDF + FYM @ 12.5 t ha⁻¹, T₃–RDF + Composted coirpith (CCP) @ 12.5 t ha⁻¹, T₄ – RDF + FYM @ 12.5 t ha⁻¹+ ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹, T₅ –RDF + CCP @ 12.5 t ha⁻¹+ ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹, T₆ –RDF +

58108



**Elayaraja et al.,**

Micronutrients (Zn + Mn) Fortified FYM (MNFFYM) @ 6.25 t ha⁻¹, T₇–RDF + Micronutrients (Zn + Mn) Fortified CCP (MNFCCP) @ 6.25 t ha⁻¹, T₈–RDF + MNFFYM @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application), T₉–RDF + MNFCCP @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application), T₁₀–RDF + MNFFYM @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application) + Pink Pigmented Facultative Methylophilic bacteria (PPFM) @ 1.0 % foliar application and T₁₁–RDF + MNFCCP @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application)+ PPFM @ 1.0% foliar application. The results of the field experiment clearly indicated that treatment, T₁₁–RDF + MNFCCP @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% + PPFM @ 1.0% foliar application at pre flowering stage and flowering stage recorded the highest available nutrients and yield of sesame in coastal saline soil.

Keywords: Coastal saline soil, micronutrients fortified organic manures, soil fertility, sesame, yield.

INTRODUCTION

The soil salinization has tremendous environmental, ecological and social impacts in terms of shrinkage of agricultural lands, agricultural productivity, unstable livelihood security and poor quality of life. The net primary productivity (NPP) of saline soils is low due to toxic concentration of salts and deficiencies of essential nutrients especially micronutrients (Lal, 2009). High salt concentration and nutrient deficiencies especially micronutrients are the main factors of low crop yield in coastal saline soil (Arulrajasekaran *et al.*, 2021). In this context, almost the entire coastal tracts of soil as well as water are suffer from salinity, sodicity and seawater intrusion which resulted in the low productivity of crops. The coastal ecosystem provides livelihood to several million people and then contribute to the national economy to a significant extent. The coastal agriculture faces a host of difficult problems related to seawater, poor quality water, cyclones and flood. The low lying agriculture lands frequently suffer from severe drainage and soil salinity problem. Soil and water salinity hampers crop production in the coastal ecosystem to greater extent.

Sesame is the most important oil seed crop of India as well. A glimpse of the sesame crops in India's position *vis-à-vis* other countries in the world shows that it occupies 35.2 per cent of area and 28.6 per cent production. India ranks first in area (29%), production (26%) and export (40%) of sesame in the world. Sesame seeds are rich source of protein, minerals, edible oil and bio-medicine. Sesame oil has excellent nutritional, medicinal, cosmetic and cooking qualities for which it is known as "The Queen of Oils". Due to the presence of potent antioxidants, sesame seeds are called as "the seeds of immortality". In majority of the coastal area, oilseed crops are cultivated in nutrient impoverished soils. Among the oilseeds, sesame (*Sesamum indicum* L.) is one of the most important oilseed crop grown in coastal soils. India is the highest producer of sesame in the world which occupies an area of 17.6 lakh ha with a production of 7.85 lakh tones, however the average yield of coastal sandy soil is very low (446 kg ha⁻¹) as compared to national average yield of around 700-800 kg ha⁻¹ (Elayaraja *et al.*, 2019). In Tamil Nadu, the area under cultivation of sesame is 1.12 lakh hectares with a production of about 16,000 tonnes and average productivity is 589 kg ha⁻¹ (Kaul *et al.*, 2020). The short duration, drought tolerant, low water and nutrient requirement of sesame attracts many farmers in coastal regions to cultivate this crop. However, the yield obtained on the coastal regions are very low and far below the national average yield.

Micronutrient deficiencies in soils limit crop yields and nutritional quality, which in turn negatively affect human health, especially in most of the salt affected soils in coastal regions of Tamilnadu. Majority of the coastal coarse textured soils have multiple micronutrient deficiencies which makes soils non responsive to NPK fertilization. Poor crop yields in combination with diets that are mainly based on staple crops, causes widespread micronutrient deficiencies among the population. A suggested strategy to alleviate micronutrient deficiencies in this region is agronomic bio-fortification, particularly of staple foods. The impact of agronomic bio-fortification largely depends on the

58109



Elayaraja *et al.*,

bioavailability of micronutrients throughout the entire pathway/ entire crop growth periods from soil to plant, from plant to food and uptake by the human body. Factors that determine bioavailability are mainly soil conditions, crop variety, food processing, concentration of micronutrient inhibitors or enhancers in food, dietary intake, the forms of micronutrients in food, interactions among nutrients, and physiological condition of individuals. These effects of fortified organic manure with micronutrients like zinc, iron and manganese to maximizing the potentiality of bio-fortification of micronutrients and yield, nutritional quality of sesame crops and human health. In this context, the use of fortified organic manures is one of the technologies to enhance the nutrient use efficiency as well as decrease the nutrient losses (Aswini *et al.* 2015). The aim of enrichment of organic manures is to minimize excess use of fertilizers for optimum yield and quality of sesame crops without harming soil and environment health by the application of micronutrients fortified organic manures like plant nutrient enriched FYM.

To prevent further soil deterioration, the use of pink pigmented facultative methylotrophic bacteria (PPFM) that have the ability to colonize different habitats, including soil, sediment, water and both epiphytes and endophytes as host plants has been suggested for sustainable agriculture. Methylotrophic bacteria are known to play a significant role in the bio-geochemical cycle in soil ecosystems, ultimately fortifying plants and sustaining agriculture. Hence, inclusion of recommended dose of NPK and micronutrient fertilizer along with Zn or Mn fortified manures techniques becomes an imperative need to improve the soil fertility and yield of oil seed production (Gawad *et al.*, 2015 and Rachanya, 2022).

MATERIALS AND METHODS

The field experiment was conducted in the farmer's field at Perampattu coastal village, near Chidambaram, Cuddalore district, Tamil Nadu, India. The experimental site is geographically located at 11°24'N latitude, 79°44'E longitudes and altitude of ± 5.79 M above mean sea level (MSL) in the southern part of India and 15 km away from the Bay of Bengal coast. The experimental soil was sandy loam texture and taxonomically classified as *Typic Ustifluvent* with pH-8.41, EC-4.11 dSm⁻¹ and analysed low status of soil organic carbon (2.27 g kg⁻¹). The soil was low in alkaline KMnO₄-N (139.50 kg ha⁻¹), Olsen-P (9.30 kg ha⁻¹) and medium in NH₄OAc-K (162.31 kg ha⁻¹). The available DTPA Zn content (0.71 mg kg⁻¹) and manganese content (0.92 mg kg⁻¹) was also low in the soil. The various treatments imposed in the study were T₁ –Control (RDF/100% NPK alone), T₂–RDF + FYM @ 12.5 t ha⁻¹, T₃–RDF + Composted coirpith (CCP) @ 12.5 t ha⁻¹, T₄ – RDF + FYM @ 12.5 t ha⁻¹+ ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹, T₅–RDF + CCP @ 12.5 t ha⁻¹+ ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹, T₆–RDF + Micronutrients (Zn + Mn) Fortified FYM (MNFFYM) @ 6.25 t ha⁻¹, T₇–RDF + Micronutrients (Zn + Mn) Fortified CCP (MNFFCCP) @ 6.25 t ha⁻¹, T₈–RDF + MNFFYM @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application), T₉ –RDF + MNFFCCP @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application), T₁₀ – RDF + MNFFYM @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application)+ Pink Pigmented Facultative Methylotrophic bacteria (PPFM) @ 1.0 % foliar application and T₁₁–RDF + MNFFCCP @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (foliar application)+ PPFM @ 1.0% foliar application. The experiment was arranged in a Randomized Block Design (RBD) with three replications. As per standard procedure of Jackson (1973), the soil samples were collected at critical stages like flowering, capsule formation and at harvest stage and analysed for various properties like physico-chemical properties (pH, EC and organic carbon), available (N, P and K) and micronutrients (DTPA extractable Zn and Mn) and biological properties (bacteria, fungi and actinomycetes) in soil. The seed yield from each plot was recorded at 14 per cent moisture content and dry weight of stalk yield from each plot was recorded and expressed in kg ha⁻¹.

RESULTS AND DISCUSSION

Physico-chemical properties of the soil (Table 1)

The influence of various fortified organic manure treatments, application of recommended dose of fertilizer (RDF) along with organics or Zn and Mn fortified organics and foliar spray of PPFM altered the pH, EC and organic carbon content of the soil at different critical stages of sesame was significant.



Elayaraja *et al.*,

pH and EC

The effect due to different fortified organic manure treatments proved its worthiness in reducing the soil pH and EC at all the growth stages of sesame. The various fortified organics treatments exerted a significant role in reducing the pH and EC of the soil at all the growth stages viz., flowering, capsule formation and at harvest stage. The treatment recommended dose of NPK alone recorded a pH and EC of 8.50 and 4.26 dSm⁻¹ at flowering, 8.44 and 4.22 dSm⁻¹ at capsule formation and 8.42 and 4.09 dSm⁻¹ at harvest stage, respectively. Though both the organics studied were useful in reducing the soil pH and EC. Among the various fortified treatments, application of micronutrients (Zn and Mn) fortified composted coirpith (MNFCCP) @ 6.25 t ha⁻¹ through soil application and foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% along with PPFM @ 1.0% twice (T₁₁) brought out significant reduction on soil pH and EC to a greater extent at all the growth stages. At harvest, this treatment recorded the lowest pH and EC of 8.01 and 3.85 dSm⁻¹. However, this was found to be on par with treatment T₉, supplied with RDF + MNFCCP @ 6.25 t ha⁻¹ through soil along with foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (T₉). This was followed by the next best treatment T₁₀, the application of micronutrients fortified FYM (MNFFYM) @ 6.25 t ha⁻¹ through soil application and foliar spray of ZnSO₄ and MnSO₄ @ 0.5 per cent registered a pH and EC of 8.06 and 3.88 at harvest stage. This was followed by the treatments arranged in the descending order like T₈>T₇>T₆>T₅>T₄>T₃ and T₂. These treatments were also statistically significant. The control recorded the highest pH (8.42) and EC (4.09) of the soil at harvest stage.

The decrease in soil pH may be attributed to the higher production of CO₂ and organic acid during the decomposition of fortified organics and bio-resources. Further, application of phytomass and FYM/CCP amendments in salt affected soils alleviated the salt effects and lowered EC. These results are conformity with Malik *et al.* (2004) and Akbari *et al.* (2011) and Elayaraja and Jawahar (2021).

Organic carbon

The influence of micronutrients fortified organic manures in enhancing the organic carbon content of soil was significant. All the organic manure applied treatments from T₂ to T₁₁ significantly increased the organic carbon content of soil. Of all the treatments, a significantly higher organic carbon content was recorded in application of RDF + MNFCCP @ 6.25 t ha⁻¹ along with foliar application of ZnSO₄ @ 0.5% + MnSO₄ 0.5% + PPFM @ 1.0% (2.89 g kg⁻¹). However, this was found to be on par with treatment T₉. This was followed by the next best treatment T₁₀, application of RDF + MNFFYM @ 6.25 t ha⁻¹ along with foliar application of ZnSO₄ @ 0.5% + MnSO₄ 0.5% + PPFM @ 1.0% recorded an organic carbon content of 2.80 g kg⁻¹ at harvest stage. However, it was found to be comparable with the treatment T₈, This was followed by the treatment T₇, the application of RDF + MNFCCP @ 6.25 t ha⁻¹ and treatment T₆, the application of RDF + MNFFYM @ 6.25 t ha⁻¹ which recorded an organic carbon status of 2.68 and 2.61 g kg⁻¹ at harvest stage, respectively. This was followed by the treatments arranged in the descending order as T₅>T₄> T₃ and T₂. Application of recommended dose fertilizer (RDF) or NPK alone recorded the lowest organic carbon content of 2.30 g kg⁻¹ at harvest stage.

Micronutrients (Zinc and Manganese) fortified organic manuring with FYM and composted coirpith was reported to increase the status of organic carbon and total nitrogen. (Rachanya, 2022). The effect due to organic amendments as a component of fortified organics treatment in increasing the organic carbon content in soil would be expected due to higher content of organic matter present in them as reported by Veeranagappa *et al.* (2010); Chaturvedi *et al.* (2011) and Kumawat *et al.* (2013). The increased biological activity hastened the decomposition process of the added fortified organic manures resulted in higher organic carbon into the soil (Sharma *et al.*, 2004). Further, the increased organic carbon content of post harvest soil with application of various micronutrients fortified organic manure treatments in oil seed crops was reported by Kumar *et al.* (2009); Sharma and Abraham (2010) and Arulrajasekaran (2019) and in sesame was reported by Elayaraja and Jawahar (2021).

Available major nutrient content of the soil (Table 2)

The availability of nitrogen, phosphorus and potassium in coastal soils are very low due to poor crop residues, microbial activity, leaching of nutrients associated with poor structure and low use efficiency of applied nutrients. The



Elayaraja *et al.*,

influence of various micronutrients fortified organic manure treatments significantly and positively increased the availability of major nutrient in soil which was well documented in the present investigation.

Among the various micronutrients fortified organic manure treatments, application of recommended dose of fertilizer along with (micronutrients) Zn + Mn fortified composted coirpith (MNFCCP) @ 6.25 t ha⁻¹ through soil and foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% + PPFM @ 1.0% twice (T₁₁) recorded the highest available nitrogen (168.74 kg ha⁻¹), phosphorus (173.59 kg ha⁻¹) and potassium (168.74 kg ha⁻¹) at FS, CFS and harvest stage, respectively. This was followed by the treatment T₉, which received RDF + MNFCCP @ 6.25 t ha⁻¹ through soil application along with ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% + PPFM @ 1.0% through foliar application. This treatment recorded 176.60, 10.69 and 198.26 kg ha⁻¹ of alkaline KMnO₄-N, Olsen – P and NH₄OAc-K at harvest stage, respectively. However, it was found to be equally efficacious with application of recommended dose of fertilizer (RDF) + micronutrients fortified FYM (MNFFYM) @ 6.25 t ha⁻¹ through soil application (SA) + foliar application of ZnSO₄ and MnSO₄ @ 0.5% along with PPFM @ 1.0 per cent (T₁₀). This was followed by the treatments T₈, (RDF + MNFFYM @ 6.25 t ha⁻¹ through soil application along with ZnSO₄ + MnSO₄ @ 0.5 % foliar application). The treatments T₇ (RDF + MNFCCP @ 6.25 t ha⁻¹) and T₆ (RDF + MNFFYM @ 6.25 t ha⁻¹) recorded a lowest alkaline KMnO₄-N, Olsen – P and NH₄OAc-K content as compared to above said treatments. This was followed by the treatments arranged in the descending order like T₅>T₄>T₃ and T₂. The control registered the lowest available NPK status in soil.

With the addition of micronutrients like Zn+ Mn fortified organic manures there might be improved physical properties of the soil, thus created favourable conditions for microbial activity and resultant increase in N availability of soil. In addition, the added fortified organic manure as an energy source for a majority of the heterotrophic bacteria stimulated native beneficial microbial activity, thus resulting in higher N availability of soil (Sridevi *et al.*, 2010) and Mohanty *et al.*, (2015). Incorporation of FYM and composted coirpith along with inorganic fertilizers like NPK, ZnSO₄ and MnSO₄ increase the availability of P and this is attributable to reduction in fixation of water soluble P, increased mineralization of organic P due to microbial action and enhanced mobility of P. These results are in conformity with the earlier findings of Mali *et al.* (2015) and Ashwani *et al.* (2016). The effect of micronutrients along with organics treatments in increasing the available phosphorus in soil were earlier documented by Singaravel *et al.* (2006) and Akande *et al.* (2010). Further the addition of fortified organics along with recommended dose of NPK fertilizers reduced the K fixation and release of K due to the interaction of organic matter with clay besides the direct addition of potassium to available pool of the soil contributed for increased K availability (Elayaraja, 2008). Organics also minimized the leaching loss of K by retaining K ions on exchange sites of the decomposition products. Similar results were also reported by Hossain *et al.* (2012) and Ganesh and Suresh Kumar (2016).

Available micronutrients content of the soil (Table 3)

DTPA-Zinc

Coastal soils are well known for the restricted availability of micronutrients especially zinc and manganese in soil due to poor organic matter, high leaching, prevailing high pH and salinity. The profound influence of various fortified organic manure treatments in increasing in DTPA–Zn content of soil was well established in present study. The availability of DTPA-Zn content in the soil significantly increased at all the growth stages of sesame with the application of different fortified organic manures applied treatments. The highest available zinc status at flowering (2.33 mg kg⁻¹), capsule formation (1.87 mg kg⁻¹) and at harvest stage (1.18 mg kg⁻¹) was recorded with the combined application of 100 per cent recommended dose of NPK + micronutrients fortified composted coirpith (MNFCCP) @ 6.25 t ha⁻¹ through soil and foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% + PPFM @ 1.0% twice at pre flowering and flowering stage (T₁₁). This was followed by the treatment which received RDF + MNFCCP @ 6.25 t ha⁻¹ through soil along with foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (T₉) which recorded 1.13 mg kg⁻¹ of DTPA-Zn content of soil at harvest stage. This was comparable with treatment which received RDF + micronutrients fortified FYM (MNFFYM) @ 6.25 t ha⁻¹ through soil along with foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% and PPFM @ 1.0% twice at pre flowering and flowering stage (T₁₀) which recorded 1.12 mg kg⁻¹ of DTPA-Zn content of soil at harvest stage. This treatment was followed by recommended NPK + MNFFYM @ 6.25 t ha⁻¹ through soil along with foliar application of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% (T₈) which recorded a DTPA-Zinc content (1.06 mg kg⁻¹) of soil at harvest stage. This

58112



**Elayaraja et al.,**

was followed by the treatments significantly arranged in the descending order as $T_7 > T_6 > T_5 > T_4 > T_3$ and T_2 . These treatments were also statistically significant. The control treatment (RDF alone) registered the lowest DTPA-Zn availability of 0.52 mg kg^{-1} at harvest stage.

In general, most of the coastal saline soils, including the coastal region are well supplied with micronutrients with exception of Zn. The deficiency of micronutrients is induced in saline soils due to the reduction of sulphate salts to sulphides and subsequent precipitation of the micronutrients (Maji and Bandyopadhyay, 1990). The increased zinc availability might be attributed to the direct addition of these nutrients by fertilizer and enriched organic manures, which maintain maximum available Zn and other micronutrients status in post harvest soil. Further the complexation of micronutrients with applied organics might have mobilized and increased the availability of Zn in soil. These findings are accordance with Elayaraja (2008); Ahamad *et al.* (2012) and Patel *et al.* (2016).

DTPA-Manganese

The positive influence of micronutrient (zinc and manganese) fertilization either through soil or foliar along with micronutrients fortified organics (CCP and FYM), recommended dose of NPK and PPFM foliar spray was also significantly increasing the availability of DTPA-Mn was well evidenced in the present study. The highest DTPA-Mn was registered with recommended dose of fertilizer (RDF) + ZnSO_4 + MnSO_4 @ 0.5% and PPFM @ 1.0% foliar spray along with micronutrients fortified composted coirpith (MNFCCP) @ 6.25 t ha^{-1} (T_{11}) which recorded a Mn content of 2.45, 2.12 and 1.63 mg kg^{-1} at FS, CFS and at the harvest stages, respectively. This was followed by the treatments T_9 , application of NPK + MNFCCP @ 6.25 t ha^{-1} through soil along with foliar spray of ZnSO_4 and MnSO_4 @ 0.5 per cent. However, it was found to be equally efficacious with the treatment T_{10} (RDF + MNFFYM @ 6.25 t ha^{-1} through soil + ZnSO_4 and MnSO_4 @ 0.5% + PPFM @ 1.0% foliar spray). The treatment T_{10} registered a DTPA-Mn content of 2.35, 2.03 and 1.45 mg kg^{-1} , respectively at the above said three critical stages of sesame. This was followed by the treatments T_8 , application of NPK + MNFFYM @ 6.25 t ha^{-1} + through soil along with ZnSO_4 @ 0.5% + MnSO_4 @ 0.5% through foliar spray.

Application of micronutrients with fortified or without fortified organics applied treatments viz., T_7 (RDF + MNFCCP @ 6.25 t ha^{-1}), T_6 (RDF + MNFFYM @ 6.25 t ha^{-1}), T_5 (RDF + CCP + ZnSO_4 @ 25 kg ha^{-1} + MnSO_4 @ 5 kg ha^{-1}), T_4 (RDF + FYM + ZnSO_4 @ 25 kg ha^{-1} + MnSO_4 @ 5 kg ha^{-1}), T_3 (RDF + CCP @ 12.5 t ha^{-1}) and T_2 (RDF + FYM @ 12.5 t ha^{-1}) recorded the lowest available Mn content of 1.23, 1.15, 1.08, 1.01, 0.94 and 0.71 mg kg^{-1} at harvest stage, respectively as compared to above said treatments at all the stages of crop growth. The lowest DTPA-Mn was recorded with T_1 , the control treatment (RDF alone) that did not received organics, zinc and manganese. The increased manganese availability might be attributed to the direct addition of these nutrients by fertilizer and organic manures, which maintain maximum available Mn status in post harvest soil. Further the complexation of micronutrients with applied organics might have mobilized and increased the availability of Mn in soil. These findings are accordance with Tiwari (2002); Elayaraja (2008) and Javia *et al.* (2010).

Microbial population of the soil (Table 4)

Beneficial microbial populations of soil microorganisms viz., bacteria, fungi and actinomycetes was significantly increased with various fortified organic manures applied treatments was well evidenced. An increase in the microbial population upto capsule formation stage and a decline thereafter was noticed (at harvest stage). Among the various fortified organics treatments, the combined application of recommended dose of NPK along with micronutrients (Zn + Mn) fortified/enriched composted coirpith (MNFCCP) @ 6.25 t ha^{-1} through soil application and foliar spray of ZnSO_4 @ 0.5% + MnSO_4 @ 0.5% + PPFM @ 1.0% twice (T_{11}) recorded the highest population of bacteria (24.59×10^6), fungi (18.01×10^5) and actinomycetes (10.24×10^4) at harvest stage. However, it was found to be equally efficacious with the treatment T_9 (RDF + MNFCCP @ 6.25 t ha^{-1} through soil + ZnSO_4 + MnSO_4 @ 0.5% FA). This was followed by the treatment T_{10} (application of RDF /100% NPK + MNFFYM @ 6.25 t ha^{-1} through soil along with ZnSO_4 + MnSO_4 @ 0.5% + PPFM @ 1.0% FA) which registered the population of bacteria (23.05×10^6), fungi (17.05×10^5) and actinomycetes (9.71×10^4) at harvest stage, respectively. However, it was found to be equally efficacious with the treatment T_8 (RDF + MNFFYM @ 6.25 t ha^{-1} through soil + ZnSO_4 + MnSO_4 @ 0.5% foliar). This was followed by the



**Elayaraja et al.,**

treatment T₇ (RDF + MNFCCP @ 6.25 t ha⁻¹) and treatment T₆ (RDF + MNFFYM @ 6.25 t ha⁻¹) which recorded the microbial population like bacteria (18.69×10^6 , 20.27×10^6 and 19.17×10^6), fungi (14.23×10^5 , 13.29×10^5 and 14.07×10^5) and actinomycetes (7.51×10^4 , 9.93×10^4 and 8.55×10^4) at flowering, capsule formation and at harvest stage, respectively. The treatments T₅ (RDF + ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹ + CCP @ 12.5 t ha⁻¹), treatment T₄ (RDF + ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹ + FYM @ 12.5 t ha⁻¹), treatment T₃ (RDF + CCP @ 12.5 t ha⁻¹) and treatment T₂ (RDF + FYM @ 12.5 t ha⁻¹) which recorded the lowest microbial population count noticed at all the growth stages as compared to above said fortified organics treatments. The lowest microbial population of soil was noticed with application of NPK alone as compared to either fortified or without fortified organics treatments. The control treatment T₁, application of recommended dose of fertilizer alone (100% NPK alone) recorded a comparatively lowest microbial population counts of bacteria (12.66×10^6), fungi (8.95×10^5) and actinomycetes (6.42×10^4) at harvest stage, respectively.

In the present study, application of different micronutrients fertilization and fortified organics treatments showed a significant improvement in the population of soil microorganism's viz, bacteria, fungi and actinomycetes was noticed with combined application of recommended dose of NPK + micronutrients fortified composted coirpith (MNFCCP) @ 6.25 t ha⁻¹ through soil along with foliar application of ZnSO₄ + MnSO₄ @ 0.5% and PPFM @ 1.0 per cent twice at pre flowering stage (PFS) and at flowering stage (T₁₁) recorded the highest microbial population of soil microorganisms at capsule formation stage. This was followed by the treatment T₁₀, which received RDF micronutrients fortified (Zn + Mn) FYM (MNFFYM) @ 6.25 t ha⁻¹ through soil along with foliar application of ZnSO₄ + MnSO₄ @ 0.5% and PPFM @ 1.0 per cent twice. In general, the microbial population increased upto capsule formation stage and then decreased thereafter. This could be attributed to the presence of flush of easily metabolizable compounds at the beginning and the crop was also under active growth phase releasing higher amount of root exudates which support numerous and diverse micro flora. These results corroborate with the findings of Nath *et al.* (2015) and Singaravel *et al.* (2016).

Yield of Sesame (Figure 1)

The sesame responded well to micronutrients application. The significant influence of micronutrient fertilization (zinc + manganese) along with 100% recommended NPK and Zn + Mn fortified organics in increasing the seed and stalk yield of sesame was well documented in the present study. The yield realized under the nutrient poverished coastal sandy loam soil, the highest seed yield (953 kg ha⁻¹) and stalk yield (1788 kg ha⁻¹) was recorded with combined application of 100 per cent recommended dose of NPK fertilizer + micronutrients fortified composted coirpith (MNFCCP) @ 6.25 t ha⁻¹ through soil as well as foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5 per cent + PPFM @ 1.0 % twice at pre flowering and flowering stage (T₁₁). This was followed by the treatments T₉, (RDF + MNFCCP @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% FA) and T₁₀ (RDF + MNFFYM @ 6.25 t ha⁻¹ + ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% + PPFM @ 1.0 % FA) which recorded the seed (920 and 911 kg ha⁻¹) and stalk (1696 and 1683 kg ha⁻¹) yield of sesame, respectively The treatments T₉ and T₁₀ were found to be on par with each other. This was followed by the treatment T₈ (RDF + MNFFYM @ 6.25 t ha⁻¹ through soil application along with ZnSO₄ + MnSO₄ @ 0.5 per cent through foliar application).

Individual or sole application of micronutrients (Zn or Mn) fortified organics alone or micronutrients + organics alone (without fortified) along with NPK treatments recorded the lowest yield of sesame as compared to above said treatments (RDF+ fortified organics + micronutrients and PPFM). This was followed by the treatments arranged in the descending order like T₇ (RDF + MNFCCP @ 6.25 t ha⁻¹), T₆ (RDF + MNFFYM @ 6.25 t ha⁻¹), T₅ (RDF + CCP + ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹), T₄ (RDF + FYM + ZnSO₄ @ 25 kg ha⁻¹ + MnSO₄ @ 5 kg ha⁻¹), T₃ (RDF + Composted coirpith (CCP) @12.5 t ha⁻¹) and T₂ (RDF + FYM @ 12.5 t ha⁻¹), respectively. Among the various micronutrients fortified organics applied treatments, the treatment (T₁₁), 100% recommended dose of NPK + micronutrients (Zn + Mn) fortified composted coirpith @ 6.25 t ha⁻¹ through soil application along with foliar spray of ZnSO₄ @ 0.5% + MnSO₄ @ 0.5% and PPFM @ 1.0% twice recorded a seed and stalk yield of 953 and 1788 kg ha⁻¹ which was 34.73 and 51.67 per cent increase over control or 100 per cent NPK alone (without micronutrients and fortified organics). The control treatment T₁, 100 per cent NPK alone recorded a lower seed (622 kg ha⁻¹) and stalk (864 kg ha⁻¹) yield of sesame.



Elayaraja *et al.*,

The application of NPK as chemical fertilizer supplied nutrients initially required for sesame growth and resulted in higher growth and yield characters leading to increased seed and stalk yield. Thirupathi *et al.* (2001) and Jayasingh (2002) earlier reported the increased yield of sesame with NPK and enriched organic applications. Further, higher yield in the enriched organic manures applied treatment might also be due to the contribution of micronutrients released from enriched organic manures attributed to involvement in many enzyme system, recycling functions and auxin production (Veeranagappa *et al.*, 2010a) and enhanced synthesis of carbohydrates and their transport to the site of seeds formation (Ahmad *et al.*, 2012).

Associated with improved growth, yield characters and yield of sesame was also increased with the application of recommended dose of NPK + micronutrients (Zn + Mn) enriched composted coirpith @ 6.25 t ha⁻¹ through soil application and foliar application of ZnSO₄ + MnSO₄ @ 0.5 per cent and PPFM @ 1.0 per cent twice at pre flowering and flowering stage. Application of NPK and micronutrients fortified organic manures helped in the slow and steady rate of nutrient release into soil solution to match the absorption pattern of sesame thereby increased the seed yield. Further, the favourable effect of Zn, Mn and NPK nutrients on seed and stalk yield was also could be attributed to their effect in maintaining soil available nutrients in balanced proportions for better growth and higher seed yield of sesame. This was corroborates the earlier report of Duhoon *et al.* (2004); Krishnaprabu and Kalyanasundaram (2007) and Ravi *et al.* (2008).

CONCLUSION

The present investigation clearly concluded the beneficial effect of fortified organics and micronutrients fertilization for increasing sesame production in coastal saline soil. Application of recommended dose of NPK + micronutrients (zinc and manganese) fortified composted coirpith (MNFCCP) @ 6.25 t ha⁻¹ through soil application along with foliar spray of ZnSO₄ + MnSO₄ @ 0.5 per cent and pink pigmented facultative methylotrophs (PPFM) @ 1.0% twice at critical stages *viz.*, pre flowering and flowering stage was identified as best treatment combination and it can be recommend to the farmer's of coastal areas to realize the maximum profit in sesame yield and to sustain soil health in coastal saline soil.

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Table 1. Effect of fortified organic manures and micronutrient fertilization on the physico-chemical properties of soil

Treatments	pH			EC (dSm ⁻¹)			OC (g kg ⁻¹)		
	FS	CFS	HS	FS	CFS	HS	FS	CFS	HS
T ₁	8.50	8.44	8.42	4.26	4.22	4.09	2.18	2.23	2.30
T ₂	8.45	8.40	8.38	4.22	4.19	4.06	2.21	2.27	2.36
T ₃	8.40	8.35	8.33	4.19	4.17	4.04	2.24	2.31	2.42
T ₄	8.36	8.31	8.29	4.17	4.15	4.02	2.28	2.36	2.49
T ₅	8.31	8.26	8.24	4.14	4.12	3.99	2.31	2.40	2.55
T ₆	8.26	8.22	8.20	4.12	4.10	3.97	2.34	2.44	2.61
T ₇	8.22	8.17	8.15	4.09	4.07	3.94	2.37	2.48	2.68
T ₈	8.17	8.13	8.11	4.07	4.05	3.92	2.41	2.52	2.74
T ₉	8.12	8.07	8.05	4.04	4.00	3.87	2.45	2.57	2.82
T ₁₀	8.13	8.08	8.06	4.05	4.01	3.88	2.44	2.56	2.80
T ₁₁	8.07	8.03	8.01	4.01	3.98	3.85	2.48	2.61	2.89
SE _D	0.01	0.02	0.01	0.01	0.009	0.008	0.01	0.01	0.02
CD (p=0.05)	0.03	0.04	0.03	0.02	0.019	0.018	0.02	0.03	0.05

Table 2. Effect of fortified organic manures and micronutrient fertilization on the major nutrient availability (kg ha⁻¹) in soil

Treatments	Alkaline KMnO ₄ -N			Olsen-P			NH ₄ OAc-K		
	FS	CFS	HS	FS	CFS	HS	FS	CFS	HS
T ₁	140.61	133.01	130.67	10.95	9.98	9.23	180.45	168.64	159.54
T ₂	145.10	137.30	134.69	11.10	10.17	9.35	184.84	173.13	165.63
T ₃	149.62	141.62	138.74	11.21	10.36	9.50	189.26	177.65	169.65
T ₄	154.08	145.98	142.83	11.34	10.60	9.67	193.61	182.08	173.68
T ₅	158.59	150.29	146.94	11.46	10.75	9.81	197.94	186.64	177.74
T ₆	163.15	154.65	151.12	11.58	10.89	9.99	202.31	191.21	181.81
T ₇	167.59	159.09	155.33	11.69	11.03	10.18	206.63	195.83	185.83
T ₈	172.18	163.48	159.44	11.82	11.18	10.40	211.02	200.42	189.92
T ₉	176.84	169.18	164.67	11.97	11.41	10.60	216.23	206.03	194.25
T ₁₀	176.60	167.90	163.48	11.93	11.36	10.56	215.39	205.11	194.01
T ₁₁	181.35	173.59	168.74	12.09	11.62	10.69	220.54	210.54	198.26
SE _D	2.09	2.02	1.88	0.04	0.05	0.05	2.04	2.02	1.87
CD (p=0.05)	4.39	4.25	3.95	0.10	0.12	0.11	4.29	4.25	3.94



Elayaraja *et al.*,Table 3. Effect of fortified organic manures and micronutrient fertilization on the micronutrients availability (mg kg⁻¹) in soil

Treatments	DTPA-Zinc			DTPA-Manganese		
	FS	CFS	HS	FS	CFS	HS
T ₁	0.68	0.59	0.52	0.84	0.77	0.71
T ₂	1.58	1.20	0.74	1.74	1.42	0.94
T ₃	1.70	1.29	0.79	1.82	1.56	1.01
T ₄	1.79	1.37	0.84	1.90	1.64	1.08
T ₅	1.90	1.45	0.89	2.01	1.71	1.15
T ₆	1.98	1.56	0.95	2.11	1.79	1.23
T ₇	2.08	1.64	1.01	2.19	1.87	1.31
T ₈	2.19	1.71	1.06	2.27	1.94	1.38
T ₉	2.25	1.79	1.13	2.37	2.05	1.46
T ₁₀	2.23	1.78	1.12	2.35	2.03	1.45
T ₁₁	2.33	1.87	1.18	2.45	2.12	1.63
SE _D	0.032	0.030	0.024	0.033	0.030	0.028
CD (p=0.05)	0.069	0.063	0.049	0.071	0.062	0.060

Table 4. Effect of fortified organic manures and micronutrient fertilization on the microbial population in soil

Treatments	Bacteria (× 10 ⁶ /g soil)			Fungi (× 10 ⁵ /g soil)			Actinomycetes (× 10 ⁴ /g soil)		
	FS	CFS	HS	FS	CFS	HS	FS	CFS	HS
T ₁	13.04	13.25	12.66	10.21	8.96	8.95	5.53	7.01	6.42
T ₂	14.08	14.61	13.97	10.97	9.82	10.07	5.87	7.56	6.84
T ₃	15.19	15.98	15.24	11.86	10.71	11.22	6.25	8.17	7.31
T ₄	16.38	17.37	16.55	12.59	11.54	12.21	6.57	8.75	7.63
T ₅	17.59	18.81	17.83	13.44	12.39	13.15	7.04	9.38	8.06
T ₆	18.69	20.27	19.17	14.23	13.29	14.07	7.51	9.93	8.55
T ₇	19.82	21.59	20.43	15.11	14.17	15.05	7.89	10.50	8.91
T ₈	20.97	23.04	21.76	15.82	15.08	16.02	8.38	11.16	9.33
T ₉	22.32	24.71	23.24	16.76	15.94	17.08	8.74	11.86	9.79
T ₁₀	22.11	24.41	23.05	16.67	15.89	17.05	8.69	11.75	9.71
T ₁₁	23.41	26.19	24.59	17.54	16.77	18.01	9.07	12.54	10.24
SE _D	0.46	0.59	0.55	0.29	0.34	0.33	0.10	0.18	0.10
CD (p=0.05)	0.97	1.24	1.17	0.62	0.72	0.71	0.21	0.39	0.22





Elayaraja et al.,

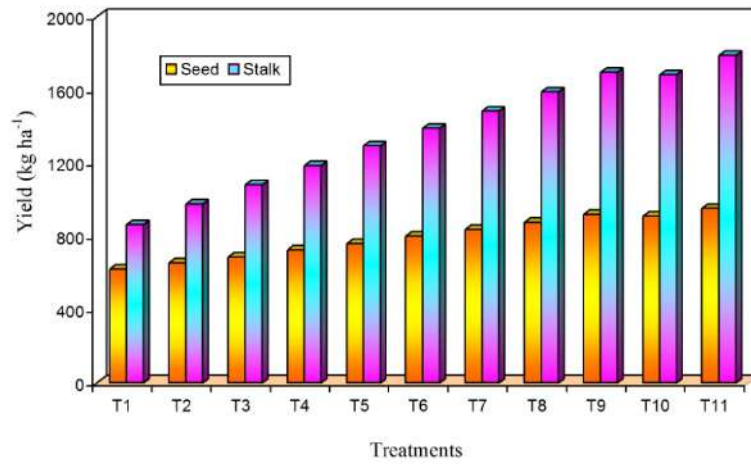


Figure 1. Effect of fortified organic manures and micronutrient fertilization on the yield of sesame





Application of Arbuscular Mycorrhizal Fungi (AMF) Zinc Tolerance on Groundnut (*Arachis hypogea*. L)

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ABSTRACT

The present investigation has found out the effect of zinc and AM fungi on the morphological analysis of groundnut plants at 20, 40, 60, 80 and 100 DAS. The groundnut plant was raised in pots containing the soil 5 kg with different concentrations of zinc (Control, 2.5, 2.5 + AMF, 5, 5 + AMF, 7.5, 7.5 + AMF, 10, 10 + AMF, 12.5, 12.5 + AMF) each treatment was replicated thrice in a randomized block design. Observations were complete on germination percentage, root and shoot length, number of leaves, total leaf area, fresh and dry weight of groundnut at 20, 40, 60, 80 and 100 DAS. Among the results, all the parameters increased in control treatments but 12.5 mg zinc treatment decreased maximum inhibition in all growth parameters and morphological parameters were recorded.

Keywords: Zinc, Groundnut, Morphological parameters.

INTRODUCTION

The reign of the 21st century is prone to pollution. Due to environmental pollution, various types of waste generation, large-scale use of toxic pesticides, global climate change, frequent occurrence of various disasters around the globe etc. are the major concern of today's world. It is essential to explore the causes of global climate change and



**Munnaji et al.,**

its impact on human health, agriculture, water resources and civilization. The necessity to manage and mitigate pollution is inexorable. Awareness may serve as a short-term remedy but sustaining it demands long time guidelines. In the interest of comprehending the causes of persistent human diseases, environmental pollution has to be given more attention. (Xu *et al.*, 2022). Environmental variables, comprising hazardous biological, physical, and chemical components in the environment, are thought to account for 24% of the global disease burden and 23% of fatalities (Laborde *et al.*, 2015). As science and technology advance, new environmental threats emerge from the pollution of synthetic chemicals, airborne particles, heavy metals, and E-waste (Barreto *et al.*, 2012). The above facts clearly speak for themselves about the alarming rate and situation that many developing countries are facing, including Nigeria due to environmental degradation (Gana, 2014). Groundnut is an important food crop in African and Asian countries. One of the largest producers of groundnut is Nigeria. It is either grown for its nut, oil or its vegetative residue (haulms). In northern Nigeria where the crop is mostly grown, Kaduna, Kano, Adamawa, Niger, Bauchi, Bornu and Taraba states, accounted for close to 80% of the total production (Abalu and Harkness, 1979).

MATERIALS AND METHOD

Pot Culture Experiment

The seeds groundnut seeds were obtained from Tamilnadu Agricultural University (TNAU), Coimbatore, Tamilnadu, India. The uniform seeds are selected for the experimental purpose. The source of zinc stock solution is prepared by dissolving the molecular weight of zinc and different concentrations (Control, 2.5, 2.5 + AMF, 5, 5 + AMF, 7.5, 7.5 + AMF, 10, 10 + AMF, 12.5, 12.5 + AMF) of zinc the solution was prepared freshly at the time of experiments. The pods were filled with 5 kg of garden soil selected groundnut seeds were sown in the pods irrigated with normal tap water was maintained as the control.

AM Fungi

The AM Fungi (*Glomus fasciculatum*) were collected from the Department of Microbiology, Tamilnadu Agricultural University, Coimbatore, Tamilnadu, India.

Morphological Parameters

The germination study was conducted with groundnut seeds treated with zinc. The seeds of groundnut seeds were surface sterilized with 0.2 per cent of $HgCl_2$ for two minutes and they were thoroughly washed with tap water. The seeds were arranged in pods filled with garden soil and they were treated with different concentrations (Control, 2.5, 2.5+AMF, 5, 5+AMF, 7.5, 7.5 + AMF, 10, 10 + AMF, 12.5, 12.5 + AMF) of zinc. The control set was maintained by using tap water. Three replicates were maintained for each treatment. On the 20, 40, 60, 80 and 100 DAS- the germination percentage, shoot length, root length, total leaf area, seedling fresh weight and seedling dry weight were taken.

Shoot and root length (cm/seedling)

Twenty seedlings were taken from each treatment and their shoot length and root length were measured by using a cm scale and the values were recorded.

Total leaf area

The total leaf area was calculated by measuring the length and width of the leaf as described by Yoshida *et al.* (1972).

Where

Leaf area (cm^2) = $K \times \text{Length} \times \text{Breadth}$

K = Kemp's constant (for dicot leaves 0.66)

Fresh weight (g/seedling)

Ten seedlings were collected from each treatment and their fresh weights were measured with the help of an electrical single pan balance.



**Munnaji et al.,****Dry weight (g/seedling)**

The same seedlings used for fresh weight were kept in a hot air oven at 80°C for 24 h. Then, the seedlings were taken from the oven and kept in desiccators for some time. Their dry weights were taken by using an electrical single-pan balance.

RESULTS AND DISCUSSION**Shoot length**

The effect of zinc with AMF on the shoot length of groundnut at various stages of growth is presented in Fig. 1. The highest shoot length (29, 33.5, 43.5, 53.2 and 61.2 cm/plant) was observed at 15, 30, 45, 60 and 75 DAS of T₂ treated plant. Similarly, the lowest shoot length (12.3, 13.5, 15.2, 24 and 30 cm/plant) was recorded in the T₉ zinc-treated plants at 20, 40, 60, 80 and 120 DAS respectively.

Root length

The influence of various concentrations of zinc with AMF treatment on the root length of groundnut at various stages of its growth is given in Fig. 2. The maximum root length (9, 19.1, 21.5, 24.5 and 26.8 cm/plant) was recorded in the plant irrigated with T₂ treatment at 15, 30, 45, 60 and 75 DAS respectively. Similarly, the smallest root length (3.1, 7.3, 15.3, 15.8 and 16.2 cm/plant) was recorded in the plant irrigated with T₉ (12.5 mg) zinc concentration at 20, 40, 60, 80 and 120 DAS respectively.

Fresh weight of plant

The effect of zinc with AM fungi on the fresh weight of groundnut at various stages of growth is presented in Fig. 3. The uppermost fresh weight (27.4, 49.87, 55.92, 75.98 and 87.26 /plant) was observed at 15, 30, 45, 60 and 75 DAS of T₂ treated plant. Similarly, the least fresh weight (23.97, 30.74, 32.62, 57.22 and 62.74 /plant) was recorded in the T₉ zinc treated plants at 20, 40, 60, 80 and 120 DAS respectively.

Dry weight of plant

The effect of zinc with AMF on the dry weight of groundnut at various stages of growth is presented in Fig. 4. The greatest dry weight (10.5, 16.6, 18.5, 28.5 and 29.8 /plant) was observed at 15, 30, 45, 60 and 75 DAS of T₂ treated plant. Similarly, the lowest dry weight (5, 10.2, 10.9, 18.7 and 20.9 plant) was recorded in the T₉ zinc treated plants at 20, 40, 60, 80, 100 and 120 DAS.

Number of leaves

The maximum number of leaves recorded were, AM Fungi treated plants (6, 29, 32, 41 and 45) respectively. The minimum (3, 14, 17, 19 and 23) was observed at 12.5 (T₉) mg zinc concentration. The maximum Total leaf area is recorded in AM Fungi treated plant. The minimum total leaf area was observed at 12.5 (T₉) mg Zinc concentration.

DISCUSSION

Heavy metal contamination of soil and water is a serious problem for the ecosystem, which poses strong negative effects on plant growth and development (Kabata, 2001). The Plant growth rate in the current study was observed at the interval of 10 days for 60 days and after 60 days plants were uprooted and their biomass was recorded. From the results, it has been observed that treated plants showed better results than the controlled plants. In contrast with this, other reports suggested that Zinc supplied at concentrations above 70 mM produced toxic effects typical of metal stress in pea plants. Treatment with zinc to a reduction in the root, stem and leaf growth. The leaves showed signs of induced chlorosis (Stoyanova and Doncheva, 2002). Application of varying rates of Zn and P on groundnut revealed that the two nutrients have an effect on the vegetative growth (plant height, plant spread), yield, yield parameters, nutrient concentration and heavy metals accumulation of groundnut. Application of Zn increased plant height and spread through the effect was not significant on the parameters. An increase in the vegetative parameters may be



**Munnaji et al.,**

due to the Zn encouraging vegetative growth and increased plant capacity for building metabolites. It could also be a result of auxin production by the plants, which facilitated the production of more plant cells. Similar findings were from Tomar *et al.* (1990) and Saxena and Chandel (1997), whom they reported that auxin and better dry matter production are indicators of the application of Zn-enhanced plant growth. In another study, the effects of various concentrations of Zinc on biomass, chlorophyll content, and zinc contents of *Sorghum bicolor* and *Chenopodium album* were studied. Results indicated that, generally, with increasing zinc concentration in soil, plant height, the content of chlorophyll a, b and total chlorophyll and biomass decreased significantly (Mirshekali *et al.*, 2012).

The effect of Zn and B on the plant height of groundnut is depicted in Fig. 1. The plant height of groundnut increased with the age of the crop and attained maximum at harvest. At the vegetative stage of the crop, the treatments did not show any significant differences in plant height. Although there were significant differences among the treatment in plant height at flowering and harvesting stages, the height of the plant varied from 28.3 – 35.6 cm and 31.3 - 41.5 cm at the flowering and harvesting periods respectively among the treatments. Combined application of Zn and B significantly enhanced the height of the plant being the maximum under Z2B2 at both flowering and harvesting followed by Z2B1. Z2B2 recorded a maximum 39% increase in plant height at the flowering stage followed by Z2B1 (32%) Das (1992) also observed the increased vegetative growth of groundnut with foliar applications of Zn and B. Though, the sole application of B did not have any effect on plant height during the entire growth phase. The lowest value of plant height was noted under control (Z0B0) throughout the growth stages. The leaf area of the plant denotes the activity of photosynthesis by regulating the interception of sunlight. There was a continuous increase in leaf area over time from vegetative to maturity. Throughout the growing phase leaf area ranged 0.032 – 0.034, 0.036 – 0.053 and 0.046 – 0.068 m²/plant during the vegetative, flowering and harvesting periods, respectively. Though at the vegetative stage, the application of Zn and B either singly or in combination did not affect the leaf area significantly. The leaf area of Z2B2 significantly increased over other treatments during flowering (55%) and the pod formation period (29%). The Z2B1 and Z1B2 were increased over Z1B1 and other sole applications of Zn or B. Z1B1 showed 8.5% more leaf area than Z2B0 during the flowering period; though during the harvesting period, their value became statistically at par. This result clearly indicated the effect of less concentration of simultaneous Zn and B application was better than the application of higher concentration of Zn or B separately. This might be due to the synergistic interaction between Zn and B which was corroborated by findings in mustard (Sinha *et al.*, 2000). During the flowering to harvesting period, the leaf area of groundnut under Z2B1 increased the maximum by about 65% followed by Z1B2. The Z0B2 and Z0B1 had no significant effect on leaf area development throughout the growing period. Combined application of RDF, Zn, Mo, *Rhizobium* and PSB increased leaves plant⁻¹, branches plant⁻¹, plant height and root length as compared to other treatments (Table 2). Increased availability of N and P due to the application of biofertilisers and application of Zn and Mo, having specific roles in plant growth, resulted in the enhanced photosynthetic activity of crop plants and thus the observed increase in a number of leaves, branches and height per plant. These results corroborate the findings of Hameeda *et al.* (2006)

Different micronutrients application also influenced Zn uptake by kernels, haulm and total Zn uptake significantly. Soil (25 kg ha⁻¹) and foliar (0.5%) application of ZnSO₄ (S₄) recorded considerably higher Zn uptake by kernels, haulm and total Zn uptake (67.42, 153.61 and 221.03 g ha⁻¹, respectively) when compared to other treatments. However, it was found on par with soil (25 kg ha⁻¹) application of ZnSO₄ (S₂) with respect to the uptake of Zn (137.64 g ha⁻¹) in haulm. The increase in Zn uptake was due to the better and greater availability of Zn at the root zone. Similar results were also recorded by Pattar *et al.* (1999) and Patel *et al.* (2007). Debroy *et al.* (2013) also observed increased Zn uptake in kernels and haulm due to soil and foliar application of zinc in green gram.

Many authors reported inhibition of Seed germination by heavy metals whereas at 100% of effluent concentration decrease in length of root and shoot was recorded at 10, 15, 20, 25 and 30 days. Inhibition of seed germination may be due to high levels of dissolved solids, which enrich the salinity and conductivity of the absorbed solute by the seed before germination (Gubrelay *et al.*, 2013). The study reported by Rout *et al.* (2000) that seed germination was reduced by 25% with the treatment of 200 mM Cr concentration. The heavy metal stress could be assigned to the accelerated breakdown of stored nutrients in seeds and the alteration of selection permeability properties of cell membranes. However, Wu



**Munnaji et al.,**

et al. (2008) mentioned that the seedlings of *Citrus tangerine* and *Poncirus trifoliata* importantly higher shoot and root dry weights, plant height, leaf area, leaf number per plant, and stem diameter with the influence of mycorrhizal (AM). Further, studies reported inhibition of seed germination by the heavy metal (Cavusoglu and Yalcin, 2010). Muhammad et al. (2008) announced that *L. leucocephala* seedlings demonstrated a slow reduction in dry weight with an increment in the treatment of cadmium, which was clear in the poor development of roots and elevated parts. Fresh and dry weights of the plant were reduced with increasing concentrations of cadmium.

CONCLUSION

The present investigation carries out the detection of the response of groundnut when subjected to zinc through irrigation on AM fungi application under the backdrop of an ecological experiment in the control vicinity. A germination study was conducted on the crop with different concentrations (Control, 2.5, 2.5 + AMF, 5, 5 + AMF, 7.5, 7.5 + AMF, 10, 10 + AMF, 12.5, 12.5 + AMF) on groundnut in this experiment the parameter such as root length, shoot length fresh and dry weight, number of leaves and total leaf area, increased in with AMF and then it decreased at a high level of zinc treatment, reduction in morphological parameter and growth at higher concentration of zinc might be due to the higher amount of toxicity which caused changes in the osmotic relationship of the plant and water.

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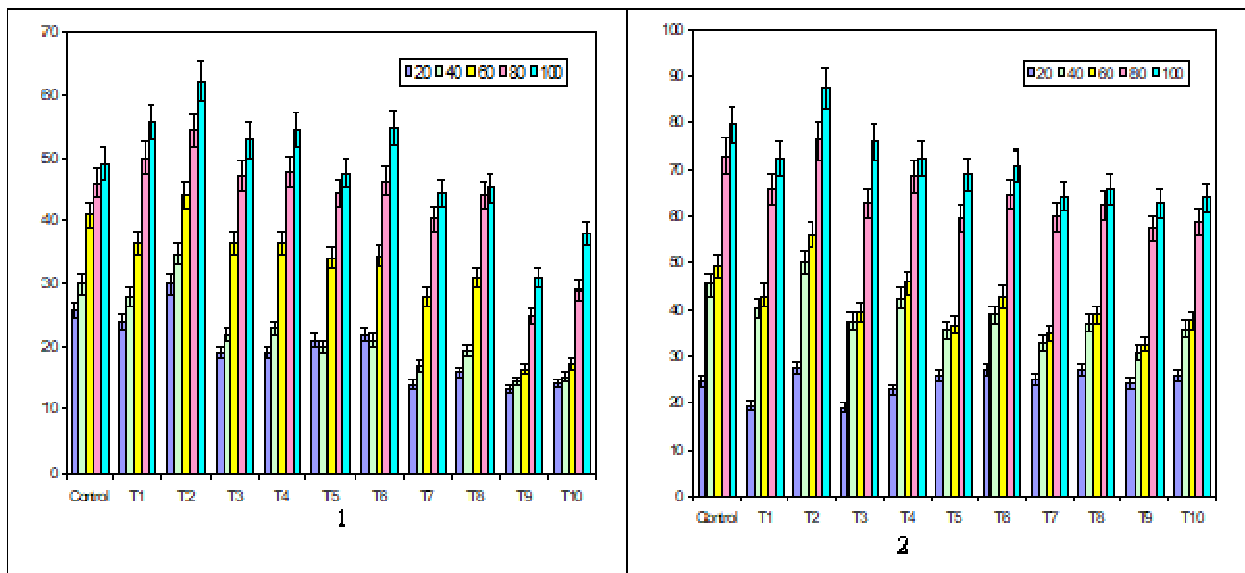
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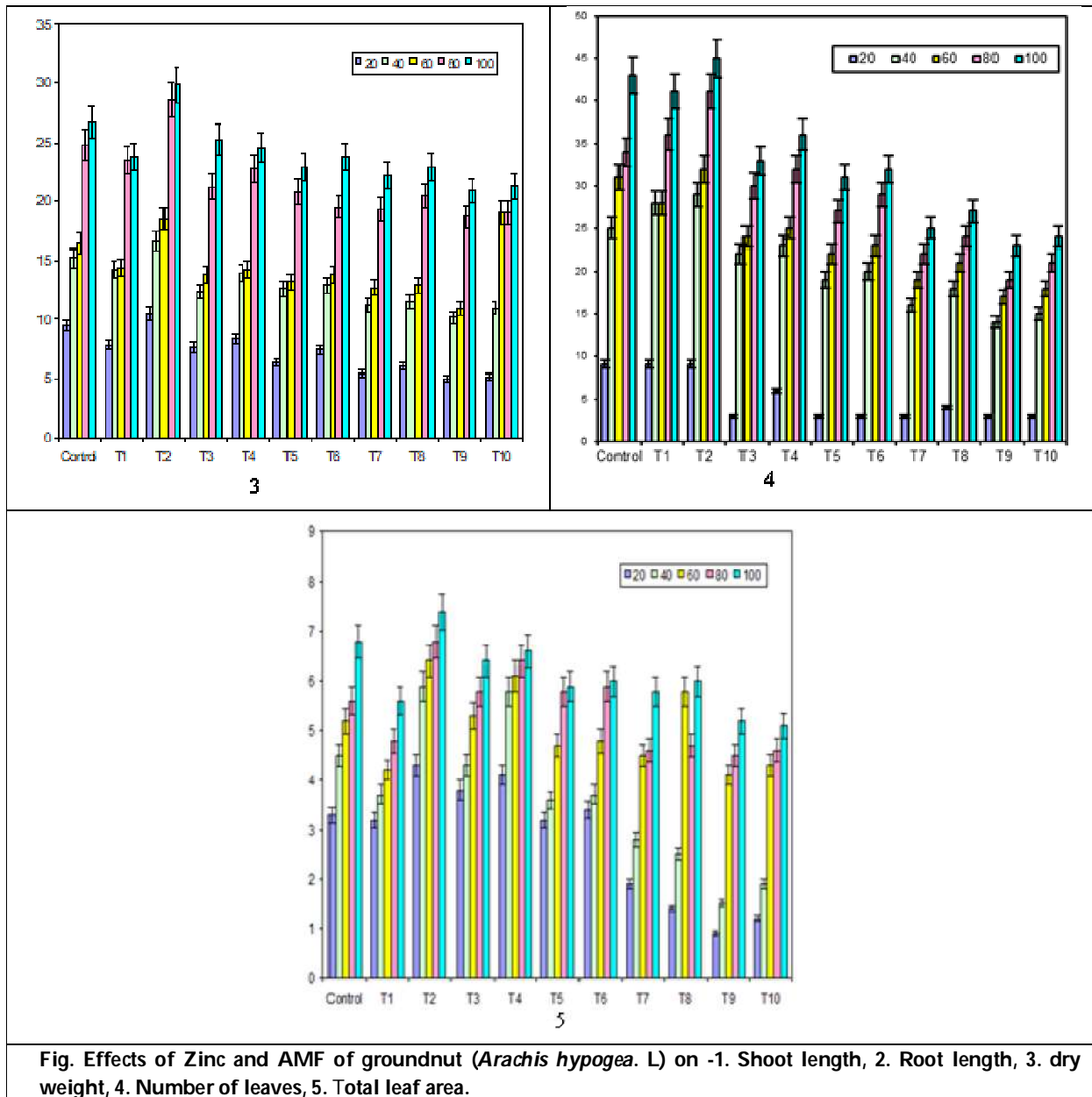
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Munnaji et al.,





Impact of Visual Art Therapy for Children with Intellectual Disability : An Experimental Study

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ABSTRACT

Intellectual disability is a condition characterized by significant limitation in intellectual functioning and adaptive behavior which covers a range of social and practical skills. Children with intellectual disability are vulnerable to communication impairments. Various therapies have been made for the improvement of these impairments from time to time. The New York Child Study Center reports that cognitive abilities differ widely across the four categories of intellectual disability. The mildly intellectually disabled are considered to be “educable,” meaning that they can achieve academically at about a sixth-grade level. They have an ability to create, take pride in and be admired for their creativity, provided with the exposure of visual art. Children with Intellectual disability have difficulty in expressing themselves verbally. They need an alternative means of coping with stress and overwhelming emotions. Many children with Intellectual disability need to get in touch with the part of themselves that is wise, that has the emotional information and perceptions. They need to create and not feel judged, either by themselves or others. Art is an expression of persons reactions to experiences. It gives form to thought the use of design and materials. Visual art therapy is a form of psychotherapy that uses art media, images and the creative processes to encourage clients to express their thought and feelings. The benefits of visual art therapy make visible and immediately understood known self-experience as well as potential symbolic meaning not yet understood. Expressive art can boost success of other types of therapy. Group art therapy is used to express themselves in a way that is difficult to put into words. This experimental study has been carried out to know the impact of art therapy for the improvement of communication skills and

58127



**Rayees Zahoor Shah and Swarna Kumari**

other important skills in children with intellectual disability. Because art therapy is a potential communication tool. Researcher selected sample of about 40 children with intellectual disability in the age group of 10 to 15 years in the special schools. The result of this research finds improvement in communication abilities and other skills in children exposed with visual art therapy as compared to the other children which were not given the art therapies.

Keywords: visual art, intellectual disability, adaptive behavior.

INTRODUCTION

Intellectual Disability – An Overview

Intellectual disability is a term used when there are limits to a person's ability to learn at an expected level and function in daily life. Levels of intellectual disability vary greatly in children.: intellectual disability means a significant reduced ability to understand new or complex information and to learn and apply new skills, this results in a reduced ability to cope independently (impaired social functioning) and begins before adulthood with lasting effect on development. Rights of persons with disabilities act 2016: intellectual disability a condition characterized by significant limitation both in intellectual functioning (reasoning, learning, problem solving) and in adaptive behavior which covers a range of everyday social and practical skills. Sub average general intellectual functioning which originates during the developmental years and is associated with impairment in adaptive behavior Severity of intellectual disability is based on the levels of intellectual quotient Mild (IQ =55-69), moderate (IQ=40-54), severe (IQ =25-39), profound (IQ below 25).

Visual art therapy

Visual art therapy plays a major role for children with intellectual disability because of its amazing potential as a communication tool. Through visual art, children with intellectual disability can develop imagination, memory sequencing skills, hand eye coordination, creativity, offer important vehicles for expression can solve the problems and emergent literacy and master a new outlet for exploration and discovery. Visual Art Therapy can provide a means of expression and communication which can assist in improving functional abilities and resolving emotional issues of children with intellectual disability. Art Therapy can also improve the self-esteem and enhance the enjoyment and expression hence will lead to improvement in the quality of life. The use visual of art as therapy for children with intellectual disability implies that the creative process can be a means both of reconciling emotional conflicts and of fostering self-awareness and personal growth. When using visual art as a vehicle for psychotherapy, both the product and the associative references may be used in an effort to help the individual find a more compatible relationship between his inner and outer world.

LITERATURE REVIEW

Robert Nurf 2001study finds that art therapy in the classroom have an impact on success and has impact on behavior. Jackie Brinkman 2004 study reveals that a picture drawn by an intellectually disabled child is a worth thousand words. American art therapy association 2009 study finds that art therapy improves and enhances intellectual and emotional wellbeing. Ashley ailing art 2009 study finds that visual art therapy have a direct impact on attention of child with intellectual disability.





Rayees Zahoor Shah and Swarna Kumari

RESEARCH METHODOLOGY

This research study is an experimental study with purposive sampling. The data was collected through observation method by giving visual art activities. Researcher selected about 60 sample but finds 40 samples suitable for the research as per the criteria. 20 samples in control group and 20 samples in experimental group. The researcher collected data from control group without giving intervention, and the therapy was given to the experimental group for 6 months. After intervention the researcher collected data from the experimental group.

Research design of the study

Experimental research design was used for the purpose of this research

Universe and Sampling

The universe of the study was confined to the Chennai city. Sampling strength of this study was 40 samples of children with Intellection disability who were already diagnosed. Sampling place was from five special schools in Chennai, Tamil Nadu. Purposive sampling technique was used for the purpose sampling. Half of the sample was made a control group and half as an experimental group.

Variables

- Gender – Boys and girls
- Age – 10-15 years
- Attention and concentration
- Visual perception
- Fine motor coordination
- Intellectual ability
- Concept formation
- Creativity

Description of tool

The entry and exit level performance of both experimental group and control group was collected through a self-prepared questionnaire with 3-point scale which incorporates the demographic detail of experimental group and control group along with 6 parameters.

Collection of data

Data was collected by the method of observation of control group as they were provided the art therapy for the period of six months by the therapist and the effect was observed on the control groups.

Data analysis

Data of the sample was analyzed by the use of statistical package of social science-SPSS and the appropriate methods were used for the analysis. All the statistical instruments like tables, figures or other diagrams were made by using SPSS.

Findings of the study

The Result of the study finds that giving visual arts therapy for the children with Intellectual disability facilitated attention and concentration, visual perception, fine motor coordination, intellectual ability, Concept Formation and physical energy. Art therapy allows children with Intellectual disability to communicate through imagery and creativity, while maintaining a social relationship with the art therapist and the work being produced the rapid increase in performance of children with Intellectual disability. Visual art therapy contributes to the psychotherapy process. Research finds that art therapy improves imagery, objectification, permanence, spatial matrix and creativity etc. This study finds that there is a significant difference in the effectiveness of various dimensions in visual arts



**Rayees Zahoor Shah and Swarna Kumari**

between experimental group and the control group with regard to age, gender, with regard to urban or the rural, effectiveness with regard to educational background and finally there is significant difference with regard to economic status.

CONCLUSION

Art therapy is designed to foster creativity and individual expression through the use of various art modalities. This therapy is a therapeutic tool that offers unique sensory and motivational experiences as it purportedly impacts visual discrimination as well as proprioceptive control. Creating art engages the whole brain involving both the hemispheres of the brain encourages integration of feelings, cognition and sensation which can create new understanding for children with intellectual disability. It also promotes visual and sequence reasoning. Children with the intellectual disability are able to express themselves in a way that is very difficult for them to put into words.

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A Survey: Cloud Resource Scheduling Algorithms

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ABSTRACT

Cloud computing is a pattern of shared computing that uses the Internet to abstract, virtualize, manage, and dynamically supply computing components like network services, processing, services, storage and apps. The constituent that deliver services to consumers must now be carefully managed due to the skyrocketing demand for cloud computing. Identified the techniques incapacity to adequately handle changes that occur at runtime resource scheduling. Resource management and monitoring activities will face new difficulties. This paper discuss resource scheduling algorithm that is the best system and high performance computing. throughput. Scheduling controls response and processing times, and effective scheduling practises ensure that resources are used to their fullest potential. Undoubtedly, during execution, the keep up of flexible adaptability became essential for exigency management. The subject that has undergone extensive research in order to address circumstances and changes. This research outline all significant resource scheduling strategies that optimise the user.

Keywords: Resource Scheduling, Static Scheduling , Dynamic Scheduling, Cloud

INTRODUCTION

On-demand computing is a growing high tech trend that utilizes the cyberspace to provide computer assistances such as processing, virtual data bank, automated tasks, interconnected computing devices, and application software in an abstracted, virtualized, managed, and dynamically demand driven manner. Instead of our local system, the resources that offer the services are someplace on the Internet. And consumers may access all of this at any time,





Pandi Prabha and BhuvanaJayabalan

anywhere in the world, using the Internet, just like they would any other utility. It relieves the users of the responsibility of managing by giving them gear, software, storage, and networks *with a* collection of virtualized resources that they can access as needed, introducing the idea of elasticity. As such For a variety of factors, cloud computing and the Internet are compared present day. A lot of servers has been involved in the green computing technology to provide resources, storage, and services. Anytime a user needs one of the cloud services, he or she can access it by promptly paying for it. Because of the benefits of the cloud, more consumers are using it today. Different applications use a variety of resources in different amounts. The main difficult problem in the cloud environment is resource allocation. resource allocations is effective assignment of the available resources, including central processing unit, memory, network, I/O, and storage. In order to lessen the workload on cloud data centres and boost resource utilisation, we must assign resources in an effective and efficient manner.

Resource Scheduling

Any component that can serve as a user's service in any way is referred to as a resource, whether it be a logical or physical one. Examples of logical resources include operating systems, energy, throughput, bandwidth, and network elements. Efficient provisioning and scheduling are both important components of these resources' management. Resource provisioning is the process of correctly identifying, choosing, and allocating the resources required to carry out the activities and workflows. The process of figuring out which tasks will be assigned to which resources is known as resource scheduling. Both of these processes have a strong connection to upholding external service agreement and providing Class of Service. In this survey, the *focal point* is on the phase of scheduling the resource and on methods designed to provide efficient schedules.

Using the cloud interface, the individual customer or agent acting on their behalf submit request or workflows to the utility computing environment. The Resource Management System (RMS) is in charge of monitoring the submission condition of the target, ensuring that the quantity of resources needed is upheld, and completing tasks successfully. Resource Provisioner chooses the resources for the jobs with great care. The resource scheduler contacted RMS after the resources were successfully made available for the execution. The resource scheduler has a lot of different parts, such as the Quality of Service (QoS) monitor, execution manager, request monitor, and priority checker. Depending on the purpose they are serving, resource scheduling algorithms can be divided into a number of different categories. Some researchers categorise algorithms according to the layers on which they operate, for example, allocating in the framework, computing platform, and software layers. Algorithms are divide into static and dynamic types by few academics formed on the required scheduling knowledge. The methods can be divided into non dependent task scheduling and workflow scheduling based on the type of data they use. Workflow in this context refers to a group of interconnected tasks that must all be completed successfully for the workflow to be finished. Based on the methodologies employed the scheduling discipline are divided into deterministic and stochastic algorithms. While stochastic algorithms rely on the user's judgement to find the solution and use random search techniques without any predefined rules, deterministic algorithms base computing on specific mathematical rules that cannot be changed and only allow for one direction of search.

RELATED WORK

SI No	Title	Author	Methodology	Findings	Limitation
1	Static Scheduling in Clouds	Thomas A. Henzinger	Proposed a Flexitic technique	The Flexitic technique helps the user choose the multiple scheduling options. the responsibility of scheduling the jobs with the cloud provider enables the provider to achieve good utilization of its resources	The designed Flexitic technique had several issues such as monitoring the process of the task has to be shown to the user, as well as fault tolerance need to addressed in the technique.





Pandi Prabha and BhuvanaJayabalan

2.	Fault-tolerant scheduling with dynamic number of replicas in heterogeneous systems	Laiping Zhao; Yizhi Ren; Yang Xiang; Kouichi Sakurai	Proposes a new fault tolerant scheduling algorithm MaxRe.	The algorithm implemented reliability test into the active replication schema , and used a dynamic number of replicas for different tasks.	Performace of the proposed system has to be enhanced and better efficient method need to improve better resource handling
3.	Trusted Dynamic Scheduling for Large-Scale Parallel Distributed Systems	Wei Wang; Guosun Zeng	Proposed a dynamic level scheduling algorithm	This algorithm used to decrease the failure probability of the task assignments, and assurance of the execution of tasks in a security environment.	The security of the algorithm has to improve to the probability failure of links and security software deployed in the nodes.
4	Feedback Dynamic Algorithms for Preemptable Job Scheduling in Cloud Systems	Jiayin Li; MeikangQiu; JianweiNiu; Wenzhong Gao; ZiliangZong; Xiao Qin	propose two algorithm for dynamic scheduling algorithms for the cheduling mechanism.	The proposed algorithm results show that FDMMS work better than FDLS.	The algorithm need to enhance the performace in homogeneous cloud system.
5	Improved cost-based algorithm for task scheduling in cloud computing	S. Selvarani; G. Sudha Sadhasivam	proposed scheduling approach an improved cost-based scheduling algorithm	The proposed cloud scheduling approach makes use of an improved cost-based scheduling algorithm to efficiently map tasks to available cloud resources. This scheduling algorithm measures both resource cost and computation performance; it also improves the computation/communication ratio by grouping user tasks based on the processing capability of a specific cloud resource and sending the grouped jobs to the resource.	The development of this algorithm should focus on discussing simultaneous task scheduling rather than independent task scheduling in a cloud environment. And handle more complex scenarios involving dynamic factors such as a dynamically changing cloud environment and other QoS attributes
6	BAR: An Efficient Data Locality Driven Task Scheduling Algorithm for Cloud Computing	JiahuiJin; Junzhou Luo; Aibo Song; Fang Dong; Runqun Xiong	proposed the Balance-Reduce(BAR) heuristic task scheduling algorithm, in which an initial task allocation is generated first, and the job completion time is gradually reduced by tuning the initial task allocation.	BAR schedules tasks from a global perspective and dynamically adjusts task data locality based on network state and cluster workload. BAR makes every effort to improve data locality. When a cluster is overloaded, BAR reduces data locality to allow tasks to begin sooner. BAR is assessed by comparing it to other related algorithms. The simulation results show that BAR has improved and can handle a large problem instance in a matter of seconds.	The network state and cluster workload change frequently in a real-world platform, an efficient rescheduling algorithm should handle machine failure, task stragglers, and network anomalies.





Pandi Prabha and BhuvanaJayabalan

7	A load-adaptive cloud resource scheduling model based on ant colony algorithm	Xin Lu; Zilong Gu	This paper proposes a load-adaptive cloud resource scheduling model based on ant colony algorithm.	The virtual machine's performance parameters are monitored in real time, it schedules fast cloud resources using the ant colony algorithm to bear some load on the load-free node. It can adapt to changing load requirements.	By analysing result, the model can meet the goals and requirements of self-adaptive cloud resource scheduling and improve resource utilisation efficiency. It can be detected once these parameters exceeded the threshold. Hence need to improve the parameters.
8	Cloud Task Scheduling Based on Load Balancing Ant Colony Optimization	Kun Li; Gaochao Xu; Guangyu Zhao; Yushuang Dong; Dan Wang	The Load Balancing Ant Colony Optimization (LBACO) algorithm is proposed as a cloud task scheduling policy.	The contribution is to balance the overall system load while attempting to minimise the make span of a given task set. The proposed LBACO algorithm outperformed FCFS (First Come, First Serve) and the basic ACO in experiments (Ant Colony Optimization)	To accommodate the heterogeneous processing of tasks, the availability vector should be extended in the future to include information about task requirements, and considering the work that all Tasks are mutually independent.
9	Job scheduling based on ant colony optimization in cloud computing	Xiangqian Song; Lin Gao; Jieping Wang	proposed a job scheduling algorithm based on Ant Colony Optimization.	The algorithm reduce job completion time. The results of the experiments revealed that it is a promising Ant Colony Optimization algorithm for job scheduling in a cloud computing environment.	To achieve on-demand resource allocation in the dynamic cloud computing paradigm, effective job scheduling is essential.
10	Cloud Loading Balance algorithm	Zhang Bo; Gao Ji; Ai Jieqing	proposed a Cloud Loading Balance algorithm, adding capacity to the dynamic balance mechanism for the cloud.	The dynamic balance mechanism for the cloud now has capacity. the proposed cloud loading balance algorithm. The experiments show that the algorithm achieves a higher level of load balancing while taking less time to load all tasks.	Numerous algorithms are employed to balance the workload on Cluster-servers, but they fall short in adequately considering the common approach used by heterogeneous servers and the current state of each server's load.





Pandi Prabha and BhuvanaJayabalan

The digital signal data processing and quality of service (QoS) guarantees are crucial for particular number of applications. The SAQA scheduling method takes into account real-time jobs with QoS demands on heterogeneous clusters, so it can provide better service quality for customers [29]. QoS assurances are essential for specific system or software applications, like as signal data processing. SAQA (self-adaptive aere technique) is used to account for QoS demands on heterogeneous clusters with real-time jobs.

RESOURCE SCHEDULING ALGORITHMS

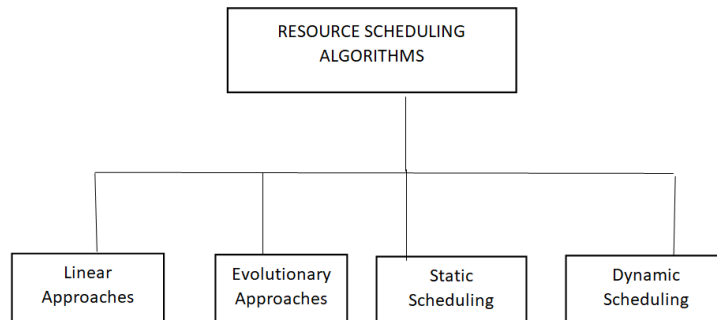


Fig. 1. Resource scheduling algorithms

Deterministic/ Linear Approaches for Resource Scheduling

We examine different methods that used linear approaches in this type of work, including priority, integer programming, etc. The scale of any programme or job does not determine its complexity, according to the activity-based costing approach [7], hence bulk-based expense operator do not yield reliable findings. A effective strategy to calculate the cost of each computing parts (CPU, Memory, and I/O) that a task uses during it is running. In addition to helping to bring accurate costs and more profit, this would distribute the disturbed costs fairly [9]. provided a load-distributing method for scheduling resources while taking into account cloud properties like elasticity and flexibility. Their strategy was successful on two levels: first, by allocating jobs to the proper virtual machines, and second, by placing those virtual machines on the proper hosts in order to distribute the load equally on both levels. Tasks' dynamic nature was taken into account, and any necessary virtual machine migration was accomplished in conformity with the tasks' need.

They concentrated on a quicker response time, which decreased make pan and improved resource utilisation. The moment at which the most latest task provided was assessment results is referred to in this context as the computation time. A priority-based job scheduling technique was utilised by Ghanbari et al. [10]. (PJSC). They applied the cross-disciplinary Analytical Hierarchy Process (AHP), which is a decision-making paradigm. Depending on its values, it determines which work should be assigned to which resource. It calculates priority vectors and comparison matrices. They ran a numerical simulation with this reliable comparison matrix in mind, trying to shorten the make span while maintaining priorities.

Evolutionary/Adaptive Approaches for Resource

Finding the optimal answer through the use of linear algorithms is not particularly practicable due to the scheduling problem's difficulty. As a result, researchers are quite interested in algorithms that draw inspiration from nature. The scale of the challenge has a quadratic relationship with the algorithmic complexity of evolutionary techniques. The work carried out in the Cloud Computing environment, as well as the most well-known evolutionary algorithms: Genetic Algorithms (GA), Ant Colony Algorithms (ACO), Particle Swarm Algorithms (PSO), and BAT algorithm. An objective function was created by Zhao et al. [27] to shorten the duration of any activity's optimum running. Two duties and two resources were used in the numerical simulation, and a quick solution was found.



**Pandi Prabha and Bhuvanajayabalan**

by swapping out the population set created by performing the Min-Min and Max-Min algorithms for the community with the entirely random population set. They were able to provide a better beginning population set in [14]. The duration for the identical collection of tasks grew as well as the standard evolutionary algorithms fared as a result. Operating similarly to an evolutionary algorithms is how particle swarm optimization works. A swarm is a population set made up of a collection of particles. The dimensions of each particle correspond to a certain task. Each particle is a plausible solution that determines movement in the direction of the best position based on the local and global best particle positions. A placements and velocities of the particles are unique. Each particle assesses its own performance, and during this process, it is controlled by two variables: retrospective thought and interpersonal communication. The fitness function is used to update the particle's locations and speeds, and the best outcome is then realised.

Operating similarly to a genetic algorithm is how particle swarm optimization works. A swarm is a population set made up of a assemblage of elements. The dimensions of each particle correspond to a certain task. Based on the local and global best particle positions, Each particle determines progress in the direction of the ideal position by being a viable approach. The particle locations and speeds are distinctive. Each particle evaluates its own performance, and two factors—retrospective thought and interpersonal communication—are in control of this process. The particle's locations and speeds are updated using the fitness function, and the best result is then realized. operations. A deadline was suggested by Rodriguez et al. [21]. resource scheduling restrictions and resource employing PSO as a provisioning approach. They sought to reduce the while keeping the deadline limit, execution costs. It is PSO algorithm is what was used. Only the desired outcome is important. regarding the environment for cloud computing. For Ant Colony Optimization, pheromone values and ants are used. locating the best answer. Initialization of the population. the pheromone vales indicate. Afterward, in each generation, Heuristic data and performance pheromone are taken to aid in locating the most appropriate resource for each activity. This undertaking usually viewed as one insect's step. Typically, this technique is utilised in balancing techniques for loads. In terms of resource allocation, Banerjee et ACO algorithm was enhanced by al. [2] by changing the pheromone. updating system. Moreover, the duration of the jobs completed lowered a great deal. Compared to fundamental ACO improved algorithm's performance. One of the most difficult issues in the cloud is allocating resources for workflow apps. It has so attracted the attention of the research community in recent years. Indeed, both the type and quantity of resources allocated have an impact on how long a workflow takes to complete and how much it costs. Several researchers have created innovative solutions to this issue. Many scheduling algorithms that can be divided into static algorithms and dynamic algorithms have been proposed by researchers.

Analysis techniques for Static Scheduling

This sort of algorithm is predicated on the notion that all workflow tasks ought to be scheduled before being carried out. It therefore takes into account the cloud platform's initialization. Static algorithms may be used to schedule a single Workflow or a number of activities.

Scheduling One Workflow, First

The study of [3] presents a method to address the issues with cloud environments' allocation and scheduling workflows. Based upon three complementing bi-criteria techniques, this strategy. It considers both the entire overall response time and the cost associated with using a particular collection of elements. The 1st strategy makes it possible to reduce execution costs. The second makes an effort to speed up the process overall. By choosing only the non-dominated solutions, The 3rd strategy incorporates the objectives of the previous two strategies. Other strategies concentrate on lowering workflow execution costs while still adhering to a user-specified timeline. By Abrishami et al. [1], one of the most recent efforts in this field was presented. They improve upon an earlier technique for grid environment workflow scheduling with deadline constraints. This patch adds two new algorithms for the IaaS cloud environment (IC-PCP and IC-PCPD2). The optimization technologies factor in the key aspects of cloud computing, including on-demand resource provisioning, homogeneous networks, and the pay-as-you-go pricing model. They



**Pandi Prabha and BhuvanaJayabalan**

make an effort to complete a workflow prior to the client deadline while reducing the cost of the workflow's execution. [8] suggest a scheduling method that takes the time-limit and the financial state into account. The suggested approach involves allocating resources from the private cloud to the demanding jobs. If a work cannot be finished on a private cloud, it is scheduled on the public cloud. Additionally, it ensures that the application will be submitted by the deadline. The word "sub-deadline" refers to the goal for each job that is largely depended on the operational deadline. Level-based scheduling means that the entire workflow application is divided into levels, where tasks will be completed concurrently and independently of one another. Instead of arranging every activity in the workflow application at once.

Planning Several Workflows

The issue of resource provisioning for a single process is addressed in the previously stated studies. [13] present a more and profitable optimization approach for multi clouds to itinerary many dependent activities. After confirming the range of dependencies between the workflows, this technique has the capacity to decrease run time and charge.

The writer of [5] offer the Hybrid Cloud Optimized Cost (HCOC) technique for scheduling numerous workflows in hybrid clouds in the same context. While keeping the execution time under a deadline restriction, the suggested approach seeks to optimise the financial execution costs. In order to decrease deadline violations, It considers multiprocessing resources. HCOC creates a preliminary lineup that only takes into account private resources and determines whether those resources already meet the deadline. The algorithm begins choosing the resources it will seek from the third-party managed platform if the period is not met. Additionally, this method takes into account deadlines, performance, and cost as well as the relationship in the middle of the quantity of concurrent jobs being planned and the number of cores of each resource.

The rubberiness of resources provided by the utility computing cannot be taken advantage of by the ways already mentioned. In actuality, resources are chosen before applications ever begin. While the workflow is being executed, there could be changes in the cloud environment, such as resource availability, resource communication times changing, and so on. Hence, a reactive mode is needed when managing scheduling process on the cloud.

Algorithms for Dynamic Scheduling

Vibrant testing methodology of leasing tools and allocating processes in real time to take into account the variability of the cloud. Based on the resources and network conditions available at the time, they periodically recalibrate them appear answers in an effort to lower the production costs. In actual fact, they alter a few variables throughout each scheduling iteration, like the cost of resource communication.

Scheduling One Workflow, First

A scheduling heuristic based on the Particle Swarm Optimization (PSO) approach is Pandey et al[20] .s main contribution. The cloud-based workflow application costs as little as possible to run. PSO takes into account the cost of computation and data transport between tasks. The authors provide a dynamic method that adjusts the communication costs in each scheduling loop to try to minimize the overall cost. The goal is to compute the PSO mapping while only allocating tasks that are ready to the compute resources. Until all of the tasks in the workflow are scheduled, these steps are repeated. It is suggested to improve this algorithm in several ways. For instance, Bilgaiyan et al. [4] present the CSO (Cat Swarm Optimization) method a brand-new optimization heuristic algorithm inspired by feline social behaviour. Each cat illustrates a mapping between tasks and resources. The finest mapping with the lowest overall cost is provided by the final solution, which is symbolised by the cat at the best position. This cost includes the total toll of all tasks' execution in addition the total cost of fact flow between groups of related tasks. In terms of iterations, CSO outperforms the currently used PSO.

Another method suggested in [25] calls for the scheduling of a cloud-based workflow application using revised discrete particle swarm optimization (RDPSO). RDPSO accounts for both computation cost and job execution time by



**Pandi Prabha and BhuvanaJayabalan**

meeting a deadline restriction. Verma et al. have also suggested Bi-Criteria Priority based Particle Swarm Optimization (BPSO). The goal is to assign process activities to the available cloud resources in a way that reduces execution time and cost while maintaining deadline and budgetary constraints.

Planning Several Workflows

Mao et al. [18] offer a new automated approach for workflow application models. By using resources that are less expensive, it is intended to guarantee that all tasks are completed before their respective deadlines. To increase speed and reduce data transfer costs, a task bundling strategy that requires activities to operate on the same instance is first suggested. They estimate the number of instances and construct an efficient resource plan for each work using deadline assignment algorithms. Additionally, they use a method to reduce task semantic information in boost object utilisation. The majority of vendor also feature an instance-hour billing approach. Thus, a partial hour's worth of usage is always rounded up to an hour. Then, in order to prevent wasting partial instance-hours, a procedure of instance consolidation is suggested. It entails putting jobs on the same instance even though some of them might not operate more efficiently or affordably on that system. The suggested auto-scaling method also helps determine the acquisition time of each instance. Each instance must actually wait before it can be used. This waiting period is referred to as "instance acquisition lag." After determining the number of instances of each VM type, jobs are scheduled on each one using the Earliest Deadline First (EDF) algorithm. They expand on their strategy in [19] to account for a financial restriction. To reduce project turnaround time while staying within budgetary limits for cloud processes, two auto-scaling technologies are put into practise. Prior to scheduling process tasks on the acquired instances, the scaling-first approach first assesses the size and type of the cloud resources. The scheduling-first approach selects the quickest execution strategy for each job, allots the application's overall budget to that task, and then purchases cloud resources. Additionally [26] suggest a multi-workflow scheduling technique with different QoS constraints (MQMW). Multiple workflows that can be started at any time can be scheduled using this strategy, which also takes into account QoS requirements.

CONCLUSION

The resources that deliver services to consumers must now be carefully managed due to the rising demand for cloud computing. This idea is covered by resource scheduling. This paper has discussed numerous approaches to the resource scheduling. we have examined and contrasted various methods for cloud-based workflow scheduling. Based on this study, we identified the techniques' incapacity to adequately handle changes that occur at runtime. Resource management and monitoring activities will face new difficulties. Without a doubt, emergency management has become dependent on the assistance of dynamic adaptation throughout execution. It is a subject that has undergone extensive research in order to address circumstances and changes. the dynamic workflows can be implemented more effectively because to the elastic nature of cloud environments, which makes it possible to change resource quantities on the fly. Depending on the demands of the workflow, resources can be added or released as needed during runtime.

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Pandi Prabha and BhuvanaJayabalan

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Ideal based on New Nano Open Sets

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ABSTRACT

We make provided a new category of solid pre $*-nI$ -open sets in which firmly located at division of entire pre- nI -open and the division of entire pre $*-nI$ -open of ideal nanotopological spaces. Further, discuss the relations between them and related other sets with new operators are established.

Key words and phrases. \mathcal{P}^*-nI -open set, \mathcal{SP}^*-nI -open and almost strongly- nI -open.

INTRODUCTION

Lellis Thivagar *et al.*, [1] defined and studied by the concept of nano topological spaces. Parimala *et al.*, [5] introduced the notion of nI -open sets and several properties of such sets in an ideal nanotopological spaces. Several kinds of nI -openness have been initiated. Rajasekaran and Nethaji [8] was introduced by the notions of several nano open sets in an ideal nano topological spaces. Recently, Nethaji *et al.*, [3] introduced the notions of semi $*-nI$ -open and so on sets and studied in detail.

In this paper is to introduce a new category of solid pre $*-nI$ -open sets in which firmly located at division of entire pre- nI -open and the division of entire pre $*-nI$ -open of ideal nanotopological spaces. Further, discuss the relations between them and related other sets with new operators are established. We using some remarks and definitions which are necessary for this study in the sequel.

Definition 1.1 [1] A subset A of a nano topological space (U, \mathcal{N}) is called





Shyamala Malini and Jeyalakshmi

1. nano semi open set (briefly ns -open set) [1] if $A \subseteq n-cl(n-int(A))$.
 2. nano pre open set (briefly np -open set) [1] if $A \subseteq n-int(n-cl(A))$.
 3. nano β -open set (briefly $n\beta$ -open set) [10] if $A \subseteq n-cl(n-int(n-cl(A)))$.
- The complements of the above mentioned sets are called their respective nano closed sets.

Definition 1.2 A subset A of a space (U, \mathcal{N}) is called

1. nano dense (briefly n -dense) [11] if $n-cl(A) = U$.
2. **nano codense (briefly n -codense) [3] if $U - A$ is n -dense.**

Definition 1.3 A subset A of a space (U, \mathcal{N}, I) is called

1. nano- I -open (briefly nI -open) [5] if $A \subseteq n-int(A_n^*)$.
2. n \star -perfect [6] if $A = A_n^*$.
3. n \star -closed [6] if $A_n^* \subseteq A$.
4. nano \star -codense (briefly n \star -codense) [3] if $U - A$ is n \star -dense.

Definition 1.4 [8] A subset A of a space (U, \mathcal{N}, I) is said to be

1. nano α - I -open (briefly α - nI -open) if $A \subseteq n-int(n-cl^*(n-int(A)))$.
 2. nano semi- I -open (briefly semi- nI -open) if $A \subseteq n-cl^*(n-int(A))$.
 3. nano pre- I -open (briefly pre- nI -open) if $A \subseteq n-int(n-cl^*(A))$.
 4. nano b - I -open (briefly b - nI -open) if $A \subseteq n-int(n-cl^*(A)) \cup n-cl^*(n-int(A))$.
 5. nano β - I -open (briefly β - nI -open) if $A \subseteq n-cl^*(n-int(n-cl^*(A)))$.
- The complements of the above mentioned sets are called their respective closed sets.

Definition 1.5 A subset A of a space (U, \mathcal{N}, I) is said to be

1. nano strongly semi \star - I -open (briefly strongly \mathcal{S}^* - nI -open) [4] if $A \subseteq n-cl^*(n-int^*(A))$
2. nano weakly semi- I -open (briefly weakly semi- nI -open) [4] if $A \subseteq n-cl^*(n-int(n-cl(A)))$.
3. nano almost strongly- I -open (briefly almost strongly- nI -open) [7] if $A \subseteq n-cl^*(n-int(A_n^*))$. The complements of the above mentioned sets are called their respective nano closed sets.

Definition 1.6 [9] A subset A of a space (U, \mathcal{N}, I) is said to be

1. nano $t^\#$ - I -set (briefly $t^\#$ - nI -set) if $n-int(A) = n-cl^*(n-int(A))$.
2. nano pre- I -regular (briefly pre- nI -regular) if A is pre- nI -open and $t^\#$ - nI -set.
3. nano $\mathcal{O}p$ - I -set (briefly $\mathcal{O}p$ - nI -set) if $A = B \cap C$ where B is n -open and C is pre- nI -regular.
4. nano strongly \mathcal{S} - I -set (briefly strongly \mathcal{S} - nI -set) [4] if $A \subseteq n-int(A) = n-cl^*(n-int(n-cl(A)))$.

Definition 1.7 [2] A subset A of a space (U, \mathcal{N}, I) is said to be nano pre \star - I -closed (briefly pre \star - nI -closed) if $n-cl^*(n-int(A)) \subseteq A$.

The complements of the above mentioned set is called open set.

Definition 1.8 [4] In an ideal nano space (U, \mathcal{N}, I) is called nI -extremally disconnected $\Leftrightarrow n-cl^*(n-int(A)) \subseteq n-int(n-cl^*(A))$, for every subset A of U .

\mathcal{SP}^* - nI -open sets

Definition 2.1 A subset B of an ideal nano topological space (U, \mathcal{N}, I) is called a Solid \mathcal{P}^* - nI -open set (as a short form \mathcal{SP}^* - nI -open) if $B \subseteq n-int^*(n-cl^*(B))$. \mathcal{SP}^* - nI -open if its complement is \mathcal{SP}^* - nI -closed.

The family of all \mathcal{SP}^* - nI -open (resp. \mathcal{SP}^* - nI -closed) is denoted by $\mathcal{SP}^*O(U)$ (resp. $\mathcal{SP}^*C(U)$).

Lemma 2.2 In an ideal nano topological space (U, \mathcal{N}, I) , for any $B \subseteq U$, then the following results are true.

1. any pre- nI -open set $\Rightarrow \mathcal{SP}^*O(U)$.

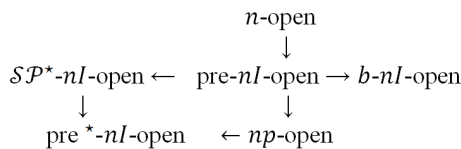




Shyamala Malini and Jeyalakshmi

2. any $\mathcal{SP}^*O(U) \Rightarrow \text{pre}^*nI\text{-open}$.

Remark 2.3 We have the following implications between $\mathcal{SP}^*nI\text{-open}$ set and other related sets.



The reverse implications are not true as seen from the following Examples.

Example 2.4 Let $U = \{f_1, f_2, f_3, f_4\}$ with $U/R = \{\{f_1\}, \{f_2, f_3\}, \{f_4\}\}$ and $X = \{f_1, f_2\}$ then $\mathcal{N} = \{\phi, U, \{f_1\}, \{f_2, f_3\}, \{f_1, f_2, f_3\}\}$. Let $I = \{\phi, \{f_1\}, \{f_4\}, \{f_1, f_4\}\}$. Clearly the subset $\{f_3, f_4\}$ is $\mathcal{SP}^*nI\text{-open}$ set but not $\text{pre-}nI\text{-open}$ in (U, \mathcal{N}, I) .

Example 2.5 Let $U = \{f_1, f_2, f_3, f_4\}$ with $U/R = \{\{f_4\}, \{f_1, f_2, f_4\}\}$ and $X = \{f_1, f_2, f_3\}$ then $\mathcal{N} = \{\phi, U, \{f_3\}, \{f_1, f_2, f_4\}\}$. Let $I = \{\phi, \{f_1\}\}$. Clearly, the subset $\{f_3, f_4\}$ is $\text{pre}^*nI\text{-open}$ set but not $\mathcal{SP}^*nI\text{-open}$ in (U, \mathcal{N}, I) .

Remark 2.6 The collections of $\mathcal{SP}^*nI\text{-open}$ sets and the collections of $b\text{-}nI\text{-open}$ sets are independent concepts in (U, \mathcal{N}, I) . As shown in below Examples.

Example 2.7 1. In Example 2.4, then the subset $\{f_2, f_4\}$ is $\mathcal{SP}^*nI\text{-open}$ set but not $b\text{-}nI\text{-open}$.
 2. then the subset $\{f_2, f_4\}$ is $b\text{-}nI\text{-open}$ set but not $\text{pre}^*nI\text{-open}$.

Example 2.8 Let $(U, \mathcal{N}, I) = (\{1, 2, 3, 4\}, \{\{1, 3\}, \{2\}, \{4\}\}, \{\{1, 4\}\})$ then $\mathcal{N} = \{\phi, \{1, 4\}, \{1, 3\}, \{1, 3, 4\}\}$. Let $I = \{\phi, \{1\}, \{4\}, \{1, 4\}\}$. Clearly the subset $\{3\}$ is $n\text{-open}$ set but not $\text{pre}^*nI\text{-open}$ in (U, \mathcal{N}, I) .

Theorem 2.9 Let (U, \mathcal{N}, I) be an ideal nano topological space, then B is $\text{pre}^*nI\text{-open}$ set \Leftrightarrow there exists $n\text{-open}$ set C such that $B \subseteq C \subseteq n\text{-cl}^*(B)$.
 Proof. Let B be a $\text{pre}^*nI\text{-open}$ set, we have $B \subseteq n\text{-int}^*(n\text{-cl}^*(B))$. We put $C = n\text{-int}^*(n\text{-cl}^*(B))$, which is a $n\text{-open}$ set. Then $C = n\text{-int}^*(C) \subseteq n\text{-int}^*(n\text{-cl}^*(C))$ is $\mathcal{SP}^*nI\text{-open}$ set such that $B \subseteq C \subseteq n\text{-cl}^*(B) \subseteq n\text{-cl}^*(C)$.
 Conversely, if C is a $\mathcal{SP}^*nI\text{-open}$ set such that $B \subseteq C \subseteq n\text{-cl}^*(B)$, taking $n\text{-cl}^*$ closure, then $n\text{-cl}^*(B) \subseteq n\text{-cl}^*(C)$.
 On the other side $B \subseteq C \subseteq n\text{-int}^*(n\text{-cl}^*(C)) \subseteq n\text{-int}^*(n\text{-cl}^*(B))$. Thus B is $\text{pre}^*nI\text{-open}$.
0 Let (U, \mathcal{N}, I) be an ideal nano topological space, then B is a $\mathcal{SP}^*nI\text{-open}$ set \Leftrightarrow there exists $n\text{-open}$ set $B \subseteq C \subseteq n\text{-cl}^*(B)$.
 Proof. Obvious.

Corollary 2.11 Let (U, \mathcal{N}, I) be an ideal nano topological space, if B is a $\mathcal{SP}^*nI\text{-open}$ set then $n\text{-cl}^*(B)$ is strongly $\mathcal{S}^*nI\text{-open}$.
 Proof. Let B be $\mathcal{SP}^*nI\text{-open}$. Then $B \subseteq n\text{-int}^*(n\text{-cl}^*(B))$ and $n\text{-cl}^*(B) \subseteq n\text{-cl}^*(n\text{-int}^*(n\text{-cl}^*(B)))$. This implies $n\text{-cl}^*(B)$ is a strongly $\text{semi}^*nI\text{-open}$.

Corollary 2.12 Let (U, \mathcal{N}, I) be an ideal nano topological space, if B is a strongly $\mathcal{S}^*nI\text{-open}$ set, then $n\text{-int}^*(B)$ is a $\mathcal{SP}^*nI\text{-open}$.
 Proof. Let B be strongly $\mathcal{S}^*nI\text{-open}$, then $B \subseteq n\text{-cl}^*(n\text{-int}^*(B)) \Rightarrow n\text{-int}^*(B) \subseteq n\text{-int}^*(n\text{-cl}^*(n\text{-int}^*(B)))$. This implies $n\text{-int}^*(B)$ is a $\mathcal{SP}^*nI\text{-open}$.

Theorem 2.13 Let (U, \mathcal{N}, I) be ideal nano space and $B, C \subseteq U$, then
 1. $U \in \mathcal{SP}^*O(U)$, for each $\alpha \in \Delta \Rightarrow \cup\{H_\alpha : \alpha \in \Delta\} \in \mathcal{SP}^*O(U)$.
 2. $B \in \mathcal{SP}^*O(U)$, and $C \in \mathcal{N} \Rightarrow B \cap C \in \mathcal{SP}^*O(U)$.





Shyamala Malini and Jeyalakshmi

Proof. (1) Since $H_\alpha \in \mathcal{SP}^*O(U)$, $H_\alpha \subseteq n\text{-int}^*(n\text{-cl}^*(H_\alpha))$ for each $\alpha \in \Delta$. Then $\bigcup_{\alpha \in \Delta} H_\alpha \subseteq \bigcup_{\alpha \in \Delta} n\text{-int}^*(n\text{-cl}^*(H_\alpha)) \subseteq n\text{-int}^*(\bigcup_{\alpha \in \Delta} n\text{-cl}^*(H_\alpha)) = n\text{-int}^*(\bigcup_{\alpha \in \Delta} (H_\alpha^* \cup H_\alpha)) = n\text{-int}^*(\bigcup_{\alpha \in \Delta} H_\alpha^* \cup \bigcup_{\alpha \in \Delta} H_\alpha) \subseteq n\text{-int}^*((\bigcup_{\alpha \in \Delta} H_\alpha^*) \cup \bigcup_{\alpha \in \Delta} H_\alpha) = n\text{-int}^*(n\text{-cl}^*(\bigcup_{\alpha \in \Delta} H_\alpha))$. Thus $\bigcup_{\alpha \in \Delta} H_\alpha \in \mathcal{SP}^*O(U)$.

(2) Let $B \in \mathcal{SP}^*O(U)$ and $C \in \mathcal{N}$. Then $B \subseteq n\text{-int}^*(n\text{-cl}^*(B))$ and $C = n\text{-int}(C) \subseteq n\text{-int}^*(C)$. So $B \cap C \subseteq n\text{-int}^*(n\text{-cl}^*(B)) \cap n\text{-int}^*(C) = n\text{-int}^*(n\text{-cl}^*(B) \cap C) = n\text{-int}^*((B^* \cup B) \cap C) = n\text{-int}^*((B^* \cap C) \cup (B \cap C)) \subseteq n\text{-int}^*((B \cap C)^* \cup (B \cap C)) = n\text{-int}^*(n\text{-cl}^*(B \cap C))$.

Remark 2.14 The intersection of two \mathcal{SP}^* - nI -open sets need not be \mathcal{SP}^* - nI -open as shown in below Example.

Example 2.15 In Example 2.4, then the subsets $\{f_3, f_4\}$ and $\{f_2, f_4\}$ are \mathcal{SP}^* - nI -open sets but intersection of subset $\{f_4\}$ is not \mathcal{SP}^* - nI -open in (U, \mathcal{N}, I) .

Theorem 2.16 In an ideal nano topological space (U, \mathcal{N}, I) , where I is n -codense then the results are true.

1. each \mathcal{SP}^* - nI -open set $\Rightarrow n\beta$ -open.
2. each \mathcal{SP}^* - nI -open set \Rightarrow weakly semi- nI -open.
3. each \mathcal{SP}^* - nI -open set $\Rightarrow np$ -open.

Proof. Obvious.

Theorem 2.17 Let be an ideal nano topological space (U, \mathcal{N}, I) , if B is n \star -perfect then

1. each \mathcal{SP}^* - nI -open set is almost strongly- nI -open.
2. B is a \mathcal{SP}^* - nI -open set $\Leftarrow nI$ -open set.

Proof. 1. Let B is an \mathcal{SP}^* - nI -open, then $B \subseteq n\text{-int}^*(n\text{-cl}^*(B)) = \text{int}(n\text{-cl}^*(B)) \subseteq n\text{-cl}^*(\text{int}(n\text{-cl}^*(B))) = n\text{-cl}^*(\text{int}(B_n^*))$. This implies B is almost strongly- nI -open.

2. Let B is a \mathcal{SP}^* - nI -open, then $B \subseteq n\text{-int}^*(n\text{-cl}^*(B)) \subseteq n\text{-int}^*(n\text{-cl}(B)) = n\text{-int}(B_n^*)$. Hence B is nI -open. Conversely, if B is nI -open, then $B \subseteq n\text{-int}(B_n^*) \subseteq n\text{-int}^*(B_n^*) = n\text{-int}^*(n\text{-cl}^*(B))$. Hence B is \mathcal{SP}^* - nI -open.

Corollary 2.18 In an ideal nano topological space (U, \mathcal{N}, I) , if B is n \star -perfect then each \mathcal{P}^* - nI -open set is \mathcal{SP}^* - nI -open.

Proof. Let B is \mathcal{P}^* - nI -open set, since it is n \star -perfect, then $B \subseteq n\text{-int}^*(cl(B)) = n\text{-int}^*(n\text{-cl}^*(B))$. Hence B is \mathcal{SP}^* - nI -open.

Theorem 2.19 In an ideal nano topological space (U, \mathcal{N}, I) , any nI -open set is \mathcal{SP}^* - nI -open.

Proof. If B is nI -open, then $B \subseteq n\text{-int}(B_n^*) \subseteq n\text{-int}^*(B_n^* \cup B) \subseteq n\text{-int}^*(n\text{-cl}^*(B))$. Hence B is \mathcal{SP}^* - nI -open.

Theorem 2.20 In an ideal nano topological space (U, \mathcal{N}, I) , where I is n -codense. Then \mathcal{P}^* - nI -open $\Leftarrow \mathcal{SP}^*$ - nI -open.

Proof. It is obvious.

Theorem 2.21 If $B \subseteq U$ is np -open and ns -closed then B is \mathcal{SP}^* - nI -open.

Proof. Let B is np -open, then $B \subseteq n\text{-int}(n\text{-cl}(B))$. Since B is ns -closed then $n\text{-int}(n\text{-cl}(B)) = n\text{-int}(B)$, now $B \subseteq n\text{-int}(B) \subseteq n\text{-int}^*(n\text{-cl}^*(B))$. Thus B is \mathcal{SP}^* - nI -open.

Theorem 2.22 If $B \subseteq U$ is \mathcal{SP}^* - nI -open and n \star -closed then B is strongly \mathcal{S}^* - nI -open.

Proof. Let B is \mathcal{SP}^* - nI -open, then $B \subseteq n\text{-int}^*(n\text{-cl}^*(B))$. Since B is n \star -closed then $n\text{-int}^*(n\text{-cl}^*(B)) = n\text{-int}^*(B)$. Now $B \subseteq n\text{-int}^*(B) \subseteq n\text{-cl}^*(n\text{-int}^*(B))$. Thus B is strongly \mathcal{S}^* - nI -open.

Theorem 2.23 In an ideal nano topological space (U, \mathcal{N}, I) , if $B \subseteq U$ then

1. B is \mathcal{SP}^* - nI -open set, if it is both weakly semi- nI -open and strongly \mathcal{S} - nI -set.
2. B is \mathcal{SP}^* - nI -open set, if it is both semi- nI -open set and $t^\#$ - nI -set.

Proof. 1. Let B is weakly semi- nI -open set, then $B \subseteq n\text{-cl}^*(n\text{-int}(n\text{-cl}(B)))$. Since B is strongly \mathcal{S} - nI -set then, $n\text{-int}(B) = n\text{-cl}^*(n\text{-int}(n\text{-cl}(B)))$. Now $B \subseteq n\text{-int}(B) \subseteq n\text{-int}^*(n\text{-cl}^*(B))$. Thus B is \mathcal{SP}^* - nI -open.





Shyamala Malini and Jeyalakshmi

2. Let B is semi- nI -open set, then $B \subseteq n-cl^*(n-int(B))$. Since B is $t^\#$ - nI -set then, $n-int(B) = n-cl^*(n-int(B))$. Now $B \subseteq n-int(B) \subseteq n-int^*(n-cl^*(B))$. Thus B is \mathcal{SP}^* - nI -open.

Theorem 2.24 In an ideal nano topological space (U, \mathcal{N}, I) , any \mathcal{SP}^* - nI -open set if it is both \mathcal{P}^* - nI -open and n -closed.

Proof. Let B is \mathcal{P}^* - nI -open set, then $B \subseteq n-int^*(n-cl(B))$. Since B is n -closed set, then $B \subseteq n-int^*(n-cl(B)) = n-int^*(B) \subseteq n-int^*(n-cl^*(B))$. Hence B is \mathcal{SP}^* - nI -open.

Theorem 2.25 Let (U, \mathcal{N}, I) be a nI -extremally disconnected space and $B \subseteq U$. Then each semi- nI -open \mathcal{SP}^* - nI -open.

Proof. B is semi- nI -open $\Rightarrow B \subseteq n-cl^*(n-int(B))$. By Definition 1.8, we have $B \subseteq n-int(n-cl^*(B)) \subseteq n-int^*(n-cl^*(B))$. Hence B is \mathcal{SP}^* - nI -open.

Lemma 2.26 An ideal nano space (U, \mathcal{N}, I) is nI -extremally disconnected $\Leftrightarrow n-cl^*(n-int^*(B)) \subseteq n-int^*(n-cl^*(B))$, for each $B \subseteq U$.

Proof. Follows from the Definition 1.8, we have $n-cl^*(B)$ is n -open. Therefore $n-cl^*(n-int^*(B)) \subseteq n-cl^*(B) = int(n-cl^*(B)) \subseteq n-int^*(n-cl^*(B))$. Hence $n-cl^*(n-int^*(B)) \subseteq n-int^*(n-cl^*(B))$.

Conversely, since $n-cl^*(int(B)) \subseteq n-cl^*(n-int^*(B)) \subseteq n-int^*(n-cl^*(B)) \subseteq n-int^*(n-cl(B))$. Therefore U is nI -extremally disconnected.

Corollary 2.27 Let (U, \mathcal{N}, I) be a nI -extremally disconnected space and $B \subseteq U$, then each strongly S^* - nI -open set is \mathcal{SP}^* - nI -open.

Proof. Follows from the Lemma 2.26.

Theorem 2.28 Let (U, \mathcal{N}, I) be an ideal nano space and $B, C \subseteq U$, if B is \mathcal{SP}^* - nI -open set and C is np -open set then $B \cup C$ is \mathcal{P}^* - nI -open.

Proof. Let B is \mathcal{SP}^* - nI -open then $B \subseteq n-int^*(n-cl^*(B))$, and C is a np -open then $C \subseteq n-int(n-cl(C))$. Now $B \cup C \subseteq n-int^*(n-cl^*(B)) \cup n-int(n-cl(C)) \subseteq n-int^*(n-cl(B)) \cup n-int^*(n-cl(C)) \subseteq n-int^*(n-cl(B \cup C))$. Hence $B \cup C$ is a \mathcal{P}^* - nI -open.

Theorem 2.29 Let be an ideal nano topological space (U, \mathcal{N}, I) and $B, C \subseteq U$, if B is \mathcal{SP}^* - nI -open set and C is weakly semi- nI -open set then $B \cup C$ is β^* - nI -open.

Proof. Let B is \mathcal{SP}^* - nI -open, then $B \subseteq n-int^*(n-cl^*(B))$, C is weakly semi- nI -open then $C \subseteq n-cl^*(n-int(n-cl(C)))$.

Now $B \cup C \subseteq n-int^*(n-cl^*(B)) \cup n-cl^*(n-int(n-cl(C))) \subseteq n-cl(n-int^*(n-cl(B))) \cup n-cl(n-int^*(n-cl(C))) = n-cl(n-int^*(n-cl(B)) \cup n-int^*(n-cl(C))) \subseteq n-cl(n-int^*(n-cl(B \cup C)))$. Hence $B \cup C$ is a β^* - nI -open.

Theorem 2.30 Let be an ideal nano topological space (U, \mathcal{N}, I) , where I is n -codense then B is α - nI -open \Leftrightarrow strongly S^* - nI -open and \mathcal{SP}^* - nI -open.

Proof. Necessity is trivial. Sufficiency, let B is strongly S^* - nI -open and \mathcal{SP}^* - nI -open, we have $B \subseteq n-int^*(n-cl^*(B)) \subseteq n-int^*(n-cl^*(n-cl^*(n-int^*(B)))) = n-int^*(n-cl^*(n-int^*(B))) = int(n-cl^*(int(B)))$. Thus B is α - nI -open.

Further properties

Lemma 3.1 For any $B \subseteq U$, then the following results are true.

1. each pre- nI -closed set is $\mathcal{SP}^*C(U)$.
2. each $\mathcal{SP}^*C(U)$ is \mathcal{P}^* - nI -closed.

Proof. Obvious.

Theorem 3.2 For any $B \subseteq U$, \mathcal{SP}^* - nI -closed $\Leftrightarrow n-cl^*(n-int^*(B)) \subseteq B$.

Proof. Let B be \mathcal{SP}^* - nI -closed of (U, \mathcal{N}, I) , then $(U - B)$ is \mathcal{SP}^* - nI -open and hence $(U - B) \subseteq n-int^*(n-cl^*(U - B)) = U - n-cl^*(n-int^*(B))$. Therefore $n-cl^*(n-int^*(B)) \subseteq B$.





Shyamala Malini and Jeyalakshmi

Conversely, let $n-cl^*(n-int^*(B)) \subseteq B$, then $(U - B) \subseteq n-int^*(n-cl^*(U - B))$ and hence $(U - B)$ is \mathcal{SP}^*-nI -open. Therefore B is \mathcal{SP}^*-nI -closed.

Theorem 3.3 Let be an ideal nano topological space (U, \mathcal{N}, I) , if I is n -codense then B is \mathcal{SP}^*-nI -closed $\Leftrightarrow n-cl^*(int(B)) \subseteq B$.

Proof. Let B be a \mathcal{SP}^*-nI -closed set of U , we have $n-cl^*(n-int(B)) = n-cl^*(n-int^*(B)) \subseteq B$.

Conversely, let B be any subset of U , such that $n-cl^*(int(B)) \subseteq B \Rightarrow n-cl^*(n-int^*(B)) \subseteq B$. Thus B is \mathcal{SP}^*-nI -closed

Theorem 3.4 In an ideal nano topological space (U, \mathcal{N}, I) and $B \subseteq U$, then

1. B is a \mathcal{SP}^*-nI -open set $\Rightarrow nI-scl(B) = n-int^*(n-cl(B))$.

2. B is a \mathcal{SP}^*-nI -closed set $\Rightarrow nI-int_s(B) = n-cl^*(n-int(B))$.

Proof. 1. Let B be a \mathcal{SP}^*-nI -open set in U . We have $B \subseteq n-int^*(n-cl^*(B)) \subseteq n-int^*(cl(B))$. Hence $nI-scl(B) = n-int^*(n-cl(B))$.

2. Let B be a \mathcal{SP}^*-nI -closed set in U , we have $B \supseteq n-cl^*(n-int^*(B)) \supseteq n-cl^*(n-int(B))$. Thus $nI-int_s(B) = n-cl^*(n-int(B))$.

Theorem 3.5 A subset B of an ideal nano topological space (U, \mathcal{N}, I) is called a \mathcal{SP}^*-nI -closed set \Leftrightarrow there exists a \mathcal{SP}^*-nI -closed set C such that $n-int^*(B) \subseteq C \subseteq B$.

Proof. Let B be a \mathcal{SP}^*-nI -closed set of U , then $n-cl^*(n-int^*(B)) \subseteq B$. We put $C = n-cl^*(n-int^*(B))$ be a n - \star -closed set. i.e., C is \mathcal{SP}^*-nI -closed. And $n-int^*(B) \subseteq n-cl^*(n-int^*(B)) = C \subseteq B$.

Conversely, if C is a \mathcal{SP}^*-nI -closed set such that $n-int^*(B) \subseteq C \subseteq B$, then $n-int^*(B) = n-int^*(C)$.

On the other hand, $n-cl^*(n-int^*(C)) \subseteq C$ and hence $B \supseteq C \supseteq n-cl^*(n-int^*(C)) = n-cl^*(n-int^*(B))$. Therefore $B \supseteq n-cl^*(n-int^*(B))$. Hence B is \mathcal{SP}^*-nI -closed.

Corollary 3.6 A subset B of a space (U, \mathcal{N}, I) is a called \mathcal{SP}^*-nI -closed set \Leftrightarrow there exists a n - \star -closed set C such that $n-int^*(B) \subseteq C \subseteq B$.

Remark 3.7 The union of two \mathcal{SP}^*-nI -closed need not be \mathcal{SP}^*-nI -closed as shown in following Example.

Example 3.8 In Example 2.4, then the subsets $\{b\}$ and $\{c\}$ are \mathcal{SP}^*-nI -closed but union of subset $\{b, c\}$ is not \mathcal{SP}^*-nI -closed.

Theorem 3.9 Let be an ideal nano topological space (U, \mathcal{N}, I) and $B, C \subseteq U$, then $B \cap C$ is a \mathcal{P}^*-nI -closed set if B is \mathcal{SP}^*-nI -closed and C is np -closed.

Proof. Follows from the Theorem 2.28.

Theorem 3.10 Let be an ideal nano topological space (U, \mathcal{N}, I) , then each $pre-nI$ -regular set in U is \mathcal{SP}^*-nI -open set and \mathcal{SP}^*-nI -closed.

Proof. It follows from the fact that each $pre-nI$ -regular set is $pre-nI$ -open and $pre-nI$ -closed $\Rightarrow \mathcal{SP}^*-nI$ -open and \mathcal{SP}^*-nI -closed.

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Shyamala Malini and Jeyalakshmi

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Child Abuse in Schools : The Case of the Indian Sub Continent

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ABSTRACT

With the unique context of the Indian Subcontinent, this paper aims to critically evaluate the problem of child abuse in educational institutions through combining primary data in the form of interviews and secondary data in the form of existing literature. The paper analyses reasons for why different kinds of child abuse take place, highlights individuals who are disproportionately abused in schools and evaluates the wide-ranging impacts on student performance and child psychology. Moreover, the paper reviews problems that need to be addressed to tackle child abuse including lack of access to therapy, overcrowding of classes, decreased reporting of abuse in schools, and inadequate funding of schools. Finally, the researchers suggest additional solutions that would contribute to tackling this pressing problem more efficiently: teacher training, the inclusion of sex education in school curriculums, and the training of police officers and healthcare workers to detect abuse. This research concludes that simply implementing legislation that bans child abuse is not enough because this problem is entrenched in the socio-cultural environment of the Indian Subcontinent, and hence the tackling of social norms and stakeholder-wise solutions are necessary.

Keywords : Child abuse, indian subcontinent, bullying, corporal punishment, sexual violence

INTRODUCTION

According to the Ministry of Women and Child Development in India [1], among the 12500 children surveyed, 54 percent of boys and 45 percent of girls were victims of corporal punishment. The solution, however, is not just implementing a law banning any form of child abuse in schools: The Indian Government implemented The



**Kaustubh Jain et al.,**

Protection of Children from Sexual Offences [POCSO] Act in 2012, which seeks to make it easier for children to report abuse and lays out a set of stringent punishment for people in positions of power (for example, staff persons in educational institutions) who abuse children. [2] Children in India - especially women and children from low-income and minority communities - continue to be abused with exponentially low cases being reported to authorities. Passing laws to prohibit child abuse of any form is an important first step, but to eradicate this problem, we need to look at the mindset which perpetuates and normalizes abuse, and structural problems that decrease the effectiveness of laws. Even after it is committed, most of the abuse against children in schools - especially sexual violence - never gets reported. [3] As Kenny [4] notes, part of the reason is that teachers themselves are not trained in detecting abuse, which makes it easier for abusers to get away with committing abuse. In addition, Akundi[5] observes that even in certain high-income schools where access to counselors does exist, children are not allowed to talk about sexual relations, and anything seemingly related to this topic because it is considered a taboo. These reasons, however, just scratch the surface. This research - focused on the Indian Subcontinent, including India, Pakistan, and Bangladesh - aims to provide a comprehensive review of the culture that leads to the perpetuation and normalisation of abuse, and then provides a framework through which different stakeholders - teachers, schools, governments, parents - can contribute to solving this problem.

MATERIALS AND METHODS

Aim

The paper aims to explore the different types of abuse (bullying, corporal punishment, and sexual violence) faced by children in schools, explore underlying factors which influence the abuse, study existing barriers to implementing policies to address this abuse and suggest solutions.

Operational definitions

Child Abuse

The World Health Organization defines child abuse and maltreatment as all forms of physical and/or emotional ill-treatment, sexual abuse, and neglect which results in actual and/or potential harm to the child's development, health, and survival in the context of a relationship which is built on trust, responsibility, or power.

School-based violence

School-based violence falls under the broader category of *community violence*. Community violence is defined as violence that takes place between individuals who are mostly unrelated, and who may or may not know each other. It is generally perpetuated outside the home.

Bullying

Bullying includes a range of activities like - including but not limited to - name-calling; intentionally making false accusations; physical violence; damaging or stealing belongings or money; spreading unsubstantiated rumours; threats as well as intimidation; sending offensive and derogatory texts; or publicly posting insulting messages on the internet to humiliate the victim. [3].

Corporal Punishment

The United Nations Committee on the Rights of the Child defines corporal punishment as any punishment which involves the use of physical force, and one which intentionally causes some degree of pain and/or discomfort to the victim.

Child Sexual Violence

The World Health Organization defines child sexual violence (CSV) as the involvement of a child in a sexual activity that he or she does not entirely understand, is impotent to give informed consent to, or for which the child is not mentally and physically prepared for.



**Kaustubh Jain et al.,****Data Collection**

The data collection procedure primarily involved an extensive study and analysis of previously published research papers as well as other reliable secondary sources like books, journals, reports, and articles, et cetera. All these sources are referenced in the references section. Moreover, the paper also consists of primary sources such as interviews with subject matter experts and therapists. The secondary data interpreted was predominantly qualitative in nature. In the case of the primary research, the researchers analysed the content of each interview after transcribing each interview word to word and thematically coding the data collected using Atlas.ti. Each important area that the subject matter expert discussed was colour-coded according to the principal idea that it presented. These principal ideas were then condensed into distinct themes and objectives. The content in the thematically coded primary data was then combined with the content in secondary sources. Just like the primary data, the secondary data was also reduced into specific themes which are relevant to the objectives of the paper.

Ethical considerations

The researchers obtained written informed consent from each subject matter expert. They were asked for their permission before the interview was recorded and transcribed. The subject matter experts were requested if their name could be shared in the official findings. However, they were not persuaded to do so in the instance that they hesitated. No data was misused or given to any individual apart from the researchers. A strictly professional environment was maintained during the interview and there were no questions asked about the interviewee's personal life. The reluctance to answer any question was thoroughly respected.

RESULTS AND DISCUSSION

This section of the paper will highlight the factors leading to abuse, highlight the stakeholders who are uniquely susceptible to abuse, and discuss the impacts of abuse on children. Furthermore, it will analyze existing problems that hinder the implementation of policies and finally suggest additional solutions to tackle child abuse.

Factors leading to abuse

An interview conducted by the researchers with Nikola Jones, a Specialist Researcher in Gender, Social Policy, and Social Protection, reflected on authoritarian teaching styles in school as a prime factor for the perpetration of child abuse in schools. According to Ms. Jones, there is not enough space within school structures to question the actions of teachers. This is especially a problem in the developing world where there are broader societal factors that coerce children to respect their teachers unconditionally. When there is not enough space for children to challenge teachers' opinions and actions, it allows teachers to get away with committing abuse with no accountability [Nikola Jones. Child Abuse in the Indian Subcontinent. [Personal Interview, 16 September] Jaipur; 2020 [unpublished]. UNICEF [6] also mentions that the hierarchical societies in the Indian Subcontinent are a prominent reason for child abuse in schools, where certain acts of abuse that children experience are deemed as acceptable. The same paper also suggests that if children do not obey the direct instructions of teachers, they are exposed to physical forms of violence like corporal punishment, as well as extreme psychological violence such as being screamed at condescendingly. Geiger [7] also notes that students do not speak out or report abuse because teachers are in a position of authority. This ensures the continuation of abuse without teachers being held accountable. Moreover, it is important to discuss how this *culture* of abuse is normalized. Suryaningrat et al. [8] note that a history of family aggression is a significant determinant as to whether children think that violence and aggression are acceptable. Karmaliani et al. [9] conducted a study that looked at the associated factors which lead to peer violence reported that children who perpetrated abuse on their peers were significantly more likely to have witnessed domestic abuse and/or seen their parents fight violently. Crucially, this *culture* is not only normalized in the minds of children by parents or other elders but by the mass media generally in the way in which it glorifies and normalizes violence against children. Finally, there is also a problem of overcrowding in classrooms which makes it harder for teachers to control large groups of students. Because of this, they are more likely to discipline children using violence. This analysis is also supported by Malak et



**Kaustubh Jain et al.,**

al. [10] where teachers in Bangladeshi schools reported to be *in control* of the class when they had the mechanism of corporal punishment to discipline children.

Who is more likely to be abused?

Division based on gender

UNICEF identifies that in many schools in the Indian Subcontinent, there is a division of roles based on gender. Girls are encouraged to do jobs that are more *ladylike* (for e.g. Decorating) and boys are associated with jobs that reflect leadership skills and ones that require physical strength. Any deviation from these roles, therefore, is met with reprimand and violence by authority figures and bullying by peers. Dunne [11] adds on to this analysis by noting that this kind of division (for e.g., girls may sit at the front of classrooms and boys in the back because it is easier to misbehave at the back) actively reinforces gender stereotypes in a way which results in abuse. So, for instance, the study reports that boys who are not *aggressive* or *masculine* enough are likely to face more abuse in the form of corporal punishment to discipline them into conforming to backward societal norms. Similarly, girls who do not conform to stereotypes that restrict them to be *feminine* are likely to be bullied and humiliated to a greater extent. In addition, the study mentions that boys committing abuse on other boys, or their bullying/intimidation of girls is ignored by using the narrative of *boys will be boys*, which prevents this kind of abuse to be dealt with systematically. Carson et al. [12] note that boys, on average, face more corporal punishment while girls face more sexual violence because of norms that dictate that boys are “tough” and can thus deal with physical punishment. Leach [13] further notes that these routine practices of schooling not only cause more abuse while students are children but in the long term when children think that masculinity is associated with aggression and femininity requires obedience, it is much more likely that violence within their own adolescent and adult relationships is perpetuated as well as tolerated. Moreover, Altinyelken and Le Mat [14] also note that gender divisions in schools and the entrenchment of pervasive patriarchal norms also lead to sexual violence, most often committed on girls by male students and teachers. This analysis is in line with various studies on sexual violence in schools. Abrahams et al. [15] for instance, published a study that analyzed the prevalence of sexual violence in three schools. Girls in all three schools reported sexual violence by male teachers as a serious problem.

Younger students

Schools also establish hierarchical structures where, apart from teachers, older students also can abuse younger students who feel scared to report the perpetrator who is in a position of power. In addition, people with disabilities - who are socially excluded and stigmatized - are at a greater risk of abuse.

Low-income students

In the collection of primary data, it was also identified that students who belong to unprivileged socio-economic backgrounds are much more likely to be abused in schools. The children faced bullying because they accessed education through a government policy that provided them with education at a low cost [A. Joseph. Child Abuse in schools. [Personal interview, 13 October] Jaipur; 2020 [unpublished]. Ogando Portela and Pells[16] identify various reasons for why this might be true: first, children belonging to a low-income community are more likely to attend schools where there is a higher likelihood of being subject to corporal punishment. This aligns with primary data where Joseph noted that children are more likely to be bullied in low-income schools which do not have CCTV cameras, are overcrowded, and do not have reporting mechanisms. The second reason that Ogando Portela and Pells[16] provide is that these children are more likely to be physically punished than their peers in the same school. This hypothesis was confirmed by their study. Morrow and Singh [17] explain the reasoning behind this hypothesis where they mention that poor children are more likely to be subject to corporal punishment when they lack study material or take frequent leaves to undertake household work.

Impacts of abuse

Impacts on school performance

Research has consistently shown that abuse against children is related to worse school performance. Following students in India facing corporal punishment at age 8, a study analyzed their performance in class relative to the



**Kaustubh Jain et al.,**

median and the children reported both lower math as well as vocabulary schools [16]. Gershoff [18] adds to this analysis by theorizing a reason for this correlation. The paper notes that when the schooling environment becomes increasingly hostile for students, they do not take interest in learning because school is a place where they are constantly fearful of being abused. Another reason why child abuse is linked to lower school performance is that children become fearful to participate in class activities and ask teachers for help [19]. This result is also replicated in research conducted in Pakistan where corporal punishment was directly related to poor school performance. In addition, respondents who didn't do well at school were more likely to be involved with at least one violent based incident in the preceding year - thus showing a clear link between child abuse and poor school performance. [20] In certain cases, the consistent abuse and humiliation combined with other factors forced children to drop out of school entirely.

Economic impacts

As described in this paper, lower-income children are more likely to be victims of violence. Since it is directly related to higher dropout rates, child abuse hurts the ability of low-income individuals to get access to job opportunities and climb the socio-economic ladder and therefore has an impact of widening the income inequality gap [21,2]. Pereznieta et al. [21] also note that on average, an extra year of schooling is related to individuals earning about 5 percent to 15 percent higher than they would have without the extra year of schooling. Therefore, child abuse also has more macro-level economic impacts in terms of decreasing GDP growth and hindering economic development.

Psychological impacts

Naz et al. [22] note that abuse in schools has severe impacts on children in terms of causing depression, lowering self-esteem, and causing pessimism among students. Research conducted in schools in Bangladesh also notes that children begin to think that they are at fault when being abused and begin to blame their behavior or poor school performance for such exploitation. Interestingly, the paper also noted that because of the cultural norms that define our society, children faced corporal punishment at both school and home [23]. Therefore, abuse in schools not only has severe psychological impacts but it also means that schools are unable to provide safe spaces for children who face abuse at home by their parents. UNICEF notes that these problems [depression, anxiety, increased probability of committing suicide, diminished self-esteem] don't just exist in the school years of a child but are instead long-term problems that are harder to overcome. Lastly, it is also important to note that using violence against a child increases the probability that they use violent acts themselves [24]. This theory was also supported in primary data collection where an interview with Mohammad Mostafizur Rahman Khan - adjunct professor at Indiana University - revealed that teachers are seen as role models in society, and when teachers use violence - children are also normalized to this violence and continue to perpetuate it themselves [M. Khan, Child Abuse in schools. [Personal interview, 7 November] Jaipur; 2020 [unpublished].

Existing problems

This section will analyse the existing problems in the Indian Subcontinent which need to be overcome to implement effective policy to tackle child abuse in schools.

Overcrowding

Overcrowding of schools is a primary reason for the ineffective implementation of policy to tackle child abuse. Overcrowding means that peer to peer violence - violence perpetrated by children on children - becomes difficult to control. In boarding schools, for instance, where children live in overcrowded and unsupervised dormitories, the chances of non-consensual sexual activity increase [25]. This claim was supported by primary data where one of the subject matter experts claimed that lower and middle-income schools [a significant number of schools in the developing world] have sixty to eighty children in one classroom which not only means that violence is difficult to regulate, but also that children who are either perpetrators of peer to peer violence or victims of the same do not get the specialized attention they need to bring about changes in behavior.



**Kaustubh Jain et al.,****Inadequate Funding**

Another significant reason why reform is effective is because of inadequate funding of schools in the Indian Subcontinent. Pereznieta et al. [21] suggest that the most effective way to tackle the problem of child abuse is school-based intervention [changing teaching techniques, establishing clear boundaries about what is considered acceptable etcetera]. However, these interventions require some resources to pay for training, support materials which teachers require, and the organization of occasional workshops along with regular monitoring of children who are most at risk. The lack of resources in most schools in India, Pakistan, Bangladesh means that these interventions are ineffective. Additionally, another study by Beck et al. [26] also notes that due to the lack of adequate funding, teachers do not get training to deal with cases of child abuse, therefore making it harder for them to identify cases of abuse (peer to peer abuse or abuse which takes place at home) and take action.

Lack of awareness

One of the most prominent themes in the interviews revealed a lack of awareness of already existing solutions that exist. Mr. Khan, identified that even when child abuse in schools is legally prohibited in Bangladesh, victims - especially those in lower-income schools - are often not informed of their rights as a child and which punishments are considered legal because of structural barriers like lack of access to internet facilities in low-income communities which makes it harder for people to access information about laws. Another subject matter expert who was interviewed also added to this reasoning by saying that there exist socio-cultural norms which normalize child abuse. The impact of this is that even when information is disseminated, the socio-cultural norms which are entrenched in traditions mitigate the impacts of children having access to this information. This analysis is supported by various studies which mention not only information accessibility to children, but also to parents as a problem [27,2]. The primary data collected in the form of interviews further added to this warrant where Ms. Anika Joseph - a school counselor - identified parents as important stakeholders who are crucial in holding teachers accountable when they commit abuse. However, this is not possible if parents don't have access to information or themselves believe that abusing children in certain circumstances is justified and necessary.

Lack of reporting of abuse

Reporting abuse to authorities is a significant step in tackling child abuse. However, due to a lack of teacher training, abuse is not identified and hence not reported [26,4]. Even in instances where there are adequate facilities to identify child abuse as well as funding to train teachers and carry on prevention programs, abuse is often not reported. This theme was further discovered in the collection of primary data where Ms. Nikola Jones identified important reasons for inadequate reporting. First, children themselves are hesitant to report abuse because of the power dynamics between teachers and students where authoritarian teaching styles instill fear in children and prevent them from coming forward. This reason was also identified by a study by Jones et al. [3] which mentions that this is particularly true of girls who face sexual violence. The concept of sexual purity means that they often do not report because of shame and blame themselves for getting abused. Khalaf et al. [28] provide evidence in the form of interviews that highlight how important the concept of sexual purity is to girls in specific - because it is directly related to their marriage prospects in a society that places extreme importance on girls remaining virgins pre-marriage. Second, in most schools, there is no mechanism to report abuse. Schools do not have anonymous complaint boxes for children to report abuse, or do not have funding for therapists. Additionally, parents do not report abuse committed by school authorities because they feel that their children will be dismissed from the school. This is particularly important in the case of specially abled children because there are very few school programs that cater to their specific needs.

Lack of therapy

Therapy as a mechanism to abuse was explored further by the researchers in the collection of primary data where various therapists who are working with schools in the Indian subcontinent were interviewed. An interviewee noted that even when schools hire therapists, often the queries they get are regarding the academic performance of students where parents ask therapists about ways to improve the child's academic performance. They also added that there are certain cultural norms that act as barriers to children accessing therapy. Even in the most privileged,



**Kaustubh Jain et al.,**

urban areas of the Indian Subcontinent, therapy is considered a last resort and people reach out to their friends and family much more easily, even when the option of professional help is accessible to them. This creates a vicious cycle of only turning to friends and family for help, and then, being influenced by traditional cultural norms, advising victims to “move on” - thus reducing reporting overall [I. Chatterjee. Child Abuse in schools. [Personal interview, 31 October] Jaipur; 2020 [unpublished]. In addition, even when therapists exist, a lot of students do not trust them with matters of personal significance because they fear confidentiality being broken. Most people, however, do not even report these things to friends and family because talking about abuse (specifically sexual violence) is considered a family's ‘private business’ and something which should not be let out because it affects the family's reputation negatively[12].

Ms. Anika Joseph identified that girls were much more willing to open about abuse that they faced when compared to boys, who were more reluctant because of a culture of toxic masculinity that prevented boys from opening about the abuse they are exposed to because they are scared of being seen as *weak* or less *masculine*. This theory is also supported by Frederick [25] as the paper mentions that patriarchal norms coerce boys into asserting their masculinity, leading them to deny that abuse has occurred. The implication of this is that boys and/or men do not seek psychological help in many instances. The primary data also identified parents as a stakeholder which is important in the discussion of reporting. Ms. Jones mentioned that because of the traditional upbringing of parents, they themselves believe that corporal punishment is a necessary action to discipline children. In this context, even parents encourage teachers to physically reprimand their children.

Additionally, a study by Cowan et al. [29] mentions that even if cases are reported to school authorities, they don't have incentives to deal with the situation in a tangible manner. The reason mentioned is that the logistical work - reporting the incident to the police, talking to parents as well as child protection services - prevents them from taking the complaint forward. In her interview, Ms. Jones added to this theme by mentioning that it also reflects badly on the school's reputation that a teacher in school premises perpetrated this abuse, which also prevents them from implementing action. She mentioned that the broader cultural norms which undermine the severity of pain that victims feel means that even if school authorities report abuse to the police, there is no strict action taken against the perpetrator, and often they are just shifted from one branch of the school to another. This means that they continue teaching even after being identified as a perpetrator of abuse.

Solutions

This section of the paper will evaluate the solutions that various stakeholders can take to tackle child abuse in schools.

Teachers

The first big step to tackling child abuse in schools is carrying out teacher training. Teachers are in a favorable position to identify child abuse because they generally have a child's trust and have regular contact with them to identify cases of physical abuse. However, since teacher training is not a priority, even when teachers recognize that the child is *disturbed*, they do not have the expertise to identify abuse and aren't informed about the mechanisms through which they can help the child [25]. Jones et al. [3] add on to this analysis by noting that teachers have a strong influence over shaping children's values and ideals, and then recognizing the root causes of child abuse is pertinent. Primary data also adds to this review by identifying that teachers are role models in society - people look up to them and model the way that they behave. Therefore, when they use corporal punishment as a way of ‘disciplining’ young minds, they reinforce traditional socio-cultural norms. Within this theme, it is also important to identify what teacher training would consist of. In a study conducted to find the extent of emotional abuse perpetrated by teachers, they were found using ‘vulgar language’ and humiliation techniques to bully students into discipline [30]. With this problem in mind, the researchers asked the subject matter experts about what changes the schooling system needs to implement to make schools a safer learning environment. Ms. Jones noted that educating teachers about children's rights and shifting from corporal punishment to positive disciplinary techniques which are not based on fear, humiliation or physical punishment is an important step in tackling child abuse. Zuković and



**Kaustubh Jain et al.,**

Stojadinović[31] further expand on this by noting that the application of positive discipline for student development is incredibly important in adolescence when the school is certainly an environment that has a humongous amount of influence on the development of the individual.

School Management

School authorities have significant power over the kind of policies that are implemented to tackle child abuse. Overcrowding, as discussed in this paper, is a huge barrier to implementing any policy. Hiring more teachers to reduce the overburdening of teachers as well as the pressure that comes with handling a large classroom is pertinent to tackle child abuse [32]. Reducing the size of classes has had a positive effect on decreased rates of abuse in various Bangladesh schools. [3] In addition, the recruitment of female teachers and school-based social workers or counselors is important because girls are likely to feel more comfortable reporting to them [3]. The primary data also aligns with this point of view where a therapist in an Indian school reported that girls were more likely to approach a female therapist because they are seen as more approachable.

A change in curriculum across all schools should be another top priority. There needs to be a trend towards incorporating intangible life skills which are crucial in maintaining positive personal and professional relationships. These include skills aimed at reducing and managing conflicts, peer mediation, enhancing communication et cetera. Additionally, maintaining specific rules against bullying and providing safe spaces for victims of abuse within schools is an important factor in tackling this problem [33]. While implementing these curriculum changes, it is also important for schools to provide particular attention to students who are most at-risk - students with disabilities, those not learning in their first language or gender, ethnic and economic minorities - and make the education system as accommodating as possible [16]. The primary data further identifies the need for a new trend of informing children of their human rights within the education curriculum. Unless children are aware of their rights, the likely scenario is that they do not report cases of abuse either because it is seen as acceptable.

In addition, sex education needs to be included in the education curriculum. A subject matter expert noted that sex education helped children understand topics of consent better. In Delhi, various schools hold 'good touch' and 'bad touch' workshops, which are important in establishing boundaries and identifying abuse. Another expert mentioned that sex education helped children to become more sensitive to sexual and gender minorities - therefore having an effect of reducing bullying based on someone's identity. Lastly, school authorities also need to make it easier to report instances of abuse. Setting up anonymous reporting boxes in school as well as allocating responsibility to school staff to address the instances of abuse can be used to do so. [34] Additionally, taking stronger action against perpetrators of abuse in schools is another step to instill trust among other victims and incentivize them to come forward too.

Governments

The primary data strongly suggests that breaking down the misconception that violence and humiliation are needed to discipline children is of extreme importance for any government policies to work. Even if every government implements legislative reform to ban any form of child abuse, no policy will work if citizens - teachers, students, and parents still continue to believe that corporal punishment is necessary. Mohiuddin et al. [32] and Lucas [35] support this solution by mentioning that governments need to run mass campaigns to change the cultural attitudes that continue to support violence. In addition, there is also an urgent need for governments to allocate more funding to public income schools since they are underfunded in India, Pakistan, and Bangladesh [36-38] This is incredibly important to solve the problems [overcrowding, lack of teacher training et cetera] described above. Lastly, governments also need to invest significantly in the training of police officers and healthcare workers. Police workers are not currently trained in dealing with cases of abuse. So even if reporting to police authorities is made easier, the police officers themselves need to be equipped to deal with such cases. Healthcare workers are also not entirely equipped to identify cases of abuse. All these problems hinder the capacity for victims to get justice. The secondary data also notes that not only police officers and law enforcement agencies, but also judges, registrars, and bench



**Kaustubh Jain et al.,**

clerks are ignorant of child protection laws and mechanisms to deal with abuse. Therefore, government investment into the training of such important stakeholders is key.

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CONCLUSION

The findings of the paper indicate that deeming child abuse illegal by law is simply not enough. Rather, child abuse in schools is a result of a culture that perpetuates and normalizes child abuse. This paper establishes that children who do not conform to traditional societal norms, children belonging to low-income communities, younger children oppressed by hierarchical structures, and children with disabilities are at far greater risk for abuse. This paper also acknowledges that there are pressing problems like inadequate funding to carry out teacher training and hire therapists, lack of reporting of abuse, overcrowding in schools, etcetera, all of which give rise to various implications for the stakeholders discussed in the study: Schools need to make it easier for students to report abuse, increase access to therapists and hold perpetrators accountable. Governments need to train police officers and healthcare workers in detecting abuse and break stereotypes that normalize child abuse. The strength of this paper lies in its rigorous analysis of reasons for why different kinds of child abuse occur with the unique context of the Indian Subcontinent. There are two big additions that the researchers make to existing literature: First, most of the existing literature provides reasons for why reporting of abuse at home is low. This paper fills in that gap by extensively analyzing reasons why children do not report abuse in the context of schools, and laying out the problems that stakeholders need to tackle to increase abuse. Second, most of the literature about child abuse is focused on problems that explain why abuse is easily perpetuated and normalized. This paper takes a more solution-oriented approach and analyses the steps that different stakeholders need to undertake. The limitation of this study is that it does not analyze existing policies in India, Bangladesh, and Pakistan which seek to tackle child abuse, and the researchers call for further research to be conducted on a critical evaluation of these policies.

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An Overview: Water Pollution and Management by using Nanoparticles

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ABSTRACT

Drinking water is now a scarce resource in many regions of the world due to the world's population boom, water shortages, and climate change-related protracted droughts and floods. The water business needs to produce reliable, affordable and efficient materials and ways for supplying enough fresh water. Due to the rising water demand, strict health regulations, and growing contaminants, conventional water/wastewater treatment processes are still unable to provide enough access to safe water. Water/wastewater treatment problems are being solved at a reasonable cost by multipurpose, extremely effective techniques based on nanotechnology which do not require expensive infrastructure or centralized systems. The purpose of the current research is to review potential applications of nanoparticles for the eradication of pollutants from storm water. Natural organic matter, metal ions, inorganic solutes, heavy metals, nitrates, complicated organic compounds and other contaminants present in groundwater, underground aquifers, and/or industrial water will be briefly reviewed in this paper along with the availability and use of various nanomaterial's (particles). Finally, suggestions are presented for a standalone water purification system for eliminating all types of toxins from wastewater based on the current practices of nanotechnologies in the water sector.

Keywords: Nanoparticles, Wastewater Management, Pollution

INTRODUCTION

Many nations have had serious issues with water pollution. In many underdeveloped nations, it is equally crucial to have access to clean water for drinking. As population increase, protracted droughts, and pollutants from numerous industrial wastes deplete the majority of the water supplies, there is an expanding need for new, clean water. And

58159



**Reeta Meher and Preeti Pandey**

over a million individuals every year pass away from water-related illnesses, while an additional approximately 2.3 billion individuals experience illnesses brought on by using contaminated water. However, parasitic and infectious disorders brought on by contaminated water account for 60% of all occurrences of child death worldwide [1-3]. The two main procedures that make up the general wastewater management process are the primary phase, when heavy debris like twigs, gravel, and trash are removed, and the available microbiological possible treatments, where the sewage is cleansed by removing the majority of toxins. Titanium nanoparticles are used in this work as the detoxification process's catalyst during the secondary stage [4-6]. Since nanotechnology is so effective in eliminating the contaminants and microbes present in contaminated water sources, it has recently been used for water purification. The employment of nanoparticles, nanomembranes, and nanopowders has been the main focus of contemporary wastewater management strategies for the removal of biochemical, microbiological and pollutant exposure [8-10]. The high ratio of volume to surface of nanotechnology, which enables it to reach all of the targeted components in the water, accounts for its superior performance over other existing strategies in water filtration.

Water

Water is an inanimate, clear, flavourless, odourless, and almost colourless chemical that makes up the majority of the Earth's hydrosphere and the bodily fluids of all currently recognised living things. Even though it doesn't contain any calories or organic nutrients, it is essential for all known life forms [11]. Since water has the chemical formula H_2O , each of its components consists of two hydrogen atoms linked by covalent bonds and one oxygen atom. One oxygen atom is joined by two hydrogen atoms at an incidence of 104.45° . The liquid form of H_2O at conventional ambient temperatures and pressures is referred to as water. Aerosols that resemble fog are produced, along with rain. Clouds are made up of snow and water droplets that are floating in air. Crystalline ice has the potential to create snow when finely split [12-15]. Steam or water vapors is the gaseous form of water. Water typically reaches the sea as a result of the continual processes of precipitation, evaporation, condensation, transpiration and rounding off. Water covers 71% of the Earth's surface, mostly in oceans and seas. Groundwater (1.7%), glaciers and ice caps in Greenland and Antarctica (1.7%), clouds (composed of melted ice vapour floating in the air), and snowfall (0.001%) of the sky all contain minuscule amounts of water.

The global economy depends heavily on water. Agriculture uses over 70% of the freshwater that people use. For many regions of the world, fishing in bodies of fresh and salt water is a significant food source. Commodity (including oil, shale gas, and manufactured goods) are frequently transported across vast distances by boats over the rivers, lagoons, streams and ocean. In both industry and residences, huge amounts of snow, freshwater and vapours are utilized for thermal mass. Since water is an excellent solvent for a variety of compounds, both minerals and chemical, it is widely used in industrial processes as well as in cooking and washing. A few activities that involve water, ice, and snow include windsurfing, swimming, recreational boating, spearfishing, diving, ice skating, boat racing & skiing.

Waste water

Water which has been utilized for home, commercial, and industrial purposes is referred to as wastewater. Waste water is made up of 99.9% water, with the remaining 0.1% being eliminated. Organic material, bacteria, and inorganic substances are all present in this 0.1%. Various habitats, including lakes, ponds, streams, rivers, estuaries, and seas, are exposed to wastewater effluents. Storm runoff also counts as wastewater since it contains dangerous compounds that are washed off of rooftops, parking lots, and highways. As much suspended particles as feasible must be eliminated during treatment of wastewater before the leftover water, known as effluent, is released back into the environment. The oxygen that is needed by the aquatic plants and animals is depleted during the breakdown of solid matter.

Wastewater is cleaned via a process known as wastewater processing, which produces effluent that can be added back into the water cycle. A wastewater treatment plant is where the treatment takes place. At the right kind of treatment facility, a variety of effluent kinds are processed. Sewage treatment plants are used to treat domestic



**Reeta Meher and Preeti Pandey**

sewage, sometimes referred to as municipal wastewater or sewage. The wastewater is reused or has an acceptable impact on the environment after it is added back into the hydrological cycle (called water reclamation). Industrial wastewater is handled by either a sewage treatment plant or a separate wastewater management facility (usually after some form of pre-treatment). Additional types of wastewater treatment facilities include leachate processing plants and agricultural enterprises that treat wastewater. In the literature, "sewage treatment" is frequently referred to as "wastewater treatment" [17–18].

RESULT AND DISCUSSION

Reactive phosphorous

Fig. A typical plot of various phosphate concentrations and its absorbance utilising spectrophotometer analysis at 890 nm wavelengths is shown in Figure 1. Both the activities of the generated nanocomposite of different percentages of TBOT coatings of the Fe₃O₄ magnetic nanoparticles at various times as well as the decreases in the growing concentration of phosphate were evaluated. The activities of the various synthesised particles were evaluated in order to improve process optimization [19–20].

From the outcome depicted in Fig. 2. It is notable that the average efficiency of the TiO₂/Fe₃O₄ MNPs' phosphate elimination is around 50% across all of the standard generated concentrations. Figure 3 displays the outcomes of a test that used a sampling of polluted water. Two different applications were used to conduct these tests. First, the test was conducted with UV light (photocatalysis), and then it was done without any UV light. Two wastewater samples (outlet and inlet) were used for both tests [21]. The graph clearly shows how well the TiO₂/Fe₃O₄ MNPs reduced the amount of phosphate in the effluent. When comparison to the output, the wastewater at the intake contains more phosphate. Following the TiO₂/Fe₃O₄ MNP incubation time, the inflow wastewater exhibits a substantial drop in phosphate concentration (Fig. 3). The synthesis of enhanced photosynthetic particles with an inner super paramagnetic Fe₃O₄ was successfully completed using the titrimetric co-precipitation approach, followed by the sol-gel method, and the particles had good magnetic properties. Normally, photocatalytic particles need to be exposed to UV light during the reaction process to have good activity. However, the manufactured particles were found to have more activity during in the breakdown of phosphate blue even while they were not exposed to UV radiation. As a result of the addition of the Fe₃O₄ inner core, this indicates that the TiO₂/Fe₃O₄ MNPs were functional under visible light [22].

Using the titration co-precipitation approach, followed by the sol-gel method, the synthesis of higher photocatalytic particles with an inner super paramagnetic Fe₃O₄ was accomplished successfully, and the particles had good magnetic characteristics. Normally, photocatalytic particles need to be exposed to UV light during the reaction process to have good activity. But even when they weren't exposed to UV light, the synthesised particles were observed to have a higher activity during the reduction of phosphate blue. As a result of the addition of the Fe₃O₄ inner core, this indicates that the TiO₂/Fe₃O₄ MNPs were functional under visible light [22]. Alcohols, carboxylic acids, phenolic derivative, or chlorinated aromatics have been the main targets of the photocatalytic process, which converts them into atmospheric CO₂, moisture, and simple mineral acids that are extremely safe for both people and the environment. In addition to the removal of organic molecules, the photocatalytic surface of TiO₂ has shown photochemical alterations in the reduction of inorganic compounds such nitric oxides, azides, chlorate or bromated halides, palladium, and sulphur species. These substances are immobilised on different thin film surfaces using TiO₂. These substances are immobilised on different thin film surfaces using TiO₂. Sol-gel synthesis was used to create TiO₂/Fe₃O₄ MNPs, which exhibited about 80% activity after 60 minutes of irradiation. Even after being reused, these particles continued to exhibit impressive photo catalytic activity. Alcohols, carboxylic acids, phenolic derivative, or chlorinated aromatics have been the main targets of the photocatalytic process, which converts them into atmospheric CO₂, moisture and simple mineral acids that are extremely safe for both people and the environment.



**Reeta Meher and Preeti Pandey**

The findings of this study demonstrate that the synthesised particles' activity in the removal of methylene blue, nitrate, phosphate and methylene blue can even be attained during the first stages of the reaction, when it is between 70 and 80 percent. When the photocatalytic nanoparticles were digested without UV light, their activity were higher. The photocatalytic activity of the $\text{TiO}_2/\text{Fe}_3\text{O}_4$ MNPs was sufficient even at lower concentrations. Since the particles can be applied in lower concentrations, this can be said to be particularly cost-effective. The preparation method is also a straightforward and simple procedure. When the created $\text{TiO}_2/\text{Fe}_3\text{O}_4$ MNPs were employed in suspension throughout all of the experiments, a magnetic stand restored them with ease. When the particle concentrations are lower than when they are higher, the recovery of the particles is observed to occur more quickly. This may be as a result of the TiO_2 coating's blockage of the magnetic core material. The magnetic polarity of the granules likewise diminish when the surface coating's concentration rises [23–24].

CONCLUSION

Although many in the scientific world consider nanotechnology to be the next buzzword, information on the topic is still widely scattered and fragmented because of the relative youth of the technology. However, the growing trends in research that have been previously described have demonstrated that nanotechnology has a tremendous potential to be turned into a very effective water treatment instrument of the twenty-first century. In actuality, the nanotechnology revolution is being driven by nanomaterials and all of their diverse manifestations. Water treatment is only one of the many environmental engineering and technology disciplines that will be significantly impacted by nanomaterials in particular. However, the majority of nanotechnology-based wastewater treatment methods have only been studied at the laboratory scale, and not all of them are likely to be workable replacements for current treatment methods, most likely for financial reasons. This makes it challenging to forecast what the future will hold for us in terms of this emerging technology at this time. Another significant problem is the integration of nanomaterials into current water purification systems. Because they are adaptable, scalable, modular, and generally simple to operate and maintain, membrane technologies like RO and NF are becoming into the industry standard for water purification. It will therefore be necessary to conduct additional laboratory research and pilot scale testing in order to incorporate innovative nanostructured membranes into already-existing water filtration systems. Concerns with choosing and designing materials for water purification include a material's toxicity and environmental consequence. The toxicity, transport, and environmental destiny of nanomaterials are poorly understood. Therefore, it is important to keep in mind that nanotechnology can have a double-edged effect and that any desirable attribute of nanomaterials may also provide a threat to the nature. Consequently, it is essential to carefully weigh the benefits and drawbacks of nanotechnology in light of how it may affect the environment. To the greatest of our knowledge, no thorough research has been done evaluating the stability of nanomaterials in both natural and artificial environmental systems. On the plus side, nanoparticles can be developed into the best possible candidates for water treatment and may help to find solutions to upcoming problems in the field of modern methods for treating water, with their extraordinary high potential in combination with their great specificity. Therefore, there is still room for study and development in the area of groundwater remediation, which holds great promise for nanotechnology.

The mole fraction of TiO_2 to Fe_3O_4 in the synthesised particles was observed to have a significant impact on the particle's activity. Increasing the molar ratio of TiO_2 causes an increase in activity, and vice versa. The synthesised particles were effective in reducing nitrates, dye removal and phosphate at lower concentrations of the targeted chemical. The magnetic properties of the generated particles also decrease as the ratio of TiO_2 increases. The results show that all these nanoparticles have good photocatalytic performance for the filtration of effluent. One may argue that the treatment is less expensive because it is less time-consuming.





Reeta Meher and Preeti Pandey

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Reeta Meher and Preeti Pandey

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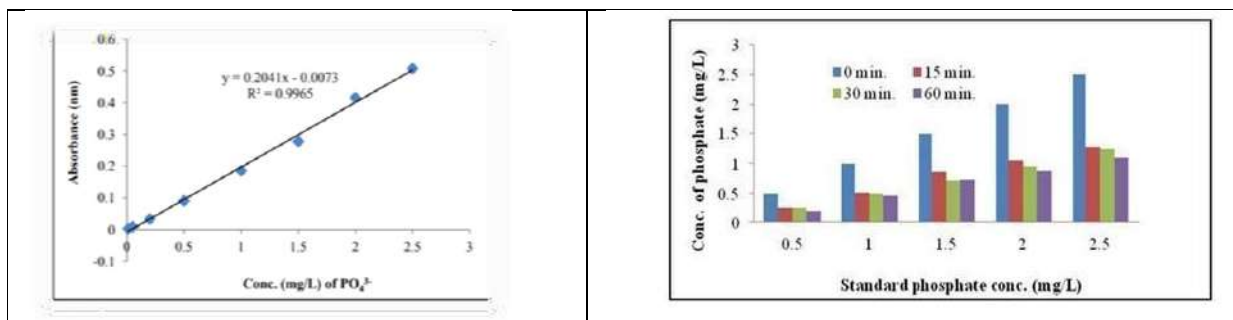


Figure 1 :- (Standard curve for phosphate test)

Figure 2 :- Total elimination of phosphate in solutions produced to standards using 11.5 mg/ml TiO₂/Fe₃O₄ mnps

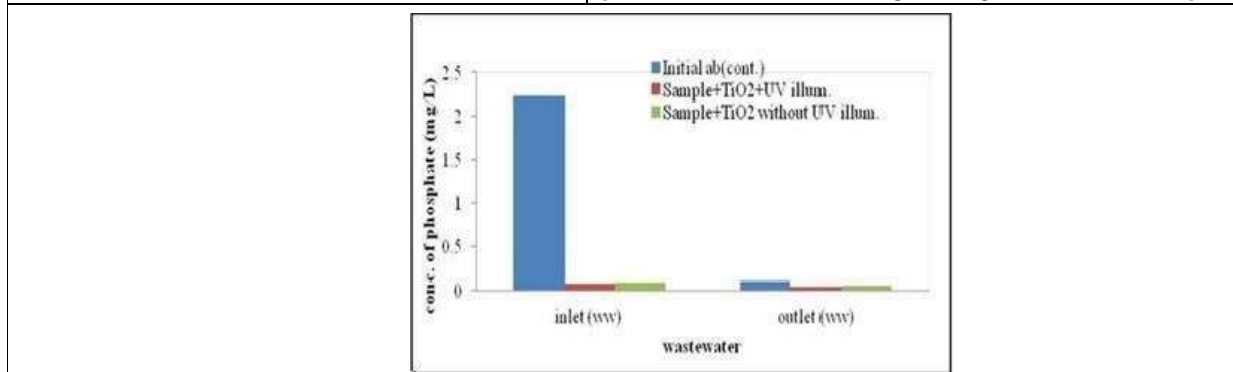


Figure 3 :- Total phosphate elimination in wastewater applying 26.3 mg/ml TiO₂/Fe₃O₄ mnps after incubation for 30 minutes.





Analysis of Machine Learning in Smartphone with AI Tax in Mobile SoCs

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ABSTRACT

Mobile software is growing more and more feature-rich, and it frequently includes machine learning's strong decision-making capabilities as an accessory. (ML). System and hardware architects incorporate specialized hardware units onto their system-on-chips (SoCs) together with frameworks to efficiently delegate computation in order to meet the resulting greater power and performance expectations. ML model performance and power efficiency are being rapidly improved by these SoC developments, but additional data processing and supporting infrastructure to enable ML model execution can significantly change a system's performance profile. The time spent on tasks other than model execution is proposed as an artificial intelligence tax in this paper. We describe the open source ML benchmarks' and Android applications' execution pipelines in terms of the AI tax and talk about potential performance bottlenecks.

Keywords:- Artificial intelligence, Android applications, system-on-chips, AI hardware and Software

INTRODUCTION

Artificial intelligence (AI) has become increasingly prevalent in mobile apps due to improvements in device computing and storage capacity. The usage of AI-driven features such as super resolution face recognition, picture segmentation, virtual assistants, audio transcription, sentiment analysis, and gesture recognition is prevalent in many of today's mobile applications [1]. AI must be regularly implemented on mobile platforms in order to make an application usable by a wider audience, which poses the following



**Vedanandaprabhu and Karunakara Reddy**

three major difficulties: First, using general-purpose mobile CPUs for AI computation wastes energy and power, necessitating the adoption of specialized hardware accelerators. Traditional GPUs and DSPs as well as specialized AI processing engines like Google's Coral MediaTek's Dimensity Samsung's Neural Processing Unit and Qualcomm's AIP are examples of commonly used AI hardware accelerators. Despite the fact that these AI engines provide hardware acceleration, they may also add offloading overheads that are frequently overlooked or unstudied in performance evaluations of AI systems, depending on how they are incorporated into the larger system. Second, SoC suppliers depend on AI software frameworks to handle the underlying AI hardware[2]. Examples include Qualcomm's Snapdragon Neural Processing Engine (SNPE) , Google's Android Neural Network API (NNAPI) , and MediaTek's NeuroPilot.

These frameworks control frameworks for AI tax algorithms. Hardware End to End (E2E) Performance Pre-processing Post-processing of an AI Model Drivers for data capture Offload Planning Multi Tenancy Variability from run to run .Taxonomy of AI processing overheads, which we build upon in this research to point out typical problems when evaluating AI performance on mobile chipsets. Execute ML models on a variety of hardware, and then choose an application run-time scheduling strategy. While this lessens development effort, abstracting model preparation and offload can make it challenging to reason about performance predictability because the framework's run-time behaviour varies depending on system setup, hardware support, model specifics, and the end-to-end application pipeline.

Application of Electronics

Application often needs a lot more algorithmic processing in order to support the execution of a machine learning (ML) model [3]. The retrieval of data from sensors, the pre-processing of the inputs, the initialization of ML frameworks, and the post-processing of outcomes are a few examples of this algorithmic processing. Although every ML application and its underlying model(s) must go through these necessary processing steps, performance analysis frequently ignores these overheads. In this study, we measure the performance costs incurred at each stage of the execution of open-source ML benchmarks and Android applications on cutting-edge mobile SoC chipsets .The total end-to-end delay of the ML execution pipeline is what we refer to as the "AI tax."

The high-level analysis of an application's end-to-end performance and how AI tax and AI model execution time can be used to segment end-to-end performance. Algorithms, frameworks, and hardware are the three areas of the AI tax that include overheads[4]. These groups each have unique overhead sources. For instance, algorithmic processing entails the runtime overhead related to data collection, pre-processing for the neural network, and execution of post-processing code that frequently produces the output. Driver code in frameworks synchronizes scheduling and optimizations.

Finally, due to multi-tenancy, the CPU, GPU, or accelerator itself may experience offloading costs, run-to-run unpredictability, and slowness. (or running concurrent models together). We use AI tax to highlight potential algorithmic bottlenecks and dangers of delegation frameworks that would not be apparent from a standard workload study on hardware that simply considers inference. For instance, a significant flaw in many current works, including industry-recognized benchmarks like MLPerf and AI Benchmark is that they place too much emphasis on ML inference performance. They achieve this while ignoring the remaining processing pipeline overheads, such as the fraction of AI taxes.



**Vedanandaprabhu and Karunakara Reddy**

"Missing the forest for the trees" is the result. Because they are either only concerned in pure inference performance or because the ad-hoc nature of these overheads makes it difficult to represent them in a consistent way, ML inference-only workload performance analyses frequently do not include the non-model execution overheads. Although many ML mobile applications follow a similar layout, the high-level application execution pipeline varies slightly between ML models and frameworks. As a result, patterns of where bottlenecks arise might be systematically identified and that could help us avoid inefficiencies [5]. In order to determine the contribution of AI tax in the application time of machine learning, we characterize the significance of end-to-end study of the execution pipeline of real ML workloads.

We look at this in terms of algorithmic processing, overheads and inefficiencies in the framework, and hardware capabilities. These overheads must be quantified when evaluating the performance of mobile AI applications since they can account for a sizable fraction of end-to-end AI application performance. Along with ML execution, it is also required to take into account simultaneously speeding up these seemingly unimportant but crucial data processing operations. Additionally, we give a thorough analysis of ML offload frameworks and show how they can be successfully combined with an AI tax to support optimal hardware delegation decisions. The underlying hardware support can have a significant impact on program performance, although the end user may not always be aware of this.

As a result, this is yet another argument in favour of the importance of evaluating the performance of an entire AI program, rather than simply its hardware component. Our contributions, in brief, are as follows: 1) When evaluating the performance of AI in mobile chipsets, end-to-end performance analysis should be taken into account. Current state-of-the-art benchmarks, in particular, excessively emphasise model execution while omitting system-level implications that are essential for AI usability. 2) Because they can take up to 50% of the actual execution time, the data collection and AI pre- and post-processing phases are equally as important for AI performance as the core ML computational kernels.

3) It is crucial to take into account how well the ML software framework is tuned for the underlying chipset while undertaking AI performance research. Some frameworks do not work well with all chipsets and models. 4) Cold start penalties, run-to-run variability, and multi-tenancy overheads can all affect AI hardware performance, many of which are currently disregarded. We think that customers across the stack will find this analysis of end-to-end AI performance to be both interesting and important. End users (app developers) are concerned since they might wish to invest in more complexity to reduce pre-processing costs. (Instead of focusing on inference). The creators of the framework might want to give consumers more information regarding pre- and post-processing or data collection. The scheduling of hardware-based pre- and post processing processes may be something framework programmers wish to consider. Designers of AI accelerators might wish to think about using a less expensive DSP with pre-processing capabilities rather than an expensive tensor accelerator. The remaining sections of the essay are structured as follows. Section II outlines the procedures for applying an ML model from within a mobile application, from data collection to result interpretation. We describe our experimental setup, along with the frameworks, models, apps, and hardware we tested, in Section III. We specify and quantify the AI tax.





Machine Learning

The ML pipeline, which we describe as the normal flow of events while invoking an ML model on a SoC, is presented in this section. This establishes the framework for our end-to-end analysis of the performance of AI[6]. The section elaborates on the specific roles played by each of the stages. A. Data Gathering Data collection from sensors may appear simple at first glance, but it can quickly complicate an application's architecture and have an impact on system design choices. For instance, choosing the wrong image resolution can result in non-linear performance decreases if image processing algorithms in subsequent portions of the ML pipeline do not scale with image size, or taking raw photographs quicker than the application can manage can strain system memory and I/O. Some systems gather information from several sensors, in which case further data processing (such as combining various sources of information into a single metric) or sanitization may be necessary. This additional processing frequently utilizes the same set of cores as the rest of the application, which introduces synchronization overheads and interference into the mix.

As an alternative, it could be delegated to co-processors like the DSP. An example of the steps in a typical end-to-end flow for a machine learning task for image classification. Data from the camera is transformed in a pre-processing step into the shape that the target model anticipates. The ML framework initializes once and loads the model before planning any subsequent steps. The framework of choice can be platform-independent (like NNAPI) or offered by a chipset vendor (like Qualcomm's SNPE). Then, at "operation" granularity, the framework schedules model execution on hardware. The model output is then made sense of in a post-processing step, for example by choosing the most likely classes to which the image belongs.

Hardware Platforms

The hardware platforms we look at in our characterization evaluation are listed in Table II. We concentrate on the Qualcomm Snapdragon chipsets in the SD835 through SD865 series because they are the most extensively used in the ecosystem. Although our testing findings show that the trends are representative across the various, older and newer chipsets, we only offer data for the Google Pixel 3 (SD845). The hardware accelerators are the same for the other chipsets. A CPU, GPU, and DSP are included in the chipsets for processing AI-related activities. Additionally, Qualcomm produced the ML Perf Inference and most recent ML Perf Mobile findings using these chipsets.

We conducted a comparable set of tests through Qualcomm's SNPE, a non-NNAPI framework, utilizing open-source software obtained from Qualcomm's Developer Network and using the SNPE benchmark tool rather than TF Lite's. We reached similar conclusions on end-to-end latency trends, but since there are not many models and Android apps available that target these systems, we chose to limit our talk to NNAPI. Because many of the performance trends we highlight are effects of how frameworks and apps use hardware rather than the core SoC hardware itself, we anticipate seeing similar results across non Qualcomm SoCs.

The performance reduction brought on by our instrumentation infrastructure is minimized in our measurements. We present the arithmetic mean of 500 runs to reduce the variation in our findings. Comparison of inference latency between the TF Lite command-line benchmark utility, TF Lite Android



**Vedanandaprabhu and Karunakara Reddy**

benchmark app, and example Android applications is particularly relevant to mobile SoCs. We make care to run benchmarks after the CPU has been cooled to its idle temperature, which is about 33 °C. With hardware acceleration enabled (through SNPE or NNAPI) and our driver instrumentation enabled, we notice a 4-7% increase in inference time. Pre-processing or inference carried out on the CPU is unaffected. Since the instrumentation only reveals code paths and measures time spent in drivers, these higher figures are not the ones we utilize in our evaluation. The offload section is the only place where results with instrumentation active that affected latency in milliseconds' order are displayed.

Mobile AI tax the AI TAX,

which is the total latency of all non-inference ML pipeline stages, is the amount of time a system expends on operations that enable the execution of a machine learning model. (Defined in section II). We contend that analyzing benchmark results and model performance in terms of AI tax can direct the mobile systems community toward promising research topics and focus attention on the components of a system that are the cause of performance bottlenecks and require optimization. We compare the performance of ML models when they are run as (1) pure benchmarks from the command line; (2) packaged into benchmark apps with a user interface TF Lite Android benchmark utility and (3) executed as part of a real application in order to comprehend and quantify the real-world effects of the end-to-end AI processing. Figure 3 displays an illustration of how benchmarks or proxy apps can differ from the performance of real-world applications. We assessed the end-to-end latency of various models that were running on the CPU. We note that very little pre-processing is needed to run a model because TF Lite's benchmark utility concentrates on assessing inference performance.

Both benchmarking tools hide the end-to-end performance costs associated with data collection and preprocessing, even the one that purports to be more representative of Android applications. Pre-processing and data collection times are compared to inference times in the TF Lite benchmark tool versus Android apps. While in (b) we report the data capture and pre-processing delay in relation to the inference latency, in (a) we report absolute values for each of the three components. When compared to benchmarks, the same model embedded in a real application waits a long time for data to be collected and processed before being used for inference. Our results in all of the categories are presented in the ensuing sections. The time invested on OS and vendor drivers quickly amortizes across hardware delegation frameworks, according to our research. They make up a very minor portion of the total execution time when combined with post-processing. However, the time required to gather and then prepare data for use by ML models can add up to a significant portion of the execution time. A. Algorithms and AI Tax This section displays our pre-/post-processing and inference latency metrics and illustrates how benchmarks and Android applications perform in different ways.

To emphasize the different performance characteristics between benchmarks and applications, we track the time spent gathering and pre-processing input data. Although the majority of our findings point to negligible post-processing delay, more difficult tasks like picture segmentation and object detection demonstrate that applications need a significant amount of additional work on the model output. (e.g., mask flattening and bounding box tracking, respectively).



**Vedanandaprabhu and Karunakara Reddy****Data collection and pre-processing.**

Compares the data capture and pre-processing delay between Android applications employing the same models via NNAPI as the underlying software framework and those assessed in inference benchmarks. Figure 4b displays the processing overheads in relation to the inference latency to focus on specifics, whereas Figure 4a displays the data capture, pre-processing, and inference latencies. These demonstrate that rather than actual inference, a large percentage of a model's time is spent on data collection and preprocessing. However, the time varies on the model under consideration as well as whether we focus on benchmarks or applications. In both benchmarks and applications, models like SSD Mobile Net v1 and quantized Mobile Net v1 took up to twice as long to gather and process data as to conduct inference. Similar patterns are observed when embedding floating-point models within programs, including Pose Net, Efficient Net, and Deep Lab v3. On the other hand, inference latency is the dominant factor in benchmarks. The "data capture," which in the context of the inference benchmarks is random data generation, is typically minimal for floating-point data.

It appears to somewhat resemble genuine uses in quantized models. This, however, is one of the errors in this method of data gathering. Real numbers are produced substantially more quickly than integers by the default C++ library (libc++), which this benchmark just so happened to be compiled against. We noticed the exact opposite outcome when utilizing a different standard library (libstdc++). Only the quantized and floating-point Inception-v3 model exhibits significant inference lag. The Inception models not only have much more parameters and operations than the other, more mobile-friendly models we evaluate, but they can only be offloaded via NNAPI to a limited extent and conduct about half of their inference on the CPU.

System Designer

A system designer should bear in mind that post-processing overheads, similar to pre-processing overheads, might quickly become an application's primary bottleneck depending on the workload; these patterns are again likely to be missing from a benchmark report. Conclusion from AI Tax: Algorithms It is critical to quantify the end-to-end performance of ML systems when evaluating or benchmarking them because overheads associated with data collection as well as pre- and post-processing can account for as much as 50% of the entire execution time. Therefore, focusing exclusively on ML performance may cause us to miss the bigger picture.

The performance of the DSP is greatly improved when we move the framework to the vendor-optimized Qualcomm SNPE. Figure 6: Results from the Snapdragon Profiler, which display data from measurements made when the EfficientNet-Lite model was executing on the CPU, TFLite Hexagon delegate, and NNAPI. The command-line benchmarking tool for TFLite was used to conduct the test. The DSP executes the models better than the CPU. (as one would expect). This demonstrates how the software framework we choose can have a significant impact on the chipset's performance. The software created by the SoC vendor is specifically customized for the SoC and offers neural network operators the best possible support.

Vendor-optimized software back ends have the unpleasant side effect of fostering silos, which can make it challenging for application developers to determine which framework is best for extensive deployment. Until the developers (1) download the framework, (2) choose a set of ML models to run, and



**Vedanandaprabhu and Karunakara Reddy**

(3) profile those models on the selected frameworks for their target SoCs, it is not evident which framework(s) provides the best (and most flexible) support.

AI Tax

Frameworks for software Not every structure is made equally. Frameworks that (at least partially) insufficiently support models revert to utilizing the CPU, which leads to inferior performance than using the CPU straight away instead of attempting to take use of the promised hardware accelerator performance. As a result, there is a need for frameworks used for performance analysis to be more transparent. Hardware Performance and AI Tax Multiple accelerators for various issue domains, such as audio, sensing, image processing, and broadband, can be found in modern mobile SoCs [34]. These accelerators' behavior is closely related to how their software equivalents use them. We evaluate the impact of invocation frequency on AI performance. frozen start. We employ the Qualcomm Snapdragon 8xx chipsets that have a Hexagon DSP, also known as one of Qualcomm's Neural Processing Units, that has been over time optimized for machine learning applications. (NPU). It resembles a vector processing engine from VLIW. Fast Remote Procedure Call (Fast RPC) framework was created by Qualcomm to facilitate quick communication between CPU and DSP.

We only need to complete the initial DSP setup once, which involves mapping the DSP to the application process, and we may use that setup to make multiple inferences. According to the findings, there is cause for worry because current benchmarks and performance analyses frequently permit warm-up time that is not necessarily indicative of a real-world application. In ML benchmarks and workload performance research, the end-user experience, particularly in smartphone installations, comprises a cold start penalty that should also be quantified. The model initialization time breakdown provided by the TF lite benchmark tool is useful for determining how frequently an application switches between models or reloads them.

Multi-tenancy. The increased need to support several models running at once is an emerging use-case in real-world applications. Hand tracking, depth tracking, gesture recognition, etc. are a few examples of application use-cases in AR/VR. However, most modern technology allows for the execution of just one model at once. In order to accomplish this, we examine how AI hardware performs when more jobs are allocated to the CPU and AI processors. Figure 9 displays the Android application's latency breakdown when we schedule an increasing number of inferences using the NNAPI Hexagon Delegate in the background. (using the TF lite benchmark utility). As a result of the inference being halted due to resource availability, we find a linear rise in latency per inference.

Although there is only one DSP available for ML model acceleration on this specific SoC, the main inference is running on the DSP. Pre-processing and data collection are roughly constant in the meanwhile because the concurrent inferences have no impact on CPU activity. Figure 10 contrasts this by depicting the application latency with all background inferences occurring on the CPU. (While the image processing app still offloads to the DSP). Because more activities are executing concurrently on the CPU, pre-processing and data gathering take longer than they should. Since there are no longer any competing processes for the DSP, inference latency has become constant.



**Vedanandaprabhu and Karunakara Reddy**

This straightforward experiment highlights potential pitfalls. Consider a scenario in which we, as system designers or application developers, isolated only one aspect of the execution pipeline (for example, pre-processing in Figure 9 or inference latency in Figure 10). In that instance, we can incorrectly draw the conclusion from the findings that the device choice and schedule are ideal. However, there may be alternative options available, such as amortization of overhead over successive inferences. Similar applications running simultaneously that compete for the same hardware resources may need to reconsider how resources are allocated; for example, one model might run on the CPU while another uses the DSP, or other execution stages might be offloaded in some cases.

Although NN accelerators can speed up execution, benchmarks that only concentrate on inference latency may mislead SoC designers into allocating silicon space for hardware that accelerates a particular model while omitting other components that might be valuable. For instance, whereas a particularly designed NPU normally cannot perform such operations, DSPs are widely utilized for routine image processing tasks (mostly through computer vision frameworks like Fast CV). In some situations, it may be more practical to forgo a larger NPU in favor of a smaller one that is linked with a DSP for pre-processing, freeing up the CPU to work on other aspects of the application. Run-to-run varying.

For mobile developers, performance variability is a big worry because it impacts the end-user experience. However, it is frequently overlooked while evaluating gadget performance. The mobile AI benchmarks used today explicitly ignore this area. Due to background interference, performance of apps running on a real device varies from run to run, impacting user experience. When the same AI models are bundled into a real application form factor, Figure 11 illustrates performance variance to measure the performance difference between benchmarks and mobile AI performance. The findings indicate that benchmark executions that are repeated have a fairly narrow performance distribution. The variance from the mean latency is hardly noticeable. However, we observe a fairly dramatic dispersion in mean latency for models operating within an app.

The latency can differ from the benchmarks' median by as much as 30%. The non-ML portion of the application code is to blame for the high degree of performance unpredictability. Multiple hardware components and processing subsystems are used in data capture, pre-processing, and post processing. Such oscillations are a result of the Android operating system's scheduling choices, delays in interrupt handling from sensor input streams, etc. Workload performance analysis must report statistical distributions in performance because of this significant variability. Instead, reporting a single ML is now considered best practice.

Mobile AI/ML Benchmarks.

In recent years, numerous initiatives have been made to measure mobile AI performance. These include the Procyon AI Inference Benchmark Neural Scope, Xiaomi's Mobile AI Benchmark [38], AI Benchmark , AI Mark [40], AITUTU , and AI Benchmark from Xiaomi. Almost all of these benchmarks give consumers the option to choose from a variety of ML hardware delegation frameworks by offering a flexible way to choose the software backend. Numerous of these benchmarks use open-source or vendor-specific TFLite delegates to execute a collection of pre-selected models with different bit widths (INT8, FP16, or FP32). Even support for heterogeneous IP is offered by some of them.



**Vedanandaprabhu and Karunakara Reddy**

Despite all of these features, they ignore the fundamental problem of evaluating performance from beginning to end, which is the ultimate goal of our work. Our goal is to increase public awareness of AI tax so that future benchmarks can be expanded to include more examples of practical AI applications. complete performance analysis of AI. The end-to-end performance pipeline of DNNs in server-scale systems was examined by Kang et al. [44], who also came to the same conclusion about pre-processing being the primary bottleneck in hardware-accelerated models. The authors suggest re-ordering, fusion, and datatype modifications inside the network compilation graph as frequent pre-processing phase optimizations. It offers a thorough examination of ResNet and suggests a model that considers pre-processing costs to cut down on end-to-end latency.

We investigate a wider selection of mobile device models and applications. Additionally, we provide studies of ML algorithms, frameworks, and hardware, as well as a systems-level analysis of the outcomes. Similar to this, Richins et al. Conduct a study that is tailored to the workloads and designs of data centres. The primary bottlenecks in end-to-end data enter AI applications, which sometimes have many inference phases, are identified as the network and storage. (e.g., video analytics applications). The authors demonstrate that despite the fact that the application under discussion is based on cutting-edge AI and ML techniques, it heavily relies on pre- and post-processing code, which can take up to 40% of a general-purpose CPU's total processing time.

Our research focuses on mobile SoCs and identifies the non-AI sources of overhead typical for consumer market handheld AI devices, which differ from PC and data centre hardware in the type and number of accelerators available on a given SoC and currently target a very different software infrastructure.

CONCLUSION

End-to-end performance evaluation of AI systems is required. More transparency into the real end-to-end execution is crucial for mobile systems because of the heterogeneous ecosystem of hardware and software. The AI tax overheads we analyze across hardware, software frameworks, and algorithms open up new avenues for ML performance assessment projects to enhance their measurement approaches. Instead of concentrating exclusively on the ML application kernels, our work encourages characterization research across more ML frameworks and SoCs with a balanced focus on the complete system and the end-to-end pipeline. Latency distribution for image classification using Mobile Net v1 on the CPU. We separately compare the distribution in applications to the TF Lite benchmark tool. These research will assist us in creating a more thorough performance model that can assist programmers and SoC architects in accelerating the various phases of the ML pipeline and reducing bottlenecks in ML applications.

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Vedanandaprabhu and Karunakara Reddy

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Application of Pharmacometrics in Indian Scenario

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ABSTRACT

Pharmacometrics is a multidisciplinary approach to pharmaceutical research that highlights the integration of the relationships between illnesses, pharmacological features, and individual variability throughout the research and development phases enabling reasoned and methodologically health - related decision. The primary objective of pharmacometrics is to develop models that promote direction and prediction for pharmaceutical research, including study designs, efficacy correlation, dose regimen improvement, and endpoint assessment, as well as for supporting regulatory decisions and enhancing diagnosis and treatment for specific patient demographics. The article below provides a quick overview of pharmacometrics efforts around the world and its most recent methods. Additionally, describe how pharmacometrics is used in detail in the creation of drugs, their repurposing, and the regulatory authorities' approach to it.

Keywords: Modelling, pharmacometrics, pharmacokinetics, pharmacodynamics, stimulating, pharmaco-economic, repurposing.





INTRODUCTION

Pharmacometrics is a developing field of research that quantifies data on treatments, diseases, and clinical trials to assist with efficient medication improvement and/or regulatory decisions. Pharmaceutical modelling, describe how patient-specific variables, exposure (also known as pharmacokinetics), and response (also known as pharmacodynamics), relate to both desired and undesirable consequences [1]. The influence of placebos, the development of disease, and the relationship between biometrics and improved patient outcomes are all explained by disease models. A participation criteria, patient withdrawal, and commitment are all described in the trial models. Pharmacometrics has traditionally focused on pharmaceutical modelling, also referred to as concentration-effect, dose-response, and PKPD correlations. In the context of clinical, regulatory, and clinical research decisions, these pharmacometric evaluations are developed, carried out, and reported. The most important strength of such analyses is the capacity to absorb knowledge [2].

Three goals guide FDA's pharmacometrics work

1. It is vital to decide whether to approve and label the drug product while paying close attention to the medicine dose for every patient. This has been the main area of attention for the study.
2. Giving sponsors advice on trial design choices is a consulting function where the focus is on trial success as well as creating dose regimens that are likely to be beneficial in all patient populations.
3. Based on the unique data accessible at the FDA, research is conducted to provide new knowledge bases to help with regulatory and drug development decisions (i.e., prior NDA submissions). Studies are conducted to create new models of disease development, the placebo effect, dropout rates, and treatment effectiveness or to confirm those that already exist. In order to represent changes in the main disease endpoints, research is also done to help establish the relevance of biomarkers across clinical trials for a particular disease or drug class [3].

Model types in Pharmacometrics:

1. Pharmacokinetics (PK)- Models which explains the processes of Pharmacokinetic [3,4].
2. Pharmacodynamics (PD)- Models which explains the processes of Pharmacodynamics [3,4].
3. Physiologically based Pharmacokinetics- Models which is physiologically based pharmacokinetics.
4. Exposure-Response- These models explain how exposure (also known as pharmacokinetics) and response (also known as pharmacodynamics) relate to both desirable and undesirable outcomes [3,4].
5. Disease progression- A disease's normal time course is frequently dynamic, with a propensity to go worse without therapy. Disease progression models are mainly used to understand the relationship between therapy, biomarker changes, and clinical outcomes. To determine the disease trajectory, these models monitor changes in a biomarker level or another clinically important endpoint that reflects the sickness condition across time. The three primary groups are empirical, semi-mechanistic, and systems biological disease progression models. Most models of illness progression are empirical and focus more on the course of the disease than on its physiological causes. The simplest model used to represent illness progression is a linear one, where it is assumed that the change in disease state over time is constant [3,4].
6. Trial- These models illustrate how things like patient withdrawal and poor commitment to the dosing schedule might cause variations from the nominal trial methodology [3,4].

History

The earliest citations in the History of Pharmacometrics were found in Lee's works from 1971 and 1976, which is a very recent period. Prior to 1960, the field began with the quantification of drug concentration time courses in bio-fluids (PK) from laboratory studies. Then, researchers created strategies to connect drug exposures to ongoing pharmacologic reactions (PD). To create novel approaches and tools for analysing data from clinical trials, the principles of PK and clinical pharmacology had to be combined [5]. In order to quantify trends in observational data, pharmacometric scientists utilised econometric and biometric approaches (mixed effects modelling) in 1979, expanding the possibilities beyond the small homogeneous investigations [6].





Preeti S. Atanur *et al.*,

Guidelines issued by the US FDA in 1989 (available at www.fda.gov) for the evaluation of medications that are likely to be administered to older patients called for "pharmacokinetic screening," which entails gathering limited PK data from registration trials in order to identify the causes of variability. Later, in 1999 and 2003, the FDA provided industry with instructions on population analysis and exposure-response correlations. By this stage, pharmacometric analyses have been used to support labelling claims on intrinsic and extrinsic variables [3]. The importance of pharmacometrics was characterised by significant breakthroughs in the late 1990s and early 2000s. As a result, pharmacometric studies started to affect decisions about medication approval and development, and the introduction of clinical trial simulations started to turn toward designing trials. Building quantitative disease and medication trial models has been a recent focus of research [7].

Role of Pharmacometrics

In order to support regulatory decisions and improve clinical care for individual patient populations, pharmacometrics aims to develop models that provide guidance and decision assistance for drug development, including trial design, efficacy comparisons, dose regimen optimization, and endpoint analysis [3]. Table 1

Purpose of Pharmacometrics

Pharmacometrics' purpose is to enhance clinical evaluation of efficacy and safety in order to lower costs and accelerate development. In the past ten years, business, academia, and regulatory authorities, with a focus on the US, have choices and opportunities for a greater use of pharmacometric techniques in pharmaceutical research and applied pharmacotherapy, with specific emphasis from the U.S Food and Drug Administration [7].

Utilization of software and population-based modeling

The specialised Physiological based pharmacokinetic modelling and simulation (PBPK) software packages are: PK-Sim: [<http://www.systems-biology.com/products/pk-sim.html>], Simcyp: [<http://www.simcyp.com>], and GastroPlus: [<http://www.simulations-plus.com>], which accept less model development flexibility but also insist less mathematical and modelling expertise. These software programmes give the user the choice of opening an existing model or clicking and dragging to assemble the model structure. They can act as a general whole body PBPK model or duplicate certain PK-related processes (such as intestine absorption or metabolism). Simulating complex absorption, distribution, metabolism, and excretion outcomes including various drug interactions, parent drugs, and parent drug and metabolite profiles is made possible by the additional capabilities, such as Simcyp and PK-Sim. Specialized PBPK modelling software packages are more difficult to use than general purpose software even though they don't require programming knowledge. Users of these software tools should have a solid foundation in clinical pharmacology, including knowledge of pharmacokinetics subjects like drug absorption, distribution, metabolism, and elimination processes, as well as pharmacogenetics and pharmacodynamics, as well as the molecular mechanisms underlying these processes. This is not just because there are a variety of input possibilities and a lot of menus and windows that need to know about these parameters, where they are, and how to use them.

Numerous software tools, including NONMEM, ADAPT, and MONOLIX, have been extensively employed in population pharmacokinetics and population pharmacodynamics. Each of these programmes makes a different number of assumptions regarding the statistical distribution of the derived parameters. The parametric approach of this software firmly assumes either the Gaussian distribution or the Bayesian approach, a semi-parametric perspective with loose assumptions, or a nonparametric (no assumptions) approach. The most popular software programmes are NONMEM and PsN, with Berkeley Madonna, WinNonlin, Monolix, and generic statistical software packages coming in close second and third. The most powerful feature for population pharmacometric modelling right now is the NONMEM programme, which was first developed by Lewis Sheiner and Stuart Beal (ICON Development Solutions, Ellicott City, MD, USA). By today's standards, NONMEM might not be regarded as user-friendly because it must be run from the command line. As a result, a number of free auxiliary software tools have been created to make using NONMEM easier. Phoenix NLME (Pharsight Corporation, Cary, NC, USA) and Monolix (Lixoft, Paris, France) are two further pieces of software created for this methodology and both include graphical user interfaces. Additionally, general statistical tools like SAS (SAS Institute, Cary, NC, USA), S-Plus (TIBCO





Preeti S. Atanur *et al.*,

Software, Palo Alto, CA, USA), and R can be used to perform population pharmacokinetics modelling. The first step in modelling is to look into various structural models, like compartmental PK models. The best combination is then chosen after examining a number of variability models for both residual error models and between-subject parameter variability. In the later stages, covariate modelling typically comes into focus [8].

India Pharmacometrics Network

The Asian Pharmacometrics Network (APN) was established to provide training opportunities throughout Asia by organising educational workshops and yearly regional symposiums to enhance regional pharmacometrics development. As of December 2021, the APN will have a maximum membership of 16 countries, up from nine when it first started in 2017. The Asian Network in Pharmacometrics was established during the first World Conference on Pharmacometrics (WCoP), which was held in Seoul, Korea, from September 5 to 7, 2012 [9].

APN's latest activities

The 2019 APN symposium

The first APN symposium was held on November 19–20, 2019, in Bangkok, Thailand, and was organised by Dr. Korbtham Sathirakul at the Faculty of Pharmacy at Mahidol University. On November 18, 2019, further workshops were held. About 200 people attended the first-ever 2019 APN symposium, which shows that the event was successful in terms of introducing APN. The speaker allocation was also equitably allocated, with 18 speakers invited from nine APN countries (six from Thailand, two from each of India, Japan, Korea, and Taiwan, and one each from Malaysia, Nepal, Singapore, and Sri Lanka). The symposium was held outside of Japan, China, and Korea as part of APN's attempts to improve and broaden networking and regional growth possibilities. The provision of a pan-Asian networking opportunity, which is not present at other major meetings in Asia, including APC, was therefore realised by APN 2019. Drs. Korbtham Sathirakul and Dongwoo Chae of Mahidol University in Thailand and Yonsei University in Korea respectively organised the two satellite workshops, one on quantitative systems pharmacology and the other on PBPK [9,10].

The 2020 APN symposium

Due to COVID-19 constraints, the second APN symposium was held virtually on November 18 and 19, 2019, with no registration fees to promote involvement. Under the leadership of Dr. Surulivelrajan Mallayasamy of the Manipal Academy of Higher Education, it was hosted by the Society of Pharmacometrics and Health Analytics of India. The 2020 APN symposium was once again a success with 365 registrations. The eight APN countries—India, Japan, Korea, Singapore, Thailand, Indonesia, Nepal, and Sri Lanka—were equally represented among the 18 invited speakers, with 16 of them coming from those countries.¹¹

The 2021 APN workshop and symposium

On June 3, 2021, the Faculty of Pharmacy at Universitas Gadjah Mada in Indonesia, under the direction of Dr. Akhmad Kharis Nugroho, held the Basic Pharmacometrics Course Using Monolix training session for the 2021 APN. The goal of the course was to introduce students and scientists who are unfamiliar with or want to learn more about pharmacometrics. 200 people, the maximum allowed, registered for the session. The third APN symposium, which was organised by the College of Medicine at National Taiwan University under the direction of Dr. Yunn-Fang Ho, was also held digitally on November 25 and 26, 2021, and satellite workshops were held on November 21 and 24 as a result of COVID-19 restrictions.

The 2021 APN symposium was a success, comparable to the 2019 and 2020 symposiums. There were 268 attendees, speakers from 10 APN countries (two from Taiwan and one from each of Japan, China, Korea, Singapore, India, Malaysia, Indonesia, Vietnam, and Pakistan), and seven student speakers from APN nations were also invited. Dr. Holford gave a satellite workshop on November 24 with the topic "Disease Progress and Drug Action," which was organised for those to be trained as future workshop instructors. Dr. Vijay Ivaturi gave a satellite workshop on November 21–24 for Pumas with the same topic as his 2020 APN satellite workshop but with advanced material [9].





Preeti S. Atanur *et al.*,

Influence of recent activities of APN

The strong enrolment at APN symposiums thus far has a positive correlation with academic performance in the field. According to a PubMed search, there were 41 more articles on pharmacometrics in APN countries between 2019 and 2021 than there were in China, Japan, and Korea, however this increase could also be linked to other factors [9].

Pharmacometrics Application in Drug development.

Development and progress in tuberculosis

Up to 25 percent of the population, mostly in underprivileged areas, are infected with tuberculosis (TB), which continues to be one of the top sources of mortality from a transmissible disease. Tuberculosis is the leading source of death from a transmissible disease (TB). Mycobacterium TB infection affects 25% of the population, mostly in low- and middle-income countries. Improved population-level dosing of anti-TB medications and concurrently delivered antiretrovirals is now supported scientifically by pharmacometrics approaches. Pharmacometrics is one area where machine learning (ML) and artificial intelligence (AI) approaches are increasingly being used in healthcare. As they have been successfully used in the pharmaceutical industry for drug development, traditional pharmacometric techniques can be integrated with AI/ML to improve medication research [12].

It has been demonstrated that pharmacometric analysis of trial data is more likely to discover relevant exposure-response connections. Model-based analysis was used to uncover a substantial exposure-response association between rifampicin exposure and time-to-positivity in mycobacterial growth incubator tubes that was undetected by traditional statistical analysis. Quantitative systems pharmacology (QSP) models that are more complex can include multiple levels of data. Various data layers are combined using the QSP approach. Preclinical data can be scaled to humans using this method. Plasma drug exposures can also be converted into dynamic concentrations at infection sites. It can be used to incorporate the effects of several medications and account for immunity. The multi-state TB pharmacometric (MTP) model predicts the change in bacterial counts for fast, slow, and non-multiplying bacterial subpopulations, with and without drug effects; the analysis of phenotypic changes in persistent TB bacteria between in-vitro systems and patient sputum; models explaining the spatio-temporal distribution of drugs in granulomas and cavitary TB lesions; Recent research has shown the value of models imitating medication transfer to cerebrospinal fluid (CSF) in directing the management of TB meningitis by correlating poor outcomes with low CSF concentrations of rifampicin and isoniazid. The MTP-GPDI model incorporating QSP model components can accurately predict early clinical trial data by fusing preclinical and translational traits. Pharmacometric analysis is crucial to both vertical integration of data from confirmatory trials to drug discovery in translational medicine. Even now, pharmacometrics is essential to the fight against tuberculosis. Of course, there are challenges involved in implementing pharmacometrics to improve TB treatment. Research findings are frequently complicated, necessitating interpretation and clear explanation of how they might be applied to better patient care. Pharmacometrics has had a significant impact on clinical outcome, particularly in respect to modifications to recommended dose regimens, as the vast majority of TB cases worldwide are treated with standard regimens [13].

Pharmacometrics in the Clinical Development and Pharmacotherapy of Anti-Infectives

The discovery of new anti-infectives and the optimization of treatment regimens and combination therapies for known antimicrobials have recently received a lot of attention due to the growing occurrence of anti-infective resistance in recent years. In current history, the field of pharmacometrics has become an invaluable tool in the pharmaceutical industry, academia, and regulatory agencies for facilitating the integration of preclinical and clinical development data and for providing a scientifically supported framework for rational dosage regimen design and treatment optimization. This field uses quantitative numerical modelling and simulation techniques. The creation and use of new antibiotics has made extensive use of pharmacometrics. Moreover, dose selection of authorised antibiotics already in clinical use has recently received considerable attention, with a strong emphasis on quantitative benefit-risk analyses.¹⁴. The value and usability of pharmacometrics and particular modelling and simulation (M&S) methodologies in the clinical application approach in 3 distinct areas of anti-infective drug development:





Preeti S. Atanur *et al.*,

1. Identifying PK/PD indices and susceptibility thresholds in clinical populations that are predictive of antibiotic activity.
2. Development of optimum dosing protocols for targeted populations, such as young children, as well as general populations, to ensure effective and safe antimicrobial therapy.
3. Improving important study design components for clinical development and post-marketing evaluations [15].

The use of pharmacometric analyses based on modelling and stimulating methodologies has developed over past ten years into the most essential tools for analysing and combining substantial and varied preclinical and clinical data sets and converting it into an instructional knowledgebase. Regulatory agencies are increasingly using internal decision-making to gather and analyse data for labelling and approval because industry leaders believe it is realistic to encourage it throughout phases of the development of pharmaceuticals. The dose of levofloxacin chosen for secondary prevention therapy of inhalational anthrax in children based on pharmacometrics is a typical example of the application of methodology in regulatory statements. A structured population PK model was created using data from two PK trials that included 47 adults at two different dosages (500 mg/kg and 750 mg/kg) and 90 paediatric patients at a dose of 7 mg/kg for 90 paediatric patients. The area under the Curve (AUC), were used to develop dosing recommendations for paediatric patients after a 500 mg/kg dose that, in terms of the highest and minimum concentration during multiple dosing at steady state, mirror adult exposure. A dose regimen of 8 mg/kg two times a day for children 50 kg and younger than 6 months old and 500 mg every day for children weighing 50 kg was advised and included in the labelling material based entirely on this technique [15,16]

Developing model for Leukaemia and other Cancer Cell

The recently created mechanism-based, multi-scale PK-PD model for the innovative chimeric antigen receptor (CAR)-T cells, which are developing into a treatment alternative for leukaemia and other cancers, is a remarkable example of the use of improved decision-making in the process of drug development [17]. (Table-2). These models were developed for the discovery and mathematical characterization of the physiological processes involved with the multiphasic CAR-T cell profile. They were used in the construction of translational cellular kinetics (CK) and cellular dynamics (CD) connection, which incorporated the system-specific and defined the in vitro functional activities, biodistribution and tumour growth inhibition, and clinical PK and other disease biomarkers, drug development, etc. The established CK-CD link was used to answer significant CAR-T cell development-related questions, including Lead Candidate selection, dose E-R connection, First in Human (FIH) threshold dose prediction, and identification of confounders; figuring out how the patient's tumour burden, dosage, and affinity affect the CAR-T cells' clinical PK-PD (preclinical) [18].

The use of pharmacometrics in virtual or simulative clinical trials (VCT)

Pharmacometrics has been used to simulate clinical trials in order to gain an essential deep knowledge of the factors influencing anticipated research results and logically plan clinical trials. Another choice is that they provide a VCT viewpoint without employing any human beings. The virtual Tamoxifen Response by CYP2D6 Genotype-based Treatment-1 study, which replicated the trial utilising the PBPK technique, is a best example of its applicability. (Table-3) Even though the trial was conducted under real-world conditions, this simulation was run to anticipate the initial study results before they were realised. Along with the factors affecting this, it was also evaluated whether the suggested dosing would be more likely to produce optimal results than the traditional standard dosing. This study used physiology-based PK models with produced parameters that were optimised with Cluster Newton Method to assess the trial's outcomes. The findings of this virtual investigation revealed inconsistent conclusions due to sample size effects and the fact that individuals with the same CYP2D6 genotype displayed significant variance in Endoxifen levels. Even though the outcomes of this study have not yet been compared to those of this prediction, it is believed that this information will be useful in creating a clinical trial that will be successful [19].

Drug interaction study using Pharmacometrics

Pharmacometrics may also be implemented to provide information on Drug interaction labelling to the regulatory authorities. By applying the right models, exposures can be simulated in situations where there are few clinical data





Preeti S. Atanur *et al.*,

or where it would be impossible to treat certain populations, and DDIs can be anticipated. Using the PBPK modelling technique to generate, confirm, and predict drug-drug interactions for the anti-cancer medication Osimertinib to inform the label is a current example of this use. According to in vitro research, Cytochrome P450 3A (CYP3A) primarily controls the metabolism of Osimertinib, and both CYP3A inducers and inhibitors may interact with the medicine. The purpose of this study was to forecast this drug interaction and offer the appropriate dosage modifications [20].

Bioavailability/bioequivalence (BA/BE) studies using Pharmacometrics

In addition to its utility in the process of designing new therapeutics, pharmacometrics can be particularly helpful in the Bioavailability/bioequivalence (BA/BE) investigations of essential medicines. This is demonstrated by the public workshop held by the USFDA under the title "Leveraging Quantitative Methods and Modeling to Modernize Generic Drug Development and Review". This workshop revealed the novel role that modelling and simulation play in the "Drug Completion Action Plan's" successful execution as well as in the enhancement of regulatory decisions. The FDA has made clear that it intends to increase funding for initiatives that support the advancement of cutting-edge modelling and simulation technologies and their use in the creation and assessment of generic medications. These techniques decrease the price and time required for product development, increase the first-cycle approval rates for generic drugs, and hasten the approval of secure and efficient generic medications [21]

Development of product specific guideline (PSGs)

In order to improve the process of developing new drugs, regulatory bodies can also use pharmacometrics to create PSGs. The quantitative analysis of the PK-PD connection of misuse opioid medications serves as an example of this research. By educating regulators on the analysis of abuse-deterrent features, this internal USFDA effort aims to assist in the development of guidelines on the "General Principles for Evaluating the Abuse Deterrent of Generic Solid Oral Opioid Drug Products" and PSGs. Utilizing the clinical information made available by the new drug applications, the E-R connections between the different PK parameters and the potential for abuse of three medications were assessed. The study's conclusions suggested that early partial area under the curve (pAUCs) (AUCs) be added to the traditional PK parameters in the rational PSGs in order to build BE with reference products. This is due to the E-R modelling finding that the pAUCs (for instance, pAUC 0–3 hours) and the maximum Drug Liking Visual Analogue Scale are related [22].

Future applications of pharmacometrics and regulatory decision-making

The use of pharmacometrics by organizations and regulatory agencies was seen optimistically in recent research conducted between May and September 2017 and prepared in collaboration with the model informed drug discovery and development workgroup of the European Federation of Pharmaceutical Industries and Associations. The primary audiences for this survey were the USFDA, EMA, and clinical pharmacology colleagues from across industry. According to the consolidated evidence gathered from the target audience, model informed drug discovery and development is currently seen as a growing methodology that is beginning to live up to its promise of improving research efficiency in the years to come. In the next 5 years, a significant increase in its applications and its impact on decision-making is anticipated. The degree to which model informed drug discovery and development techniques have an impact on decision-making has only slightly increased over the last 5 years [23].

Pharmacometrics and Pharmacoeconomics (PE)

As contrast to Pharmacoeconomics models that exclusively focus on economic efficacy, pharmacometric models have up till now been used in Pharmacoeconomics research to build PK-PD-PE models. For evaluating how drug pharmacology influences long-term clinical and financial outcomes, such as cost-effectiveness and value-based pricing, these models provide the ideal framework. The use of a connected pharmacometric/PE model to evaluate the effects of non-adherence and flare resolution on the cost-effectiveness of gout medications is one example among many [24].





Preeti S. Atanur *et al.*,

Benefits in patients with complicated characteristics

The finest application of personalised medicine is frequently required by challenging patient traits and medical situations. Due to the lack of clearly defined clinical objectives, patients who have undergone organ transplantation and are receiving immunosuppressive medication typically need routine effective drug monitoring to keep drug levels within target ranges. When using pharmacometrics in the clinic, this can create a challenging situation. Using pharmacometrics-guided dose in the intervention group and conventional dosing in the control group as an example, the accomplishment of tacrolimus target concentrations in renal transplant patients is compared in the prospective randomised trial. When compared to conventional dosage, the intervention group's Bayesian dosing with Best Dose software delivered significantly more concentrations per patient inside the target range [25]. Another challenging scenario that causes several physiological changes and primarily affects the PK of medicines is pregnancy. In these situations, to predict the usually noticed in medication disposition and alter the prescription, pharmacometric models can be employed. One example of this use is adjusting the dose of the second-generation antipsychotic quetiapine when pregnant. The study developed new dosing regimens to address issues with previously reported quetiapine in pregnant side effects using PK modelling approaches and PBPK models. For the duration of gestation, the target dosage range was set at 50–500 ng/ml, and deviations of the trough concentrations from the target were seen in nearly all populations of pregnant and non-pregnant women in all trimesters. These differences were attributed to a number of processes, including a relative decrease in protein binding and enhanced metabolic clearance. In the second trimester, there was a sharp fall in trough concentration of around 58%, and it was suggested that an increase in quetiapine dosage to 500–700 mg twice day would be a reasonable course of action to address the suboptimal plasma concentrations [26].

Pharmacometrics has also been utilised to improve drug therapy in the neonatal age group, it might be challenging to collect enough samples. To estimate the ideal dosage of opioids for infants, pharmacometrics is being used in response to the sharp rise in neonatal opioid withdrawal syndrome (NOWS). In order to get the best symptom control and the highest weaning rates, one of these studies evaluated the initial dose and up-titration of buprenorphine in NOWS. It accomplished this by relating medication exposure to NOWS symptom scores using a PD model. Simulations showed that, in contrast to the time to wean and the time to quit, which were dosage-dependent, the initial dose had little to no impact on the equilibrium time. Positive effects on stabilisation and weaning were seen when the up-titration rate was increased by 30% along with the initial dose. This model-based strategy makes it possible to implement tailored care guidelines that can reduce the length of hospital Furthermore, by correlating the foetal exposures to the maternal dose, which is frequently illogical and immoral to determine, pharmacometrics can also be applied to identify the foetal exposures. To achieve the stated goal of predicting the likelihood of drug toxicity in infants by assessing foetus exposure to pharmaceuticals across gestational ages, a parent PBPK model has been created and validated for sensitivity [28].

Applications to control overdosing and ADRs

When combined stays and the amount of time needed for treatment for neonates with NOWS [27]. with PBPK models, quantitative systems pharmacology (QSP) and quantitative systems toxicology (QST) models can provide mechanistic insights into the treatment of drug toxicity and overdoses at the bedside. A biologics-inclusive QSP model Managing the immunogenicity of therapeutic proteins, which is a key difficulty during patient care, was the reason PBPK was created [29]. More than 50% of overdose-associated cases of acute liver failure and 20% of liver transplant cases in the US are connected to acetaminophen, the most often prescribed over-the-counter analgesic. Acetaminophen can cause hepatotoxicity in excessive dosages, an issue that remains globally [30]. Pharmacometric models can aid in the early detection of liver toxicity and the requirement for an antidote. A PK/PD model of Acetaminophen was created in a study to link Acetaminophen dosages with a panel of biomarkers, which provided mechanistic insights that improved the prediction of hepatotoxicity [31]. The Rumack-Matthew nomogram, which frequently proves to be inaccurate in predicting the need for appropriate doses of N-acetylcysteine, is frequently used in the management of drug overdose. PopPK models for Acetaminophen overdoses were developed in a study, and a later Bayesian dosing approach was used to quickly and precisely determine when to provide NAC [32].





Preeti S. Atanur *et al.*,

Application of Pharmacometrics in Repurposing: Repurposing approach to Novel Pathogen (NP)

Traditional drug discovery takes too long for new molecular entities focused at NPs to be accepted as first-line therapy. Repurposed drugs (RD), which are generally delivered as commercial products, are highly suited to the pandemic condition. The use of authorized medications is favourable since they usually have a reduced failure rate due to safety issues, particularly during study designs, as well as a shorter time to market and a reduced price. Viral pathogens dominate their bacterial counterparts in terms of quantity, and pandemic infections are frequently either bacterial or viral in form. Although the methods are probably relevant to both, the study described here concentrates on viral pandemics because they are the primary issue being studied. The suggested model-informed drug repurposing (MIDR) strategy makes it easier to decide what matters most and how during a pandemic. This approach has two configurations. The first arrangement is based on analytical activities that get more difficult as one learns more about the Novel Pathogen. In the second arrangement, these quantitative tasks are divided into those that can be finished before a Novel Pathogen emerges, those that can be completed during the pandemic, and that should be viewed as incremental improvements after the pandemic has ended. Both configurations present reasonable perspectives on the same methodology [33].

The first step in analysing the *in vitro* potency of drugs that have shown beneficial against pathogens identical to the clinical isolates of the NP is to acquire information on the mechanism of infectivity and the site of action of infection. Information on *in vitro* potency is contrasted with reported clinically achievable exposures to estimate the chance of reaching clinically efficacious concentrations. (Step 1). Even though there may be some question over the application of the *in vitro* clinical results, these data describe the scope of the information that is relevant. A posology created for the treatment of a marked indication is not necessarily the best option for treating an NP. This is not a given. However, clinical pharmacokinetics (PK) could be researched for RDs that exhibit potential in order to create suggestions for the best posology (Step 2). The sufficiency of the currently available safety data may need to be re-evaluated prior to moving on to clinical trials. We can understand the dynamics of the NP virus more thanks to the accumulation of data over time. This information develops a viral kinetic (VK) model (Step 3), which controls clinical trial design by linking viral life cycle events to the Pharmacokinetics of the medication.

With more RD therapy experience as the epidemic has progressed, it is now possible to compare, contrast, and synthesise. When clinical response data are available, exposure-response (E-R) analysis can be used to determine if the patient group has received an adequate level of exposure and to comprehend the elements that influence response (Step 4). Using this information, queries regarding the preliminary *in vitro* outcomes as well as the dose and regimen specific to the NP can be resolved. Many data points are accessible following a clinical trial, but comparisons are challenging because there are noticeable differences. To statistically evaluate the effects of medication therapy, model-based meta-analysis (MBMA) can be utilised to extract the most information from these trials. (Step 5) [34]. Since pandemics are time-sensitive, challenges with data quality and quantity arise at every level of the model-informed drug repurposing process. Initial *in vitro* and *in vivo* investigations are less likely to be produced in accordance with GLP guidelines. Concerns about clinical trial data quality are also raised when monitoring or data gathering are restricted. Data from the early phases of a pandemic may be used in model-based ways to analyse expected outcomes and the related uncertainty. Weighting methods, which are frequently used to weight research based on sample size, can also be used to get around the unpredictable nature of data quality. The potency information from multiple data sources is weighted in accordance with the validity and quality of the information, particularly as the information quality improves over the course of a pandemic, in *in vitro* or preclinical research. Additionally, studies that incorporate data from the early and late stages of the pandemic could address these changes quantitatively and benefit decision-making when data quality improves and *in silico* models are improved [35].

In the event of a pandemic, logistics and treatment-to-patient decisions can be made easier with the help of model-informed drug repurposing. Prioritizing practical treatments for the clinic is made possible by segmenting the process and utilising the data provided at each phase. By combining RD PK and *In vitro* data, NP VK, clinical endpoints, and MBMA learnings, decision-making and prioritisation can be improved. This model-informed





Preeti S. Atanur *et al.*,

medication repurposing strategy offers a framework for a pragmatic, pharmacometric approach to innovative pandemic preparedness, response and reflection [34].

CONCLUSION

Pharmacometrics is worldwide expanded field which explains the connection between patient specific factors, exposure and response for both desired and undesirable outcomes. Various modelling techniques are used to maintain the accuracy in drug development which include trial design, efficacy decisions and enhancing clinical care for patient. With resemble to modelling and simulation, latest softwares are used. From the above discussion, Pharmacometrics model are applicable in development and progress in many critical diseases, clinical development, and pharmacotherapy. It had widely developed in the repurposing of medicine. Also, pharmacometrics had brought a remarkable scope in regulatory bodies by many of companies and it had a positive impact in educational institution of India. In future, application of pharmacometrics can make a powerful impact on decision making of growing research methodology in India.

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**Preeti S. Atanur et al.,**

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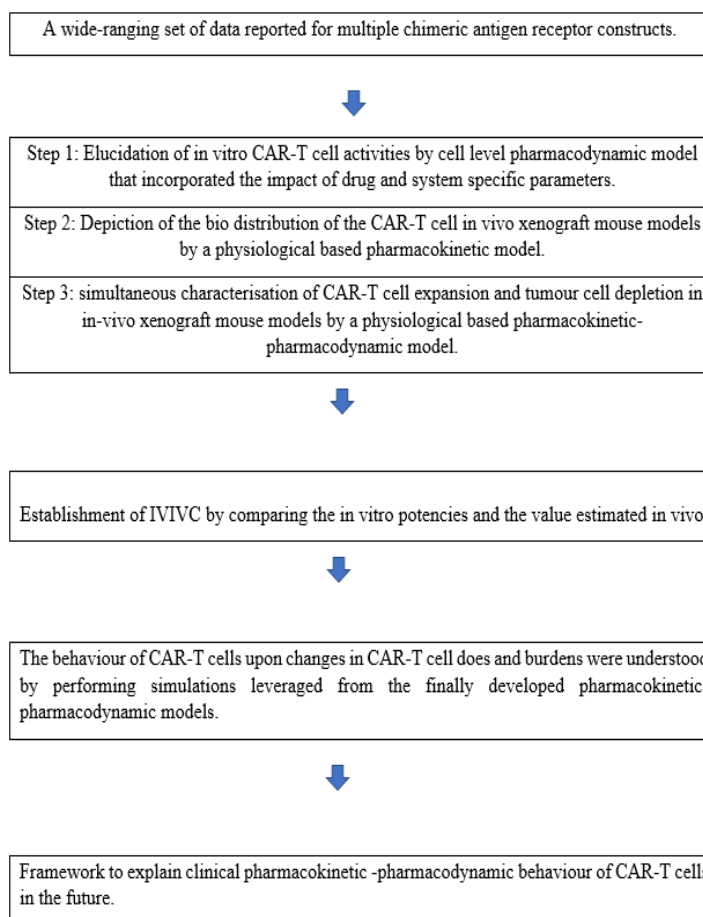




Table 1 Disease Modals Used In Pharmacometrics

No.	Diseases Model	Use
1	Non-small cell lung cancer model	Late phase clinical trial design
2	Parkinson’s disease model	Endpoint selection and clinical trial design.
3	Alzheimer’s diseases model	Endpoint selection and clinical trial design
4	Diabetes diseases model	Clinical trial design
5	Huntington’s diseases model	Patient enrichment and clinical trial design
6	Duchenne muscular dystrophy disease model	Patient enrichment and clinical trial design
7	Human immunodeficiency virus model	Clinical trial design
8	Schizophrenia model	Pediatric extrapolation
9	Bipolar I disorder model	Pediatric extrapolation
10	Weight loss model	Clinical trial design

Table 2: Developing Model for Leukaemia and Cancer Cell





Preeti S. Atanur et al.,

Table 3: Pharmacometrics in virtual and simulative clinical trials.

Step-1	Step-2	Step-3	Step-4
Collection of parameters (physiological, genetic, pathologic, physicochemical, details on metabolic pathway)	Development and inter-connection of individual physiological based pharmacokinetic models for tamoxifen and four of its metabolites using the parameters optimized by CNM	Virtual clinical trial using Monte-Carlo simulation of the virtual study population accounting for inter-individual variability and probability model to link endoxifen tumoral ER levels to clinical response.	Prediction of the outcome of TARGET-I study using the model-based virtually simulated trial

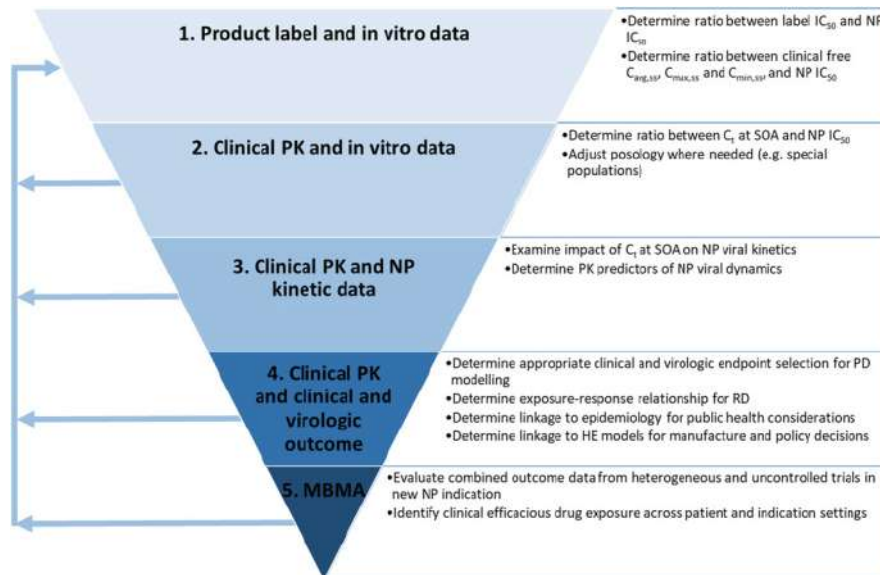


Figure 1. Pharmacometrics in Repurposing





Subspace Inclusion Graphs from Vector Spaces

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ABSTRACT

Algebraic graph theory is a branch of Mathematics in which algebraic methods are applied to problems about graphs. A part from its combinatorial motivation, graph theory also helps to characterize various algebraic structures. It is interesting to study about graphs associated with algebraic structures. Recently, lot of researches have been performed in connecting graph structures to various algebraic objects. In this paper, graphs are associated with subspaces of vector spaces and graph structure is defined on a finite dimensional vector space V over a field F , called subspace inclusion graph of V . Also some properties of graphs are characterized using the algebraic properties of vector subspaces.

Keywords: Girth, Triangulated, Clique number, Chromatic.

INTRODUCTION

A graph $G = (V, E)$ means a non-empty set V and a symmetric binary relation (possibly empty) E on V . The set V is called the set of vertices and E is called the set of edges of G . The graph $H = (W, F)$ is called as a sub graph of G if H itself is a nonempty graph and $W \subseteq V$ and $F \subseteq E$. If all the vertices of G are pairwise adjacent, then G is said to be complete. A complete subgraph of a graph G is called a clique and a maximal clique is a clique which is maximal with respect to inclusion. The clique number of G , written as $\omega(G)$, is the maximum size of a clique in G . The chromatic number of G , denoted as $\chi(G)$, is the minimum number of colours needed to label the vertices so that the adjacent vertices receive different colors. A graph is connected if for any pair of vertices $u, v \in V$, there exists a path

58189





Velwet Getzimah and Kalaiyarasi

joining u and v . A graph is said to be triangulated if for any vertex u in V , there exist v, w in V , such that (u, v, w) is a triangle. The diameter of a graph is defined as $diam(G) = \max_{u,v \in V} d(u, v)$, the largest distance between pairs of vertices of the graph, if it exists. Otherwise, $diam(G)$ is defined as ∞ . The *girth* of a graph is the length of its shortest cycle, if it exists. Otherwise, it is defined as ∞ . In this paper we introduce Subspace Inclusion graph of a Vector Space and find its Clique number, Chromatic number and also discuss some of its properties. Throughout this paper, even if it is not mentioned explicitly, the underlying field is F and V is finite dimensional.

SUBSPACE INCLUSION GRAPH OF A VECTOR SPACE

Definition 2.1:

Let V be a finite dimensional vector space over a field F of dimension greater than 1 and θ as the null vector. We define the subspace inclusion graph of the vector space V as a graph $In(V) = (V, E)$ where V = the collection of nontrivial proper subspaces of V and for $W_1, W_2 \in V, W_1 \sim W_2$ or $(W_1, W_2) \in E$ if either $W_1 \subset W_2$ or $W_2 \subset W_1$. Since, $dim(V) > 1, V \neq \emptyset$.

Lemma 2.2: If V is a vector space over a field F and W is a subspace of V with dimension greater than 1, then $In(W)$ is a subgraph of $In(V)$.

Proof:

The Proof follows from the definition of $In(V)$ and the fact that every subspace of W is a subspace of V .

Lemma 2.3:

If W_1, W_2 are two distinct subspaces of V of same dimension, then W_1 is not adjacent with W_2 in $In(V)$.

Proof:

Let W_1 and W_2 be two distinct i -dimensional subspaces of V . If possible, let $W_1 \sim W_2$. Then without loss of generality, we have $W_1 \subset W_2$ and $dim(W_1) = dim(W_2) = i$.

However, this implies $W_1 = W_2$, giving a contradiction.

Colollary 2.4:

If $dim(V) = 2$, then $In(V)$ is an edgeless graph.

Proof

As $dim(V) = 2$, only nontrivial proper subspaces have dimension 1.

Now, by previous lemma, it follows that no two vertices of $In(V)$ are adjacent.

Corollary 2.5:

$In(V)$ is not complete.

Proof

Since, $dim(V) > 1$, there exists at least two linearly independent vectors α and β in V . Then $\langle \alpha \rangle$ is not adjacent with $\langle \beta \rangle$, thereby proving the theorem.

LEMMA 2.6

If $dim(V) \geq 3$, then $In(V)$ is connected and $diam(In(V)) \leq 3$.

Proof.

Let $W_1, W_2 \in V$. If W_1 and W_2 are adjacent, then $d(W_1, W_2) = 1$.

Let $d(W_1, W_2) \neq 1$.

Case 1

$dim(W_1) = dim(W_2) = 1$.





Velwet Getzimah and Kalaiyarasi

Then $W_1 \sim W_1 + W_2 \sim W_2$, since $\dim(W_1 + W_2) = 2$, $W_1 + W_2 \neq V$ as $\dim(V) \geq 3$. Hence $d(W_1, W_2) = 2$.

Case 2

$\dim(W_1) = 1$ and $\dim(W_2) > 1$.
 Choose $\alpha (\neq \theta) \in W_2$ and let $\langle \alpha \rangle = W_3 \subset W_2$.
 Then $W_1 \sim W_1 + W_3 \sim W_3 \sim W_2$.
 Since $\dim(W_1 + W_3) = 2$, $W_1 + W_3 \neq V$.
 Hence, $d(W_1, W_2) \leq 3$.

Case 3

$\dim(W_1) > 1$, $\dim(W_2) > 1$.
 If $W_1 + W_2 \neq V$ or $W_1 \cap W_2 \neq \{\theta\}$, we have either $W_1 \sim W_1 + W_2 \sim W_2$ or $W_1 \sim W_1 \cap W_2 \sim W_2$ and hence in any case $d(W_1, W_2) = 2$.
 If $W_1 + W_2 = V$ and $W_1 \cap W_2 = \{\theta\}$, choose $\alpha (\neq \theta) \in W_2$.
 Then $W_1 \sim W_1 + \langle \alpha \rangle \sim \langle \alpha \rangle \sim W_2$.
 Here $W_1 + \langle \alpha \rangle \neq V$, as $\dim(W_1) > 1, \dim(W_2) > 1$ and $W_1 + W_2 = V$ implies that $\dim(W_1) < n - 1, \dim(W_2) < n - 1$. Hence, $d(W_1, W_2) \leq 3$.

Theorem 2.7

If $\dim(V) \geq 3$, then $\text{diam}(In(V)) = 3$.

Proof.

Let $\{\alpha_1, \alpha_2, \dots, \alpha_n\}$ be a basis of V and $W_1 = \langle \alpha_1 \rangle$, $W_2 = \langle \alpha_2, \dots, \alpha_n \rangle$. Then W_1, W_2 are two nontrivial proper subspaces of V . Clearly, W_1 is not adjacent with W_2 . If possible, $d(W_1, W_2) = 2$. Then there exists a path $W_1 \sim W \sim W_2$ for some nontrivial proper subspace W of V . Since $W_1 \sim W$, either $W_1 \subset W$ or $W \subset W_1$. If $W \subset W_1$, then W is not adjacent with W_2 as $W_1 \cap W_2 = \{\theta\}$. Thus, $W_1 \subset W$.
 Again, since $W \sim W_2$, either $W_2 \subset W$ or $W \subset W_2$.
 If $W \subset W_2$, then W is not adjacent with W_1 as $W_1 \cap W_2 = \{\theta\}$. Thus, $W_2 \subset W$.
 Combining, we obtain W to be a subspace containing both W_1 and W_2 . Since V is the only such space, $W = V$, which is a contradiction. Thus $d(W_1, W_2) \geq 3$. Again, from previous lemma we get $\text{diam}(In(V)) \leq 3$.
 Thus $\text{diam}(In(V)) = 3$.

LEMMA 2.8:

If $\dim(V) = 3$, then $In(V)$ does not contain any cycle of length 3, 4 or 5.

Proof.

We prove the lemma in three separate cases.

Case 1:

If possible, let $W_1 \sim W_2 \sim W_3 \sim W_1$ be a cycle of length 3 in $In(V)$.
 Since, $\dim(In(V)) = 3$, dimension of each W_i is either 1 or 2.
 As two subspaces of same dimension cannot be adjacent and W_i are pairwise adjacent, $\dim(W_1), \dim(W_2)$, and $\dim(W_3)$ are distinct integers which are either 1 or 2 which is a contradiction.

Case 2:

If possible, let $W_1 \sim W_2 \sim W_3 \sim W_4 \sim W_1$ be a cycle of length 4 in $In(V)$.
 Since, $\dim(In(V)) = 3$, dimension of each W_i is either 1 or 2.





Velwet Getzimah and Kalaiyarasi

As two subspaces of same dimension cannot be adjacent, without loss of generality we can assume that $\dim(W_1) = \dim(W_3) = 1$ and $\dim(W_2) = \dim(W_4) = 2$.
 Let $W_1 = \langle \alpha \rangle$ and $W_3 = \langle \beta \rangle$ where α and β are linearly independent in V , otherwise $W_1 = W_3$. Since, $W_2 \sim W_1$ and $W_2 \sim W_3$ and $\dim(W_1) = \dim(W_3) = 1$, we have $W_1 \subset W_2$ and $W_3 \subset W_2$.
 Thus, $\langle \alpha, \beta \rangle \subset W_2$. However as $\dim(W_2) = 2$ and α, β are linearly independent, $\langle \alpha, \beta \rangle = W_2$. Similarly, it can be shown that $\langle \alpha, \beta \rangle = W_4$ and hence contradicting the distinctness of W_2 and W_4 .

Case 3:

If possible, let $W_1 \sim W_2 \sim W_3 \sim W_4 \sim W_5 \sim W_1$ be a cycle of length 5 in $In(V)$.
 Since, $\dim(In(V)) = 3$, dimension of each W_i is either 1 or 2.
 As two subspaces of same dimension cannot be adjacent, without loss of generality we can assume that $\dim(W_1) = \dim(W_3) = \dim(W_5) = 1$ and $\dim(W_2) = \dim(W_4) = 2$. However, it is contradictory to the fact that W_5 and W_1 are adjacent.
 Thus, combining all the cases, $In(V)$ does not contain any cycle of length 3, 4, or 5.

THEOREM 2.9:

If V be an n -dimensional vector space, then girth

$$g(In(V)) = \begin{cases} 3 & \text{if } n \geq 4 \\ 6 & \text{if } n = 3 \\ \infty & \text{if } n = 2 \end{cases}$$

Proof.

The case $n = 2$ follows trivially from Corollary
 If $n \geq 4$, let α, β, γ be three linearly independent vectors in V .
 Let $W_1 = \langle \alpha \rangle$, $W_2 = \langle \alpha, \beta \rangle$, $W_3 = \langle \alpha, \beta, \gamma \rangle$, Then
 $W_1 \sim W_2 \sim W_3 \sim W_1$ is a triangle and hence its girth is 3.

Note that as $n \geq 4$, none of W_1, W_2 , and W_3 is equal to V and therefore W_1, W_2 and W_3 are proper subspaces of V .
 If $n = 3$, by Lemma, there does not exist any cycle of length 3, 4, or 5. We demonstrate a cycle of length 6 to show that $g(In(V)) = 6$.

Let $V = \langle \alpha, \beta, \gamma \rangle$ and $W_1 = \langle \alpha \rangle$, $W_2 = \langle \alpha, \beta \rangle$,
 $W_3 = \langle \beta \rangle$, $W_4 = \langle \beta, \gamma \rangle$, $W_5 = \langle \gamma \rangle$, $W_6 = \langle \alpha, \gamma \rangle$.
 Then $W_1 \sim W_2 \sim W_3 \sim W_4 \sim W_5 \sim W_6 \sim W_1$ is the required 6-cycle.
 The aforementioned theorem guarantees that there always exist at least one 3-cycle in $In(V)$ when $\dim(V) \geq 4$. Now we prove a stronger result for $In(V)$ when $\dim(V) \geq 4$.

Theorem 2.10.

If $\dim(V) \geq 4$, then $In(V)$ is triangulated.

Proof:

We will show that any vertex of $In(V)$ is a vertex of a triangle.
 If $\dim(V) \geq 4$. For this, we start with a subspace W of V .
 If $\dim(W) = 1$ and since $\dim(V) \geq 4$, there exist two subspaces W' and W'' of V with $\dim(W') = 2$, $\dim(W'') = 3$ and $W \subset W' \subset W''$.
 Similarly, if $\dim(W) = 2$, there exist two subspaces W' and W'' of V with $\dim(W') = 1$, $\dim(W'') = 3$ and $W \subset W' \subset W''$.
 If $\dim(W) = k \geq 3$, then there exist two subspaces W' and W'' of V with $\dim(W') = k - 1$, $\dim(W'') = k - 2$ and $W'' \subset W' \subset W$.
 In any case, we can form a triangle with vertices W, W' , and W'' , and hence the theorem.





Velwet Getzimah and Kalaiyarasi

CLIQUE NUMBER AND CHROMATIC NUMBER OF SUBSPACE INCLUSION GRAPH

Lemma 3.1:

Let M be a clique in $In(V)$, then M is a chain of nontrivial proper vector subspaces of V .

Proof.

Since M is a clique, for any two $W_1, W_2 \in M$ either $W_1 \subset W_2$ or $W_2 \subset W_1$. Thus, any two elements in M are comparable and hence the lemma.

Theorem 3.2:

V is an n -dimensional vector space if and only if $\omega(In(V)) = n - 1$.

Proof:

Let V be an n -dimensional vector space and $\{\alpha_1, \alpha_2, \dots, \alpha_n\}$ be a basis of V .

Let $W_i = \langle \alpha_1, \alpha_2, \dots, \alpha_i \rangle$ for $i = 1, 2, \dots, n - 1$.

Clearly $M = \{W_1, W_2, \dots, W_{n-1}\}$ is a clique.

If possible, let $M \cup \{W\}$ be a clique where W is a nontrivial proper subspace other than W_i 's.

Thus by Lemma, there exists $k \in \{1, 2, \dots, n - 2\}$

such that $W_k \subset W \subset W_{k+1}$.

Since, each inclusion is proper and V is finite dimensional, we have $\dim(W_k) < \dim(W) < \dim(W_{k+1})$ i.e., $k < \dim(W) < k + 1$, which is a contradiction.

Thus M is a maximal clique of size $n - 1$. Finally, we prove that there does not exist any clique of size n .

If possible, let $M' = \{W'_1 \subset W'_2 \subset \dots \subset W'_k\}$ be a clique of size n .

Again, as each inclusion is proper and V is finite dimensional, we have $0 < \dim(W'_1) < \dim(W'_2) < \dots < \dim(W'_n) < n$.

As $\dim(W'_i)$ are distinct integers between 1 and $n - 1$, we have n integers in $[1, n - 1]$ which is a contradiction.

Thus, the clique number of $In(V)$, $\omega(In(V)) = n - 1$.

For the converse, let $\omega(In(V)) = n - 1$. If possible, let V be of dimension m . Then by the above mentioned arguments, $\omega(In(V)) = m - 1$. Thus, $m = n$ and hence the proof.

Corollary 3.3:

Let V_1 and V_2 be two finite dimensional vector spaces over the same field F . Then V_1 and V_2 are isomorphic as vector spaces if and only if $In(V_1)$ and $In(V_2)$ are isomorphic as graphs.

Proof

It is quite obvious that if V_1 and V_2 are isomorphic as vector spaces, then $In(V_1)$ and $In(V_2)$ are isomorphic as graphs. For the other part, let $In(V_1)$ and $In(V_2)$ be isomorphic as graphs. Let $\dim(V_1) = n_1$ and $\dim(V_2) = n_2$.

Then, by Theorem, the clique numbers of $In(V_1)$ and $In(V_2)$ are $n_1 - 1$ and $n_2 - 1$, respectively.

However, as the two graphs are isomorphic,

$n_1 - 1 = n_2 - 1$, i.e., $n_1 = n_2 = n$ (say).

Thus V_1 and V_2 are of same finite dimension over the field F and hence both are isomorphic to F^n as vector spaces.

Corollary 3.4

If V be an n -dimensional vector space with $n \geq 6$, then $In(V)$ is not planar.

Proof

Since $\omega(In(V)) = n - 1$, for $n \geq 6$, $In(V)$ has a clique of size at least 5. That is, it has a complete graph K_5 as a subgraph. Thus, it is not planar.





Velwet Getzimah and Kalaiyarasi

Theorem 3.5:

If V be an n -dimensional vector space, then $\chi(In(V)) = n - 1$.

Proof.

As clique number of $In(V)$ is $n - 1$, then $\chi(In(V)) \geq n - 1$. To establish the equality, we demonstrate a $n - 1$ colouring of $In(V)$ for $W \in V$, colour W with the i^{th} colour if $dim(W) = i$. This is a proper colouring, As the lemma ensures that two i -dimensional subspaces are never adjacent, the theorem follows.

PROPERTIES WITH FINITE FIELDS:

In this section, we study some properties of $In(V)$ if the base field F is finite, say of order $q = p^r$ where p is a prime.

Proposition 4.1: Let V be an n -dimensional vector space over a finite field of order q . Then $In(V)$ is a graph of order $G(n, q) - 2$, where $G(n, q)$ is the Galois number.

Proof

Since, the number of k -dimensional subspaces of an n -dimensional vector space over a finite field of order q is the q -binomial coefficient

$$\binom{n}{k}_q = \frac{(q^n - 1)(q^{n-1} - 1) \dots (q^{n-k+1} - 1)}{(q^k - 1)(q^{k-1} - 1) \dots (q - 1)},$$

the total number of nontrivial proper subspaces of V is given by

$$\sum_{k=1}^{n-1} \binom{n}{k}_q = G(n, q) - 2.$$

Theorem 4.2

If W is a k -dimensional nontrivial proper subspace of V , then $deg(W)$ in $In(V)$ is

$$\sum_{i=1}^{k-1} \binom{k}{i}_q + \sum_{i=1}^{n-k-1} \binom{n-k}{i}_q.$$

Proof:

If W is a k -dimensional subspace of V , then the non-trivial proper subspaces of V which are adjacent to W are the non-trivial subspaces of V properly contained in W and the proper subspaces of V properly containing W .

Now, by theorem, the number of nontrivial subspaces of V properly contained in W is

$$\sum_{i=1}^{k-1} \binom{k}{i}_q$$

For the number of proper subspaces of V properly containing W , we observe that proper subspaces of V containing W are in one-to-one correspondence

with nontrivial proper subspaces of $\frac{V}{W}$.
That is, $\{A : W < A < V\} \leftrightarrow \{B : 0 < B < \frac{V}{W}\}$.

Thus, by applying Proposition 6.1 on $\frac{V}{W}$ of dimension $n - k$, we get the second count as

$$\sum_{i=1}^{n-k-1} \binom{n-k}{i}_q.$$

Hence, the theorem.





Velwet Getzimah and Kalaiyarasi

Corollary 4.3

If W_1 and W_2 be k and $(n - k)$ dimensional nontrivial proper subspace of V respectively then $deg(W_1) = deg(W_2)$ in $In(V)$.

Proof

From theorem 4.2 and using the observation that

$$\binom{n}{k}_q = \binom{n}{n-k}_q.$$

We have the result $deg(W_1) = deg(W_2)$ in $In(V)$ where W_1 and W_2 are k and $(n - k)$ dimensional nontrivial proper subspace of V .

CONCLUSION

In this paper, the subspace inclusion graph of a finite dimensional vector space is introduced and various inter-relationships among $In(V)$ as a graph and V as a vector space have been studied. The main goal of these discussions will bring into focus, the basic properties of completeness, connectedness, clique, and chromatic number. As a topic of further research, one can look into the structure of dominating sets and independent sets of such graphs in the case when F is finite.

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Effect of Catalyst Preparation and Temperature on Growth of Multiwall Carbon Nanotubes by Chemical Vapor Deposition

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ABSTRACT

The thermal chemical vapor deposition is most conventional and economical for the growth of multivalued carbon nanotubes. The robust technology is enable to prepare bulk carbon nanotubes for industrial manufacturing. The powder catalyst are the base of the nanotubes growth. This paper reports on the role of ball milled catalyst for Carbon Nanotube (CNT) growth in Chemical Vapor Deposition (CVD). To identify the effect of planetary ball milling and the effects of two different growth temperatures in CVD were investigated. The surface morphology was analyzed using the Scanning Electron microscope (SEM) and Transmission electron microscope. It's clearly shows the growth parameters were influenced morphology of the nanotube based on the milling time of the catalyst. It reveals that 60 minutes ball milled catalyst at growth temperature 850°C give gave better result.

Keywords: Multiwall carbon nanotubes, ball milling, Chemical vapor deposition.

INTRODUCTION

The upcoming nanotechnology and the nanostructured materials draw the industry and academic science community. Nanomaterials are going to play the important role in the upcoming industry revolution. The famous chemical element with atomic number 6 is called Carbon. The allotropes of Nanostructured carbon materials are Carbon nanotubes, Graphene, Fullerene. Among these Carbon nanotube is showing the promising future. The carbon nanotube were classified as single walled carbon nanotube (SWCNT) and Multiwall Carbon nanotube (MWCNT). Multi walled Carbon nanotubes have attracted researchers due to their unique one-dimensional nanostructure



**Pradeep and Uma**

properties [1]. Various methods were used for growth of multi-walled nanotubes (MWNTs), including arc-discharge [2], laser ablation [3], and chemical vapor deposition (CVD) methods.

Among the other methods Chemical vapor deposition (CVD) is one of the best methods to grow high-quality, high-purity MWNT's. Different techniques were used to grow as single walled carbon nanotube (SWCNT) and Multiwall Carbon nanotube (MWCNT) in CVD. For the Multiwall Carbon nanotube growth Catalyst were used as the base material. In the chemical vapor deposition method catalysts which were used for the growth of nanotubes were of several types such as thin film catalysts [4], wet catalyst [5] and powder catalysts. The preparation of catalysts playing important role in carbon nanotube growth in the thermal chemical vapor deposition. Many ways to prepare the catalyst depending on the final application of the nanotubes such as co-precipitation [6], impregnation [7], Sol-Gel Technique [8], combustion route [9], Solvothermal process [10] were used.

Various method of Preparation of multiwall carbon nanotube have been reported so far however the preparation method parameter vary the size and shape of the carbon nanotubes. The Preparation method effect the final carbon nanotube structure and shape. As per the literature survey catalyst structure and shape are playing important role for the carbon nanotube synthesis. It's worth to prepare catalyst on different parameters and analyze the carbon nanotubes. In this paper we report the influence of catalyst preparation conditions for the synthesis of multi-wall carbon nanotubes (MWCNTs) by thermal chemical vapor deposition (TCVD).

EXPERIMENTAL

Catalysts

A set of catalysts were prepared using Mo: Fe: Al₂O₃ mixture and its characterized, and these catalysts were use to grow carbon nanotubes in different temperature conditions in thermal chemical vapour deposition technique.

Preparation of Catalysts

The catalyst of Mo: Fe: Al₂O₃ used in this report was obtained in the steps as follows:

All materials used in this experiment are research-grade from different suppliers. The powders Mo: Fe: Al₂O₃ molar ratio was mixed. Few grams of ammonium hexa molybdate tetra hydrate were added to the Mo: Fe: Al₂O₃. The mixing of powder was added to ferrous sulphate heptahydrate and alumina powder in methanol. The solvent was evaporated at 100°C in 2hrs using magnetic stirrer. The final product was a yellow colored powder. The mixture powder was annealed with argon gas for 1hr at 800°C. The end product was a grey colored powder. The annealed sample powder is ball milled. The ball-milling was carried out at a rotation speed of 250 rpm in the ratio of ball to powder is 10:1 under air atmosphere. Two different milling times of 30min and 60 minutes were taken.

Growth of carbon nanotubes

The two different catalysts are prepared by ball milling for 30 minutes and 60 minutes respectively were used to grow nanotubes at two different temperatures at 800°C, 850°C. The carbon nanotubes preparation was done using the thermal CVD. An alumina boat was loaded with about few mg of (Mo, Fe, Al₂O₃) catalyst and it was fed into a quartz tube. It was heated till the required temperature under an Argon (Ar) flow for preheating. The Argon flow was shut off and Acetylene (C₂H₂) of and Hydrogen (H₂) was introduced in growth temperature. After a reaction time of 60 min, the C₂H₂, H₂ flow was switched back to Ar while the system was cooled to room temperature. The final product was a black powder.





Pradeep and Uma

RESULTS AND DISCUSSION

X-Ray Diffraction (XRD) Analysis

Figure 2 shows the XRD patterns of the milled powder mixture containing (Mo, Fe, Al₂O₃) after the milling time of 1hr. The ball milled powder causes only a small difference, except the broadening of Bragg peaks which is caused by reduction of the crystallite size and increase in the lattice strain.

SEM shows the amount of product from two different growths

Temperatures and gas pressures with fixed flowing gas of C₂H₂, H₂ are also shown. The following figures illustrate the typical surface features of carbon nanotubes growth temperature at 800°C and 850 °C for the catalysts of 30min ball milled. To study the effect of different ball milling conditions on catalyst. Formation we performed growths for two different temperatures at 800°C, 850 °C. In Figure 3 (a) The SEM image shows clearly the samples contain small amount of carbonaceous by-product such as, a-C. A twisted nanotube with different lengths structure was attained exactly from fewer catalyst clusters. This is because carbon nanotubes need less than a micrometer size of catalyst particles for nucleating growth especially in the chemical vapor deposition technique. The 30min ball milled powder was not able to form smaller catalyst particles within the short period so the CNT yield is very less. In Figure 3 (b) The SEM image indicates that CNT yield is more compared to, at 800°C along with carbonaceous by- product. At 850°C, twisted coiled and thicker diameter nanotubes are grown. It can be seen the diameter of the tubes varies, and this indicates there was not enough time for milled the catalyst particle, even though the yield of nanotubes is higher because of higher temperature which led to decomposition of hydrocarbon [11], hydrocarbon gas cannot grow CNT without small size catalyst.

In Figure 4 (a) The SEM image shows, short carbon nanotubes were found in the sample grown for 800°C temperature, the 60min ballmilled helps yield more nanotubes compared to 800°C min for 30min milled powder, however the yield is less because of the imperfection in catalyst size and as its not in nanoregime. The XRD evidence also explains the catalyst characteristics. Even at this stage, the impact energy was not enough to break down the particle. It has proved that the nanotube growth the particle size was considered as the most important factor [12].

Figure 4(b) at the higher temperature, the of CNT growth were high.it has been captured as shown in the figures that high-dense CNT has been successfully synthesized at the higher synthesis temperature (850 °C). By increasing the ball milling time the catalyst geometry and size were affected. It can also be seen that there were no catalyst particle detected in the image that indicates the catalyst particle were become nanotubes. Most interestingly, the hydrocarbon source may all decompose at the higher temperature, the prepared CNT diameter range between 20nm to 40nm and length of the nanotubes ranges from few nm to micrometer.

Observation and Analysis of Transmission Electron Microscope (TEM)

Figure 5 shows TEM and HRTEM images of CNT was grown at 850°C temperature, ball milled at 60 minutes. Low magnification TEM images shows in Figure 5(a) indicates randomly distributed carbon nanotubes. Some of the nanotubes were coiled and few of the nanotubes are sharp bended. Figure 5(b) shows the HRTEM image of the single nanotubes, it clearly shows that the nanoparticles are on the surface of the CNT . The Figure 5(c) shows the closed end of the nanotube which can be spotted in middle of the lengthy nanotubes. This is quite peculiar growth of CNT. Catalyst particle can be spotted on tip of the nanotubes as well as the middle of the nanotubes. Figure 5 (d) shows the higher magnification of the tip of the nanotubes. Perfectly aligned multi walls are clearly visible in this image. Figure 5 (e) and 5(f) shows respectively sharp end tip, bended nanotubes.

CONCLUSION

Multiwall nanotubes were grown from two different milling time catalyst of Mo: Fe: Al₂O₃ using Thermal chemical vapor deposition (CVD) method. The grown nanotubes have shown effective ways ball milling has played a



**Pradeep and Uma**

significant role, along with growth temperature chemical vapor deposition. Based on the result, the formation of CNT has synthesis temperature at 850°C which is in good agreement with FESEM and TEM. At 850°C nanotube morphology and growth were good without impurity of catalyst compare than ball milled growth temperature parameters. As a concluded, synthesis temperatures and milling catalysts were strongly affected by the growth of CNT.

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Pradeep and Uma



Figure 1: Image of Thermal CVD

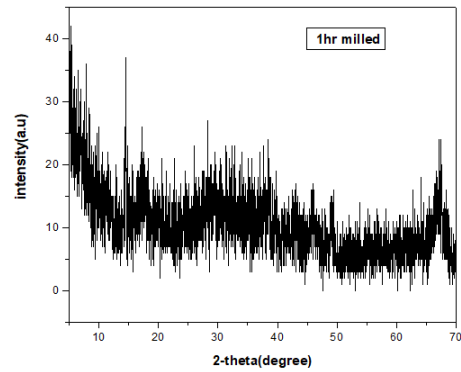


Figure 2: XRD Spectrum of Catalyst

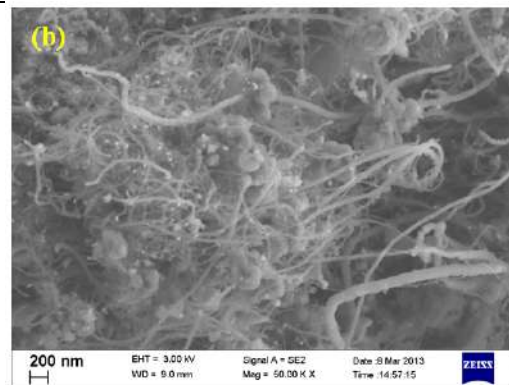
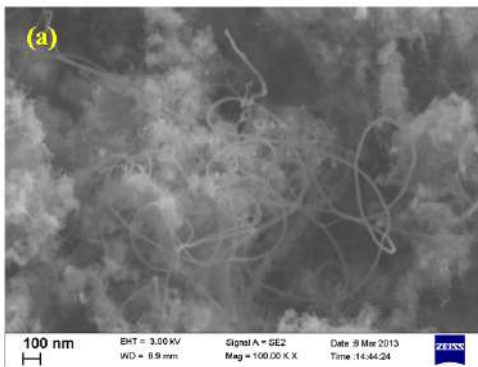


Figure 3: SEM images of Carbon nanotubes 30 minutes ballmilled (a) 800°C (b) 850 °C

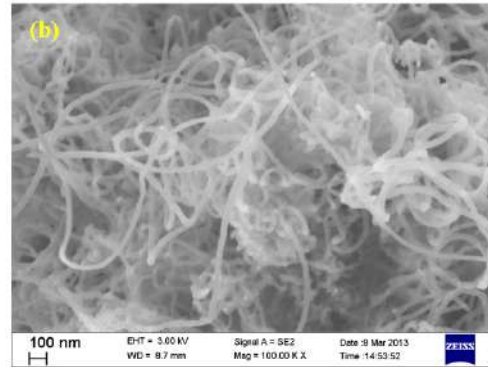
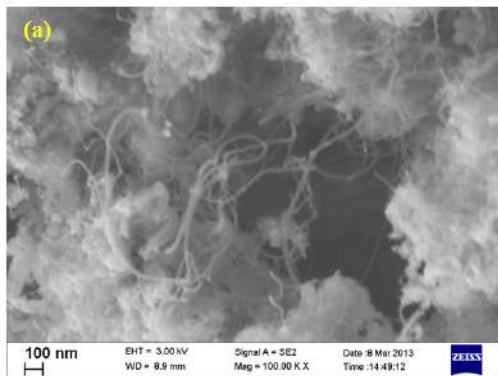
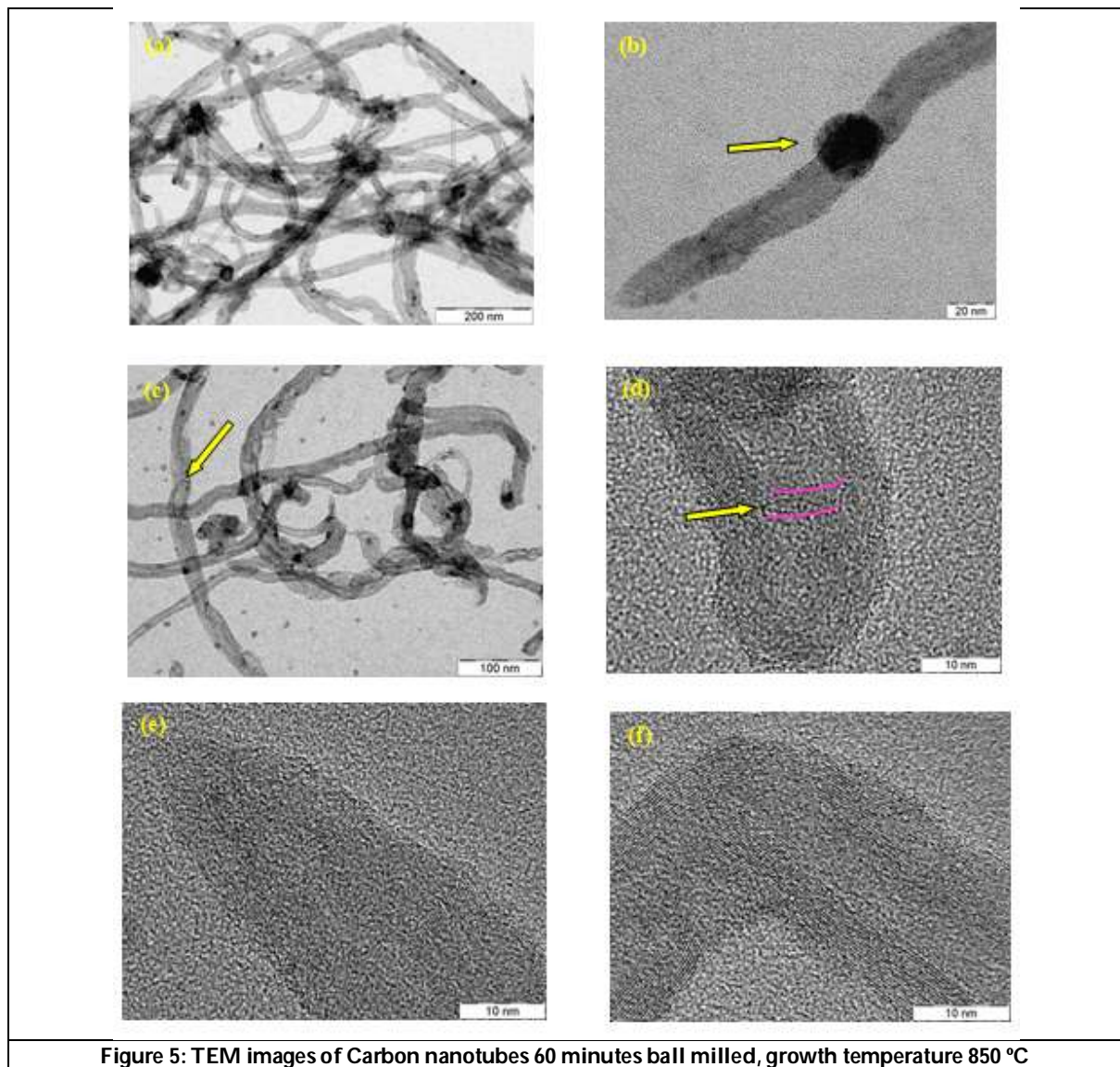


Figure 4: SEM images of Carbon nanotubes 60 minutes ballmilled (a) 800°C (b) 850 °C





Pradeep and Uma





Paired Neighbor Connected Dominator Coloring Set in Graphs

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ABSTRACT

In this paper, paired neighbor connected dominator coloring of a graph is combined with a real life application. Let $G(V, E)$ be a graph such that a set $S \subseteq V$ is a neighborhood set of G such that $G = \bigcup_{v \in S} \langle N[v] \rangle$, where $\langle N[v] \rangle$ a subgraph of G induced by v and containing all vertices adjacent to v . A neighborhood set $S \subseteq V$ is said to be a paired neighbor connected dominator coloring set (pnd-set) of G if each color class $V_i; 1 \leq i \leq k$ contains atleast one vertex, which belongs to S . The minimum cardinality taken over the set of all paired neighbor connected dominator coloring of graph G is called the paired neighbor connected dominator chromatic number and is denoted by $\chi_{pnd}(G)$. We derive bounds for general graphs and characterize corresponding extreme graphs.

Keywords: Domination number, paired neighbor connected dominator chromatic number (pnd-set), Paired neighbor connected domination number.

INTRODUCTION

Let $G(V, E)$ be a graph, where V and E the vertex and edge set of G . Denote $V = p$ and $E = q$, refer to [1] and [2]. The topic of the coloring and dominating set can be referred to [3,4]. The concept of dominator coloring was





Jothiraj and Chandralekha

studied in [5]. For more details on neighborhood sets and its related parameters, refer to [6, 7]. The idea of neighborhood connected domination in graphs is referred to [8]. The idea of cyclic open shop scheduling in a circular coloring and paired neighbor connected dominator coloring of circular-arc graphs in [9]. Minimizing the C_{\max} , another well-studied objective in scheduling theory is to minimize the sum of completion times of jobs, which is the same as minimizing the average completion time. A related coloring problem is minimum sum coloring, introduced in [10]: We are looking for the color of the conflict graph such that the sum of the colors assigned to the vertices is minimal. Except for trees, partial k-trees, and tree edges, minimum sum coloring is *NP-hard* on most types of graphs.

On the other hand, it turns out that the sum of the colorings is easier to approximate than the C_{\max} [11, 12]. This is because the sum of the coloring and the C_{\max} of the coloring will be very different when recoloring a small part of the graph. If we recolor a small part of the graph, this change has only a small effect on the sum of the colors, but it changes the C_{\max} significantly. In this paper, we use this idea to construct a paired neighbor connected dominator chromatic number; a paired neighbor two dominator number, and a scheduling theory of G . The following is the plane of the paper: Section 2 preliminary results. Section 3 discusses Paired neighbor connected dominator coloring using bipartite graphs. Section 4 discusses a Paired neighbor connected two dominating number. Section 5 gives the conclusions.

Preliminary results

Theorem 2.1 [5]. Let G be a connected graph of order $p \geq 2$. Then $\chi_d(G) = 2$ iff G is a complete bipartite graph of the form $K_{a,b}$, where $1 \leq a \leq b \leq p$ and $a + b = p$.

Theorem 2.2 [5]. Let G be a connected graph of order p . Then $\chi_d(G) = 2$ iff G is the complete graph K_p .

Paired neighbor connected dominator coloring using bipartite graphs

Theorem 3.1. Let G be a connected bipartite graph. Then $2 \leq \chi_{pnd}(G) \leq \left\lfloor \frac{p}{2} \right\rfloor + 1$. The bounds are sharp.

Proof. Let G be a connected bipartite graph. Each paired dominator color must be a perfect color, and $\chi_{pnd}(G) = 2$, such that $\chi_{pnd}(G) \geq 2$. For an upper bound, let V_1 and V_2 be two bipartite sets of G . $|V_1| \leq |V_2|$. Then assign colors $1, 2, \dots, |V_1|$, for the vertices of V_1 , and the color $|V_1| + 1$ for the vertices of V_2 is a paired of neighboring connected dominator colorings, in which the vertices of V_1 give the dominating color classes since the vertices G are connected. Thus $\chi_{pnd}(G) \leq |V_1| + 1$, and $|V_1| \leq \left\lfloor \frac{p}{2} \right\rfloor$, the result follows.

Now, for the sharpness of limits, the complete bipartite graph $K_{a,b}$ ($a, b \geq 2$) has a paired of neighboring connected dominator chromatic number 2, so the lower limit is sharp. For the upper bound, consider the corona of the path P_p , which is the graph obtained from P_p by attaching a pendant to each end of the path. Since each pendant or its stem must belong to a dominating set, the vertices of the path form a minimal dominating set of P_p , so $\gamma(P_p) = p$. Also, color assigning colors $1, 2, \dots, p$ for the vertices of P_p , and the color $p + 1$ is $V(P_p) -$ is a minimal paired connected dominator coloring. To see that, note that each pendant dominates its own color class. So





Jothiraj and Chandralekha

atleast p vertices must get their unique color, and the remaining vertices need atleast one more color. Hence

$$\chi_{pnd}(P_p) = \left\lfloor \frac{p}{2} \right\rfloor + 1.$$

Theorem 3.2. Let G be a bipartite graph of order atleast 2. Then $\chi_{pnd}(G) = 2$ iff $G = K_{m,n}$.

Proof. If $G = K_{m,n}$, then a paired of neighboring connected dominator colors assigns one color to one bipartite set and another bipartite set is a paired neighbor connected dominator coloring, so $\chi_{pnd}(G) = 2$. Thus $\chi_{pnd}(G) = 2$ for some bipartite graph G . Then, up to isomorphism, there is a unique dominator coloring that assigns color 1 to the bipartite set V_1 and color 2 to the bipartite set V_2 . We want to show that we have a complete graph. We consider two cases.

Case 1. $|V_i| = 1, i = 1$ or $i = 2$. Then $G = K_{1,n}$, which is a complete bipartite graph. Hence, both $|V_i| \geq 2$, for $i = 1, 2$.

Case 2. $|V_i| \geq 2$, for $i = 1$ or $i = 2$. Let $x \in V_1$. Since x cannot dominate the color class of V_1 , x dominates all vertices in V_2 . Similarly, for some vertex $y \in V_2$, y must be near all vertices of V_1 , and the result follows.

Theorem 3.3. Let G be a bipartite graph. Then $\gamma_{pnd}(G) \leq \chi_{pnd}(G) \leq 2 + \gamma(G)$.

Proof. Let c be a minimal paired neighborhood connected to the dominator coloring of G with colors $1, 2, \dots, \chi_{pnd}(G)$. For each color class of G , with $1 \leq i \leq \chi_{pnd}(G)$, let x_i be a vertex in color class i . Consider the set $S = \{x_i : 1 \leq i \leq \chi_{pnd}(G)\}$. Let S be a paired neighbor connected two dominating set.

Let $x \in V(G)$. Each vertex of G must dominate a color class, and since dominance is reflexive, x dominates all vertices of some color class of G . S is dominated by a few peaks. Thus the dominator is a lower bound for the connected dominator chromatic number in the paired neighbor connected dominator chromatic number in the graph. For the upper bound, since the chromatic number of a bipartite graph G is two, we can color the vertices of G by interchanging two colors, a and b ($a \neq b$), so that no two adjacent vertices are shared the same color. Now, define a paired neighbor connected two coloring dominator coloring of G by assigning the colors $1, 2, \dots, \gamma(G)$, joins the two dominating sets S of G to the minimal paired of neighboring vertices, and let the remaining vertices be colored a and b as before.

Note that this is a paired neighbor connected dominator coloring of G because (1) it is a perfect coloring because no two adjacent vertices share the same colors, and (2) the vertices of any two connected dominating paired provide color classes. Each vertex of G is dominantes.

Theorem 3.4. For any complete multipartite graph $G = K_{r_1, r_2, \dots, r_k}$ with $r_1 \leq r_2 \leq \dots \leq r_k$ vertices, $\chi_{pnd}(K_{r,s}) = r_1 + k - 1$.

Proof. Clearly, $K_{r,s}$ is a complete bipartite graph with partition sets V_1 and V_2 . Hence $\chi_{pnd}(K_{r,s}) = 2$. By choosing all r – vertices from the vertex color class of say minimum cardinality V_1 , those r – vertices cover all





Jothiraj and Chandralekha

edges of the graph $K_{r,s}$. Adding any vertex of the other color class, we obtain the minimal paired neighbor connected dominator color set of $K_{r,s}$.

Theorem 3.5. Let G be a graph with $\delta(G) = 1$. Let V_1 be the set of all support vertices of G and $|V_1| = k$. Then $\chi_{pnd}(G) = k + 2$ if and only if the following conditions are satisfied:

- (i) $\langle V - V_1 \rangle$ is a trivial bipartite graph, and
- (ii) If V_1 is not a dominating set, then $\langle V - V_1 \rangle$ a complete bipartite graph $V_2 = V - N[V_1]$ is one of the disjoint sets.

Proof. Let $\chi_{pnd}(G) = k + 2$. $C = \{[v] : v \in V_1\} \cup \{C_1, C_2\}$ is a dominator color of G with a $\chi_{pnd}(G)$ – paired of neighbor connected such that C_1 contains all pendant vertices of G . A trivial bipartite diagram with clearly bipartite C_1, C_2 . Now, suppose that V_1 is not a dominating set. Then $V_2 = V - N[V_1] \neq \emptyset$ and every vertex of V_2 dominates the color class C_2 . It follows that $V_2 \subseteq C_1$ or $V_2 \subseteq C_2$. Hence, $\langle V - V_1 \rangle$ as a complete bipartite graph, V_2 has a non-trivial component that is one of the sets of segmentation.

Conversely, assume that (i) and (ii) are satisfied. Clearly $\chi_{pnd}(G) \geq k + 2$. Now if V_1 is a dominating set, then $\{[v] : v \in V_1\} \cup \{C_1, C_2\}$, where C_1, C_2 is a dominator coloring of G that is a bipartition $\langle V - V_1 \rangle$ of a $\chi_{pnd}(G)$ – connected side. If V_1 is not a dominating set, then $\{[v] : v \in V_1\} \cup \{C_1, C_2\}$, where C_2 is a connected dominator coloring of V_2 and all isolated vertices $\langle V - V_1 \rangle$ are a $\chi_{pnd}(G)$ – paired neighbor connected dominator coloring of G . $\chi_{pnd}(G) = k + 2$.

Theorem 3.6. Let k be an integer with $2 \leq k \leq \lfloor \frac{p}{2} \rfloor + 1$. Then a connected bipartite graph G and paired neighbor connected dominator chromatic number k and order p .

Proof. Consider the graph G derived from the P_k path with $V(P_k) : v_1, v_2, \dots, v_k, v$ by adding the vertices u_1, u_2, \dots, u_k , so that $u_i v_i \in E(G)$ for all $i (1 \leq i \leq k)$, and v_k by adding $p - 2k$ vertices $u_j (0 \leq j \leq p - 2k)$. Then the set v_1, v_2, \dots, v_k forms a minimum paired neighbor connected two dominating set, since each pendant $u_i (0 \leq i \leq k)$ must belong to any paired v_i or u_i a minimum paired neighbor connected two dominating set. Thus $\gamma(G) = k$. On the other hand each pendant $u_i (0 \leq i \leq k)$ dominates its own color class.

Theorem 3.7. Let G be a connected graph of order p . Then $\chi_{pnd}(G) = 2$ iff $G \cong K_{m,n}$, for some $m, n \in N$.

Proof: First $\chi_{pnd}(G) = 2$. Let C_1 and C_2 be two color classes of G . Let $x \in C_1$. Since x cannot dominate C_1 , it must dominate C_2 . Also at any vertex $y \in C_2$, y dominates C_1 . Thus G is a complete bipartite graph with segmentation C_1 and C_2 . Hence $G \cong K_{m,n}$, for some $m, n \in N$.

Observation 1. For any bipartite graph $\omega(G) \leq \gamma(G) \leq C_{\max} \leq \chi(G) \leq \chi_d(G) \leq \chi_{pnd}(G) \leq \Delta(G)$.





Jothiraj and Chandralekha

Theorem 3.8. Let G be a connected graph of order p . If $\Delta(G) = p - 1$, then $\chi_{pnd}(G) \leq \chi_d(G) \leq \chi(G)$.

Proof. Let $f = V_1, V_2, \dots, V_m$ be a perfect coloring of G , where $m = \chi(G)$, and $V_1 = \{v\}$ for some vertex $v \in V(G)$. Then $v > V_i$ for every vertex $v \in V(G) - V_1$. and for every $2 \leq i \leq m$, $v > V_i$. Hence f is a paired coloring of neighbors connected to the dominator coloring of G with $\chi(G)$ coloring classes, so $\chi_{pnd}(G) \leq \chi_d(G)$. Now observation 1 implies that $\chi_{pnd}(G) \leq \chi_d(G) \leq \chi(G)$.

Paired neighbor connected two dominating number.

Definition 4.1

If every vertex in $V - S$ is adjacent to atleast two vertices in S and the induced subset is connected, then a set $S \subseteq V$ is a two-dominated set of a graph G called a Paired neighbor connected two dominating set(pnd-set). The minimal cardinality of a pnd-set of G is called a Paired neighbor connected two domination number of G and is denoted by $\gamma_{pnd}(G)$.

Theorem 4.1. A superset of a paired of neighbors connected to a two-dominant set is a paired-neighbor connected superset of two dominating set.

Proof. Let S be a paired of neighbors connecting two dominating sets of a graph G and let $S_1 = S \cup \{v\}$, where $v \in V - S$. Clearly $v \in N(S)$ and S_1 is a paired neighbor connected two dominating set of G . Now, let $x, y \in N(S_1)$. If $x, y \in N(S)$, then any $x - y$ path in $N(S)$ is an $x - y$ path in $N(S_1)$. If $x \in N(S)$ and $y \notin N(S)$, then $y \in N(v)$ and any $x - v$ path in $N(S)$ followed by an edge vy is an $x - y$ path in $N(S_1)$ and if $x, y \in N(S)$ then (x, v, y) is an $x - y$ path in $N(S_1)$. Thus it is paired neighbor connected two dominating set of G .

Theorem 4.2. A paired neighbor connected two dominating set S of a graph G is a minimal paired neighbor connected two dominating set if and only if for every $u \in S$, one of the following holds.

(i) $|N(u) \cap S| \leq 1$

(ii) there exists a vertex $v \in V - S \cap N(u)$ such that $|N(u) \cap S| = 2$.

(iii) there exist two vertices $x, y \in N(S)$ such that every $x - y$ path in $\langle N(S_1) \rangle$ contains atleast one vertex of $N(S) - (S - \{u\})$.

Proof. Let S be a minimal paired neighbor connected with two dominating sets and $u \in S$. Let $S_1 = S - \{u\}$. Then S_1 is not a paired neighbor connected two dominating set. This means that S_1 is not the two dominant paired connected or disconnected. If S_1 is not a paired neighbor connected two dominated set, then there exists $v \in V - S_1$ such that $|N(u) \cap S| \leq 1$. If $v = u$ then $|N(u) \cap (S - \{u\})| \leq 1$ such that $|N(u) \cap S| \leq 1$. Assume $v \neq u$. If $|N(v) \cap S_1| < 1$, then $|N(u) \cap S| \leq 1$ and hence S is not a paired neighbor, which is connected to a conflicting two dominated set.





Jothiraj and Chandralekha

Hence $|N(v) \cap S_1| = 1$. Thus $v \in N(u)$. Hence $v \in (V - S) \cap N(u)$ such that $|N(v) \cap S| = 2$. If $\langle N(S_1) \rangle$ is disconnected there are two vertices $x, y \in N(S_1)$ such that there is no $x - y$ path in $\langle N(S) \rangle$. Being connected, every $x - y$ path $\langle N(S) \rangle$ has atleast one vertex of $N(S) - N(S - \{u\})$.

Conversely, if S is a paired of neighbors connected to a two-dominated set of G satisfying the conditions of the theorem, then S is 1-minimal, so the result follows from Theorem 4.1.

Theorem 4.3. For any graph G , equality exists iff $\gamma_{pnd}(G) + \chi_{pnd}(G) \leq 2p$ and G is isomorphic to K_2 .

Proof. The inequality is obvious. Now suppose $\gamma_{pnd}(G) + \chi_{pnd}(G) = 2p$. It follows that $\gamma_{pnd}(G)$ and $\chi_{pnd}(G)$. Hence G is isomorphic to K_2 . The conversation is transparent.

Remark 4.1. Any graph G has equality if and only if $\gamma_{pnd}(G) \leq p$ and G is isomorphic to K_2 .

Theorem 4.4. Let T be a tree of order p . Then $\gamma_{pnd}(G) + \chi_{pnd}(G) = p - 1$ iff T is $K_{1,4}$ is obtained by dividing atleast two edges from $K_{1,3}$ once.

Proof: Let T be a tree with $\gamma_{pnd}(G) + \chi_{pnd}(G) = p - 1$. Since $\chi(G) = 2$, $\gamma_{pnd}(G) = p - 3$ and hence $p = 5$. If $\Delta = p - 1$ then $\gamma_{pnd}(G) = 2$. so $p = 5$ and $T = K_{1,4}$. Let $u_1, u_2 \in V - N[v]$. If $u_1, u_2 \in N(v_i), 1 \leq i \leq 3$, then $\gamma_{pnd}(G) = 2$ which is a contradiction. Hence u_1 is close to v_i and u_2 is close to $v_j; j \neq i$. T is isomorphic to the graph obtained from $K_{1,3}$ by bisecting two edges once. Let $\deg(v_2) = 1$ and $\deg(v_3) = 2$ and $u_1, v_3 \in E(T)$. If $u_1, u_2; u_2, u_3 \in E(T)$, then $\gamma_{pnd}(G) = 3 \neq p - 3$. This is a paradox. If $u_1, u_2; u_2, u_3 \in E(T)$, then $\gamma_{pnd}(G) \neq p - 3$. This is a contradiction. Hence $\deg(v_i) = 2; 1 \leq i \leq 3$. Thus T is isomorphic to the graph obtained from $K_{1,3}$ by dividing all edges once. The conversation is transparent.

Let G be a connected graph of order $p \geq 2$. A dominator color requires atleast two different colors because there are atleast two vertices adjacent to each other. Also, if each vertex gets its own unique color, we have a dominator color. Thus $2 \leq \chi_{pnd}(G), \chi_{pnd}(G) \leq p$, and these boundaries are sharp for $K_{a,b}$ and $K_p (a, b, p \geq 2)$. And each paired (k, p) is realized as a color dominance number and order of some graph [11].

Theorem 4.5. Let G be a connected graph of order p . Then $\chi_{pnd}(G) = 2$ iff $G = K_{a,b}$ for $a, b \in N$.

Proof. Let G be a graph. V_1 and V_2 are paired neighbor connected dominator color classes, then $\chi_{pnd}(G) = 2$. If $|V_1| = 1$ or $|V_2| = 1$, then G is connected, since $G = K_{1,p-1}$. Thus $|V_1| \geq 2$ and $|V_2| \geq 2$. Let $v \in V_1, V_1$ is independent and $|V_1| \geq 2, V_1$ cannot dominate color class, so v color class dominates V_2 . Similarly for the arbitrary peak of V_2 . Thus every vertex of V_1 is adjacent to every vertex of V_2 , and V_1 and V_2 are independent. Hence $G = K_{a,b}$ for $a, b \geq 1$.

Theorem 4.6. Let G be a connected graph of order p . Then $\chi_{pnd}(G) = p$ iff $G = K_p$ for $p \in N$.

Proof. Let G be a connected graph of order p with $\chi_{pnd}(G) = p$. Assume to the contrary, that $G \neq K_p$. Thus, there are atleast two nonadjacent vertices, say x and y . Define a coloring of G such that x and y receive the





Jothiraj and Chandralekha

same color, and each of the remaining vertices receive a unique color. This is a paired neighbor connected dominator coloring, and so $\chi_{pnd}(G) \leq p - 1$, contradiction. Thus $G = K_p$.

Theorem 4.7. Let G be a connected graph. If $\gamma(G) = 1$, then $\chi_{pnd}(G) = \chi(G)$, and every paired $(1, a)$ with $a \geq 1$ such that $\gamma(G) = 1$ and $\chi_{pnd}(G) = \chi(G) = a$.

Proof. Let G be a connected graph of order p with $\chi_{pnd}(G) = 1$. Then the radius of G is 1, so the star $K_{1, p-1}$ is a spanning subgraph of G . Let v be a vertex. G is of degree $p - 1$. A minimal paired neighbor connected dominator coloring of G uses $\chi(G - v) + 1$ colors because v is close to all vertices of $G - v$. This coloring is the minimal paired neighbor connected dominator coloring of G , where each vertex dominates the coloring class of v . Construct G from $K_a (2 \leq a \leq p)$ by concatenation to see if every paired $(1, a)$ is realizable. One pendant per vertex of $P - K_a$. Then $\chi_{pnd}(G) = \chi(G) = a$ and $\gamma(G) = 1$.

Theorem 4.8. Let G be a connected graph of order $p \geq 2$. Then $4 \leq \chi_{pnd}(G) + \chi_{pnd}(\overline{G}) \leq 2p$. Also iff $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 4$ and $G = K_2$ and $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 2p$ iff $G = K_p$.

Proof. Since $2 \leq \chi_{pnd}(G) \leq p$, the inequalities are trivial. Also $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 2p$ iff $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 2p$, so it follows from Theorem 2.1 that $G = K_p$. Also $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 4$ iff $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 2$, so it follows from Theorem 2.2 that $G = K_2$. The converse is obvious.

Proposition 4.1. Let G be a graph of order p . Then $\chi_{pnd}(G) = p$ iff $G = K_a \cup (p - a)K_1$ where $1 \leq a \leq p$.

Theorem 4.9. Let G be a connected graph of order p . Then $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 2p - 1$ iff $G = K_p - e$.

Proof. Let $\chi_{pnd}(G) + \chi_{pnd}(\overline{G}) = 2p - 1$. If $\chi_{pnd}(G) = p$, then from Theorem 2.2 $G = K_p$ and $\chi_{pnd}(\overline{G}) = p$, which is a contradiction. Hence $\chi_{pnd}(G) = p - 1$ and $\chi_{pnd}(\overline{G}) = p$. Hence it follows from Proposition 4.1 that $\overline{G} = K_a \cup (p - 2)K_1$, so that $G = K_p - e$. The converse is obvious.

Theorem 4.10. Let G be any graph with $\delta(G) = 1$. Then $\chi_{pnd}(G) > \gamma(G)$.

Proof. Let $\{V_1, V_2, \dots, V_k\}$ is a $\chi_{pnd}(G)$ -paired neighbor connected dominator coloring of G such that each supported vertex is a single coloring class and the set of all leaves of G in a coloring class, say V_1 . $S = \{v_1, v_2, \dots, v_k\}$ where $v_i \in V_i, 2 \leq i \leq k$. Clearly S contains all support vertices. Let $V \in V - S$ and let v dominate the color class V_i . If $i > 1$, then v dominates. If $i = 1$, then v is a support vertex or leaf and is therefore dominated by S . Thus $\gamma(G) \leq |S| = \chi_{pnd}(G) - 1$. Proposition 4.2

Let G be a connected graph. Then $\max\{\chi(G), \gamma(G)\} \leq \chi_{pnd}(G) \leq \chi(G) + \gamma(G)$. Also the bounds are sharp.

Theorem 4.11. For any graph G , and $\chi(G) \leq \chi_{pnd}(G)$.





Jothiraj and Chandralekha

Theorem 4.12. Let G be a $(p - 2)$ regular graph with n , then $\chi(G) = \chi_{pnd}(G)$.

Proof. By Theorem 4.11, we have $\chi(G) \leq \chi_{pnd}(G)$.

Also $\gamma(G) = 2$, for $(p - 2)$ regular graph and $\chi_{pnd}(G) > 2$.

Hence Proposition 4.2,

$$\max \{ \chi(G), \gamma(G) \leq \chi_{pnd}(G) \leq \chi(G) + \gamma(G) \}$$

That is, $\{ \chi(G) \leq \chi_{pnd}(G) \leq \chi(G) + 2 \}$

Suppose and $\{ \chi_{pnd}(G) = \chi(G) + 2 \}$ and $\{ \chi_{pnd}(G) = \chi(G) + 1 \}$

Paired neighbor connected dominator coloring partition has more color class compared to dominator chromatic number. And every vertex in G is not adjacent to only one vertex; So each paired of vertices gets a different color. If

G has even p vertices, then there are $\frac{p}{2}$ color classes, each with two vertices. And each vertex dominates atleast

one color class. So the increase of a paired neighboring connected dominator chromatic number over the paired neighboring connected dominator chromatic number does not have the correct dominator color class. So $\chi_{pnd}(G) \leq \chi(G)$.

Theorem 4.13. Let G be a graph with $\Delta(G) = n - 1$, then $\chi_{pnd}(G) = \chi(G)$.

Proof By Theorem 4.11, we have $\chi(G) \leq \chi_{pnd}(G)$.

Hence by Proposition 4.2, $\{ \chi(G), \gamma(G) \leq \chi_{pndc}(G) \leq \chi(G) + \gamma(G) \}$

That is, $\{ \chi(G) \leq \chi_{pndc}(G) \leq \chi(G) + 1 \}$

Suppose, $\chi_{pnd}(G) = \chi(G) + 1$.

Compared to paired neighbor connected dominator coloring distribution, paired neighbor connected dominator chromatic coloring has more color class. All vertices have a vertex near them; so only that vertex gets a color. And clearly that color class dominates all other color classes. So multiplying a paired of neighboring connected dominator coloring numbers over the chromatic number does not have a valid dominator color class. So $\chi_{pnd}(G) = \chi(G)$.

Theorem 5.20. Let G be a crown graph, then $\chi_{pnd}(G) = \chi(G) + \gamma(G) = 4$.

Proof

Let G be a crown graph. By definition of Crown graph, it is clear that $\chi_{pnd}(G) = 2$ and $\gamma(G) = 2$.

Let the vertex set in the crown graph be $\{x_0, x_1, x_3, \dots, x_{p-1}, y_0, y_1, \dots, y_{p-1}\}$.

Now the paired neighbor connected dominator color class distribution is given by $\{x_i\}, \{y_i\}$,

$\{x_0, x_1, x_3, \dots, x_{p-1}, y_0, y_1, \dots, y_{p-1}\}$. Each vertex in the color class distribution dominates atleast one color class.

Hence $\chi_{pnd}(G) = 4$. Also, $\chi(G) + \gamma(G) = 4$. Therefore, $\chi_{pnd}(G) = \chi(G) + \gamma(G) = 4$.

Theorem 2.5. The complete graph K_2 is perfect.

Proof. A complete graph of order $2K_2$ is perfect, because $\omega(K_2) = \chi_{pnd}(K_2) = 2$ and K_2 has no perfect induced subgraphs. Assume that the complete graphs of order n are perfect. Let K_{p+1} be a complete graph of





Jothiraj and Chandralekha

order $p + 1$ and let H be an induced subgraph of K_{p+1} . All induced subgraphs of complete graphs are complete graphs. If H is a proper subgraph of K_{p+1} , it is a complete graph of order p or less and is proper by the induction hypothesis, thus $\omega(H) = \chi_{pnd}(H)$. Finally, if $H = K_{p+1}$, $\chi_{pnd}(H) = p + 1$. Every order 2 graph is a complete graph, so every order 2 graph is perfect.

Theorem 2.7. All open chains are perfect.

Proof. Let $G = (V, E)$ be an open chain. Let H be an induced subgraph of G . There are two possible cases.

Case I: H has no neighboring nodes. If H has no neighboring vertices, $\omega(H) = 1$. The function $c(v_i) = red$ for all $v \in H$ is 1-coloring of H , so $\omega(H) = \chi_{pnd}(H)$.

Case II: H has neighboring nodes. There are no cliques of size three or more, so $\omega(H) = 2$. The function c is the dominator coloring of 2-paired neighbor connected H , so $\omega(H) = \chi_{pnd}(H)$.

$$c(v_i) = \begin{cases} red & i \text{ is odd} \\ blue & i \text{ is even} \end{cases}$$

Exact value for some special graphs:

1) For any **Möbius-Kantor graph** is a symmetric bipartite cubic graph with 16 vertices and 24 edges given in Figure 1.

Möbius-Kantor graph, paired neighbor connected dominator chromatic number, $\chi_{pnd}(G) = 2$ and also $\gamma(G) = 3$.

Here $S = \{v_1, v_4, v_6\}$ is a minimum dominating set.

2) For any **Desargues graph** is a symmetric bipartite cubic graph with 16 vertices and 24 edges given in Figure 2.

Desargues graph, paired neighbor connected dominator chromatic number, $\chi_{pndc}(G) = 2$ and also $\gamma(G) = 3$. Here

$S = \{v_1, v_4, v_6\}$ is a minimum dominating.

CONCLUSION

Applications

(1) Bipartite graphs: We can check whether a graph is bipartite or not by coloring the graph using the paired wise neighbor connected dominator color set. A given graph is bipartite if its 2-paired neighbor connected dominator is colorable, otherwise it is not.

(2) Job Scheduling: Here jobs are considered as vertices of the graph and there is an edge between two jobs. There is a 1-1 correspondence between the possible scheduling of jobs and the colors of the graph.

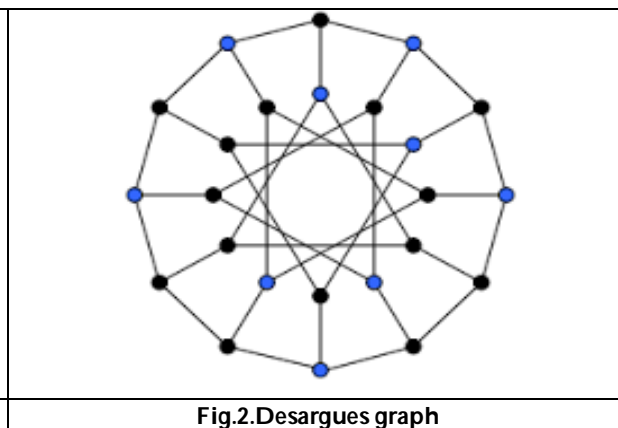
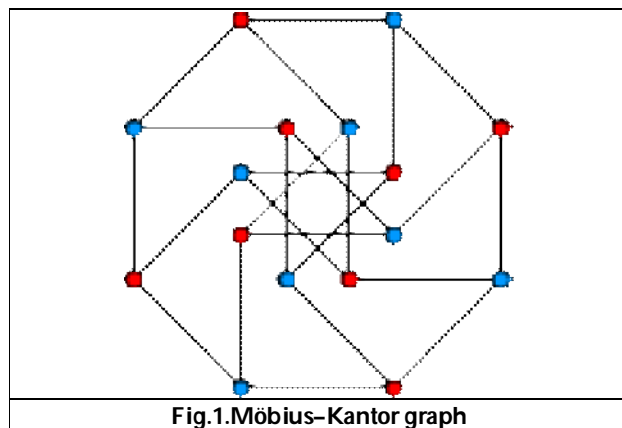
(3) Aircraft scheduling: Assuming there are k aircraft, p flights are to be allocated to them. The i^{th} flight must be in the time interval (a_i, b_i) . If two flight overlap, the same aircraft cannot be assigned to both flights. This problem is formulated graphically as follows. The vertices of the graph correspond to the flights. If the corresponding time slots overlap, two nodes are connected. Hence, the graph is an interval graph that is optimally colored in polynomial time.





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Unilateral Supernumerary Premolar : a Case Report

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ABSTRACT

Supernumerary teeth, one of the common dental anomaly characterized by the presence of more than usual number of teeth. The rate of diversification in the supernumerary teeth varies in different ethnic group. Supernumerary teeth can be either supplemental teeth or rudimentary teeth depending on its relevance to the natural teeth. Various syndrome associated with the supernumerary teeth include Cleidocranial Dysostosis, Gardner's Syndrome, Down's Syndrome, Fabry Anderson Syndrome, Ehler Danlos Syndrome, etc. This case report shows the presence of the supplementary tooth in the mandibular premolar region. An overall favourable position of the impacted supplementary teeth was observed with no associated clinical signs and symptoms, thus the patient was advised to wait and watch without any further clinical intervention.

Keywords: Supernumerary Teeth, Supplemental Teeth, Mandibular Premolar Region, Rudimentary Teeth.

Key Message: supernumerary teeth, not a regular clinical finding is detected accidentally on a routine dental check-up. Eruption pattern and the potential of such teeth should be regularly monitored so as to avoid any further clinical complications.





Shikha Sharma et al.,

INTRODUCTION

Supernumerary teeth (ST) are the developmental anomaly in the number of teeth, i.e. presence of more than the usual number of teeth, and are most commonly found in the humans (Ardakani et al. 2007). It shows a diversity among the different ethnic group with an overall prevalence in permanent and deciduous dentitions be 1.5% to 3.8% and 0.2% to 0.8% respectively. The prevalence of occurrence in men is twice than the women [1].

While the supernumerary teeth which are well aligned within the arch and have a resemblance with the normal anatomy of the teeth are called supplemental teeth. Whereas the 'rudimentary' teeth are the one which have an abnormal shape and size. The commonly found supernumerary teeth with the order of the frequency is enlisted,

1. Maxillary Midline Supernumeraries;
2. Maxillary Fourth Molars;
3. Maxillary Paramolars (Rudimentary supernumeraries that develop buccally or lingually to the maxillary molars)
4. Mandibular Premolars;
5. Maxillary Lateral Incisors;
6. Mandibular Fourth Molars;
7. Maxillary Premolars.

Supernumerary teeth can remain impacted and unnoticed for years without clinical, pathologic, or orthodontic complications. In this respect the supernumerary premolar have found to be most commonly impacted with a complete asymptomatic clinical picture and diagnosed with the eruption of the premolars [2]. Literature supports the occurrence and incidences of the supplementary premolars and molars in the prehistoric man. The most common cause of the supplementary teeth includes uncontrolled proliferation of the dental lamina. By the Darwin's theory of evolution of disuse atrophy, as human evolved the minimally used organs became vestigial, which included appendix, tail bone, fourth molar. But in rare instances occurrence of supplementary molars and supplementary premolars are found [3]. Supernumerary premolars account for only 10% of all the supernumerary cases. These are mainly found in the mandible unlike the other supernumeraries. The number of supernumerary premolar teeth if found is usually one. The percentage of occurrence of the Single supernumeraries, in 76-86% of cases, double supernumeraries occur in 12-23% of the cases and multiple supernumerary teeth in less than 1% of cases [4].

Variations in the morphology of the supernumerary maxillary premolars is seen, the most commonly found is the conical. Whereas in the mandible the shape of the crown is predominantly that of the normal premolar crown [5]. Hyperdontia, which is an increase in the number of teeth more than the usual number is classified according to the chronology, topography, and morphology. So on the basis of the chronology, the supernumerary teeth can be classified as

Predeciduous– ST which develops before the primary dentition

Post-permanent dentition –ST which develops contemporary to the permanent teeth, or after the permanent dentition [6]. The incidence of occurrence of the ST in the permanent dentition is more in comparison to the deciduous dentition, where in they are found only in 0.8% of the population [5].

In the present case report, a female patient aged 21 years reported to the department with a chief complaint of pain in the left lower back tooth region and difficulty in opening the mouth. On clinical examination impacted third molar was observed on the same side. The teeth were well aligned with no crowding and spacing. The patient was advised to get it extracted as preventive treatment modality. Further on radiographic examinations, OPG (fig 1) supplementary premolar (third premolar) was observed on the lower left side in the region 35-37 region as an accidental finding. Morphologically the supernumerary third premolar resembled the normal premolar. To further investigate about the exact position of the third premolar, CBCT of the same region was done. The CBCT report finding revealed the obliquely placed supplemental tooth in the region 35, 36, 37 (fig 2). The tooth was impacted

58213



**Shikha Sharma et al.,**

lingually involving the lingual cortical plate. The total length of the tooth estimated was 19.8 mm. the crown of the tooth was found to be at a depth of 1.5 mm from the alveolar crest whereas the apical portion of the root was present at a depth of 13.1mm, extending towards the inferior border of the mandible. Further intra oral scans of the patient were performed (fig 3-7), to supplement our current investigations. No significant finding wrt the adjacent area both clinically and radiographically was seen viz resorption of the adjacent teeth and impingement of the inferior alveolar nerve. In axial view a depression in the anatomy of the coronal portion of the teeth was seen. (fig 8) Thus an overall favourable position of the supplemental tooth was found. The patient was given the option of extraction or wait and watch with the same. The patient opted to wait and watch till the commencement of any positive signs with the impacted third premolar.

DISCUSSION

Supernumerary teeth prevalence varies from single tooth occurrence in 76-86% to multiple teeth in <1% cases. Most commonly these supernumerary teeth are associated with some syndromes like Cleidocranial Dysostosis, Gardner's Syndrome, Down's Syndrome, Fabry Anderson Syndrome, Ehler Danlos Syndrome, etc. with a mean incidence of < 1% [7]. However the prevalence of a non – syndromic associated supernumerary teeth are a rare finding. Stafner et al [8] found 8.1% supernumerary teeth which were not associated with any syndrome, out of which premolars accounted for 6.6 % in mandible. The literature search suggests that mandibular parapremolar is most likely to occur as a supernumerary tooth, however its form, location and origin remain an enigma. About 74% of parapremolar in mandible remains unerupted or impacted and asymptomatic [9,10,11] with male predilection of about 3-5 times more than in females [12,10,13]. The size of such premolars is normally smaller than any other mandibular premolar.¹³Its occurrence is found more in other races compared to Caucasians.

Although, the exact aetiology of the origin of parapremolar remains unknown, genetic and environmental factors may play a role in its explanation. This premolar belongs to new generation of tooth series; post permanent or para – post permanent dentition that develops from an existing extension of dental lamina. The development of parapremolar is usually delayed by 7.5 - 11 years after the development of normal dentition (Bow Dew) [14]. This fact is also advocated by Price and Hoggins [10] and Rubenstein [15]. Various origin points can be associated with mandibular parapremolar, but most commonly it is found in the lingual aspect of the mandible. Root formation is usually incomplete with such premolars, but a very few cases of complete root formation have also been recorded. It is hard to determine the exact origin, i.e., whether it is transported from the mandibular molar or from the premolar itself. The best one can assume is through the 3-D radiographs to locate its exact location and its relation to other structures. The diagnosis of an unerupted, asyndromic parapremolar is often incidental during routine dental examination. In most cases the development is found lingually and apical to the normal dentition.

One must observe its position and determine if it is causing harm to the adjacent structures. Commonly such parapremolars may interfere with occlusion by causing lack of closure of spaces [16] for malocclusion due to tooth drifting. Sometimes fusion of the roots with molars may be seen [17,18] or it may result into formation of cyst [11,19]. Therefore, it is important for clinician to decide what is important for their patient. In case of symptomatic tooth or any threat of cyst formation in future, it is advised to get it removed. In case of incomplete root formation, it is advised to remove the tooth after root formation is complete. Non symptomatic cases should be monitored regularly, and intervention is the only requirement if it causes any changes undesirable for dentition [19]. In this case report, the tooth was detected using 3D CBCT radiography for determining its location and origin. The size is smaller than the normal premolar, located in the lingual aspect with crown towards the cortical bone and complete-root formed towards the pre molars. Hence, we suspect the origin of this tooth is from the extension of dental lamina from 2nd premolar.No fusion or connection between parapremolar and natural dentition was observed.



**Shikha Sharma et al.,**

At present, the patient shows no sign and symptoms of any such discomfort, paraesthesia, or any pathology. It is suggested to observe the case over the period with sequential radiographs and if any changes occur such that the damage to normal dentition is caused, then extraction would be advised.

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An Economic Analysis of Socio- Economic Factors Affecting Households Consumption Expenditure Pattern in Villupuram District of Tamil Nadu

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ABSTRACT

Every production process has consumption as its ultimate goal. Because of this, it is acceptable to expect economic growth and to encourage increase in demand everywhere. Changes in individual consumer consumption are in a micro level, and these changes in behaviour, way of life, values, and requirements have an impact on changes in our consumption habits in a macro level. In developing countries like India, rising income is a major component in the predicted growth of consumption Expenditure. However, raising household income is sometimes insufficient to improve everyone's level of living and guarantee access to a nutritious diet for all. The current study's objective was to investigate the variables affecting the consumption and spending habits of rural households. Using multiple linear regression analysis, with the sample size of 120 respondents from the three occupational groups like Agriculturist, Agricultural labour and Other workers to analyse the socio economic factors that are affecting the rural household consumption expenditure pattern/income. The co-efficient of determination is $(R^2)^*$ is 0.66, for Agricultural labourer, the Co-efficient of determination (R^2) is 0.87 and for Other Workers it is 0.74. in this study the family size, days of employment and annual income is highly affecting the household consumption expenditure in all the three occupational groups. According to this study, extending the number of workdays for employees like MGNREGAs and supporting cottage and small-scale companies can boost the income of rural households.

Keywords: Agriculture, Consumption Pattern, Employment, Household, MGNREGAs.



**Prasanth and Ponnarasi**

INTRODUCTION

India is one of the nations in the world that is developing fastest, and its population is also expanding quickly. However, rising unemployment and rapid population growth are impeding food consumption and nutritional security in the country. Thus, it is crucial for a nation's economic development and welfare to have a proper consumption pattern. The study's primary goal is to examine the effects of various socio-economic variables on the consumption expenditures of the households in the study area. Food consumption pattern is under-going substantial change in many countries as economic development proceeds. The trend moves from traditional cereals towards higher value and higher protein foods (Rae, 1999).

Consumption is an essential activity carried out by the household sector. India's per capita income (expenditure) has increased as a result of post-globalization, and this has had a substantial impact on the country's food consumption habits by changing the composition of food consumption baskets. The quicker rate of economic growth in India since the 1990s has increased per capita income (expenditure) and dramatically altered the structure of the country's food consumption habits, which were previously observed prior to the implementation of reforms. This makes it more important to consider the makeup of India's food consumption basket. (Deshmukh, 2018). It is considered that individual customers have the greatest ability to assess their own needs and preferences and to make their own decisions. It is reasonable to assume that when people choose one consumption pattern over another, they are aware of what they are looking for and have a preference for it. The limitations on consumption substitutes are the result of many causes. Not just money, though. The availability, infrastructure, basic goods and services, time utilisation, information, social barriers, and the family environment are additional considerations. The main objective of the present study is, to analyse the impact of different socio-economic factors on consumption expenditure of the households in the study area.

MATERIAL AND METHODS

Villupuram district of Tamilnadu was purposively selected for the study. Villupuram district was chosen as the first stage unit, community development blocks with higher populations were chosen as the second stage unit, villages with high populations were selected as the third stage unit, and households from three occupational groups were chosen as the fourth and final stage unit for study. This study used a purposive sampling technique. In the second round of selection, the district's block with the highest population was chosen. The first two villages from the block were chosen at the third round of sampling, which involved placing the villages in the block with the highest population in descending order. Veerapandi, Kandachipuram and Oddampattuvillages of Mugaiyur block was selected as the study area. The number of sample respondents was set at 90, and samples were evenly dispersed among the various occupational categories in each of the chosen villages. Both primary and secondary sources were used to compile the necessary data for this investigation. The respondents' main behaviour is that they did not adequately maintain their spending, consumption, and income records, but with the aid of an interview schedule and a previously established questionnaire for gathering primary data, they were able to recall and provide the necessary information. For the purpose of in depth investigation, the sample households were stratified into three occupational groups based on household occupation as Agriculturist, Agricultural labour and Other (Non-Agricultural) workers.

Analytical Tools

The descriptive analysis was undertaken using percentage analysis to analyse the general characteristics of respondents. To overcome the age differences of individuals in a household, the data were converted into per unit consumption to arrive at more appropriate and meaningful results. For this purpose, Lusk Co-efficient (Rao, 1983) was used in this present study. These conversions facilitated inter-family comparisons and prevented the likely specification error.



**Prasanth and Ponnarasi****Multiple Linear Regression Analysis**

Multiple regression analysis was used to find the variables influencing consumption expenditure in the sample households. Annual consumption expenditure was used as the dependent variable in the analysis to show the effects of socio-economic variables on consumption of various food and non-food items.

The model specified for the present study was;

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + e$$

Where,

Y = Annual Consumption expenditure (Rs/Family)

X₁ = Annual income of the households (Rs)

X₂ = Family size of the household (Lusk co-efficient)

X₃ = Head's age in years

X₄ = Number of Days of Employment

X₅ = Social class (Dummy Variable, SC=1/Non-SC=0)

a = Constant

b₁ to b₅ = Co-efficients of independent variable

e = error term

RESULT AND DISCUSSION**Annual Consumption Expenditure of Sample Households**

The sample households spent money on various food and non-food items. The level of annual consumption expenditure of sample households was analysed and results are presented in Table 2. It is observed from the Table 2 that, the sample respondents of Agriculturist, Agricultural labour and Other workers had an average annual expenditure was amount of Rs. 1,20,357.30, Rs. 96,603.50 and Rs. 1,12,043.30 respectively. The amount spent on food constituted nearly 52 to 55 per cent of the total amount in both Agriculturist and Agricultural labour households and around 44 per cent in Other worker households. The expenditure spent on clothing constituted 8.88 per cent, 6.75 per cent and 10.68 per cent in Agriculturist and Agricultural labour and Other worker households respectively. The household's spending on education constituted 23.06 per cent, 21.74 per cent and 25.65 per cent in Agriculturist and Agricultural labour and Other workers respectively. The other important consumption expenditure reported was on health which was around 4 to 6 per cent in all the three occupational groups. Expenditure on other items like recreation, social and other expenditure worked out to nearly 1 to 3 per cent. Expenditure on festival constituted 6 per cent in Agriculturist, Agricultural labour and 9.47 per cent in Other workers among the sample respondents.

Factors Affecting Food Consumption Pattern

The effects of Socio-economic variables on consumption of different food items have been estimated using multiple linear regression analysis (Table 3). It could be seen from the Table 3 that, the independent variable like age, caste, annual income, days of employment and family size were analysed for identifying the factors affecting food consumption of sample respondents. For agriculturist, Days of employment was positively significant at 5 per cent level and annual income was Positively significant at 5 per cent level with co-efficient of determination (R²) as 0.66. For Agricultural labour, the variable social class and family size was positively significant at 5 per cent level with the co-efficient of determination (R²) as 0.87. And for Other workers the constant was positively significant at 1 per cent level and Days of employment was negatively significant at 5 per cent level with the co-efficient of determination (R²) as 0.74. The regression co-efficient of social class was negatively significant for Agriculturist and Other worker. The regression co-efficient of Age, Family size, Annual income and Days of employment was positively significant for Agriculturist and Agricultural labour and Family size social class was negatively significant for Other workers. And the co-efficient of Annual income were positively significant at 5 per cent level for all the three occupational groups. The social class, days of employment and family size was negatively significant for agricultural labourers.





Prasanth and Ponnarasi

CONCLUSION

This study has provided a clear picture of the factors affecting household consumption spending on different occupational groups. There are all the three occupational groups affected by the Socio – economic factors. The findings of this study strongly suggest that household income, which is influenced by the occupation of the household, has an impact on consumption expenditure and pattern. The diversified occupational opportunities and increase the awareness about the agricultural commodities transferred into value added products. Therefore, it is suggested to the decision-makers to create more employment chances in rural areas. By encouraging cottage industries and small-scale businesses, it is possible to increase the number of days that each household works, which will raise the household's income.

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Prasanth and Ponnarasi

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Table 1. Distribution of sample households based on occupation

Occupational Groups	Mugaiyur Block			Total
	Veerapandi	Kandachipuram	Oddampattu	
Agriculturist	10	10	10	30
Agricultural labour	10	10	10	30
Other Workers	10	10	10	30
Total	30	30	30	90

Table 2. Annual Consumption Expenditure of Sample Households

S. No	Particulars	(Value in Rs.)		
		Agriculturist	Agricultural Labour	Other Workers
1.	Food	62,625.00 (52.03)	53,613.00 (55.50)	49,040.00 (43.77)
2.	Clothing	10,691.00 (8.88)	6,522.50 (6.75)	11,968.00 (10.68)
3.	Education	27,750.00 (23.06)	21,003.00 (21.74)	28,738.00 (25.65)
4.	Health	7,716.30 (6.41)	4,602.50 (4.76)	5,672.50 (5.06)
5.	Recreation	2,330.00 (1.94)	2,845.00 (2.95)	1,582.50 (1.41)
6.	Festival	7,680.00 (6.38)	5,862.50 (6.07)	10,613.00 (9.47)
7.	Social	1,087.50 (0.90)	1,440.00 (1.49)	1,388.80 (1.24)
8.	Others	477.50 (0.40)	715.00 (0.74)	3,042.50 (2.72)
	Total	1,20,357.30 (100.00)	96,603.50 (100.00)	1,12,045.30 (100.00)

Figures in the parentheses represent percentage to total

Table 3. Factors affecting Food Consumption Expenditure

S. No	Independent Variable	Agriculturist		Agricultural Labour		Other Workers	
		Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
1.	Constant	-97125.05	0.1855	-34613.66	0.3940	14129.87***	0.0001
2.	Age	30.1466	0.9598	47.8844	0.7970	-338.553	0.5359
3.	Social class	-7617.971	0.47417	598.783**	0.0160	-1970.4092	0.7471
4.	Annual Income	0.00168**	0.0340	0.64794	0.2140	0.4679	0.0520
5.	Days of	3529.75**	0.0939	1492.994	0.7970	-338.553**	0.0359



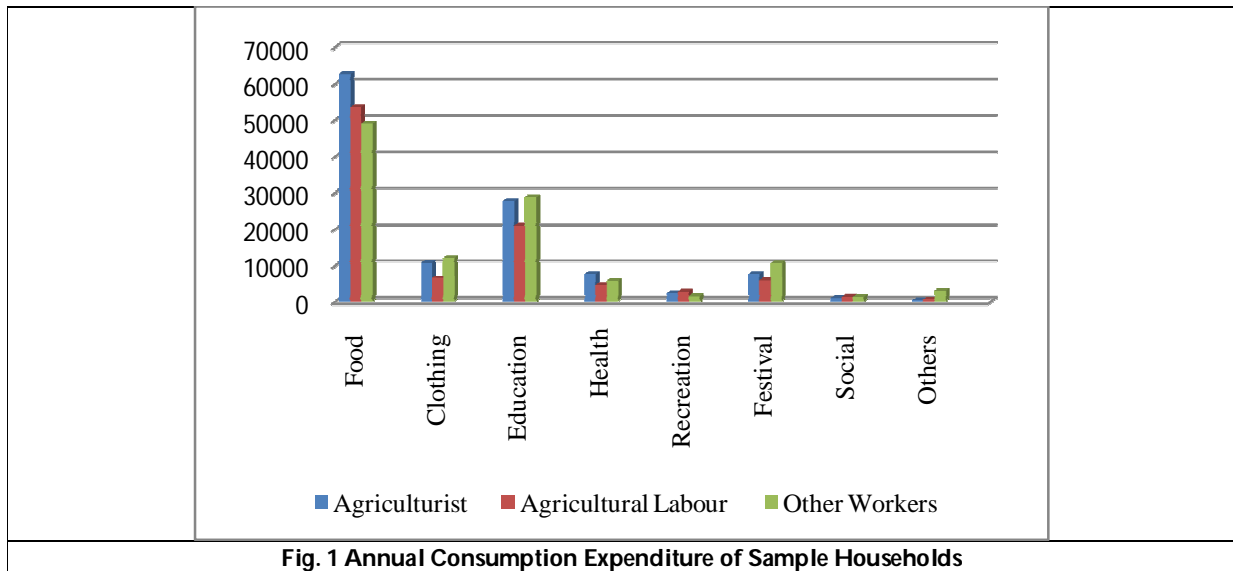


Prasanth and Ponnarasi

	Employment						
6.	Family Size	37154.02	0.4150	3986.034**	0.0910	-1664.18	0.8013
	R ²	0.66		0.87		0.74	

*** - Significant at 1 per cent level

** - Significant at 5 per cent level





A Study to Assess the Effectiveness of Structured Teaching Programme on Knowledge of Interpretation and Management of Arrhythmias among Staff Nurses in a Selected Hospital, Bangalore

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ABSTRACT

Arrhythmia is a disorder of the formation or conduction of the electrical impulse in heart. This disorder can cause the disturbance of heart rate, heart rhythm either electrical or mechanical activity or both. Abnormal electrical activities may result in arrhythmias. In India cardiac arrhythmias following Myocardial Infarction is more and increases day by day, the incidence of cardiac arrhythmia is more in males than females. This study explores the possibility to assess the effectiveness of structured teaching programme on knowledge of interpretation and management of arrhythmias among staff nurses. Preexperimental research design with one group pre-test and post-test which consist of 60 staff nurses from a selected hospital, Bangalore were included in the study. Pre-test scores were taken using a self-administered questionnaire to assess the knowledge of interpretation and management of arrhythmias among staff nurses. This was followed by a structured teaching program on the interpretation and management of arrhythmias for 30 mins. Post-test scores were taken again using the same self-administered questionnaire which was used to collect the pre-test scores. The result showed that the level of knowledge on the interpretation and management of arrhythmias among staff nurses significantly improved following a Structured Teaching Program.

Keywords: Staff Nurses, Structured Teaching Program, Arrhythmia, Self-Administered Questionnaire.





INTRODUCTION

The heart starts beating from the fourth week of intrauterine life, the human heart beats 100,000 times a day and pumps 5 liter of blood throughout the body covering 60,000 miles of cardiovascular system to nourish the living tissue. The heart is a muscular pump of the circulatory system where each heart beat originates as an electrical impulse from a small area of tissue in the right atrium of the heart called sinus node or Sino-atrial node [1]. Many forms of heart disease can interrupt the normal contract-relax cycle causing abnormally fast or unusually slow heart rates called arrhythmias. This condition makes heart pump less effectively, so that not enough blood reached the brain and other vital organs when the body's blood flow is inadequate [2]. Arrhythmia is a disorder of the formation or conduction of the electrical impulse in heart. This disorder can cause the disturbance of heart rate, heart rhythm either electrical or mechanical activity or both abnormal electrical activities may result in arrhythmias [3]. Cardiovascular disease is the leading cause of death in India, taking a life every 30 sec. In light of the staggering health and economic costs of this disease as well as stunning advances in prevention, diagnosis and treatment, the health care industry needs cardiovascular advanced practice nurses to be among those taking the lead in prevention and treatment [4].

In India cardiac arrhythmia following Myocardial Infarction is more and increases day by day, the incidence of cardiac arrhythmia is more in males than females. The clients who are over 60 years of age are more prone to get this and also it can occur in the age group between 30-60 due to changing life style including stress of everyday life [5]. Nurse plays a critical role in arrhythmia identification and management at the bedside. The nurse may collect further data and notify the physician, who determines treatment recommendations based on the rhythm interpretation of the nurse, based on the nurse's interpretation of the ECG monitor data. Therefore, it is vitally important to understand the nurse's perception of their understanding of arrhythmias and, in the end, to develop tools to assess their competence in identifying ECG rhythm [6]. A precise interpretation of the arrhythmia for each patient must be made by the nurses. Assessment of the patient's hemodynamic response to an arrhythmia provide guidance in therapeutic intervention [7]. To improve the standard of care and to give patients with arrhythmia the care they need, nurses who care for patients around-the-clock must possess a higher level of knowledge and expertise in the interpretation and management of arrhythmia. Consequently, the purpose of this study is to evaluate the effect of a structured teaching program on staff nurses' comprehension of the interpretation and management of arrhythmias [8].

MATERIALS AND METHODS

Study Design

The objective of the study is to assess the effectiveness of Structured Teaching Programme on knowledge of Interpretation and Management of arrhythmias among staff nurses. The design used in this study is a pre-experimental one group pre-test post-test research design. It was conducted among the staff nurses who were working in Jayadeva Institute of Cardiovascular Sciences and Research Hospital, Bangalore.

Participants

A sample of 60 staff nurses both male and female, working in Jayadeva Institute of Cardiovascular Sciences and Research Hospital, Bangalore and who fulfilled the following criteria were included in the study. All participants provided written informed consent.

Inclusion criteria

- Presently working in a selected hospital, Bangalore.
- Willing to participate in the study.
- Available at the time of data collection.



**Roshni Moirangthem et al.,****Exclusion criteria**

- Not a registered nurse.
- Who had a previous knowledge exposure to similar topic.
- On night duty.

Intervention programme

60 staff nurses were selected through non probability convenient sampling technique. Proper information was given to the samples about the aim of the study, nature of questionnaire and adequate care was taken for confidentiality and identity. The pre-test was conducted by administration of self-administered questionnaire that consists of section A- Demographic data, section B- questionnaire which included 22 items on the knowledge about arrhythmia. The pre-test was followed by the teaching program through Section C- lesson plan on interpretation and management of arrhythmias for 30mins. Post-test scores were collected using the same self-administered questionnaire which was used for pre-test. The data obtained were analysed on the basis of the objectives of the study using descriptive and inferential statistics. Paired 't' test was used to determine the effectiveness of structured teaching program.

RESULTS AND DISCUSSION

Table 2 shows that there is statistically significant difference on the level of knowledge regarding interpretation and management of arrhythmia among staff nurses at the level of $p < 0.01$. The finding of the study shows that in the pre-test scores among 60 samples, 27(45%) samples had poor knowledge, 33(55%) had average knowledge and none of the sample had good and very good level of knowledge regarding interpretation and management of arrhythmia. After Structured Teaching Program, post-test scores showed, 10(16.67%) samples had average knowledge, 33(55%) samples achieved good level of knowledge, 17(28.33%) samples had very good level of knowledge and none of the samples had poor knowledge. The results confirm that the level of knowledge regarding interpretation and management of arrhythmias improved after the Structured Teaching Program among staff nurses in a selected hospital, Bangalore.

CONCLUSION

The results of the study confirm that knowledge of interpretation and management of arrhythmias among staff nurses improved and highly effective after intervention with a structured teaching program of 30mins. Therefore, this study proves that the nurses' interpretation of arrhythmias would enhance following a Structured Teaching Program and ultimately the standard of care of patients with arrhythmias would significantly improve. A larger trial is needed to better evaluate the efficacy of Structured Teaching Program on interpretation and management of arrhythmias to confirm the results.

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Roshni Moirangthem et al.,

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Table1: Distribution of samples according to pre-test and post-test level of knowledge (N=60)

ASPECT			EXPERIMENT	
			N	%
Pre-test level of knowledge	Poor	0-15	27	45
	Average	16-30	33	55
	Good	31-45	0	0
	Very good	46-60	0	0
Post- test level of knowledge	Poor	0-15	0	0
	Average	16-30	10	16.67
	Good	31-45	33	55
	Very good	46-60	17	28.33

Table 2: Comparison of pre- test and post -test scores among staff nurses.

Knowledge assessment	Means	Mean difference	SD	df	Paired 't' value	P value
Pre-test	14.36	11.08	19.10	59	21.82	< 0.01
Post-test	25.45		22.38			





A Study on Financial Analysis of Central Public Sector Enterprises: Special Reference to Agro Based Industries in India.

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ABSTRACT

Agro-based companies are those that source their raw materials from products derived from either plants or animals grown in agricultural operations. Additionally, they increase the value of the agricultural production by processing it and producing goods that are both marketable and useful. Because of its enormous growth potential, likely socio-economic impression giving vital potentiality on employment and income generation, also generally keep itself recession proof, the agro-based industry is considered as the sunrise sector of the Indian economy. This is due to the fact that it can keep itself from falling into recession. Additionally, agriculture and sectors closely related to agriculture support around 70 percent of the total population. The present paper evaluates the financial data of two Central Public Sector Enterprises (CPSEs) Agro Based industries in operation in India. The data was collected for financial years 2015-16 to 2020-21; findings reveals the financial position of the agro based industry as weak. Relevant findings were drawn related to financial parameters of the industries.

Keywords: Agriculture, Agro based industries, Agro Financial analysis in India.

INTRODUCTION

Agro based processing connects agriculture and manufacturing industries. Assured access to safe and healthful food is so ensured, with food that is plentiful and affordable. The Indian food business is set to increase enormously, increasing every year its contribution to international food trade. In India, because of their huge value adding potential, in especially within the Agro based processing business, the food sector has developed as a high-crop also income generating groups. Including contribution to GDP, generating of employment and investment and Agro based industry is a key segment of the Indian economy and is one of the driving forces behind growth in the

58226



**Venkatesh**

country in the near future. Agro based industries playing main role of creating agro products, Agriculture and industry are both important parts of the development process. This is because agriculture provides inputs for industry, and industry outputs are used to increase production in agriculture. Agricultural production is the foundation of many industries. The raw materials and other basic inputs for agro-based industries come from farming. This interdependence needs to be set up in a way that meets the needs of our country and state. When agricultural production stabilises and grows, output and jobs in agro-industries move quickly forward.

Also, the combination of agrarian growth and the growth of agro based industries makes it easier for industries to grow and for different parts of the economy to work together. And mainly Food processing industries and non-food processing industries are the two main types of agro-based industries. The main things that food processing industries do are keep perishable foods fresh and use by-products for other things. In these kinds of businesses, wheat, rice, maize, barley, pulses, meat, fruits, vegetables and other foods are processed. The only two Central Public Sector Enterprises (CPSEs) in operation are HPCL Biofuels Ltd. and National Seeds Corporation Ltd., making up this cognate group.

Statement of the Problem

The phrase "Agro-Based Industry" is used to describe as the segment of huge manufacturing sector particular works with inputs and outputs from the agricultural sector. Farming, cattle, forests, and fisheries are all part of the particular agro based industry. The development of agro based industry has had far-reaching consequences for the betterment of the agricultural and rural economy. While it may not be a solution for agriculture's ills, agro-based economic growth is being stoked by the practise. It has the potential to serve as a bridge between rural areas and urban centres. The agro-based sector has the potential to spur economic growth as a whole. That's what agro based Industry is so important to India's Economic Growth. Low profitability in the agro based industry is a direct outcome of the industry's inability to maintain liquidity due to an unbalanced capital structure and inadequate liquidity. Dividends, interest, and debt payments are becoming increasingly difficult to make as industry losses rise. So, it's a never-ending cycle for the Agro-Based sector of the economy. In order to carry out their complex roles, financial managers in the Agro-Based industry need to have a firm grasp of the issues mentioned above, and the means by which to mitigate their impact on fixed assets management, inventory management, and cash management. Even in the Agro- Based sector, such concerns concerning budgeting and administration are inevitable.

Main Objectives of the Study

The fundamental objective of the study is to measure the financial position of Agro based industries. Further, considering the scope of the study and the specific objectives are stated below.

- To measure the Liquidity Position of the Agro-Based Industry
- To assess the Profitability Position of the Agro-Based Industry
- To identify of the factors affecting the financial health of the agro-based industry

RESEARCH METHODOLOGY

This research combines primary and secondary data. This research collects secondary data to portray the demographic profile, determine the role of various government entities in growth, and identify the prospects of the Agro Based industry. For the year 2015-16 to 2020-21, data on several facets of agro processing were obtained via Public Enterprise survey and Ministry of Finance Department of Public Enterprises Also Different data sets were categorised and tabulated in preparation for a comprehensive study. The study made considerable use of tabular analysis to calculate ratios, averages, and indices to determine various performance characteristics of the agro-processing sector.



**Venkatesh****Findings**

Due to less product sales and less subsidy income, HPCL Biofuels Ltd.'s revenue dropped from 30,024 lakhs in FY 2019-20 to 18,195 lakh in FY 2020-21, which negatively impacted the performance of the entire business group. Covid-19 had a minor effect on CPSEs in this related category, as their combined revenues fell from 1,36,021 lakhs in FY 2019-20 to 1,19,713 lakh in FY 2020-21 while their losses rose from 5,563 lakhs to 7,764 lakhs in during the same year. Two CPSEs in this category had inventory of 481 crores at the end of FY 2020-21, down from 498 crores at the end of FY 2019-20. In FY 2020-21, the inventory (days) increased to 139 from 133 in FY 2019-20. This indicates that it took longer for CPSEs in the comparable group to convert unsold stock into revenue.

Companies in this cluster rely heavily on agricultural outputs for both inputs and finished products. They deal in the manufacturing and distribution of agricultural goods and are also involved in forestry. In FY2019-20, CPSEs contributed a total of 245.8 crore to the economy. There were 2,711 people working for the CPSEs in the related group as of March 31, 2020. The Agro-based Industries cognate group saw a rise in Gross Revenue from Operations of 10.1% per year, from 924.7 crore in Financial Year 2015-16 to 1,360.2 crore in Financial Year 2019-20. By far the largest contributor to this related group's Gross Revenue from the operations in Financial Year that 2019-20 was NSC, at 78%, followed by HBL, at 22%. Companies in this group had inventory worth Rs 520.03 crore at the end of 2017-18, up from Rs 223.01 crore at end of the previous year. As of the end of 2017-18, there were enough goods on hand to last 189 days, up from 68% at end of the previous year.

CONCLUSION

Agro-based industry as a whole is crucial because it facilitates the production of more agricultural goods, the creation of more jobs, the acquisition of foreign exchange, the expansion of income, the employment of women, and the development of previously underdeveloped regions. All of these benefits can be achieved while reducing the impact of migration and population growth, increasing equality of opportunity, and making efficient use of scarce resources. This requires only a minimal amount of imported materials and zero outside funding or cutting-edge technology. The agricultural industry in India has benefited greatly from the assistance provided by the Agro-based businesses. In India, the industrial sector is dependent on the agricultural sector for the supply of raw materials, so farmers have an incentive to increase output. Demand has risen thanks to the expansion and increased productivity of these industries, and this growth has been accompanied by an increase in the quality of production. Farmers are making significant investments in commercial farming to increase their ability to provide high-value crops for these industries. To put it another way, this will improve the lot of the peasantry economically.

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Venkatesh

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Table 1: Category wise Agro based Industries in India

Sl. No.	Category (Based on Raw Material)	Finished Products
1	Cereals Based Industry	a) Wheat Flour b) Biscuit Manufacturing c) Confectionary and Bakery Items d) Rice (puffed and flaked) e) Rice Bran and Rice Bran Oil f) Corn flakes g) Canned Baby Corn h) Starch Material
2	Pulses Based Industry	a) Gram Flour b) Papad c) Whole or Split Dal
3	Oilseed Based Industry	Edible Oil Animal Feed Processed Seed (Sesame)
4	Fruits & Vegetables	a) Frozen fruits & Vegetables b) Chips & Wafers (Ready to Eat snacks) c) French Fries (Ready to Eat snacks) d) Dehydrated Vegetables e) Ketchups, Purees & Concentrates f) Juices g) Pickles
5	Spices Based Industry	a) Pastes & Powders b) Oleoresins c) Aromatic Extractions
6	Dairy Based Industry	Skimmed Milk Powder, Ghee ,etc.
7	Floriculture Based Industry	Fresh & Dried Flowers
8	Fisheries Industry	Fish Processing Fish meal Fish / Prawn Pickle
9	Livestock & Poultry	a) Processed Poultry Products b) Meat Gravy Concentrates c) Mutton & Lamb Processing
10	Medicinal Herbs Based Industry	Medicinal Products
11	Cotton & Jute Based Industry	Fibres processing
12	Sugarcane Based Industry	Jahangir Confectionary & Bakery Products
13	Plantation Crops based Industry	Tea Powder Coffee Powder
14	Others	Honey Mushrooms





Venkatesh

Source: Ministry of statistics and programme implementation, GOI (2011)

Table 2: Value of inventory

(Rs. In crore)					
Agro Based industries	2016-17	2017-18	2018-19	2019-20	2020-21
HPCL Biofuels Ltd.	50.76	189.76	245.92	181	168
National Seed Corporation Ltd.	172.25	330.27	304.91	317	313
Total	223.01	520.03	550.83	498	481

Table 3: Cost of Production

(Rs. In crore)

Agro Based industries	2016-17	2017-18	2018-19	2019-20	2020-21
HPCL Biofuels Ltd.	380.37	183.64	245.65	342	225
National Seed Corporation	815.41	822.09	1130.27	1021	1040
Total	1195.78	1005.73	1375.92	1363	1265

Table 4: Inventory Turnover Days

(Rs. In crore)

Agro Based industries	2016-17	2017-18	2018-19	2019-20	2020-21
HPCL Biofuels Ltd.	70	437	365	194	272
National Seed Corporation Ltd.	77	147	98	113	110
Average Inventory turnover days	68	189	146	134	139

Table 5: Extracts of Profit and Loss of Central Public Sector Enterprises Agro Based Industries in India from 2015-16 to 2020-21

(Rs. in Lakhs)

Particulars	2015-16	2017-18	2018-19	2019-20	2020-21
Total Income	147082	144338	141594	138850	136106
Revenue from Operations	145405	142277	139149	136021	132893
Other Income	1677	2061	2445	2829	3213
Total Expenditure	148073	145821	143569	141317	139065
Power and Fuel	1372	1530	1688	1846	2004
Materials Consumed (incl. store spares)	s & 31464	28261	25058	21855	18652
Employee Benefit Expenses	15915	16017	16119	16221	16323
Depreciation, Amortization and Impairment	4888	4733	4578	4423	4268
Finance Cost	7941	7117	6293	5469	4645
Exceptional and Extraordinary items	-106	-211	-316	-421	-526
Other Expenditure	86599	88374	90149	91924	93699
Profit / Loss Before Tax	-991	-1483	-1975	-2467	-2959
Tax Provisions	-4248	-1800	648	3096	5544
Profit / (Loss) after tax from Continuing Operations	3257	317	-2623	-5563	-8503
Profit / (Loss) after tax from Discontinuing Operations	0	0	0	0	0
Profit/loss for the Period	3257	317	-2623	-5563	-8503

Source: Compiled from Public Enterprises Survey 2015-16 to 2020-21





Venkatesh

Table 6: Extracts of Asset and Liabilities of Central Public Sector Enterprises Agro Based Industries in India from 2015-16 to 2020-21 (Rs. in Lakhs)

Particulars	2016-17	2017-18	2018-19	2019-20	2020-21
Equity and Liabilities	209543	210527	211511	212495	213479
Total Share Holders funds	83263	76753	70243	63733	57223
Share Capital	68249	68249	68249	68249	68249
Total Non-Current Liabilities	34913	40147	45381	50615	55849
Long Term Borrowings	17083	20909	24735	28561	32387
Total Current Liabilities	91367	93627	95887	98147	100407
Total Assets	209543	210527	211511	212495	213479
Total Non-Current Assets	91320	86965	82610	78255	73900
Net Fixed Assets (incl. Capital)	58869	62877	66885	70893	74901
Work in Progress)					
Investment	3366	3528	3690	3852	4014
Total Current Assets	118223	123562	128901	134240	139579
Cash and Bank balances	-1684	216	2116	4016	5916

Source: Compiled from Public Enterprises Survey 2015-16 to 2020-21

Table 7: Extracts Key ratios of Central Public Sector Enterprises Agro Based Industries in India from 2015-16 to 2020-21 (Rs. in Lakhs)

Particulars	2016-17	2017-18	2018-19	2019-20	2020-21
Financial Investment	85332	89158	92984	96810	100636
Capital Employed	100346	97662	94978	92294	89610
Net Worth	83263	76753	70243	63733	57223
EBITDA	11732	10156	8580	7004	5428
Asset Turnover Ratio	0.74	0.71	0.68	0.65	0.62
Contribution to Central Exchequer	-776	537	1850	3163	4476
Dividend declared/paid	-233	258	749	1240	1731
Net Profit Margin	2.47	0.31	-1.85	-4.01	-6.17
Operating Margin (%)	4.84	3.86	2.88	1.9	0.92
Return on Net worth (%)	6.27	1.27	-3.73	-8.73	-13.73
Return on Assets (%)	1.52	0.14	-1.24	-2.62	-4
Return on Capital Employed (%)	7.15	5.85	4.55	3.25	1.95
Debt/Equity Ratio (times)	0.15	0.25	0.35	0.45	0.55
Sales/Capital Employed (%)	144.77	145.64	146.51	147.38	148.25

Source: Compiled from Public Enterprises Survey 2015-16 to 2020-21





Assessment of Methanolic Leaf Extract of *Lantana camara* on Morpho-Biochemical Parameters of *Psoralea corylifolia* L.

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ABSTRACT

Laboratory bioassays were conducted to investigate the foliar spray of leaf, root and stem aqueous extracts of *Lantana camara* on *Psoralea corylifolia*. The effect of different leaf extracts of *Lantana camara* (25, 50, 75 and 100%) were recorded and compared with control (Distilled water). The aqueous leaf extracts of *Lantana camara* 25% causes enhancement effect on shoot length, number of leaves, no. of branches, biochemical parameters such as chl a, chl b, amino acid, protein amino acid and phenolic content of *Psoralea corylifolia*. Results depicted that significant ($P < 0.05$) difference in concentration levels and their interaction for the aforementioned parameters. From this study it is found that *Lantana* shows positive effect on morphological and biochemical parameters of a *Psoralea corylifolia* due certain chemicals present in it.

Key words: *Lantana camara*, *Psoralea corylifolia*, Biochemical parameters, Extract

INTRODUCTION

Exotic invasive weeds has become a global issue owing to the wide spread and tremendous growth overcoming the native flora. *Lantana camara* is a prime and notorious perennial thorny shrub of the family verbenaceae which is native to the American tropics commonly known as wild sage. In India also it has wide reach in agricultural, forest, community land and waste lands. The invasion of new territories by alien plant species threatens the biodiversity and the stability of the ecosystems (Davis, 2003). Invasion is considered as the second most widespread threat to global biodiversity next to habitat destruction (Leadley *et al.*, 2010).



**Mehvish Ayub et al.,**

As the density of *Lantana camara* in forest increases, allelopathic interactions increase and hence there is decline in species richness (Day *et al.*, 2003). Allelochemicals are plant secondary metabolites normally released into the environment through volatilization, leaching, root exudation and decomposition of plant residues in the soil (Khalaj *et al.*, 2013). Weeds species are often rich sources of secondary metabolites (allelochemicals) and these chemicals modify the environment of other plants growing in their vicinity and this phenomenon is known as allelopathy (Nandal *et al.*, 1994). Allelopathy has traditionally been considered only the negative chemical warfare of one organism upon another (Bansal, 1998). The different parts of *lantana* contain allelochemicals mainly aromatic alkaloids and phenolic compounds (Manohar *et al.*, 2017) which can interfere with seed germination and early growth of many plant species (Ahmed *et al.*, 2007).

Psorelea corylifolia L. Commonly known as 'Babchi' is an important medicinal plant belonging to leguminosae family, distributed in the tropical and subtropical regions (1). It is used as laxative, aphrodisiac, anthelmintic, diuretic and diaphoretic in febrile conditions. Pharmaceutical companies largely depend upon materials procured from naturally occurring stands, causing rapid depletion of this important source of medicinal herbs. Propagation of *Psorelea* through seed is restricted due to its reduced span of viability & low germination rate. Wild seedlings of this plant exhibit high mortality. Its natural population has declined very fast due to indiscriminate and illegal collections and destructions of its habitat. The present study was aimed to find out the impact of foliar spray of methanolic leaf extract of *lantana camera* on morpho-biochemical parameters of *P. Corylifolia*.

MATERIALS AND METHODS

Lantana Camara L. root, stem and leaves were collected in its natural habitat from M. L. B. College, Bhopal (M.P.). 100 g of *Lantana camara* L. root stem and leaf powder and 100 ml of methanol using Soxhlet apparatus. Extraction was considered to be completed when the root, stem and leaf material become exhausted of their constituents that were confirmed. The filtrates obtained are dried at temperature of $40 \pm 2^\circ\text{C}$ to have gummy concentrate of the crude extract. In the present study we have used *Lantana camara* as the donor plant. The experiment was designed in Completely Randomized Design (CRD) in the laboratory with different concentrations of leaf extract (control, 25%, 50%, 75% and 100%).

Preparation of leaf extract

For the preparation of leaf extracts 100 g of dry leaves was soaked in 500 mL distilled water and kept in 28°C room temperature for 24 hours. The solution was filtered through double layered muslin cloth. The filtrate was again filtered through Whatman No.1 filter paper into a conical flask. This solution was diluted to make 25%, 50%, 75% and 100% (on the basis of volume) and used for seed treatment. The experiment was carried out in sterile petridishes of 12 cm in size placing double layered Whatman No.1 filter paper on petridish. The extract of each concentration was added to each petridish of respective treatment daily in such an amount just enough to wet the seeds. The control was treated only with distilled water. 10 seeds each of *Psorelea corylifolia* were placed in the petridish replicating 4 times and was set in the laboratory. The experiment was extended over a period of 30 days to allow the germination of last seed and the measurement of the shoot and root length. The seed was considered as germinated, when radical emerged. The germination was recorded daily and the results were determined by counting the number of germinated seeds and measuring the length of primary root and main shoot. The biomass was calculated by taking the fresh of roots and shoots.

Determination of morphological parameters

The length between the shoot tip and point of the root-shoot transition region was taken as stem length (SL). Data were also recorded for the number of branches per plant; total number of leaves was counted for each treatment.



**Mehvish Ayub et al.,****Plant pigment analysis**

Chlorophyll contents were measured according to Arnon's method (1949). Fresh leaves were extracted with 80% acetone (V/V), chlorophyll contents were estimated by using a spectrophotometer, expressed in terms of microgram per gram of fresh weight ($\mu\text{g/g FW}$). The carotenoid content was extracted according to (Kirk and Allen, 1965) and absorbance was measured at 480nm by using a spectrophotometer and expressed in (nmol/g FW).

Protein estimation

The proteins were extracted and estimated by (Lowery *et al.*, 1951). A 0.5g of plant material was macerated in a mortar and pestle with 0.1N trichloroacetic acid followed by centrifugation at 10,000g for 15 minutes. The supernatant was thrown away, and to the pellets, 0.1N NaOH was added followed by centrifugation for 15 minutes. The supernatant was made up to 10ml with 0.1N NaOH. The extract was used for protein valuation using Bovine Serum Albumin (BSA). The absorbance was read at 660nm.

Estimation of Total phenols

Total phenol was estimated by Folin – ciocalteu method given by Bray and Thorpe(1952). For estimation of total phenol content, weighed 1 gm of tomato root and grinded it in 10 times volume of 80.00 percent ethanol with help of grinder. Centrifuged the homogenate at 10,000 rotations per minute for twenty (20) minutes and saved the supernatant. Reextracted the residue with five times the volume of 80.00 percent ethanol, centrifuged and pooled the supernatants. Then evaporated the supernatant to dryness and dissolved the residue in 5ml of distilled water. Then pipetted out different aliquots (0.2 to 2 ml) into test tube and made up the volume in each tube to 3 ml with and add 0.5 ml of Folin – ciocalteu reagent. After 3 minutes, 2 ml of 20% Na_2CO_3 solution added to each tube and placed the tubes in a boiling water bath for exactly 1 minute, cooled and measured the absorbance at 650 nm against a reagent blank. The standard curve was prepared using different concentration of catechol (μg).

Estimation of amino acid content

Free amino acid contents of different parts of the plant were determined following the method by Moore and Stein (1948). Amino acids react with Ninhydrin reagent which is originally yellow and give a purple color product (diketohydrin). The color intensity produced is proportional to the amino acid concentration. 0.1 g dry powdered plant material was extracted in 10 mL hot 80% ethanol. The extract was filtered through Whatman No. 1 filter paper. The filtrate was collected and used for assay.

RESULTS AND DISCUSSION**Effect of *Lantana camera* on growth parameters**

The data in table 1, 2nd and 3rd clarified the effect of foliar application of different concentrations of *Lantana camera* on morphological parameters of *Psorelea corylifolia*. The results revealed that there was significant increase in morphological parameters at optimum concentration however by increasing the concentration beyond the threshold level, no increase in growth parameters was observed. The most effective concentration of *Lantana camera* leaf extract was found to be 25%. The average height of *Psorelea corylifolia* L is shown in table 1. The study revealed that maximum enhancement stem length; number of branches and leaves was in *Psorelea corylifolia* L was found at 25% methanolic leaf extract of *Lantana camera* at 110 days after sowing. Statistically pronounced significant effect was found at 25%, by increasing the concentration beyond 25% there was drastic decline in height of the test plant compared to control group as well as compared to optimum concentration. Stimulatory effect of *Lantana camera* leaf extract was due to allelochemicals present in the leaf particularly phenolics. The promotive effect of leaf extract might be due to increase in ion uptake, photosynthesis nutrient uptake, enzymatic activities protein synthesis and source sink relationship (Rather *et al.*, 2022). The positive response was found to be due to enhancement in photosynthetic tissues and regulating cell division and cell proliferation. This increase in plant height is in accordance with Velmani *et al.*, (2015).





Mehvish Ayub et al.,

Effect of *Lantana camera* on biochemical parameters Photosynthetic parameters

The results in Fig 1a, 1b, 1c, showed that the effect of methanolic different concentrations of root stem and leaf extract of *lantana camera* on photosynthetic pigments. Chlorophyll a, chl b and carotenoid content increases with direct concentration of extract. As far as leaf extract is concerned 25% showed best results, for stem extract 50% of methanolic extract showed stimulatory response and root extract showed best results at 75% compared to control plant. The inhibitory effect of leaf extract was found at 100% as it drastically reduced the pigment content of our experimental material compared to control plant which was not subjected to foliar application of *Lantana camera* extract. Exogenously applied *lantana camera* foliar spray may up-regulate the synthesis of antioxidant molecules and chl biosynthetic genes, down regulating senescence associated genes and chlorophylase enzyme.

Figure 1(a, b, c). Effects of foliar application of methanolic root stem and leaf extract *Lantana camera* extract on chlorophyll a, chlorophyll b and carotenoid content of *Psoralea corylifolia* The obtained values were analyzed by using one-way analysis of variance (ANOVA)-using SPSS 16.0 software. The values are mean (\pm SE) of treatments (n=5) at P<0.05 significant level.

Protein content

Our results showed that foliar spray of methanolic leaf root and stem extract of *lantana camera* enhanced the protein content in *Psorelea corylifolia* L. (Fig 2a). The maximum increase in protein content was observed at 25% of leaf extract at 110 days after sowing compared to control group. However by increasing the leaf extract concentration it showed negative response. The stem and root extract showed best results at 50 and 75% compared to control plant. However at 100% extract of root, stem and leaf extract it showed detrimental effect on protein content of *Psorelea corylifolia*. The positive response of optimum concentration was due to different phytochemicals which enhanced the protein content of this very medicinal plant. Figure 2(a). Effects of foliar application of methanolic root stem and leaf extract of *Lantana camera* extract on total protein content of *Psoralea corylifolia* .The obtained values were analyzed by using one-way analysis of variance (ANOVA)-using SPSS 16.0 software. The values are mean (\pm SE) of treatments (n=5) at P<0.05 significant level.

Total phenolic content

The levels of total phenolic compounds were increased in all treatments; the levels remained higher than for the control in the treatments exposed to foliar spray of 25% leaf, 50% stem and 75 % root extract of *Lantana camera* (Figure 3a). However by increasing the concentration of extract beyond 75% there was drastic decline in phenolic content in *Psorelea corylifolia*. Djanaguiraman et al. (2005) reported that allelochemicals increase the phenolic content in *Sorghum bicolor* and *Phaseolus vulgaris*. Ladhari et al. (2014) stated that allelochemicals increase the phenolic content in lettuce roots. Figure 3(a). Effects of foliar application of methanolic root stem and leaf extract of *Lantana camera* extract on total phenol content of *Psoralea corylifolia* .The obtained values were analyzed by using one-way analysis of variance (ANOVA)-using SPSS 16.0 software. The values are mean (\pm SE) of treatments (n=5) at P<0.05 significant level.

Amino acid content

The amino acid content of the tested plant was increased at 25% of foliar application of methanolic leaf extract of *Lantana camera* (Figure 4a). However by increasing the concentration of the extract beyond 25% there was significant decrease in amino acid content compared to control plant. The root extract of methanol showed best results at 50% foliar application. The foliar application of stem extract of *Lantana camera* to our experimental material showed noteworthy results at 75%. However by increasing the concentration beyond 75% there was no significant increase in amino acid content in the tested plant material.

Figure 4(a). Effects of foliar application of methanolic root stem and leaf extract of *Lantana camera* extract on amino acid content of *Psoralea corylifolia* .The obtained values were analyzed by using one-way analysis of variance (ANOVA)-using SPSS 16.0 software. The values are mean (\pm SE) of treatments (n=5) at P<0.05 significant level.





Mehvish Ayub et al.,

CONCLUSION

So the findings of the current study showed that positive role of external foliar application of methanolic extract of *Lantana camara* on morphological and biochemical parameters of *Psorelea corylifolia*. Finally it can concluded that among various concentrations of methanolic extract of leaf, the most effective concentration was found to be 25% which showed positive results for all morphological and biochemical parameters.

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Mehvish Ayub et al.,

Table 1: Demonstrates the effect of different concentrations of root, stem and leaf extract on height (in cm) of treated plants of *Psoralea corylifolia* L. in comparison to control after 50,70 90 and 110 DAT (days after treatment).

Sample	Concentration	Days After Treatment			
		50	70	90	110
Root extract		50	70	90	110
	25%	9.2±0.12	13.6±0.42	18.5±0.16	24±0.04
	50%	10±0.21	13.2±0.22	18.6±0.31	24.6±0.07
	75%	11±0.2	14.4±0.31	18.8±0.12	26.3±0.003
	100%	7.6±0.5	10.8±0.14	17.8±0.002	22±0.21
	Control	9±0.01	13±0.33	19.2±0.121	27.6±0.213
Stem extract	25%	9.6±0.42	13.4±0.326	16.4±0.012	24.8±0.06
	50%	10.4±0.121	14±0.14	19±0.2	25.8±0.5
	75%	8.4±0.42	13.6±0.2	17.6±0.08	23.4±0.074
	100%	8±0.50.2	13±0.052	17±0.14	21.6±0.42
	Control	9.4±0.121	13.8±0.015	19.4±0.5	27.5±0.03
Leaf extract	25%	8.5±0.23	12.8±0.005	17.2±0.03	26±0.05
	50%	7.9±0.04	12.2±0.02	16.5±0.002	19.6±0.002
	75%	7.9±0.02	12±0.05	16±0.02	18.6±0.04
	100%	7±0.001	11.9±0.06	17.5±0.012	23±0.01
	Control	9.4±0.03	13.2±0.01	18.8±0.04	27.6±±0.02

Table 2: Demonstrates the effect of different concentrations of root, stem and leaf extract on number of branches of treated plants of *Psoralea corylifolia* L.in comparison to control after 50,70 90 and 110 DAT (days after treatment).

Sample	Concentration	Days After Treatment			
		50	70	90	110
Root extract		50	70	90	110
	25%	8.3±0.020.05	12.5±0.03	10.2±0.12	9.5±0.012
	50%	8.4±0.02	12.6±0.002	10.3±0.32	9.7±0.33
	75%	8.6±0.04	12.8±0.021	12.6±0.12	10±0.41
	100%	8.2±0.03	11.5±0.032	9.8 ±0.22	9±0.31
Control	9±0.01	13.6±0.012	13.2±0.25	14.4±0.52	
Stem extract	25%	8.2±0.001	9.4±0.012	11.2±0.14	9.1±0.02
	50%	8.5±0.02	13.2±0.025	12.4±0.123	11±0.032
	75%	8.1±0.03	13±0.014	10±0.21	8.5±0.24
	100%	7.9±0.02	12.8±0.032	9.8±0.32	8.2±0.21
	Control	10±0.05	13.8±0.052	12.8±0.24	14.3±0.23
Leaf extract	25%	9.40±.01	13.2±0.03	11.6±0.32	9.8±0.032
	50%	7.80±.05	9.2±0.01	11.3±0.12	8±0.025
	75%	7.5±0.025	9±0.14	11±0.32	7.8±0.012
	100%	6.4±0.012	7.8±0.23	9.2±0.33	7.2±0.021
	Control	9.2±0.022	14.8±0.024	16±0.14	14.6±0.22





Mehvish Ayub et al.,

Table 3: Demonstrates the effect of different concentrations of root, stem and leaf extract on number of leaves of treated plants of *Psoralea corylifolia* L.in comparison to control after 50,70 90 and 110 DAT (days after treatment).

Sample	Concentration	Days After Treatment			
		50	70	90	110
Root extract	25%	10±0.52	12.4±0.12	12±0.285	7.2±0.121
	50%	10.8±0.32	12.7±0.21	12.9±0.356	7.4±0.324
	75%	10.6±0.11	13.2±0.14	13±0.254 0.352	7.8±0.333
	100%	8.4±0.52	12±0.32	10±0.154	7±0.121
	Control	10.9±410.36	14.4±0.52	14.8±0.245	10.4±0.256
Stem extract	25%	9.4±0.12	11.8±0.14	12.40.263	7.4±0.245
	50%	10.6±0.63	13±0.23	13.2±0.285	12.4±
	75%	9.1±0.21	11.4±0.214	11.6±0.241	6.2±0.123
	100%	9±0.14	11.2±0.23	11±0.362	6±0.124
	Control	10.8±0.22	14.2±0.24	14.5±0.251	12.6±0.321
Leaf extract	25%	10±0.14	11.8±0.142	11.5±0.22	9.2±0.213
	50%	8.6±0.45	9.2±0.221	11.2±0.124	8.6±0.321
	75%	7.8±0.140	8.6±0.412	10±0.121	8.4±0.254
	100%	7.6±0.154	8.2±0.341	9±0.235	4±0.321
	Control	10.8±0.321	13.8±0.521	15.7±0.22	14.5±0.33

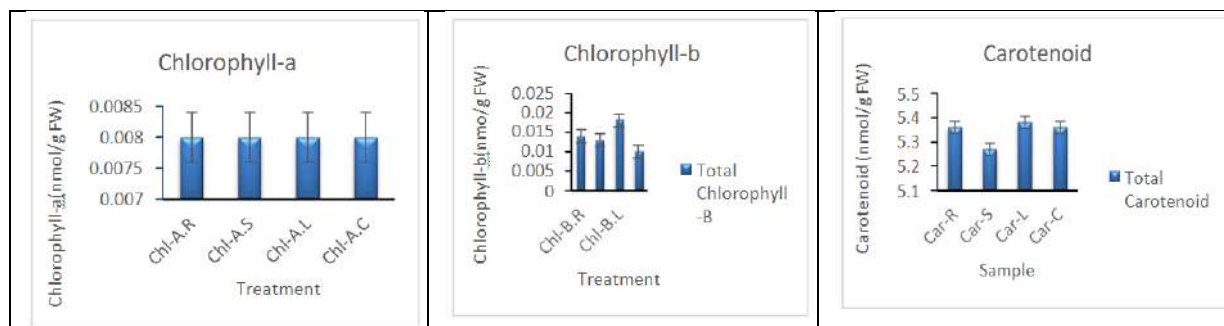


Figure 1(a, b, c). Effects of foliar application of methanolic root stem and leaf extract *Lantana camera* extract on chlorophyll a, chlorophyll b and carotenoid content of *Psoralea corylifolia*





Mehvish Ayub et al.,

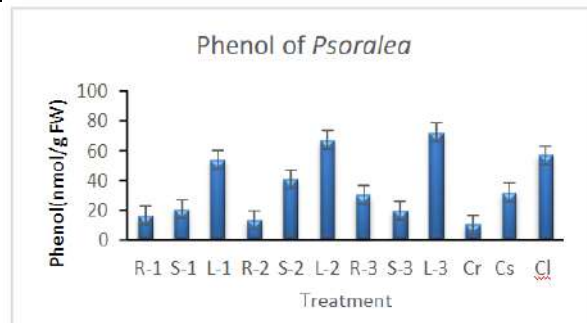
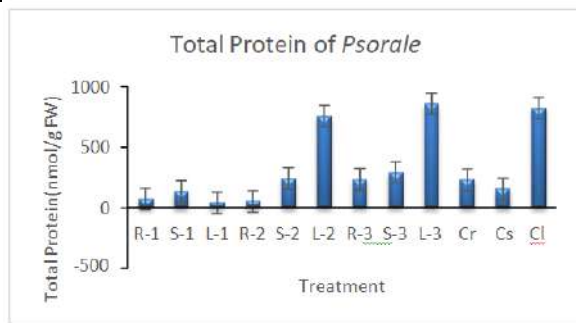


Figure 2(a). Effects of foliar application of methanolic root stem and leaf extract of *Lantana camera* extract on total protein content of *Psoralea corylifolia* .The obtained values were analyzed by using one-way analysis of variance (ANOVA)-using SPSS 16.0 software. The values are mean (\pm SE) of treatments (n=5) at P<0.05 significant level.

Figure 3(a). Effects of foliar application of methanolic root stem and leaf extract of *Lantana camera* extract on total phenol content of *Psoralea corylifolia* .The obtained values were analyzed by using one-way analysis of variance (ANOVA)-using SPSS 16.0 software. The values are mean (\pm SE) of treatments (n=5) at P<0.05 significant level.

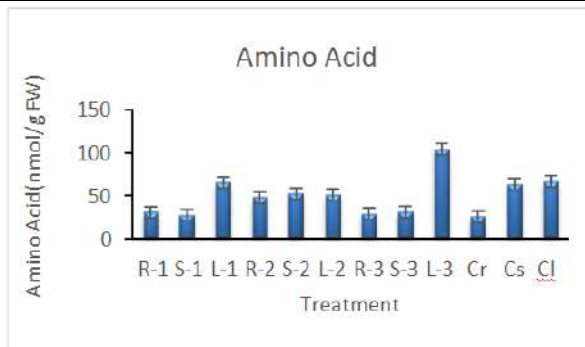


Figure 4(a). Effects of foliar application of methanolic root stem and leaf extract of *Lantana camera* extract on amino acid content of *Psoralea corylifolia* .The obtained values were analyzed by using one-way analysis of variance (ANOVA)-using SPSS 16.0 software. The values are mean (\pm SE) of treatments (n=5) at P<0.05 significant level.





Recent Therapeutic Target in Treatment of Asthma

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ABSTRACT

In this review we explore recent articles on asthma and discuss about the different aspects of asthma such as epidemiology, pathophysiology, asthmatic target, and its recent therapeutic approaches. Asthma development is influenced by a variety of molecular pathways, risk factors and protective factors. In asthmatic situations, generally fluctuate the level of mediator level like those of Eosinophils, Lymphocyte, Basophils, Neutrophils, lipid derived mediators, interleukins etc. At the sites of asthmatic inflammation several cytokines and chemokines play role in the selective recruitment of eosinophils. These include genetic and epigenetic variables, microbiome, and environmental exposure, particularly to indoor and outdoor pollutants. The most important experimental findings that contribute to our knowledge of molecular and immunological systems and may point to novel therapeutic targets are presented. The treatment of asthma is dependent on a precise diagnosis, type of illness, and monitoring of disease. Implementing recent therapeutic approaches that act on specific targets and avoid unnecessary common antiasthmatic drugs may positively affect asthma. This review will summarise recent developments in therapeutic strategies aimed at managing the level of specific mediator responsible for asthma.

Keywords: Asthma, Mediators, Therapeutic approach, Airway hyperresponsiveness, Inflammation, Allergen.



**Advait B. Chautmal et al.,**

INTRODUCTION

Asthma is a diverse disease characterized by reversible airflow obstruction, bronchial hyper-reactivity, airway inflammation, mucus hypersecretion [1] and structural alteration to the airways (remodelling) [2]. These manifestations lead to breathlessness attacks, wheezing, coughing, and chest tightness often occurring after exposure to allergens, pollutants, infections, or drugs. Inflammation of airway is a defence mechanism against cellular injuries and also shows the main feature of asthma. The release of reactive oxygen species, however, results in severe cellular and tissue damage when this advantageous reaction happens in an unregulated manner (ROS) [3]. Asthma is a common disease that is increasing in prevalence globally. Around 15% of the adult population in industrialised nations are most likely to have it [4]. Globally, 300 million individuals suffer with asthma, and by 2020, that number is projected to reach 400 million [5]. The incidence of the disease is increasing, affecting 1 in 10 children and 1 in 12 adults. 6–8 People with this illness range significantly in age, from teenagers to the elderly. The World Health Organisation estimates that asthma causes more than 180,000 fatalities per year [3].

It is rarely fatal, but the financial impact related to asthma is extensive due to direct and indirect medical costs, including prescription drug costs, healthcare utilisation and productivity losses [6]. Asthma & Chronic Obstructive Pulmonary Disease (COPD) are distinct clinical entities with different management strategies, although in clinical practice they are often treated with the same medications [7]. However, Some people seem to exhibit symptoms of both illnesses, which is termed asthma–chronic obstructive pulmonary disease overlap syndrome (ACOS) [7]. The inflammatory and immune response associated with asthma includes prominent infiltration of the airway with eosinophils and Th2 lymphocytes [8], reactive oxygen species [9, 2]. Several mediators such as Interleukin-3, IL-5, IL-11 [10] IL-9, Th2 cytokines (interleukin IL-5, IL-13, IL-4, and IL-9) LTB₄, Th9 and Th17 cells [5], transforming growth factor- β (TGF- β), Vascular Endothelial Growth Factor (VEGF), ADAM metalloproteinase domain 33 (ADAM-33), matrix metalloproteinase-9 (MMP-9), and peptido-lipids LTs, i.e. LTC₄, LTD₄ and LTE₄ [11] & GM-CSF, along with Thymic Stromal Lymphopoietin (TSLP), IL-4, IL-17, IL-25, and chemokines acting through the chemokine receptor CCR3, cause extensive inflammation, mucosal remodelling, and mucus hypersecretion in the airways [12]. LIGHT (TNFSF14), tumor necrosis factor (TNF)- α , and basic fibroblast growth factor (bFGF) are additional mediators have recently been identified [13].

Mast cells are triggered and degranulate following IgE cross-linkage of the high-affinity IgE receptor (Fc ϵ RI), which results in the release of mediators and the activation of eosinophils [8]. Eosinophils release pro-inflammatory mediators such as preformed major basic protein, newly synthesized leukotrienes, platelet activating factor, tumor necrosis factor (TNF) [4], interleukin (IL)-5, and other cytokines [8], leading to bronchoconstriction, mucus secretion, and denudation of the airway epithelium. The late phase of the inflammatory response is brought on by the recruitment of Th2 cells [8]. Most of the fatty acids like arachidonic acid (AA), triglycerides, cholesterol, phospholipids, and glycolipids are actively involved in several intercellular and intracellular processes [14]. Migration and proliferation of eosinophils depend on signalling of several chemokines and cytokines. Raised levels of the cytokines IL-33 and TSLP [12]. Eosinophils travel to the lung and other organs after mobilising from the bone marrow in response to cytokines and locally produced chemoattractants. Certain lipid mediators, including products of arachidonic acid metabolism, and chemokines, such as eotaxin, are potent stimulators of this process. 5-oxo-6E,8Z,11Z,14Z-eicosatetraenoic acid (5-oxo-E₄E), a lipid that triggered the oxoeicosanoid (OXE) receptor, is a newly recognised eosinophil chemoattractant [2]. These events result in chronic inflammation and destruction of tissue and enhancing DNA damage. Considering this mechanism, PARP enzymes (PARPs) have shown inflammatory activity in a wide range of animal models of diseases [3].

RISK FACTOR

Risk factors responsible for asthma are shown in fig. 1:



**Advait B. Chautmal et al.,****PATHOPHYSIOLOGY OF ASTHMA**

Asthma is an inflammatory condition that affects the airways and may entail a variety of cellular and cytokine-mediated processes of tissue damage [19].

Airway hyperresponsiveness

Relationship between inflammation and clinical symptoms of asthma is not clear. Even when airway function is normal, asthmatic patients exhibit a noticeable physiological anomaly known as enhanced airway reactivity. It is likely that there are several factors that underlie this increased responsiveness to constrictor agents, particularly those that act indirectly by releasing bronchoconstrictor mediators from airway cells. Ahr may be due to increased release of mediators (such as histamine and leukotrienes from mast cells), abnormal behavior of airway smooth muscle, thickening of the airway by reversible (oedema) and irreversible (airway smooth muscle thickening, fibrosis) elements [20].

Inflammatory cells

Eosinophils, mast cells, lymphocytes, monocytes, and neutrophils can all be seen in the inflammatory infiltrate that is present in asthmatic people's bronchial submucosa. As time, symptoms, treatments, and severity change, so can this infiltration of inflammatory cells [21].

Eosinophils-

Asthma can be divided into eosinophilic & non-eosinophilic asthma depending on the presence or absence of airway eosinophils. The inference from this is that eosinophils are not a prerequisite for the asthmatic phenotype or the clinical manifestations of asthma. Despite this, therapies that reduce sputum eosinophilia are effective in both forms of asthma [22]. The degranulation of these eosinophils suggests that they are triggered within the bronchial tissue. Proinflammatory mediators that are known to cause epithelial damage, smooth muscle contraction, bronchial hyperresponsiveness (bhr), and increased vascular permeability with mucosal oedema are released by the activated eosinophil. Major basic protein (mbp) and eosinophil cationic protein (ecp) in secretory granules are two of these mediators[21].

Lymphocyte

A paradigm that suggested that the primary cause of asthma was a disruption of the normal th1/th2 cells. Even if this hypothesis still has some merit, other t-cell subtypes' increasing roles in asthma suggest that it is oversimplified. Th17 cells are a diverse population of cd4 cells that produce il-17a, il-17f, il-22, tnf- a, and il-21, and express the transcription factor ror g t. recently, biopsy samples taken from asthmatic patients were used to isolate th17 cells [23].cd4 is expressed by lymphocytes that invade the airway mucosa of asthmatics[21].

Basophils

Basophils have a crucial role in initiating allergic inflammation through the binding of antigen-specific ige antibodies at the fc ε r1[24]. Through the synthesis of il-4 and direct cell-cell interaction, basophils also promote th2 cell development of activated naive cd4 1t cells [25].

Neutrophils

Severe asthma has a significant neutrophilic response with a variety of pulmonary illnesses, including copd, bronchiectasis with or without cystic fibrosis, and bronchiolitis [21]. Most people with mild-to-moderate chronic asthma do not have neutrophils as their major cell type; nevertheless, patients with more severe asthma seem to have neutrophils as their primary cell type in their airways and induced sputum. Although the exact process underlying neutrophilic inflammation is not yet known, it is believed that a number of mediators, notably cxcl8 (il-8), are involved [20].



**Advait B. Chautmal et al.,****Mast cells**

Acute bronchoconstrictor reactions to allergens and likely other indirect stimuli, such as exercise and hyperventilation, are obviously triggered by mast cells (via osmolality or thermal changes). Sensitized smooth muscle of airway contains more mast cells [20]. Mast cell activation is likely to play an important role in the symptoms of asthma and during acute exacerbations. There is infiltration smooth muscle of airway by mast cells in patients with asthma that is related to the characteristic disordered airway function of this condition [26].

Dendritic Cells

Pulmonary dendritic cells are antigen presenting cells with the capability to rapidly migrate to draining lymph nodes. Dendritic cells may dictate the subsequent T-cell response. Two major subsets of dendritic cells have been described, based on CD11c expression. Myeloid (CD11c) dendritic cells are proinflammatory, critical to both Th2 sensitization and the secondary immune response, and typically produce IL-12 [24].

Lipid derived mediators

Phospholipases A2 (PLA2), which is primarily in charge of releasing the AA from the cell membrane, are secreted as a response of allergen exposure. AA produced by PLA2 undergo enzymatic or non-enzymatic oxidation to produce additional lipid-based mediators. Enzymatic pathways consist of lipoxygenase (LO), cyclooxygenase (COX) & cytochrome P450 (CYP) enzymes whereas Reactive Oxygen Species (ROS) is the main factor of the non-enzymatic pathway. Following are some arachidonic acid derived lipid metabolites in plays role in asthma depicted in fig.2 [14].

Summary of the Key Mediators with their source and cellular action

Table. 1 Summary of the Key Mediators of Asthmatic Inflammatory Response [27-34, 24]

Summary of major therapeutic target in the treatment of asthma with examples - as shown below in table. 2

Table.2 Summary of major therapeutic target in treatment of asthma [4,7,35,36,28, 39,41,42,45,48,49,51,53, 55,58]

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Table. 1 Summary of the Key Mediators of Asthmatic Inflammatory Response [27-34, 24]

Mediator	Source	Action	Reference
IL 4 (late phase mediator)	Mast cells, Basophils	Leukocyte migration to the airways is facilitated by up-regulation of adhesion molecules, activation of mucus-producing cells and fibroblast, and induction of B-cells to alter their isotypes and produce IgE.	[27]
IL- 5 (late phase mediator)	Eosinophils, Mast cells	It has been discovered to increase the effector capabilities of eosinophils and prolong their longevity, which contributes to the pathophysiology of late-phase asthmatic reactions.	[28]
IL -13 (late phase mediator)	Mast cells, basophils	IL-13 has similar biological properties and activities to IL-4.	[29]
IL -17 (Th 2 Cytokine)	Th-17 cells	Pro-inflammatory cytokines can be induced by IL-17, which acts on epithelial, endothelial, and hematopoietic cells.	[30]
IL-9 (Th 2 Cytokine)	Mass cell, lymphoid cells	Promote development and proper functioning of mast cells. The growth and operation of B-cells are both influenced by IL-9. It increases B-cell IgE and IgG production that is mediated by IL-4.	[31]
IL-33 (Th 2 Cytokine)	Structural cells such as epithelial cells	Promote Th2 cell development, act as a chemoattractant for Th2 cells, and increase cytokine production and mast cell survival.	[32]
TNF a	Mast cells, alveolar macrophages, T cells, epithelial cells, airway smooth muscle	Release of pro-inflammatory cytokines by structural cells, stimulation of neutrophilia triggered by Th17, dendritic cell movement, CD4 T-cell migration, antigen presentation, and Treg cell regulation	[24]
TGF-β (transforming growth factor)	structural and immune cells involved in inflammation	TGF-β induces proliferation of fibroblast cells as well as induces proliferation and survival of and ECM secretion in Airway Smooth Muscle Cells (ASMCS)	[33]



Advait B. Chautmal *et al.*,

VEGF (vascular endothelial growth factor)	Structural eosinophils cells,	Airway vascular permeability, angiogenesis, subepithelial collagen deposition, airway smooth muscle hyperplasia, and the emergence of physiological abnormalities of the airway are all significantly influenced by VEGF.	[34]
SCF	Structural cells, mast cells, and eosinophils	SCF signaling promotes mast cell to produce IL-13	[24].

Table.2 Summary of major therapeutic target in treatment of asthma [4,7,35,36,28, 39,41,42,45,48,49,51,53, 55,58]

Sr No.	Class of drug	Example	Action	Reference
1	TH2/crth2 inhibitor	Suplatastosilate, succatast	Reduction in both IL-4 and IL-5 and airway inflammation	7,35
2	BRONCHIAL THERMOPLASTY	Bronchial thermoplasty	reduce smooth muscle mass	36,7
3	ANTI IL-5 monoclonal antibodies	Mepolizumab, Reslizumab and Benralizumab	Enhanced basophilic and eosinophilic antibody-dependent cell-mediated cytotoxicity	7, 39
4	ANTI IL 33	ILC2s	Reduced inflammation	7
5	ANTI IL 17	Brodalumab	lowered the numbers of neutrophils, eosinophils, and lymphocytes	41, 42
6	ANTI TNF	Etanercept, Infliximab	improve lung function and airway hyperresponsiveness	4, 42, 43
7	ANTI IL-13/ IL-4 PATHWAY	Tralokinumab, Lebrikizumab, Anrukizumab, RPC4046 and QAX576	activating signal transducer and reduce eosinophils	44, 45
8	NRF-2 agonist	Dimethyl fumarate	Reduce oxidative injury	47, 48
9	PD1 AND PD2	fusion proteins or antibodies	reduce airway inflammation	49
10	JAK- STAT INHIBITOR	p27kip, Bcl-6	Reduces cytokines, including IL-4, IL-5, IL-6, IL-10, and IL-13	50
11	ANTISENSE OLIGONUCLEOTIDE	Durason, EPI2010, GATA-3, EPI-4067, EPI-30051	Destroys mRNA and prevents protein translation	51
12	Anti - C5A	Eculizumab	reduce a variety of proinflammatory cellular responses	52, 53





Advait B. Chautmal et al.,

13	Tryptase inhibitor	APC366 and BAY17	Inhibit eosinophil chemotaxis and inactivation of lung fibroblasts	38
14	Anti Ige	Omalizumab, Ligelizumab	Inhibiting the degranulation, pro-inflammatory mediator release and production of newly formed lipid mediators from mast cells.	36, 39
15	Nf- kb inhibitors	SP650003, SP100030 and gliotoxin	Antiinflammatory activity	38, 40
16	K+ channel openers	BRL 34915 (cromakalim) and BRL 38227 (lemakalim)	bronchodilators	38, 53
17	Kinase inhibitors	SYK, IKK2, P38 MAPK, JNK, PI3K	Reduces expression of inflammatory genes	7, 37
18	Anti TSLP	AMG 157	inhibits the release of proinflammatory cytokines	12, 39
19	HDAC2 activation	theophylline	inhibition of oxidant-activated PI3K δ	7, 37
20	MACROLIDES	azithromycin	via inhibiting NF-kB and other transcription factors, reduce inflammation	7, 37
21	ANTI IL 9	MEDI-528	reduced airway inflammation and hyperresponsiveness	5, 46
22	ANTI IL 25	EPR5743(2)	Reduce IL-4, IL-5 and IL-13, serum IgE, eosinophils, and prevented AHR	5, 41
23	phosphodiesterase inhibitors	SK&F 94836, rolipram, denbufylline, AH 21-132 (benzafentrine), roflumilast and zardaverine	Bronchodilator and anti-inflammatory	7, 53
24	CXCR2 antagonist	SCH527123 and AZD5069	inhibiting neutrophilic airway inflammation	7, 41
25	ANTI GM-CSF:	MT203	decreasing survival and activation of peripheral human eosinophils	12, 42
26	TLR9 AGONIST	CYT003-QbG10	immunostimulatory activity	40, 54
27	SYK KINASE inhibitors	R343	Inhibit mast cell and basophil activation and the release of mast cell mediators	40, 55





Advait B. Chautmal et al.,

28	5-oxo-EETE	4Z,7Z,10Z,13Z,16Z,19Z docosahexaenoic acid, 5Z,8Z,11Z,14Z,17Z-eicosapentaenoic acid, di-homo-g-linolenic acid and 11Z,14Z,17Z eicosatrienoic acid	eosinophil-mediated allergic reactions	2, 56
29	Gene vaccination with plasmid DNA	CpG oligodeoxynucleotide	blunt the allergic inflammatory process	38, 57

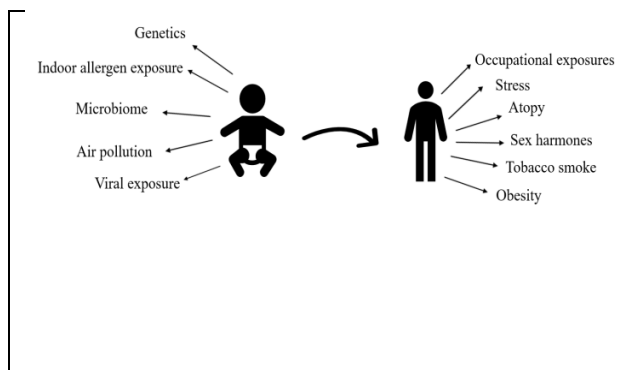


Fig.1 Risk factors [15-18]

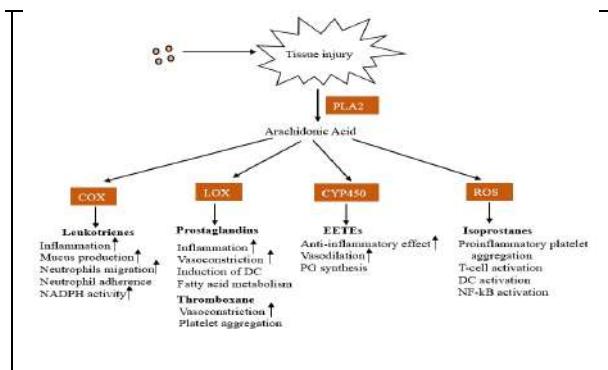


Fig. 2 Role of arachidonic acid derived lipid metabolites in asthma [14].





A Study on Impact of Artificial Intelligence and Its Challenges in Software Testing

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ABSTRACT

The past history of Artificial Intelligence and Machine Learning dates back to 1950's. In recent years, there has been an raise in popularity for applications that implement AI and ML technology. As with traditional development, software testing is a complex component of an efficient Artificial/Machine Learning application. However, the approach to development methodology used in Artificial /Machine Learning varies significantly from traditional development. Numerous software testing challenges occur, owing to these variations .This paper aims to recognize and to explain some of the biggest challenges that software testers face in dealing with AI/ML applications. This study has key implications for future research. Each of the issues and challenges specified in this paper is ideal for further analysis and has great potential to shed light on the way to more productive software testing strategies and methodologies that can be applied to AI/ML applications.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Software Testing.

INTRODUCTION

Overview of Artificial Intelligence and Machine Learning

Artificial Intelligence (AI), a widely used branch of Computer Science, refers to any smart machine that exhibits human like intelligence. By learning to follow the perception, logical and realistic thought, and managerial capabilities of human intelligence, AI helps machines to represent intelligent human behaviour.



**Sathyavathy et al.,**

There is a great effort in software development between the competing pressures of developing software and meeting the needs. Software Testers have to meet the requirements and satisfy the needs set by clients and executives, all while still delivering software quality. Automation is a very popular techniques to developers, so it's no surprise that the advances in artificial intelligence (AI) and machine learning (ML) are now being implemented to software testing to improve the performance, accuracy, and cost of testing [1].

IMPACT AND NEED OF AI IN SOFTWARE TESTING

Artificial Intelligence is piercing into various operations performed by the software industry in software Testing domain, AI technology holds the potential and capability to test the software and diagnose itself to make the self corrections. This leads to the huge savings in the consumption of the resources.

Need of AI in Software Testing

Software Testing came into existence as a result of the evolution of the technical development and methodologies. AI in software testing is the right path to solve these challenges [3]. AI can develop error free applications while enabling greater automation in the software testing. It reduces the testing time and improves the quality of software.

Improves Object application categorization

AI is widely used in wide variety of application particularly object application categorization. Once the hierarchy of the controls is categorized, testers can generate a technical map to obtain labels for the different controls. AI will become capable of observing users perform exploratory testing on the testing phase and once user behaviour is assessed, it can assign, monitor, and categorize the risk preference.

Automation of Test Case Writing

AI tools have become capable of implementing business usage scenarios of test applications [4]. The test case writing makes it easier for the tester to find and validate differences and diagnose issues.

Enhanced Accuracy

Source analysis requires manual resources to accomplish the task. Human error and the tendency to misplace focus further impair the experts involved in software testing. It can be unfortunate if bugs caused by these errors are caught by consumers before project stakeholders. AI can educate systems to learn source analysis and, in the future, to apply this acquired knowledge. This ensures that testers have greatly improves accuracy. It eliminates the probability of human error and also reduces the time to run a test and increases the possibility of finding defects or bugs.

Automation without the user interface

AI-based techniques can be incorporated for non-functional tests such as performance, security and unit testing and integration testing. It can also be applied on various application logs which assist in developing automatic capabilities such as bug prediction. AI algorithms can enhance User Interface testing, expect the next test, resolve the outcomes for subjective and complex tests and much more. In other words, AI could increase the overall test coverage while it increases the depth and scope of the test itself [5].

Reduces cost and decreases time to market

The need for manually replicating a test is time-consuming and extremely expensive. But with AI, such tests can be automated to repeat several times over. Each time the software test is automatically repeated, the source code gets modified to correct any bugs. This eliminates the additional cost of repeating the test and increases the speed of the test from days to hours, which in turn saves time and cost. Artificial Intelligence (AI) and Machine Learning (ML) are the next huge progress when it comes to solving the complex problems in a data driven world. Everything is surrounded by smart machines for analysing the data; many of them are handled by the consumer, and dependent on smart technologies.



**Sathyavathy et al.,**

CHALLENGES IN SOFTWARE TESTING

Number of possible Solutions

The first challenge is the number of feasible solutions involving AI technologies. Testing these systems requires a customized approach, adjusted for each specific scenario and client needs. The algorithms also vary in complexity. An easy machine learning algorithm which represents a single line through a data set. An inadequate or incomplete data set or one with low quality data can lead to biases in the solution, where a system is over-trained to see the same thing or is not qualified enough to make an accurate judgement.

Amount of Data

The second challenge of AI testing is quantity of data required to test the system. Insufficient data items will not provide statistical assurance of the system. In Deep Neural Networks (DNNs), the information about decision making, and therefore defects, is out-of-sight within layers of neurons, similar to neurons in the human brain. Extracting the specific properties which caused a DNN to make a decision is very difficult, and is a subject of academic research [7].

Tester Skillset

The method allows coverage of every process in the AI/ML development lifecycle including upstream and downstream integration. All of the data out and in has to be validated and carefully prepared, which is tackled by combination of manual and automation approaches. The difficulty and uniqueness of solutions is solved by algorithm specific testing techniques like boundary testing and dual coding [10].

Benefits of AI in Software Testing

Artificial Intelligence can help to support for the software testers for the bottlenecks. Automating the process of software testing with the help of AI has more benefits [12]. They include:

Improved Accuracy

The use of AI in Software Testing eliminates the probability of errors occurring in the testing phase. The Artificial Intelligence software analyzes the data and completes the task with the intended accuracy, time after time. It can quickly classify the lines of code with the error. The tester can rapidly make changes to the code or the AI software can itself make change due to machine learning capabilities. This automated process reduces the time for testers to perform related tasks.

Reduced Time

Manual Testing is a slow process and every code modification requires new tests that consumes the same amount of time. AI can be leveraged to automate the test process. AI provides for precise and consistent testing.

AI IN SOFTWARE TESTING

The current state of the process includes autonomous and intelligent agents, referred to as “test bots,” to automate activities such as application discovery, prototype, test case generation, and failure detection [13]. A combination of machine learning techniques is used to apply the test bots. These include various methods that include decision tree learning, neural networks, and reinforcement learning. Machine learning allows the test bots to be robust and react under conditions of uncertainty of traditional test automation tools and frameworks. Examples of AI-driven testing approaches are as follows:

Differential testing-Comparison testing of various application versions overbuild, classifying the differences, and learning from feedback on the categorization.

Visual testing — Testing image-based learning and screen differences to test the user interface of an application.

Declarative testing — Testing the Specification for the goal of a test in a natural or domain-specific language, and having the system to build to carry out the test.





Sathyavathy et al.,

Self-healing automation — Auto-correcting of element selection in tests when the User Interface changes.

At all testing levels, AI will take over automation. In all the testing phases, AI performs automation tasks that require decisions that a human could make within a fraction of second. Initially, higher-order testing tasks may still require manual inputs or intervention. These are the tasks that require more process such as test case generation, usability testing, performance testing, and test cases. However, over time as technologies emerge, and as the machines are trained on the activities of these higher-order tasks, AI is likely to take over those activities as well and solve problems that involve deeper perspective.

CONCLUSION

In AI/ML applications, software testing is just as critical as it is in any other software development form. Due to the nature of AI systems work and are built, there are many difficulties that software testers face with AI applications. Such issues range from conventional methodologies for white box and black box testing to problems that are very special to AI systems, such as overfitting and proper splitting of data into training and test data sets. In the efficient testing of AI/ML applications, this paper has enumerated and provided an overview of ten challenges. For future studies, each of these challenges is ideal for seeking solutions that alleviate the problem and illuminate the path to more efficient software testing methods and methodologies that can be applied to AI/ML applications.

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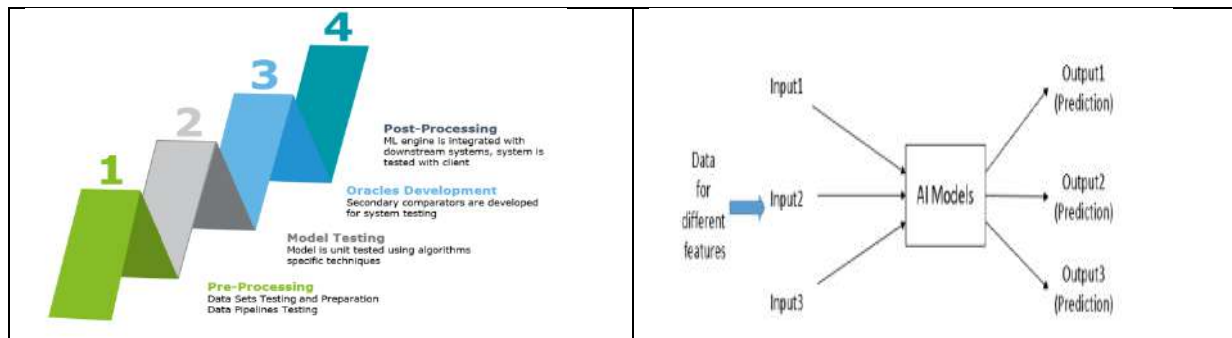


Fig.1. Artificial Intelligence and Machine Learning in Software Testing

Fig. 2.Measurement of Effectiveness of Functionality Testing

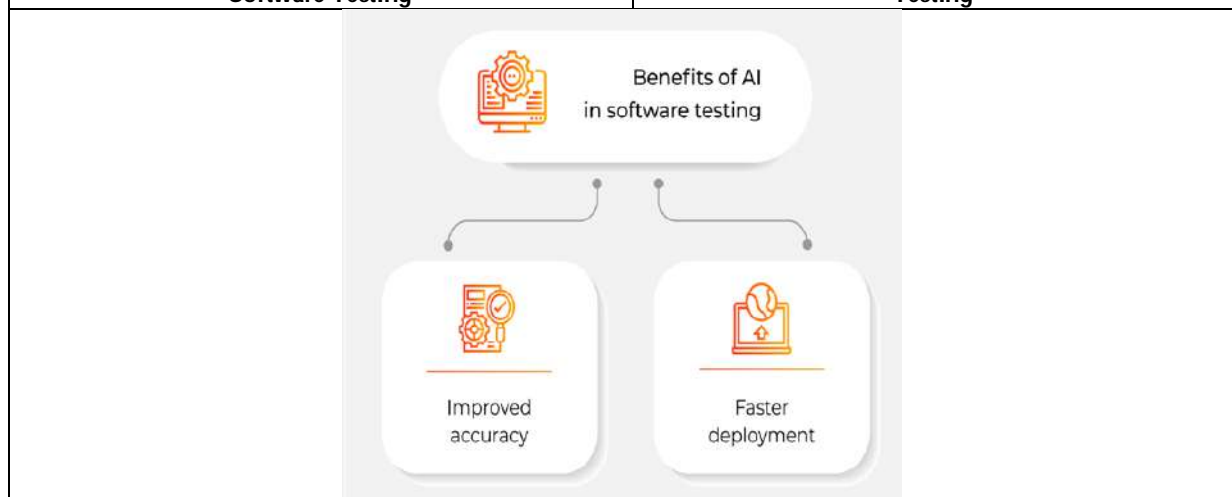


Fig.3.Benefits of AI in Software Testing





Statistical Optimization of Ultrasonic Pretreatment of Municipal Wastewater for Biomass and Lipids Production Using Newly Isolated *Scenedesmus quadricauda* Kutz.

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ABSTRACT

Microalgal biomass are used as an one of the prime feedstock for production of the third generation biofuels than the territorial biomass. In the present investigation, municipal wastewater (MWW) was ultrasonically pre-treated at 0.35 WmL^{-1} for 20 min and then used as a sole medium for biomass and lipids production by newly isolated *Scenedesmus quadricauda* Kutz. The newly isolated *S. quadricauda* was showed maximum biomass production of $4.73 \pm 0.11 \text{ gL}^{-1}$ and lipids content of $37.45 \pm 0.31\%$ when grown in the ultrasonic pre-treated MWW. Lipids was analyzed by Gas Chromatography and found highest amount $89.2 \pm 0.21\%$ of triacylglycerides in the lipid content of *S. quadricauda*. The results of present study, suggest that the newly isolated freshwater microalga *S. quadricauda* could efficiently be utilized for MWW treatment with concomitant biomass and lipids production for biodiesel production.

Keywords: Biomass, Municipal wastewater, Lipids, *Scenedesmus quadricauda*, Ultrasonic.

INTRODUCTION

Microalgae biomass can be used as a potential feedstock for the production of sustainable bioenergy and biomaterials. Development of microalgal based fine chemicals and clean energy technology are the keys to trouncing



**Malathy et al.,**

the problems including fossil fuel depletion, environment pollution, and global warming. Furthermore, microalgal biomass is mainly composed of carbohydrates, proteins, and lipids that can be used as feedstock for production of biofuels and value added products (Panahi *et al.*, 2019; Kumar *et al.*, 2020). Furthermore, the algal biomass contained a tiny amount of hemicellulose and unimportant lignins therefore the hydrolysate can be produced from algal without pre-treatment process and enhance its fermentation efficiency (Chandra *et al.*, 2019). Apart from biofuel production, the algal biomass can also be used as a source of human nutrients, animal feed, biofertilizers, and wastewater treatment (Mathimani *et al.*, 2019). The outstanding oleaginous nature of algal biomass than the oil seed plants, it is a imminent candidate for biofuels production by the implementation of different processes and technologies (Kumar *et al.*, 2020).

Microalgae are known to have higher growth rate than terrestrial plants, and can grow in diverse water ecosystems such as fresh and seawater, as well as wastewater. However, the high production cost is still the biggest limitation to the commercialization of microalgae based products and biofuels (Lu *et al.*, 2020). The use of synthetic culture media for large scale microalgae biomass production is economically nonviable, therefore using wastewaters as a culture medium for cultivation of microalgae is a cost-effective promising approach. Microalgae also have an ability to remove nutrients from wastewater by phycoremediation and sequester CO₂ in the atmosphere during growth (Raheem *et al.*, 2018). However, the efficiency of wastewater nutrients removal and production of biomass strongly depends on properties of wastewater and microalgae species. Both the organic and inorganic chemicals including nitrogen and phosphorus are present in the wastewater; however, the excess concentration of these compounds limits the microalgae growth (Xie and Liu, 2010).

Wastewater outcome of different domestic, farming, and industrial water operations and they contains anthropogenic pollutants in addition to organic and inorganic chemicals that are released into the environment (Patwardhan, 2017; Mofijur *et al.*, 2021; Le *et al.*, 2021). These lead to ecological devastation and cause human health risks if not treated appropriately (Prosser and Sibley, 2015). Thus, the wastewater management is one of the main programs in various parts of the world to evade threats to water quality and accessibility (Abdel-Raouf *et al.*, 2012; Ahmed *et al.*, 2022). A variety of organic substances for example carbohydrates, proteins, lipids and amino acids are present in wastewater in addition to a high quantity of inorganic compounds and wide diversity of microorganisms (Wen *et al.*, 2020; Goswami *et al.*, 2021). Therefore, wastewater needs suitable pre-treatment for converting complex organics into simpler ones, which can be competently utilized by microalgae. Besides, immediate execution is not achievable since these solutions should be economically viable and environmentally friendly (Ahmed *et al.*, 2022). To complete this, different single and combined disintegration methods including ultrasonic, thermochemical, and thermo-chemo-sonic digestion have been applied with high-energy inputs, as reported in the literature. Various organic compounds can be decomposed by application of aforesaid technologies (Kavitha *et al.*, 2013; Selvakumar and Sivashanmugam, 2017).

Ultrasonic (US) pre-treatment, as a physical pre-treatment method, is an efficient way for enhancing the disintegration of organic pollutants with ultrasound frequencies of 20–100 kHz (Mischopoulou *et al.*, 2016). When ultrasound is introduced into water, it will leads to the production of cavitation bubbles in the liquid phase, and violent collapse of these bubbles produces high shearing forces and free radicals (Ciggin *et al.*, 2021), which disrupt organic particles and destruct bacterial cells (Pilli *et al.*, 2011; Zhao *et al.*, 2020). US pre-treatment can be used prior to utilization of wastewater for cultivation of microalgae for the biodiesel production. Because it is a low operating cost technique than other pre-treatment methods. In addition, ease of operation, low power necessities and does not need complicated equipment reformatting or severe technical procedure (Thanh *et al.*, 2010; Naveena *et al.*, 2015). The low intensity ultrasound was improved the biological nitrogen and phosphorus removal, and bio-activity of activated sludge (Xie *et al.*, 2008; Zhang *et al.*, 2008; Xie and Liu, 2010). Nevertheless, either too low power or too high level of ultrasonic led to reduce the biological activity and degradation rate (Schlafer *et al.*, 2002). In the present study, Response Surface Methodology (RSM) involving Central Composite Design (CCD) was performed to assess the influence of ultrasonic parameters including ultrasonic intensity and exposure time in the pre-treatment of MWW used as sole medium for biomass and lipids production by newly isolated *Scenedesmus quadricauda* Kutz.



Malathy *et al.*,

MATERIALS AND METHODS

Materials

All chemicals used in the experiments were of highest purity or analytical grade (Hi-media Pvt. Ltd. Mumbai, and SRL India), obtained from the recognized chemical supplier (National Scientific Supplier, Chennai).

Organism and Growth Conditions

Green microalga *Scenedesmus quadricauda* Kutz was isolated from waterfront of Mamandur Lake (12°45'14" °N and 79°39'24" °E) which is situated in Cheyyar Taluk's, Tiruvannamalai District, Tamil Nadu, India, and Purified in an axenic culture. It was maintained in the Modified Chu13 medium (pH 6.7) (Tansakul *et al.*, 2005). Culture was maintained in Erlenmeyer flasks as well as in agar slants. The cultures were revived after every month. Cultures were kept under continuous illumination by white light (33 μ mol photons m⁻² s⁻¹) with a 12 h light:12 h dark cycle at 25 \pm 1°C.

Collection and Characterization of Municipal Wastewater

Municipal wastewater (MWW) was collected from Tiruvannamalai, Tamil Nadu, India. On the spot, the raw wastewater was first filtered through a 20-mesh sieve to separate coarse solids and other large materials were found in raw MWW. Then collected MWW was transferred to the laboratory, until used for study, it was stored at 28 \pm 2 ° (room temperature (RT)). Dissolved organic matter (DOM) concentration of MWW, before and after US pre-treatment was estimated by the method of Khan *et al.*, (2014).

Optimizing Ultrasonic Treatment of MWW

US pre-treatment of MWW was conducted with probe type Sonicator (Lark Innovative Fine Teknowledge, Chennai, India) combined with a transducer and a metallic probe of 1.2 cm in diameter. About 150 mL of 50% diluted MWW was taken in a 250 mL stainless steel beaker and the US probe was dipped up to 1 cm depth in the sample. The US pre-treatment parameter such as ultrasonic power intensity range from 0.2-0.5 WmL⁻¹ and exposure time range from 10-20 min were optimized by statistically using RSM-CCD. The design connoisseur Software-MINITAB 12 was used to design and formulate 13 experiments for these two parameters. As shown in Table 1, each parameter (independent variable) was tested at low, medium and high coded level. During the US pre-treatment the desired temperature of MWW maintained by insertion the MWW contained beaker in a water bath (Yiyang *et al.*, 2009). The sample without US pre-treatment was used as a control. Each run (experiment) was performed in replicates and the concentration of biomass was taken as a response. The regression analysis, analysis of variance (ANOVA) with statistical significance was done for the obtained data. The three dimensional (3D) response surface curves also were plotted to study the interaction among these factors. The predicted biomass concentration and optimal condition of the variables were found by solving the model designed using Software-Minitab 12. Optimized ultrasonic pre-treated MWW (UPMWW) concentration was used for further process.

Cultivation of Microalga in UPMWW

The cultivation of microalga *S. quadricauda* Kutz was carried in 250 mL Erlenmeyer flasks contained 100 mL of UPMWW as sole batch culture medium for biomass and lipids production. Prior to inoculation, the initial pH of culture medium was adjusted into pH 7.0 using 1N HCl/NaOH. Then the culture was inoculated with 10 % (v/v) of *S. quadricauda* Kutz seed inoculum and kept in the shaking incubator at 100 rpm in RT under the light intensity of 33 μ mol photons m⁻² s⁻¹ for 15 days.

Biomass Estimation

Biomass was estimated gravimetrically by the method of Rai *et al.*, (1991). 10 mL of culture broth was taken in pre-weighed glass centrifuge tube and centrifuged at 14000 rpm for 10 min. The harvested biomass was washed with deionized water and then dried in the hot air oven at 105 °C, until attained the constant weight. The dried biomass was cooled in a desiccator and the final weight was recorded using electronic balance. The difference between the





Malathy et al.,

initial weight and final weight was considered as grams of dry weight of biomass per liter. This was performed in triplicate and the values are given as mean \pm standard deviation (SD).

Estimation of Bacterial Population

By the plated counting technique, the bacterial population of MWW was estimated, before and after US pre-treatment. The spread plates were prepared by addition of 1 mL of diluted MWW sample on the nutrient agar plates and then incubated at 35 °C for 24 h. End of the experiment, petri plates contained bacterial colonies were counted using digital colony counter. The colony forming unit(CFU) was arrived using the following formula,

$$\text{CFU/mL} = \frac{\text{No. of colonies} \times \text{dilution factor}}{\text{volume of culture plate}}$$

Lipid Extraction and Estimation

Total lipids was extracted from microalgae biomass and estimated by the method of Bligh and Dyer (1959).

Gas Chromatography Analysis

The major lipid components of the sample were analyzed by method of Widjaja et al., (2009). Lipids was dissolved in the ethyl acetate and then 0.5 mL of this sample was injected into a Shimadzu GC-17A equipped with flame ionization detector using DB-5HT (5% phenyl)-methylpolysiloxane non-polar column (15m X 0.32mm ID). Both the injection and detector temperature was 370 °C. Initial temperature of chromatography column was 240 °C, and then the temperature was amplified into 300 °C at a temperature rise of 15 °C/min.

Statistical Analysis

All the experiments were carried out in triplicates and results are presented as the mean \pm SD values of three independent replicates. Data were further analyzed using one-way analysis of variance (ANOVA) using MINITAB 12 software. A significant difference was considered at the level of $p < 0.05$.

RESULTS AND DISCUSSION

Optimizing Ultrasound Pretreatment of MWW

The CCD of RSM was used to optimize the US pre-treatment of MWW and studied the interaction between ultrasonic parameters. In this study, *S. quadricauda* biomass was used as an indicator for optimization of US pre-treatment parameters. The CCD analysis was done with a set of 13 experiments, which was carried out in duplicate. The design matrix Table 2, shows the two independent variables of X_1 and X_2 with the experimental and predicted biomass values. The estimated regression coefficients values of biomass produced from UPMWW using *S. quadricauda* Kutz are given in the Table 3. The model articulated through the following regression equations (1), which represent biomass production as a function of X_1 and X_2 .

$$Y_{CODED} = 4.70 + 0.150X_1 + 0.783X_2 - 1.35X_1^2 - 0.45X_2^2 + 0.175X_1X_2 \text{ -----(1)}$$

where, Y is the biomass production (gL^{-1}), X_1 and X_2 are the coded values of ultrasonic intensity and exposure time respectively.

A 3D response surface curve was plotted for the results of CCD analysis. As shown in the Figure 1, highest biomass $4.73 \pm 0.11 \text{ gL}^{-1}$ was obtained from *S. quadricauda* Kutz when grown in MWW pre-treated ultrasonically at 0.35 WmL^{-1} for 20 min. Lipids content $37.45 \pm 0.31\%$ was also obtained in the same conditions. Hence, the ultrasonic intensity 0.35 WmL^{-1} and exposure time 20 min was found to be an optimum level for ultrasonic pre-treatment of MWW for biomass and lipids production by newly isolated *S. quadricauda* Kutz..

ANOVA was performed to study the significance and satisfactoriness of second-order polynomial equation (Table 4). The correlation measures for testing the goodness of fit of the regression equation is the coefficient of



**Malathy et al.,**

determination (R^2). While R^2 be nearer to 1, correlation is better between the predicted and experimental values through the second order polynomial model (Akhazarova and Kefarov, 1982; Dhandayuthapani *et al.*, 2022). In the present study, the high R^2 (0.98) implies a high level of correlation between the predicted as well as observed values. Therefore, the model was well fitted to symbolize the effect of chosen two variables on ultrasonic pretreatment of MWW using CCD statistical optimization.

The small p-values indicates the higher significance of the matching variables. A model obtained in this study was very significant at $p < 0.05$, which suggesting that the ultrasonic power intensity as well as exposure time can play a synergistic role in altering the chemical properties of MWW. The statistical outcome showed that the ultrasonic pretreatment is a noteworthy factor in prior use of MWW for production of biomass and lipids using *S. quadricauda* Kutz ($p = 0.012$, $p < 0.05$). These be able to considerably improve the growth of *S. quadricauda* Kutz. About 19% enhanced methane was produced from meat wastewater using ultrasound pretreatment prior to anaerobic processes (Erden *et al.*, 2010).

Major Lipids Composition

The major composition of raw lipids of *S. quadricauda* Kutz grown in ultrasonic pretreated MWW was determined by GC analysis. The results are listed in Table 5. Highest amount of triacylglycerides present in lipid content of *S. quadricauda*. So this lipids could be used as a feedstock for production non-toxic as well as biodegradable biodiesel by the process of transesterification. Generally, the high amount of hydrocarbons and triglycerides contained lipids, which are obtained from biomass, considered as a best feedstock for biodiesel production by transesterification (Rawat *et al.*, 2013).

Bacterial Growth in UPMWW

MWW was pretreated at 0.35 WmL^{-1} for 20 min. Without ultrasonic pretreatment the sample was used as control. 1mL of sample was spread on LB plates aseptically and incubated at 35°C for 24 h. It was observed that the maximum bacterial colonies 267 in the untreated MWW. While no bacterial, colonies were noticed in the UPMWW. Ultrasound can be used as a disinfection to kill bacteria in wastewater treatment and aquaculture. The physical effects of cavitations inactivate and lyse bacterial cells (Drakopoulou *et al.*, 2009, Broekman *et al.*, 2010).

Estimation of DOM

A larger amount of DOM $35.12 \pm 0.14 \text{ mgL}^{-1}$ was observed in the UPMWW at 0.35 WmL^{-1} for 20 min, than untreated MWW ($12.41 \pm 0.11 \text{ mgL}^{-1}$). The DOM concentration was increased in the MWW by the result of ultrasonic pretreatment. The ultrasonic treatment thoroughly lysis the microorganisms cell wall and its biomolecules through ultrasound waves. Therefore, the DOM levels increased in the wastewater. Consumption of supplementary soluble organic substance from culture medium can be obtained the larger quantity of preferred products (Guo *et al.*, 2016).

CONCLUSION

The ultrasonic pretreatment process parameters were statistically optimized using CCD-RSM and found that the low ultrasonic intensity 0.35 WmL^{-1} and the exposure time 20 min as optimum conditions for pretreatment of MWW for the cultivation of *S. quadricauda* Kutz and lipid production. The newly isolated *S. quadricauda* was produced a maximum biomass of $4.73 \pm 0.11 \text{ gL}^{-1}$ and lipids content of $37.45 \pm 0.31\%$ when grown in the MWW pretreated by ultrasonically at these conditions. Because no bacterial contamination and higher amount of DOM in the MWW after ultrasonic pretreatment. The lipids content of UPMWW grown *S. quadricauda* contained the highest amount of triacylglycerides, which could be used for production of non-toxic and biodegradable biodiesel through transesterification. Overall, the low ultrasonic pre-treatment of MWW prior to use for microalgae cultivation was a good move toward the future biofuel production. The results of this study advocate that the newly isolated



**Malathy et al.,**

freshwater *S. quadricauda* Kutz could successfully be used for phycoremediation of UPMWW with concomitant biomass and lipids production as a best feedstock for biodiesel production.

Conflict of Interest

The authors declare no conflict of interest

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**Malathy et al.,**

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Malathy et al.,

Table 1 Two independent variables levels of CCD for ultrasound pretreatment of MWW

Independent Variables	Code	Levels		
		Low (-1)	Medium (0)	High (+1)
Ultrasound power density (WmL ⁻¹)	X ₁	0.2	0.35	0.5
Exposure time (min)	X ₂	10	20	30

Table 2 Factorial design matrix of independent variables used for optimization of ultrasonic pretreatment of MWW for cultivation of *S. quadricauda* Kutz

Run Order	Ultrasonic intensity (W/mL)	Exposure time (min)	Biomass concentration (gL ⁻¹)	
			Experimental	Predicted
1	0.20	10.00	2.14±0.22	2.14
2	0.50	10.00	2.15±0.14	2.09
3	0.20	30.00	3.53±0.15	3.36
4	0.50	30.00	4.24±0.31	4.01
5	0.13	20.00	3.15±0.11	3.20
6	0.56	20.00	3.31±0.12	3.50
7	0.35	5.85	3.52±0.13	3.51
8	0.35	34.14	4.71±0.12	5.03
9	0.35	20.00	4.71±0.14	4.70
10	0.35	20.00	4.73±0.11	4.70
11	0.35	20.00	4.69±0.03	4.70
12	0.35	20.00	4.71±0.05	4.70
13	0.35	20.00	4.71±0.11	4.70
Control -55% diluted MWW	-	-	1.56±0.12	

Table 3 Estimated regression coefficients for biomass production from UPMWW using *S. quadricauda* Kutz

Variables	Estimated Coefficients	t-value	p-value
Model	4.70	59.795	<0.001*
Ultrasonic	0.150	1.941	0.093
Exposure	0.783	10.136	<0.001*
Ultrasonic X Ultrasonic	-1.350	-11.852	<0.001*
Exposure X Exposure	-0.450	-3.951	<0.006*
Ultrasonic X Exposure	0.175	1.849	0.107

R-Sq = 97.9% R-Sq(adj) = 96.5% * Significant





Malathy et al.,

Table 4 Analysis of variance (ANOVA) for biomass production from UPMWW using *S. quadricauda* Kutz

Source	Degree of freedom (DF)	Sum of Squares (SS)	Mean Square (MS)	F-value	p-value
Regression	5	11.976	2.39	66.85	<0.001
Linear	2	3.817	1.91	53.26	<0.001
Square	2	8.038	4.019	112.15	<0.001
Interaction	1	0.123	0.122	3.42	0.107
Residual Error	7	0.251	0.036	-	-
Lack of fit	3	0.24	0.079	-	0.004
Pure Error	4	0.012	0.000	-	-
Total	12	12.228	-	-	-

Table 5 Major composition of lipids extracted from *S. quadricauda* Kutz grown in optimum level UPMWW

Major lipid components	Composition (%)
C16 Free fatty acid (FFA)	0.51±0.22
C18 FFA	0.78±0.13
DG	8.02±0.11
Triacylglycerides (TG)	89.2±0.21
Others	1.49±0.12

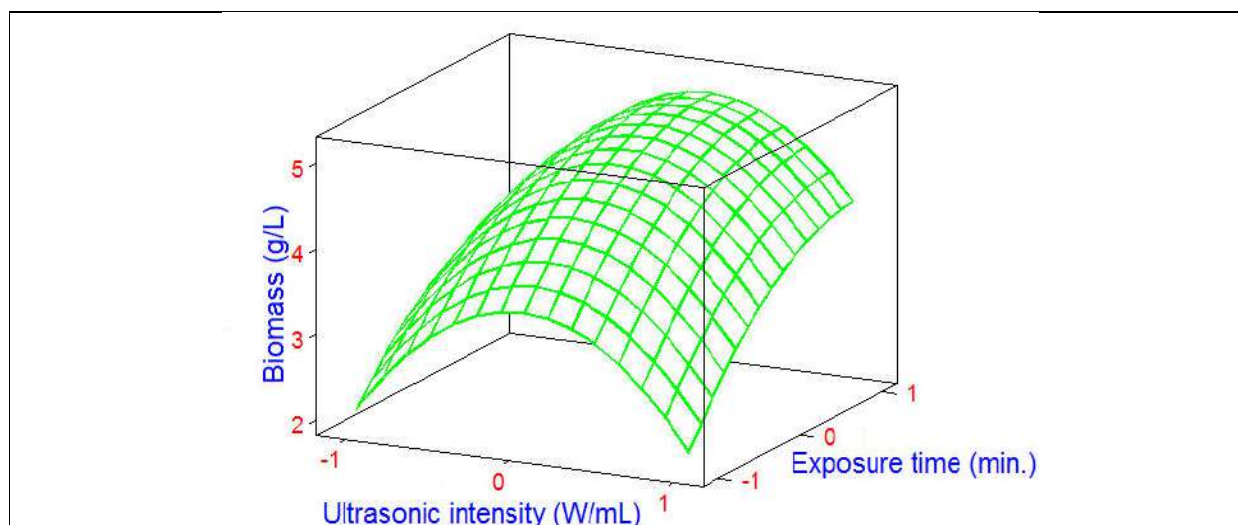


Figure 1. The response surface plot showing the effects of ultrasound intensity and exposure time on biomass production from UPMWW using *S. quadricauda* Kutz





Provenance Studies on the Art of Making Ancient Indian Pottery

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ABSTRACT

Globally, during ancient and modern days, most important attractive ancient pottery samples offer the data on the performance of the kilns used in their manufacture and technical capabilities of the ancient potters. Archaeological pottery samples were collected from Thirumangalam (TRM), Tamilnadu and characterized through FTIR, SEM and EDX techniques. The type of minerals present in the clay (pottery samples) and its structural deformation on firing were identified through FTIR analysis. The maximum firing temperature attained during baking, firing atmosphere (open/reduced) and iron mineral phase changes are well studied. SEM analysis of archaeological artifacts illustrates the microstructural behavior and traces the consequent growth of vitrification stages, thus the firing temperature being confirmed. Quantitative elemental compositions (major elements like SiO₂, Al₂O₃, Fe₂O₃, CaO, Na₂O, K₂O, TiO₂, MgO and ZnO) of the collected samples were analyzed through EDX analysis and it shows that Si is the major proportion in all studied samples.

Keywords: Archaeological Pottery, FTIR, SEM-EDX, Spectroscopy





Anand et al.,

INTRODUCTION

In archaeology, ancient potteries play a vital role during ancient and modern days to key out the technological and civilizing revolution in worldwide [1]. It is worthy to note that such a valuable potteries were made up of clay based materials present in various archaeological sites. Clay is one among in natural gift and it is primarily composed of fine grained materials, which is plastic at appropriate water contents. The transformation of clay into pottery, brick, tiles, etc. was one of the earliest technological operations of mankind. Since, it exhibits the moulding and drying properties of the wares being produced, it is widely used in ceramic industries. On firing the clay materials (to get better mechanical strength, durability etc., of the final products) undergo some structural and chemical modification such as dehydration, oxidation, decomposition and formation of new phases etc. These modifications on heating (duration and under which atmosphere) depend on the chemical and mineralogical compositions of the clay [2].

Many researchers [1-4] have successfully analyzed the clay type, firing temperature and firing atmosphere by different characterization techniques like FTIR, XRD, SEM, Mossbauer, DTA, etc.. FTIR analysis is utilized to know the clay mineralogy and structural deformation due to temperature effects which provides the information on dehydroxylation and dehydration since it is sensitive to OH and water [3]. The SEM analysis offers very useful information about the internal morphology, degree of vitrification (amount of glassy phase), pore structure and crystalline phases which characterize the initial clay and its refractory properties [4]. In most of the cases, elemental compositions of the clay and pottery could be achieved through EDX analysis [4]. Hence, the current investigation is focused to (i) assess the complete mineralogy, clay mineral type and study the structural deformation of all collected samples from Thirumangalam, Tamilnadu by FTIR; (ii) know the microstructure of the collected samples through SEM, and Finally, (iii) appraise the quantitative elemental compositions (SiO_2 , Al_2O_3 , Fe_2O_3 , CaO , Na_2O , K_2O , TiO_2 , MgO and ZnO) (major elements) of the collected samples by EDX analysis.

MATERIALS AND METHODS

Importance of the excavation site and Sample collection

Tamilnadu state is well known for its cultural heritage and civilization over the past 1400 years. Thirumangalam (TRM) is one of the locations which identified as archaeological sites by Rural Education and Conservation of Heritage (REACH), Chennai. It is an ancient settlement situated on the left bank of the river Cauvery, seven kilometer west of Kumbakonam in Tanjavur district. In this place, numbers of archaeological evidence belonging to the Iron Age period are available. In addition to red, black and red, black ware with the graffiti, bangles and three types of beads like glass, paste and quartz are also found in that site. The pottery shreds were collected manually from the Thirumangalam site and are named as TRM-1, TRM-2, TRM-3, TRM-4 and TRM-5.

Sample preparation and experimental techniques

The collected samples were oven dried at 105°C through over night before analysis. The sub samples were broken and powdered by an agate mortar for FTIR analysis. The FTIR spectra were recorded by using paragon 500, Perkin-Elmer spectrophotometer model in the wave number region of $4000 - 400 \text{ cm}^{-1}$ (accuracy of $\pm 4 \text{ cm}^{-1}$) using standard KBr pellet technique. For SEM with EDX analysis, samples were washed with water and dried in hot air oven at 100°C for an hour. Fracture of the samples was coated with platinum and their surface was analyzed by Scanning electron microscope (model - JSM-5160 series) with an accelerating voltage of 20 kv.





RESULTS AND DISCUSSION

FTIR Analysis

Firing temperature and firing conditions influence on the physical properties of pottery since potteries are made up of clay materials which include clay minerals, accessory minerals and amorphous materials. Through FTIR, many studies [5-9] have confirmed the similar observations on clay minerals and their transformation during firing. In the present study, the FTIR spectra were recorded for the local clay (TRM-Clay) and pottery sherds in as-received state (ARS) and fired to different temperatures in steps of 100 °C to 800 °C in laboratory conditions (Figure 1). The presence of band at around 3700 cm^{-1} region is due to the symmetric stretching vibrations of hydroxyl groups. The bands observed at 1100 and 915 cm^{-1} may be due to the vibration of aluminum hydroxyl in the octahedral sheet structure. On heating to clay between 300 and 500°C, it is observed that the progressive destruction of octahedral layer is accompanied by the weakening of these bands. At 600°C these bands completely disappeared [10] followed by crystal structure collapse and broadening of the SiO stretching band is observed at 1030 cm^{-1} for red clay and 1080 cm^{-1} for white clay type [11]. The bands observed at 1030 and 462 cm^{-1} are assigned to Si-O-Si stretching and bending mode respectively and are free from any temperature effect.

The Si-O-Al bending vibration noticed at 530 cm^{-1} may be due to the presence of residual Al in octahedral sheet. The absorption bands at 540 and 580 cm^{-1} indicate the presence of iron oxides which ascribable to the substitution of aluminium with iron approximately 600°C [12]. Referring to Wagner et al. [1], the crystallized hematite was formed on firing the clay materials between 700 and 900 °C under oxidizing atmosphere. This was caused by layer structure of the clay breaks down together and structural iron contained in the clays. The spectra of local clay show prominent bands centered around 3620 cm^{-1} attributed to inner O-H group of adsorbed water. The presence of Al is well recognized with the feeble shoulder at 1100 and 915 cm^{-1} by the substitution of Al in octahedral sheet. On firing the clay in steps of 100 °C, the intensity of the bands at 3620, 1100 and 915 cm^{-1} decrease and they disappear above 600 °C. The presence of weak broad absorptions at 3440 (O-H stretching) and 1640 cm^{-1} (H-O-H bending) are presented due to the adsorbed water molecules in the samples [13]. Generally, these bands are diminished on heated above 100°C, but the existence of these bands at higher temperatures attributed to the absorption water molecules from atmospheric air while recording the spectra. A broad band centered at 1030 cm^{-1} with asymmetry around 1100 and 915 cm^{-1} becomes symmetry at 700°C indicates that the destruction of octahedral sheet structure has taken place above 600°C.

Observed peaks at 795, 775 along with 695 cm^{-1} indicate the presence of quartz [14, 15]. The presence of Quartz and Feldspar in clays are common, in some cases they are added in clay as temper. The weak band at 640 cm^{-1} is attributed to Al-O co-ordination vibration. The intensity of the band 530 cm^{-1} decreases above 400 °C and is shifted to 540 cm^{-1} due to the replacement of Al by Fe [16]. The band 540 cm^{-1} along with the appearance of weak shoulder at 580 cm^{-1} is attributed to iron oxides at 500°C. Intensity of the above bands beyond 600°C is increases which indicate the crystallization of hematite.

Figures 2 and 3 show the FTIR spectra of selected pottery samples TRM-1 and TRM-3 in ARS and refired at 300, 600 and 800°C. It is noteworthy to mention that the TRM-1 (Red ware), TRM-3 (Redware) and TRM-5 (Black and Red ware) have been fired above 600 °C and made up of disordered clay. It could be confirmed through the absence of hydroxyl bands and the presence of broad symmetry band centered around 1030 cm^{-1} in the ARS spectra. The firing temperature has also been confirmed as above 600 °C and presence of iron oxides by the well resolved and distinct peaks at 540 and 580 cm^{-1} in ARS spectra. The eminent absorptions at 540 and 580 cm^{-1} in TRM 1 and TRM 3 confirms that they have been fired under reduced atmosphere. Moreover, at high temperature air has been allowed during the cooling process which facilitates the oxidation of iron at reduced atmosphere. It causes the formation of red colour of the pottery. It is a common practice for coloration of the baked clays by allowing the air during cooling process. The presence of weak band at 1440 and 860 cm^{-1} indicates the presence of calcite in the sample TRM-3, it persists up to 700 °C and disappears at 800 °C. In ARS spectra of TRM-5, it is confirmed that sample has been fired under strong





reduced atmosphere and air has been admitted only at lower temperature due to the presence of band at 540 and weak shoulder at 580 cm^{-1} . This is the reason for inner black and outer red colour surface of the sample. No remarkable changes are observed on refiring the examined samples up to 500 °C. However, the intensity of the bands at 540 and 580 cm^{-1} increase on firing to 800°C which indicates further oxidation of iron components. The increase in intensity of the band 580 cm^{-1} is more in TRM-5, as it is fired under strong reduced atmosphere. Thus, the samples TRM-1, TRM-3 and TRM-5 have been fired above 600°C under dissimilar ambience (reducing followed by oxidising at different temperatures) and the clay used is disordered type.

SEM with EDX studies

Elemental composition of the potteries was examined by EDS analysis (Table 1). It can be seen that most abundant oxide in all TRM potteries are SiO_2 , Al_2O_3 and Fe_2O_3 ranging from 53.64 to 61.24, 13.83 to 18.52, 7.57 to 8.70 respectively, which confirms the presence of low refractory clays [16] in the samples. Among the potteries, TRM -3 had highest CaO. This shows that it made up of calcareous clay [16]. The SEM analysis (Figure 4) of the pottery in ARS can serve the valuable information on structural alteration during their firing /manufacturing process, especially on the degree of vitrification and formation of localized pores. The texture and chemical compositions of clay (particularly calcium and iron content), firing temperature and atmosphere in the kiln play a vital role to fix the degree of vitrification in final artifact. On the basis of these factors, there are four principal vitrification stages (i.e. No vitrification, Initial vitrification, Extensive vitrification and Total vitrification) proposed by Maniatis and Tite [17].

Initial vitrification in fired clay could be described by formation of isolated smooth surface structure. On the other hand, the extensive vitrification was also associated with increment of glassy phase and area of bloating pores [17]. The Initial vitrification and extensive vitrification occurs in the temperature range from 750°C to 950°C and from 850°C to 1050°C in calcareous and non calcareous clay respectively. The total vitrification lies in between 850 and 1000°C for non calcareous and between 1050 to 1200°C in calcareous clays, in which the extent of the glassy phase increases with densified structure. Morphology of all the samples demonstrate that the internal morphology of pottery sherds exhibits plate like structure and there are no contacts among the grain boundaries that enabled us to conclude that all potteries are fired at relatively low temperatures. However, the disappearance of rounding edges and slight buckling of clay plates reveals that the initial vitrification stage in ARS has no vitrification. As no vitrification stage is observed in TRM-1, 2, 4 and 5, samples belong to non calcareous type ($\text{Ca} < 5\%$) which reveals that the sample TRM-1 was fired below 800°C under oxidizing atmosphere and the sample TRM-5 has been fired below 750°C under reduced atmosphere. From the FTIR analysis, the sample TRM-3 belongs to calcareous and no-vitrification in as-received state which reveals that the sample is fired below 800°C. The SEM images of all the samples refired at 900°C (Figure 5) show the smooth surface areas in the fractured surface which indicate that initial vitrification started irrespective of the clay (calcareous / non calcareous) type.

At 900 °C, increment of glassy phase and area of localized bloating pores confirms the extensive vitrification in TRM-1, 2, 4 and 5 which belong to non calcareous clay. The extensive vitrification is not seen in TRM-3 refired at 900°C which belongs to calcareous clay and the same is also reflected in FTIR spectra.

CONCLUSION

The combinations of FTIR and SEM techniques provide the chemical and mineralogical information for deducing the materials and manufacturing conditions of pottery sherds. The studied ancient Indian domestic pottery sherds mainly consist of quartz, plagioclase and hematite which show that they are made of different clays and fired above 600°C under different environmental conditions. The samples TRM-1, 2, 4 and TRM-5 are made of non-calcareous clay and TRM-3 is made of calcareous clay, which is reflected from the morphology of the samples through SEM-EDX studies. From the above information it is evident that the samples TRM-1, 2, 4 and TRM-5 have been made of local clay of non-calcareous type, the other one being calcareous type which might have been made of clay



**Anand et al.,**

transported from other regions. The above study reveals the artisans awareness towards the art of controlling temperatures and firing conditions in making different coloured and good quality pottery in ancient time.

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Anand et al.,

Table 1. Major Elemental concentration of archaeological pottery sherds TRM using EDX analysis

Elements	Elemental concentration (%)				
	TRM-1	TRM-2	TRM-3	TRM-4	TRM-5
Silicon (SiO ₂)	57.009	61.247	59.824	59.105	53.64
Aluminium (Al ₂ O ₃)	15.361	18.523	16.051	18.269	13.83
Iron (Fe ₂ O ₃)	8.703	8.280	6.367	7.579	7.57
Calcium (CaO)	3.434	0.956	7.46	1.011	3.64
Sodium (Na ₂ O)	0.679	0.571	0.728	0.293	1.37
Potassium (K ₂ O)	4.75	2.568	1.867	2.953	5.95
Titanium (TiO ₂)	0.703	0.983	0.849	0.826	0.53
Magnesium (MgO)	1.836	0.827	1.212	0.713	2.73
Zinc (ZnO)	0.345	0.150	0.080	0.508	0.30

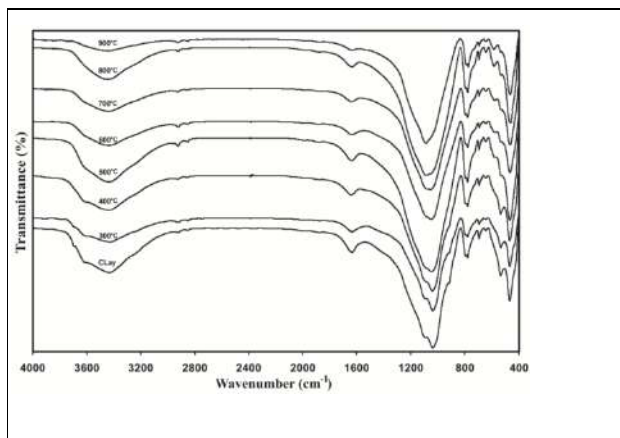


Figure 1. FTIR spectra of local clay (TRM- Clay) in as received state to 900 °C.

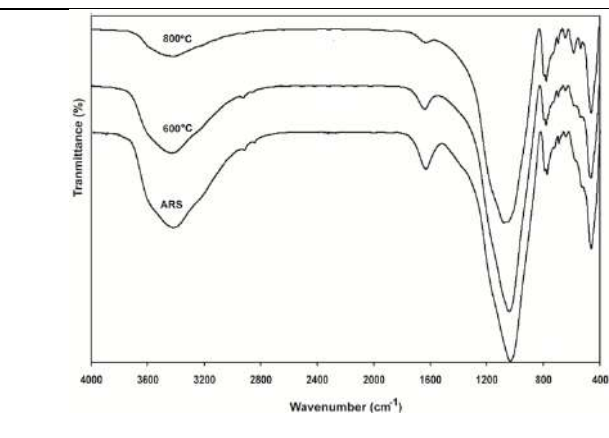


Figure 2. Representative FTIR Spectra of pottery sherds sample (TRM -1) as received state and refired at 600 and 800 °C.

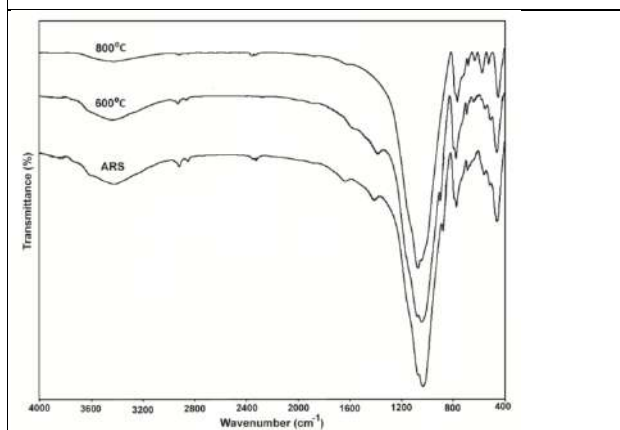


Figure 3. Representative FTIR Spectra of pottery sherds sample (TRM -3) as received state and refired at 600°C and 800°C.

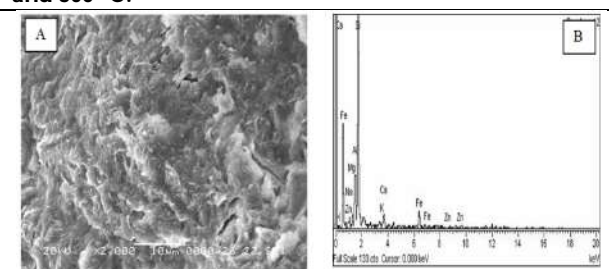


Figure 4. SEM image and EDX spectrum of the sample TRM-1 in as received state





Anand et al.,

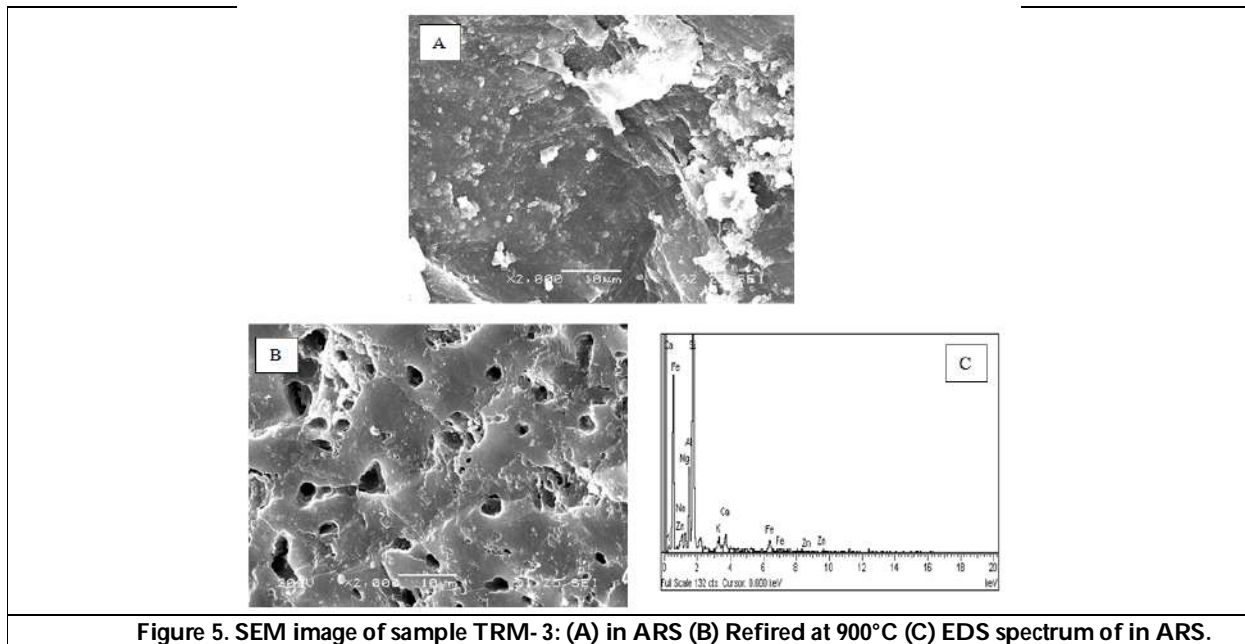


Figure 5. SEM image of sample TRM- 3: (A) in ARS (B) Refired at 900°C (C) EDS spectrum of in ARS.





Self Distributive STBE-Algebras

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ABSTRACT

In this paper, we introduce the concept of left and right maps in a self distributive STBE- Algebras. From the collection of subsets of the right maps of a self distributive STBE-Algebra, we obtain a special topology, called RS -Topology on the class of all right maps. Then we construct the set of all right maps as a $STBE$ - Algebra under a binary operation \odot and the topology τ_s .

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Keywords: Self-distributive $STBE$ -algebra, Left and right maps, Open sets, Semi-open sets

INTRODUCTION

In[4] H. S. Kim and Y. H. Kim introduced the notion of BE-algebras, which is a generalization of BCK algebras. They also introduced the notion of commutative BE-algebras and studied their properties and characterization. In our earlier paper [11], we introduced the concept of $STBE$ -Algebras and studied its topological properties. In[12], Zekiye Ciloglu and Yilmaz Ceven introduced Self-distributive BE-Algebras. Motivated by this, we introduce the notion of left and right maps on a Self-distributive $STBE$ -Algebras and construct a topology on the set of all right maps of the considered $STBE$ -Algebras.

PRELIMINARIES

Definition 2.1 [4] A BE-algebra $(X, *, 1)$ of type $(2,0)$ (A non-empty set together with a binary operation $*$ and a constant 1) satisfying the following conditions.





Lakshmi Kumari and Thiruvani

1. $x * x = 1$
2. $x * 1 = 1$
3. $1 * x = x$
4. $x * (y * z) = y * (x * z), \forall x, y, z \in X.$

Definition 2.2 [2] A BE -algebra $(X, *, 1)$ is called a commutative BE -algebra if it satisfies the identity, $(y * x) * x = (x * y) * y, \forall x, y \in X.$

Theorem 2.3 [2] If X is a commutative BE- algebra then $x * y \neq 0$ or $y * x \neq 0$, for all distinct $x, y \in X.$

Definition 2.4 [12] A BE -algebra $(X, *, 1)$ is called self-distributive if $x*(y*z) = (x * y) * (x * z), \forall x, y, z \in X.$

Definition 2.5 [5]

- i) A subset A of a topological space is said to be semi-open if $A \subseteq \overline{Int A}.$
- ii) The complement of semi-open set is called semi-closed.
- iii) The semi-closure of a subset A of a topological space is the intersection of all semi- closed set containing $A.$ It is denoted by $\bar{A}^s.$
- iv) A subset A of a topological space is said to be regular-open if $A = \overline{Int A}.$

Definition 2.6 [11] A BE-algebra $(X,*)$ together with a topology τ is called a S-topological BE-algebra (STBE-algebra) if the function $f: X \times X \rightarrow X$ given by $f(x, y) = x * y,$ which satisfies the condition that for each open set M containing $x * y,$ there exists an open set U containing x and a semi-open set V containing y such that $U * V \subseteq M, \forall x, y \in X.$

LEFT AND RIGHT MAPS ON STBE-ALGEBRAS

Definition 3.1 Let X be a BE- Algebra and $a \in X.$ A left map $L_x: X \rightarrow X$ is defined by $L_x(y) = x * y, \forall y \in X$ and right map $R_x: X \rightarrow X$ is defined by $R_x(y) = y * x, \forall y \in X.$

Example 3.2 Consider a STBE-algebra $(X = \{1, a, b, c, d\}, *, 1),$ where $*$ is defined as follows

*	1	a	b	c	d
1	1	a	b	c	d
a	1	1	b	c	d
b	1	1	1	c	c
c	1	1	b	1	b
d	1	1	1	1	1

and $\tau_s = \{X, \emptyset, \{a, c, d\}, \{b, d\}\}$ is a s-topology.
 We define a right map $R_b: X \rightarrow X$ as $R_b(x) = x * b, \forall x \in X.$
 That is $R_b(1) = 1 * b = 1, R_b(a) = a * b = 1, R_b(b) = b * b = 1, R_b(c) = c * b = b, R_b(d) = d * b = 1.$

Notation We denote the set of all right maps on X as $\mathbb{R}(x).$

Theorem 3.3 Let X be a STBE-algebra. Then every left and right map on X is continuous.

Proof: Let $x \in X.$ Then $L_x(y) = x * y, \forall y \in X.$
 Let M be any open set containing $x * y.$
 Since X is a STBE-algebra, there exists a open set U of x and a semi-open set V of y such that $U * V \subseteq M.$
 Then $x * V \subseteq U * V \subseteq M.$
 $\Rightarrow L_x(V) \subseteq M \Rightarrow L_x$ is continuous.





Lakshmi Kumari and Thiruvani

Similarly, we can prove that R_x is also continuous.

Definition 3.4 Let X be a STBE-algebra. Define a binary operation \odot on $\mathbb{R}(X)$ as
 $(R_a \odot R_b)(x) = R_a(x) * R_b(x), \forall x \in X$.

Example 3.5 In Example 3.2, we see that $R_a \odot R_b = R_b$.

Theorem 3.6 Let X be a self-distributive STBE-algebra. The $(\mathbb{R}(X), \odot, R_1)$ is a BE-algebra.

Proof: Let $R_a, R_b \in \mathbb{R}(X)$. Now,

$$\begin{aligned} (R_a \odot R_b)(x) &= R_a(x) * R_b(x) \\ &= (x * a) * (x * b) \\ &= x * (a * b) \quad (\text{Since } X \text{ is self-distributive}) \\ &= R_{a*b}(x) \end{aligned}$$

Hence, we have

(1)

$$\begin{aligned} (R_a \odot R_a)(x) &= R_a(x) * R_a(x) \\ &= R_{a*a}(x) = R_1(x) \end{aligned}$$

$\Rightarrow R_a \odot R_a = R_1$

(2)

$$\begin{aligned} (R_a \odot R_1)(x) &= R_a(x) * R_1(x) \\ &= R_{a*1}(x) = R_1(x) \end{aligned}$$

$\Rightarrow R_a \odot R_1 = R_1$

(3)

Similarly $R_1 \odot R_a = R_a$

$$\begin{aligned} (R_a R_a \odot R_a)(R_a \odot R_a)(x) &= R_a(x) * R_a(x) \\ &= R_{a*b}(x) = R_1(x) \end{aligned}$$

$\Rightarrow R_a \odot R_a = R_a$

(4)

$$\begin{aligned} (R_a \odot (R_b \odot R_c))(x) &= R_a(x) * (R_b(x) * R_c(x)) \\ &= R_a(x) * R_{b*c}(x) \\ &= R_{a*(b*c)}(x) \\ &= R_{b*(a*c)}(x) \quad (\text{Since } x, y, z \in X) \\ &= R_b(x) * R_{a*c}(x) \\ &= R_b(x) * (R_a(x) * R_c(x)) \\ &= (R_b \odot (R_a \odot R_c))(x) \end{aligned}$$

Hence, $\mathbb{R}(X)$ is a BE-algebra.

Definition 3.7 Let X be a self-distributive STBE-algebra and A be any subset of X . Define

$$\mathbb{R}_A = \{R_a / a \in A\}.$$

Definition 3.8 Let X be a STBE-algebra. Define a map $\Phi : X \rightarrow \mathbb{R}(X)$ by

$$\Phi(x) = R_x, \forall x \in X.$$

Remark 3.9

(1) Let X be a self-distributive STBE-algebra and A, B be any two subsets of X . If $A \subseteq B$, then $\Phi(A) \subseteq \Phi(B)$.

(2) Let X be a self-distributive STBE-algebra. If G_1 and G_2 are any two subsets of X , then

(a) $\Phi(G_1 \cup G_2) = \Phi(G_1) \cup \Phi(G_2)$.

(b) $\Phi(G_1 \cap G_2) = \Phi(G_1) \cap \Phi(G_2)$.

Theorem 3.10 Let X be a self-distributive STBE-algebra. Then the map $\Phi : X \rightarrow \mathbb{R}(X)$ is a BE-isomorphism.

Proof Let $x, y \in X$.

Clearly Φ is one-one and onto. Also $\Phi(x * y) = R_{x*y}$ ----- (1)

$$\begin{aligned} \text{Now, } R_{x*y}(t) &= t * (x * y) = (t * x) * (t * y) \\ &= R_x(t) * R_y(t) \end{aligned}$$

$$= (R_x \odot R_y)(t)$$

$$\Rightarrow R_{x*y} = (R_x \odot R_y) = \Phi(x) \odot \Phi(y).$$

Hence, from (1), we have $\Phi(x * y) = \Phi(x) \odot \Phi(y)$.





Lakshmi Kumari and Thiruveni

$\Rightarrow \Phi$ is a BE-isomorphism.

Theorem 3.11 Let $(X, *, \tau_s)$ be a self-distributive STBE-algebra. Then $\tau'_s = \{ \Phi(G) / G \in \tau_s \}$ is a topology on $\mathbb{R}(X)$.

Proof Clearly, $\mathbb{R}(X), \emptyset \in \tau'_s$.

Let $\{ \Phi(G_i) \}_{i \in I} \in \tau'_s$.

Then $\{ G_i \}_{i \in I} \in \tau_s \Rightarrow \cup_{i \in I} G_i \in \tau_s$.

Therefore, $\cup_{i \in I} \Phi(G_i) \in \tau'_s$.

Similarly, finite intersection of elements of τ'_s is in τ'_s .

Hence τ'_s is a topology on $\mathbb{R}(X)$.

Remark 3.12 Let $(X, *, \tau_s)$ be a self-distributive STBE-algebra. Then the collection of subsets $\tau'_s = \{ R_A \subseteq \mathbb{R}(X) / A \in \tau_s \}$ of $\mathbb{R}(X)$ is called a RS-topology on $\mathbb{R}(X)$.

Theorem 3.13 Let $(X, *, \tau_s)$ be a self-distributive STBE-algebra. Then $(\mathbb{R}(X), \odot, \tau'_s)$ is a STBE-algebra.

Proof Let $x, y \in X$. Then $\Phi(x), \Phi(y) \in \mathbb{R}(X)$.

Since, X is a STBE-algebra, for any open set M of $x * y$, there exists a open set U of x and a semi-open set V of y such that $U * V \subseteq M$.

From theorem 3.11, we have, for every open set $\Phi(M)$ of $R_x \odot R_y$, there exists a open set $\Phi(U)$ of R_x and a semi-open set $\Phi(V)$ of R_y such that

$$\Phi(U) \odot \Phi(V) = \Phi(U * V) \subseteq \Phi(M).$$

Thus $(\mathbb{R}(X), \odot, \tau'_s)$ is a STBE-algebra.

Theorem 3.13 Let $(X, *, \tau_s)$ be a self-distributive STBE-algebra. If $\{1\}$ is open in X , then τ'_s is a discrete topology on $\mathbb{R}(X)$.

Proof For every $x \in X, R_x \in \mathbb{R}(X)$.

Since $R_x \odot R_x = R_1$ and $\{R_1\}$ is open in $\mathbb{R}(X)$, we have for every open set $\Phi(\{R_1\})$, there exists a open set $\Phi(U)$ of R_x and a semi-open set $\Phi(V)$ of R_x such that $\Phi(U) \odot \Phi(V) = \Phi(U * V) \subseteq \Phi(\{R_1\})$.

Let $W = U \cap V$.

Then $\Phi(W * W) \subseteq \Phi(\{1\}) \Rightarrow \Phi(W) \subseteq \Phi(\{x\})$.

$\Rightarrow \tau'_s$ is a discrete topology on X .

CONCLUSION

We have constructed the set of all right maps of a self-distributive STBE-Algebras under the binary operation \odot and the topology τ'_s . We can further study the topological properties of these STBE-algebras.

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Nano Topology Based on New Generalized Closed Sets and Functions

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ABSTRACT

In this paper is to introduce and study the concepts of nano lightly $g^\#$ -closed sets by using the concept of nano $g^\#$ -closed set in nano topological spaces. Further, we discuss the notions such as nano lightly $g^\#$ -continuous functions, nano lightly $g^\#$ -open functions and nano lightly $g^\#$ -closed functions.

Keywords: $ng^\#$ -closed, $nlg^\#$ -continuous, $ng^\#$ -compact and $nlg^\#$ -compact.

INTRODUCTION

Lellis Thivagar, *et al* [6] was the main brain behind developing the concept of nano topology. It is constructed in terms of lower and upper approximations and boundary region of a subset of a universe. The elements of the nano topology are called the nano open sets. He further established the weak forms of nano topology, nano extremally disconnected space, nano topology in Čech rough closure space, nano topology via neutrosophic sets so on. Recently several researcher were introduced and studied the new sets and functions in nano topological spaces for example [[10], [2] and [17]]. In this paper is to introduce and study the concepts of nano lightly $g^\#$ -closed sets by using the concept of nano $g^\#$ -closed set in nano topological spaces. Further, we discuss the some notions such as nano lightly $g^\#$ -continuous functions, nano lightly $g^\#$ -open functions and nano lightly $g^\#$ -closed functions with suitable examples are given.

Preliminaries

Definition 2.1 [15] Let U be a non-empty finite set of objects called the universe and R be an equivalence relation on U named as the indiscernibility relation. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair (U, R) is said to be the approximation space. Let $X \subseteq U$.





Shyamala Malini

1. The lower approximation of X with respect to R is the set of all objects, which can be for certain classified as X with respect to R and it is denoted by $L_R(X)$. That is, $L_R(X) = \bigcup_{x \in U} \{R(x) : R(x) \subseteq X\}$, where $R(x)$ denotes the equivalence class determined by x .
2. The upper approximation of X with respect to R is the set of all objects, which can be possibly classified as X with respect to R and it is denoted by $U_R(X)$. That is, $U_R(X) = \bigcup_{x \in U} \{R(x) : R(x) \cap X \neq \phi\}$.
3. The boundary region of X with respect to R is the set of all objects, which can be classified neither as X nor as not - X with respect to R and it is denoted by $B_R(X)$. That is, $B_R(X) = U_R(X) - L_R(X)$.

Definition 2.2 [6] Let U be the universe, R be an equivalence relation on U and $\tau_R(X) = \{U, \phi, L_R(X), U_R(X), B_R(X)\}$ where $X \subseteq U$. Then $\tau_R(X)$ satisfies the following axioms:

1. U and $\phi \in \tau_R(X)$,
2. The union of the elements of any sub collection of $\tau_R(X)$ is in $\tau_R(X)$,
3. The intersection of the elements of any finite subcollection of $\tau_R(X)$ is in $\tau_R(X)$.

Thus $\tau_R(X)$ is a topology on U called the nano topology with respect to X and $(U, \tau_R(X))$ is called the nano topological space. The elements of $\tau_R(X)$ are called nano-open sets (briefly n -open sets). The complement of a n -open set is called n -closed. We denote a nano topological space (or) space by (U, \mathcal{N}) , where $\mathcal{N} = \tau_R(X)$. The nano-interior and nano-closure of a subset A of U are denoted by $nint(A)$ and $ncl(A)$, respectively.

Definition 2.3 A subset H of a space (U, \mathcal{N}) is called

1. nano semi open [6] if $H \subseteq ncl(nint(H))$.
2. nano regular-open [6] if $H = nint(ncl(H))$.
3. nano β -open [18] if $H \subseteq ncl(nint(ncl(H)))$.
4. nano b -open [13] if $H \subseteq nint(ncl(H)) \cup ncl(nint(H))$
5. nano π -open [1] if the finite union of nano regular-open sets.
6. nano α -open set [6] if $H \subseteq nint(ncl(nint(H)))$.

The complements of the above used sets are called their respective closed sets.

Definition 2.4 A subset H of a space (U, \mathcal{N}) is called

1. nano g -closed [3] if $ncl(H) \subseteq G$, whenever $H \subseteq G$ and G is nano open.
2. nano πg -closed [16] if $ncl(H) \subseteq G$, whenever $H \subseteq G$ and G is nano π -open.
3. nano $g\alpha$ -closed [8] if $nacl(H) \subseteq G$ whenever $H \subseteq G$ and G is nano α -open.
4. nano αg -closed set [8] if $n\text{-}acl(H) \subseteq G$ whenever $H \subseteq G$ and G is nano open.
5. nano sg -closed set [4] if $nscl(H) \subseteq G$, whenever $H \subseteq G$ and G is nano semi open.

The complements of the above used sets are called their respective open sets.

Definition 2.5 A subset H of a nano topological space (U, \mathcal{N}) is called

1. nano regular closed [6] if $H = ncl(nint(H))$.
2. nano semi open set [6] if $H \subseteq ncl(nint(H))$.
3. nano rg -closed [20] if $ncl(H) \subseteq G$ whenever $H \subseteq G$ and G is n -regular open.
4. nano dense [19] if $ncl(H) = U$.
5. nano nowhere dense [7] if $nint(ncl(H)) = \phi$.
6. nano codense [11] if $U - H$ is n -dense.

Definition 2.6 A subset H of a space (U, \mathcal{N}) is called

1. nwg -closed set [9] if $ncl(nint(H)) \subseteq V$ whenever $H \subseteq V$ and V is nano open.
2. $nrrwg$ -closed set [9] if $ncl(nint(H)) \subseteq U$ whenever $H \subseteq U$ and U is regular open.
3. nwl_{rg} -closed set [12] if $(nint(E))^* \subseteq F$ whenever $E \subseteq F$ and F is a n -regular open.
4. $ng^\#$ -closed set [5] if $ncl(H) \subseteq G$ whenever $H \subseteq G$ and G is nag -open.

In future nano topological spaces $(U, \tau_R(X))$ is referred as a space $(U, \tau_R(X))$.





Shyamala Malini

Nano lightly $g^\#$ -closed sets

We introduce the definition of nano lightly $g^\#$ -closed sets in nano topological spaces and study the relationships of such sets.

Definition 3.1 A subset E of a space $(U, \tau_R(X))$ is called a nano lightly $g^\#$ -closed (briefly, $nlg^\#$ -closed) set if $ncl(nint(E)) \subseteq G$ whenever $E \subseteq G$ and G is $n\alpha g$ -open in U .

Proposition 3.1 Each $nlg^\#$ -closed set is $nlg^\#$ -closed in a space $(U, \tau_R(X))$.

Remark 3.1 The converse of Proposition 3.1 is need not be true as seen from the following example.

Example 3.1 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1, h_2\}, \{h_3\}\}$ and $X = \{h_1, h_2\}$. Then $\tau_R(X) = \{\phi, \{h_1, h_2\}, U\}$. Then the subset $\{h_1\}$ is $nlg^\#$ -closed set but not a $ng^\#$ -closed in $(U, \tau_R(X))$.

Proposition 3.2 Each $nlg^\#$ -closed set is nwg -closed in a space $(U, \tau_R(X))$.

Proof. Let E be any $nlg^\#$ -closed set and G be any nano open set containing E . Then G is an $n\alpha g$ -open set containing E . We have $ncl(nint(E)) \subseteq G$. Thus, E is nwg -closed.

Remark 3.2 The converse of Proposition 3.2 is need not be true as seen from the following example.

Example 3.2 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1\}, \{h_2, h_3\}\}$ and $X = \{h_1\}$. Then $\tau_R(X) = \{\phi, \{h_1\}, U\}$. Then the subset $\{h_1, h_2\}$ is nwg -closed set but not $nlg^\#$ -closed in $(U, \tau_R(X))$.

Proposition 3.3 Each $nlg^\#$ -closed set is $nw\pi g$ -closed in a space $(U, \tau_R(X))$.

Proof. Let E be any $nlg^\#$ -closed set and G be any $n\pi$ -open set containing E . Then G is a nsg -open set containing E . We have $ncl(nint(E)) \subseteq G$. Thus, E is $nw\pi g$ -closed.

Remark 3.3 The converse of Proposition 3.3 is need not be true as seen from the following example.

Example 3.3 In Example 3.2, then the subset $\{h_1, h_3\}$ is $nw\pi g$ -closed but not $nlg^\#$ -closed.

Proposition 3.4 Each $nlg^\#$ -closed set is $nrrwg$ -closed in a space $(U, \tau_R(X))$.

Proof. Let E be any $nlg^\#$ -closed set and G be any nano regular open set containing E . Then G is an $n\alpha g$ -open set containing E . We have $ncl(nint(E)) \subseteq G$. Thus, E is $nrrwg$ -closed.

Remark 3.4 The converse of Proposition 3.4 is need not be true as seen from the following example.

Example 3.4 In Example 3.2, then the subset $\{h_1\}$ is $nrrwg$ -closed but not $nlg^\#$ -closed.

Theorem 3.1 If a subset E of a space U is both nano closed and ng -closed, then it is $nlg^\#$ -closed in U .

Proof. Let E be a ng -closed set in U and G be any nano open set containing E . Then $G \supseteq ncl(E) \supseteq ncl(nint(ncl(E)))$. Since E is nano closed, $G \supseteq ncl(nint(E))$ and hence $nlg^\#$ -closed in U .

Theorem 3.2 If a subset E of a space U is both nano open and $nlg^\#$ -closed, then it is nano closed.

Proof. Since E is both nano open and $nlg^\#$ -closed, $E \supseteq ncl(nint(E)) = ncl(E)$ and hence E is nano closed in U .

Corollary 3.1 If a subset E of a space U is both nano open and $nlg^\#$ -closed, then it is both nano regular open and nano regular closed in U .

Theorem 3.3 Let U be a space and $E \subseteq U$ be nano open. Then, E is $nlg^\#$ -closed if and only if E is $ng^\#$ -closed.





Shyamala Malini

Proof. Let E be $ng^\#$ -closed. By Proposition 3.1, it is $nlg^\#$ -closed. Conversely, let E be $nlg^\#$ -closed. Since E is nano open, by Theorem 3.2, E is nano closed. Hence E is $ng^\#$ -closed.

Theorem 3.4 *If a set E of U is $nlg^\#$ -closed, then $ncl(nint(E)) - E$ contains no non-empty nag -closed set.*

Proof. Let H be an nag -closed set such that $H \subseteq ncl(nint(E)) - E$. Since H^c is nag -open and $E \subseteq H^c$, from the definition of $nlg^\#$ -closedness it follows that $ncl(nint(E)) \subseteq H^c$. i.e., $H \subseteq (ncl(nint(E)))^c$. This implies that $H \subseteq (ncl(nint(E))) \cap (ncl(nint(E)))^c = \phi$.

Proposition 3.5 *If a subset E of a space U is nano nowhere dense, then it is $nlg^\#$ -closed.*

Proof. Since $nint(E) \subseteq nint(ncl(E))$ and E is nano nowhere dense, $nint(E) = \phi$. Therefore $ncl(nint(E)) = \phi$ and hence E is $nlg^\#$ -closed in U .

Remark 3.5 *The converse of Proposition 3.5 need not be true as seen in the following example.*

Example 3.5 *Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1\}, \{h_2, h_3\}\}$ and $X = \{h_1, h_2\}$. Then $\tau_R(X) = \{\phi, \{h_1\}, \{h_2, h_3\}, U\}$. Then the subset $\{h_1\}$ is $nlg^\#$ -closed set but not nano nowhere dense in U .*

Remark 3.6 *The following examples show that the concepts of $nlg^\#$ -closed and the concepts of nano semi-closed are independent of each other.*

Example 3.6 *In Example 3.1, then the subset $\{h_1, h_3\}$ is $nlg^\#$ -closed set but not nano semi-closed in U .*

Example 3.7 *Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1\}, \{h_2\}, \{h_3\}\}$ and $X = \{h_1, h_2\}$. Then $\tau_R(X) = \{\phi, \{h_1\}, \{h_2\}, \{h_1, h_2\}, U\}$. Then the subset $\{h_1\}$ is nano semi-closed set but not $nlg^\#$ -closed in U .*

Remark 3.7 *From the above discussions and known results, we obtain the following diagram, where $E \rightarrow F$ represents E implies F but not conversely.*

Diagram

nano closed \rightarrow $nlg^\#$ -closed \rightarrow nwg -closed \rightarrow $nwng$ -closed

Definition 3.2 *A subset E of a space U is called $nlg^\#$ -open set if E^c is $nlg^\#$ -closed in U .*

Proposition 3.6 *In a space U , Then the following statements are true:*

1. Every $ng^\#$ -open set is $nlg^\#$ -open but not conversely.
2. Every ng -open set is $nlg^\#$ -open but not conversely.

Theorem 3.5 *A subset E of a space U is $nlg^\#$ -open if $H \subseteq nint(ncl(E))$ whenever $H \subseteq E$ and H is nag -closed.*

Proof. Let E be any $nwg^\#$ -open. Then E^c is $nlg^\#$ -closed. Let H be an nag -closed set contained in E . Then H^c is an nag -open set containing E^c . Since E^c is $nlg^\#$ -closed, we have $ncl(nint(E^c)) \subseteq H^c$. Therefore $H \subseteq nint(ncl(E))$. Conversely, we suppose that $H \subseteq nint(ncl(E))$ whenever $H \subseteq E$ and H is nag -closed. Then H^c is an nag -open set containing E^c and $H^c \supseteq (nint(ncl(E)))^c$. It follows that $H^c \supseteq ncl(nint(E^c))$. Hence E^c is $nwg^\#$ -closed and so E is $nwg^\#$ -open.

Definition 3.3 *Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be a function. Then f is said to be nano contra $g^\#$ -continuous if the inverse image of every nano open set in V is $ng^\#$ -closed set in U .*





Shyamala Malini

Theorem 3.6 The following are equivalent for a function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$,

1. f is nano contra $g^\#$ -continuous.
2. the inverse image of every nano closed set of V is $ng^\#$ -open in U .

Proof. Let G be any nano closed set of V . Since $V \setminus G$ is nano open, then by (1), it follows that $f^{-1}(V \setminus G) = U \setminus f^{-1}(G)$ is $ng^\#$ -closed. This shows that $f^{-1}(G)$ is $ng^\#$ -open in U .

Converse part is similar.

Nano lightly $g^\#$ -continuous functions

Definition 4.1 Let U and V be two nano topological spaces. A function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is called nano lightly $g^\#$ -continuous (briefly, $nlg^\#$ -continuous) if $f^{-1}(G)$ is a $nlg^\#$ -open set in U for each nano open set G of V .

Example 4.1 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1\}, \{h_2, h_3\}\}$ and $X = \{h_1, h_2\}$. Then $\tau_R(X) = \{\phi, \{h_1\}, \{h_2, h_3\}, U\}$ in U . Let $V = \{h_1, h_2, h_3\}$ with $V/R = \{\{h_1\}, \{h_2\}, \{h_3\}\}$ and $Y = \{h_1\}$. Then $\tau'_R(Y) = \{\phi, \{h_1\}, V\}$ in V . The function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ defined by $f(h_1) = h_2$, $f(h_2) = h_3$ and $f(h_3) = h_1$ is $nlg^\#$ -continuous, because every subset of V is $nlg^\#$ -closed in U .

Theorem 4.1 Each $ng^\#$ -continuous function is $nlg^\#$ -continuous.

Proof. It follows from Theorem 3.1.

The converse of Theorem 4.1 need not be true as seen in the following example.

Example 4.2 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1\}, \{h_2, h_3\}\}$ and $X = \{h_1, h_2\}$. Then $\tau_R(X) = \{\phi, \{h_1\}, \{h_2, h_3\}, U\}$ in U . Let $V = \{h_1, h_2, h_3\}$ with $V/R = \{\{h_1\}, \{h_2\}, \{h_3\}\}$ and $Y = \{h_2\}$. Then $\tau'_R(Y) = \{\phi, \{h_2\}, V\}$ in V . Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be the identity function. Then f is $nlg^\#$ -continuous but not $ng^\#$ -continuous.

Theorem 4.2 A function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is $nlg^\#$ -continuous if and only if $f^{-1}(G)$ is a $nlg^\#$ -closed set in U for each nano closed set G of V .

Proof. Let G be any nano closed set of V . According to the assumption $f^{-1}(G^c) = U \setminus f^{-1}(G)$ is $nlg^\#$ -open in U , so $f^{-1}(G)$ is $nlg^\#$ -closed in U .

The converse can be proved in a similar manner.

Definition 4.2 A space U is said to be nano locally $g^\#$ -indiscrete if every $ng^\#$ -open set of U is nano closed in U .

Theorem 4.3 Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be a function. If f is nano contra $g^\#$ -continuous and U is nano locally $g^\#$ -indiscrete, then f is nano continuous.

Proof. Let H be a nano closed in V . Since f is nano contra $g^\#$ -continuous, $f^{-1}(H)$ is $ng^\#$ -open in U . Since U is nano locally $g^\#$ -indiscrete, $f^{-1}(H)$ is nano closed in U . Hence f is nano continuous.

Theorem 4.4 Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be a function. If f is nano contra $g^\#$ -continuous and U is nano locally $g^\#$ -indiscrete, then f is $nlg^\#$ -continuous.

Proof. Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be nano contra $g^\#$ -continuous and U is nano locally $g^\#$ -indiscrete. By Theorem 4.3, f is nano continuous, then f is $nlg^\#$ -continuous.

Proposition 4.1 If $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is perfectly nano continuous and $nlg^\#$ -continuous, then it is nR -map.

Proof. Let H be any nano regular open subset of V . According to the assumption, $f^{-1}(H)$ is both nano open and nano closed in U . Since $f^{-1}(H)$ is nano closed, it is $nlg^\#$ -closed. We have $f^{-1}(H)$ is both nano open and $nlg^\#$ -closed. Hence, by Corollary 3.1, it is nano regular open in U , so f is nR -map.





Shyamala Malini

Definition 4.3 A space U is called $ng^\#$ -compact if every cover of U by $ng^\#$ -open sets has finite subcover.

Definition 4.4 A space U is nano lightly $g^\#$ -compact (briefly, $nlg^\#$ -compact) if every $nlg^\#$ -open cover of U has a finite subcover.

Remark 4.1 Each $nlg^\#$ -compact space is $ng^\#$ -compact.

Theorem 4.5 Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be surjective $nlg^\#$ -continuous function. If U is $nlg^\#$ -compact, then V is nano compact.

Proof. Let $\{E_i: i \in I\}$ be an nano open cover of V . Then $\{f^{-1}(E_i): i \in I\}$ is a $nlg^\#$ -open cover in U . Since U is $nlg^\#$ -compact, it has a finite subcover, say $\{f^{-1}(E_1), f^{-1}(E_2), \dots, f^{-1}(E_n)\}$. Since f is surjective $\{E_1, E_2, \dots, E_n\}$ is a finite subcover of V and hence V is nano compact.

Definition 4.5 A space U is nano lightly $g^\#$ -connected (briefly, $nlg^\#$ -connected) if U cannot be written as the disjoint union of two non-empty $nlg^\#$ -open sets.

Theorem 4.6 If a space U is $nlg^\#$ -connected, then U is nano almost connected (resp. $ng^\#$ -connected).

Proof. It follows from the fact that each nano regular open set (resp. $ng^\#$ -open set) is $nlg^\#$ -open.

Theorem 4.7 For a space U , the following statements are equivalent:

1. U is $nlg^\#$ -connected.
2. The empty set ϕ and U are only subsets which are both $nlg^\#$ -open and $nlg^\#$ -closed.
3. Each $nlg^\#$ -continuous function from U into a discrete space V which has at least two points is a constant function.

Proof. (1) \Rightarrow (2). Let $K \subseteq U$ be any proper subset, which is both $nlg^\#$ -open and $nlg^\#$ -closed. Its complement $U \setminus K$ is also $nlg^\#$ -open and $nlg^\#$ -closed. Then $U = K \cup (U \setminus K)$ is a disjoint union of two non-empty $nlg^\#$ -open sets which is a contradiction with the fact that U is $nlg^\#$ -connected. Hence, $K = \phi$ or U .

(2) \Rightarrow (1). Let $U = E \cup F$ where $E \cap F = \phi$, $E \neq \phi$, $F \neq \phi$ and E, F are $nlg^\#$ -open. Since $E = U \setminus F$, E is $nlg^\#$ -closed. According to the assumption $E = \phi$, which is a contradiction.

(2) \Rightarrow (3). Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be a $nlg^\#$ -continuous function where V is a discrete space with at least two points. Then $f^{-1}(\{a\})$ is $nlg^\#$ -closed and $nlg^\#$ -open for each $a \in V$ and $U = \cup \{f^{-1}(\{a\}): a \in V\}$. According to the assumption, $f^{-1}(\{a\}) = \phi$ or $f^{-1}(\{a\}) = U$. If $f^{-1}(\{a\}) = \phi$ for all $a \in V$, f will not be a function. Also there is no exist more than one $a \in V$ such that $f^{-1}(\{a\}) = U$. Hence, there exists only one $a \in V$ such that $f^{-1}(\{a\}) = U$ and $f^{-1}(\{a_1\}) = \phi$ where $a \neq a_1 \in V$. This shows that f is a constant function.

(3) \Rightarrow (2). Let $K \neq \phi$ be both $nlg^\#$ -open and $nlg^\#$ -closed in U . Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be a $nlg^\#$ -continuous function defined by $f(K) = \{c\}$ and $f(U \setminus K) = \{d\}$ where $c \neq d$. Since f is constant function we get $K = U$.

Theorem 4.8 Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be a $nlg^\#$ -continuous surjective function. If U is $nlg^\#$ -connected, then V is nano connected.

Proof. We suppose that V is not nano connected. Then $V = E \cup F$ where $E \cap F = \phi$, $E \neq \phi$, $F \neq \phi$ and E, F are nano open sets in V . Since f is $nlg^\#$ -continuous surjective function, $U = f^{-1}(E) \cup f^{-1}(F)$ are disjoint union of two non-empty $nlg^\#$ -open subsets. This is contradiction with the fact that U is $nlg^\#$ -connected.





Shyamala Malini

Nano lightly $g^\#$ -open functions and nano lightly $g^\#$ -closed functions

Definition 5.1 Let U and V be spaces. A function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is called nano lightly $g^\#$ -open (briefly, $nlg^\#$ -open) if $f(G)$ is a $nlg^\#$ -open set in V for each nano open set G of U .

Definition 5.2 Let U and V be spaces. A function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is called nano lightly $g^\#$ -closed (briefly, $nlg^\#$ -closed) if $f(G)$ is a $nlg^\#$ -closed set in V for each nano closed set G of U .

It is clear that an open function is $nlg^\#$ -open and a nano closed function is $nlg^\#$ -closed.

Theorem 5.1 Let U and V be spaces. A function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is $nlg^\#$ -closed if and only if for each subset G of V and for each nano open set H containing $f^{-1}(G)$ there exists a $nlg^\#$ -open set S of V such that $G \subseteq S$ and $f^{-1}(S) \subseteq H$.

Proof. Let G be any subset of V and let H be a nano open subset of U such that $f^{-1}(G) \subseteq H$. Then $S = V \setminus f(U \setminus H)$ is a $nlg^\#$ -open set containing G and $f^{-1}(S) \subseteq H$.

Conversely, let P be any nano closed subset of U . Then $f^{-1}(V \setminus f(P)) \subseteq U \setminus P$ and $U \setminus P$ is nano open. According to the assumption, there exists a $nlg^\#$ -open set S of V such that $V \setminus f(P) \subseteq S$ and $f^{-1}(S) \subseteq U \setminus P$. Then $P \subseteq U \setminus f^{-1}(S)$. From $V \setminus S \subseteq f(P) \subseteq f(U \setminus f^{-1}(S)) \subseteq V \setminus S$ it follows that $f(P) = V \setminus S$, so $f(P)$ is $nlg^\#$ -closed in V . Therefore f is a $nlg^\#$ -closed function.

Remark 5.1 The composition of two $nlg^\#$ -closed functions need not be a $nlg^\#$ -closed as we can see from the following example.

Example 5.1 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1\}, \{h_2, h_3\}\}$ and $X = \{h_1\}$. Then $\tau_R(X) = \{\phi, \{h_1\}, U\}$. Let $V = \{h_1, h_2, h_3\}$ with $V/R = \{\{h_1\}, \{h_2, h_3\}\}$ and $Y = \{h_1, h_2\}$. Then $\tau'_R(Y) = \{\phi, \{h_1\}, \{h_2, h_3\}, V\}$. Let $W = \{h_1, h_2, h_3\}$ with $W/R = \{\{h_1, h_2\}, \{h_3\}\}$ and $Z = \{h_1, h_2\}$. Then $\tau''_R(Z) = \{\phi, \{h_1, h_2\}, Z\}$. We define $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ by $f(h_1) = h_3, f(h_2) = h_2$ and $f(h_3) = h_1$ and let $g: (V, \tau'_R(Y)) \rightarrow (W, \tau''_R(Z))$ be the identity function. Hence both f and g are $nlg^\#$ -closed functions. For a closed set $K = \{h_2, h_3\}$, $(g \circ f)(K) = g(f(K)) = g(\{h_1, h_2\}) = \{h_1, h_2\}$ which is not $nlg^\#$ -closed in W . Hence the composition of two $nlg^\#$ -closed functions need not be a $nlg^\#$ -closed.

Theorem 5.2 Let U, V and W be spaces. If $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is a nano closed function and $g: (V, \tau'_R(Y)) \rightarrow (W, \tau''_R(Z))$ is a $nlg^\#$ -closed function, then $g \circ f: (U, \tau_R(X)) \rightarrow (W, \tau''_R(Z))$ is a $nlg^\#$ -closed function.

Definition 5.3 A function $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ is called a nano lightly $g^\#$ -irresolute (briefly, $nlg^\#$ -irresolute) if $f^{-1}(G)$ is a $nlg^\#$ -open set in U for each $nlg^\#$ -open set G of V .

Example 5.2 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_2\}, \{h_1, h_3\}\}$ and $X = \{h_2, h_3\}$. Then $\tau_R(X) = \{\phi, \{h_2\}, \{h_1, h_3\}, U\}$. Let $V = \{h_1, h_2, h_3\}$ with $V/R = \{\{h_2\}, \{h_1, h_3\}\}$ and $Y = \{h_2\}$. Then $\tau'_R(Y) = \{\phi, \{h_2\}, V\}$. Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be the identity function. Then f is $nlg^\#$ -irresolute.

Remark 5.2 The following examples show that the concepts of αg -irresoluteness and the concepts of $nlg^\#$ -irresoluteness are independent of each other.

Example 5.3 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1, h_2\}, \{h_3\}\}$ and $X = \{h_1, h_2\}$. Then $\tau_R(X) = \{\phi, \{h_1, h_2\}, U\}$. Let $V = \{h_1, h_2, h_3\}$ with $V/R = \{\{h_1\}, \{h_2\}, \{h_3\}\}$ and $Y = \{h_1\}$. Then $\tau'_R(Y) = \{\phi, \{h_1\}, V\}$. Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be the identity function. Then f is $nlg^\#$ -irresolute but not αg -irresolute.

Example 5.4 Let $U = \{h_1, h_2, h_3\}$ with $U/R = \{\{h_1\}, \{h_2\}, \{h_3\}\}$ and $X = \{h_1, h_2\}$. Then $\tau_R(X) = \{\phi, \{h_1\}, \{h_2\}, \{h_1, h_2\}, U\}$. Let $V = \{h_1, h_2, h_3\}$ with $V/R = \{\{h_1, h_2\}, \{h_3\}\}$ and $Y = \{h_1, h_2\}$. Then $\tau'_R(Y) = \{\phi, \{h_1, h_2\}, V\}$. Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ be the identity function. Then f is αg -irresolute but not $nlg^\#$ -irresolute.





Shyamala Malini

Theorem 5.3 Let $f: (U, \tau_R(X)) \rightarrow (V, \tau'_R(Y))$ and $g: (V, \tau'_R(Y)) \rightarrow (W, \tau''_R(Z))$ be functions such that $g \circ f: (U, \tau_R(X)) \rightarrow (W, \tau''_R(Z))$ is $nl_g^\#$ -closed function. Then the following statements hold:

1. if f is nano continuous and injective, then g is $nl_g^\#$ -closed.
2. if g is $nl_g^\#$ -irresolute and surjective, then f is $nl_g^\#$ -closed.

Proof. (1). Let S be a nano closed set of V . Since $f^{-1}(S)$ is nano closed in U , we can conclude that $(g \circ f)(f^{-1}(S))$ is $nl_g^\#$ -closed in W . Hence $g(S)$ is $nl_g^\#$ -closed in W . Thus g is a $nl_g^\#$ -closed function.

(2). It can be proved in a similar manner as (1).

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A Snapshot of Regulatory Approval of Medical Devices in Australia and China

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ABSTRACT

Building up an inventive medicinal product (medical device) from the ideal stage to the promoting stage is a costly and complex procedure. Intense competition exists over the particulars of the regulations that control the development, distribution, and approval of medical technology. Protecting, enhancing, and monitoring the public's health requires that these tools be of the highest possible quality, safety, and efficacy. Medical device development takes several long periods of research and development work. The primary aim is to support business visionaries who produce products for medicinal services to promote regulatory awareness that oversees product development and confirms administrative continuity. It seems to be used as an initiating stage for the final product. Instead of placing a set of rules, the document speaks about the specific concepts and principles of complex issues. The prime purpose is to place a product into the market for timely use by the public, irrespective of time & money invested. In order to achieve public expectations, the firm needs to comply with the regulatory prerequisites set by the targeted agencies. This study has thrown light on the pathway for applications of medical devices in Australia & China.

Keywords: Ideal stage, regulations, regulatory prerequisites.





Gowthami et al.,

INTRODUCTION

Regulatory agencies and organizations are responsible for effective drug regulation necessary to assure the safety, effectiveness & quality of pharmaceuticals, as well as the accuracy and appropriateness of the drug information accessible to the public. The location of the regulated content, which includes Acts, Regulations, and Guidelines, on the websites of regulatory bodies, must be known in order to acquire information about medications. (1,2)The right information is then saved at various regulatory websites, which must be understood in order to retrieve it. Harmonization of medical devices is vital since it shortens the time and money needed to bring a product to market, increases the efficiency of government by easing cooperation between regulators and even in organizing regulatory activities, promotes more trade and commerce, and betters the safety of the public.(3–5)

This process can be accessed with the help of a “navigation pathway” to get regulatory authorization from a particular agency. We need to file an application for a particular product and they are submitted to their particular agencies to market their products and ensure that the products are safe and effective healthcare to individuals around the world. So, we need a particular navigation pathway for particular applications or drug products. Implementing a robust regulatory information management (RIM) solution offers a relatively straightforward solution to a myriad of complex issues. Regulatory agencies becoming more safety conscious and demanding more data, and regulatory information management (RIM) which leads to an increase in demand for navigation pathways. The key difficulties of regulatory agencies and organizations across the world are to assure the safety, quality, and efficacy of medicines and medical devices, standardize legislative procedures connected to drug development, and regulate, and ensure compliance with statutory requirements.(6–8)

Components of the product development life cycle

- Stage 1: The medical device's classification
- Stage 2: To describe the healthcare assertion and/or product
- Stage 3: Identifying the healthcare market
- Stage 4: To establish the regulatory framework
- Stage 5: To build a product development strategy
- Stage 6: To implement product development strategy.
- Stage 7: To carry out the clinical plan
- Stage 8: To gain insight for regulatory submittal.
- Stage 9: To collate the data for regulatory submission
- Stage 10: To ensure post-marketing surveillance (6,9,10)

DISCUSSION:

OVERVIEW OF REGULATORY FACTSHEET OF MEDICAL DEVICES IN AUSTRALIA

DISCUSSION:

OVERVIEW OF REGULATORY FACTSHEET OF MEDICAL DEVICES IN AUSTRALIA

REGULATORY FACTSHEET	
Medical Devices	
PRODUCT	Medical Devices
COUNTRY	Australia
REGULATORY AGENCY	Therapeutic Goods Administration
REGULATORY DEPARTMENT	Australian Government Department of Health





Gowthami et al.,

INTRODUCTION: Medical Devices

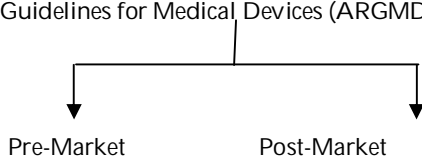
- Using humans
- Provide medical aid
- Typically, it has a physical or functional impact on the body, whether it is used to assess whether control body functions.
- Medical equipment ranges from gauze that you can put on a cut to high-risk products, such as vegetables, lodged in the body.(8,11)

Types of other medical instruments include:

- Artificial knees, which lubricate eye drops
- Orthodontics - eg braces, fillings
- Tongue depressors
- Breast implants
- Condoms
- * MRI scanners
- * Syringes
- * Blood pressure monitors
- * Catheters

OVERVIEW

Australian Regulatory Guidelines for Medical Devices (ARGMD)



CLASSIFICATION

Classification	Level of Risk
Class I	Low
Class I-supplied sterile	Low-Medium
Class I-incorporating a measuring function	
Class II a	Medium-High
Class II b	
Class III	High
Active implantable medical devices (AIMD)	High

Table 2 : Australian Division of Medical Equipment (12,13)

GUIDANCE DOCUMENTS:

SI No.	Title
01.	Australian regulatory guidelines for medical devices (ARGMD)
02.	IVD guidance documents
03.	Clinical evidence guidelines documents for medical devices
04.	Conformity assessment

Table 3 : Guidance Documents for Medical Devices in TGA (4,14)





APPROVAL PROCEDURE

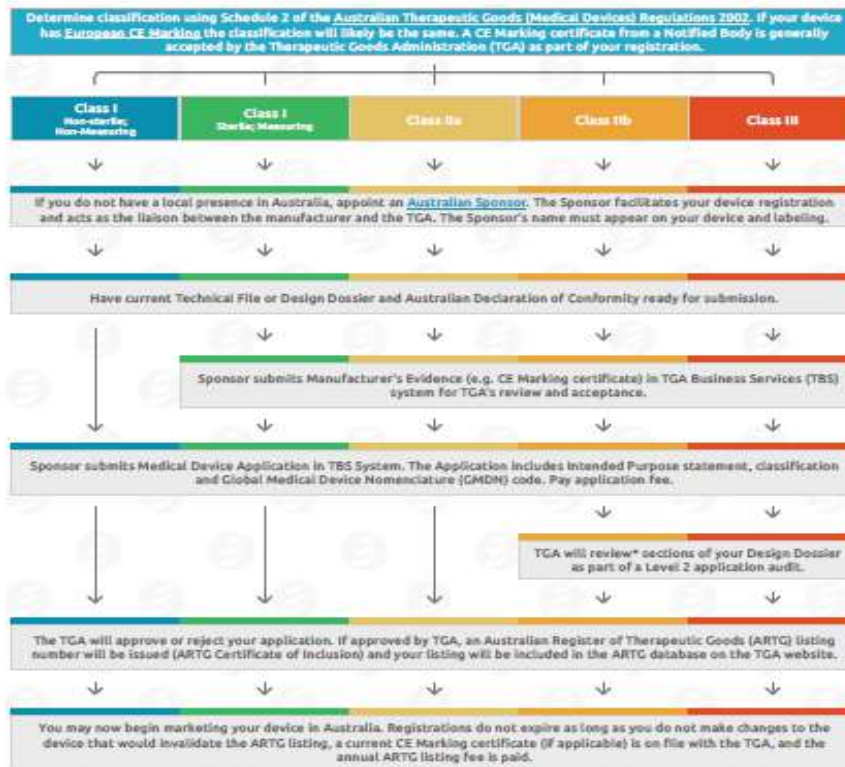
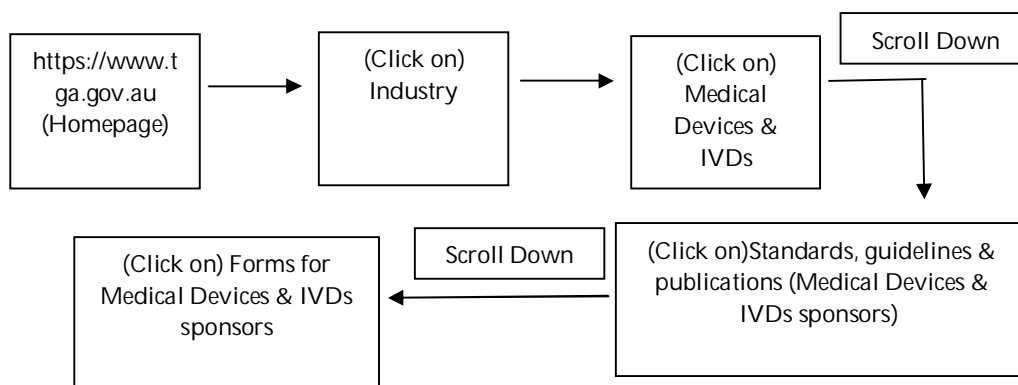


Figure 1: Approval Process for MAA-Medical Devices in Australia (5,8)

SUBMISSION PATHWAY: Medical Devices



NAVIGATION PATHWAY – Medical Devices(15,16)





Gowthami et al.,

Figure 2 : TGA Medical Medical Devices Pathway (11)

CHECKLIST:
Link provided below (11,12,17)

REGULATORY FACTSHEET - Medical Devices	
PRODUCT	Medical Devices
COUNTRY	China
REGULATORY AGENCY	China Food & Drug Administration
TYPE OF APPLICATION	Market Authorisation Approval (MAA)
INTRODUCTION	
<p>"Medical devices" as characterized by these guidelines alludes to: Every tool, contraction, equipment, substance or other object, whether used alone or in conjunction, as well as a component that is central to its legal usage. It doesn't accomplish its chief activity in or on the human body by methods for pharmacology, immunology or digestion, yet which might be aided its capacity by such methods; the utilization of which is to accomplish the accompanying planned destinations:</p> <ol style="list-style-type: none"> 1. Illness detection, avoidance, control, recovery or relaxation 2. Diagnosis, care, rehabilitation or reimbursement of an illness or disability. 3. Anatomical examination, substitution or alteration or a physiological cycle 4. Conception Command. (18,19) 	
REGULATIONS	





Gowthami et al.,

SI No.	Regulation	Issued
01.	Regulation for implementation of the Drug Administration Law of the people- Republic of China	2002
02.	CFDA Guidance on Medical Device Registration	2014
03.	CFDA Guidance on Medical Device Labeling	2014
04.	Guideline for Technical Review of Medical Device Software Registration	2015
05.	CFDA Guidance on IFU, Labels and Packaging Logos of Medical Devices	2014
06.	Medical device registration dossier requirements and approval documents format announcement	2014

Table 5: Regulations for CFDA (20,21)

CLASSIFICATION

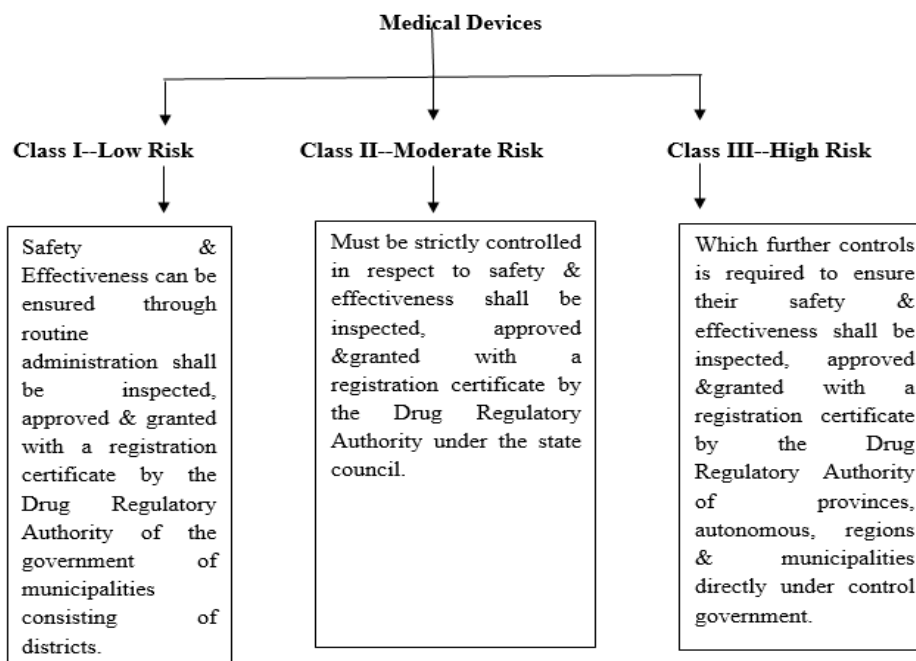


Table 6: Classification of Medical Devices-China (3,10,22)

APPROVAL PROCEDURE



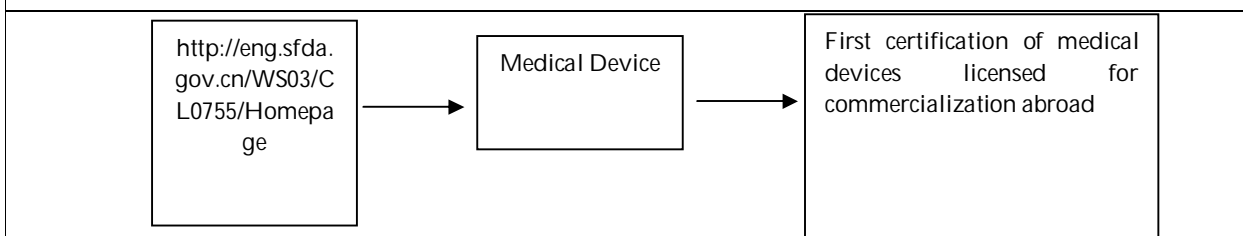


Gowthami et al.,



Figure 3: Approval Procedure for MAA Medical Devices- China (22-24)

SUBMISSION PATHWAY



NAVIGATION PATHWAY



Gowthami *et al.*,

CFDA China Food and Drug Administration

Chinese(GB) Contact cFDA

HOME ABOUT CFDA WHAT'S NEW LAWS & REGULATIONS REGULATORY GUIDE DATA SEARCH SITE MAP

Search Go

Home >> Regulatory Guide

Medical Devices

Initial registration for overseas medical devices that are approved for marketing at abroad

Figure 4: China MAA-Medical Devices Pathway (3,20)

CHECKLIST:
Link provided below (23,25)

CONCLUSION

The goal of this study is to identify the best means of collecting critical regulatory data for Life-Cycle Management of medical devices in Australia and China, so that a Navigation Pathway may be developed. A detailed Factsheet and comparison table were compiled to assist in the gathering of the most crucial regulatory data for medical devices from the respective websites of the authorities in Australia and China. Our study provides a detailed regulatory information management of the act/regulations and suggests ways forward for both Australia and China.

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Pert Evaluation Review Technique using Trapezoidal Type -2 Fuzzy Numbers

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ABSTRACT

The network diagram plays a crucial role in determining the time required for the completion of project. Network analysis is a technique used to determine the sequence of activities in a project and estimate the project completion time. PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method) are commonly used techniques for planning and controlling projects by identifying the longest path in an acyclic project network. The majority of research in project scheduling has focused on fuzzy PERT, which incorporates uncertainty into the analysis. This paper focuses on the application of fuzzy PERT with type-2 trapezoidal fuzzy numbers. We introduce new ranking methods to identify fuzzy PERT within an acyclic project network. Additionally, we provide an illustrative example to demonstrate our proposed approach.

Keywords: fuzzy PERT, type-2 trapezoidal fuzzy numbers, acyclic project network,

INTRODUCTION

Fuzzy set theory was introduced by L.A. Zadeh in 1965, extending classical set theory to accommodate elements with varying degrees of membership. While traditional logic relies on the binary truth values of True and False, it often falls short in describing human reasoning. Fuzzy logic, on the other hand, employs a continuum of values between 0





Balasowandari et al.,

(representing false) and 1 to capture the nuances of human reasoning. In 1975, L.A. Zadeh introduced the concept of type-2 fuzzy sets, which possess a high level of expressive power and conceptual appeal. Subsequent studies on type-2 fuzzy sets were conducted by Mizumoto and Tanaka in 1976, Yager in 1980, Mendel in 2009, Jammeh in 2009, and Mendoza, Wagner, and Hagrass in 2010. Type-2 fuzzy sets offer an additional degree of freedom through their membership function, allowing for improved modeling of uncertainties. This enhancement enables type-2 fuzzy sets to excel in certain types of inference, particularly when faced with increasing imprecision, uncertainty, and fuzziness in information. Two widely used methods in project planning, namely PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method), have proven to be successful, particularly when dealing with projects that require specific technological sequences for activity execution. The fundamental objective of PERT and CPM is to identify the longest path through a network of tasks, which serves as a basis for project planning and control. This paper is structured as follows: Section 2 discusses some fundamental concepts, while Section 3 presents properties related to total slack fuzzy time. Section 4 covers network terminology, and Section 5 introduces an algorithm for determining PERT with type-2 trapezoidal fuzzy numbers using the Area measure. Finally, Section 6 illustrates the proposed Algorithm through a numerical example.

Basic concepts

Definition 1

Let X represent a collection of objects, typically denoted by x . In the context of fuzzy set theory, a fuzzy set A in X can be defined as a set of ordered pairs, where each pair $(x, \mu_A(x))$ consists of an element x from X and a membership grade (or membership value) $\mu_A(x)$ that ranges between 0 and 1. The membership function μ_A maps each element of X to its corresponding membership grade.

Definition 2

Let X be a non-empty finite set, which is referred as the universal set. A type-2 fuzzy set \tilde{A} , is characterized by a type-2 membership function $\mu_{\tilde{A}}(x, u) : X \times I \rightarrow I$ where $x \in X$, $I = [0, 1]$ and $u \in J_x \subseteq I$ that is

$\tilde{A} = \{((x, u); \mu_{\tilde{A}}(x, u)) / x \in X, u \in J_x \subseteq I\}$, where $0 \leq \mu_{\tilde{A}}(x, u) \leq 1$. \tilde{A} can also be expressed as

$$\tilde{A} = \int_{x \in X} \int_{u \in J_x} \frac{\mu_{\tilde{A}}(x, u)}{(x, u)} = \int_{x \in U} \frac{p_x(u)/u}{x}, J_x \subseteq I, \text{ where } p_x(u) = \mu_{\tilde{A}}(x, u).$$

The class of all type-2 fuzzy set of the universe X is denoted by $P_{T2}(X)$.

Definition 3

A fuzzy number $\tilde{A} = (a, b, c, d)$ is said to be a trapezoidal fuzzy number if its membership function is given by

$$\mu_{\tilde{A}}(x) = \begin{cases} \frac{(x-a)}{(b-a)}, & a \leq x \leq b \\ 1, & b \leq x \leq c \\ \frac{(d-x)}{(d-c)}, & c \leq x \leq d \\ 0, & \text{otherwise.} \end{cases} \text{ where } a, b, c, d \in R.$$

Definition 4





Balasowandari et al.,

A fuzzy number $\tilde{A} = ([a_1, a_2, a_3, a_4], [b_1, b_2, b_3, b_4], [c_1, c_2, c_3, c_4], [d_1, d_2, d_3, d_4])$ is said to be a type-2 trapezoidal number if its membership function is defined by $\tilde{A} = [\mu_{\tilde{a}}(x), \mu_{\tilde{b}}(x), \mu_{\tilde{c}}(x), \mu_{\tilde{d}}(x)]$ where,

$$\mu_{\tilde{a}}(x) = \begin{cases} \frac{(x-a_1)}{(a_2-a_1)}, & a_1 \leq x \leq a_2 \\ 1, & a_1 \leq x \leq a_3 \\ \frac{(a_4-x)}{(a_4-a_3)}, & a_3 \leq x \leq a_4 \\ 0, & \text{otherwise.} \end{cases} \quad \mu_{\tilde{b}}(x) = \begin{cases} \frac{(x-b_1)}{(b_2-b_1)}, & b_1 \leq x \leq b_2 \\ 1, & b_1 \leq x \leq b_3 \\ \frac{(b_4-x)}{(b_4-b_3)}, & b_3 \leq x \leq b_4 \\ 0, & \text{otherwise.} \end{cases}$$

$$\mu_{\tilde{c}}(x) = \begin{cases} \frac{(x-c_1)}{(c_2-c_1)}, & c_1 \leq x \leq c_2 \\ 1, & c_1 \leq x \leq c_3 \\ \frac{(c_4-x)}{(c_4-c_3)}, & c_3 \leq x \leq c_4 \\ 0, & \text{otherwise.} \end{cases} \quad \text{and} \quad \mu_{\tilde{d}}(x) = \begin{cases} \frac{(x-d_1)}{(d_2-d_1)}, & d_1 \leq x \leq d_2 \\ 1, & d_1 \leq x \leq d_3 \\ \frac{(b_4-x)}{(b_4-b_3)}, & d_3 \leq x \leq d_4 \\ 0, & \text{otherwise.} \end{cases}$$

A set with type-2 trapezoidal fuzzy numbers is called type-2 trapezoidal fuzzy set. The class of all trapezoidal type-2 fuzzy set of the universe X is denoted by $P_{T_2T_2}(X)$.

Definition 5

If $\tilde{A} = \bigcup_{forall \tilde{a}} \tilde{FOU}(\tilde{A}_{\tilde{a}}) = (A^L, A^M, A^N, A^U)$

$$= ((a_1^L, a_2^L, a_3^L, a_4^L), (a_1^M, a_2^M, a_3^M, a_4^M), (a_1^N, a_2^N, a_3^N, a_4^N), (a_1^U, a_2^U, a_3^U, a_4^U))$$

and $\tilde{B} = \bigcup_{forall \tilde{b}} \tilde{FOU}(\tilde{B}_{\tilde{b}}) = (B^L, B^M, B^N, B^U)$

$$= ((b_1^L, b_2^L, b_3^L, b_4^L), (b_1^M, b_2^M, b_3^M, b_4^M), (b_1^N, b_2^N, b_3^N, b_4^N), (b_1^U, b_2^U, b_3^U, b_4^U))$$

be two normal type-2 trapezoidal fuzzy numbers then using extension principle the following operations are defined.

Addition

$$\tilde{A} + \tilde{B} = \left[\bigcup_{forall \tilde{a}} \tilde{FOU}(\tilde{A}_{\tilde{a}}) \right] + \left[\bigcup_{forall \tilde{b}} \tilde{FOU}(\tilde{B}_{\tilde{b}}) \right]$$

$$= (A^L + B^L, A^M + B^M, A^N + B^N, A^U + B^U)$$

$$= ((a_1^L + b_1^L, a_2^L + b_2^L, a_3^L + b_3^L, a_4^L + b_4^L), (a_1^M + b_1^M, a_2^M + b_2^M, a_3^M + b_3^M, a_4^M + b_4^M),$$

$$(a_1^N + b_1^N, a_2^N + b_2^N, a_3^N + b_3^N, a_4^N + b_4^N), (a_1^U + b_1^U, a_2^U + b_2^U, a_3^U + b_3^U, a_4^U + b_4^U))$$

Subtraction





Balasowandari et al.,

$$\begin{aligned} \tilde{A} - \tilde{B} &= (A^L - B^U, A^M - B^N, A^N - B^M, A^U - B^L) \\ &= ((a_1^L - b_4^U, a_2^L - b_3^U, a_3^L - b_2^U, a_4^L - b_1^U), (a_1^M - b_4^N, a_2^M - b_3^N, a_3^M - b_2^N, a_4^M - b_1^N), \\ &\quad (a_1^N - b_4^M, a_2^N - b_3^M, a_3^N - b_2^M, a_4^N - b_1^M), (a_1^U - b_4^L, a_2^U - b_3^L, a_3^U - b_2^L, a_4^U - b_1^L)) \end{aligned}$$

Properties of Fuzzy Pert Network

Property 1: (Forward pass calculation)

To calculate the earliest starting fuzzy time in the project network, set the initial node to zero for starting (ie)

$$F\tilde{E}S_j = 0$$

$$F\tilde{E}S_j = \max_i \{ F\tilde{E}S_i + F\tilde{E}T_{ij} \}, j \neq i, j \in N, i = \text{number of preceding nodes.}$$

($F\tilde{E}S_j$ = The earliest starting fuzzy time of node j). Ranking value is utilized to identify the maximum value. Earliest finishing fuzzy time = Earliest starting fuzzy time (+) Fuzzy activity time.

Property 2: (Backward pass calculation)

To calculate the latest finishing time in the project network set $F\tilde{L}F_n = F\tilde{E}S_n$.

$F\tilde{L}F_j = \min \{ F\tilde{L}F_j(-)F\tilde{E}T_{ij} \}, i \neq n, i \in N, j = \text{number of succeeding nodes.}$ Ranking value is utilized to identify the minimum value. Latest starting fuzzy time = Latest finishing Fuzzy time (-) Fuzzy activity time.

Property 3:

For the activity $t_{ij}, i < j$

Total fuzzy slack: $F\tilde{T}S_{ij} = F\tilde{L}F_j(-)(F\tilde{E}S_i(+))F\tilde{E}T_{ij}$ (or)

$$(F\tilde{L}F_j(-)F\tilde{E}T_{ij})(-)F\tilde{E}S_i, 1 \leq i \leq j \leq n; i, j \in N,$$

Property 4:

$$F(P_n) = \sum_{\substack{1 \leq i \leq j \leq n \\ i, j \in P_k}} F\tilde{E}T_{ij}, P_k \in P, P_n \text{ denotes the number of possible paths in a network from source node to the}$$

destination node, k=1 to m.

Network Terminology

A directed acyclic project network consisting of five nodes and six edges are considered. Each edge in this network is assigned by type-2 trapezoidal fuzzy numbers. The set of all possible paths are denoted by P. The fuzzy PERT is identified from the set P.

Algorithm

Step 1: Construct a project network $G(V, E)$ where V is the set of vertices and E is the set of edges.

Step 2: Expected time in terms of type-2 fuzzy numbers is defuzzified into crisp numbers using definition.

Step 3: Let $F\tilde{E}S_1 = 0$ and calculate earliest starting time $F\tilde{E}S_j, j = 1, 2, \dots, n$ according to forward pass calculation

Step 4: Calculate Earliest finishing time.

Step 5: Let $F\tilde{L}F_n = F\tilde{E}S_n$ and calculate Earliest finishing time $F\tilde{L}F_i, i = n - 1, n - 2, \dots, 1$ according to backward pass calculation.





Step 6: Calculate latest starting time.

Step 7: Calculate total float for each fuzzy activity.

Step 8: Calculate all possible paths P_i from source node to destination node and the corresponding path lengths are identified using addition operation.

Step 9: Decide the fuzzy PERT with minimum rank.

Numerical Example

The problem is to find the fuzzy PERT in a acyclic project network whose edges are assigned with type-2 trapezoidal fuzzy numbers.

Activities, fuzzy optimistic time, most likely time and pessimistic time durations for each activity for type-2 trapezoidal fuzzy numbers in the given table 6.1.

All the possible paths $P = \{(1-2-5), (1-3-5), (1-4-5)\}$ are found in a given acyclic project network using properties of network. The path 1---4---5 is identified as a fuzzy PERT by using Area measure.

CONCLUSION

The primary objective of this paper is to employ fuzzy numbers in the context of Fuzzy PERT (Program Evaluation and Review Technique) networks. The paper proposes the utilization of the area measure to defuzzify type-2 trapezoidal fuzzy numbers for each activity, including the optimistic time, most likely time, and pessimistic time within a given fuzzy acyclic project network. By incorporating fuzzy theory and seeking assistance from experienced experts, estimating time and cost planning can be approached effectively, addressing the challenges posed by uncertainties. The presented methodology in this paper offers a fuzzy-based approach to estimate project time and cost, aiming to minimize the impact of uncertainties on the final results. The proposed methodology is designed for ease of use and simplifies calculations involving fuzzy numbers. Additionally, it is suggested that future research explore alternative fuzzy functions such as ranking functions, distances, and other measures to further enhance the accuracy of project time and cost estimation.

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Table 6.1

Activity	t ₀	t _m	t _p
1-2	((2.5,2.8,3.0,3.5),(2.2,2.5,3.0,3.2), (2.1,2.3,2.5,3.0),(2.0,2.3,2.5,3.0))	((2.6,2.9,3.1,3.6),(2.3,2.6,3.1,3.3), (2.2,2.4,2.6,3.1),(2.1,2.4,2.6,3.1))	((2.8,3.0,3.4,3.7),(2.4,2.9,3.2,3.6), (2.3,2.6,2.9,3.2),(2.1,2.5,2.8,3.2))
1-3	((2.6,2.7,2.8,3.0),(2.5,2.6,3.0,3.5), (2.3,2.5,3.0,3.3),(2.2,2.4,2.5,2.8))	((2.9,3.0,3.2,3.4),(2.8,2.9,3.1,3.8), (2.6,2.9,3.2,3.4),(2.5,2.8,2.9,3.6))	((2.8,2.9,3.2,3.6),(2.7,2.9,3.4,3.5), (2.4,2.8,3.2,3.6),(2.4,2.5,2.8,3.1))
1-4	((2.8,2.9,3.2,3.6),(2.6,2.9,3.2,3.6), (2.5,2.7,3.1,3.3),(2.2,2.8,3.3,3.6))	((2.9,3.0,3.3,3.7),(2.8,3.1,3.4,3.7), (2.6,2.8,3.2,3.6),(2.4,2.5,2.8,3.8))	((3.0,3.2,3.5,3.9),(2.8,3.2,3.5,3.8), (2.5,2.8,3.2,3.7),(2.4,2.6,2.9,3.4))
2-5	((2.3,2.5,2.9,3.2),(2.3,2.4,3.3,3.4), (2.2,2.6,3.3,3.8),(2.0,2.5,2.9,3.3))	((2.5,2.8,3.0,3.4),(2.4,2.6,3.5,3.8), (2.4,2.8,3.6,3.9),(2.4,2.6,3.2,3.4))	((2.5,2.9,3.2,3.4),(2.5,2.8,3.4,3.6), (2.6,2.8,3.6,4.0),(2.2,2.9,3.2,3.6))
3-5	((2.8,2.9,3.3,3.5),(2.6,2.8,3.3,3.4), (2.5,2.6,2.9,3.3),(2.3,2.6,2.9,3.5))	((2.9,3.0,3.6,3.8),(2.8,2.9,3.6,3.8), (2.8,2.9,3.1,3.5),(2.4,2.8,3.1,3.6))	((3.2,3.4,3.8,3.9),(2.6,2.9,3.5,3.8), (2.7,2.8,3.3,3.5),(2.5,2.8,3.4,3.6))
4-5	((2.5,2.7,3.0,3.5),(2.3,2.6,3.2,3.5), (2.2,2.6,3.3,3.6),(2.1,2.5,2.8,3.0))	((2.7,2.9,3.2,3.4),(2.6,2.8,3.4,3.6), (2.3,2.7,3.5,3.7),(2.4,2.7,2.9,3.2))	((2.8,2.9,3.4,3.8),(2.5,2.9,3.5,3.8), (2.5,2.8,3.6,3.8),(2.4,2.7,3.1,3.4))

Solution:

Activity	t ₀	t _m	t _p	t _e
1-2	-0.1	-0.1	-0.1	-0.1
1-3	0.075	0.1	0.3	0.129
1-4	0.175	0.025	0.1	0.0625
2-5	0.175	0.125	0.25	0.154
3-5	0.05	-0.2	0.025	-0.121
4-5	0.05	0.15	0.025	0.113





Balasowandari et al.,

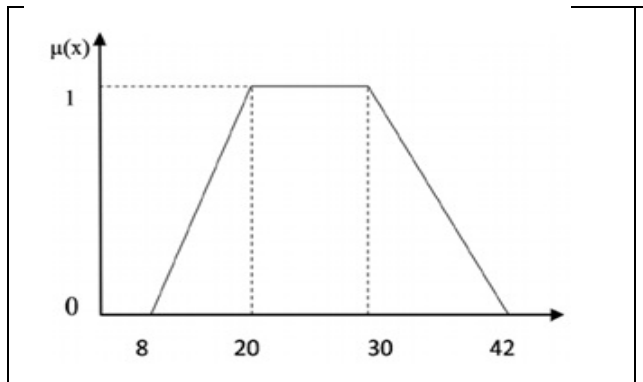


Fig 1 Trapezoidal membership function

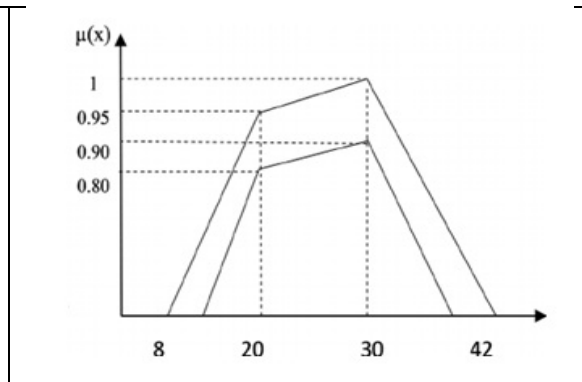


Fig 2: Type-2 Trapezoidal membership function

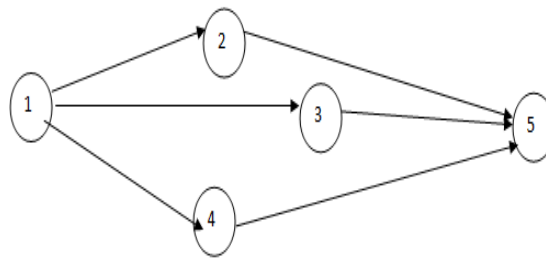


Fig.3 Fuzzy acyclic project network





Analysis of the Effects of Social Media on Business Performance based on Opinions of Industry Personnel

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ABSTRACT

The usage of the internet and various social media platforms is practically universal among corporate leaders nowadays. Because of its extensive availability, the cheap barrier to entry, and high return on investment, social media has quickly become the digital medium that is used by the greatest number of people today. By the usage of social media, businesses have the opportunity to gather vital information about the market, their competitors, and their customers. These insights can then be used to strengthen currently implemented strategies or to create whole new ones. In addition, communication via social media can extend well beyond the realm of providing service to customers. The primary goal of this research is to determine how social media platforms affect the way a business operates and which platform has the greatest impact. This article additionally examines how the performance of industries is impacted by social networking sites. In order to accomplish this, we have collected 100 industry expert's views, and then analysed the data through correspondence analysis, which is based on MDS and factor analysis using R-programming. Also, we have presented the data graphically using MS-Excel. Through this analysis, we've tried to figure out how social media and different business aspects are correlated using perceptual map.

Keywords: Digital platform, Social media ,Business performances ,MDS, Correspondence Analysis, Perceptual map, R-Programming.





Prasant Kumar Rout and Gobinda Chandra Panda

INTRODUCTION

With the increasing use of social media, businesses have recognized the potential for using these platforms to reach their target audience and promote their products and services. Social media allows companies to engage with their customers in real-time, share relevant content, and build relationships with their followers. Additionally, social media provides businesses with valuable data about their customers, such as their preferences and buying habits, which can help them to create more targeted marketing campaigns. Social media platforms have become a crucial part of our daily lives, with millions of people using them to connect with friends, family, and businesses. For businesses, social media offers an opportunity to reach a large audience and engage with potential customers in a more personal way. By sharing content such as photos, videos, and other information about their products and services, businesses can build brand awareness and attract new customers. Moreover, social media provides a platform for customers to leave feedback, ask questions, and share their experiences with a brand or product, which can be incredibly valuable for businesses looking to improve their offerings and customer experience.

Social media platforms have become a go-to source of information for people when researching and making purchasing decisions. Users turn to these platforms to learn more about brands, products, and services, and to read reviews and recommendations from other users. Social media also allows businesses to engage with their customers, build brand loyalty, and encourage advocacy. Additionally, social media platforms offer powerful tools for businesses to track user behaviour and preferences, enabling them to tailor their marketing efforts and product offerings to better meet the needs and interests of their target audience. Therefore, it's essential for businesses to have a strong social media presence and engage with their audience regularly to remain relevant and competitive in today's digital marketplace. With the increasing importance of social media in business and marketing, it's becoming more and more common for professionals to use social media platforms for work-related purposes. This includes using social media like Facebook, YouTube, Instagram, Twitter to promote their company's products or services, to establish a strong brand identity, build brand awareness, to promoting products and services to a wide audience, to provide businesses with a direct line of communication to their customers, allowing them to address concerns, answer questions, and provide support in real-time, to monitor and analyze the activities of competitors, as well as to develop strategies for staying ahead of the competition. to provide customers with valuable information about a brand's products or services as well as stay up-to-date with industry news and trends, and to managing customer relationships, including tracking customer behaviour and preferences, providing personalized recommendations, and responding to customer feedback and reviews.

Facebook: Facebook is a powerful platform for branding, promotion, advertising, and sharing information. Here are some ways businesses and individuals can use Facebook for these purposes: Branding: Facebook offers several ways to establish and reinforce your brand on the platform. You can customize your profile and cover photos, create branded posts with your logo or tagline, and use consistent branding across all your social media channels. You can also create a Facebook Page for your business or organization, which can help build brand recognition and loyalty among your followers. Promotion: Facebook is an excellent tool for promoting your products, services, events, or other offerings. You can create Facebook Ads to target specific demographics, interests, or behaviours, or use boosted posts to increase visibility for your content. You can also collaborate with influencers or other brands to cross-promote your offerings and reach new audiences. Advertisement: Facebook Ads are a popular way to reach your target audience and drive conversions. You can create various types of ads, including image, video, carousel, and more, and choose from a variety of ad formats and placements, such as in-feed, Stories, or Messenger. You can also use Facebook's Ad Manager tool to track your ad performance and optimize your campaigns. Information: Facebook is a powerful platform for sharing information and engaging with your audience. You can create posts, videos, or live streams to inform and educate your followers, answer their questions, or address their concerns. You can also use Facebook Groups to build communities around specific topics or interests and share valuable content with your members. Service and Competition: Facebook can be used to provide customer service and support to users. Many businesses use Facebook as a platform to address customer complaints, answer questions, and provide



**Prasant Kumar Rout and Gobinda Chandra Panda**

support. This can be done through public posts, private messages, or chatbots. Additionally, Facebook can be used to monitor and analyze competitors' social media presence, strategies, and promotions. Customer Relationship Management: Facebook can be an effective tool for customer relationship management (CRM). By using Facebook's targeting and advertising tools, businesses can reach out to customers and create personalized experiences for them. This can include targeted ads, custom messaging, and promotions. Additionally, Facebook allows businesses to collect and analyze customer data, This can be utilised to enhance products and services, uncover opportunities, and develop targeted marketing campaigns. Instagram: Instagram is a prominent social media network that offers businesses a variety of tools and features to improve their branding, promotion, advertisement, information, service competition, and customer relationship management strategies. Here are some key aspects of Instagram in each of these areas: Branding: Instagram is a highly visual platform that allows businesses to showcase their brand and personality through photos and videos. By posting high-quality and engaging content, businesses can create a consistent brand image and attract followers. Additionally, Instagram offers tools such as Instagram Stories and Reels that can be used to create more interactive and engaging content. Promotion and Advertisement: Instagram provides a range of advertising options, including photo and video ads, carousel ads, and sponsored posts. These advertisements let businesses to target specific audiences based on demographics, interests, and other factors. Additionally, Businesses can tag products in their Instagram posts with the "shoppable posts" feature, which makes it easier for Instagram users to buy things right from the app.

Information: Instagram's caption feature allows businesses to provide additional information about their products, services, and brand. By using hashtags and geotags, companies can increase the visibility of their content to people with shared interests. Service and Competition: Instagram can be used to provide customer service and support through direct messages and comments. Additionally, businesses can use Instagram to monitor and analyze their competitors' social media presence, strategies, and promotions Customer Relationship Management: Instagram provides businesses with a range of tools and features to manage their relationships with customers. Companies may exhibit their dedication to creating a good experience for customers by replying to their comments and private communications. Moreover, with Instagram's Insights, companies can monitor user interaction with their content, follower growth, and other metrics that can be used to optimize their social media strategy. YouTube: YouTube is a powerful video sharing platform that provides businesses with a range of tools and features to enhance their branding, promotion, advertisement, information, service competition, and customer relationship management strategies. Here are some key aspects of YouTube in each of these areas: Branding: YouTube allows businesses to create their own branded channel where they can share videos that showcase their brand and personality. By creating high-quality and engaging videos, businesses can attract subscribers and build a loyal following. Additionally, businesses can customize their channel with branding elements such as logos, banners, and profile pictures. Promotion and Advertisement: YouTube offers a range of advertising options, including in-stream ads, display ads, and sponsored content. These advertisements allow businesses to target certain demographics, interests, and behaviours. Additionally, YouTube's True View ads allow businesses to only pay for ads that are viewed for a certain amount of time, making it a more cost-effective advertising option.

Information :Businesses can give additional information about their products, services, and brand using YouTube's video descriptions and annotations. By utilising relevant keywords and tags, businesses can also increase the discoverability of their videos among consumers who are interested in comparable themes. Service and Competition: YouTube can be used to provide customer service and support through video comments and messages. Additionally, businesses can use YouTube to monitor and analyze their competitors' video content, strategies, and promotions. Customer Relationship Management: YouTube offers businesses a variety of tools and services for managing their client connections. Twitter: Twitter is a dynamic social media platform that businesses can utilise to grow their brand, promote their products and services, advertise to prospective customers, communicate information, and manage client relationships. Here are some ways businesses can use Twitter to their advantage: Branding: Twitter can help businesses build brand recognition by using a consistent brand voice, logo, and messaging. By creating a profile and posting regular updates, businesses can establish themselves as thought leaders in their industry and gain followers who are interested in what they have to offer. Promotion: By sharing links to



**Prasant Kumar Rout and Gobinda Chandra Panda**

sales pages or product pages, Twitter can be used to get the word out about a product or service. Businesses can reach more people and get people interested in what they have to offer by using hashtags and other Twitter features. Advertisement: Twitter also offers advertising options that can help businesses reach even more potential customers. Twitter ads can be targeted based on factors such as location, interests, and demographics, making it a powerful tool for reaching specific audiences. Information: Twitter is also a great platform for sharing news and updates about a business, industry trends, or other relevant information. By regularly sharing helpful content, businesses can position themselves as thought leaders and build trust with their audience. Service & competition: Twitter can also be used to monitor competitors and stay on top of industry trends. By following competitors and tracking relevant hashtags, businesses can stay up-to-date on what their competitors are doing and adjust their own strategies accordingly. Customer relationship management: Twitter can be used to keep in touch with customers and respond to their questions and concerns quickly. Businesses can show how much they care about customer service by responding quickly and helpfully to mentions and direct messages.

LITERATURE REVIEW

According to (Edosomwan, 2011), Conversation is the most important part of social media. When a social media site is used for a business, buzzes that mention the brand name spread the conversation. (Kietzmann et al., 2011) tried to create a theoretical framework that describes social media by using seven functional building blocks: identity, conversations, sharing, presence, relationships, reputation, and groups. As different social media activities are defined by how much they focus on some or all these blocks, he explains what each block means for how businesses should use social media. (Bashar & Wasiq, 2012) analysed the effectiveness of social media as a marketing tool has been examined, as has the extent to which social media influences consumers' purchasing decisions. In addition, strategies for maximising the effectiveness have been proposed. (Stoica et al., 2013) Studied and demonstrated the impact of social media on the evolution of electronic business (e-business) and to offer viable solutions to businesses or even governments. A detailed analysis of the current trends in the global business environment and the approach that corporations need to take in order to build a sustainable strategic advantage. Social media-based business models are important for the growth and development of companies in the global business environment of today (Abuhashesh, n.d.). (Paniagua & Sapena, 2014) identified Twitter is a better tool for improving business performance than Facebook .

A framework was made that shows that "followers" and "likes" are good for a company's share price, but only after a certain number of followers are reached. Asper (Georgescu & Popescu, 2015) The widespread adoption and use of social media has produced a paradigm shift in the business world, one in which traditional organisational structures are dismantled and replaced by horizontal networks that include not only employees but also customers, suppliers, and other business partners. (Hassan et al., 2015) talks on use of AIDA framework as the basis for developing and suggesting a strategy for using social media as a marketing tool for small businesses. (Grizane & Jurgelane, 2016) designed a model that shows that social media influences the restaurant industry and customer habits in Jelgava town, but none of the restaurants evaluated have realised the full potential of this influence. The designed model is suitable for assessing the benefits of investments in the use of social media in other business fields. (Jayasuriya et al., 2017) studied various way to find out how social media affects brand equity in the aviation industry. He looked at how entertainment, customization, interaction, and EMOW affect brand awareness in a big way. (Ahmad et al., 2018) describe how unlike traditional WOM, e-WOM and social media information influence consumer perception and purchase intent. (Venkateswaran et al., 2019) examined the impact of social media on business organisations by highlighting the competitive advantage of social media-using organisations and to identify the reasons why businesses prefer social media as marketing and communication tools over other methods. (Chatterjee & Kumar Kar, 2020) identifies the factors that may encourage Indian small and medium-sized enterprise's (SME's) to use the social media marketing (SMM) mechanism to increase their business's impact on the web. In a review of the literature, (Olanrewaju et al., 2020) focuses on entrepreneurs are now using social media for purposes other than marketing, such as business networking, information search, and business crowdfunding.



**Prasant Kumar Rout and Gobinda Chandra Panda**

(Dolega et al., 2021) explained that social media increases web traffic, but it has little to no impact on the number of product orders or sales revenue. However, larger social media campaigns typically generate a noticeably higher volume of orders and revenue from sales, with Facebook emerging as the most successful channel. (Tiwarly et al., 2021) talks about through SM, B2B marketers can increase brand awareness and credibility in target markets worldwide, which in turn can aid in the acquisition of new customers and the development of lasting partnerships with suppliers in other countries.

Here is how the other parts of this work are put together. The research objective stated in Section 3, while methodology, sample, and questionnaire design are covered briefly section 4. In section 5, the full data collection and analysis is performed, and in section 5.1 data interpretation is covered, Section 6 provides specifics regarding managerial decisions. Section 7 gives the conclusions.

Research Objective

The purpose of the investigation is to do first-hand research on how four important social platforms, like Facebook, Instagram, YouTube, and Twitter, have affected the growth of six important aspects, like branding, service, P&A, information, competition, and CRM. 1. to determine the relationship between the various attributes in relation to the social platform utilizing "R programming" and a perceptual map. 2. To provide valuable information for industries to develop more effective marketing strategies through the use of social media as a platform to interact with customer.

RESEARCH METHODOLOGY

Based on the information in a contingency table, correspondence analysis (Hoffman & Franke, 1986) shows how two groups of variables are related to each other. Because of this, we are better able to construct a perceptual map using the responses that we have gathered, which is the end goal of the research that we have been doing. MDS includes a component known as correspondence analysis, which is an extremely helpful component that may provide a graphical depiction of the data obtained from primary research interviews with respondents. This technique is helpful for our study not only because it focuses on the objective, but also because it enables us to comprehend, with the aid of perceptual maps (Gigauri, 2019), how the customer perceives the world around them.

Sample design and data collection method

As we already know, most young people utilise social media daily for purchasing products and service, 100 questionnaires were issued to personnel in various industries, of which 71 were returned with responses. In the following part, 4.2, the detailed design of questionnaires together with the Likert scale is discussed. Social networking is becoming increasingly important to businesses worldwide. Businesses can contact more people without time, distance, or accessibility limitations. The industry is booming. A corporation must first build a website for continual promotion and marketing to survive in a competitive market. Businesses must use online social networking platforms such as Facebook, YouTube, Instagram, and Twitter, and others to reach more people online. All firms use these social media platforms today. The study seeks to determine how much of an effect does each social media platform have on the success of businesses for different types of organisations. This article examines how social media affects numerous businesses.

Questionnaires Design

The present study is based on industries views regarding different attributes of business affected by social media platforms. So, here we have formed questionnaires to collect the data from industries. Our questionnaire comprises of six separate questions. Every question that seeks to determine the influence of social networks on a specific quality is worth ten points. The Likert scale goes from one to ten, with ten being the greatest and one being the lowest possible score. We have chosen to focus on 4 unique social networks such as Facebook, YouTube, Instagram, and Twitter in addition to 6 factors as Branding, Service, P&A, Information, Competition, and CRM.



**Prasant Kumar Rout and Gobinda Chandra Panda****Analysis of data collected from Industries**

A four-by-six contingency matrix displays questionnaire responses. Rows indicate social platforms and columns six factors. Our study also examined responder perspective similarity, as shown in the following table. The following correlation between social media and company characteristics can be seen in the residual table. Based on the numerical values, the following table is divided into two columns, indicating the highest and lowest association. High numbers are indicative of a strong association.

Data Interpretation based on industry personnel's responses

Here we have analysed the industries views from the perceptual map i.e. fig.1.3:

According to the perceptual map i.e. fig. it is divided into four quadrants and each quadrant is having some social platforms and business attributes. As we know that perceptual map is a MDS based correspondence analysis. Here in this study we have tried to find the correspondence between business attributes and social media based on our collected data.

- From the above figure first quadrant having social platform Instagram and business attributes Information, Competition and CRM. It implies there is strong association between Instagram with Information, Competition and CRM. Also we observed that Twitter and Facebook are positioned in fourth quadrant, so there is a moderate association between Twitter and Facebook with Information, Competition and CRM. As YouTube is positioned in third quadrant and it is diagonal quadrant to first quadrant, so there is no association between YouTube Information, Competition and CRM.
- So from the above figure it shows that service is present in second quadrant and there is no other social platform present in second quadrant. So its shows that no social platforms is giving direct importance to service. As Instagram and YouTube are placed in first and third quadrant so we can conclude that service is less associated with YouTube and Instagram. And also service and the social platform (Twitter, Facebook) positioned in opposite quadrant so there is negatively relation between said social platform and service.
- According to the figure presented above, the third quadrant include YouTube in addition to Branding and P & A. As a result, we can draw the conclusion that there is a significant connection between Branding and P & A on YouTube. As a result of their placement in the fourth quadrant, Twitter and Facebook have a moderate degree of association with branding and public relations and advertising.

Managerial Decision and recommendation for future research

From a management decision perspective, this research reveals that Instagram should place a great deal of attention on information and competition as opposed to its current emphasis on branding and P&A of a product or service and nearly as much on service and CRM. It's the same way with Twitter; it's more linked to knowledge and rivalry than to customer service and CRM. But from a management judgement point of view, Twitter should put more emphasis on branding and P&A since it is farther removed from these areas. The research also demonstrates that Facebook has strong linkages to CRM, as well as to competitiveness, information, branding, and P&A. Despite the fact that there is a negative correlation between Facebook and service, this research focuses on service in an effort to keep companies afloat. In the end, YouTube is inextricably related to service, and it is also almost inextricably linked to rivalry and data. In spite of this, there remains a stigma attached to the service that YouTube users must overcome.

CONCLUSION

This research set out to determine how different types of companies may benefit from using social media. The benefits of social media to companies were the focus of this research. Branding, service, P&A, information, competition, and customer relationship management are all improved by using social media platforms like Facebook, YouTube, Instagram, and Twitter (CRM). With today's social media channels, businesses may expand and improve their operations. In this study, we conducted primary research with student consumers and business personnel using a rating scale questionnaire. Correspondence analysis, a hybrid of factor analysis and



**Prasant Kumar Rout and Gobinda Chandra Panda**

multidimensional scaling, serves as the foundation for all of the work. In order to better interpret primary data, we utilised the computer language R to create a perceptual map based on the concept of correspondence analysis. As soon as we had the perceptual map, we started analysing the locations of various qualities and social media to see how they were interconnected. Discussion centres on the findings and the interpretation in fine detail. So that the data may be easily understood by the responder, it is often shown in a variety of graph types, including pie charts and line graphs.

FUTURE WORK

We spent sufficient time and energy on the preliminary research in order to construct a reliable model. Correspondence analysis, which combines factor analysis and multidimensional scaling, has allowed us to present a conceptual model that has been confirmed. During two months in the middle of 2022, we conducted our survey work and obtained 71 usable replies from industry personnel. We've investigated the various facets of business that are impacted by social media and attempted to deduce what it all means. The field of research on the effects of social media on various aspects of business has room to grow. A researcher may focus on any number of sectors, such as the fashion industry, the restaurant business, the automotive sector, the tourism sector, the academic sector, the medical sector, and so on. Researchers can examine the ways in which social media facilitates access to services in the aforementioned domains by employing a variety of statistical methods.

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Prasant Kumar Rout and Gobinda Chandra Panda

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Table -1. Contribution of different author's year wise and our contribution

Authors	Research Contribution	Method	Findings
Chih-Wen Wu (2016)	Structural equation modeling (SEM) and fuzzy set qualitative comparative analysis (fsQCA) are used to analyse the research questions and test relationship predictions using mail survey data from the sample.	Structural equation modeling (SEM)	The results show that how well an organization does its job has a big effect on how well it does business.
Grizane & Jurgelane (2017)	The concept model shows how social media can attract customers	Stella-Excel model	How social media impacts restaurants' business and how





Prasant Kumar Rout and Gobinda Chandra Panda

	to local eateries and how the choice model might help achieve this goal.		customers behave. Many kinds of businesses can use this method to look at their investments in social media. Social media influences restaurant
Anas A. Al Bakri (2017)	Management of SMEs, entrepreneurship, small and micro firms, and their impact on economic, technological adoption, and SMEs performance	Structural equation modeling	The study found no significant correlation between SME social media activity and competitive advantage.
Drummond et al.(2018)	Social media and entrepreneurial resource mobilization	Interview Method	The outcomes of the study provide evidence that the activity structures of business-to-business connections and networks are beneficial.
Voorveld et al. (2018)	This study analyses how social media use affects advertisement engagement.	Principal components analysis (PCA)	According to the research, the level of involvement a business receives from its customers in social media is greatly reliant on the environment.
Wardati& ER (2019)	SME Sales Processes and Social Media	Systematic Literature Review (SLR)	The study looks at how SME customers, stakeholders, business partners, and competitors are affected by social media.
Annisa& ER (2019)	The Influences of Social Media Alignment on Business Process Performance in SMEs Conceptual Model Development	Process Classification Framework (PCF)	This research developed a conceptual model using Task-Technology Fit to examine how social media affects SME business process performance (SMEs).
Chatterjee & Kar (2020)	Why do small and medium-sized businesses use social media marketing, and what are the consequences? empirical observations from India	Structured equation modelling	The results show that the effectiveness of SMM following adoption by SMEs is influenced by how useful, easy to use, and compatible it is.
Olanrewaju et al. (2020)	Assessing the Literature on Social Media and Business	Systematically reviews research	This finding suggests that business owners are increasingly turning to social media for purposes beyond simple advertising, such as professional networking, research, and crowdsourcing.
Dolega et al. (2021)	In the process of becoming digital? The effect of social media advertising on foot traffic, online	Autoregressive integrated moving average	Conclusions reveal that although social networking sites do improve website





Prasant Kumar Rout and Gobinda Chandra Panda

	purchases, and revenue at a retail establishment	(ARIMA)	traffic, they do not substantially increase product purchases. And its effectiveness is proportional to the difficulty of production, the price, and the product's name recognition.
Tiwary et al. (2021)	Impact analysis on the application of social media in B2B marketing, including a comprehensive study of the relevant research and recommendations	Bibliometric analysis	In contrast to B2C enterprises, B2B ones aren't making the most of social media's many advantages for their operations.
Kumar & Sharma (2022)	Findings from a literature review on the use of social media for B2B marketing, with an emphasis on sales and the sales process		The study's findings provide a basis for grouping the investigation into three categories: application, efficiency, and structure. There is a lack of studies exploring the effects of social media on B2B sales.
Sedalo et al. (2022)	Exploring social media affordance in relationship marketing practices in SMEs	Thematic analysis technique	Three advantages of social media for relationship marketing in SMBs were found in the study: brand visibility, sharing, and relationships. These social media advantages result in consumer acquisition.
Present Paper	An analysis of industry experts' perspectives on the impact of social media on companies' performance	Perceptual Mapping using correspondence Analysis	This research used a perceptual map and correspondence analysis to illustrate the interconnectedness of various company traits and social media outlets. We have also developed a set of guidelines a manager may follow to ensure a solid foundation is laid between qualities and social media.

Table 2. Correspondence Table

Social Media	Attributes						
	Br.	Ser.	Pr. & Adv.	Inf.	Comp.	CRM	Total
Facebook	21	15	19	17	19	20	111
YouTube	18	17	22	17	17	17	108
Instagram	21	13	20	14	17	20	105
Twitter	12	14	16	13	14	18	87
Total	72	59	77	61	67	75	411

(Br.-Branding, Ser.-Service, Pr. & Adv.- Promotion & advertisement, Inf.-Information, Comp.- Competition, CRM- Customer relationship management)

Based on the data, Expected value = $\frac{\text{total number of observation in the table}}{\text{row total} \times \text{column total}}$





Prasant Kumar Rout and Gobinda Chandra Panda

Table 3. Expected values table

Social Media	Attributes					
	Br.	Ser.	Pr. & Adv.	Inf.	Comp.	CRM
Facebook	19.45	15.93	20.80	16.47	18.09	20.26
YouTube	18.92	15.50	20.23	16.03	17.61	19.71
Instagram	18.39	15.07	19.67	15.58	17.12	19.16
Twitter	15.24	12.49	16.30	12.91	14.18	15.88

(Br.-Branding, Ser.-Service, Pr. & Adv.- Promotion &advertisement, Inf.-Information, Comp.- Competition, CRM- Customer relationship management)

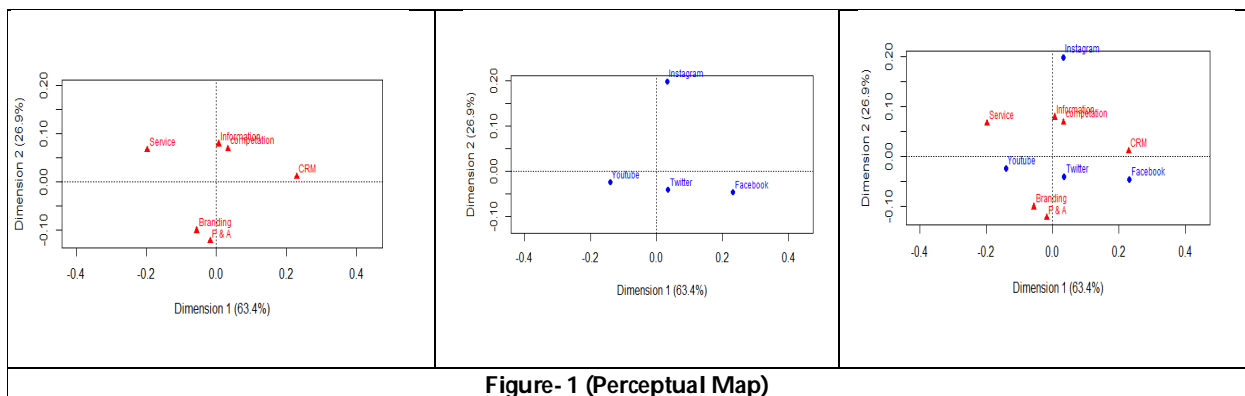
Table 4.Residuals Table

Social Media	Attributes					
	Br.	Ser.	Pr. & Adv.	Inf.	Comp.	CRM
Facebook	1.55	-0.93	-1.80	0.53	0.91	-0.26
YouTube	-0.92	1.50	1.77	0.97	-0.61	-2.71
Instagram	2.61	-2.07	0.33	-1.58	-0.12	0.84
Twitter	-3.24	1.51	-0.30	0.09	-0.18	2.12

(Br.-Branding, Ser.-Service, Pr. & Adv.- Promotion &advertisement, Inf.-Information, Comp.- Competition, CRM- Customer relationship management)

Table 5. From the above table we have got the following highest and lowest factor of different attributes.

Highest			Lowest		
Facebook	Branding	1.55	Facebook	P & A	-1.80
YouTube	Promotion & Advertisement	1.77	YouTube	Customer Relationship Management	-2.71
Instagram	Branding	2.61	Instagram	Service	-2.49
Twitter	CRM	2.12	Twitter	Branding	-3.24





A Novel Artificial Intelligence Assisted Data Security Enhancement using Image Steganography

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ABSTRACT

In every industries, there has been a lot of interest in data privacy. Data and visual privacy has grown to be a significant issue in recent years. As a result, Reversible Data Hiding (RDH) in encrypted images has received a lot of interest from the privacy, security, and protection areas. The previous RDH methods could only conceal an insignificant quantity of data with unacceptable reconstructed image quality due to their low embedding capacity. To be able to effectively compress images while yet maintaining a high hiding capacity, this study proposes a novel reversible information-hiding strategy in RECM images. Tagged encrypted photographs may be decoded with the proposed method without the need to perform information extraction, enabling the generation of marked pictures with a payload. The proposed method utilises image coding standards to potentially obscure sensitive information while also efficiently compressing encrypted images with embedded tags. A generative adversarial network and encoder-decoder are used to construct an information concealing paradigm. To cut down on the amount of data needed to represent a picture, image compression methods can be used before sending the data embedded image to the receiver. These approaches produce outcomes that are superior to those of the earlier method. The results demonstrate very high embedding capacities and excellent reconstructed picture quality as compared to the prior technique.

Keywords: Data Privacy; Data Hiding; Reversible Data Hiding (RDH); Losslesscompression; Hiding capacity; Generative adversarial network.





INTRODUCTION

In recent decades, the subject of picture security has focused on image data concealing, a typical security method for digital data that subtly embeds hidden data into a cover picture. In particular, when the encoded payload is successfully removed, reversible data concealment can perfectly recover the original photos. It works well for photographs that are not just natural but also medical, military, evidentiary, and other types of images. For plain photos, many RDH approaches have been put forth. Significant efforts are being made to study RDH in encrypted images (RDH-EI) in recent years [1] [2]. A substantial hiding capacity is a common need for information concealment methods. If the potential for concealment is good enough, we may include not only the most fundamental copyright details, but also a certificate and other critical papers. Since it is challenging to tell encrypted photos apart simply by looking at them, RDH-EI must allow us to embed data about the images' material so that we can tell what kind of pictures they are without needing to decode them. On another front, a user of photographs can want to get unique images or premium images that yet hold secrets. Such requirements are successfully met by RDH-EI techniques [3].

In order to successfully hide an extensive amount of confidential communications within a cover medium without arousing the suspicion of listeners, data concealment's end purpose is to safely transfer information via an apparently harmless channel. The information-hiding community is especially interested in digital photographs, among other cover items, because of their widespread use and easy accessibility. Up to three billion images are uploaded online every day. The irreversible and reversible approaches are the two basic categories into which algorithms created for concealing visual data are divided [4]. The receiver can extract hidden messages from stego pictures using the earlier approaches. The latter ones, however, provide the recipient the ability to recover the stego picture as well as extract hidden messages, creating a restored image that is similar to the cover image.

In order to permanently conceal data, the least significant bit (LSB) replacement method can be used to overwrite the least significant bits with the hidden data. Due to their great embedding effectiveness and minimal sensitivity to steganalytic identification, matrix embedding and employing modifying direction (EMD) [5] are two well-liked irreversible information-hiding strategies. Even if the original cover pictures are lost forever with irreversible techniques, the embedding capacity is still rather high. Digital material, including photos, music, text, and videos, is now being transmitted quickly thanks to the development of the internet. Meanwhile, the development of forgery tools and applications makes it simple to change, copy, and destroy digital content while it is being transmitted. Encryption of information and concealment are two of the primary tools available in a safety measure for protecting information while in transit and keeping it from being tampered with. Encryption, frequently referred to as cryptography, is the act of transforming information with a crypto-key to make it unintelligible to unauthorised parties. Different applications built on client/server architectures use encryption algorithms to protect their data while it is being transmitted. Information hiding, on the other hand, is the art and science of concealing sensitive information such that its existence cannot be discovered. Steganography and watermarking are two other categories under which information might be concealed. The integrity of transmitted data is ensured and intellectual property rights are protected through watermarking. Generally speaking, watermarking is helpful for little pieces of information like an author's tags or a corporate logo. Steganography is the practise of employing a communication medium in a way that masks the presence of sensitive information. Image, text, audio, or video can all be used as the communication medium.

In general, the three main views of capacity, visual symmetry, and security are used to evaluate the picture steganographic approach [6]. The optimal steganographic technique should therefore be able to provide large capacity, superb visual symmetry, and undetectability all at once. High payload steganographic techniques are frequently prone to steganalysis and bring distortion artefacts into stego-images. Additionally, the low payload makes good visual quality steganographic methods difficult to use. Due to the conflicts between them, achieving high capacity, visual symmetry, and security at the same time is a difficult research topic.



**Raja**

There are several ways for picture steganography that may be found in the literature [7]. The spatial and frequency domains are divided into two basic categories for these techniques. The secret information is directly incorporated in the cover pictures' modified coefficient in the frequency domain that it is embedded in the spatial domain via changing the pixel intensities. Compared to the spatial domain, frequency domain approaches are more resistant to detection assaults, but they have limited payloads and are computationally costly. The suggested technique presented in this study is based on the spatial domain since it has a high payload, good visual quality, and a cheap computing cost that make it effective for picture steganography.

Data embedding software has separated steganographic techniques into irreversible and reversible ways. After removing the hidden message from the stego-images, the reversible steganographic techniques rebuild the original picture [8]. Compared to irreversible procedures, such embedding approaches have a lower payload. Data compression techniques are used on the secret message before the embedding procedure in order to boost the embedding capacity of reversible systems [9]. Irreversible steganography, on the other hand, focuses more on achieving a large embedding payload and strong visual symmetry than on retrieving the cover-image during the extraction procedure. In this research, we provide a novel framework for encrypting images that may regulate both the capacity for concealing information and the effectiveness of lossless compression. Without sacrificing any of the RDI method's benefits, our approach addresses the poor concealing capacity that is its primary drawback. In order to keep annotated encrypted photos with the least amount of data possible while preserving the necessary concealing capacity, we built the RECM framework. Savings on data transport and storage expenses may result from this. There are several deep learning-based information concealing techniques as a result of the transformation of steganography techniques into steganography techniques that rely on autonomous network learning. Due to its extensive steganographic potential, the deep learning-based method of concealing pictures with images has caught the interest of many academics.

Related works

The emergence of the big data age has made company big data, government big data, and network user big data extremely valuable in a variety of industries. However, it is also possible to track and record any human behaviour. The demand from the public for privacy protection is also rising. A HEVC reversible video data concealing method and encryption technology are suggested in paper [10] for video large data to achieve privacy protection. The information is encoded using a monoalphabetic substitution cypher method, before being integrated into the proposed multivariate array of the 4 x 4 luminance DST blocks to minimise distortion drift. By doing the opposite procedure on the multidimensional array in the decoder, the attached video is a perfect recreation of the original encrypted video. Data from both theory and practise suggests that the proposed approach can deliver on its promises of high embedding capacity, security, with little visual distortion. Assessments of the suggested design's effectiveness to those of existing systems are provided to demonstrate its superiority.

Since their widespread adoption in cloud computing as well as medical image transfer, reversible information hiding techniques have gained a lot of attention in recent years. Utilising a block-wise, multi-level picture encryption technique, the writer of paper [11] proposes a unique, reversible data hiding strategy for hiding lengthy encrypted messages in images. As part of the proposed procedure, the data hider will employ not only the picture encryption key K, but also the two extra secret keys K0 and K1 for backwards-compatible information concealing. As part of the data-hiding process, an image that has been encrypted will be utilised as input, yielding a refined encrypted image with secret information. In order to extract data and recover an image, the receiver needs the primary decryption key K, as well as the supplemental decryption keys K0 and K1. After evaluating the picture blocks' simplicity quality, a multi-level decryption method is utilised to retrieve the image blocks. The University of Southern California's USC-SIPI dataset serves as an outline for the experimental inquiry.

Information security research is now being done in the domain of reversible data hiding (RDH). In the recent years, a number of methods for reversible data concealment in digital photographs have been developed. Generally speaking, there are three major categories that may be used to group reversible data hiding techniques: difference





Raja

expansion-based RDH, RDH based on histogram shifting, and RDH based on lossless compression. On the basis of the histogram shifting technique, several algorithms are available in the literature. Overflow or underflow when the histogram is being shifted is one of the main problems with the histogram shifting based technique. By including some extra marking bits in the picture along with the secret message bits when embedding them, the author of study [12] suggests a practical method for handling overflow or underflow. The suggested method guarantees the precise recovery of the original picture and aids in lowering the overhead associated with handling overflow or underflow in Histogram displacement is the foundation of the RDH system. On the common image data set, all experimental research is conducted.

The writer of paper [13] suggests a hybrid reversible image information hiding approach (RIDH) to rebuild the original picture once the data that was embedded has been removed. Encryption of information and masking are two effective methods of data security. When an image is encrypted, it becomes unreadable cipher text, but data hiding allows for extra data to be embedded into the image itself. This study proposes employing the rivets cypher 4 (RC4) for encryption and decryption, in addition to information concealing employing the advanced encryption standard (AES), eliminating the need for an encrypted data hiding key, in contrast to existing methods. The original image may be reconstructed from the embedded one by using the Support Vector Machines (SVM) classifier, which calculates the characteristics of each block to determine which ones are encrypted and which ones are not. Finally, a sample result is presented to demonstrate the superiority of our approach.

Many fields, including cloud computing as well as medical imaging transfer, could benefit from data that is reversible hiding, which is why it has become increasingly popular in recent years. An innovative method for reversible hiding information in encrypted pictures is proposed in paper [14]. According to this plan, the data hider can include a single extra data bit into a tiny chunk of the encrypted picture. The encrypted picture will be processed by accessing each of the non-overlapping areas (blocks) in a predetermined order. No changes to the pixel values are necessary to embed a bit value of 0 in an encrypted picture block. All of the pixels in the first column of the chosen picture block will be translated into a new pixel value according to a predetermined function if bit value 1 is to be embedded. By comparing the proximity of the pixels in each block of the encrypted picture's adjacent columns, information retrieval and picture restoration are carried out on the receiving end. Protecting the privacy of content creators when their images are to be utilised as a host for specific data has brought a lot of focus on the irreversible concealment of information in the encrypted picture domain. The writer of [15] suggests a decoupled RDHEI method that balances safety, embedding capacity, and quality of the decrypted picture. The method secures the picture blocks using either rotational encryption or the Advanced Encryption Standard (AES), based on the complexity of the images. Data is hidden using low-complexity blocks and the alteration of prediction error technique. Results from experiments suggest that the suggested technology has the potential in order to improve the safety and efficiency of embedding without negatively impacting the quality of the directly decrypted pictures.

METHODOLOGY

Using a technique called Reversible Data Hiding (RDH), information may be buried in digital images for secure communication without permanently altering the original image. Methodology proposed Reversible data-concealment in Encrypted Images (REI) uses features from prior work to control lossless compression efficiency and data concealment efficacy. To begin, it splits a source picture into two halves. The current approaches fall short of achieving great embedding capacity and excellent visual quality. The earlier technique used the MSB to conceal one bit per pixel. Its visual quality and embedding capabilities are not very good. Additionally, the fact that a digital image typically needs a large number of bits creates a serious issue for the transmission and storage of digital image data. Due to these factors, we describe here a novel, highly-capable, reversible data-hiding strategy for encrypted pictures that is based on MSB (two most significant bits) prediction. The proposed algorithm's goal is to concurrently improve the embedding capability and quality of the rebuilt picture. With this method, confidentiality is maintained during decryption in the encrypted domain, and it is simpler to predict the MSB values. Additionally, we can use





Raja

image compression techniques to lower the bandwidth needed to transmit an image and lower the amount of data needed to represent it. One of the most successful and important technologies in the field of digital image processing is compression. The RECM is employed in the other region to accomplish extremely effective lossless compression. The suggested approach can also decode the later portion without information extraction. This indicates that using our technology, marked photos can be obtained.

We provide a high-capacity RDH approach for encrypted photos in this section. Due to the employment of the encryption and compression approach, the suggested method may compress marked encrypted pictures without loss. Our technique successfully implemented a prediction-error expansion and histogram-shifting mechanism, which led to a high concealing capacity. We first provide a detailed outline of the method's operation. The method's efficacy is then explained. Following encryption and information hiding, the interpixel correlation within every frame remains unchanged. therefore this strategy might compress annotated encrypted pictures utilising image coding standards. Reversibility is a crucial need in our strategy for precisely recovering an original picture. The suggested method's outline is shown in Figure 1.

We suppose that a picture has two areas labelled region α and region β . For instance, in Figure 2, region α is shown by the regions highlighted in red.

The concatenation of the colour components is done in Step 1 in an arbitrary sequence and direction. Due to α region's use of RECM, which enables reversible encryption and compression, we can first embed a payload before encrypting the labeled α . As a result, the payload may be flexibly embedded in plain or encrypted domains in α . Step 2 defines the categorisation of the areas α and β randomly. Region α is represented by the areas shown in red in Figure 2, which is a categorization example. We'll go through how the user decodes a tagged, encrypted picture to discover details about the two locations.

Effectiveness of Proposed Method

The suggested approach thoroughly examines the shortcomings of the earlier works and makes efficient use of their strengths. The RDH-MSB approach improves the concealing capacity, which is significantly poor in the RECM method. The RECM method's maximum concealing rate is 0.07 bpp. In comparison, the RDH-MSB technique's concealing capacity is around 1 bpp. The overall concealing capacity for the full encrypted picture is increased to about 0.1 bpp when the RDH-MSB technique is employed for 10% of the spatial domain in a desired picture. This is without taking into account the capacity of the remaining 90%. It exceeds the RECM method's sole maximum hiding capacity. when a result, the suggested approach can boost concealing capacity when the RDH-MSB method's application region expands. Furthermore, in place of the RDH-MSB method, our method can employ any high-capacity REI method.

A tagged encrypted picture created with the RDH-MSB method cannot be compressed using ordinary image coding techniques. By introducing the RECM technique, our approach is superior. While the RDH-MSB technique encrypts images at the pixel level, it disregards the compression efficiency of watermarked encrypted images. In contrast, lossless compression is possible with both JPEG-LS and JPEG 2000 when employing the RECM technique due to the introduction of block scrambling-based encryption. Compared to the RDH-MSB approach, the suggested method allows for much more compression in the region handled by the RECM method. Marked encrypted photos, in general, can be compressed to some extent. If the RECM technique was used across a larger area, compression efficiency would improve. Keep in mind that there is a compromise to be made between privacy and compression ratios.

We improved an RDH approach for stereo images based on PEE-HS and included it into the suggested method. Each block in our method—that is the similar block used in the encryption procedure—includes payload bits. The following is a description of the data-hiding process. Step 1: For pixels $q_{(k,l)}$ in every block, where $0 \leq k < R_a$ and $0 \leq l < R_b$, anticipated values $\hat{q}_{(k,l)}$ are obtained from





Raja

$$\hat{q}_{k,l} = \begin{cases} \min(q_{k-1}, q_{k,l-1}), & \text{if } q_{k-1,l-1} \geq \max(q_{k-1,l}, q_{k,l-1}) \\ \max(q_{k-1}, q_{k,l-1}), & \text{if } q_{k-1,l-1} \leq \min(q_{k-1,l}, q_{k,l-1}) \\ q_{k-1,l} + q_{k,l-1} - q_{k-1,l-1}, & \text{otherwise} \end{cases} \quad (1)$$

Here, (1) makes it impossible to obtain the predicted values $\hat{q}_{0,k}$ and $\hat{q}_{k,0}$. So, we define

$$\hat{q}_{0,l} = q_{0,l-1}, 1 \leq l \leq R_b, \quad (2)$$

$$\hat{q}_{k,0} = q_{k-1,0}, 1 \leq l \leq R_a, \quad (3)$$

Each block's top-left $q_{0,0}$ was exempt from data concealing for reversibility.

Step 2: Calculate the prediction errors $z_{k,l}$:

$$z_{k,l} = \hat{q}_{k,l} - q_{k,l} \quad (4)$$

Step 3: Using the following equation, empty bins in the ranges of $[-2S - 1, -S - 1]$ and $[S + 1, 2S + 1]$ are produced for the prediction-error histogram.

$$z'_{k,l} = \begin{cases} z_{k,l} + (S + 1), & \text{if } z_{k,l} \geq S + 1 \\ z_{k,l} - (S + 1), & \text{if } z_{k,l} \leq -S + 1 \\ z_{k,l}, & \text{otherwise} \end{cases} \quad (5)$$

Where $z'_{k,l}$ indicates a shift-related mistake.

Figure 3 depicts the suggested method's restoration procedure, including data extraction and decryption. There are three ways to restore region α . First, by performing the standard restoration procedure, our method can retrieve an original image. Another option for the procedure is to exclude data extraction and merely decode the region α . This option allows us to get a tagged picture with a payload. Region α can also be encrypted, and the payload can then be retrieved. A reconstruction of the original image is used in the first and third choices. As a result, following decryption, we can acquire a tagged picture carrying a payload in area. The RDH-MSB approach, on the other hand, needs to extract a payload from the encrypted domain in order to decode marked encrypted pictures. Figure 4 displays an illustration of the suggested approach being used to decode data just in region α , which contains the left-side rabbit. The decrypted edition is obviously of good quality, even though the payload is still in your possession. We assume three distinct models because of the flexibility with which we may embed and retrieve the payload in. The owner of the content embeds a payload before encrypting it. Another scenario involves a third party, like a channel provider, hiding a payload after encryption has taken place. This payload may include server data and timestamps. The third model can use the first two models independently for each field by further subdividing the fields. In any event, it is possible to recover the embedded payload from both plain and encrypted domains.

Here, we take the suggested method's security into account. Please take notice that we likely make the methods for encrypting and hiding data available. Resistance against ciphertext-only attacks (COAs), which include brute force invasions as well as jigsaw puzzle solver assaults, must be discussed when an attacker is interested in obtaining visual information from a target image. The resistance of the RECM approach to COAs was carefully investigated. Key management is also important for robustness since the RDH-MSB technique utilized an exclusive-or operation. Consequently, the suggested approach is safe if the keys are managed properly. The attacker has a similar uphill battle in trying to decipher encrypted payloads before data concealment.





Raja

We improved an RDH technique for stereo pictures on the basis of Prediction-error expansion and Histogram Shifting and included it in the suggested approach. Each block in our method—that is the same block used in the encryption process—includes payload bits. The following is a description of the data-hiding process.

High hiding capacity

The suggested approach stops the encryption of a target picture, allowing for interpixel correlation in each block to remain stable before or after encryption. The concealing capacity of our technique employing PEE-HS was around 1 bpp since we were able to acquire prediction values in the encrypted domain with excellent accuracy. The suggested approach has a great concealing capability, allowing us to embed information on picture content, such as categorization and annotation data, in addition to copyright information and time stamps. With this information, we could determine what images were intended to be stored in encrypted space.

Flexible restoration

Our technique may bypass the data extraction step and decode just designated encrypted photos, similar to the usual way, however the typical method requires the payload to be extracted before decryption. A user can choose from one of the following three privileges thanks to the flexible restoration process: information extraction and decryption, information extraction alone, or decryption. Because of this benefit, we are able to broaden the scope of our applications.

Encoder-Decoder Network

Conventional designs that utilize AI and previous knowledge may be transformed by combining deep learning with data hiding to take advantage of the vast computational resources of computers and the powerful feature extraction capabilities of deep learning. The suggested system model consists of a preprocessing system, an encoding system, and a decoding system. The hidden picture is scaled down to the same dimensions as the cover image, and the characteristics of the color-based pixels are altered to improve encoding performance in the preprocessing system. The encoder system creates a hidden picture that is visually indistinguishable from the cover image; the U-Net network's advantages allow for an exchange of operation between up sampling and down sampling, as well as the image's shallow as well as deep layers are maintained, so the image that has been decrypted has a high degree of similarity to the original hidden picture. The color deformation of dense pictures is easily noticeable, and this approach can only hide grayscale images with a single channel. The CNN infrastructure's feature extraction capability was continuously combined with the unique properties of the concealed image throughout feature extraction of the cover image to ensure statistical consistency between the encrypted image and the cover image. The concept for concealing pictures within images is depicted in Figure 5.

A generative adversarial network-based paradigm for information concealment is put forth. The objective of a GAN is to constantly lower the loss function until the generator and discriminator are in a Nash equilibrium, which optimises the network parameters. The generative model is supposed to create a target picture that is in line with the original cover image. The robustness of the final target images and the robustness of the noisy hybrid training are both improved by the employment of a regular discriminating model and inconsistencies loss. When input into a computer network, the cover and hidden images are decomposed via the discrete wavelet transform (DWT) into low-frequency as well as high-frequency wavelets, respectively. The inverse wavelet transform creates the dense image at the output end.

RESULT

We assess the usefulness of the suggested approach based on its capability for concealing information and lossless compression performance. We utilised 24 test photos with different dimensions from the image database. Horizontally, the original picture is divided into two sections; in our simulation, the top and bottom portions are designated as ROI and non-ROI, respectively. To evaluate the effect of image dimension, we used test images of two





Raja

different dimensions: the entire dimension and 1/16 the full size. Examples of photos from each database are shown in Figure 6. As seen in Figures 7 and 8, we horizontally combined three colour components in the following order: R, G, and B. The encryption block size was 8 by 8 pixels. The RDH-MSB approach was developed for grayscale photos, therefore each colour component received a separate application of the algorithm.

Lossless Compression Performance

The performance of lossless compression for various models is displayed in Figure 9 and Table 1. It is evident that as the ROI area grows, more compression performance may be produced. The bitrates are greater whenever the RDH-MSB technique is used to process the complete image when the area ratio is 0:100. This indicates that the compressed image now contains more data than the original image did. In contrast, the suggested technique allows for the RDH-ETC method to be applied to a segment of the picture, allowing for compression of the complete output image and control of compression performance. Although each of the pictures had a different value as well as slope in general, Figure 10 and Table 2 show that the trade-off among the lossless compression and the achievement exhibits a linear fluctuation for every image. Regarding lossless compression, the RECM could be used throughout the entire image to achieve the best performance. On the other hand, when the RDH-MSB approach was applied across the board, the largest concealing capacity could be reached. The suggested technique does not, however, simultaneously achieve the best compression efficiency and concealing capacity since it allows us to mix the RECM and RDH-MSB methods. However, by employing the suggested method, pictures can be stored with the least number of information while maintaining the necessary secret capacity. The suggested methodology might be applied to more industries, such as cloud computing and social networking services.

Hiding Capacity

Our technique has a larger capacity as the non-ROI area grows. The concealing capacity is substantially lower than 0.1 bpp if the area ratio is 100:0, or if the RECM technique is used on the full image. The RDH-MSB approach, on the other hand, achieves the high capacity, which is close to 1 bpp. The suggested approach adjusts the area ratio of ROI and non-ROI to increase capacity by around 1 bpp. The performance of compression and concealing capacity may be traded off, as the previous explanation shows. The greatest benefit of our strategy is the ability to regulate both of them with great flexibility by using the RECM and RDH-MSB procedures individually for various locations. The suggested framework is anticipated to be used in a larger range of industries, such as cloud computing and online community software. The data concealing capacity is depicted in Figure 11 and Table 3.

Peak Signal-to-Noise Ratio

Peak signal-to-noise ratio (PSNR) is a metric that assesses a signal's highest signal-to-noise ratio and is frequently used to image and video data. PSNR is a metric for comparing the peak error of two pictures. Table 4 and Figure 12 compare the PSNR of several models. PSNR has an infinite value for perfectly identical pictures and a zero value for fully dissimilar ones. Pictures encrypted with the technique proposed in this article are found to have a lower PSNR than the original images when compared to other investigation schemes, demonstrating that the encrypted versions are significantly different from the originals and the technique has good encryption effectiveness.

Time Complexity

A significant statistic for judging the efficacy of a method is its time complexity, a function that is utilised to qualitatively define how long it takes to carry out the procedure. Low-order terms and the function's first-term coefficient, both represented by O , are left out. In this work, we describe a method for encrypting images when the length and width are both identical, on the assumption that n is represented by these dimensions. Figure 13 and Table 5 present an examination of the models in terms of their temporal complexity.





CONCLUSION

The rapid advancement of technology for processing digital images and the consistently increasing use of electronic recording equipment have made digital image processing very straightforward to use, even for a beginner user. Anyone can alter digital images with the help of current software for processing digital images, making it nearly impossible to visually tell a fake from the original data. In this research, we suggested a new RECM framework. When compared to the related work, our method has two key advantages. To start, all we need is the minimal amount of information under the required concealing capacity for storing marked encrypted photos. Following encryption and information hiding, an image is randomly split in half; one half has the potential to be compacted to a high degree, while the other half has a big capacity for concealment. Steganography methods based on deep learning are used by data concealing technology. These methods include the encoder-decoder system as well as the generative adversarial system. Research into information concealing techniques that utilises deep learning is crucial for ensuring secure data transmission in networks. Information concealment technology has gained fresh momentum thanks to deep learning technology, which has also accelerated its development. When compared to the existing models, the PSNR value of the proposed model is significantly lower.

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Raja

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Table 1. Lossless Compression Performance among models

Model	Hiding Capacity
RDH-MSB	1.3
RECM	0.5

Table 2. Lossless compression performance between Multiple Images

A:B Compression	RECM	RDH-MSB
100:0	3.5	5.2
50:50	7	8
0:100	9	11

Table 3. Data hiding capacity.

A:B Compression	RECM	RDH-MSB
100:0	0.15	0.2
50:50	0.5	0.7
0:100	0.9	1.0

Table 4. PSNR Comparison of different models.

Models	PSNR
ResNet	9
MobileNet	9
GAN	7
CNN	7

Table 5. Analyzing the Time Complexity of Various Models.

Models	Time (ms)
ResNet	2.75
MobileNet	3.25
GAN	2.0
CNN	2.2





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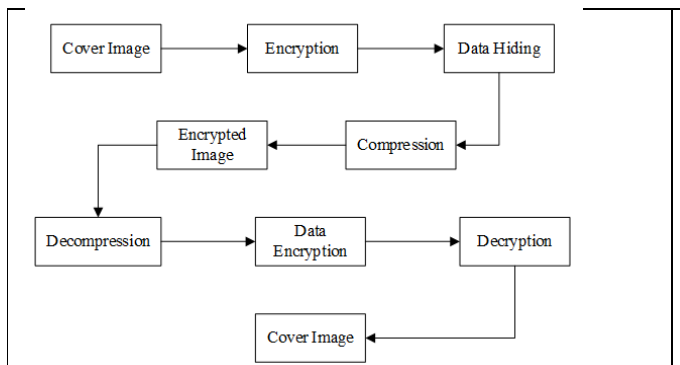


Figure 1. Overview of the suggested approach.

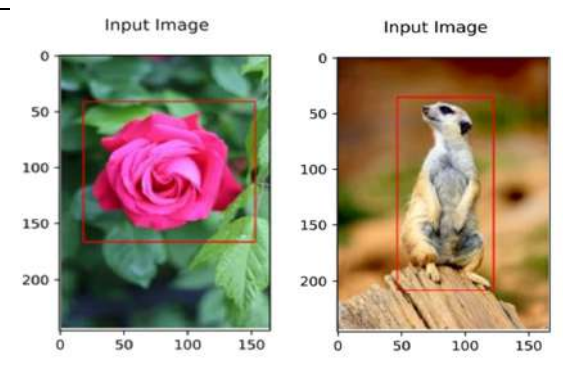


Figure 2. Regions are categorised for both regions. Region α is the regions contained inside the red frames, while Region β is the rest of the world.

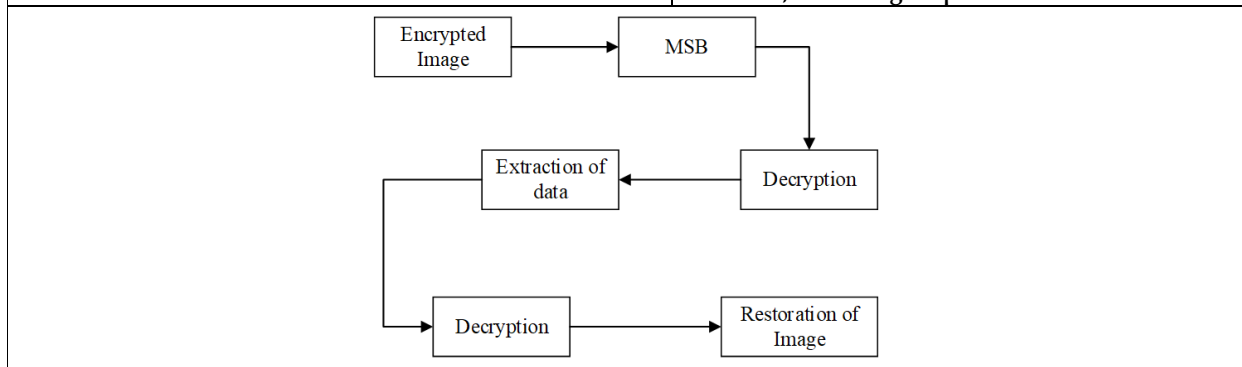


Figure 3. Restoration of the RDH-MSB technique.

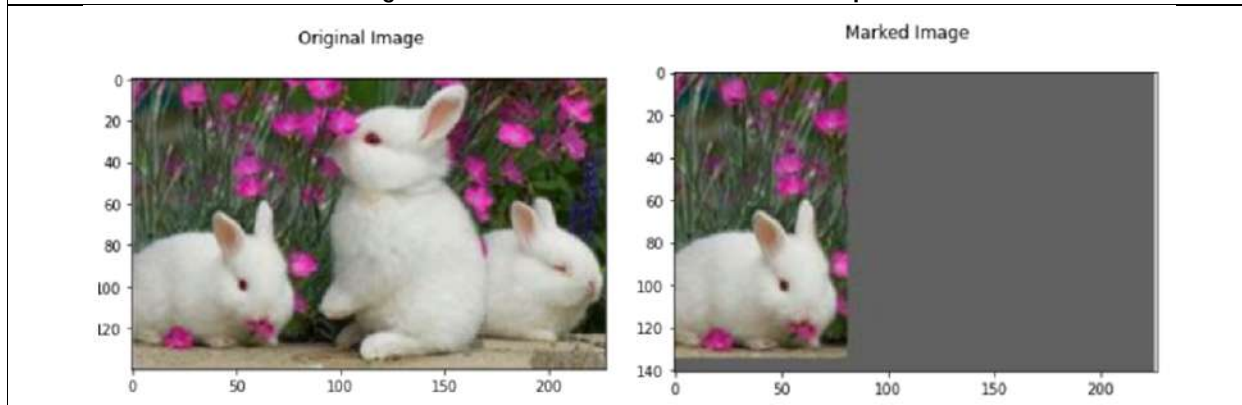


Figure 4. Finished picture using simply decryption. (a) Original photo (b) marked photo.





Raja

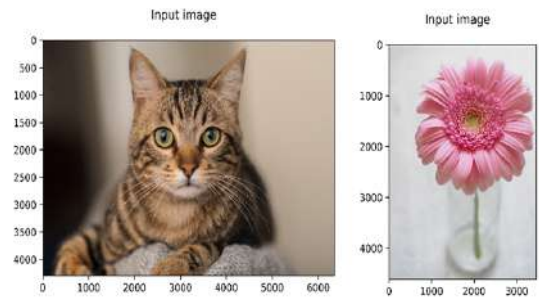
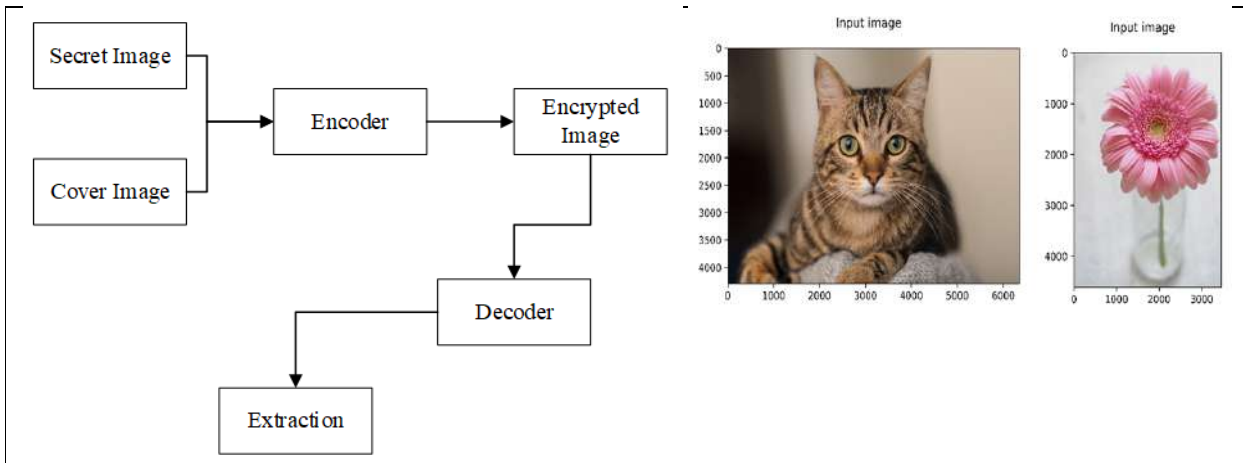


Figure 5. The technique for concealing pictures inside photographs

Figure 6: Examples of Test Images

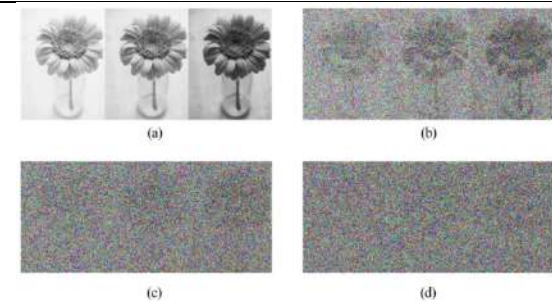
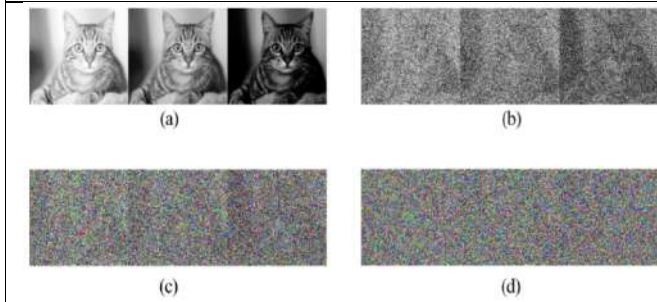


Figure 7. Tagged photos with encryption. (a) Grayscale picture, (b) L-1, (c) L=3, and (d) L=10;

Figure 8. Tagged photos with encryption. (a) Grayscale picture, (b) L-1, (c) L=3, and (d) L=10;

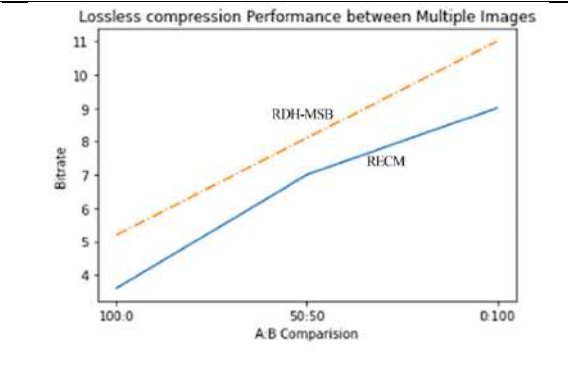
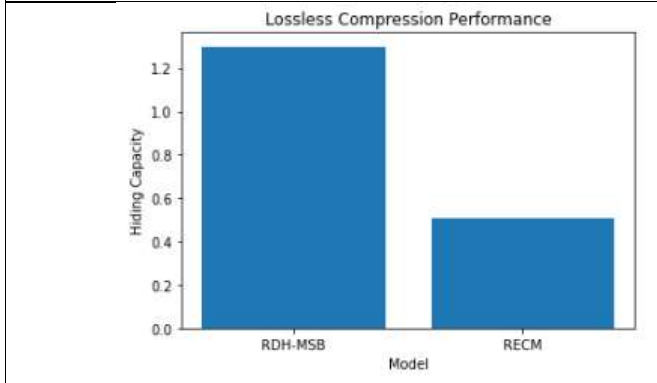


Figure 9: Performance of Lossless Compression in Different Models

Figure 10. Performance Comparison of Multiple Images with Lossless Compression





Raja

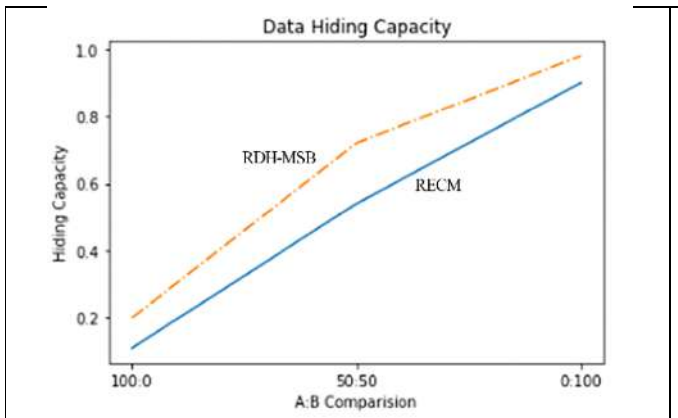


Figure 11. Ability to conceal data.

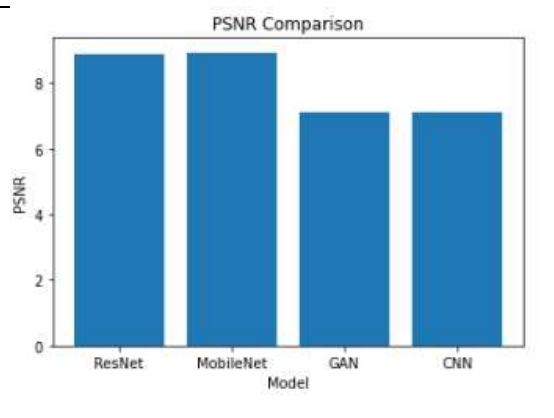


Figure 12. Comparison of several models' PSNR.

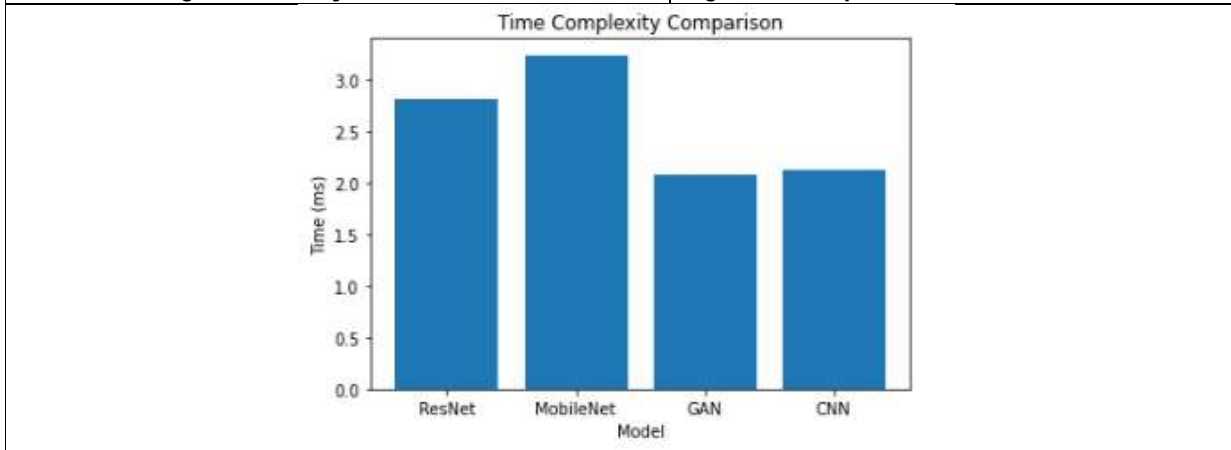


Figure 13. Comparing several models' time complexity.





Breaking Barriers: The Significance of Translation in Portraying Diverse Perspectives and Cultures : A Survey – based Study

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ABSTRACT

Translation and the translator play a crucial role in conveying diverse perspectives and cultures through literary works. This research paper examines the significant role of translation in breaking language barriers and promoting cross-cultural understanding. The paper focuses on the impact of translation in portraying diverse perspectives and cultures, and examines the readers' perspectives through their literary reading experiences. The study has employed a research method that involves a literature review and a survey analysis to interpret the data collected. The paper concludes that translation is a critical tool in promoting cross-cultural communication, and recommends that translators must be knowledgeable about the original work, its context, connotations and target cultures to ensure that translations are effective in conveying the intended message while preserving the cultural identity of the original text.

Keywords: Translations, diverse perspectives, Cultural contexts, breaking barriers.

INTRODUCTION

Translation is the process of transferring meaning from one language to another, and it has been an important tool in promoting cross-cultural communication and understanding. Translation plays a critical role in breaking language barriers and promoting cultural diversity, giving an access to readers about ideas and perspectives from different cultures. The purpose of this research paper is to examine the significance of translation in portraying diverse perspectives and cultures, and to identify the challenges and opportunities that arise in the process of translation. The paper will begin by outlining the objectives of the study, followed by a literature review, research methodology, scope, survey analysis. The paper concludes by summarizing the findings of the study and offering suggestions

58325



**Bhuvaneshwari and Rajeshwari**

drawn from the responses. Translator and Translation plays an important role in breaking down barriers and bonding cross-cultural understanding. It should allow for diverse perspectives and cultures to be expressed, shared and understood across linguistic and geographical boundaries.(Köksal & Yürük, 2020) Through translation, works of literature and other forms of cultural expression can reach wider audiences and have a greater influence and impact. One of the main advantages of translations is the ability to give voice to marginalized communities and underrepresented perspectives. In many cases, these perspectives are excluded or overlooked in the dominant language and cultural context. Translations can help to cut this gap by providing access and expressions to these perspectives and allowing them to be heard and understood by a broader audience.

Translation plays a key role in preserving cultural heritage. It allows for the transmission of knowledge, traditions, and customs from one generation to the next, ensuring that cultural legacies are not lost over time. By making these cultural artifacts accessible to a wider audience, translation helps to promote cultural diversity and preserve the richness of human experience. Moreover, translation fosters intercultural communication and understanding.(Velavan, 2023) By providing access to works of literature, philosophy, and science from different cultures, translation enables people to learn from and appreciate diverse perspectives. This can help to promote empathy, tolerance, and respect for cultural differences, which are essential for building a more peaceful and harmonious world.

LITERATURE REVIEW

Translation has been an important tool in promoting cross-cultural communication and understanding for centuries. (Cross-Cultural Communication and Translation, n.d.)It allows readers to access ideas and perspectives from different cultures, thereby promoting cultural diversity. Translation has been instrumental in the development of postcolonial literature,(Hermans, 1996) allowing works from non-English speaking countries to be read and appreciated by a wider audience. The literature review will examine and explore the challenges and opportunities that arise in the process of translation. The role of translators in breaking language barriers and promoting cultural diversity is immense and crucial.(Benjamin & Rendall, 2021).

Scope

This research paper focuses on the significance of translation and translators role through a survey conducted for a small section of respondents who are regular readers. The paper examines the impact of translation in portraying diverse perspectives and cultures, and identifies the challenges and opportunities that arise in the process of translation. The study is limited to literary works and does not include other forms of translation, such as legal or technical translation.

Objectives

The main objectives of this research paper are to:

1. Examine the readers' opinion regarding the significance of translation in promoting cross-cultural communication and understanding.
2. Explore the respondents' version of translation in portraying diverse perspectives and cultures.
3. Identify the challenges and opportunities that arise in the process of translation based on the readers responses through the survey
4. Analyze the role of translators in breaking language barriers and promoting cultural diversity.





RESEARCH METHODOLOGY

This research paper has adopted a qualitative and descriptive statistics research method based on empirical evidences through a survey analysis. Readers of different ages have helped to gather the information for this paper. A questionnaire designed with the survey's objectives in mind was used to collect the data. A Google form was used to conduct the survey. College students, who are proficient readers and products of the digital era, make up the majority of the responses. Responses from college professors, who have extensive experience reading and interpreting translated literature, were also gathered as part of the study to broaden its reach. Others who were keen readers and had read novels in translation were also given access to the form.

The age category of the respondents' scales from 18 to 64 years. The size of respondents for the study is 88 out of which 68.2% (60) are female and 31.8% (28) are male. Out of 88 respondents, the majority of the respondents are college students with 48.9%, (43), whereas 36.4% (32) of the respondents are teachers or scholars. 14.8% (13) are categorized under others.

Data Interpretation and Analysis

Qtn No. 1: Readers' acquaintance with the translated texts

The first question is an inquiry on the readers' familiarity with the translated texts was posed. Of the total respondents, 14.8% are regular readers, compared to 67% who read occasionally. Even if the percentage of frequent readers is lower and the number of occasional readers is higher, their responses are still helpful for the survey. It's interesting to see that 18.2% of surveyed people have never read any translated literature.

Qtn No. 2: Potential to introduce to new perspectives/cultures

The question that translations have a better potential to spark interest in new, unexplored cultures and ideas was highly supported by 51% of the respondents. 39.8% of them have expressed some degree of agreement. 6.8% of the respondents are indifferent, while 1.1% of them expressed severe and mild disagreement, respectively.

Qtn No. 3: Readers motivation to read translations

To better understand what inspires readers to read translated literature, we can see that 52.3% of them have really stated a desire to know about various cultures and their perspectives. 18.2% of them claimed that readers are drawn to writers' works by the author's fame. According to 29.5% of them, the theme/subject matter is what draws their attention.

Qtn No. 4: Accuracy of the theme and context translations

Many readers of the translations are bilingual or multilingual, making eligible judges to assess whether the content has been successfully represented in the translated language or not. 42.3% of respondents think that the translated works sometimes don't do justice. 15.9% of them have stated that the theme translations are completely unacceptable. 40.9% of them concur that the translations do a good job of capturing the original culture and its viewpoints.

Qtn No. 5: Voice and Power to the underrepresented cultures

In order to evaluate this factor, the survey asked whether translations have the power to give voice to the underrepresented cultures. A majority of 42% of respondents said they were confident that it empowers their voices. History is a great example of how the dominance of a certain race has always discriminated against, exploited, and subdued the voice of the marginalized section of society. 38.6% of them have said that they would agree with that to some extent. 17% of those surveyed are unsure of such fact. 2.3% of them believe that it doesn't provide them any ability to make their voices louder.



**Bhuvaneshwari and Rajeshwari****Qtn No. 6: Role of Translations**

To ascertain if readers believe that translations of literary works play a big significant role or not, 76.1% of them have demonstrated their confidence that it will foster cross-cultural dialogues and understanding. In the context of the cultural exchange, 23.9% of them disagree with the minor relevance.

Qtn No. 7: Inspires to read more about the new culture

The literary works open up a world of fascinating journeys to other cultures and perspectives. 31.8% of the respondents believed that translations have inspired readers to get familiar with and read a variety of other related similar works in order to comprehend that culture. 50% of them have stated that it occasionally performs that role, whereas 18.2% of people have thoroughly refuted the notion.

Qtn No. 8: Translator -linguistic and cultural context of the original

The translator must have a solid understanding of both the original text and the target language in order to provide justice to the translation in the true spirit. 71.6% of respondents, or the majority, said that the translator should have in-depth understanding of the society and its beliefs. 23.9% of them have said that it is not very significant, 2.3% have said that it is not significant at all, and 2.3% have said that it is not very important.

Qtn No. 9: Translations role as breaking barriers among cultures

According to 64% of those surveyed, translated works serve as bridges to reduce cultural divides and foster better understanding between differing communities. 5.8% of them have refuted this idea, whereas 30.2% of them have demonstrated some degree of agreement with the reality.

FINDINGS

The following is a brief summary of the findings reached at after analyzing the respondents' expectations from translated works.

- Every literary effort contributes significantly to shedding light on the dark, as the proverb "Pen is mightier than sword" states. The majority of the time, it dispels myths with facts. There are numerous Indian cultural traditions that are mistakenly thought of as blind beliefs, yet we lack the knowledge and solid scientific justifications or purposes for them. By translation to the rest of the world, these studies can enable true study and knowledge of our culture.
- Instead of merely translating the book word for word, a translator should be skilled in rendering the text in an understandable manner. To provide readers the best reading experience possible, translations should be simple to grasp. It is important to remember that a translated version should never lose the ability to convey the essence of the original literature with its authentic feelings. (Cross-Cultural Communication and Translation, n.d.)
- In order to preserve the integrity of the original text, the translator should not add any of their own observations or viewpoints to the circumstances of any book they are translating. Yet, due to the variety of languages, even simple translations can be challenging. It would be better if the translator includes a guidance note on how to better grasp the translated version rather than making modifications to the original text of the book.
- The literal translation and the author's opinion as a result of his or her research into a particular culture should be the two main components. The translation should have the potential to enthrall the reader with the plot/concept without modifying the context or even the syntax.
- A greater grasp of all literature, history, and the way many things functioned in the culture at that time is understood after the reading of the translations. (Broderick, 2022)
- Proverbs and regional sayings/expressions of the primary text should be explained correctly.
- Each translated work should communicate the spirit of the original text rather than a precise word-for-word translation. For this, the translator has to be well-versed in the subject matter and conduct extensive background study on the author's culture and upbringing. (Bedecker & Feinauer, 2009)





Bhuvaneshwari and Rajeshwari

Suggestions

The following are the few suggestions drawn through the survey respondents.

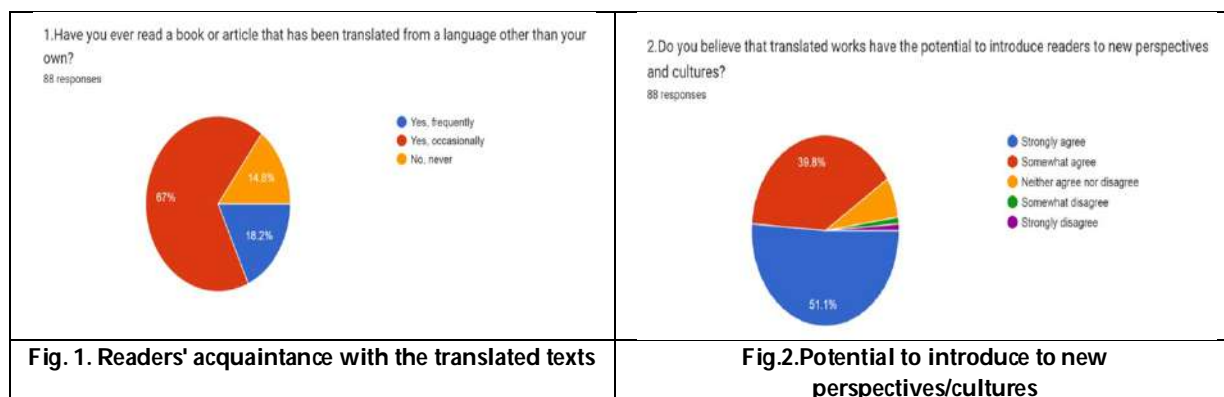
- It's interesting to see that 18.2% of the respondents have never read any translated literature, which helps us realise that more awareness has to be raised in this area.
- Award-winning books are to be translated into every language so that the greatest number of people may read them.
- Reading translated masterpieces in our own language strikes our hearts and is a wonderful experience. The Vedas and Epics are accessible to everyone because of skilled translators. Any literary translation when read in one's own regional tongue, it has a strong emotional impact.

CONCLUSION

In order to promote cross-cultural understanding and communication, translation is an essential tool for overcoming language barriers. The research has proven that translation is crucial in giving voices to the underrepresented cultures and perspectives. To guarantee that translations effectively express the desired native, authentic meaning, while maintaining the cultural uniqueness of the original text, it is important for translators to have a thorough understanding of both the original and target cultures.

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Bhuvaneshwari and Rajeshwari

<p>3. What motivates you to read translated works? 88 responses</p> <ul style="list-style-type: none"> I am interested in learning about other cultures and perspectives I enjoy reading books from famous writers I am interested in the subject matter of the book. 	<p>4. Have you ever read a translated work that you felt did not accurately convey the cultural context or message of the original text? 88 responses</p> <ul style="list-style-type: none"> Yes, frequently Yes, occasionally No, never
<p>Fig. 3. Readers motivation to read translations</p>	<p>Fig. 4. Accuracy of the theme and context translations</p>
<p>5. Do you think that translated works have the power to amplify underrepresented voices and cultures? 88 responses</p> <ul style="list-style-type: none"> Yes, definitely Yes, somewhat Not sure No, definitely not 	<p>6. In your opinion, what role does translation play in promoting cultural exchange and understanding? 88 responses</p> <ul style="list-style-type: none"> it plays a crucial role it plays a minor role
<p>Fig. 5. Voice and Power to the underrepresented cultures</p>	<p>Fig. 6. Role of Translations</p>
<p>7. Have you ever read a translated work that made you want to learn more about the culture or language it originated from? 88 responses</p> <ul style="list-style-type: none"> Yes, frequently Yes, occasionally No, never 	<p>8. How important do you think it is for translators to have a deep understanding of the cultural and linguistic context of the original text they are translating? 88 responses</p> <ul style="list-style-type: none"> Very important Somewhat important Not very important Not at all important
<p>Fig. 7. Inspires to read more about the new culture</p>	<p>Fig. 8. Translator -linguistic and cultural context of the original</p>
<p>9. Do you think that translated works can help to break down cultural barriers and promote empathy and understanding between different communities? 88 responses</p> <ul style="list-style-type: none"> Yes, definitely Yes, to little extent No, definitely not 	
<p>Fig. 9. Translations role as breaking barriers among cultures</p>	





A Study on Legal Regulation of Cryptocurrency between India and G-20 Countries: A Comparative Analysis

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ABSTRACT

The usage of cryptocurrency has been extensive in India and it requires legislative framework to regulate them. Cryptocurrency are widely accepted means of payment investment and generation of income which need to be regulated in terms of taxation. This article considers the experience of legal regulations of cryptocurrencies in various G20 countries. This paper identifies the various tax structure in G20 countries. Government of India has cautioned the Indian investors related to risk associated with cryptocurrency usage but still investors are investing in crypto and experiencing various issues. Therefore, the Government of India has to create appropriate legal framework for solving the issues related to cryptocurrency. For creating a robust and comprehensive regulatory framework, it is required to learn lessons from experiences of cryptocurrency regulations from different countries. This paper uses secondary data sources and relies on comparative methodology to study the various regulatory aspects. This paper highlights the regulatory approaches related to cryptocurrency among G20 countries. The paper concludes by highlighting the need for comprehensive regulatory framework for adopting cryptocurrency.

Keywords: Cryptocurrencies, G20 countries, Legality, Regulations

INTRODUCTION

Indian government as well as Reserve Bank of India do not recognize crypto currency as legal. However, with emergence of online trading platforms like CoinDCX, WazirX, Coinswitch Kuber, Unocoin etc for trading in crypto

58331



**Divya and Shobha**

currency, in 2022, Indian govt has recognised Crypto currency as a digital asset and has proposed a tax levy of 30% on gains of such assets. Further it is also proposed to collect a 1% TDS on transfer of such assets. Loss from handover of these digital assets cannot be set off against any other income. The story of cryptocurrency is similar to India in many other countries and the legislative structures, taxation proposals are evolving with increasing acceptance and popularity among the citizens. With India taking the Chair for G20 presidency in 2022, countries in G20 are at various levels of accepting and implementing taxation structures and legislations on cryptocurrency, it is apt to try and understand the legal aspects and include if any in the cryptocurrency laws that India comes up with to avoid possible loop holes as well as to have a standardised, at par with international laws on cryptocurrency.

Legal Status of cryptocurrency in India

The Government of India planned various initiatives to make digitalized India one among them is Pradana Mantri Jan Dhan Yojana which made Fintech procedure systematic and simple. In India for Cashless transaction Bharat Bill Payment system was introduced. However, regulating legal framework for virtual currency like cryptocurrency remain same. (Singh, 2018) In India since 2012 crypto currency like Zepay, CoinDCX or Unocoin were operating in large and was generating large volume of revenue in Indian market until RBI prohibits its purchase and sales in April 2018 and declares in annual budget that cryptocurrency is not a legal tender. (Banwari, 2017) While the government of India is impressed by the innovation in blockchain technology and passed a bill in the parliament to introduce central bank digital currency and prohibit all the private currency. (Cvetkova, 2018) RBI in opinion that virtual currency will be associated with highest risk related Anti Money Laundering and Counter terrorist financing demands firm to carry out KYC Norms and compliance to AML, CFT, FEMA and PMLA regulation. In India Virtual Currency service provider are not regulated by RBI so any crypto service provider is regulated by securities exchange board of India (SEBI). In Union Budget 2022 RBI announced to take pilot study to launch its own CBDC with the selected bank, merchant and customer. The purpose of the study is to test the banking and infrastructure capabilities to trade digital assets. (John Garvey, 2022)

In February 2022 the guidelines to advertise cryptocurrency was released by Advertising Standards Council of India which came into effect from April 1st 2022. As per the new guidelines the terms like currency, depositories, securities and custodians are prohibited while advertising in order to overcome the confusions in the mind of customer related to the regulation associated with the above terms. (Reuters, 2022) In India, Goods and Service tax is applicable on cryptocurrency trading. Central Board of Indirect tax Taxes and Customs proposed to charge 18% GST on every dealing of cryptocurrency in India. (Marina Chudinovskikh, 2019) In opinion of Indian government, the cryptocurrency usage is associated with high risk and people should be caution while using such currency as there is no regulatory framework to protect the interest of the customer. In mere future it can be expect from the government to create awareness among the people regarding crypto risk for which government has set up a separate committee to examine the risk and release a report in the official gadget. (Reuters, 2022)

REVIEW OF LITERATURE

(Mohsin, 2022) The author in this paper have studied about the cryptocurrency legal and regulation status in international scenario. This study has given the idea about current regulation of cryptocurrency and its trading activities related to cryptocurrency. The author also further discuss about how the countries are handling crypto assets and the regulatory trends of cryptocurrency. (Marina Chudinovskikh, 2019) The author in this paper conducted comparative studies related to regulatory framework of BRICS And Eurasian Economic Union. The study identified the three approaches to regulation of crypto based on the analysis like Conservative, Neutral and liberal based on which comparative analysis was made. As a result the study concluded that there is a requirement of regulatory framework of cryptocurrency in BRICS and Eurasian economic Union to avoid the migration of capital and investment in other countries.



**Divya and Shobha**

(Cvetkova, 2018) The author in this paper discusses the cryptocurrency legal regulation in various countries. The author at the first discuss about the legal status of cryptocurrency as a financial instrument, money, money surrogate, commodity, property, security. Further author have discuss about legal regulation of virtual currencies in European and non-European countries. the author further conclude that along with cash and e money it is necessary to conduct studies on crypto legislation and its function. (Moorthy, 2018) The author studies about the rising effect of cryptocurrency in Malaysia in the legal system. The purpose of the study is understand the central bank role in regulation of cryptocurrency in the country, Further author also tries to explain the regulatory changes that are adopted by the eleven nations. The author conclude the paper with suggestive changes in regulation related to cryptocurrency regulation in Malaysia. (Mykola Inshyn L. M., 2018) The author in this paper made a comparative study related to cryptocurrency regulation in different countries. The author at first discuss about the issue of cryptocurrency that Ukraine facing related to legal regulation. Later comparative analysis have been done related crypto regulation in various countries to lesson learn from their experience in crypto legal regulation. The conclusion in the study act as proposal for development of regulatory framework in the Ukraine countries and also help for further studies.

Research Objective

1. To ascertain the legal status of cryptocurrency in various G20 economies.
2. To identify the taxation treatment of cryptocurrencies in 20 countries.
3. To highlight the regulatory compliance for cryptocurrencies among G20 countries and learn lesson for better regulatory framework in other countries.

RESEARCH METHODOLOGY

This study is based on facts and data which have been collected from secondary sources like Journals, Website, Google Scholar, Research gate and Research articles.

DISCUSSION**Overview of cryptocurrency regulation across the G20 countries:**

Any issues related to cryptocurrency can solved through legislative framework, it is important for the India to know the regulation experience of the different countries.

G1: Argentina

Legal Status: Virtual currency transactions or Bitcoin transaction in Argentina is legal, since it is not issued by central bank and does not have any regulatory bodies it is not consider as legal tender. (Reuters, 2022)

Cryptocurrency Exchange

Cryptocurrency exchange in Argentina is Legal and regulated by the Argentina securities and exchange commission. As per the in the plan every crypto transaction made to be reported to a Financial Information Unit in complains to Anti money laundering. (Cifuentes, 2019)

Taxation Policy All digital transactions taxable in Argentina whereas any income from crypto transactions is taxable at a rate between 4% to 6.5%. Argentina taxation authority is responsible for tax regulation in Argentina. (Reuters, 2022)

Future Regulation The government of Argentina as already issued regulation for taxation and Anti money laundering and now have proposed legislation to make crypto usage as legal and regulatory guidelines for crypto payments, investments and transactions. (John Garvey, 2022)

G2: Australia

Legal Status Cryptocurrency is treated as property and declared as legal in 2017 by Australian Government and are subject to Anti money laundering regulation. (Benson, 2020)



**Divya and Shobha**

Cryptocurrency Exchange Crypto exchange is legal in Australia and subject to registration with the Australian government Agency (AUSTRAC) who are the regulatory bodies for money laundering and terrorist financing. The companies register under AUSTRAC are subject to maintain records and report (Reuters, 2022). The CEO of AUSTRAC charge the companies who fails to fulfil the obligation to register and maintain records about cryptocurrency exchange. (Mohsin, 2022)

Taxation Policy Australian Taxation Authority is responsible for tax regulation and Cryptocurrency are subject to taxation under the head the capital gain which range from 19% to 45%. (Reuters, 2022)

Future Regulation The Serious flaws are identified in the Australian financial industry which may have impact on AUSTRAC Approach towards cryptocurrency regulation and to be addressed by the Australian government. (John Garvey, 2022)

G3: Brazil

Legal Status Cryptocurrency is not a legal tender in Brazil. However, the Brazilian government have created various regulatory sandbox and proposed rules to regulate crypto market. The existing Anti money laundering law is applicable for crypto market. (Benson, 2020)

Cryptocurrency exchange It is legal to have crypto exchange in Brazil. The Brazilian Securities and Exchange Commission have approved crypto electronic fund transfer and involved in regulation of crypto exchange. (Marina Chudinovskikh, 2019)

Taxation Policy The federal revenue authorities are responsible for tax regulation in Brazil and cryptocurrency is considered as assets, taxable under the head capital gain. (Reuters, 2022)

Future Regulation The Brazil Ministry of finance and Brazilian Securities commission to adapt new regulation to manage cryptocurrency market. The central bank of Brazilian however has announced to launch their own cryptocurrency i.e., central bank digital currency in 2023. (Marina Chudinovskikh, 2019)

G4: Canada

Legal Status: The notes and coins that are issued by the Canadian banks are considered as legal tender not any other digital currency including bitcoin. (Benson, 2020)

Cryptocurrency exchange: The cryptocurrency exchange in Canada is legal. As per the PCMLTFA 2020 amendment all the cryptocurrency exchanges need to register with FinTRAC (Financial Transactions and reports analysis centre) of Canada. (Reuters, 2022) In 2022 the Canada government has approved 40 crypto exchange traded funds. (Cvetkova, 2018)

Taxation Policy: Cryptocurrency is considered as Commodity by the Canadian government and taxed by the Canada Revenue Authority. (Reuters, 2022)

Future regulation: In August 2022 CSA provided guidelines to regulate crypto assets trading platform but fails to register the guidelines with the principal register. (Mohsin, 2022) In order to continue its operation in protecting investor interest the CSA has to register the guideline with the principal register. (John Garvey, 2022)

G5: China

Legal Status: The government of China banned usage of cryptocurrency in 2013. however in 2019 the government reconfirmed that crypto mining is legal in China. Again in 2021 all the crypto activities in China are banned. (Moorthy, 2018)

Cryptocurrency exchange: In China the cryptocurrency banned extended to Cryptocurrency exchange. It is considered as illegal activity to exchange crypto in China. (Cvetkova, 2018) The government also announced to ban the companies that involve in cryptocurrency exchange and instruct the bank not to provide any service related to crypto market. (Mohsin, 2022)

Taxation Policy: According to the report, the individual crypto investors and Bitcoin miners are charged with the personal income tax at the rate of 20%. (Marina Chudinovskikh, 2019)

Future Regulation: There is no indication in mere future China government to loosen the cryptocurrency ban in the country. The China government also banned the financial institution and payment companies involved in cryptocurrency transaction even after the clear instruction. (John Garvey, 2022)



**Divya and Shobha****G6: France**

Legal Status: The cryptocurrency is considered as legal in France and are regulated by financial market authority. On December 9th 2020 issued № 2020-1544 to provide rules and guidelines to regulate crypto market. (John Garvey, 2022)

Cryptocurrency exchange: It is legal to exchange cryptocurrency in France and it is mandatory to register the companies involved in crypto business along with obtaining licensing and strict KYC in May 2022. The French companies are regulated within the legal frame work of Anti money laundering. (Reuters, 2022)

Taxation Policy: Cryptocurrency are considered as movable property and taxable at the of 30% for miners and 45% for professional traders. (Kuzhelko, 2022)

Future regulation: A member of French Senate commission Herve Maurey proposed to remove amendment related allowing cryptocurrency exchange operation without any full license. (John Garvey, 2022)

G7: Germany

Legal Status: The cryptocurrency trading is considered as legal only when financial institution obtains licence and Custody service from the government. However, it's not issued by government or bank in German so not considered as legal tender. (M., 2021)

Cryptocurrency exchange: In 2013 Ministry of finance announced that exchange of crypto currency is official with special permission or licences. The firm involved in crypto exchange must obtain licences from BaFin. Germany does not have separate regulatory framework for digital currency however the general laws are applied. (Reuters, 2022)

Taxation Policy: In Germany Cryptocurrencies are considered as private money for tax purposes. The German federal central tax officers are responsible for tax collection. If Gain from cryptocurrency held less than a year and less than 600 Euros is tax free. If it's held more than a year exemption from tax. Neither of the condition is satisfied than taxable at ordinary rate of tax. (Kuzhelko, 2022)

Future Regulation: There is an expectation of implementation of various legislation in Germany related to MiCA and AML regulation in Mere future. And also, in future German crypto assets provider can expect changes in German crypto value transfer ordinance, European Union second payment service directive and E- money directive. (John Garvey, 2022)

G9: Indonesia

Legal Status: In Indonesia Bitcoin and other cryptocurrency are approved and to be traded as commodities by Bappebti (Badan Pengawas Perdagangan Berjangka Komoditi) in 2019. However, it is not a legal tender as cryptocurrency is not issued either by bank or government. (Cvetkova, 2018)

Cryptocurrency Exchange: As per the Regulation Number 18/40/PBI/2016 bank of Indonesia banned to use cryptocurrency as a means of payment, however it is allowed to use as crypto assets in Indonesia under the supervision of Commodity Future Trading Supervisory Agency and BAPPEBIT. (SusiIowardhani, 2022)

Taxation Policy: In Indonesia there is no specific tax structure that applicable for any transaction that take place through cryptocurrency. (Cvetkova, 2018)

Future Regulation: The ministry of Indonesia is providing the separate market for digital assets called Digital future exchange. Bank of Indonesia in the view of protecting its economy and society have planned to ban the cryptocurrency usage for next 10 years. (Reuters, 2022)

G10: Italy

Legal Status: Cryptocurrency is not a legal tender in Italy as it is not issued by a central bank which used as medium of exchange of goods and services. In Italy cryptocurrency is regulated as per the legislative Act no 90. (Reuters, 2022)

Cryptocurrency exchange: In Italy it is legal to use crypto as a medium of exchange with the registration and reporting requirement with EU AMLD5. In February 2022 Italy government announced new rules for Anti- money laundering. Also, Financial action task force provided guidelines for crypto firm. As per the guidelines all the crypto firm should involve in registration process. In 2022 June bank of Italy also provided guidelines to regulate the digital assets. (Reuters, 2022)



**Divya and Shobha**

Taxation: In case crypto assets value exceed 100 million old lira and holds for more than seven working days, chargeable at 26% tax on such values. (Kuzhelko, 2022)

Future regulation: Italy government is expected to implement MiCA and announce new Anti- money laundering rules and counter terrorist financing. (John Garvey, 2022)

G11: Japan

Legal status: In 2017 Japanese government legalised the use of Bitcoin and declared it as legal tender. Also, Japan is the first country to set up regulatory authorities called Japanese Virtual currency Exchange Association Na Japan STO Association in April 2020. (Benson, 2020)

Cryptocurrency exchange: Japan government legalised the cryptocurrency exchange. The firm involved in crypto exchange should register with financial service agency and compile to Anti- money laundering and counter terrorist financing law. (Moorthy, 2018) In Japan virtual currency are regulated by several act like Payment Service Act and Financial Instrument and Exchange Act. As per the 2016 and 2019 amendment firm should register with the financial service agency. (Cvetkova, 2018)

Taxation Policy: Japan National tax agency in December 2017 declared cryptocurrency as miscellaneous income and tax at the high rate of 55%. (M., 2021) In case of corporate income from cryptocurrency is chargeable under corporate tax and any sale of cryptographic goods chargeable with VAT in Japan. (Reuters, 2022)

Future regulation: Japan continues to be the friendly nature with crypto market and expected to bring new legislative related to Anti money laundering, Counter terrorist financing and travel rule in mere future 2023. (John Garvey, 2022)

G12: Mexico

Legal status: In June 2021 Mexico government declared crypto assets are not a legal tender. The Bank of Mexico have permitted certain cryptocurrency to use in the country which are operated by licensed Fintech companies. (Benson, 2020)

Cryptocurrency exchange: Mexico government prohibits the crypto exchange in the country. In March 2018 Mexico federal AML law declared that any activities related to virtual currency is vulnerable under Financial Activities Task Force (Cvetkova, 2018). Also, in the same month government and Commission Nacional Banc aria y de Valore's (CNBV) provided certain guidelines to regulate virtual currency. (Reuters, 2022)

Taxation Policy: There is no specific tax regime related to income earned from cryptocurrency sale, purchase or any other activities by individual or companies in Mexico. (Reuters, 2022)

Future regulation: In mere future can be expected to have separate tax structure for cryptocurrency in Mexico. Also, can expect new virtual currency launch within three years i.e., 2025 called Banxico digital currency for payment purpose. (Cvetkova, 2018)

G13: Russia

Legal Status: In Russia virtual currency is not a legal tender. Article No 27 of federal law clearly mention only Rouble is the currency of Russia. (Moorthy, 2018)

Cryptocurrency exchange: In 2020 cryptocurrency was considered as means of payment and investment not for exchange of goods and services which was announced by Russian President. (O S Bolotaeva, 2019)The Central bank of Russia become the regulators for digital assets in Russia who oppose the use of cryptocurrency however the Ministry of Finance passed the bill in February 2022 to regulate the organize the digital currencies in Russia. (Shovkhalov, 2021)

Taxation Policy: In Russia any gains from cryptocurrency are subject to personal income tax which was announced in November 2018 by Ministry of Russian Finance. (Benson, 2020)

Future Regulation: The Russian Authorities, Regulators and officers are working towards regulatory framework related to cryptocurrency also serval drafts related to law were proposed to the state Duma. With this draft law Russia can expect relaxation in Anti Money laundering and counter terrorist financing rules and regulation in mere future. (Benson, 2020) The central bank of Russia was about to conduct the pilot program to develop own digital currency called Ruble. (Reuters, 2022)



**Divya and Shobha****G14: Saudi Arabia**

Legal Status: The government of Saudi Arabia does not consider the cryptocurrency as a legal tender. The central bank of Saudi Arabia and Ministry of finance are opinion that cryptocurrency may involve in fraudulent activities since cannot be considered as legal tender. (Reuters, 2022)

Cryptocurrency exchange in Saudi Arabia: The Government of Saudi Arabia declares that cryptocurrency exchange or trading is illegal and does not provide any provision related to customer protection towards cryptocurrency investment. (Reuters, 2022)

Taxation Policy: In Saudi Arabia there is no tax structure for cryptocurrency yet. People of Saudi Arabia can trade the cryptocurrency at free. (Reuters, 2022)

Future regulation: The government of Saudi Arabia can expect to collaborate with United Arab Emirates to attract crypto companies to the region and also can expect the central bank to use blockchain technology in banking sector. The Government of Saudi Arabia and central bank are working towards regulation to usage of blockchain technology in the country and also created regulatory sandbox for blockchain technology and new digital currency. (John Garvey, 2022)

G15: South Africa

Legal Status: In South Africa the use of cryptocurrency is not a legal tender. There is no separate legislative found for the regulation of cryptocurrency. (Benson, 2020)

Cryptocurrency exchange regulation:

It is legal to use cryptocurrency has a means of exchange and payment in South Africa. In 2016 the intergovernmental FinTech working group and in 2019 crypto assets regulatory working group were set up by the government to plan regulatory framework. (Reuters, 2022) In August 2022 the guideline to control crypto assets were given by the Prudential Authorities to the bank of South Africa. In October 2022 the financial conduct authorities have declared that the crypto service provider should obtain licence from the government. Also, companies involved in crypto exchange are subject to governing under Anti money laundering and Counter terrorist financing Act which was announced in November 2022. (John Garvey, 2022)

Taxation Policy: On April 6th 2018 in the official website announced by the tax authorities that any income from cryptocurrency transaction is taxable which is based on short term or long-term holding. If currency is hold for short term, then taxable at 18% and long term taxable at 40%. (John Garvey, 2022)

Future regulation: The regulatory framework for cryptocurrency can be expected in 2023 and expected the south Africa government to response to the crypto scam in the countries and protect the interest of the investors. Also, the travel rule guidelines can be expected from the government in mere future. (John Garvey, 2022)

G 16: South Korea

Legal status: Currently, in South Korea the cryptocurrency is not a legal tender, However the bank of South Korea has showed the interest to launch their own cryptocurrency. There is no separate law governed the cryptocurrency but compile to South Korea other legislative. (Moorthy, 2018)

Cryptocurrency exchange regulation:

It is Legal in South Korea to use cryptocurrency as a means of exchange and payment but the firm or crypto service provider has to register and compile Anti money laundering law as per the Financial Transaction Reports Act. (Benson, 2020) In 2018 financial service commission announced that banks should report the crypto exchange held in their bank and also made a strict rule that crypto trading is held only with real name banks account. Also, in 2021 South Korea government announced that firm should obtain the licence from Financial Service Commission. (Reuters, 2022)

Taxation Policy: In 2022 tax authorities have announced any profits from cryptocurrency is taxable at the rate of 20% if it exceeds 2.5 million or \$2200. Also announced that this tax is applicable to the foreign crypto exchange and business. (Reuters, 2022)

Future regulation: It can be expected the restructure of tax policies in South Korea related to cryptocurrencies and continue to work with FAFT to bring changes in ANTI Money Laundering policies. (Mohsin, 2022)



**Divya and Shobha****G 17: Turkey**

Legal Status: In Turkey cryptocurrency is not a legal tender as it is not introduced by Turkey government or bank. In April 2021 Turkey government announced that users are not allowed to use crypto assets for payment directly or indirectly. (Reuters, 2022)

Cryptocurrency exchange: In Turkey the law was passed no 5549, According to which the users can make crypto exchange through bank and report the doubtful transaction to the Turkey financial crimes investigation board. The Financial Crimes Investigation Board (TFCIB) governs the Anti- money laundering and the Capital Market Board crypto market in Turkey. (Reuters, 2022)

Taxation Policy: There is no tax scheme for the individual income from crypto exchange however business that hold crypto currency transactions are subject to corporate tax of 20% (Reuters, 2022)

Future Regulation: The government of Turkey have set up a special group to investigate the future development in regulation. The president of Turkey announced that bill will be passed in future related to crypto assets. IFCIB may guide the crypto service provider with guidelines to regulate the crypto services to the Turkey. (John Garvey, 2022)

G18: United Kingdom

Legal Status: United Kingdom is one of the favourable place and jurisdiction for the cryptocurrency business but still there is no separate legislative for cryptocurrency and not a legal tender. Financial Conduct Authority has banned the crypto trading activities (Benson, 2020)

Crypto exchange regulation: Crypto exchange in UK is legal only when the firm, resident or client register with Financial Conduct Authority (FCA) since January 10 2021. In UK Financial Conduct Authority, HM treasury and Bank of England are the regulators of Cryptocurrency. (Moorthy, 2018) In January 2019 FCA provided guidelines to the institution and consumer to protect the interest of their investment. The regulation covers the types of crypto assets covered, KYC norms, Anti money laundering and Counter terrorist financing. (M., 2021) In January 2020 the fifth EU money laundering derivative was announced to regulate money laundering and terrorist financing. (Mohsin, 2022)

Taxation Policy: The UK government has provided tax treatment which varies according to the usage of cryptocurrency. Personal investment is liable to pay capital gain tax and Individuals are subject to income tax. (Reuters, 2022)

Future Regulation: In 2023 it is expected to HMT to extend protection against investor investment, integrity of market and promotion of crypto trading. Final Financial conduct activity rules towards crypto assets can be expected in 2023 along with final rules by financial market service board to regulate payment in stable coin. (John Garvey, 2022)

G: 19 United states

Legal Status: In US it is difficult to decide the legal status of crypto as US has dual banking system means virtual currency are regulated either at state level or Federal level. However, neither Financial Crime Enforcement Network nor Internal Revenue Service consider virtual currencies as a legal tender but defines cryptocurrency in their own way. (Benson, 2020)

Cryptocurrency exchange regulation

In US it is legal to exchange cryptocurrency and are subject to regulation under different authorities in the Countries. The regulation and regulators of crypto is depend on Classification of crypto. (Moorthy, 2018) If crypto is considered as payment instrument are subject to the regulation under Money Business Service, if considered as commodity instrument are provision to Commodity Exchange Act and if considered as Security instrument are regulated under Security exchange Act 1993. (Reuters, 2022) Any business that includes crypto payment must register with the money business provider same way any company involve with crypto exchange should register with Securities and exchange commission. Federal Government in addition enlisted the other authorities to regulate virtual currency in US like Federal Trade Commission, Commodity Future Trading Commission, Security Exchange Commission, Financial Crime Enforcement Network, Office of Foreign Asset Control, US treasury Department, Federal Banking and Internal Revenue Service department. (Cvetkova, 2018)





Divya and Shobha

Taxation Policy: In US, Internal Revenue Service department are tax authorities. The Authorities demands the crypto investors to disclose the cryptocurrency related activities in the tax return. (Mykola Inshyn L. M., 2018)

Future Regulation: In 2023 US investors can expect guidelines related to liquidity risk and finder activities from Federal Reserve bank (Fed), Office of comptroller of the Currency (OCC) and Federal deposit Insurance Commission FDIC. Also, Stable coin legislation can be expected in mere future. (John Garvey, 2022)

G20: European Union

Legal Status: Cryptocurrency is legal and but the member countries are restricted to launch their own cryptocurrency. The regulation of cryptocurrency is subject to the individual member countries. (Benson, 2020)

Cryptocurrency exchange: It is legal in European Union to use crypto as a medium of exchange and it is classified as Qualified financial instrument. The firm in order to provide crypto services are entitled to obtain QFI license and subject to their regional level regulation. (M., 2021) Regulation may vary to the state level but subject to compliance with European banking system, European commission, European Supervisory authorities for securities, European central bank and European Insurance and pension. (Mohsin, 2022) The firm that deals with cryptocurrency deals with Anti- Money laundering and controller terrorist finance. In January 2020 5MLD and in December 2020 6MLD came into force which are subject to regulate Anti-Money Laundering and Counter Terrorist financing. (Benson, 2020)

Taxation policy: Taxation also varies with the states but certain member state considered the crypto income as capital gain and levied tax that range from 0 – 50%. (Benson, 2020)

Cryptocurrency future regulation: It is expected to have a single anti money laundering and counter terrorist financing which is obligation for the member countries to follow the rules. The European commission have proposed new regulation called Market in Crypto asset regulation. The proposal includes rules for introducing license system, industry conduct rule and consumer protection. (Mohsin, 2022)

RESULTS

Findings of Various attributes of cryptocurrencies across G20 Countries

SL.NO	Country Name	Legal Tender Status	Crypto trading status	Separate law crypto	Taxation	Regulatory approach
1	Argentina	No	Legal	No	Taxable @rate Between 4% to 6.5%	Liberal
2	Australia	No	Legal	Regulated existing with framework	Treated as capital gain, taxable 19% to 45%	Liberal
3	Brazil	No	Legal	No	Taxable under the head capital gain	Conservative
4	Canada	No	Legal	No	Taxable under commodity	Liberal
5	China	No	Illegal	No	Taxable at 20% for both investors and Bitcoin miners	Conservative
6	France	No	Legal	No 2020 – 1544 draft provided rules and guidelines	Taxable at 30% for miners and 45% for traders	Liberal
7	Germany	No	Legal	No	Exempted upto 600 Euros	Liberal





Divya and Shobha						
8	India	No	Legal	No	Proposed to levied GST @18%	Conservative
9	Indonesia	No	Legal	No	No specific tax structure	Conservative
10	Italy	No	Legal	No	Chargeable @26% which holds income for more than 7 working days	Liberal
11	Japan	No	Legal	Regulated existing framework with	Taxable at 55% and treated as miscellaneous income	Liberal
12	Mexico	No	Legal	No	No separate tax structure	Conservative
13	Russia	No	Legal	Draft has developed been	Subject to personal income tax	Neutral
14	Saudi Arabia	No	Illegal	No	No specific tax structure	Conservative
15	South Africa	No	Legal	No	Tax @18% for short term and for long term 40%	Conservative
16	South Korea	No	Legal	No	20% taxable if income exceed 2.5 million	Liberal
17	Turkey	No	Legal	No	Chargeable corporate tax @20%	Liberal
18	United Kingdom	No	Legal	No	Personal investment liable to pay capital gain tax and individuals to pay income tax	Liberal
19	United State	No	Legal	No	Taxable under the head capital gain	Liberal
20	European Union	No	Legal	Regulation subject to individual member countries	Tax structure varies with different member countries	Liberal

CONCLUSION

Cryptocurrency has been one of the popularly used digital currency in the recent times. The study reflects that there is no set pattern in G20 countries when it comes to taxation rates, legal structure or legislation. Countries like France, Canada, Germany which have a very liberal approach towards cryptocurrency and have legally accepted trading cryptocurrencies, tax the gains from cryptocurrency with tax rates ranging from 18% to 45%. However, countries like Argentina, South Korea, Turkey which also have a liberal approach towards cryptocurrency and have legally accepted trading cryptocurrencies, tax the gains using a maximum rate of 20% while Argentina taxes only at 6.5%. On the contrary countries like Brazil, China, Indonesia, India with a conservative approach towards cryptocurrency



**Divya and Shobha**

and have not legalised trading cryptocurrency still are cautious in allowing a full-fledged trading. However, with increasing popularity and acceptance among the public in the countries for cryptocurrencies, these countries have started taxing the proceeds as capital gains with the maximum possible tax rates in their respective countries. To conclude, the author would like to highlight the need for cautious and multi-pronged approach towards legalising trading as well as acceptance of cryptocurrency as legal tender. There is a lot to learn in terms of legislations, trading systems from each other in this group

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E-Governance, Digitalisation: Challenges Faced, Central and State Level Implementation of Digitalisation, Goals and Objectives – A Study with Reference to Bengaluru

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ABSTRACT

Economies across the globe are using information and communication technologies-based solutions in order to facilitate good governance. Technology based solutions users are facing different challenges at the time of connecting citizens and government. The demand for application of digitalisation emerged from enhanced awareness among citizens about technological revolution. The previous research reveals that there has been more failure than success in terms of getting success (Pradeep Suri et al., 2017). Digital technologies, growth of computer technologies have altered the function of governance and possess strong potentiality to go for further change (Anil Kumar Vaddiraju et al., 2017). The data was congregated using a questionnaire and open-ended questions. Respondents were approached in specified four areas and interview was conducted and necessary data collected. 108 questionnaires were in the hand and 8 were rejected as they were incomplete and thus forms 92.6% of success rate. Chi-square, weighted average, Garrett Ranking Technique, and Kendall's co-efficient of concordance were performed for the purpose data interpretation. The present investigation demonstrated the existence of positive demographic profile of respondents supporting the study. The study highlighted the different challenges faced like privacy and security, huge amount is involved in implementation, and low IT literacy. Further, the study reveals about national and state level digitalisation. These include computerisation of land records, project Bhoomi, and direct cash transfer and the different goals and objectives includes transparency, accountability and decentralisation.

Keywords: Digitalisation, questionnaire, transparency ranking, arranged, reason, central and state, values, governance, benefits, objectives.





INTRODUCTION

The basic function of government is to provide welfare to its citizens. Different governments across the globe started taking steps to offer government services online. This trend is widened application due to revolution taking place in IT sector (Himamshu Sangrola et al., 2017). An essential component of developing economies is educating citizens about the significance of e-government and the benefits it offers, such as enhancing the administrative process competency, increasing transparency, enhancing services, cutting down on corruption, lowering costs, achieving specific policy outcomes, and contributing to revenue growth (Coe et al., 2001). More education and training for community members in the above-mentioned areas is beneficial to the community as a whole (Mohammad et al., 2009). Technology is crucial to the idea of a digital India. The digital India goal of "government and service on demand," "digitally empowered citizens," and "support social inclusive programmes" would be enabled via social media, mobility, analytics, and the cloud. Prime ministers Bhima Yojana, Smart Cities, Jan Dhan Yojana, Aadhar, Mobile (JAM), Direct Benefit Transfer (DBT), and others have attracted a lot of attention. Innumerable e-governance projects in India have been initiated by both central and state governments with huge budget allocations for the "National e-governance plan (NeGP)" to support some specific implementation of projects. The successfulness of e-governance much depends upon more literate, aware and educated society and better use of electronic governance (Anil Kumar Vaddiraju, 2017). India views e-governance as a means to implement administrative changes that will enhance the lives of those it serves. Direct transfer of cash in this direction can be the best example to the support ho e-governance success is achieved without the intervention of middlemen.

Statement of the problem

A scientific approach is required in India because to the complexity of governance, where old patterns must be discarded and new methodologies must be adopted to fulfil the increasing expectations of more rewarded citizens, quickly and transparently. Further, the world is moving quickly towards the use of digitalisation and therefore it is necessary on the part of government to adopt more modern methods of governance. The cyber frauds, fake news etc., can be effectively tackled. Timely approval of projects can be made easy through e-governance. With programmes like "Digital India," "Make in India," and "Skill India," the government has been working hard to promote economic inclusion and social change. This has led to a rise in the use of technology in response to public demand. Among the many benefits of electronic government are the digitalisation of property records, the establishment of a single contact point for all administrative processes inside the government, and the continued provision of basic services such as tax payments and government fees. With the adoption of e-governance the government can quickly solve the problems of citizens. The e-government applications are predicted to grow in scope and also cover more states.

REVIEW OF LITERATURE

Thomas Zwahr et al., (2005) considered the Lausanne Framework is a sophisticated technology that may be used to assess the results of projects relating to e-governance. In addition, the researchers have emphasised that their model as well as the approach that lies below it is not yet finished. Fath Allah et al., (2014) conduct a comprehensive studies of e-government quality models in order to provide suggestions for the creation of a new e-government portal quality model. The purpose of this study is to determine which models are based on a set of 150 standards and which models are not based on those requirements. Sa Rocha and Perez Cota (2016) organise and systematise relevant bibliography on the quality of conventional, electronic, and e-government services in order to construct a model that evaluates the quality of local e-government online services. This is done in order to construct a model that assesses the quality of local e-government online services. In order to perfect the model, this step has to be taken.

Tan, Benbasat, and others (2013) present a comprehensive assessment of the literature on e-service quality in order to describe aspects of IT-mediated service content and service delivery that make up e-government service quality. This



**Vedavathi and Chandan Chavadi**

was done in order to answer the question: Saurabh Chandra (2017) stated that Digital India initiatives for e-government transformation are almost huge and revolutionary. These initiatives as per the researchers not only focus on the e-government transformation by establishing info-structures, for electronic delivery of information and services but also focus on empowering citizens.

Objectives of the study

1. To investigate the socioeconomic characteristics of respondents.
2. To analyse the environmental, social, economic and technical challenges faced in e-governance and digitalisation.
3. To study the national and state level digitalisation.
4. To study governments goals and objectives behind e-governance and digitalisation.

Hypotheses

1. The socio-economic factors are not impacting on e-governance and digitalisation
2. There are no challenges faced in the e-governance and digitalisation.
3. Both the central and state governments have not introduced e-governance and digitalisation.
4. There are no variations in the objective of e-governance.

Research questions

1. What are the causes for the lack of influence of demographic variables on the research?
2. What are the challenges faced in e-governance and digitalisation?
3. What are the central and state level e-governance initiatives?
4. What are the initiatives goals and objectives behind e-governance and digitalisation?

Limitations

1. The study pertains only to Bengaluru Urban.
2. Generalisations about this study requires further in-depth study.
3. The sample is small for the study.
4. Time and financial problems faced.

RESEARCH METHODOLOGY

Research Methodology is a pre-projected for the future. It is a blue print enabling the direction of movement of research process in a methodical manner. Zikhmud (1988) defines research design as a “master plan” specifying the methods and procedure for collection and analysing the need information. Albert SzentGyorgy; (2015) stated that “Research is to see what everybody else has seen and to think what nobody else has thought”. It contains concepts like paradigm theoretical model, phases and qualitative or quantitative technique (Irny and Rose, 2005).

Questionnaire Design: To prevent delay and incompleteness, a standardised open-ended questionnaire was administered and to trail covid norms. The administration of questionnaire felt necessary for the kind of survey. The relevant questions are logically arranged and serially numbered. 5- and 3-point Likert scale was followed and accordingly the opinions expressed by respondents are presented. Weights are used against the respondents' opinions of respondents and Garrett ranking technique was performed with suitable statements and ranked.

Sample and sampling technique: A sample of 100 respondents are sufficient for the present study. Convenient sampling technique was performed at the time of data collection.

Universe of the study: The present study concentrates about e-governance and digitalisation in Bengaluru Urban only. Electronic city, Rajajinagar, Malleswaram and Jayanagar areas were considered and 25 each respondent was interviewed.



**Vedavathi and Chandan Chavadi**

Method of analysis: The present research applied statistical methods like χ^2 , contingency co-efficient, weighted average, Garrett Ranking Technique and Kendall's coefficient of concordance.

Data presentation and analysis: The demographic factors required for the study includes gender, marital status, qualification, income, occupation, age, use of digital products was covered. Further, challenges faced, national and state level digitalisation and government goals and objectives of e-governance through digitalisation were covered.

Research question No.-1: What are the causes for the socio-economic aspects not influencing on the research of e-governance and digitalisation?

Hypothesis No. - 1: H_0 :The socio-economic parameters are not influencing on the research and includes no variance.

H_1 : There exist a significant dissimilarity in the characteristics and they are supporting the study.

Table – 1 assert that there are 16 females and 84 males and 86 are married, 14 remained unmarried. 35 respondents belong to 40 to 50 years age group, 21 to the 50-60 years, 18 belongs to 30-40 years, 12 pertain to the 20-30 years group 10 to the 60-70 years. 48 respondents are degree holders, 15 are post graduates, 14 are professionals, 6 are ITI & other certificate holders. 38 are employed in private sector and 21 are government employees, 15 are involved in agriculture 14 doing business, 4 are self-employed and 8 are home makers. All demographic characteristics show significant variation and reveal a noticeable degree of association between factors and digitalisation.

Research Question No. 2: What are the challenges faced in e-governance and digitalisation?

Hypotheses No. 2: There exists no variation in the challenges faced.

H_1 :There exists great variance in the obstacles experienced.

Table – 2 reveals data about environmental, social, economic and technical challenges faced. The weights are reliant upon the well-known Likert scale. The frequencies are defined as f and respondents' opinions are defined as x and the multiplication is called as fx . The fx is divided by the N (Number of observations) to get WA. The first weighted average is awarded to the privacy and security, the second to the huge amounts involved in implementation and the third relative important weighted average is awarded to the low IT literacy and the remaining relative important WA are awarded to the different challenges depending upon strength of fx .

Research question No. 3:What e-governance efforts are being carried out both at the national and state levels?

Hypotheses No. 3: H_0 :There is not a substantial difference between the e-governance efforts implemented at the state level and the federal level.

H_1 :There is a great amount of diversity between the e-governance efforts implemented at the state and federal levels.

Table – 3 highlights about national and state level digitalisation initiatives. The impacting initiatives of central and state level are measured and ranked by using, Garrett Ranking Technique. These impacting are ranked by using the formula $100(R_{ij} - 0.5) / N_j$. The calculated values are derived from the above formula and these calculated values were referred with the Garrett Ranking conversion Table (see table-5). The opinions are defined as f and multiplication of f and opinions of respondents is defined fx . The sum of fx is further divided by N to get mean score. The first rank was awarded to computerisation of land records, the second rank has been awarded to project Bhoomi / Karnataka and the third rank was awarded to the direct cash transfer. The remaining initiatives are ranked based on strength of mean score.

Research question No. - 4: What are the goals and objectives of e-governance?

Hypotheses No. - 4: There are no variations in the objectives of governance.

H_1 :There is a substantial amount of disparity in the goals and objectives of various governments about e-governance.

Table – 4 asserts data about the objectives and goals of the government's online governance. 73 of the 100 respondents said that they strongly agree with the statement, followed by 19 respondents who agreed, and 8 respondents who slightly agreed with the statement. Out of 73 people who said they are in agreement, 22 brought up the topic of transparency, while 10 people brought up each of accountability and sustainability. 8 people spoke about the importance of inclusive development, whereas 6 talked about the importance of service orientation. There were



**Vedavathi and Chandan Chavadi**

three comments made on decentralisation and accountability out of a total of 19 respondents who claimed they were in agreement. Additionally, three more people remarked about how transparent they are. 8 people out of 100 who showed some degree of agreement brought up decentralisation, while service orientation and transparency were each brought up by two people. According to the findings of the research, w is not compatible with hypothesis H0, however it is compatible with hypothesis H1. It may be deduced that there is a significant degree of connection between the two.

CONCLUSION

Information gives the way to fight against unemployment, poverty, corruption, regional disparity. But at the same time, it is also true that on account of pace of completion of project, red-tape and resistance from government, employees and citizens may not receive the fruits of digitalisation and e-government. IT literacy level among the citizens plays an instrumental role in the successfulness of e-governance and digitalisation. E-governance in India is the early stage of development. Though there exist significant progress made by the government in providing e-governance facilities to the citizens but such facilities are available only to a small section of society. The study found about the presence of favourable demographics of the respondents impacting the study very much. The challenges faced by e-governance and digitalisation includes privacy and security, involvement of huge capital, and low IT literacy. The study also found that Central and State governments have installed digitalisation in their governance and they includes computerisation of land records, project Bhoomi, and direct cash transfer. Further, the study about goals and objectives of digitalisation, includes transparency, sustainability and decentralisation.

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Vedavathi and Chandan Chavadi

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Table 1: Demographic profile of respondents

Demographics	x ²	TV@5%	df	Result of x ²	"c"	Result of C
Gender	46.24	3.841	1	Significant	0.56	High Degree
Marital status	51.84	3.841	1	Significant	0.58	High Degree
Age in years	35.03	11.070	5	Significant	0.50	High Degree
Education	75.78	11.070	5	Significant	0.66	High Degree
Occupation	43.15	11.070	5	Significant	0.54	High Degree
Monthly income (INR)	31.39	12.592	6	Significant	0.49	High Degree
Use of digital products	31.36	3.841	1	Significant	0.49	High Degree

Source: Field Survey

Note: x² = chi-square

'c' = $\sqrt{x^2 / x^2 + N}$

Where c = contingency co-efficient, N = Number of observations

When the value of 'c' is equal or near 1, it means there is high degree of association between attributes. Contingency co-efficient will always be <1.

Table-2: Environmental, social, economic and technical challenges – weighted average technique.

Challenges faced	Weight	5	4	3	2	1	T	WA
	Likert scale	SA	A	N	DA	SDA		
Different language: people of different states speak different languages.	f	68	21	8	2	1	100	
	fw	340	84	24	4	1	453	30.20
Low literacy: Illiterates unable to access e-governance	f	67	20	10	1	2	100	
	fw	335	80	30	2	2	449	29.93
Low IT literacy	f	79	16	2	1	2	100	
	fw	395	64	6	2	2	469	31.26
Services are not easily accessible	f	65	22	5	4	4	100	
	fw	325	88	15	8	4	440	29.33
Recognition of application	f	62	25	6	2	5	100	
	fw	310	100	18	4	5	437	29.13
Digital divide: Aware and not aware	f	78	15	3	2	2	100	
	fw	390	60	9	4	2	465	31.00
Struggle to change from paper base to web base	f	69	21	6	3	1	100	
	fw	345	84	18	6	1	454	30.27
Population – lack of unique identity	f	71	18	8	2	1	100	
	fw	355	72	24	4	1	456	30.40
Lack of communication better different departments	f	65	22	9	2	2	100	
	fw	325	88	27	4	2	446	29.73
Lack of awareness among people	f	80	14	3	2	1	100	
	fw	400	56	9	4	1	470	31.33
Huge amount is involved in implementation	f	82	13	2	1	2	100	
	fw	410	52	6	2	2	472	31.47
Maintenance of electronic devices	f	65	21	8	4	2	100	
	fw	325	84	24	8	2	443	29.53





Vedavathi and Chandan Chavadi

Low per capita income	f	74	15	4	3	4	100	
	fw	370	60	12	6	4	452	30.13
Limited financial resources	f	75	16	5	3	1	100	
	fw	375	64	15	6	1	461	3073
Scale of application	f	76	15	6	3		100	
	fw	380	60	18	6		464	30.93
Multimodal interaction	f	74	16	3	4	3	100	
	fw	370	64	9	8	2	453	30.20
Privacy and security	f	81	14	3	1	1	100	
	fw	405	56	9	2	2	474	31.60
Scope of applications	f	68	22	4	3	1	100	
	fw	340	88	12	6	2	448	29.87
Tried and tested technologies	f	65	23	8	2	2	100	
	fw	325	92	24	4	2	447	29.80
Geographical problems	f	79	13	4	2	2	100	
	fw	395	52	12	4	2	465	31.00
Confidence on technology	f	75	16	2	3	4	100	
	fw	375	64	6	6	4	455	30.33

Table – 3: National and state level digitalisation – Garrett Ranking Technique.

Initiatives	Scale & Scale Value														T	MS	R
	Scale	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII			
	Value x	84	74	67	62	58	54	50	46	42	38	33	26	16			
Aadhaar	f	42	20	8	5	3	2	3	4	2	3	3	2	3			
	fx	3528	1480	536	310	174	108	150	184	84	114	99	52	48	6867	68.67	7
Mygov.in	f	30	15	16	9	4	5	3	3	4	2	2	3	4			
	fx	2520	1110	1072	558	232	270	150	138	168	76	66	108	64	6532	65.32	11
Digital locker	f	25	18	12	10	6	8	4	3	4	3	2	3	2			
	fx	2100	1332	804	620	348	432	200	138	168	114	66	108	32	6462	64.32	12
Pay Gov	f	25	10	8	10	6	8	4	5	6	4	3	6	5			
	fx	2100	740	536	620	348	432	200	230	252	152	99	156	80	5945	59.45	13
Mobile Seva	f	40	18	10	7	4	2	3	3	4	3	4	2				
	fx	3360	1332	670	434	232	108	150	138	168	114	132	52		6890	68.90	6
Computerisation of land records	f	45	25	5	4	3	2	3	2	3	3		3	2			
	fx	3780	1850	335	248	174	108	150	92	126	114		108	32	7117	71.17	1
E-Seva	f	40	20	10	3	6	4	5	3	2	2	2	3				
	fx	3360	1480	670	186	348	216	250	138	84	76	66	108		6982	69.82	4
Khajane Project	f	35	18	6	8	6	8	4	5	3	2	2		3			
	fx	2940	1332	402	496	348	432	200	230	126	76	60		48	6696	66.96	10
Lokvani Project	f	38	17	10	5	3	6	3	4	2	5	2	3	2			
	fx	3192	1258	670	310	174	324	150	184	84	190	66	108	32	6742	67.42	9
Project Bhoomi	f	45	22	6	5	2	2	3	2	4	2	3	2	2			
	fx	3780	1628	402	310	116	108	150	92	168	76	99	52	32	7013	70.13	2
Direct Cash transfer	f	44	25	3	6	2	4	2	2	1	3	2	4	2			
	fx	3696	1850	201	372	116	216	100	92	42	114	66	104	32	7001	70.01	3
Aadhar enabled payment system	f	42	26	8	2	3	4	2	1	2	3	2	2	1			
	fx	3528	1924	536	124	174	216	100	46	84	114	66	52	16	6980	69.80	5





Vedavathi and Chandan Chavadi

Project Swagath	f	35	22	10	8	3	5	1	2	3	4	2	2	3			
	fx	2940	1628	670	496	174	270	50	92	126	152	66	52	48	6764	67.64	8

Table 4: Governments goals and objectives of e-governance.

Different goals and objectives	SA	A	SDA	RT	RT2
Service Orientation	6	2	2	10	100
Decentralisation	5	3	3	11	121
Market alignment	7	2	-	9	81
Accountability	10	3	-	13	169
Sustainability	10	2	-	12	144
Transparency	22	3	2	27	729
Inclusive development	8	2	-	10	100
Productivity enhancement	5	2	1	8	64
Total	73	19	8	100	1508

Source: Field Survey

Note: SA - Strongly Agree, A - Agree, SWA - Somewhat Agree, RT - Row Total

$$SSR = \frac{\sum RT^2 - (\sum RT)^2}{N}$$

$$= \frac{1508 - (100)^2}{8}$$

$$= \frac{1508 - 1250}{8} = 258$$

$$W = \frac{12 \times SSR}{K^2 N (N^2 - 1)}$$

$$= \frac{12 \times 258}{9 \times 8 (64 - 1)}$$

$$= \frac{3096}{4536} = 0.69$$

Test the significance of "W" by using the chi-square statistic.

$$x^2 = k (n-1) w$$

$$= 3 (8-1) 0.69$$

$$= 3 \times 7 \times 0.69 = 14.49$$

Decision: At 7d.f. with 0.05 level of significance the TV = 14.067. The calculated value being 14.49 higher than the critical table value and hence 'w' fails to accept H₀ and accepts H₁. Therefore, it is concluded that there exists significant relationship between the goals and objectives and governance.

Table – 5: Garrett Conversion Table

Sl.No.	100 (R _j – 0.5) / N _j	Calculated Value	Garrett Value
1	100(1-0.5) / 13	3.84	84
2	100(2-0.5) / 13	11.53	74
3	100(3-0.5) / 13	19.23	67
4	100(4-0.5) / 13	26.92	62
5	100(5-0.5) / 13	34.61	58
6	100(6-0.5) / 13	42.30	54
7	100(7-0.5) / 13	50.00	50
8	100(8-0.5) / 13	57.69	46
9	100(8-0.5) / 13	65.38	42
10	100(8-0.5) / 13	73.08	38
11	100(8-0.5) / 13	80.77	33
12	100(8-0.5) / 13	88.46	26
13	100(8-0.5) / 13	96.15	16

Source: (1) Subhash Vadgale (2016). Village consumer behavior towards perishable goods. A study with respect to Ahmednagar district of Maharashtra, Pezzottaite Journals, 5, (3) 2286-2287. (2) <https://pd4pro.com.edu>





An Analytical Study on Mobile Apps available for Farmers in India

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ABSTRACT

Mobile applications are prospective digital tools that can be successfully used to quickly spread agricultural information to a large number of farmers. Through the provision of accurate information, improved input and farm management, simple marketing, connections with government agencies for policy assistance to farmers, etc., they may be utilized to increase farm revenue and productivity. These Apps will help the farmers to identify the field mapping, weather conditions predictions, Diseases and pests related apps which will increase the profitability of farmers. There are obstacles, too, including low smart phone adoption in rural India, erratic internet access, low digital literacy among farmers, and a dearth of agricultural information available in regional languages, among others.

Keywords: Agriculture, Farming, Mobile Apps used in India.

INTRODUCTION

Information and communication technologies are spreading at an astounding rate all across the world. One of the most fundamental periods of change that we have ever seen is the digital age. India's rural areas are currently undergoing tremendous technical and digital changes. According to data from "The Rising Connected Consumer in Rural India," a study by the Boston Consulting Group, this proportion of rural India will rise to 48% by 2020. In addition, while 58% of Indian households still rely on agriculture as their primary source of income, digital agriculture has to receive greater attention if India is to continue expanding and prospering. The most practical and helpful tool for farmers to employ is a farming app. It provides you with instructions for doing good scientific farming, crop cultivation, sowing, or vegetable harvesting.





Mala and Sumathi

Farmers may simply resolve any issues that put them in a tough condition, whether they are connected to pest or insect assault or another issue. Farmers' best friend in farming may be a farming software that increases output without costing them a single penny. Without spending a single rupee, they may effortlessly obtain it from your Google Play store.

Agriculture information crops are Categories are

- Business Apps.
- Conference Apps.
- Diseases and Pests apps
- Farm management apps.
- Learning and reference apps
- Location-based apps
- Market data apps
- Weather apps

RESEARCH METHODOLOGY

The material used in the article, which is based on secondary sources, was found online in journals, research papers, and professional views related to the same topic.

Objective

- To study the concept of Digitalization in agriculture sector in India
- To Know about the various Agri. mobile apps available to farmers in India
- To understand the Various advantages of Agri Mobile APP.
- To understand the Challenges of Using Agri. Mobile Apps in India

Agriculture Apps for Farmers in India

Krish-e This well-known agriculture app from Mahindra & Mahindra offers farmers a customised crop calendar in addition to practical agricultural knowledge on topics like seed treatment, irrigation, weed control, pest and disease management, fertiliser management, crop diagnosis, and sowing and planning. The most popular agriculture app among farmers is this one, which is available in eight popular Indian languages. Krish-e aims to assist Indian farmers in finding answers to their problems by recognising pests and crop diseases that harm their crops using digital agricultural solutions.

IFFCO Kisan Agriculture A division of Indian Farmers' Fertiliser Cooperative Ltd., it was established in 2015 and is run by IFFCO Kisan. Its goal is to provide Indian farmers with information that is tailored to their requirements in order to help them make educated decisions. Additionally, the user has access to a number of educational modules, such as agricultural advise, weather, market pricing, and an agriculture information library, in the chosen language, in the form of text, images, audio files, and videos. Additionally, the app provides contact information for Kisan Call Centre Services' helplines. Out of all the farming application available for Kisan, Iffco Kisan is the finest. With a simple user interface, it is a memory-efficient Android app. This Android app offers information on the most recent mandi pricing, farming suggestions, and agricultural guidance. Additionally, it offers information about weather forecasts. Additionally, it offers farmers agricultural notifications in 10 Indian languages. Using this software, farmers may quickly seek the assistance of agriculture specialists. A little over 50,000 people downloaded this app.

Pusa Krishi It is a government app that the Union Agriculture Minister unveiled in 2016 and aims to help farmers to get information about technologies developed by Indian Agriculture Research Institute (IARI), which will help in increasing returns to farmers. The app also provides farmers with information related to new varieties of crops



**Mala and Sumathi**

developed by the Indian Council of Agriculture Research (ICAR), resource-conserving cultivation practices as well as farm machinery and its implementation will help in increasing returns to farmers.

Agri App It is completely farmer-friendly software that offers comprehensive Crop information. Production, Crop Protection, and all relevant agriculture allied services. It also enables farmers to access all the information related to "High value, low product" category crops from varieties, soil/ climate, harvesting, and storage procedures. Moreover, options to chat with experts, video-based learning, the latest news, online markets for fertilizers, insecticides, etc. are also available on this app. Agri App is one of the most liked apps by farmers. It has a rating of 4.3 out of 5. It is an online farming marketplace bringing Kisan, farming input/output, government service on an online platform. It also provides chat option for farmers. Kisan can easily chat with an expert of agriculture using this app. This mobile application provides diversified videos of agriculture work. Approximately 0.1 million users downloaded this farming app.

Crop Insurance It is a fantastic app that assists farmers in figuring out insurance prices. for notified crops and provides information on cut-off dates and company contacts for their crop and location. It works as a reminder and calculator for farmers about their insurance. It can also be used to get details of the normal sum insured, extended sum insured, premium details, and subsidy information of any notified crop in any notified area. It is also connected to its online site, which offers services to all parties involved, including farmers, states, banks, and insurance firms.

Kheti-Badi "Kheti-Badi" is a social-action app that strives to help and promote "Organic Farming" and give crucial information about difficulties affecting Indian farmers. This software assists farmers in making the transition from chemical to organic farming. However, as of right now, this app is only accessible in Hindi, English, Marathi, and Gujarati.

Agri-Market The app was created with the intention of keeping farmers informed of agricultural prices and discouraging them from holding distress sales. Farmers can get information related to the prices of crops in markets within 50km of their own device location using the Agri Market Mobile App.

Shetkari Shetkari Mitra is a multipurpose mobile application created for Indian farmers. It offers expertise and information on government programmes, crop management, Agri- Business & Guidelines, market prices, and agricultural success stories.

Kisan Suvidha It was launched by PM Narendra Modi in 2016 to work towards the empowerment of farmers and the development of villages. The app design is neat and offers a user-friendly interface and provides information on current weather and also the forecast for the next five days, market prices of commodities/crops in the nearest town, knowledge on fertilizers, seeds, machinery, etc. The option to use the app in different languages makes it more widely accessible.

Agri Media Video App One of the most widely used mobile apps for farmers in the video area are the Agri Media Video App. It has a rating of 4.8 out of 5. It is an online marketplace bringing farmers, agriculture input/output, farming retail and fulfillment service on an online platform. It also provides chat service for farmers to solve their query related to agriculture with the option of upload images of infected crops. Farmers can easily chat with agriculture expert and discuss their problems. This smartphone application also provides various videos related to agriculture practice, new technologies, successful farmers, rural development, agriculture news, new govt. schemes related to agriculture etc. Approximately 10 thousand users downloaded this app.

FarmBee - RML Farmer It is fantastic on the list of farm apps for Android, with a rating of 4.3 out of 5. It is a small app in terms of memory with an easy user interface. It is available in 10 different Indian languages. It provides fertile





Mala and Sumathi

agriculture content and information at every stage of the crop life cycle. A farmer has 450 crop kinds, 1300 markets, and 3500 weather areas to select from. In addition, it offers weather forecasts and mandi prices based on the user's location. There were almost 0.5 million downloads of this software.

Kisan Yojana Another well-known and cost-free agriculture app for Android is Kisan Yojana. It informs Kisan about all governmental programmes. It bridges the information gap between rural residents and the government. Additionally, it offers the plans of the several comparable state governments. This Smartphone application also reduces the amount of time and money Kisan must spend travelling to the state government office. A little over 50,000 people downloaded this app.

For Indian farmers and the agricultural community who stay current with agricultural technology, these applications are highly helpful. These applications assist Indian farmers and close the information gap between rural residents and the government about rural development. These Android applications for farmers in India are used for agricultural and offer the most recent market prices, weather forecasts, government policies and programmes for farmers, videos of the newest technology, news about agriculture, etc. Using these applications, farmers can immediately ask questions and receive immediate answers from agriculture specialists. They can also view movies about new technologies, prosperous farmers, machinery, and other topics.

Benefits of using mobile apps in agriculture sector:

- Offers text and video messaging services for the distribution of agricultural advice.
- Having access to real-time meteorological information, such as temperature, rainfall, sunlight hours, etc., this directly influences agricultural decisions.
- Market intelligence by giving information on the pricing, quality, and quantity of agricultural commodities arriving at various marketplaces around the nation.
- Mobile apps enable online management of fisheries, livestock, agriculture, and other resources.
- The sharing of input from farmers and other stakeholders in many ag-related sectors.
- These applications make information about significant machines and equipment readily available.
- Farmers may receive services from the government in the form of input delivery and subsidy distribution by using mobile apps.
- It may be applied to sensor-based farming, managing irrigation systems in big fields, identifying various soil types, etc.
- By collecting data, analysing it, and making sensible recommendations for various organisations, it makes successful farm management possible.
- Quick and easy access to a wealth of information by category, saving time.
- It facilitates improved agricultural produce selling and storage.

Challenges of Using Mobile Apps in India

- Mobile app operation demands trained personnel, and digital literacy is a requirement.
- Local language applications are hard to create because of the country's linguistic diversity.
- The information must be translated at various points, which might lower its quality and decrease acceptance among the agricultural community.
- Using mobile apps requires a faster internet connection. Internet connection and speed are frequently a big problem in rural areas, which has an impact on mobile application services.
- Farmers lack the knowledge and expertise necessary to use mobile apps.
- Why Since many mobile applications charge a fee to use them, farmers may not be able to afford the premium services offered by these apps.
- The government must promote digital literacy to address the issue of lower adoption and use of mobile applications by farmers.
- Uneven internet access, inaccurate data in applications, and a lack of content that meets local needs are significant barriers to the adoption of mobile apps.



**Mala and Sumathi**

- In comparison to other industries, such as health, the number of agriculture applications is quite small.
- India's agricultural uses are less diverse than those in the USA or Brazil. There are digital tools that charge a fee for live services related to different agricultural solutions, which farmers are hesitant to pay.

CONCLUSION

The greatest way to deal with farming difficulties is through farmer applications. The greatest farming equipment possibilities and well-liked government programmes are supported by these applications, which also make it simple for farmers to understand how to produce crops at best-selling prices. Additionally, these helpful applications assist farmers in finding answers to any small- to large-scale question they may have about their farm and certain agricultural practices. Agriculture is increasingly utilising mobile technologies. Additionally, farmers' biggest allies today are agricultural applications. These agricultural applications also give farmers access to the best equipment, market pricing, sowing conditions, and other information. Farmers may use the app to locate their agricultural issues and receive immediate remedies. Rural farmers may utilise the majority of these applications without any problems because they are accessible in Hindi, the country's official language. Additionally, downloading these apps from the Google Play store is simple. doesn't even demand an additional cent from the farmers' purses. Prior until today, farmers were unable to increase the production on their fields because of a lack of expertise. Additionally, but today, farmers may enhance their farming practises, have alternatives for assessing the most recent tractors and farming tools of choice, and know what weather condition or fertiliser type is most suited for their soil thanks to these top agricultural apps in India.

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An Exploratory Study on Impact of Fintech on the Future of Banks and Financial Services

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ABSTRACT

Financial innovations have resulted from technological advances in macroeconomics. Fintech, a growing sector of the financial services business, offers innovative services like digital and mobile payments, e-wallets, online loans, P2P platforms, crowdfunding, online funds, and online insurance using cutting-edge technologies. The 2008 financial crisis and financial industry operators' transition to low-capital-intensive business models sparked Fintech 3.0. Fintech companies have pioneered financial services using automation, AI, and other cutting-edge technologies. Combining cutting-edge technologies and financial services, fintech is changing retail, telecommunications, pharmaceuticals, and agriculture. Legal issues, the growth of fintech products, holistic security solutions, financial literacy, and access to financial services have increased government and regulatory interest in fintech. Fintech has boosted the banking industry through internet platforms, mobile apps, and personalised user accounts. Financial institutions must restructure or cooperate with fintech companies to compete. Despite hurdles, fintech and financial institutions can benefit from collaboration.

Keywords: Fin Tech, Fintech Industry, Financial services, Cutting edge technologies, Digital Banking

INTRODUCTION

Technological development has acted as a catalyst for the transformation of macroeconomics. The introduction of fresh financial technologies, which result from careful financial management using digital technology, has been a turning point in the development of financial markets. The financial technology industry has experienced significant expansion in recent years. Fintech is still difficult to define precisely despite the rapid expansion of this phenomena.



**Kavya Y R and Anitha S Yadav**

Fintech, a developing area within the financial services sector, uses cutting-edge ideas and technology to provide a variety of high-tech services. This group of services includes electronic wallets, peer-to-peer (P2P) lending platforms, crowd funding, online funds, online insurance, and comparable services such as digital and mobile payment and transfer services. The migration of market players toward low-capital-intensity business models that were updated to fit the demands of the financial services industry today was the catalyst for the emergence of fintech 3.0 in reaction to the global financial crisis of 2008. Fintech businesses have arisen as creative new actors in the financial services sector as a result of market equilibrium. The status of financial technology is today characterised by rapid digital transitions as a result of increased usage of automation, artificial intelligence, and other cutting-edge technologies.

Hence, it can be posited that fintech has undergone a transformation from its nascent phase of deploying technological innovations solely in conventional domains of the economy, to a juncture where it represents a distinctive apparatus that can ascertain user anticipations. Fintech service providers are perceived not merely as nascent entities, but rather as proficiently administered firms possessing extensive operational proficiencies, a comprehensive range of products, and a global footprint. The burgeoning field of financial technology, or fintech, is revolutionising the conventional financial landscape and represents a rapidly expanding domain situated at the confluence of financial services and pioneering technologies. Within this particular domain, fledgling technology enterprises and nascent market contenders are implementing inventive methodologies towards their offerings, thereby influencing the prerequisites for the efficacious advancement of financial technology. The present discourse shall delve into the impact of fintech on banks, the anticipated effects of fintech on the financial system, the primary ramifications of fintech on the banking industry, and the influence of fintech on financial services.

How Fintech Affects The Financial System.

The global economic downturn has revealed serious issues and inadequacies in the management of financial institutions. In order to establish norms for this, the Financial Stability Board is continuously and thoroughly reviewing the global financial regulatory landscape. The financial institutions' inadequate collection and dissemination of risk-related data was one of the issues that the crisis brought to light. In 2013, the Basel Committee on Banking Supervision released its Principles for Risk Aggregation and Risk Reporting in response to this shift. The aforementioned development is important because it develops fundamental ideas that act as a basis for data collection and management. This can need making new technical investments and reevaluating internal processes. The complexity of global regulatory frameworks, increased demands for regulatory reporting, and the potential for significant fines as a result of the strengthening of post-crisis standards are just a few of the variables that have been linked to increases in compliance costs. The significance of this issue has only increased for global financial organisations that must traverse intricate and even contradictory regulatory frameworks.

The term "financial innovation" refers to a wider variety of developments in the financial sector than just those associated with Fintech. The creation of novel derivatives is an example of an innovation in the financial sector that is not always a financial technology. At the same time, the "digital economy" may come to embrace at least a portion of the concept of financial innovation (with Fintech being entirely encompassed, given its near-impossibility of operation sans digital technologies). Fintech, from many modern viewpoints, is seen as its own field, apart from financial services and IT. The relationship between the financial sector and technology has always been marked by mutual support and improvement. Fintech, from many modern viewpoints, is seen as its own field, apart from financial services and IT. The relationship between the financial sector and technology has always been marked by mutual support and improvement. Fintech, from many modern viewpoints, is seen as its own field, apart from financial services and IT. The relationship between the financial sector and technology has always been marked by mutual support and improvement. As previously stated, the worldwide financial crisis of 2008 served as a pivotal moment, catalysing the emergence of Fintech as a novel paradigm. The process of evolution engenders difficulties for both regulators and market participants, particularly in the delicate task of reconciling the potential advantages of innovation with the possible hazards.

At present, the realm of Financial Technology encompasses a plethora of technological startups, alongside major corporations endeavouring to enhance and streamline the provision of financial services. As of the conclusion of the





year 2014, the aggregate sum of investments in this particular sector amounted to a staggering 157 billion dollars. Subsequently, the aforementioned term came to denote a substantial and expeditiously expanding sector.

Effects of Fintech on The Banking Industry.

The fintech and banking industry sector encompasses a variety of technological trends, including:

This discussion focuses on Bigdata, which encompasses both cloud computing and massive amounts of data. By leveraging cloud computing, financial institutions are able to offer their services on a worldwide scale without requiring individual customers to install specialised software on their devices. Customers can receive more relevant and timely advertisements because to big data's analysis of a wide variety of digital data, including information from the web, internal company documents, sensor readings, and other devices. APIs, or application programming interfaces, help make this possible in customer service environments. Applications, services, and operating systems often provide their own set of classes, procedures, functions, structures, and constants known as an Application Programming Interface (API) for use by third-party developers. Using mobile devices and social media, especially through specialised apps. The amalgamation of the banking industry with social networks has facilitated the acquisition of valuable insights into customer preferences, which can be utilised to propose novel financial products, foster trust-based relationships with individual clients, and expedite the integration of blockchain technologies in customer interactions. Instances of efficacious establishment of such associations in the retail industry can be observed in the case of Amazon, while in the banking sector, Deutsche Bank serves as a notable example.

The quickest possible resolution of customer complaints is the fundamental benefit of omnichannel banking. People can save time and effort by avoiding in-person interactions at banks and other financial institutions by using the Internet and television equipment instead. Digital financial services can save money and provide more individualised service to customers by delegating some tasks to technology tools like chatbots. The present methodology exhibits a high degree of adaptability and is tailored to cater to the distinctive requirements of individual customers. In addition, one may avail the opportunity to enhance their banking experience and garner heightened customer loyalty, resulting in reduced attrition rates and improved conversion rates. The use of AI tools is shaping the future of payment systems around the world and across different platforms. By scrutinising the operation history, spending patterns, and conduct of patrons, one can prognosticate their forthcoming activity and proffer payment modes that entail diminished fees. One of the foremost trends of notable importance is the utilisation of voice-activated transactions. The exigencies of security and verification necessitate specialised approaches, constituting a significant domain for expansion. At present, financial data stands out as the most precious resource. The integration of payment solutions with other systems can facilitate a comprehensive comprehension of shopping behaviour, provide pertinent recommendations, enhance customer retention, and furnish superior experiences.

Open banking refers to the secure access granted to third-party providers to retrieve customers' financial information. The process adheres to a prescribed format as stipulated by the open banking framework and is exclusively accessible upon the acquiescence of the patron. The provision of services by companies can be facilitated by obtaining a precise understanding of the financial status of their clientele. Furthermore, it affords the opportunity for consumers to obtain a lucid depiction of their financial situation.

Why Fintech And Banks Should Work Together

The manner in which individuals utilise financial services and engage with banking institutions has undergone a process of evolution. The advent of recent technological advancements has incited a shift in the banking practises of individuals, and we are now witnessing the resultant modifications that serve as evidence of the noteworthy influence of financial technology on the banking sector. Let us enumerate a few of them:

The proliferation of mobile devices has experienced a significant surge. As per the findings of the Pew Research Centre, a staggering 81% of the adult populace in the United States possess a smartphone, while over 50% are in possession of a tablet. It is imperative for businesses seeking to establish a strong rapport with their clientele to



**Kavya Y R and Anitha S Yadav**

contemplate the development of mobile-friendly products and offers. This implies that expeditious access to a vast array of information is attainable through a device that is connected to the Internet. Similarly, the banking particulars are readily accessible to patrons of financial institutions from virtually any location. A notable benefit of contemporary times is the expedited dissemination of information, which obviates the need for overnight settlement of updates. This expedites transactions and ensures the most current information is available. An increasing number of services have become accessible through digital means. There exists a cohort of individuals who continue to exhibit a preference for availing themselves of in-person banking services at a brick-and-mortar establishment. Many individuals have become accustomed to the practise of electronically transferring funds between their various accounts, depositing checks remotely, and monitoring their financial transactions via online platforms. Initially, financial institutions provided incentives to encourage their clientele to primarily utilise digital banking services. Presently, a substantial number of patrons deem virtual amenities to be more expedient owing to their unrestricted availability.

The paramount importance of security concerns in the realm of Financial Technology (FinTech) cannot be overstated. It is imperative to underscore that this novel approach to banking is not only secure but also fosters trustworthiness in the collaborative enterprise, thereby safeguarding the confidentiality of customers' sensitive financial information. During the era of traditional banking, there was a notable lack of investment in data protection and customer education regarding the imperative need to mitigate vulnerabilities.

LITERATURE REVIEW

This study looks at IPO exit rates with bank and IVC fintech firm investments. More banks than IVCs invest in fintech companies. Additionally, banks exit IPOs more frequently than IVCs do. This study looks at the reasons why some banks do better at exits. According to our findings, banks' preferences for later-round or bigger agreements are insufficient to account for this incidence. According to our research, these banks' exit performance is not considerably improved by peer IVC success. The most prosperous fintech businesses are those that have strong ties to the financial industry or whose activities overlap with those of conventional banks. The literature on corporate venture capital (CVC) has claimed that banks' understanding of the sector helps them find and choose fintech businesses. In the fintech sector, bank board members are overrepresented. This illustrates that banks' fintech investments' success is not solely due to their ability to select firms with care. (Li et al., 2023).

This study examines how Financial Technology (FinTech) can change financial geography. FinTech in India was analysed longitudinally and multi scalarly to achieve this goal. This financial ecology study analyses the Indian FinTech ecosystem using quantitative data on firm development and investment and corporate interviews. The research identifies and assesses critical nodes in the Indian FinTech ecosystem. This research sheds light on how the export-oriented ICT sector, large-scale, open digital infrastructures, and enabling regulatory frameworks all contributed to the growth of FinTech as a state-supported, technology-driven "Tech-Fin-State" ecosystem. This study shows how these national characteristics promote FinTech development. This research analyses FinTech's city-scale impact on India's financial geography. The report shows FinTech's two-way transformation. Locational trends and investment networks made Before Mumbai, the worldwide FinTech centres of New Delhi and Bangalore emerged. The monetary re-intermediation of FinTech companies is the topic of this analysis. Its goal is to promote regional integration beyond India by explaining the connection between Bangalore (India's FinTech capital) and Mumbai (India's financial capital). Secondary data sources are used in the qualitative investigation. The study found that FinTech businesses' re-intermediation of finance is complicated and multifaceted, affecting India's and the region's financial landscape. (Migozzi et al., 2023)

According to the research, the fundamental tenets of Robo-advisory are expediency, procedural clarity, and user-friendliness. The development of robo-advisory services in India is ongoing. FinTech businesses may wish to integrate automated Robo-advice services with wealth management experience in order to deliver the best advisory solutions while taking into consideration Indian culture and emotions. The study is qualitative, hence the authors are



**Kavya Y R and Anitha S Yadav**

unable to make any generalisations. Numerical techniques can support theoretical notions in subsequent study. Consider the topic's practical ramifications. In industrialised nations, robo-advisors are well-established, but they are just now starting to gain traction in developing nations like India. Regulators place a high premium on educating investors and building a relationship of trust with service providers. The difficulties experienced by Indian FinTech service providers are qualitatively combined for the first time in this study.(Nain & Rajan, 2023). Investors and corporations are interested in FinTech. Financial technology stock research focuses on stock price prediction rather than lucrative stock recommendations. Existing methods for simulating stock price time series ignore or predetermine stock-sector relationships. Disregarding stock interdependence would mean missing crucial insights from information sharing. Predetermined linkages fail to depict stock price changes and interactions. This study uses stock price time series data and sector-specific information to propose the best companies based on return ratio. Our groundbreaking Financial Graph Attention Networks (FinGAT) model uses deep learning to solve the problem without fixed stock links. FinGAT is three-part. Initial hierarchical learning is used to identify sequential patterns in stock market data, whether short- and long-term. Following that is a comprehensive graph that links equities, and another that links industries. Stock-sector connections are another area that graph attention networks investigate. Thirdly, a multidimensional purpose was created to suggest profitable stocks and predict stock swings. The FinGAT model outperformed contemporaneous methods on Taiwan Stock, S&P 500, and NASDAQ datasets. (Hsu Y.-L.; Tsai Y.-C.; Li C.-T., 2023)

By 2022, the cryptocurrency market cap is expected to reach \$2 trillion, equaling that of Apple. The rising value of cryptocurrencies is reflected in the volume of daily transactions and trades. Predicting the price of a cryptocurrency is a difficult task for traders. As a result, bitcoin analysts have begun using AI to make predictions. In quantitative finance, machine learning algorithms have proven to be superior to its more established counterparts, making them an attractive option for use in predicting bitcoin prices. Machine learning has been used extensively to predict bitcoin values and manage cryptocurrency investments. These theories and models are always evolving. In this review, we compile the latest findings from studies that use supervised and reinforcement learning models to predict Bitcoin prices. The analysis also identifies blank spots in the literature and suggests directions for future investigation. It also draws attention to difficulties and opportunities in AI and ML study, particularly as they pertain to bitcoin.(Amirzadeh R.; Nazari A.; Thiruvady D., 2022)

Cryptocurrencies have grown in market capitalization and digital assets since Bitcoin's introduction. Given its many opportunities, bitcoin is a good place for investors. Understanding it is difficult. This study uses analytical tools to explain, capture, and divide the main cryptocurrency market patterns of 2018. Thus, we propose a clustering-based strategy to provide additional views on cryptocurrency monetary behaviour. This strategy seeks correlations between clustering outcomes and other factors not involved in the clustering process. This method employs a trifecta of partitioning clustering algorithms. The annual mean and standard deviation of returns, a return distribution that has not been applied to financial markets, and a time series of returns are all ways to depict cryptocurrency prices. We also look at the combined results of the three cluster analyses to carefully assess the market's primary trends, as each representation provides a unique vantage point. Finally, we investigate how clustering results are related to other aspects of cryptocurrencies. Examples include factors such as age, technological prerequisites, and monetary indicators derived from currency. The profiling of clusters and the identification of potential linkages with other variables will benefit from more descriptive information. For this reason, investors may immediately grasp market patterns and learn about cryptocurrencies with varying financial performance with the help of this study's comprehensive market map, which is comprised of graphic data and a scalable approach. The market can be classified into five or fewer groups after a long-term analysis of 2018 and 2019. Even with their intersections, the six most prominent populations make over 75% of the market. Our investigation shows that volume, market capitalization, and certain financial ratios correlate with particular clusters. These findings require additional research.(Lorenzo & Arroyo, 2022) Due to advancements in fintech, investors now have more options than ever before. This has opened up opportunities for profit and peril. Financial technology (fintech) risk and return in India's stock market is the focus of this research. This discussion is grounded in a market-centric study of the current and future state of price volatility in the fintech industry. For this study, we relied on secondary information from the



**Kavya Y R and Anitha S Yadav**

fintech section of the Bombay Stock Exchange's website between January 2017 and July 2022. In this analysis, we look at the risk-reward relationship in India's fintech industry. The Mean-GARCH (GARCH-M) model, which is variance-based, was applied to the Indian fintech industry to analyse the interplay between risk and return. The findings underline the significance of entering the potentially risky Indian fintech business. The amount of time an investor or manager holds onto a stock is dependent on their exposure to the equity market and the makeup of their portfolio. The possibility for profit in India's financial technology industry is dependent on the investor's risk appetite and time horizon.(Bhatnagar et al., 2022)

Increasing the efficiency and productivity of SMEs is crucial for economic expansion, as they are the backbone of the private sector. Inadequate capital prevents SMEs from expanding. Supply chain financial flow optimization could be useful for small and medium-sized enterprises' operations and investments. Supply networks in SMEs can benefit from Industry 4.0 technologies. Supply chain financing has been bolstered by FinTech's use of IT to provide financial services and improve loan and transaction processes for SMEs (SCF). Industry 4.0 technologies like the Internet of Things, cloud computing, big data, and analytics are essential to the development and expansion of the financial technology sector, or FinTech. Increased operational finances and a competitive edge are just two of the many benefits that small and medium-sized businesses (SMEs) may reap from adopting Industry 4.0 technologies. In this study, a technology selection framework based on tentative fuzzy logic is created. The finest Industry 4.0 tools for SSCF are determined by this framework.(Soni et al., 2022)

Micro-lending Fintech, which combines microfinance with mobile internet technology, has received interest recently. Micro-lending Fintech in China is profitable, attracting many investors. The government has often passed Internet lending Fintech rules due to P2P lending concerns. These steps aim to improve Fintech lending regulation. The China Banking and Insurance Regulatory Commission, the Bank of China, and other national entities are currently preparing the Interim Measures for the Management of Micro Finance, which is open for public feedback. This programme corrects intermediary corporations' micro-lending Fintech and small loan businesses. This paper examines how the New Policy may hurt publicly traded Fintech firms' stock prices. The paper also gives context and a thorough examination. Our findings show a negative impact on Fintech stock valuation after setting the milieu and manipulating variables according to event study methodology.(Wu, 2021)

New opportunities for the development of financial management, financial technology, insurance technology, wealth management technology, and investments are being sparked by the advent of big data analytics. The present publication is centred on the practical implementations of large-scale data analytics in the realm of financial operations. This editorial review employs a bibliometric analysis method to visually represent and emphasise the prevailing trends and forthcoming research agenda in this domain. Subsequently, the contribution of this special issue is underscored. (Nobanee, 2021). In recent years, socially responsible investments (SRIs) have garnered significant attention and interest from both practitioners and scholars alike. Subsequent to the financial crisis of 2007-8, professionals have exhibited heightened engagement with novel financial frameworks that amalgamate returns with affirmative social and environmental outcomes. The authors posit that antecedent imprudent financial paradigms are obsolete and advocate for a novel correlation between stakeholders and shareholders. Commencing from the popularisation of Socially Responsible Investment (SRI), the present literary work endeavours to retrieve the societal purpose of financial institutions, while also highlighting the pioneering function of crowdfunding and venture capital frameworks. The literary work presents a comprehensive and cohesive viewpoint that caters to both the enterprise and the financier, rendering it a pertinent and priceless piece of literature for academicians and professionals engrossed in the domains of sustainable development and social impact finance.(Gangi et al., 2021)

Prosumers are people who will play an integral role in the future energy systems by producing and consuming their own energy. The emergence of prosumers creates challenges for tracking carbon emission trends and developing pricing models that account for individuals' unique prosumption habits. This article proposes a novel protocol for decentralised trading of energy and carbon allowances using blockchain technology. In order to achieve regional energy balance and reduce carbon emissions, prosumers' buying and selling prices have a direct impact on the



**Kavya Y Rand Anitha S Yadav**

reconfiguration of prosumption behaviours. To encourage minimal carbon emissions, a decentralised approach for rewarding particular prosumption behaviours has been devised. Using a modified version of the IEEE's 37-bus test feeder, researchers were able to conclude that the suggested trading framework outperforms both centralised and aggregator-based alternatives. Specifically, the framework can lessen carbon emissions by 1465.90 grammes per day while exporting 0.99 kWh of energy per day. (Hua et al., 2020)

Robo advisors have become increasingly popular among Chinese investors due to the country's rapid development in the areas of internet finance and financial technology. In the case of financial concerns, the capital market is likely to be profoundly impacted by the emerging investment and financial management paradigm based on Internet-based platforms, artificial intelligence, and quantitative trading technology. The pressing issue in the Robo-advisory sector pertains to the standardisation of the platform, efficient management of financial risks during investment procedures, and safeguarding the welfare of investors. Primarily, this manuscript scrutinises the current state of progress of indigenous Robo-advisory platforms. The present discourse advances recommendations for the Robo-advisory sector to effectively navigate the challenges of sustaining profitability amidst heightened regulatory oversight. This is achieved through a comprehensive analysis of diverse financial risks and underlying factors impacting the platform. The objective is to foster the robust advancement of the investment advisory sector within the framework of financial technology. (Liu, 2020)

Modern financial institutions are rapidly changing their service offerings and customer communication protocols by integrating cutting-edge technologies into their production processes. This study examines whether traditional financial firms should switch to fintech to stay competitive. This discourse summarises theoretical and empirical research on the integration of modern information and other technology into the financial industry, focusing on banking and insurance. This discussion examines fintech companies and their evolution, with a focus on international financial technology investment. Financial technology have advanced during Russia's fintech boom. This article covers the country's top fintech developments. Preferences hasten the adoption of financial technology by the general public. The different trajectories of fintech companies and traditional financial institutions over the past decade demonstrate their distinct advantages. The report identified financial sector domains where fintech could replace conventional financial organisations that cannot adapt to the paradigm change towards financial technology integration. The research has shown that the finance sector is rapidly transforming into a conglomeration of financial and technological entities that are increasingly competitive due to their adoption of modern technologies and their focus on serving a diverse range of service consumers. (Golubev & Ryabov, 2020)

According to the "Domestic Blockchain Information Service Filing" published by the National Internet Information Office, by the end of 2019, a total of 72 businesses had registered to provide blockchain-based financial services. There were also 120 properly filed financial services. This dataset is reflective of the growing interest in blockchain-based financial systems and the expanding use cases for blockchain technology in the financial sector. The present study employs a qualitative analysis and scale method to scrutinise the blockchain financial derivatives cluster. The analysis is based on the main business operations of 122 functional blockchain financial enterprises. The research reveals that the utilisation of blockchain financial derivatives offers benefits in terms of alleviating information asymmetry and diminishing transaction expenses. Furthermore, in contrast to conventional finance, it transforms the mode of transactions rather than the essence of finance, specifically credit, and introduces novel financial enterprises that concentrate on credit and technology. The findings of this manuscript furnish a crucial point of departure for the commercial innovation metamorphosis of conventional financial establishments and the investment preferences of stakeholders. Furthermore, it implies that the administration ought to promptly implement pertinent regulations to rectify legal lacunae. (Zhang et al., 2020) This manuscript examines FinTech business models and financial institutions. FinTech companies combine technology and finance. Given its tendency to challenge existing financial sector institutions like banks, FinTech's rise has drawn attention. Bitcoin, Tag Cash, Oradian, Satago, Simple Tax, TransferWise, Holvi, and TRDATA have succeeded in penetrating a global market. Innovative FinTech models have shown promise. Small-scale entrepreneurs did not single-handedly grow FinTech. Important financial institutions made this possible. Small-scale FinTech entrepreneurs operate. They can weather failure better than big banks.



**Kavya Y R and Anitha S Yadav**

Financial organisations rely solely on public confidence. To improve their reliability, banking authorities implement strict requirements. Financial institutions must be attentive while making investment selections since they are accountable to the public.(Rathnakar& Surendar, 2019)

Regulators typically reject, integrate, or regulate FinTech. Turkey's highly regulated financial services sector is closely watched. Turkey's FinTech companies have pioneered products and services that help consumers and businesses. E-invoicing, e-payment, and e-government services have rapidly advanced, highlighting FinTechs' flexible attitude to change and innovative offerings. FinTech companies ignore financial regulation despite their agility. The universal method, epitomised by the saying "If it works here, it works everywhere," may have severe implementation difficulties. From service definition to application, firm formation, and investor history, financial industry regulations vary widely between countries. The Banking Regulation and Supervision Agency (BRSA) may deny a licence application if the country of origin fails to maintain crucial processes, as PayPal demonstrated. For select Financial Technology entities in the payment sector, Anti-Money Laundering/Counter-Terrorist Financing requires Due Diligence and customer surveillance. As they try to merge with other financial institutions, many companies discover the above requirements, which may seem daunting to a tech-savvy person. Stakeholders have trouble getting financial institution investments or contracts since these criteria may affect operational expenses, human resources, and IT infrastructure. The present paper examines both effective and ineffective FinTech payments ventures, examining their regulatory compliance and providing solutions to improve their acceptance in the Turkish financial system.(Degerli, 2019)

As "FinTech" retail payment systems become more commonplace, we investigate how a FinTech payment system's front- and back-end services are separated vertically and how this affects the allocation of resources to anti-fraud measures. Banks and credit card firms, as examples of IPPs, spend more in a FinTech payment service provider (FPP) that solely offers front-end services under the IPP liability framework. However, with the FPP liability framework, investment is dependent on the access charge. After a catastrophic event, the FPP liability scheme is more effective at discouraging fraud if the admission fee is within a certain range. Under both liability regimes, anti-fraud spending is boosted by the FPP's user base's indirect revenue and user fee revenue. The possibility of fraud is mitigated even further by the IPP liability regime. According to the results of our research, cost-of-entry regulations could strengthen a liability framework for FPPs. Economics-related areas covered by JEL include G23, G28, D43, and L22.(Yoon &Jun, 2019)

In this post, we will examine the current state of Fintech and how it relates to the creation of a cutting-edge recommendation engine. In this research, we propose a social computing platform that uses Virtual Organisations (VOs) to improve the user experience when making investment recommendations. This paper elaborates on the capabilities of agents and a method that can improve the accuracy of the Case-based reasoning (CBR) system's Recommender agent. User characteristics, asset classes, returns on investment, interest rates, stock market history, and media coverage of financial matters are all examples of data that will be collected and used to generate the CBR.(Hernández et al., 2019)

OBJECTIVES

1. To examine how fintech affects the financial system.
2. To know the effects of fintech on the banking industry.
3. To know why fintech and banks should work together.



**Kavya Y Rand Anitha S Yadav**

RESEARCH METHODOLOGY

The researcher examined data gathered from a variety of secondary sources, including the internet, scholarly literature, journals, and records of earlier studies, while using an exploratory research technique. Conducting feasibility studies is a helpful tool in advancing the conversation.

FINDING AND CONCLUSION

Fintech is a multifaceted construct that amalgamates the domains of cutting-edge technologies and monetary services, nascent enterprises and their corresponding framework. The financial services industry is progressively adopting novel technologies and instruments to execute its operations and introduce fundamentally innovative resolutions that have captured the attention of consumers. Currently, the retail sector, telecommunications sector, pharmaceutical sector, and the agricultural sector are all experiencing the permeation of innovative financial technologies into the manufacturing sector. Insurance, financing, accounting services, mass assessment of real estate, asset management, investing, and tax administration are just few of the industries feeling the effects of these technologies. There are a number of factors that have led to an increased focus on fintech by governments and regulatory bodies, including the need to address emerging legal issues, the explosion in the number of fintech products available, the importance of developing comprehensive security measures, the desire to improve citizens' understanding of money, and the desire to make financial services more accessible.

The influence of financial technology on the banking industry and its effects on financial services have provided a stimulus for the advancement of the banking sector. In contemporary banking, the presence of an online platform, a mobile application, and a personalised user account has become customary. Consequently, the user anticipates access to various amenities, such as notifications via SMS regarding fund transfers and the capacity to oversee their account through digital means. The prospect of settling bills, encompassing utilities and penalties, through online means has become a commonplace occurrence that no longer elicits surprise. The realm of financial technology is presently advancing at a pace that surpasses the mere experimental stage that traditional banking institutions are currently contemplating. It is highly probable that certain novel advancements shall establish themselves, while others may not, owing to the competitive nature of emerging financial enterprises. In order to contend with fintech ventures, financial institutions seeking to enter a nascent market must expeditiously restructure their operations or explore potential avenues for partnership with fintech enterprises. Notwithstanding the variances and challenges, it is plausible for fintech enterprises and financial institutions to derive mutual advantages through collaboration. Throughout their extensive existence, banks have amassed a wealth of experience in engaging with their clientele and have established a comprehensive suite of financial sector functionalities.

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**Kavya Y Rand Anitha S Yadav**

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Determinants of Investment Decisions of Working Women Post Covid 19 Outbreak - A Systematic Literature Review

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ABSTRACT

Every person must make important decisions about saving and investing. Women who work in particular are very cautious and weigh a variety of determinants while making financial decisions. Any unusual circumstances cause the economy to undergo a great deal of change, which affects everyone's income differently. As a result, we observe changes in individual investors' investment choices due to shift in investment requirements. With regard to working women's investment decision determinants, the study aims to identify the research gap from the existing literature and to provide a conceptual model. To conduct systematic literature review, the research publications published after 2017 and a few studies published after the Global Financial Crisis of 2008 are also taken into consideration. The study's findings offer financial institutions a road map for overcoming challenges in offering a variety of customers the financial products they require and the outcome is applicable to any sort of predicament that working women investors meet, not only the Covid dilemma.

Keywords: Working Women Investment, Investment determinants, Covid 19 Outbreak, Financial Crisis and financial Products.





INTRODUCTION

Financial independence is the key to successful investing for women, so it's critical for them to understand what works best for them when it comes to making the right investments. Women's investment criteria are based on a variety of factors, ranging from the availability of surplus funds to risk tolerance. Asset allocation, low-cost index funds, and risk-managed investments are some common investment strategies for women. Knowing what investments to make and feeling at ease with the process are critical in assisting women in reaching their financial goals. Women may need to consider the various financial crises that can affect their investment criteria based on return expectation in addition to tailored investment criteria. During a financial crisis, it's critical for women to stay informed about economic trends and be ready to adjust their investments accordingly. This could imply shifting some of their investments into more secure asset classes like cash, government bonds, and gold.

Covid-19 has caused a global financial crisis. The COVID-19 pandemic has presented investors with a one-of-a-kind challenge. It can be difficult to make the right investments when the economy is uncertain. Women should be aware of the risks of investing during a pandemic and take precautions to safeguard their investments. Women can protect their investments and weather the pandemic by taking the necessary precautions. In recent years, the financial services industry has grown and now provides a diverse range of investment opportunities. The current study reviews the various published research studies on investment decision and working women's investment behaviour, as well as the impact of Covid 19 disruption on those decisions, in order to recommend a conceptual model by identifying the investment decision determinants of working women following the Covid-19 pandemic outbreak.

The effects of the COVID-19 outbreak have frequently been compared to those of the 2008 financial crisis, which has been thoroughly researched in terms of interrelation and overabundance effect (Kenourgios, 2011). Investors are vulnerable to sensational and unexpected news during a crisis. During a crisis, an abundance of information may make it difficult to make wise decisions and limit the trading activity of individual investors.

Research Questions:

1. What are the key determinants influencing working women investors during financial crises, as evidenced by research articles?
2. What are the existing research gaps in the identified area, and what are the components of a proposed conceptual model for further study?

RESEARCH METHODOLOGY

In the present study, an analysis of available literature was done based three constructs:

- Working women's Investment determinants
- Individual investment determinants and Financial Crisis
- Individual Investment determinants and Covid 19 pandemic

Different articles published on websites like Google Scholars, Research Gate, Shodhganga, and SSRN that are open source databases and search engines are taken into consideration. The first study on individual investor behaviour was discovered in 1970, while studies on gender differences in investment decision-making began in 1995. There have been numerous studies on working women's investment decisions since the year 2000. For the study on working women and investment behaviour as well as the study on individual investment behaviour and financial crises, only works published from 2017 onward were taken into consideration. This study has conducted a systematic literature review to examine the factors influencing working women's investment choices after the Covid-19 outbreak. To gather the most pertinent and recent research on the subject, a thorough search strategy based on the PRISMA framework was used. To find pertinent research articles about the Indian region in academic and grey literature sources, a thorough search strategy was developed. This involves looking through particular databases,



**Vasudha Srivatsa and Uma Devi Ananth**

including Google Scholars, Research Gate, Shodhganga, and SSRN, as well as pertinent websites, including those of governmental and non-governmental organisations. 'Investment decisions', 'women', 'working women', 'Covid-19', 'outbreak', 'determinants', 'crisis', 'criteria', and 'India' are among the keyword terms used for the search. The review includes all studies that satisfy the selection criteria. The criteria will include background research on India, publications between 2007 and 2021, and publications following the 2008 financial crisis that focused on the factors influencing working women's investment choices following the Covid-19 outbreak.

DISCUSSION

According to a review of the literature, working women investors make irrational decisions when it comes to making investments. Numerous factors have been found to have an impact on how much they save and invest. Age, income, marital status, and educational background are just a few of the demographic variables that influence how individual investors invest. The variables that influence an investor when making investments change depending on the study's focus. The primary influencing factors of investments were risk tolerance, liquidity preferences, investment experience, way of life, and level of confidence.

Research Gap

Based on psychological and demographic factors, professional women are assessed at a justifiable rate with regard to their investment behaviour. The impact of financial factors is, however, rarely researched. Additionally, no research has been done specifically on working women's investment criteria and their choice of portfolio since the COVID-19 pandemic.

CONCLUSION

Investors can choose from a wide variety of investment opportunities thanks to the financial services industry of today. The first step in reaching your destination is planning. Plans that are clearly defined can help individuals achieve their personal wealth-generation goals, which will boost economic growth. Investment choices are influenced by a variety of factors. Depending on their own priorities, people decide what their goals should be. The research on the actions of working women who are individual investors was examined in this study. In order to manage their wealth, investors may find it very helpful to understand their saving and investing habits. Policymakers, investment firms, researchers, and company managers may also find it helpful in preparing responses to different investor behaviour.

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Vasudha Srivatsa and Uma Devi Ananth

Table.1. Review

SI No	Name of the author	Year	Purpose	Result
1	Ritika, Himanshu, Nawal Kishor	2022	The goal of the study is to determine the causes and effects of Covid-19 and the variables influencing investment behaviour in the South Asian economy.	The findings show that Covid-19 is the primary factor influencing investor perceptions of the market, investor strategy, psycho-physiological health outcomes, and financial stress.
2	Mohd Ashraf Yatoo, Dr R S Waghela	2022	To ascertain the level of financial literacy among working women	The study discovered a significant relationship between working women investors' age, education, and level of financial literacy, all of which have an impact on their investment behaviour.
3	Roziyah Mohd Rasdi, Zeinab Zaremohzzabi eh and SeyedaliAhrari	2021	To investigate how the pandemic's financial instability has spread	The study's findings indicate that during a pandemic, financial insecurity spills over into the reciprocal relationships between burnout and work disengagement, implicating interference with moonlighters' performance in the organisation.
4	Kirti Goyal and Satish Kumar, Purnima Rao, SisiraColomba ge, Ankit Sharma,	2021	To examine how the COVID-19 containment measures affected people's finances and their ability to weather such hardship.	According to the survey, even among those with higher incomes, poor retirement planning, unpaid loans, and underdiversified investments are impeding financial resilience. Affected most are people with lower incomes.
5	Himanshu1 Ritika2 Nikhath Mushir3 Ratan Suryavanshi,	2021	This study aims to examine how Covid-19 affects how individual investors decide how to allocate their portfolios.	The investment preferences have changed during COVID-19. Assets with no risk become more appealing. The most popular investment option is insurance, which is followed by gold, bank deposits, and public provident funds (PPF).
6	Angelin S. Kiruba1 and Dr.S.Vasantha	2021	To determine the psychological factors that investors considered when making stock market investment decisions during the COVID-19 growth stage	Herding, vaccination updates, fear, and risk perception have a significant impact on how investors make investment decisions.
7	Pooja Chaturvedi Sharma, Priya	2021	To learn how women investors are aware of different investment opportunities and what influences their investment choices	The findings show that a number of important factors, including attachment, informational source, risk, quality of life, and independent decisions, have a significant impact on the choice of investment avenues.
8	Arpita Gurbaxani, Rajani Gupte	2021	To understand how the COVID-19 pandemic has impacted investment and financial decisions of individuals	There is decreased investment and decline in household income and retaining cash for emergencies





Vasudha Srivatsa and Uma Devi Ananth

9	Dr. Veena M	2020	To comprehend how the COVID-19 pandemic has influenced peoples' financial and investment choices	Factors related to demographics, society, and psychology have a significant impact on how working women invest.
10	Mohamad Fazli Sabri, T.Syahrul Reza, Rusitha Wijekoon	2020	To ascertain working women's financial management, saving, investing, and financial well-being (FWB)	Working women are content with their current financial situation, had adequate financial resources, felt secure in their retirement, had no trouble making ends meet, and were responsible for managing their own finances.
11	Sanjeevni Gangwani, Haya Ali Al Mazyad	2020	To research how working women's social and financial traits affect their investment choices.	The majority of working women make investments for their families' safety and security.
12	Nelson Mathew, Sebin Joseph, Dr Cyriac Joseph	2020	To examine the part that working women play in Indian families' financial decision-making	Working women invest in risk-free products like bank deposits and savings deposits, among others.
13	Ms. Anita. H. Balsara	2019	To determine working women's investment behaviour and preferences	Working women favour safer and less risky investment options. Women investors prioritise investments in LIC, FD, RD, and gold the most.
14	Maheta Leena	2019	To ascertain the degree of awareness and the primary investment instruments that working women prefer.	A woman saves money primarily out of "Precautionary" considerations.
15	Nadia Asandimitra, Tony Seno Aji, Achmad Kautsar	2019	To assess working women's level of financial literacy	It demonstrates that working women have high financial literacy and discipline. They have control over their finances and believe that financial planning is necessary to achieve investment success.
16	Poonam Sharma, Navdeep Kaur	2019	To investigate the factors affecting women's investment stance in the education sector	Women working in the education sector value safe investment options, financial literacy, stock market investments, post office schemes, bank deposits, tangible assets, risk-taking prowess, and concern for financial issues.
17	Manish Sharma, Hima Bindu Kota	2019	To investigate how working women behave when making investment decisions	Future security, child's education, tax savings, retirement, and family emergencies round out the top 5 reasons working women invest. Lack of confidence and lack of knowledge
18	Javed Iqbal Bhabha	2018	To determine the elements or determinants behind working women's savings and investment behaviour	It has been discovered that Working women have not made any sizable investments or savings. The most important criteria for investing are return on investment.





Vasudha Srivatsa and Uma Devi Ananth

19	Dr.V. Ramanujam and Dr.T.Viswanathan	2018	To comprehend how female executives invest their money	Source of information, financial advisor assistance, investor behaviour, method implementation, and level of investment activity are the key determinants on investors' overall attitude towards investing.
20	Dr. Meenakshi Anand	2018	To analyse working women's investment behaviour	They favour financial products with low risk, like bank deposits. The key goal is to create wealth.
21	Pooja Chaturvedi Sharma, Priya	2018	To examine working women's knowledge of and attitudes towards mutual fund investing	It unveils that factors with a greater influence on investors' perceptions are fund characteristics, creditability, convenience, success factors, and fund family.
22	P. Vanishree Sah	2017	To comprehend the investment goals, information sources, factors influencing decisions, and approaches taken by women investors	Women investors are more likely to focus on safe investment options like bank deposits because they are risk-averse.
23	Arvid O. I. Hoffmann and Thomas Post	2010	To comprehend how investors felt during the 2008 financial crisis	Despite the crisis, individual investors maintain their active trading habits and do not de-risk their investment portfolios.
24	Ulrike Malmendier, Stefan Nagel	2011	To determine whether personal exposure to macroeconomic shocks has an impact on financial risk taking	Less inclined to participate in the stock market and less willing to take financial risks
25	Tabea Bucher-Koenen, Michael Ziegelmeyer	2011	How the recent financial crisis has affected private households and how it has affected those households' financial decisions	If people don't participate in the market recovery and end up with lower returns in the long run, this reaction to short-term losses could have long-term repercussions.





Vasudha Srivatsa and Uma Devi Ananth

PRISMA framework chart for SLR:

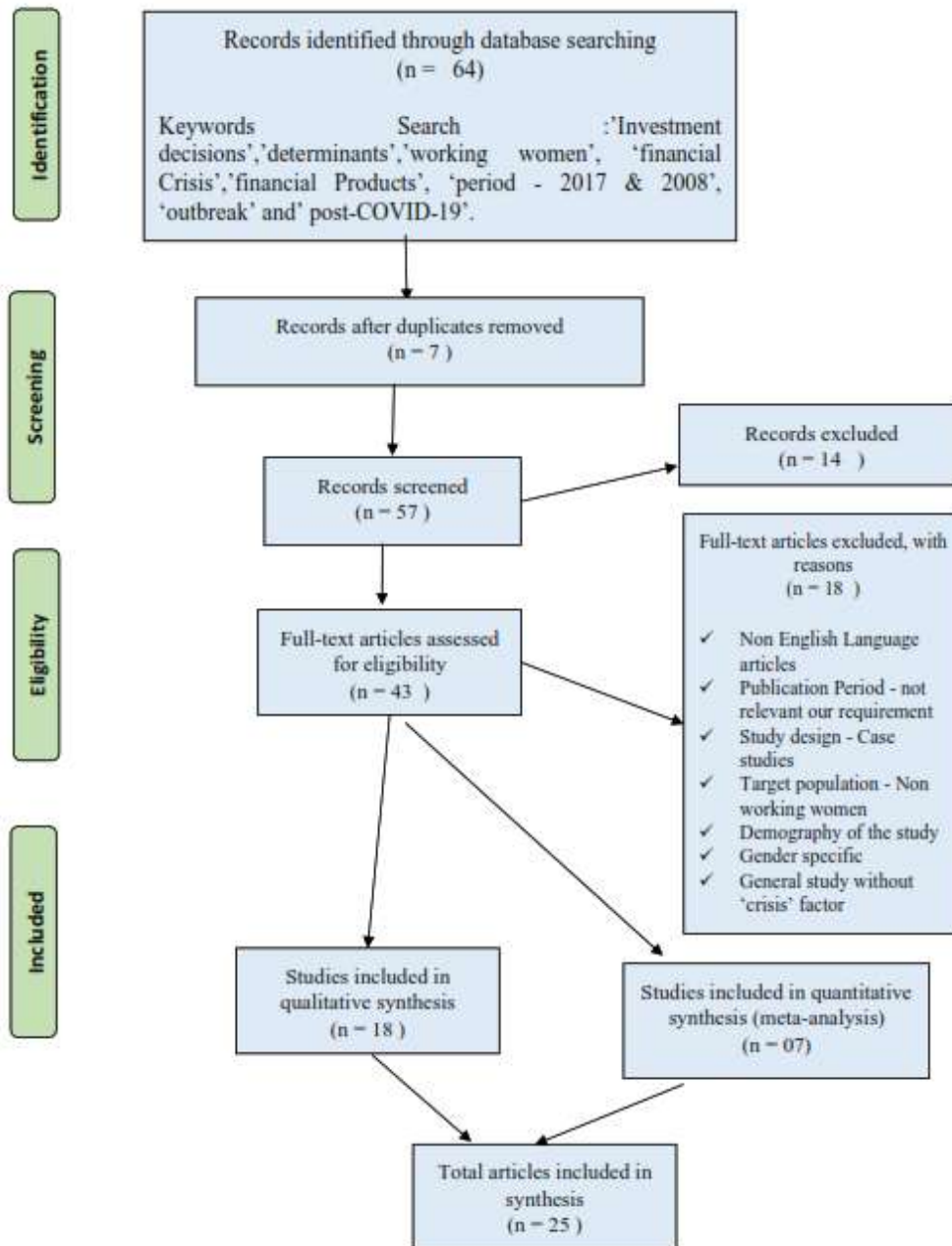


Fig.1. PRISMA framework chart for SLR





Vasudha Srivatsa and Uma Devi Ananth

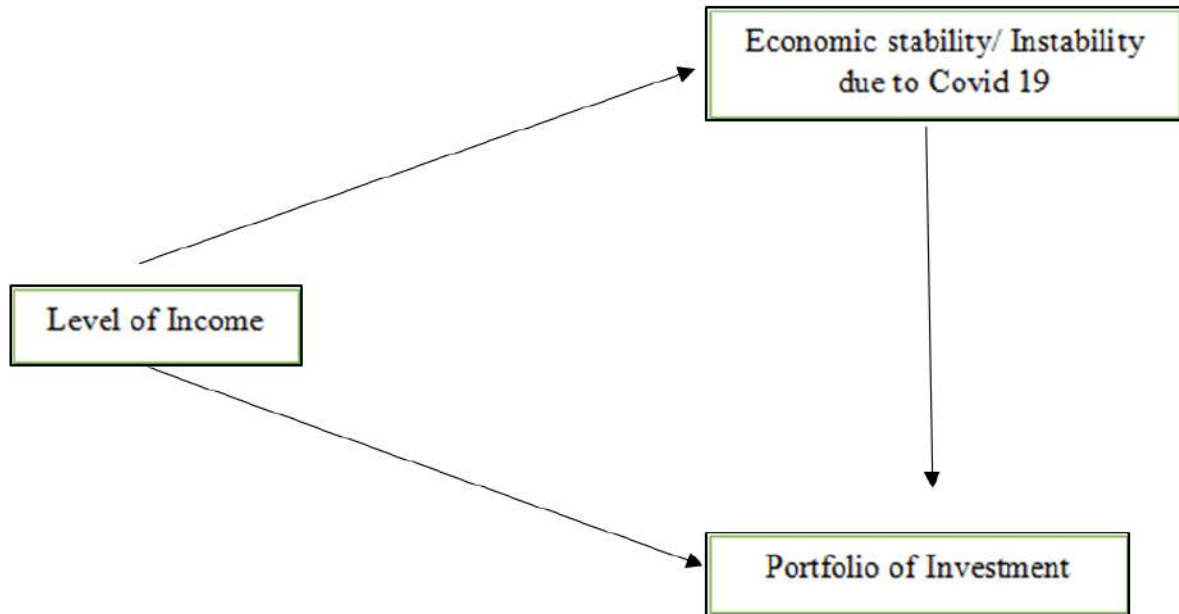


Fig.2.Proposed conceptual Model





Financing Strategies for Rural Economic Development in Mandya District: A Comparative Analysis of Government and Non-Government Organizations

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ABSTRACT

Gender equality is both a fundamental human right and necessary for a peaceful, thriving world. However, there are still considerable obstacles for women and girls everywhere in the world. Typically, women are underrepresented in positions of authority and decision-making. They are underpaid for equivalent work, and they frequently encounter obstacles at work that are legal or otherwise. This study explores available financing schemes of both government and non government organizations to enhance economic development of women empowerment in rural areas of Mandya district. The research work identify the types of financing schemes available, their target beneficiaries, and the extent of their impact on the local rural economy. The study employs a hybrid-methods approach, including surveys, interviews, and desk research, to collect data from relevant stakeholders, including government officials, non-governmental organizations, and local community members. The study also identifies various challenges and limitations in the implementation of these schemes, such as bureaucratic procedures and insufficient financial resources. The research provides insights into the potential of financing schemes to contribute to rural economic development and offers recommendations for improving their effectiveness in the future.

Keywords: Gender Equality , Women Upliftment , Organization , Employability

INTRODUCTION



**Indira and Vijayasree**

The empowerment and autonomy of women are crucial for sustainable development, and education is a critical means of achieving this goal. Unfortunately, women in maximum regions compared to men, obtain less formal schooling, and their knowledge, abilities, and coping mechanisms often go unrecognized[1]. This results in power imbalances that abstain women from attaining healthy and fulfilling lives at all levels of society. Enhancing the status of women enhances their decision-making ability and is vital for the long-term success of population and development programs[2][3]. This research paper aims to assess the efficacy of rural women empowerment schemes in Mandya, with a particular focus on comparing the effectiveness of government and non-governmental initiatives[4]. The study employs a mixed-methods research design that combines the gathering and analysis of quantitative and qualitative data[5]. The research methodology includes a survey of rural women beneficiaries of the schemes, interviews with program managers, and document analysis of policy documents and reports[6][7]. The data collected will be analyzed using appropriate statistical methods, and the findings will be presented in a comparative analysis of the different financing strategies employed by the government and non-governmental organizations[8][9]. The research will provide insights into the strengths and weaknesses of different financing strategies and initiatives, and offer recommendations for improving the design and implementation of rural women empowerment schemes to promote sustainable development and reduce poverty[10]. The main objective of the work aims to assess the effectiveness of rural women empowerment schemes in Mandya, with a comparative analysis of government and non-government organizations. Some of specific objectives of the paper is,

1. List the funding options used by governmental and non-governmental organisations in Mandya to further the empowerment of rural women
2. Analyze the key factors that contribute to the efficacy of rural women empowerment schemes.
3. List the strengths and weaknesses of the different financing strategies and initiatives, and Methods and discussion on effectiveness government and non-governmental organizations in promoting rural women empowerment in Mandya

LITERATURE REVIEW**Steps For Women Empowerment In Mandya District**

In India, reducing poverty and empowering women are the top priorities. The Indian government designated 2001 as the "Year of Women Empowerment." The Government of Karnataka introduced a number of programmes with the goal of empowering women and upliftment of the underprivileged in order to support this mission. One such plan is the Stree Shakthi Programme (SSP). Introduced in 2000–2001, it has been a success story up until this point. The current study looks at the program's impact and beneficiary profile. 145 rural women from three villages in Karnataka's Pandavapura taluk were interviewed as part of the primary data collection.. In order to increase awareness among underprivileged women who have not yet joined this movement, the study advises policy makers to revise and update the SSP's policies[11].

Role of Government and Non-Government Organizations

It is essential for the government and non government organizations to act in empowering women and girls in social and economic sectors, should take the following actions to eliminate disparities between men and women:

- Creating structures that allow women to participate equally and be fairly represented in all spheres of public life, including politics, in every community and society, and giving them the means to express their demands and concerns.
- Encouraging women to reach their full potential through education, skill-building, and employment while prioritising the eradication of poverty, illiteracy, and poor health among women;
- Enabling women to combine the responsibilities of childbearing, breastfeeding, and childrearing with employment through legislation, regulations, and other suitable measures [12].



**Indira and Vijayasree****Benefits for Economic Empowerment of Women**

The 2030 Agenda for Sustainable Development and the Sustainable Development Goals, in particular Goal 5 on achieving gender equality and Goal 8 on promoting full and productive employment and decent work for all, as well as Goal 1 on ending poverty, Goal 2 on ensuring food security, Goal 3 on ensuring health, and Goal 10 on reducing inequalities, must be achieved in order to achieve these goals [13]. Increased educational attainment among women and girls promotes inclusive economic growth and the economic empowerment of women. For women's and girls' health and wellbeing, as well as their income-generating opportunities and participation in the formal labour market, education, upskilling, and re-skilling throughout life are essential. This is especially true in light of the rapid technological and digital transformations affecting jobs. About 50% of the economic growth in OECD nations over the past 50 years can be attributed to higher educational attainment. But for the vast majority of women, huge advancements in education have not led to better outcomes on the job market [14].

RESEARCH METHODOLOGY

The research methodology adopted for the study on selected financing schemes of government and non-government organizations for economic development in rural areas of Mandya district could involve an approach using a combination of qualitative and quantitative research techniques. The following research methodology adopted for this study was, Define research objectives and question, Literature review, Research design, Sampling and

Data collection: Collect data using a combination of primary and secondary sources.

Primary data could be collected through surveys, interviews, and focus group discussions with beneficiaries, government officials, and non-government organizations. Secondary data could be collected from relevant government reports and documents. A structured questionnaire with both open-ended and closed-ended questions was used to gather the primary data. Various facets of women's empowerment, such as economic, social, and political empowerment, are covered in the questionnaire. Additionally, focus groups with the self-help groups were held to collect additional in-depth qualitative information on how GO and NGO facilities affects women's empowerment. Secondary data was collected through a review of relevant literature, reports, and government policies related to microfinance and women's empowerment. Descriptive and inferential statistics were both used to analyse the effectiveness of schemes reach the rural women and its effectiveness. Inferential statistics were used to assess the hypotheses relating to the effect of microfinance on women's empowerment, while descriptive statistics were employed to provide the frequency distribution and percentages of the data obtained. In order to gather information on different facets of women's empowerment, including economic, social, and political empowerment, a structured questionnaire was created. Both closed-ended and open-ended questions are present in the survey. More in-depth qualitative information on the effects of both government and non-government financing schemes on women's empowerment was gathered through focus group talks. A moderator facilitated the focus group talks, which involved participants from the self-help groups. Key topics were identified when the discussions were audio recorded, transcribed, and evaluated.

Data Analysis

Analyze the data using appropriate statistical software to identify patterns, relationships, and trends. Qualitative data could be analyzed thematically, identifying patterns and themes from the interview and focus group discussions. Some of non government organization working at Mandya are Gaganachukki Mahila Kalanjia Okkuta, Gothami Foundation Women's Development & Empowerment, Janatha Vidya Samsthe, Karnatak Hindi Sabha Education & Literacy, Karuna Mahila Mandali, Women's Development & Empowerment, Vikasan, Mahila sanghas, Jyothir Vikasan and many more.





Indira and Vijayasree

INTERPRETATION AND PRESENTATION OF RESULTS

Interpret the research findings and present the results in an organized and coherent manner. Use tables, graphs, and charts to visually present the results. Conclude the study by summarizing the findings and make recommendations for improving the effectiveness of financing schemes for economic development in rural areas of Mandya District.

DISCUSSION

The study provide valuable insights into the effectiveness of such schemes in promoting economic development in the region. The following are some of the potential discussion points that could arise from such a study and this expel the important step towards understanding the impact of NGOs in rural development. The study provides valuable insights into the various financing schemes and models adopted by NGOs to support the economic development of rural areas.

The impact of financing schemes: The study could provide a detailed analysis of the impact of financing schemes on the economic development of rural areas in Mandya district. This could include an assessment of the success of such schemes in improving the livelihoods of beneficiaries, the contribution of the schemes to the local economy, and the challenges faced by the beneficiaries in accessing and utilizing the financing.

The role of government in financing economic development: The study could provide insights into the role of the government in financing economic development in rural areas. This could include an analysis of the government's funding priorities, the effectiveness of government-led financing schemes in meeting the needs of the local population, and the potential for government-private sector partnerships to enhance the impact of such schemes.

The challenges of financing economic development in rural areas: The study could highlight the challenges faced by financing schemes in promoting economic development in rural areas. This could include an assessment of the challenges faced by beneficiaries in accessing and utilizing the financing, the challenges faced by government and non-government organizations in implementing such schemes, and the potential for innovative financing mechanisms to overcome these challenges.

The potential for scaling up financing schemes: The study could provide insights into the potential for scaling up financing schemes to promote economic development in other rural areas of Mandya district and beyond. This could include an analysis of the factors that have contributed to the success of such schemes, the potential for replication in other contexts, and the challenges that need to be overcome to achieve scale and also insights into the potential for financing schemes to promote economic development in rural areas, and the challenges that need to be overcome to achieve this goal. Such insights could inform policy and programmatic interventions to enhance the effectiveness of financing schemes and promote economic development in rural areas.

NGOs: Even the role of non government organization place a vital role in shape the women empowerment in rural area. NGOs have been successful in providing financial support to rural entrepreneurs, especially women entrepreneurs. The microfinance model adopted by NGOs has enabled rural entrepreneurs to access small loans at low interest rates, which has helped them establish and grow their businesses. This has resulted in the creation of job opportunities, increased income levels, and improved living standards in rural areas. NGOs have been successful in promoting sustainable agriculture and natural resource management in rural areas. They have implemented various programs to promote the use of organic farming techniques, conservation of soil, and efficient water management practices. They have implemented various programs to provide vocational training, improve literacy levels, and promote access to quality education. These programs have helped to improve the employability of rural youth and promote economic development in rural areas.



**Indira and Vijayasree****CONCLUSION**

There has been substantial global progress towards women's empowerment, but there is still a long way to go. Women still experience gender-based violence, discrimination, and unequal access to political representation, employment, and education. It is critical to recognise that the empowerment of women is a human rights problem that affects everyone, not just women. Increased economic growth, better health and educational performance, and stronger communities are just a few advantages of empowering women. However, for women, that expansion does not inevitably result in a decline in gender inequality. In contrast, it's estimated that gender disparities cost the economy about 15% of GDP. As a result, women's empowerment is a crucial problem that calls for continual work and steadfast dedication from individuals, groups, and governments. Together, we can build a society where women are respected, cherished, and empowered to make decisions that affect both their own lives and the world they live in. Among the specific results of the paper are, Research aimed to assess the impact of financial schemes of GO & NGOs relating to rural women's suffrage. According to the report, self-help groups (SHGs) have been essential in empowering women, enabling them to become more financially independent and to participate more actively in decision-making processes within their households.

1. The study also found that women who were members of SHGs, Shrishati government monitor schemes have greater access to credit, which enabled them to start their own businesses and generate additional income.
2. The study also acknowledged that there were still challenges to be addressed, such as access to credit, financial literacy, and infrastructure development, in order to fully realize the potential of macro & microfinance for women's empowerment.
3. The study uses a mixed-methods research design that involves the gathering and analysis of both quantitative and qualitative data.
4. The document analysis will be used to review policy documents, reports, and other relevant literature on rural women empowerment schemes in Mandya.

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Indira and Vijayasree

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A Conceptual Study on Non-Performance Assets of Banking Sector in India.

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ABSTRACT

A flourishing economy requires a strong banking sector. Other industries might suffer as a result of the banking industry's failure. Non-performing resources are one of the main issues for banks in India. The issue of non-performing assets has been extensively discussed for the global financial system. The problem of non-performing loans (NPAs) is affecting the economy as a whole as well as the banks. In point of fact, the high number of non-performing loans (NPAs) in Indian banks is only a sign of the industry's and trade's overall health. The analytical research design is used in this study, and official bank websites are used to collect secondary data. In order to determine the level of Non-Performing Assets in Indian banks, two public sector banks—SBI and PNB—and two private sector banks—ICICI and HDFC—are analyzed and their NPAs are compared here. In conclusion, it was observed that, around 1987, the majority of loans became non-performing assets (NPAs) on bank books, and it wasn't until 1991-92 that the RBI developed provisioning standards, which resulted in some improvement in the banking sector. The perception made and examination was completed with better comprehension of present and past situation of NPA the board. Additionally, after a thorough examination of the findings, recommendations are made.

Keywords: NPA, Banking Sector, RBI, Market discipline , Supervisory Review process, Minimum Capital Requirement.





INTRODUCTION

Non-performing resources (NPAs) are credits or advances that have been delegated uncollectible or have stayed neglected for a specific timeframe. They are frequently regarded as bad debt and are discharged by the lending institution. The lender must either raise interest rates or reduce the amount of credit they offer to make up for the amount written off, which is regarded as a loss. Loans, credit cards, mortgages, and any other type of loan that has not been paid back for a predetermined amount of time are all examples of NPAs. How much time required for a credit to be viewed as a non-performing resource shifts relying upon the sort of advance, the provisions of the credit, and the moneylender. A loan is typically categorized as a non-performing asset (NPA) if payments have not been made for at least three months.

Because they reduce the amount of money that an institution is able to lend out, non-performing loans (NPAs) can have a significant impact on the financial health of the institution. Lenders may even be forced to write off a loan, resulting in a complete loss, in some instances. If the loan was particularly large or the lender had a lot of NPAs, this can be especially damaging. Non-Performing Resource is characterized as the advances which are in risk of being default. A loan is considered a non-performing asset (NPA) if the borrower has failed to make principal and interest payments for at least 90 days. A situation of this kind is known as a "non-performing loan." NPAs have an impact on profitability as well as the smooth flow of credit, as higher NPAs result in increased provisioning, which reduces profit. These are advances and loans whose interest and principal payments have not been made in more than 90 days. The person's account is marked as out of order in this instance. The interest payment may be due for two harvest seasons if the loan is given to an individual for agricultural purposes. Companies and financial institutions both use non-performing assets (NPAs) to evaluate their non-performing assets, and a higher NPA indicates poor financial performance on the part of the institution.

NPA as Characterized by RBI

When the bank stops receiving income from it, any asset, including leased assets, can become a Non-Performing Asset. It is a loan or advance where:

- i. The principal amount or interest may remain unpaid for up to 90 days.
- ii. As described below, the account may continue to be out of order despite an overdraft or cash credit.
- iii. In the event that the bills are bought or limited then they stay late for more than 90 days period.
- iv. The portion for two of the yield seasons for brief length of harvests stay late whether it is head or interest. The portion for a really long time term crops in this way stays past due whether its advantage or head sum.
- v. As a result, the installment is late by one crop season for long-term principal or interest crops.
- vi. Regarding a securitization transaction that was carried out in accordance with securitization guidelines issued on February 1, 2006 For more than

90 days how much which like of liquidity office will stay extraordinary. Arrangement of NPAs:

NPAs must be further categorized by banks as Substandard, Doubtful, and Loss assets.

1. Inadequate assets: Resources which has remained NPA for a period not exactly or then again equivalent to a year.
2. Uncertain assets: If an asset has been in the substandard category for more than a year, it would be considered doubtful.
3. assets lost: "Loss asset is considered uncollectible and of such little value that its continuance as a bankable asset is not warranted, although there may be some salvage or recovery value," the Reserve Bank of India states. These might be pointed out by the RBI inspectors, the auditor appointed by the Bank, or the statutory auditor of the Bank.





REVIEW OF LITERATURE

1. Narula and Singla (2014) look at Punjab National Bank's non-performing assets and how they affect profitability, as well as the relationship between total advances, net profits, gross and net NPA. The research makes use of Punjab National Bank's annual reports for six years, from 2006-2007 to 2011-2012. These papers infer that there is a positive connection between Net Benefits and NPA of PNB. This is because of the bank's poor management.

2. Sat friend (2014): This paper aims to determine the actual definition of non-performing assets (NPA), as well as the causes of high NPAs and their impact on Indian banking operations.

3. DR. This paper, written by Partap Singh (2012), tries to look at trends in NPAs, as well as their causes and effects. Bank credit risk is indicated by nonperforming assets. In light of the growing competition in the banking industry, this paper compares the advances and non-performing assets of public and private sector banks. The management of NPA has improved, as the study demonstrates."

Statement of the Problem

The examination concentrate on attempts to talk about and dissect the degrees of NPA in open area and confidential area banks. Depending on the level of NPA, the banks' substance will be threatened. It would be difficult for banks to continue operating if they had a lot of accounts that turned out to be non-performing loans. The banks which have higher NPA can lose the certainty of the client and furthermore it would influence the liquidity, benefit and dissolvability position of the bank.

Objectives of the Study

To study the causes and impact of NPA on the performance of banks and the economy.

To compare the levels of NPA of private sector and public-sector banks.

To recommend solutions to improve the situation of NPA in the economy.

Data Collection

The NPA standings of State Bank of India and Punjab National Bank were used as samples for the study for public sector banks and HDFC and ICICI were used as samples for the study for private sector banks.

The data has been collected from the bank's financial statements that are available on the bank websites.

Limitations Of The Study

I. The study is limited to two public sector and private sector banks .

II. The period of the study is limited to 5 years.

INDIA'S NPA Circumstance

"The non-performing resources (NPAs) circumstance in India has been an area of worry for the financial area for quite a while. Banks are confronting mounting tension from the Save Bank of India (RBI) to tidy up their accounting reports and lessen pushed resources. All Scheduled Commercial Banks (SCBs) in India had gross non-performing assets (GNPAs) totaling Rs. 8.41 lakh crore, or a 3.9% increase from last year. Public area banks have borne the brunt of the NPA emergency with their GNPAs arriving at Rs.7.95 lakh crore in Walk 2020. A number of banks are unable to meet the RBI's regulatory requirements because of the rise in non-performing loans (NPAs). This has resulted in lower profitability and capital adequacy ratios. The public authority has found a way various ways to handle the issue, including the send off of the Bankruptcy and Chapter 11 Code (IBC) in 2016 and the setting up of the Resource Quality Survey (AQR) in 2015. The RBI has also implemented a number of measures, including the Strategic Debt Restructuring (SDR) scheme and the Sustainable Structuring of Stressed Assets (S4A) scheme. Despite the fact that the problem still persists, these measures have contributed to a decrease in the number of NPAs in the banking system."



**Sangeetha****Non Performing Assets Management.**

Non-performing resources (NPAs) the executives is the most common way of distinguishing, checking, and settling the monetary and functional issues related with NPAs. Because NPAs can have a significant impact on a bank's financial performance and overall health, it is an essential part of the risk management process. As this can assist banks in reducing losses and safeguarding their balance sheets, they must take a proactive approach to managing NPAs. The early identification of potential NPAs and the implementation of corrective measures are two aspects of NPAs management. In order to identify and address any potential issues as soon as possible, banks must also ensure that they have adequate systems in place to monitor and manage NPAs. In order to stop NPAs from occurring in the first place, banks must also make certain that they have adequate internal controls in place. This incorporates the execution of sound loaning rehearses, the support of appropriate credit risk the board frameworks, and the utilization of stress testing and other prescient investigation. Additionally, banks must make certain that they have the necessary personnel and technology to manage NPAs. In addition, banks need to make certain that they have enough capital and liquidity to cover any losses they might incur as a result of NPAs.

The reasons behind the rise in NPAs in India.

1. Unfortunate credit evaluation framework: Since Indian banks have not implemented a strict credit appraisal system, the number of non-performing assets has increased.
2. High rates of interest: Borrowers have had difficulty repaying their loans due to high interest rates, which has led to an increase in NPA.
3. Absence of sufficient capital: The ability of banks to write off bad loans has decreased as a result of inadequate capitalization of their balance sheets.
4. Economy contraction: The stoppage in the economy has affected the capacity of borrowers to reimburse their advances, bringing about an expansion in NPAs.
5. Absence of convenient mediation: NPAs have increased as a result of banks' failure to identify and restructure stressed assets in a timely manner.
6. Over-leveraging: NPAs have increased as a result of banks providing borrowers with excessive leverage and not properly assessing the risk associated with loans.
7. Administrative changes: NPAs have increased as a result of regulatory changes like the Asset Quality Review (AQR) in 2015 and the Insolvency and Bankruptcy Code (IBC) in 2016.

Explanation of the Expansion IN THE Degrees OF NPA .

- i. Banks had begun to sell large amounts of unsecured loans in order to combat competition.
- ii. Five industries: textile, aviation, mining, and infrastructure account for the majority of the NPA because PSB provides the majority of loans to these industries.
- iii. Approximately 80% of industries receive credit from public sector banks, which accounts for a significant portion of NPA. Kingfisher received a substantial loan from SBI last year during its financial crisis, which it was unable to repay.
- iv. It is challenging for banks in India to recover these loans from both corporate and non-corporate customers due to the slow legal system and the absence of a bankruptcy code.
- v. The general slowdown of the economy as a whole. For instance, the Indian economy slowed down after 2011, causing NPAs to grow more quickly.
- vi. Banks didn't direct sufficient possibility arranging, particularly for relieving project risk. They did not account for possible outcomes like the failure of gas projects to guarantee gas supply or the highway land acquisition process.
- vii. GDP decline - Between the early 2000s and 2008, the Indian economy was experiencing a boom. During this period Banks particularly, Public area banks loaned broadly to corporate. "However, a slowdown in the global economy, the prohibition of mining projects, delays in environmental permits affecting the power and iron and steel sectors, volatility in raw material prices, and a lack of were the primary factors that contributed to the decline in profits for the majority of corporations. This is the primary reason for the rise in non-performing loans (NPA) among public sector banks and has impacted their



**Sangeetha**

ability to repay loans. Rebuilding of credit office was stretched out to organizations that were confronting bigger issues of over-leverage & insufficient productivity. This issue primarily affected public sector banks.”

Effect OF NPA „S on Indian Economy

The non-performing resources (NPAs) circumstance in India is a central issue for the financial area and essentially affects the Indian economy. Because of NPAs, banks' profitability and capital adequacy ratios have decreased, making it harder to get credit and costlier to borrow money. The ascent in NPAs has likewise diminished the certainty of financial backers in the financial area, prompting a lessening in the progression of assets into the area. This has thusly affected the capacity of banks to fund tasks and ventures, bringing about a stoppage in financial development. The situation has also had an effect on the government, which frequently has to step in to resolve NPA issues. This has brought about an expansion out in the open spending, prompting a broadening of the monetary shortfall. The circumstance has also resulted in a d... ACTIONS TAKEN BY THE GOVERNMENT TO CONTROL NPA S.

1. Making a Focal Vault of Data on Huge Credits: An integrated information sharing platform for all banks and financial institutions, the Central Repository of Information on Large Credits (CRILC) has been established by the Indian government. Using this platform, potential NPAs can be detected early on and corrective actions can be taken promptly.
2. Provisioning for NPAs is required: Banks are now required by the Reserve Bank of India (RBI) to put money aside for non-performing assets (NPAs) through provisioning. Banks need to save assets for NPAs at a foreordained rate and provisioning for NPAs must be produced using their yearly benefits.
3. Bank Recapitalization: In order to assist public sector banks in recovering NPAs and improving their balance sheets, the government has provided capital.
4. Companies that reconstruct assets: These businesses were established with the sole purpose of resolving NPAs and specialize in the resolution of NPAs. They acquire NPAs from banks and attempt to resolve them through reorganization or sale to additional investors.
5. Code of Insolvency and Bankruptcy: The Insolvency and Bankruptcy Code (IBC) was created by the government to provide a framework for resolving NPAs. The IBC facilitates prompt resolution of NPAs and includes a time-bound resolution procedure.
6. Regulations include: The RBI has presented a few administrative measures like the resource quality survey (AQR) and brief remedial activity (PCA) to help banks in recognizing and settling NPAs. Banks can better manage their assets and take timely corrective actions with the assistance of these regulatory measures.

Data Analysis and Interpretation. Analysis Of NPA In Banks**Analysis**

In conclusion, the study on Non-Performing Assets (NPAs) of private and public banks in India highlights the differences and similarities between the two types of banks in terms of their asset quality and risk management practices. The data analysis shows that public banks generally have a higher NPA ratio compared to private banks, although this gap has reduced in recent years due to the proactive steps taken by public banks to tackle the issue of NPAs. However, it is worth noting that the public banks have a larger loan portfolio and serve a broader segment of society, which includes vulnerable and economically weaker sections. Therefore, their NPA ratio can be seen as an indicator of the challenges faced by the broader economy. In terms of risk management practices, private banks tend to be more proactive and adopt stricter lending standards, while public banks are focused on improving their operational efficiency and asset quality. Both types of banks have implemented various measures to improve their NPA ratios, including reducing fresh NPAs, better recovery mechanisms, and strengthening their risk management systems. Overall, the study underscores the importance of maintaining a healthy asset quality for banks, as it directly impacts their financial stability and ability to support the growth of the economy. Further research can be conducted to explore the factors that contribute to NPAs in India and to identify best practices for reducing them.



**Sangeetha****Suggestions**

- i. Compromise settlements: In the event of persistent NPAs, banks may want to consider entering into compromise agreements with the borrowers whenever it is practical to do so. The banks will be able to get at least some of the money they owe back thanks to this.
- ii. Techniques for risk and return assessment: Banks should use a variety of methods to ensure the creditworthiness of the fund seeker and the securities in relation to the loan amount before lending the amount.
- iii. Recapitalizing of Public Area Banks - The public authority value could be made underneath 51% to permit a portion of the banks raise capital in a better way while drawing in essential financial backers. Following the Chinese model, a board seat could be proposed to them, albeit not including them straightforwardly in that frame of mind to day the board.
- iv. Changes to the banking - The standards of the financial area must be made more rigid. The banking regulation act needs to be changed so that the RBI can control banks and tell them to start the insolvency resolution process to get back the money they defaulted on.

Methods to Control NPA „S

1. Enhancement of the Credit Evaluation Process: In order to ensure that only financially viable projects are funded, banks should improve their credit appraisal procedures. They should also keep an eye on their borrowers' risk profiles and take the necessary steps if anything changes.
2. Increasing Borrowers' Monitoring: In order to spot any early warning signs of trouble, banks ought to intensify their monitoring of borrowers, particularly when they are taking out large loans. In order to ensure that the borrowers are adhering to the terms of the loan agreement, regular reviews and inspections should be carried out.
3. Follow-Up on Payments Past Due: When payments are not made on time, banks should promptly follow up on overdue payments and take the necessary action.
4. Reorganization of Current Loans: Banks ought to consider rebuilding existing credits that are at risk for becoming NPAs. Rearranging the repayment terms or lowering interest rates could be examples of this.
5. Increasing the Supply: Banks ought to expand their provisioning for awful obligations and put away more assets to cover likely misfortunes. They will be better equipped to deal with an increase in NPAs as a result of this.
6. Further develop Recuperation Cycle: Banks ought to zero in on further developing their recuperation cycle in order to boost the recuperation of contribution from delinquent borrowers. This might necessitate hiring a specialized organization to help with the recovery process. Improved Risk Control: Banks ought to zero in on further developing their gamble the executives frameworks in order to distinguish likely NPAs and make a preventive move. This could include upgrading the credit examination process, further developing checking of borrowers and expanding provisioning for awful obligations
7. Embrace a gamble based approach: A risk-based approach to lending and credit management ought to be taken by banks. This means accurately evaluating the creditworthiness of potential borrowers and establishing appropriate lending limits.
8. Utilize statistical analysis: Predictive analytics should be used by banks to find potential NPAs and prevent them from happening in the first place.
9. Keep an eye on loan performance: Banks ought to screen credit execution consistently, and go to medicinal lengths when any indications of trouble are taken note.
10. Make use of debt restructuring strategies: To deal with stressed asset situations, banks should use debt restructuring schemes like the Strategic Debt Restructuring (SDR) scheme and the Scheme for Sustainable Structuring of Stressed Assets (S4A) scheme.
11. Make internal controls stronger: To avoid NPAs in the first place, banks should make sure they have adequate internal controls in place, such as credit risk management systems and the use of stress testing and other predictive analytics.
12. Increment the arrangement inclusion proportion: To ensure that losses are adequately covered, banks should raise the provision coverage ratio, which is the ratio of provisions set aside for NPAs to their total value.
13. Utilize a collaborative strategy: In order to resolve NPA situations, banks should adopt a collaborative approach by collaborating with other stakeholders like the government, the Reserve Bank of India (RBI), borrowers, and debtors.



**Sangeetha****CONCLUSION**

The study on NPAs in India's Public and Private Sector Banks found that public sector banks had higher NPAs than private sector banks did. This is because private sector banks have better risk management systems, whereas public sector banks are more susceptible to politically motivated loans. Additionally, the public sector banks have a greater volume of bad loans, which has led to a higher NPA rate. The study has also shown that public sector banks need to improve their risk management and credit appraisal systems in order to cut down on non-performing loans (NPAs). In addition, the government ought to concentrate on raising the rate at which bad loans are repaid, which would contribute to lowering the overall number of non-performing loans in the banking industry. The management of NPA is essential right now. The Bank's net profit varies significantly depending on NPA. The banking system's collapse is very likely due to the rise in NPA. As a result, banks should implement efficient risk and return evaluation procedures to cut down on unsecured loans. The NPA's management ought to be handed over to the RBI. The banks must take steps to recover the amount that was defaulted on and prevent additional defaults.

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Sangeetha

Table 1: The Value Of NPA In SBI

YEAR	2022	2021	2020	2019	2018
GrossNPA	112,023.37	126,389.02	149,091.85	172,750.36	223,427.46
Net NPA	27,965.71	36,809.72	51,871.30	65,894.74	110,854.70
%of Gross NPA	3.97	4.98	6.15	7.53	10.91
%of Net NPA	1.02	1.5	2.23	3.01	5.73

Table 2: The Value Of NPA In PNB-Punjab National Bank.

YEAR	2022	2021	2020	2019	2018
i)Gross NPA	92,448.04	104,423.42	73,478.76	78,472.70	86,620.05
ii)Net NPA	34,908.73	38,575.70	27,218.89	30,037.66	48,684.29
i)% of GrossNPA	11.78	14.12	14.21	15.5	18.38
ii)% of Net NPA	4.8	5.73	5.78	6.56	11.24

Table 3: The Value Of NPA In HDFC

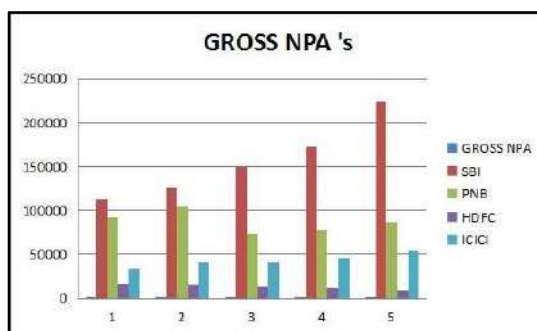
YEAR	2022	2021	2020	2019	2018
Gross NPA	16,140.96	15,086.00	12,649.97	11,224.16	8,606.97
Net NPA	4,407.68	4,554.82	3,542.36	3,214.52	2,601.02
%of Gross NPA	1.17	1.32	1.26	1.36	1.3
%of Net NPA	0.32	0.4	0.36	0.39	0.4

Table 4: The Value Of NPA in ICICI

YEAR	2022	2021	2020	2019	2018
Gross NPA	33,919.52	41,373.42	41,409.16	46,291.63	54,062.51
Net NPA	6,960.89	9,180.20	10,113.86	13,577.43	27,886.27
% of Gross NPA	3.6	4.96	5.53	6.7	8.84
%of Net NPA	0.76	1.14	1.41	2.06	4.77

Table 5 : The Value Of Gross NPA In All 4 Banks

GROSS NPA	2022	2021	2020	2019	2018
SBI	112,023.37	126,389.02	149,091.85	172,750.36	223,427.46
PNB	92,448.04	104,423.42	73,478.76	78,472.70	86,620.05
HDFC	16,140.96	15,086.00	12,649.97	11,224.16	8,606.97
ICICI	33,919.52	41,373.42	41,409.16	46,291.63	54,062.51





A Study on the Impact of Increased Goods and Services Tax (GST) on Ice Creams in India

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ABSTRACT

This secondary research paper examines the consequences of the increased Goods and Services Tax (GST) on consumer goods categories in India such as ice creams. The study investigates the reasons behind the GST hike, assesses its implications on the respective industries, analyses consumer behaviour, and explores potential business strategies to adapt to the new tax regime. Secondary data from government reports, industry publications, academic journals, and news articles serve as the primary sources of information. The findings suggest that the increased GST has positive and negative effects on the ice cream industries, influencing production costs, consumer prices, and market dynamics. The paper provides insights into the implications of GST changes and highlights the importance of strategic decision-making for businesses in response to tax reforms.

Keywords : Goods and Service Tax, Consumer Goods, Ice Cream Industry, Cost Implications, Tax Reforms

INTRODUCTION

The Goods and Services Tax (GST) is a comprehensive indirect tax system implemented in India on July 1, 2017. With a unified tax structure, it replaced multiple indirect taxes levied by the central and state governments, such as excise duty, service tax, and value-added tax (VAT). The introduction of GST marked a significant milestone in India's





Spoorthi S Kumar et al.,

taxation system, aiming to simplify tax administration, promote ease of doing business, and create a seamless nationwide market. The implementation of GST in India was driven by the need to address the complexities and inefficiencies of the previous indirect tax regime. The fragmented tax structure led to cascading taxes and compliance challenges and hindered inter-state trade. GST aimed to streamline tax procedures, eliminate tax cascading, and establish a common tax framework nationwide. Under the GST system, goods and services are categorized into different tax slabs based on their nature, with four central tax rates: 5%, 12%, 18%, and 28%. Certain goods and services also fall under specific tax categories, such as zero-rated and exempted supplies. GST is a destination-based tax wherein taxes are levied at the point of consumption rather than the point of origin, ensuring a fair distribution of tax revenue among states. The introduction of GST brought several benefits to the Indian economy. It facilitated the ease of business by simplifying tax compliance procedures and reducing the burden of multiple tax filings. The unified tax structure also eliminated tax barriers between states, creating a common national market and promoting inter-state trade.

However, the implementation of GST also presented challenges. Businesses had to adapt to the new tax regime, understand the revised tax rates, and comply with GST registration, invoicing, and return filing requirements. The transition to GST required significant adjustments and efforts from businesses, particularly in updating accounting systems, educating staff, and ensuring compliance with the new regulations. Since its implementation, GST has undergone several revisions and amendments to address industry-specific concerns, simplify procedures, and fine-tune the tax structure. The GST Council, comprising representatives from the central and state governments, plays a crucial role in making decisions regarding tax rates, exemptions, and procedural changes to ensure the smooth functioning of the GST system. Overall, implementing GST in India has had a transformative impact on the country's tax system. It has aimed to promote transparency, streamline tax administration, and foster economic growth by creating a simplified and unified tax structure.

OVERVIEW OF THE ICE CREAM INDUSTRY IN INDIA

The ice cream industry in India has witnessed significant growth and transformation over the years. It is a vibrant and competitive sector that caters to the diverse tastes and preferences of the Indian population. The industry comprises various players, including multinational companies, domestic manufacturers, and regional brands. Ice cream products range from traditional flavors to innovative and exotic varieties, offering consumers various choices. The market is characterized by organized and unorganized players, with the organized sector comprising branded manufacturers and the unorganized sector comprising small-scale local producers. The industry experiences seasonal fluctuations in demand, with peak sales occurring during the summer months. The ice cream market is driven by changing consumer lifestyles, increasing disposable income, urbanization, and the growing popularity of premium and artisanal ice cream products. Ice cream manufacturers focus on product innovation, expanding distribution networks, and effective marketing strategies to capture consumer attention in this dynamic and evolving market to stay competitive.

STATEMENT OF THE PROBLEM

In the 45th GST council meeting, it has been recommended that Ice-cream parlours supplying manufactured ice creams will be taxed @ 18% GST. The circular issued pursuant to above meeting clarified that where ice cream parlours sell already manufactured ice-cream and do not cook or prepare ice-cream for consumption like a restaurant, it is supplied ice cream as goods and not as a service, even if the supply has certain ingredients of service. Accordingly, it is clarified that ice cream sold by a parlour or any similar outlet would attract GST at the rate of 18%. The above circular has created a confusion in industry and the larger question that needed to be addressed is that whether ice cream parlours can constitute as a restaurant to provide restaurant services chargeable to GST at the rate of 5% or it is merely a sale of goods. It is legally inconsistent to provide a straightjacket taxability for ice-cream parlours wherein transaction at the outset requires ascertainment of the nature of supply as goods or services. The same test which applies to determine a restaurant service is also applicable to ice-cream parlours and the same needs to be considered while applying the rate of GST. As such, the rate should be applied not on one common scale but on





Spoorthi S Kumar et al.,

a case-to-case basis. With regard to the above, this research paper analyses the impact on the increased goods and service tax on the ice creams in India.

REVIEW OF LITERATURE

Goyal (2017) studied the Goods and Services Tax (GST) in India, emphasizing its impact as a paradigm shift in the taxation system. The author discussed the implications of GST on various sectors, highlighting the need for businesses to adapt to the new tax regime. The Ice Cream Manufacturers Association of India (2022) published its annual report, providing insights into the ice cream industry for 2021-2022. This report is a valuable source of information regarding production trends, market dynamics, and industry challenges in the context of the increased GST. Kumar and Sharma (2018) conducted an empirical analysis to examine the impact of GST on the pen industry. Their study explored the implications of the tax reforms on production costs, consumer prices, and market competitiveness in the pen sector. The Ministry of Finance, Government of India (2022) offers circulars and notifications related to the GST Council, providing up-to-date information on the government's tax policies, changes, and guidelines. These resources serve as valuable references for understanding the rationale behind the GST increase and its implications on specific industries.

The Pen Manufacturers Association of India (2021) published a statistical report on the pen industry, providing valuable data and insights into market trends, production figures, and industry challenges. This report is a significant resource for understanding the implications of the increased GST on the pen sector. Sinha and Das (2019) studied consumer behavior and preferences in the post-GST scenario, focusing on ice cream consumption. Their research examined how the increased GST influenced consumer choices, price sensitivity, and brand loyalty in the ice cream market.

RESEARCH GAP

Ever since the implementation of GST in India there has been several amendments in the percentage of increase and decrease in the GST rate of 5%, 12%, 18% and 28%. In case of the ice cream industry, the GST percentage has increased from 5% to 18% in 2021. The paper analyses the impact on this increased GST percentage on both manufacturers and consumers. Since there are no researches that discusses this change in GST rate specifically on the ice cream industry, the paper assists in understanding the cost implications on this consumer good preferred by a larger group of the population.

OBJECTIVE

1. To analyse the impact of increased GST on ice cream industry
2. To understand the cost implications on manufacturers and consumers

SCOPE OF THE STUDY

Through an analysis of secondary data from various sources, including government reports, industry publications, academic journals, and news articles, the study has provided insights into the consequences of the GST hike for Ice Creams in India

INCREASED GST AND ITS IMPACT ON THE ICE CREAM INDUSTRY

The increased Goods and Services Tax (GST) has had a notable impact on the ice cream industry in India. The higher tax rates under the revised GST regime have influenced various aspects of the industry, including production costs, consumer prices, and market dynamics. Production Costs: The increased GST rates have increased ice cream manufacturers' production costs. The higher tax burden on raw materials, ingredients, and packaging materials directly affects the cost of production. Manufacturers may have to absorb or pass on these increased costs to consumers, impacting their profitability and competitiveness.





Spoorthi S Kumar et al.,

Consumer Prices: One of the significant effects of the increased GST on the ice cream industry is reflected in consumer prices. The higher tax rates can result in higher retail prices for ice cream products. This may lead to reduced affordability and changes in consumer buying patterns, particularly among price-sensitive segments of the population. **Competitive Landscape and Market Dynamics:** The increased GST rates can influence the ice cream industry's competitive landscape and market dynamics. Small and medium-sized ice cream manufacturers, which may need help absorbing the increased tax burden, could experience difficulties maintaining their market presence. More prominent players with better economies of scale and resources may be better positioned to adapt to the new tax regime. **Tax Compliance and Administration:** The increased GST rates also require ice cream manufacturers to navigate complex tax compliance and administration processes. Businesses need to ensure accurate invoicing, tax calculation, and filing of returns. This may involve additional administrative efforts, investment in updated accounting systems, and staff training to comply with the revised tax regulations.

Consumer Behaviour: The increased GST rates can influence consumer behavior in the ice cream industry. Higher prices due to increased taxes may lead to changes in consumption patterns, with consumers either reducing their ice cream consumption or seeking alternatives. Price-sensitive consumers may explore lower-priced options or switch to homemade alternatives, impacting the overall demand for ice cream products.

ANALYSIS OF COST IMPLICATIONS FOR ICE CREAM MANUFACTURERS

The increase in Goods and Services Tax (GST) from 5% to 18% in India has significant cost implications for ice cream manufacturers. The higher tax rate directly affects various cost components in the production process, increasing manufacturers' expenses. **Raw Materials and Ingredients:** Ice cream production requires various raw materials and ingredients, such as milk, cream, sugar, flavors, stabilizers, and emulsifiers. With the increased GST rate, the tax burden on these inputs rises, resulting in higher procurement costs for manufacturers. This increase in raw material costs directly impacts the overall production expenses. **Packaging Materials:** Packaging plays a crucial role in preserving ice cream products' quality and shelf life. The increased GST rate affects the cost of packaging materials, such as paper, plastic, and labels. Ice cream manufacturers need to account for the higher tax burden on packaging materials, contributing to overall production costs.

Machinery and Equipment: Ice cream manufacturing involves specialized machinery and equipment for mixing, pasteurization, and freezing processes. The increased GST rate on machinery and equipment acquisitions can increase manufacturers' capital costs. This affects their investments in modernization and upgrading production facilities, impacting overall operational efficiency and productivity. **Transportation and Logistics:** The transportation and logistics costs associated with the distribution of ice cream products are also impacted by the increased GST rate. Higher taxes on transportation services, fuel, and maintenance expenses can increase manufacturers' operational costs. This can influence decisions regarding distribution networks, delivery routes, and logistics management.

Compliance and Administrative Costs: The increased GST rate requires ice cream manufacturers to undertake additional compliance and administrative tasks. This includes accurate invoicing, tax calculation, and filing of GST returns. Manufacturers may need to invest in updated accounting systems, staff training, and professional services to ensure compliance with the revised tax regulations. These compliance and administrative costs add to the overall operating expenses for manufacturers. The cumulative effect of these cost implications can significantly impact the profitability and competitiveness of ice cream manufacturers. They may need to analyze their cost structures, explore potential efficiency improvements, and consider strategies to mitigate the impact of increased expenses. These strategies may include seeking tax benefits and incentives, optimizing supply chain operations, and evaluating pricing strategies to balance the increased costs while remaining competitive in the market.

EFFECTS ON CONSUMER PRICES AND PURCHASING BEHAVIOR

The Goods and Services Tax (GST) increase for ice creams in India from 5% to 18% has had noticeable effects on consumer prices and purchasing behavior. The higher tax rate directly translates into increased costs for ice cream manufacturers, often leading to increased retail prices. Consequently, consumers experience an increase in the price





Spoorthi S Kumar et al.,

of ice cream products, which can influence their purchasing decisions. Higher Retail Prices: The primary effect of the increased GST rate on ice creams is the escalation of retail prices. As manufacturers pass on the higher tax burden to consumers, the cost of ice cream products rises. The extent of the price increase depends on factors such as the cost structure of manufacturers, their ability to absorb the tax hike, and competitive dynamics within the industry. The price hike can range from marginal increases to more significant jumps, affecting consumers' affordability and purchasing decisions. Impact on Price-sensitive Consumers: Price-sensitive consumers are susceptible to changes in retail prices. The increase in GST can make ice cream products less affordable for these consumers, potentially leading to a decline in their consumption. Some consumers may choose lower-priced alternatives or reduce their ice cream consumption altogether. This shift in purchasing behavior can impact the overall demand for ice creams and affect the sales volume of manufacturers.

Premium and Niche Segments: The increased GST rate may affect different market segments differently. Premium and niche ice cream segments, which cater to consumers seeking unique flavors, artisanal products, or organic options, may be less affected by price increases. These segments often target consumers who prioritize quality and are willing to pay higher prices for differentiated products. However, manufacturers may need to carefully manage price increases to balance perceived value and affordability even within premium segments. Shifts in Consumer Preferences: Increasing ice cream prices due to higher GST rates can influence consumer preferences and choices. Some consumers may reduce their consumption or opt for alternative desserts or snacks that offer better value for money. This shift in preferences can impact the demand for ice cream and prompt manufacturers to explore strategies to retain consumer interest and loyalty.

Market Competition: Increased retail prices resulting from higher GST rates can intensify competition within the ice cream market. Manufacturers may face challenges maintaining market share and profitability amidst price-sensitive consumers and rival brands. Competitors may adopt different pricing strategies, promotional activities, or product innovations to navigate the new tax regime and attract consumers. The increase in GST from 5% to 18% for ice creams in India has led to higher retail prices, affecting consumer purchasing behavior. Price-sensitive consumers may reduce their consumption or explore alternatives, while premium and niche segments may exhibit more resilience. Manufacturers must carefully manage pricing strategies, monitor consumer preferences, and consider value propositions to adapt to changing market dynamics in response to the increased GST rates.

COMPETITIVE LANDSCAPE AND MARKET DYNAMICS

The ice cream industry in India operates within a dynamic and competitive landscape. Several factors shape the competitive environment and market dynamics in this industry, such as: Market Players and Segmentation: The ice cream industry in India is characterized by both multinational companies and domestic players. Major multinational ice cream brands such as Amul, Kwality Walls, Vadilal, and Mother Dairy compete with regional and local manufacturers. The market is segmented into various categories, including artisanal ice creams, packaged ice creams, frozen desserts, and novelty ice creams. Each segment has its own set of competitors and market dynamics. Product Differentiation and Innovation: Product differentiation and innovation play a crucial role in the ice cream industry. Manufacturers strive to introduce unique flavors, formats, and packaging to attract consumers. The ability to offer a diverse range of flavors, cater to dietary preferences (e.g., sugar-free, vegan), and incorporate innovative ingredients and technologies can enhance competitiveness in the market. Companies that consistently innovate and introduce new products tend to gain an edge over competitors.

Distribution Channels: The ice cream industry relies on an extensive distribution network to reach consumers effectively. Ice creams are distributed through various channels, including supermarkets, convenience stores, specialty ice cream parlors, online platforms, and direct sales. Strong distribution networks, efficient logistics, and effective partnerships with distributors and retailers contribute to the competitive advantage of ice cream manufacturers. Branding and Marketing Strategies: Effective branding and marketing strategies are vital in capturing consumer attention and building brand loyalty. Established ice cream brands invest in advertising campaigns, promotions, and social media engagement to create brand awareness and drive consumer demand.





Spoorthi S Kumar et al.,

Brand reputation, quality perception, and consumer trust influence purchasing decisions in this highly competitive market. Pricing and Affordability: Price competitiveness is a significant factor in the ice cream industry. Manufacturers need to strike a balance between maintaining profitability and offering competitive prices. Price-sensitive consumers closely compare prices and look for value for money. Manufacturers that can optimize their production costs, leverage economies of scale, and manage pricing strategies effectively can gain a competitive edge. Consumer Preferences and Seasonality: Understanding consumer preferences and adapting to changing trends is crucial for success in the ice cream industry. Consumers' tastes, preferences, and demands for healthier or indulgent options can influence the competitive landscape. Additionally, the ice cream industry experiences seasonality, with higher demand during summer. Manufacturers must adapt their strategies to meet seasonal fluctuations and consumer demand patterns.

Regulatory Environment: Compliance with food safety and quality regulations is essential in the ice cream industry. Adhering to the regulations and obtaining necessary certifications ensures consumer confidence and competitive advantage. Manufacturers that demonstrate high standards of quality and comply with regulatory requirements tend to gain a favorable position in the market. The competitive landscape and market dynamics in the ice cream industry in India are shaped by factors such as product differentiation, distribution networks, branding, pricing strategies, consumer preferences, and regulatory compliance. Manufacturers must continually assess the market, monitor consumer trends, innovate, and differentiate their offerings to stay competitive in this dynamic industry.

FINDINGS

Implementing Goods and Services Tax (GST) in India's ice cream Industry may pose several challenges. Some potential challenges faced by these industries include:

1. Classification and Tax Rate Determination: Determining the appropriate tax rate and classification for different ice creams can be challenging. The GST tax structure includes multiple tax slabs, and correctly categorizing products can be complex. Differentiating between various types of ice creams (e.g., artisanal, packaged, novelty) and accurately applying the relevant tax rates can be challenging for manufacturers.
2. Compliance and Documentation: The GST regime requires businesses to maintain detailed records, regularly file returns, and comply with various compliance procedures. Implementing GST requires robust accounting systems and documentation processes to ensure accurate reporting and compliance. For small and medium-sized enterprises in the ice cream industries, adapting to the new compliance requirements and ensuring adherence to GST regulations can be demanding.
3. Input Tax Credit: Claiming input tax credit is significant to GST implementation. However, effectively tracking and managing input tax credits can pose challenges for ice cream manufacturers. Maintaining accurate records of input taxes paid on raw materials, packaging, machinery, and other expenses is crucial for claiming the input tax credit. Managing the documentation and compliance procedures associated with input tax credits can be time-consuming and complex.
4. Price Adjustments and Competitive Landscape: Introducing GST may lead to price adjustments in the ice cream industry. Manufacturers must evaluate the impact of increased tax rates and input costs on their pricing strategies. Adjusting prices while remaining competitive in the market can be challenging, especially if there is resistance from price-sensitive consumers. Navigating the competitive landscape and maintaining market share amid changing prices can be a significant challenge for businesses in these industries.
5. Supply Chain Management: GST implementation may require businesses to reassess their supply chain management strategies. Understanding the impact of GST on logistics, transportation, and warehousing costs is crucial for optimizing supply chain operations. Coordination with suppliers, distributors, and retailers to ensure seamless compliance and minimize disruptions in the supply chain can be challenging, particularly for businesses with complex and widespread distribution networks.
6. Transitional Issues: Transitioning from the previous tax regime to GST may involve specific transitional issues. Ensuring smooth implementation and managing the transition period can be challenging for businesses. Issues





Spoorthi S Kumar et al.,

such as adjusting to new accounting systems, addressing discrepancies in tax credits, and resolving potential disputes with tax authorities may arise during the transition phase.

7. Addressing these challenges requires careful planning, robust systems, and effective stakeholder communication. Businesses in the ice cream and pen industries must stay updated with GST regulations, seek professional advice if necessary, and develop strategies to mitigate the challenges associated with GST implementation.

SUGGESTIONS FOR MANUFACTURERS

To navigate the cost implications resulting from the increase in GST for ice cream manufacturers, here are some suggestions:

1. **Review and Optimize Supply Chain:** Conduct a thorough supply chain assessment to identify potential areas for cost optimization. This includes evaluating suppliers, exploring alternative sourcing options, and negotiating favorable contracts to mitigate the impact of increased raw material costs.
2. **Streamline Production Processes:** Improve operational efficiency by implementing lean manufacturing principles and optimizing production processes. This can help reduce wastage, minimize energy consumption, and enhance productivity, offsetting some increased costs.
3. **Explore Tax Benefits and Incentives:** Stay updated on government policies and incentives available for the food processing industry, including ice cream manufacturing. Engage with tax consultants or experts to identify potential tax benefits, exemptions, or credits that can help offset the higher GST costs.
4. **Innovate and Diversify Product Offerings:** Explore product innovation to differentiate and add value to your ice cream offerings. Introduce new flavors, formats, or packaging options that cater to changing consumer preferences. This can justify a premium price point and help absorb the impact of increased production costs.
5. **Evaluate Pricing Strategies:** Assess your pricing structure and consider adjusting prices strategically. Carefully analyze market demand, competitor pricing, and consumer willingness to pay. While passing on some increased costs to consumers may be necessary, ensure that price adjustments are reasonable and competitive.
6. **Engage in Collaborative Partnerships:** Explore collaborative approaches with suppliers, distributors, and retailers to share the burden of increased costs. Negotiate favorable pricing terms, volume discounts, and cooperative marketing efforts to optimize margins and enhance competitiveness.
7. **Focus on Branding and Marketing:** Strengthen your brand positioning and invest in marketing efforts to build consumer loyalty and demand. Effective branding, packaging, and promotional activities can help justify higher prices and differentiate your ice cream products.
8. **Monitor and Leverage Consumer Insights:** Monitor consumer behavior and preferences to stay ahead of market trends. Stay connected with your target audience through market research, surveys, and social media engagement. This will help you tailor your offerings to meet consumer expectations and drive demand.
9. **Seek Industry Associations and Government Support:** Engage with industry associations and trade bodies representing the ice cream sector. They can advocate for favorable policies, provide guidance on compliance, and support navigating the challenges of increased GST rates. Additionally, stay updated on government initiatives that support the food processing industry and leverage any available assistance or subsidies.

FOR CONSUMERS

For consumers dealing with the increased GST on ice creams, here are some suggestions:

1. **Compare Prices:** Due to increased GST, ice cream prices have been affected. Therefore, compare prices across different brands and retailers to ensure you are getting the best value for your money. Look for promotional offers, discounts, or loyalty programs that can help offset the impact of increased costs.
2. **Explore Local Brands:** Consider trying ice creams from local or regional brands. They may offer competitive prices compared to more prominent national or international brands. Local brands often focus on quality and unique flavors, providing an opportunity to discover new and delicious options.





Spoorthi S Kumar et al.,

3. Opt for Bulk Purchases: Buying ice creams in larger quantities, such as family packs or tubs, can be more cost-effective. Check if retailers offer discounts on bulk purchases or consider sharing the cost with friends or family members.
4. Follow Social Media and News Updates: Stay informed about any price changes or offers announced by ice cream manufacturers and retailers. Follow their social media accounts or sign up for newsletters to receive updates on promotions or special deals.
5. Try Homemade or DIY Ice Cream: Make ice cream at home as a fun and cost-effective alternative. Numerous recipes are available online, and you can experiment with flavors and ingredients according to your preference. Making your ice cream can be a rewarding and budget-friendly option.
6. Prioritize Quality: While price is a significant consideration, prioritize the quality of the ice cream you purchase. Look for ice creams made with natural ingredients, without excessive additives or artificial flavors. Consider the reputation and customer reviews of different brands to ensure you are getting a high-quality product.
7. Explore Seasonal and Local Flavours: Take advantage of your area's seasonal fruits and local flavors. Seasonal ice creams often offer unique and refreshing tastes. Additionally, purchasing local flavors supports local producers and can be an opportunity to try something new.
8. Share and Enjoy: Instead of buying individual servings, consider sharing an ice cream with a friend or family member. This way, you can enjoy the treat while reducing costs and minimizing wastage.
9. Plan and Budget: Include ice cream expenses in your monthly budget to ensure you allocate funds accordingly. Planning ahead allows you to manage your spending and indulge in ice creams without straining your finances.
10. Remember to adjust your expectations and budget according to the increased GST. While it may result in slightly higher prices, there are still opportunities to enjoy ice creams while mindful of your spending.

CONCLUSION

In conclusion, this research paper has examined the impact of the increased Goods and Services Tax (GST) on India's ice cream industry. Through an analysis of secondary data from various sources, including government reports, industry publications, academic journals, and news articles, the study has provided insights into the consequences of the GST hike. The research findings indicate that the increased GST has positively and negatively affected the ice cream industry. The higher tax rate has resulted in significant cost implications for manufacturers in both sectors, including increased expenses for raw materials, packaging materials, machinery, transportation, and compliance. These cost implications have posed challenges for businesses in maintaining profitability and competitiveness. Furthermore, the increased GST has influenced consumer prices and purchasing behavior. The rise in taxes has led to higher prices for ice creams affecting consumer affordability and demand. Consumer behavior has also been impacted, with potential changes in purchasing patterns, price sensitivity, and brand loyalty. To navigate these challenges, ice cream businesses need to employ strategic decision-making and adapt their operations to the new tax regime. Cost optimization, supply chain management, product diversification, pricing strategies, and collaborations with industry stakeholders are among the suggested strategies for businesses to mitigate the impact of increased expenses and maintain competitiveness. This research sheds light on the implications of GST changes on specific consumer goods. It highlights the significance of strategic decision-making for businesses in response to tax reforms. By understanding the consequences of the increased GST and implementing appropriate strategies, ice cream manufacturers can adapt to the new tax regime and strive for sustainable growth in a changing business environment.

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Effectiveness of Health Education through Picture Booklet Regarding Personal Hygiene and Eating Habits of Preschool Children among under-Five Mothers in Selected Rural Areas in Bangalore

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ABSTRACT

Poor personal hygiene is a major contributor of most of the morbidities affecting the pre-school children in a developing country like India. Children in slum are more vulnerable in getting diseases like diarrhoea, worm infestations, respiratory infections, skin diseases, dental caries, malnutrition, vitamin deficiencies, etc. not only due to poor living conditions, overcrowding, lack of safe water and sanitation: as well as for lack of proper practices of personal hygiene and faculty dietary habits. The aim of the present study is to assess the effectiveness of health education through picture booklet regarding personal hygiene and eating habits of preschool children among under five mothers in selected rural areas. For the investigation, one group pre-test post-test pre experimental design was chosen. 60 under five mothers were selected for the study and structured interview schedule was used to assess the level of knowledge and to collect data. The result showed that the mean post- test level knowledge score (25.45) was higher than the pre-test score (14.36) of the same group. This indicated that health education through picture book regarding personal hygiene and eating habits of preschool children among under-five mothers of selected rural area, Mallathahalli, Bengaluru was effective.

Keywords: Under-five mothers, preschool, picture booklet, structured interview.

INTRODUCTION

The youngster is mankind's most valuable commodity, most adored and perfect in its innocence, and a child is lovely, a source of joy and happiness, a target of love and care, and a topic of future aspirations. Hygiene is a collection of actions used to sustain one's health. "Hygiene refers to situations and behaviours that assist to preserve

58397



**Nirmala Devi et al.,**

health and prevent the spread of illnesses," according to the World Health Organization (WHO) [1]. Showering and other personal hygiene activities become part of a daily routine and should become "second nature" to your child. Making a pattern of doing things at the same time every day might make the learning process simpler. Getting in to habit of doing things at the same time each day can make easier to learn. Children under the age of five commonly develop dietary habits throughout their initial between the ages of two and three of life. Family factors and culture impact eating patterns and attitudes concerning eating patterns during childhood. Lower-income families frequently have unhealthy eating habits, typically due to a lack of nutritious fresh fruits and vegetables, along with sufficient milk and protein intakes. The importance of personal hygiene should be taught from an early get help cultivate good habits [2]. In addition, the lifestyles of homeless and migrant children place these populations at risk for inadequate food, causing nutrient deficiencies, developmental and growth delay, depression, hunger and behaviour problem [3] Hygiene status of children is an indicator of public investment in the development of its man power. It's told by social, domestic and individual factors as well as the children's knowledge of health on particular hygiene, comfort and introductory requirements, characteristics associated with child similar as their natural and lack of knowledge are adding up factors, UNICEF [4]. Healthy eating helps preschool children to help stabilize their energy, ameliorate their minds, indeed out their moods, help them maintain a healthy weight, help internal health conditions which include depression, anxiety, and ADHD [5]. As a result, poor nutrition can have a severe detrimental effect on overall health, brain development, and educational success [6].

MATERIALS AND METHODS**Study Design**

The objective of the study is to evaluate the effectiveness of health education through picture booklet regarding personal hygiene and eating habits of preschool children among under five mothers. The study is based on Pre-experimental one group pre-test post-test design. The study was conducted among under-five mothers residing at Mallathahalli, Bengaluru.

Participants

The sample for The Present Study Was conducted among 60 under five mother, who were present at the time of data collection and who fulfilled the following criteria of selection were selected for the study. To check the efficiency of health education, picture booklet regarding personal hygiene and eating habits was introduced to the concerned mothers. And the result was compared before and after health education.

Inclusion Criteria

Under five mothers who are:

- Willing to Participate in the Study.
- Available at the Time of Data Collection
- Those Who Understand English and Kannada.

Exclusion Criteria:

- Under five mothers who are cognitively impaired
- Mothers who are not interested
- Mothers who have only school going children and above

INTERVENTION PROGRAMME

A data collection instrument is a formal document used to collect and record information. The Tool Consisted Of Three sections:

Section A Demographic data,



**Nirmala Devi et al.,**

Section B Structured Interview questionnaire which included 24 items on personal hygiene and eating habits of preschool children and

Section C Health education through picture booklet on personal hygiene and eating habits of preschool children among under five mothers.

The data collection was done over a two weeks period and Purposive sampling technique was used to select the sample. The data was collected from the 60 samples by using structured interview knowledge questionnaire.

Phase I: Pre test was conducted by administration of structured interview questionnaire.

Phase II: After the pretest, health education through picture booklet was given. Duration of the Health Education Was 45 minutes.

Phase III: The post test was conducted after seven days of health education by using the same structured interview questionnaire.

RESULTS and DISCUSSION

The study findings have been presented in relation to the objects and prospects. The data attained were analyzed using descriptive and deducible statistics. Paired 't' test was used to determine the effectiveness of health education through picture book on particular hygiene and eating habits of preschool children among under five children. The Table 1 illustrates that during the pre-test among the 60 samples 27 (45%) samples had poor knowledge, 33(55%) samples had average knowledge and none of the sample had good and very good level of knowledge on personal hygiene and eating habits of preschool children among under five mothers.

During the post-test 10(16.67%) samples had average knowledge, 33 (55%) samples achieved good level of knowledge, 17 (28.33%) samples had very good level of knowledge and one of the samples had poor knowledge.

The paired 't' value was computed to determine the effectiveness of health education through picture book on personal hygiene and eating habits of preschool children among under five mothers residing in Mallathahalli, Bangalore. Table 2 illustrates that the mean post- test level knowledge score (25.45) was higher than the pretest score (14.36) of the same group. The mean difference between pretest and posttest score (11.08) of knowledge was significant at 5% level as the paired 't' value=21.82.($p < 0.01$). According to table 1 & 2, it shows that the most important habit which we can educate the child is really maintaining a good aseptic practices. With the current issues of contagious conditions like COVID- 19, the need to exercise aseptic living conditions becomes more important than ever. It can help the mothers to avoid dangerous origins and avoid getting sick of child. It will also help the child to learn and exercise good aseptic practices that come more important as they grow and approach puberty. It'll help them grow into healthy grown-ups. Good hygiene also boost confidence and tone- regard for children. Thus, staying clean should become an involuntary action of our children and not to be executed.

A healthy diet is essential for children to give the bear nutrients and enhance the vulnerable system. Eating good foods not only enhance physically but also cover against cognitive decline. Giving education for eating habits has served the mothers by furnishing a well- balanced nutritional diet while reducing the threat of illness like cardiac complaints, stroke and type 2 diabetes. According to findings of this study, we can conclude that by giving health education through picture booklet regarding personal hygiene and eating habits of child, the knowledge of mother regarding personal hygiene and eating habits will improve.

CONCLUSION

This study was taken up to evaluate the effectiveness of health education through picture book regarding personal hygiene and eating habits of preschool children among under-five mothers in a selected rural area, Bangalore. The result of this study showed that there was enhancement of knowledge among under- five mothers on particular





Nirmala Devi et al.,

hygiene and eating habits of preschool children. The enhancement was due to the administration of the health education through picture book. Therefore, the study concluded that health education through picture book was effective on perfecting knowledge of under- five mothers regarding personal hygiene and eating habits of preschool children.

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Table 1: Analysis and interpretation of pre-test and post-test knowledge score.

ASPECT		EXPERIMENT	
		N	%
Pre-test level of knowledge	Poor knowledge	27	45
	Moderate knowledge	33	55
	Good knowledge	0	0
	Very good knowledge	0	0
Post-test level of knowledge	Poor knowledge	0	0
	Moderate knowledge	1	16.67
	Good knowledge	33	55
	Very good knowledge	17	28.33





Nirmala Devi et al.,

Table 2: Effectiveness of health education on personal hygiene and eating

Knowledge Assessment	Mean	Mean Difference	SD	Df	Paired't' Value	P Value
Pretest	14.36	11.08	19.10	59	21.82	<0.01
Posttest	25.45		22.38			





A Study of the Impact of Cognitive Biases on College Students' Investment Behavior: with Financial Literacy as a Moderator

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ABSTRACT

The aim of this research is to study how cognitive biases affect investment behavior. It also examined the moderating effect of financial literacy, assessed its potential to lessen the adverse effects of cognitive biases, and made recommendations for improving financial literacy initiatives and mitigating the negative effects of cognitive biases on investment behavior. The literature review emphasizes the Theory of Planned Behavior and the prevalence of cognitive biases among college students. Cognitive biases including confirmation bias and over confidence bias can lead to poor financial decisions. Financial literacy, which comprises knowledge, behavior, and attitudes, is necessary to make informed financial decisions and avoid cognitive biases. The study focuses on 319 college students in Bangalore, India. The Data is gathered using a structured questionnaire that assesses cognitive biases and financial literacy. The results disclose correlation between cognitive biases, financial literacy, and investment behavior, highlighting the importance of addressing cognitive biases and enhancing financial literacy among college students to promote informed financial decision-making.

Keywords: Comprises Knowledge, Behavior, emphasizes, financial.

INTRODUCTION

Several financial choices that college students make could significantly affect their future. These choices include budgeting, education loans, setting aside money for the future, and stock investment. Unfortunately, a lot of students

58402



**Umme Jahanara and Vinay Joshi**

have trouble making wise financial decisions, which can have long-term effects. (Pertwi et al., 2020) Cognitive biases, which are mental shortcuts that can lead people to make erroneous conclusions, may be one cause of this difficulty (Haleem, 2022). These biases may lead to overconfidence in investment choices, excessive credit usage, and underestimation of the influence of interest rates, among other financial decision-making issues. (Shukla et al., 2020) To reduce the damaging consequences of cognitive biases, financial literacy is a critical component. (Putra et al., 2021) An individual's knowledge and comprehension towards financial concepts, such as, preparing budgets saving, investing, and management of debt, are referred to as their financial literacy. Individuals can efficiently make informed financial decisions and avoid the harmful effects of cognitive biases when they have higher levels of financial literacy. (Chhapra et al., 2018; Ratnadi et al., 2020). This Research paper aims to study how cognitive biases affect college students' investment decisions, with financial knowledge acting as a moderating influence. Cognitive biases are the systematically flawed judgements that result from false presumptions and cause choices that are inconsistent with rational thought. Investment decisions are the choices made by an individual to allocate their cash or resources to investments, like mutual funds or stocks, in the hopes of earning a return. The ability to understand and apply financial norms to make informed decisions about one's finances is known as financial literacy. (Balagobei & Prashanthan, 2021) This study can clarify and reducing the influence of cognitive biases on investment choices. The study will investigate how college students' investment choices are affected by their cognitive biases.

The study will use a mixed methods approach to achieve the objectives of this study, including both quantitative surveys and qualitative data. Participants' financial decision-making tendencies, financial literacy, and cognitive biases will all be evaluated by the survey. In-depth information about the participants' financial experiences and decision-making processes will be revealed through the questionnaire response.

OBJECTIVES

1. To study the impact of cognitive biases on the investment behavior of the college students.
2. To determine the extent to which financial literacy moderates the relationship between cognitive biases and investment behavior.
3. To determine whether financial literacy can decrease the impact of cognitive biases on investment behavior of the college students.
4. To offer suggestions for enhancing financial literacy programs in colleges and for mitigating the adverse effects of cognitive biases on investment behavior.

LITRATURE REVIEW

Making financial decisions is a difficult process that considers several cognitive and emotional aspects. The variables that affect financial decision-making have been the subject of several research. Theory of Planned Behavior (TPB) proposed by Ajzen (Ajzen, 1991) is one of the most well-known models. According to TPB, people's intentions to engage in a specific action can be influenced by attitudes, arbitrary norms, and perceived behavioral control. This theory contends that attitudes towards financial decision-making, social norms governing financial activity, and a person's sense of control over their financial behavior can all affect their financial behavior. When it comes to making financial decisions, college students represent a special population. Teenagers are frequently at a moment of transition where they are learning to manage their money on their own, which can be difficult, especially if they don't have any financial education. Several studies have demonstrated that college students lack basic financial literacy. Because of this lack of financial awareness, people may make poor financial decisions like taking on too much debt or neglecting to invest for the future. (Lusardi & Mitchell, 2014). College Students and Cognitive Biases: Students' financial decision-making can be significantly impacted by cognitive biases. College students are vulnerable to cognitive biases like the sunk cost fallacy, the framing effect, and the endowment effect, according to a number of research. By continuing on a losing course despite the financial cost or engaging in a risky business venture because of an emotional commitment, these biases can result in poor financial judgements. (Gathergood &



**Umme Jahanara and Vinay Joshi**

Weber, 2014). Cognitive biases are deliberate errors in judgement that can influence one's decisions about his finances. Confirmation bias, overconfidence bias, and availability bias are a few cognitive biases that might influence financial decision-making. The tendency to seek out information that supports already held thoughts or opinions is known as confirmation bias. The tendency to overrate the skills and expertise of an individual is known as overconfidence bias. The propensity to overestimate the chance of events that are more easily recalled in memory is known as availability bias. These biases can result in poor financial judgement, such as taking on too much debt or not setting money aside for the future.

Financial literacy: The knowledge and comprehension of people with regard to financial concepts and activities. It includes familiarity with fundamental financial ideas including budgeting, saving, investing, and debt management. By enabling people to make wise financial decisions, financial literacy can play a crucial role in financial decision-making. Financial literacy and financial behavior are strongly correlated, according to several research. (Lusardi & Mitchell, 2014; Robb & Woodyard, 2011).

Financial literacy as a Moderator: The influence of cognitive biases on financial decision-making can also be mitigated by financial knowledge. Since they comprehend financial ideas better and are able to identify and steer clear of thinking errors that result in poor financial judgements, people who are financially literate may be less prone to cognitive biases. Yet, numerous studies have also demonstrated that overcoming cognitive biases may not be possible only through financial literacy. (Lusardi & Tufano, 2015). Every person is a victim of innate tendencies that seem like flaws in conventional finance. These patterns help investors in making more informed decisions about investment risk, return, and satisfaction; this is known as financial asset performance. (ul Abdin et al., 2022). The cognitive biases in this study are measured using well-known framework proposed by Daniel Kahneman and Amos Tversky, (Tversky & Kahneman, 1987) two of the most famous psychologists in the field of cognitive psychology, this framework categorizes cognitive biases into many kinds. According to their paradigm, there are three primary types of cognitive biases:

1. Social biases - Social biases influence how we see and communicate with others and include the Confirmation bias and Halo Effect.
2. Memory biases - Memory biases influence how we retain and retrieve information, and they include the anchoring bias, and the availability heuristic.
3. Judgment biases - Judgment biases include Herding bias, Loss aversion bias, and the framing effect. These are connected to how we make decisions and judgements.

Anchoring bias, confirmation bias, overconfidence bias, and loss aversion bias are some behavioral biases which might influence financial decisions. Investment professionals should be conscious of these biases and employ strategies like mindfulness, introspection, and rational thought to mitigate their effects. (Bihari et al., 2022). Even after accounting for other elements including age, gender, income, education, and investment experience, financial literacy continued to have a substantial impact on investment choices. (Balagobei & Prashanthan, 2021). Individual investors' investment decisions are highly influenced by financial information. Individual investors typically obtain their financial information from online financial news sites and brokerage firms, and their investment choices are influenced by variables like economic indicators, stock prices, and company performance. (Ullah et al., 2020).
Overconfidence bias: The study discovered that many investors had a propensity to overestimate their investment skills and the risks associated with their portfolios. This bias may result in erroneous investing choices and reduced profits.
Herding behavior: The study discovered that rather than undertaking their own research and analysis, many investors have a tendency to follow the herd and rely their investment decisions on the behaviours of others. Market bubbles and crashes may result from herd behaviour.
Loss aversion: According to the research, many investors are more sensitive to losses than gains and frequently concentrate their investing choices on minimising losses as opposed to maximising gains. Missed opportunities and lower profits may result from this prejudice.
Anchoring bias: The study discovered that many investors have a tendency to base their investment choices on previous prices or values rather than taking into account the state of the market. This prejudice may result in missed opportunities



**Umme Jahanara and Vinay Joshi**

and bad financial choices. Confirmation bias: The study indicated that rather than taking into account different viewpoints, many investors prefer to look for evidence that supports their preexisting opinions and biases. This prejudice may result in subpar investing choices and opportunities lost. In order to attain better investment outcomes, the research paper emphasizes the significance of comprehending and minimizing behavioral biases in investing decision-making. (Madaan & Singh, 2019).

The "3-Dimensional Model of Financial Literacy," created by (Lusardi & Mitchell, 2014). is one theoretical framework frequently used to research financial literacy. The following three elements of financial literacy are identified under this model:

1. Financial knowledge: This relates to a person's comprehension of financial ideas and their capacity to use that information to make wise financial decisions.
2. Financial behavior: This relates to the decisions people make regarding their finances, including saving, investing, and debt management.
3. Financial attitude, which includes risk tolerance, financial confidence, and financial anxiety, refers to a person's views and attitudes regarding money and financial decision-making.

Some of the variables that can be examined to determine a person's level of financial literacy using this approach might be:

1. Financial knowledge: This can be assessed by questionnaires that gauge how well a person understands topics like interest rates and investment risk.
2. Financial behavior: This can be assessed using questionnaires considering things like a person's rate of saves, investment preferences, and debt management techniques.
3. Financial attitude: This can be assessed through surveys considering things like a person's level of financial stress, risk tolerance, and financial confidence.

Age, level of education, and income are among the demographic parameters that may be considered while researching financial literacy.

PROBLEM STATEMENT

College students frequently display poor financial decision-making, which may be explained by the prevalence of cognitive biases, despite the need to make wise financial decisions. These cognitive biases are part of human psychology and can affect financial decision-making, resulting in less-than-ideal results. The effects of these biases can be diminished by financial literacy, which has been proven to be helpful. It's unclear, though, how much financial literacy can influence how college students' financial decision-making and cognitive biases interact. As a result, the goal of this study is to analyze how cognitive biases affect college students' financial decision-making and how financial literacy influences this relationship. The results of this investigation will help us comprehend the elements that financial decisions made by college students and reveal how financial literacy may be used to reduce the impact of cognitive biases.

HYPOTHESIS

- Cognitive biases have a significant impact on the investment behavior of college students.
- Financial literacy moderates the relationship between cognitive biases and investment behavior among college students.

SCOPE OF THE STUDY

The study's target population is college students in Bangalore, India, who are 18 to 23 years old. And will look at how cognitive biases affect their investment behavior. The findings of the study will be useful to promote financial literacy among college students and help them make informed financial decisions that will benefit their long-term financial stability.





Umme Jahanara and Vinay Joshi

RESEARCH METHODOLOGY

Research Design

The Study used a quantitative research approach to examine how investment behavior, cognitive biases, and financial literacy relate to college students. A sample of college students will be surveyed cross-sectionally to collect data.

Sample Size and Sampling Technique

The research population is college students in Bangalore India. Random sampling technique will be used to select a representative sample of 319 college students in Bangalore, India. The sample size of 319 was decided to provide sufficient statistical power and representativeness of the sample while considering the research objectives and available resources. The data was collected between 05/03/23 to 22.03/23. This technique also decreases the possibility for selection bias, enhances the generalizability of the findings to the broader population of college students in Bangalore, India.

Data Collection Instrument

Data was collected using a structured questionnaire. The questionnaire comprises four sections, including demographic information, cognitive biases, financial literacy and investment behavior. Cognitive biases are measured using framework given by (Tversky & Kahneman, 1987). while financial literacy will be measured using "3-Dimensional Model of Financial Literacy" developed by Lusardi and Mitchell. (Lusardi & Mitchell, 2014)

Figure-1. Schematic representation of mediating effect of financial literacy between cognitive biases and investment behavior in college students.

DATA ANALYSIS AND INTERPRETATION

Reliability

Construct reliability was assessed using Cronbach's alpha. The output results revealed that the financial literacy scale with 11 items Alpha=0.809 and the cognitive biases scale with 14 items Alpha=0.753 were found reliable. Reliability results are summarized in table 1.

No items were removed or revised.

DESCRIPTIVE STATISTICS

There were 142 people that took the survey in total. According to the age distribution, most respondents are between the ages of 18 and 20, with 18 years old accounting for 28.9% of the total. In accordance with the gender distribution, 57.7% of the sample's respondents identify as male, compared to 42.3% of respondents who identify as female. 94.4% of respondents are undergraduates, 2.1% are postgraduates, and 3.5% are "Other" respondents, meaning they are pursuing other types of education or occupational training.

AWARENESS OF INVESTMENT AVENUES

Overall, there is a difference in knowledge levels between different investment options, with corporate deposits, PF/PPF, and post office investments having lower awareness levels than bank deposits, gold investments, and stock market investments.

INVESTMENT PREFERENCE

The respondents' investment preferences range widely as a whole. The most popular investing options are bank deposits and the stock market, while company deposits, PF/PPF, and post office schemes are somewhat less liked. Moderate levels of preference can be seen for gold, real estate, and insurance.



**Umme Jahanara and Vinay Joshi**

A correlation between cognitive biases, financial literacy, and investment behavior has been found. Higher financial literacy has a relationship with less cognitive bias and more favorable investment behavior. Conversely, larger degrees of cognitive bias are associated with lower levels of financial literacy and potentially less desirable investment behavior. It demonstrates how important it is to address cognitive biases and improve financial literacy in order to make informed investing decisions.

According to Model Summary Table 3, regression produces a statistically significant association between the independent and dependent variable. The multiple correlation coefficients (R), which is 0.827, indicates a strong positive link. The R Square score of 0.683 shows that the independent variable reports for 68.3% of the variation in the dependent variable. The adjusted R Square, which accounts for the size of the sample and number of independent variables, is 0.669, which means that, when these factors are taken into consideration, about 66.9% of the variance in the dependent variable is described. The average difference between the observed and anticipated values of dependent variables is represented by the standard error of the estimate, which is .26329. Smaller numbers indicate stronger prediction performance, and this value indicates the model's accuracy.

Availability, Loss Aversion, Herding, Anchoring, Confirmation, Self-Serving, Overconfidence, and Confirmation- are the independent variables that are incorporated into the model. As a predictor, the constant term is also added.

REGRESSION ANALYSIS

The Anova table, which includes the independent variables herding, anchoring, self-serving, overconfidence, availability, loss aversion, and confirmation, significantly influences the dependent variable, investment behavior (F = 46.869, p 0.001). The model significantly explains the variance of Investment Behavior (R Square = 0.683).

Financial Literacy and Cognitive Biases are included in the first model, which accounts for 42% of the variance in the dependent variable. A minor improvement is seen in the second model, which includes the interaction term CB_FL and accounts for 42.8% of the variation. The model's fit is significantly enhanced by the inclusion of the interaction component (p = 0.039). Overall, the dependent variable is significantly impacted by both cognitive biases and financial literacy.

The ANOVA table contains two models.**Model 1:**

Constant, Financial Literacy, and CognitiveBiases are independent variables. Considerable impact on elaborating on the heterogeneity in investment behavior. An extremely significant F-value of 114.573 was found (p 0.001).

Model 2:

Constant, Financial Literacy, Cognitive Biases, and CB_FL (interaction term) are independent variables.

Considerable impact on elaborating on the heterogeneity in investment behavior.

p 0.001; F-value = 78.599; extremely significant.

These results imply that cognitive biases, financial literacy, and their combination significantly affect investment behavior.

Findings of the study

- According to the results of the regression analysis, the independent variables (Herding, Anchoring, Self-Serving, Overconfidence, Availability, Loss Aversion, and Confirmation) had a substantial impact on investment behavior (F = 46.869, p 0.001).
- Financial knowledge and cognitive biases account for 42% of the variation in investment behavior. The model is slightly improved by the inclusion of the interaction term CB_FL, which is responsible for 42.8% of the variation.



**Umme Jahanara and Vinay Joshi**

- Investment behavior is significantly influenced by cognitive biases, financial literacy, and their interaction (F = 78.599, p 0.001).

SUGGESTIONS

- Enhance Financial Literacy: It is essential to support financial literacy efforts and educational programs given the enormous influence that financial literacy has on investment behavior. Giving students the knowledge and abilities to make wise financial decisions can have a positive impact on how they invest.
- Address Cognitive Biases: Biases in one's thinking can result in poor investment choices. It is crucial to spread knowledge about cognitive biases and offer solutions for reducing their negative impacts. Students can choose investments more logically if they participate in training programs that emphasize identifying and overcoming biases.
- Integrating Financial Literacy and Cognitive Bias Training: Improving investment behavior can be facilitated by integrating financial literacy and cognitive bias training. By providing students with both financial concept knowledge and the capacity to overcome prejudices, they can make informed investment decisions.

CONCLUSION

The study's findings emphasize the importance of cognitive biases and financial knowledge in affecting investment behavior. Both elements significantly influence how students make financial decisions. Students can enhance their investment behavior and make better decisions by increasing their financial literacy and overcoming cognitive biases. This study emphasizes the significance of encouraging financial literacy and creating cognitive bias mitigation measures to enable people to make better investment decisions. The study only included college students in Bangalore, India, but future work might include a wider range of people to improve the generalizability of the results. Longitudinal research may also shed light on the long-term consequences of financial literacy programs on cognitive biases and investment behavior.

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Table 1. Cronbach’s alpha

Constructs	No. of items	Alpha
Financial Literacy	11	0.807
Cognitive Biases	14	0.726

Table 2. Correlations

		Cognitive Biases	Financial Literacy	Investment Behavior
Cognitive Biases	Pearson Correlation	1	.153**	.596**
	Sig. (2-tailed)		.006	.000
	N	319	319	319
Financial Literacy	Pearson Correlation	.153**	1	.344**
	Sig. (2-tailed)	.006		.000
	N	319	319	319
Investment Behavior	Pearson Correlation	.596**	.344**	1
	Sig. (2-tailed)	.000	.000	
	N	319	319	319

** . Correlation is significant at the 0.01 level (2-tailed).

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.827 ^a	.683	.669	.26329

a. Predictors: (Constant), Herding, Anchoring, Self-Serving, Overconfidence, Availability, Loss Aversion, confirmation.

Table 4. ANOVA^a

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	45.488	14	3.249	46.869	.000 ^b
	Residual	21.074	304	.069		
	Total	66.563	318			

a. Dependent Variable: Investment Behavior
 b. Herding, Anchoring, Self-Serving, Overconfidence, Availability, Loss Aversion, confirmation.





Umme Jahanara and Vinay Joshi

Table 5 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.648 ^a	.420	.417	.34943	.420	114.573	2	316	.000
2	.654 ^b	.428	.423	.34763	.008	4.276	1	315	.039

a. Predictors: (Constant), Financial Literacy, Cognitive Biases

b. Predictors: (Constant), Financial Literacy, Cognitive Biases, CB_FL

Table 6 ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.979	2	13.989	114.573	.000 ^b
	Residual	38.584	316	.122		
	Total	66.563	318			
2	Regression	28.496	3	9.499	78.599	.000 ^c
	Residual	38.067	315	.121		
	Total	66.563	318			

a. Dependent Variable: Investment Behavior

b. Predictors: (Constant), Financial Literacy, Cognitive Biases

c. Predictors: (Constant), Financial Literacy, Cognitive Biases, CB_FL

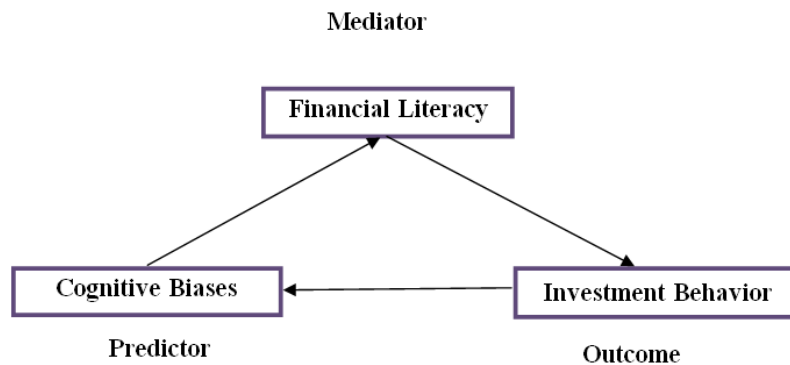


Fig.1.Mediator





Factors Impacting Dimension of Organizational Culture, its Significance and Factors Responsible towards Resistance to Change – A Study W.R.F. Selected Companies in Bengaluru

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ABSTRACT

The daily activities of an organization's employees are significantly impacted by its culture, which also generally aids a business in turning a profit. The importance of organisational culture in achieving internal integration and putting the strategy of external environment adaptation into practise (Violeta Raimande Kuloinskiene et al. (2009). Of late the researchers are showing interest and simultaneously examining the idea of organisational culture in different environments in order to develop creditability and productivity in the workplace (Jesuf Zeqiri, 2016). Numerous business managers are aware of the impact that a successful organisational culture can have on a company's performance (Unger et al., 2014). On the basis of their principles, presumptions, and beliefs, founding leaders gradually create the organisational culture. (Mamatha et al., 2020). The purpose of the present study is to highlight the impact of socio economic characteristics impacting the organisational culture, the significance of organisational culture and its drivers. Further, the study also reveals about the factors impacting organisational culture and factors responsible towards resistance to change. After taking into account the difficulties of avoiding non-response, delay, and adhering to Covid-19 guidelines, a structured questionnaire was administered as schedule. There were 116 surveys in total, and 100 of them could be used, yielding an 86.20% success rate. By speaking with the respondents, the researcher directly gathered the data. Tables were used to present the obtained data, which was then examined using quantitative measures like chi-square, weighted average, Kendall's coefficient of concordance, and Garrett ranking algorithms. The

58412



**Brunda and Irshad Nazeer**

Garrett conversion table is used to derive the Garrett values. All the socio-economic characteristics are showing significant relationship with organizational culture. The contingency coefficient demonstrates a strong link between organisational culture and factors that have an impact. It was revealed that factors like culture, predetermined policies, uniting all employees, extraction of best from employees, and promotion of healthy competition impacts the significance of organizational culture. Innumerable factors drives organizational culture. The study reveals about 19 factors are impacting organizational culture and they include relative and rank wise, goals, objectives and vision, job clarity and coordination. The study also reveals about factors responsible towards resistance to change. These are ranked by using Garrett ranking technique and includes lack of confidence in change, individual resistance, and opposing union values, narrow outlook etc.

Keywords : Organisational culture, change, values commitment, characteristics, variation.

INTRODUCTION

Growing companies require an organisational culture that supports them. Since the early 1980s, academics and practitioners have given the idea of organisational culture a lot of attention. According to Vanderberghe (1999), there is evidence to suggest that cultural dimensions differ significantly between organisations. Communications and interactions between individuals inside and outside of the organisation enhance and refine the perception and beliefs of the people who make up an organization's culture (Samson Bidunni et al., 2013). All managers and executives should have a thorough understanding of organisational culture since it will affect how they respond to the shifting demands of the business environment. Business is susceptible to change, thus corporate executives must continually anticipate the changes and actively track the interaction between customer needs, environmental factors, and organisational capabilities. Employee dedication, values, and beliefs are extremely valuable and act as a catalyst for creating the right environment in the firm. The values and beliefs are put into practise through the policies and practises, and it is important to train organisational members how to add value for their consumers (Decision & Neale, 1996). When people of a company successfully identify with their culture, employment becomes joyful. As a result, there is an improvement in teamwork, knowledge sharing, and being receptive to new ideas (Gofee and Jones, 1996). Organisational culture has a significant negative impact on decision-making in any organisation. Strong organisational culture does not always translate into improved performance, according to studies (Samson Ibidunni et al., 2013). According to Tichy (1980), a successful organisational culture must support the industry in which the corporation operates.

Statement of the problem

The organisations of late around the globe are facing innumerable difficulties regarding employees problems solving, convincing the employees, introduction of technology and establishment of good organisational culture. There has been a great pressure on the organisations to keep up with changing times in order to survive in this ever changing environment. Acute competition rapidly changing technology, greater global employee awareness, diverse needs of the work force and some of the significant factors impacting dynamic environment. This shifting trends demands the adoption of new set of beliefs and it has been seen these new trends drives the changes which impacts people in large number. At this occasion the leadership role is considered highly critical. To improve the effectiveness of organisation it becomes highly important to make the employees to be alert and needs proper motivation to make changes happen despite innumerable hurdles. It is the organisation culture that impacts the workforce to adjust with changes. Neglecting the employees in the organisations ends up in lot of losses to the organisation and could face traumatic experience.



**Brunda and Irshad Nazeer**

The internal integration of the strategy in the external environment must take into account the organisational culture. Success is guaranteed if there is a positive organisational environment because it has many positive effects on the organisation. Numerous business managers are aware of how effective organisational culture affects corporate performance. The founders' contribution to establishing the organisational culture on the basis of their principles, presumptions, and beliefs is considered to be of utmost importance. "The success of the organisation is correlated with its organisational culture."

REVIEW OF LITERATURE

According to Denise Zed Yohn (2021), culture has evolved into a strategic goal with implications for the bottom line. It can no longer just be divided up and delegated. A new culture-building strategy that holds everyone in the organisation accountable is already in effect at some organisations, according to the study. Shomi et al. (2021), focuses on an organisational culture's ability to influence the efficiency of employer branding depends on its strength. The study by Anuj Kumar Sinha et al. (2020) focuses on explanatory reports analysing the relationship between organisational culture and staff members' organisational commitment in the context of 10 chosen industries among various company groups in India. According to the empirical study, corporate culture significantly affects how employees feel about their loyalty to the organisations. The researchers have further said that their findings will significantly contribute to our knowledge of how organisational culture affects employee commitment and will do it in a more comprehensive way. Adopting and putting into practise the dimensions, according to the researchers, will produce greater results.

The organisational culture is influenced by both internal and external variables, according to Katarzyna Szczepanska et al. (2017). The founders of the organisation, its management, and its employees are among the internal variables that influence organisational culture. The external influences include shifting social, political, and economic dynamics as well as rising globalisation and mobility. According to the experts, external influences play a role in how an organisation grows. Additionally, they have stated that managers must be aware of the aspects that influence organisational culture. According to Marcoulides & Heck (1993), an organization's culture helps individuals understand, feel, and establish the principals' expectations, behaviour, patterns, and norms that lead to high levels of accomplishment. In the work of Agarwal et al. (1999) and Chow (2000), national culture may have an impact on the relationship between organisational culture and individual outcomes. As stated by Cameran and Quim (1999), a strong culture—that is, a culture with a well-integrated and effective set of values, beliefs, and behaviors—is associated to high levels of organisational performance. Chhokar (2000) stated that Indian work culture indicates that higher-power distance, collectivism and affective reciprocity are major culture values of Indian managers.

According to Gupta (2002), authors who have written about Indian culture have recognised the variety of components that make up the culture but have also emphasised the fundamental similarity that lies behind the diversity. Organisational culture has been examined in terms of achievement, expansion, control, and dependency by Singh and Kedar (1991). According to Pollania's (2006) study of software, pharmaceutical, and petroleum marketing firms, there is a lack of organisational culture that affects knowledge production across the sector, the nation, and the industry. According to Saxena and Shah's (2008) study, which used data from 332 Indian R&D experts, the aspects of organisational culture are adversely correlated with helplessness.

Objectives

1. To investigate whether socioeconomic factors affect corporate culture.
2. To examine the significance that organizational culture.
3. To study the variables influencing the organisational culture's dimensions.
4. To analyze the causes of change resistance.



**Brunda and Irshad Nazeer****Hypotheses**

1. The socio-economic factors are not impacting on the organisational culture.
2. There is no significance of organisational cultures.
3. There are no factors driving the dimensions of organisational culture.
4. There are no factors responsible for resistance to change.

Research questions

1. What are the reasons behind the socio-economic factors not impacting on organisational culture?
2. What is the significance of organisational culture?
3. What are the factors driving dimension of organised culture?
4. Which factors are responsible for resistance to change?

RESEARCH METHODOLOGY**Research design**

It refers to general structure of the research project. It gives the idea of 'how' to conduct the research. Research methodology is all about various process, proceeding and tools used to gather research data and the different ways of analysing them. Research design facilitates the smooth navigation of the various operations, thereby making research as efficient as possible gathering maximum data with minimum expenditure (Kothari, C.R., 2013). Research design must be based on more or less some methodology and commences when once the topic and problem of research has been selected. The socio economic characters and dimensions of organisational cultures, significance of organisational culture and factors responsible for resistance to change are studied in detail with the help of research design.

Questionnaire design

A questionnaire is a research instrument containing related questions for the purpose of collecting data from respondents (Saul McLeody, 2018). The present research work collects the data from both the primary and secondary sources. The primary data collected through administering a structured questionnaire as schedule after considering the possible non- response, delay and fear of Covid-19 pandemic. Secondary sources include e-journal, books and internet the relevant reference were given at the end.

Universe of the study

The present study is confined only to Bengaluru Urban. It is not possible to approach all the sample in the universe and hence 100 sample were considered for the present study. The sample 100 considered in the wake of Covid-19 pandemic.

Sample and sampling technique

Convenient sampling technique was adopted for the present study. All employees working at Bengaluru in select four categories of working employees were considered and a sample representing all these categories includes, IT sector 41, manufacturing 18, banking 21 and education sector 20.

Method of data analysis

The study adopted χ^2 , contingency co-efficient, Kendall's co- efficient of concordance, weighted average and ranking method and Garrett ranking technique. These techniques are performed as they are simple to understand and sufficient for the present study.

Limitations

**Brunda and Irshad Nazeer**

1. The sample is too small.
2. The study is only confined to Bengaluru Urban.
3. Any generalisation needs further indepth study.

Data presentation and Analysis : Demographic profile of respondents – A

The related socio-economic characteristics are essential for the study and contains gender, marital status, age, education, working employees category and work experience. The importance of studying the demographic characteristics lies in the fact that whether they impact the study on organisational culture or not.

Research Question No. 1 : What are the reasons behind socio-economic characteristics for not impacting on the organisational culture?

Hypotheses : H₀ No. 1: The socio economic characteristics do not impact on organisational culture.

H₁ : There exist significant variation in the socio-economic characteristics and hence impacts on organisational culture.

The study on socio-economic impact assessment is to decide about how a project or research work will affect the lives of respondents of an area. All the socio-economic characteristics of respondents and their significance and degree of relationship studied in relation whether they impact the study or not. Table - 1 depicts data about socio-economic characteristics of respondents. There are 75 males and 25 females and 90 respondents are married and 10 remained single. There are 38 respondents who belongs to the age group of 36-40 years followed by 26 to the group 31- 35 years, 10 to the 41-45 years, 9 to the 46-50 years and 5 each to the 20-25 years and more than 50 years. The average age is 36.9 years (SD = 6.62). On an average they had a total work experience of 4.8 years (SD = 2.49). 50 respondents studied up to degree, 15 each completed PUC and post graduation with PhD degree and 10 each studied up to post graduation and ITI. 41 respondents belongs to IT sector, 21 to banking, 20 to education and 18 manufacturing. The work experience data reveals that 31 respondents put up an experience of 4-6 years, 24 to the 2-4 years, 16 to the 6-8 years, 15 to the 0-2 years and 14 to the 8-10 years. The average experience of respondents stood at 4.8 years (2.49 = SD). All the socio-economic characteristics shows significant and showed a high degree of relationship.

Analysis and presentation of Data - B

This section reveals data and analysis of stated hypotheses sans socio-economic characteristics of respondents

Research question No. 2 : What is the significance of organisational culture.

Hypotheses : H₀ : There exist no significant variation in the factors driving significance of organisational culture.

H₁ : There exists significant variation in the factors driving the significance of organisational culture.

Table - 2 provides data about significance of organisational culture. 55 respondents out of 100 stated strongly agree followed by 30 respondents agree and 15 expressed somewhat agree. Out of 55 respondents who said strongly agree, 18 said about the organisational predetermined policies give a sense of direction at the work place, 8 identified that organisational culture brings all employees on common platform, 7 noticed organisational culture extracts the best from employees, and 5 each spoke about promotion of healthy competition and clarity in the mind of employees and further, 5 spoke about organisational work culture promotes healthy relationship among the employees. Out of the 30 who said agree 7 expressed about the significance of predetermined policies give a sense of direction at the workplace, 5 point at extracts the best from employees and 4 each spoke about organisational culture brings all employees on a common platform and every employee will have clarity in their mind. Out of 15 who expressed somewhat



**Brunda and Irshad Nazeer**

agree, 5 spoke about pre-decided policies give a sense of direction at the work place, and 2 each noticed about organisational culture promotes healthy competition and organisational culture brings all employees on a common platform. Further 2 more said about every employee is clear with the role and responsibility. 'w' fails to accept H₀ and accepts H₁ and hence it is concluded that there exist significant relation between driving factors and organisation culture.

Research questionnaire 3 : What are the factors driving dimension of organisation culture?

Hypotheses : No. 3 : H₀ : There exist no significant variation in the factors driving organisation culture.

H₁ : There exist significant variation in the factors driving organisational culture.

Table - 3 : highlights data about factors impacting organisational culture. 19 variables were selected and tested and interpreted. These factors driving the organisational culture were measured with the help weighted average and relative importance of factors has been found out. Weighted scale depends upon the scale points. Accordingly here the weighted scale is 5, 4, 3, 2, 1 which are depending upon the scale "SA to SDA". Frequencies are nothing but the total of individual opinion (N=100). The total of all individuals opinion (i.e., fw) is divided by the sum of weights (i.e., 15) to weighted average. Based on the strength of weighted average ranks are given. The first relative importance was assigned to goals, objectives and vision. The second relative important rank was assigned to job clarity and the third relative weighted importance was given to co-ordination factor. Finally the 19th relative importance was assigned to organisational learning.

Research question No. 4 : What factors are responsible for resistance to change?

Hypotheses No. 4 : H₀ : There exist no significant variation in the factors responsible to change.

H₁ : There exist significant variation in the factors responsible to change.

Table - 4 : depicts data about factors responsible towards resistance to change. To measure the resistance to change factors Garrett Ranking Technique was performed. The impacting factors responsible for resisting to change factor is highlighted. There are 9 variable and hence 9 scale points. The value (x) is obtained through the Garrett Conversion table (table-5). The percentages calculated here referred to Garrett Conversion table and Garrett values are obtained. Mean score is obtained by dividing the total by number of observation (N = 100). Depending upon the strength of mean score the ranks are awarded. The first rank was awarded to lack of confidence in change, the second rank was awarded to individual resistance arising out of human characteristics and the third rank was assigned to opposing human values etc. Finally the 9th rank was assigned to mistrust and fear of failure.

SUMMARY OF THE STUDY FINDINGS

The main objective of the present study is to highlight if socio economic characteristics impacts organisational culture, to analyse the factors driving significance of organisational culture, factors driving organisational culture and factors responsible for resisting towards change. In order to make the present most appropriate the experts contribution in the area of organisational culture were considered and taken into account. A structured closed ended questionnaire was administered as schedule in order to avoid non-response, delay and to follow norms. The target population covered belongs to urban Bengaluru. Different companies belonging IT sector, manufacturing banking and education sector were considered and respondents were approached using convenient sampling technique. The findings of the study reveals that organisation culture is important and it is influenced by factors like decides the employees way of interacting in the workplace, predetermined policies promotion of healthy competition, organisation culture brings all employees on a common platform etc., Further the study reveals about the factors influencing organisational culture and those factors includes goals, objectives and vision, job clarity and coordination in the order to ranking and the study also reveals about factors responsible towards resistance organisation culture. The Garrette values are obtained by referring to the Garrett conversion table. The per cent values are obtained by using the formula $100(R_{ij} - 0.5)/N_j$.

On the basis of respondents opinions it was found that socio-economic characteristics are impacting the organisational culture and the study found some significant factors impacts the organisational culture. These factors



**Brunda and Irshad Nazeer**

helps the administrators to formulate strategies for establishing a good organisational culture. Further, the study reveals about 19 variables which are driving organisational culture. The factors are important for the administrators to insist on them and to establish good organisational environment. They include priority wise goals, objectives and vision, job clarity and co-ordination. All these drivers are important to implement a good organisational culture. Further, the study also helpful to the administrators by highlighting factors responsible towards resistance to change. Change is inevitable and hence it guides the management to be careful about factors opposes the implementation of good organisation culture. Convenient sampling technique was followed at the time of collecting the data by administering questionnaire as primary data and secondary sources include e-journals and internet. The response from the respondents was very high and the administration should be well trained about issues pertaining to the drivers of organisational culture. All the respondents revealed about the understanding of the factors that impact organisational culture. They are aware of multiple factors impacting organisational culture. The founders of organisational are well aware of significance establishing good organisational culture. The study findings were presented, analysed and discussed using chi- square, weighted average and ranking and Garrett ranking technique and Kendall's co-efficient of concordance.

CONCLUSION

Culture of an organisation properly guides about the execution of work, interaction and communication which will impacts the performance of an organisation "as is the organisational culture so is the success of an enterprises". The founders, employees and the different stakeholders should create best culture so that the goals and objectives are attained since the organisational culture starts with the founder or leadership of the organisation. Hence it is the personality of the organisation. The organisation culture should not be allowed to be severely influenced which otherwise leads to variation in the strength of culture. Studies reveal strong culture will not result in higher performance and only a moderate positive leadership between strength and performances exists. Changing the organisation culture requires a change in images and values, the evaluative social elements of the organisation. The study reveals about better presence of socio-economic characteristics which are impacting on the organisation culture. The significance has been analysed through some variables and found all the stated variable are impacting the significance of organisational culture. Innumerable factors are impacting on organisational culture. The first rank was awarded to relative important factor goals, objectives and vision, the second ranked is job clarity and the third ranked one is consideration. The study also analyse the responsible factors towards resistance to change. The first ranked one is emotional responses, the second ranked one is lack of confidence in change and third one is about human characteristics. Bengaluru is optly nicknamed as 'silicon valley', science city, garment hub, IT hub. Innumerable employees are working at Bengaluru. The growth of industries either it may be manufacturers, IT sector, research centers and manufacturers and service centers are having better organisational culture which is driving success at present in Bengaluru

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Brunda and Irshad Nazeer

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Brunda and Irshad Nazeer

Table - 1 : Socio-economic characteristics of the respondents

Characteristics	χ^2 <u>TV@0.05</u>		df	result of χ^2	"c"	Result of 'C'
Gender	25.00	3.841	1	Significant	0.44	High Degree
Marital Status	64.00	3.841	1	Significant	0.62	High Degree
Age in years	68.02	12.592	6	Significant	0.63	High Degree
Education	57.50	9.488	4	Significant	0.60	High Degree
Working employees category	13.14	7.815	3	Significant	0.34	High Degree
Work experience	27.90	9.488	4	Significant	0.46	High Degree

Source : Field Survey

Please take note that χ^2 represents chi-square

'c' = $(\chi^2 / \chi^2 + N)$

Where,

'c' stands for the contingency coefficient. N stands for 'N' observations.

When the value of "c" is equal to 1 or close to it, a high degree of correlation between the attributes is present. The contingency coefficient is not going to be more than 1.

Table - 2 : Significance of organisational cultures - Kendall's Relationshipment Measurement Technique

Factors impacting significance	SA	A	SWA	RT	RT ²
Culture decides the way develops interact in their work place	4	3	1	8	64
Organisational culture promotes healthy competition	5	2	2	9	81
The organisational predetermined policies give a sense of direction at the workplace	18	7	5	30	900
The organisational culture brings all employees in a common platform	8	4	2	14	196
The work culture unites all the employees ranking from different backgrounds	4	2	1	7	49
Every employee is clear with the role and responsibility	5	4	2	11	121
Organisational culture extracts the best from employees	7	5	1	13	169
Work culture promotes healthy relationship among the employees	5	3	1	9	81
Total	55	30	15	100	1661

Source : Field Survey

Note : SA - Strongly Agree, A - Agree, SWA - Somewhat Agree, RT - Row Total SSR =

$\sum RT^2 - (\sum RT)^2 / N$

= $1661 - (100)^2 / 8$

= $1661 - 1250$

= 411

$W = 12 \times SSR / K^2 N (N^2 - 1)$

= $12 \times 411 / 9 \times 8 (64-1)$

= $4932 / 4536 = 1.0873$

Test the significance of W by using the chi-square statistic. χ^2

= $k (n-1) w$





Brunda and Irshad Nazeer

= 3 (8-1) 1.0873
 = 3 x 7 x 1.0873 = 22.83

Decision: The TV is 14.067 at 7 d.f. with 0.05 threshold of significance. Given that the estimated number is 22.83 more than the essential table value, 'w' takes H1 instead of H0. We may therefore draw the conclusion that there is a strong correlation between each factor and the importance of organisational culture.

Table - 3 : Factors driving organisational culture - weighted average technique

Factors	Weight Likert Scale	5 SA	4 A	3 N	2 DA	1 SDA	Total	WA
Acceptance of IT & Innovation	f	68	20	3	4	5	100	17
	fw	340	80	9	8	5	442	29.47
Management support	f	71	19	2	4	4	100	14
	fw	355	76	6	8	4	449	29.93
Communication flow	f	72	18	4	3	3	100	6
	fw	360	72	12	6	3	453	30.20
Social relation	f	69	21	3	4	3	100	14
	fw	345	84	9	8	3	449	29.93
Customers focus & service orientation	f	69	21	4	4	2	100	8.5
	fw	345	84	12	8	2	451	30.06
Knowledge creation	f	68	21	4	5	2	100	16
	fw	340	84	12	10	2	448	29.87
Coordination	f	71	21	3	3	2	100	3
	fw	355	84	9	6	2	456	30.40
Language	f	70	20	3	3	4	100	14
	fx	350	80	9	6	4	449	29.13
Performance reward	f	69	22	2	4	3	100	11
	fw	345	88	6	8	3	450	30.00
Team work	f	65	25	7	2	1	100	85
	fx	325	100	21	4	1	451	30.06
Job satisfaction	f	64	27	6	1	2	100	11
	fx	320	108	18	2	2	450	30.00
Trust in supervisor	f	73	19	2	2	4	100	4
	fw	365	76	6	4	4	455	30.33
Employee participation in decision making process	f	71	19	5	2	3	100	6
	fw	355	76	15	4	3	453	30.20
Goals, objectives & vision	f	75	20	3	1	1	100	1
	fw	375	80	9	2	1	467	31.13
Job clarity	f	73	18	11	3	2	100	2
	fx	365	72	12	6	2	457	30.46
Conflict resolution	f	70	20	5	3	2	100	6
	fw	350	80	15	6	2	453	30.20
Core values	f	75	13	4	3	5	100	11
	fw	375	52	12	6	5	450	30.00
Style of management handling employees	f	65	18	11	2	4	100	18
	fw	315	72	33	4	4	428	29.20





Brunda and Irshad Nazeer

Organisational learning	f	63	20	6	6	5	100	19
	fw	315	80	18	12	5	620	28.67

Source : Faced Survey

Likert scale : SA - Strongly Agree, A - Agree, N - Neutral, DA - Disagree, SDA - Strongly

Disagree Weights : 5 + 4 + 3 + 2 + 1 = 15

Weighted average = Total / sum of weights

Table - 4 : Factors responsible towards resistance to change Garrett Ranking Technique Ranks Scale & Score value of ranks

Factors	Scale value(x)	I 81	II 69	III 62	IV 56	V 50	VI 44	VII 38	VIII 31	IX 19	Total	Mean Score	Rank
Attitudes and feelings of individuals about a change	f	50	21	5	6	7	4	3	2	2	100		
	fx	4050	1449	310	336	350	176	114	62	38	6885	68.85	IV
Opposing union values, narrow outlook, vested interest & desire to retain existing findings	f	53	20	4	5	8	3	2	2	3	100		
	fx	4293	1380	248	280	400	132	76	62	57	6928	69.28	III
Individual resistance arising out of human characters	f	52	20	7	7	5	4	2	1	2	100		
	fx	4212	1380	434	392	250	176	76	31	38	6989	69.89	II
To cope with life complexity	f	48	18	11	7	6	3	2	3	2	100		
	fx	3888	1242	682	392	300	132	76	93	38	6843	68.43	VI
Preferring predictability & structured pattern in people life	f	45	20	10	8	4	6	3	2	2	100		
	fx	3645	1380	620	448	200	264	114	62	38	6771	67.71	VII
Time to adjust to change	f	48	17	9	6	5	7	3	2	3	100		
	fx	3888	1173	558	336	250	308	114	62	57	6746	67.46	VIII
Lack of confidence in change	f	55	21	5	4	5	3	2	3	2	100		
	fx	4455	1449	310	224	250	132	76	93	38	7027	70.27	I
Emotional responses	f	49	22	12	2	3	3	2	3	4	100		
	fx	3969	1518	744	112	150	132	76	93	76	6870	68.70	V
Mistrust and clear of failure	f	45	15	12	8	6	4	5	2	3	100		
	fx	3645	1035	744	448	300	176	190	62	57	6657	66.57	IX

Source : Field Survey

Note : X - scale value

f - number of respondents

R - Rank

Mean score = Total Score / N





Table - 5 : Garrett Ranking Conversion Table

Sl.No.	$100(R_{ij}-0.5)/N_j$	Calculated value	Garrett Value
1.	$100(1-0.5)/9$	5.56	81
2.	$100(2-0.5)/9$	16.67	69
3.	$100(3-0.5)/9$	27.78	62
4.	$100(4-0.5)/9$	38.88	56
5.	$100(5-0.5)/9$	50.00	50
6.	$100(6-0.5)/9$	61.11	44
7.	$100(7-0.5)/9$	72.22	38
8.	$100(8-0.5)/9$	83.33	31
9.	$100(9-0.5)/9$	94.44	19

Source : (1) Subhash Vadgale (2016). Village consumer behaviour towards perishable goods. A study with respect to Ahmednagar district of Maharashtra, Pezzottaite Journals, 5, (3) 2286-2287. (2) <https://pd4pro.com.edu>





Challenges of Adoption of Digitalisation in Banking Sector

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ABSTRACT

At present digitalization in India has resulted in huge change in all the sectors over the world, which has laid to changes in business model and provides new opportunities for the growth of business. Over the past few decades' technology has made several advancements. Banks, all over the world are moving towards digitalization to cope up competition and offering their customer with best services and products. The purpose of this paper is to investigate the different transformation/method, innovative banking products in banking system in context of digital economy and also the challenges faced by banking sector to provide better digitalisation services to the customers. This paper is based on secondary data using journals, articles and websites.

Keywords: Digitalization, banking sector, digital economy

INTRODUCTION

The fast development of technology over the past several decades has stunned the entire world. There are numerous instances of technology creating and breaking lives and businesses one of these being the business of banking. The disturbance of digital technology into the globe of banking sector has brought about a huge change in banking creating a way for digital banking. Digital transformation of banking industry will highly influence on digital economy. The Governor, Reserve Bank of India, Shri Shaktikanta Das, attributes the progress in digital banking to 'higher levels of sustainable development and financial inclusion. Adoption of new technology and internet has accelerated credit access and efficient payment systems for present and the future of digital banking are all accountable for this flourishing growth.

Need of the Study

India's banking sectors are transforming and empowerment of investing profoundly in digital technologies to match



**Pavithra and Vinutha**

up with leading global competitors offering wide-range of product and services. At the same time, present innovations and future trends of the Indian banking sector, are generating a rapidly rising digital citizenry. These digital users are increasingly demanding that India's banks not only keep bound with global foremost practices, but advance far beyond them by developing new, unique products, services and business models considering competitors all over the world.

Objectives of the Study

To study the recent trends in digital banking
To identify the challenges of digital banking

Recent trends in Digital Banking**ATMs**

ATMs (Automated Telling Machines), commonly referred to as automated teller machines (ATMs), are electronic devices. Tele communications tool allows customers consumers to do financial transactions, without any necessity for a human cashier, clerk, or bank teller, especially withdrawal of cash, in addition to that it helps to check deposits, receipt printing, balance inquiries, PIN generation, Passbook printing, and other operations are performed by an ATM.

Electronic Clearing Services (ECS)

The Electronic Clearing Services (ECS) is an electronic method for facilitating high volume, repetitive, and periodic interbank payments and receipts. Institutions use these services to pay in bulk for things like interest, salaries, pensions, dividend distribution, etc., or to collect in bulk for things like phone, electricity, and water bills, taxes, loan instalment repayments, periodic mutual fund investments, insurance premiums, etc. ECS essentially makes it possible to transfer money in bulk from one bank account to several bank accounts or the other way around. Transactions conducted through the National Automated Clearing House (NACH), which is run by the National Payments Corporation of India, are also included in ECS(NPCI). ECS comes in two main flavours: ECS Credit and ECS Debit.

Immediate Payment Service (IMPS)

Immediate Payment Service (IMPS) is an immediate real-time inter-bank electronic funds transfer system in India. IMPS offer an inter-bank electronic fund transfer service through mobile phones. Unlike NEFT and RTGS, the service is available 24/7 throughout the year including bank holidays. It is managed by the National Payments Corporation of India (NPCI) and is built upon the existing National Financial Switch network.

Mobile Banking

It is a banking service that enables a client to carry out financial transactions and acquire associated information anytime, anyplace, using a mobile phone or tablet without requesting the help of the bank's CRM. When mobile banking first started, it was limited to using the Short Message Service (SMS) to access financial services. Additionally, it is also known as SMS Banking.

Unified Payments Interface (UPI)

The most practical line for financial transactions was introduced on August 23rd, 2016. Through a mobile device, UPI enables rapid money transfers from any location and at any time. It makes it possible to access several bank accounts using a single mobile application that combines a number of banking services with single-click two factor authentications, a security standard that is required by law. For various operating systems like Android, iOS, Windows, etc., each bank has its own UPI.

Social Media Banking

The phrase "Social Media Banking" is a new catchphrase in the banking industry. Every major bank has a Facebook page and a Twitter account, and they all use these social media channels to interact with their clients. According to





Pavithra and Vinutha

a 2014 Capgemini analysis, banks stand to lose a lot if they limit themselves to traditional banking or solely internet banking because generation Y customers require that their bank be present on social media platforms. Banks like the Commonwealth Bank of Australia and Deniz Bank in Turkey gave consumers the option to check account balances via Facebook and send money to their Facebook friends, kicking off the trend of social media banking. India has caught on, as seen by Kotak Mahindra Bank's introduction of their "#Banking" (Hashtag Banking),

Chatbots

Chatbots are one of the most recent innovations in the Indian banking sector. In order to assist with customer care services, several commercial and government-run banks in India have started using chatbots or artificial intelligence robots. Although the use of this technology is still in its infancy, it is expected to grow soon. Banks and other financial institutions are likely to employ more chatbots with higher levels of intelligence in order to boost customer engagement and offer more personalised solutions. Utilizing technology will reduce the likelihood of human error and give clients the right answers. Additionally, it might collect survey responses and comments, look out for fraud, and support financial decisions.

Cloud Banking

The banking industry is in a cloud banking rage. It appears that the technology may soon find a home in India's banking and financial services industry. Banking and financial operations will be organised and improved through cloud computing. Utilizing cloud-based technology results in better data protection, higher productivity, improved flexibility and scalability, quicker services and solutions, and simpler integration of emerging technologies and applications. Additionally, because updating data is simpler with cloud-based banking models, banks won't need to invest in pricey software and infrastructure.

Challenges in Digital Banking

Digital Banking is online banking sponsored by an internet connection. Traditional banks are getting a break, as a large part of customer is being managed and used by apps of net banking and digital banking. The Customers of digital banking can easily access their accounts details and payments through electronic devices like tabs, smartphones, ATMs, laptops and desktops. The main goal of digital banking is to provide 24x7 services and serve according to the consumer convenience. It the fast growing economy all over the world where time and responsive services are a boon. Though the advantages outstrip the challenges. Let us understand the challenges of digital banking. Present the dependence on digital banking increased. Digital banking has encouraged to digital lending, investing and account opening. Because of digitalisation Banking is more accessible, and customer appetite for better technology is rising. However, with the growing demand and digital banking pressure, banks are being challenged to cope with the new customer expectations in various aspects of digital banking compliance.

Through Innovation Shift in Banking Habits and Products

Banks struggle to simplify customer quickness on their digital platforms while maintaining a quick network. The majority perspective for all financial services offered by banks should be to develop financial solutions through collaborative tools and modified products as the volume of digital transactions and non-cash payments increase. Products and services that satisfy customer needs should be offered in the vernacular language in order to reach the population who lacks literacy, particularly in tier 2 and higher sectors of the nation. It's important to manage disputes effectively when introducing new products. It is important to quickly recover customer real-time insights analysis, which provides greater accuracy, to address customer choice and product requirements. The bank's focus should shift from data-intensive tasks to activities as a result of the technology-enabled change.

Security Concerns

Customers and banks are both at risk of fraud in financial transactions as a result of digital banking's increased customer convenience. In order to educate customers about the types of threats they might encounter, it is the responsibility of the banks to do so. They must never give out private financial information to unknown callers, email recipients, or text message senders. They should put that into practice when carrying out financial transactions



**Pavithra and Vinutha**

and periodically change the secure credentials/passwords. Banks run on covered security checks, allowing customers to halt a transaction at any time if they have any doubts. Banks strongly advise their clients not to click on unidentified links without first verifying the Uniform Resource Locator (URL). Use the bank's official website or banking app for all financial transactions. Frauds occur frequently.

Remote Access: Customers unknowingly download an application on their mobile/computer giving access to customer data.

Phishing: Spoofed emails/SMS, designed in such a way that customers think it is from the bank.

Vishing: Sharing financial information under the pretext of KYC upgradation, unblocking account, SIM card, debit/credit card. Misusing UPI 'collect request', by sending fake messages to collect money. Fake bank numbers/e-wallets/incorrect search engine results/ frauds through social media.

Technical Issues

Banks have serious concerns about disconnectedness and a lack of reliable data. Banks are attempting to prevent issues with increased demand loads brought on by digital technologies. Relying on technologically advanced systems is the minimum expectation given the rising customer expectations for improved and quick banking. In order to scale the infrastructure based on somewhat dated core banking systems to accommodate modern technologies, banks should deploy SaaS teams of engineers. They need to make sure that the banking digital service is flexible enough to adapt to new technologies. Banks should maintain a front-end focus while embracing modern technology and innovation and making preparations to be future-ready to handle customer pressure. Banks ought to be able to manage technical decline(TD) in UPI payments as well. UPI outages need to be efficiently managed by banks.

Lack of Personal Relationships

Customer service is an important factor by which banks retain and acquire new customers. A bad experience with a service provider that is not mitigated in time by PR can damage the bank's reputation. As technology becomes the first face of digital banking, non-human robots and customer service helplines will gradually replace the personalized service that customers still love. These automated services may terminate customers. Most online banking applications generate potential questions for customers in hopes of solving problems. However, not all questions are about specific customer issues. People don't have time and are mostly impatient. They want immediate treatment. Therefore, when someone wants to know what the loan process is all about, they are directed to a list of similar questions that irritate and encourage customers to turn to another service provider. Personal support cannot be completely removed and must coexist with artificial intelligence. Customers cannot be forced to wait in long lines, but you must observe a fast attendance. The automated system needs more improvements to support accurate customer survey. The automated system needs greater improvement, supporting the exact customer query.

Growing Customer Expectations

Customers are rapidly switching to innovative online products and services. Proof of this change is the increasing growth of digital payments in India through the Unified Payments Interface (UPI), which was estimated at INR 10. lakh in August 2022. Internet banking and mobile banking also spread rapidly during the pandemic. Customers want faster and better performance with their banking applications. A younger, agile and risk-tolerant workforce needs to upgrade old technologies. Increasing security at all levels and reducing vulnerabilities increases customer confidence.

CONCLUSION

In recent years, there has been a substantial development in the Indian banking sector. The current landscape of digital banking offers the banks both a lot of potential and a lot of challenges. The major aims driving the technology-enhanced integration of financial services are convenience, efficiency, and transparency. Numerous financial innovations, including UPI, Internet Banking, Mobile Banking, Mobile Wallet, QR Code, etc., have significantly changed the way that banking is done in India. The chances can be efficiently seized, and the hurdles



**Pavithra and Vinutha**

can be easily overcome, by deploying more cutting-edge solutions and technological security measures. There is no doubting that the delivery of financial services and the customer experience have both significantly improved thanks to digital banking. Numerous financial innovations, including UPI, Internet Banking, Mobile Banking, Mobile Wallet, QR Code, etc., have significantly changed the way that banking is done in India. The chances can be efficiently seized, and the hurdles can be easily overcome, by deploying more cutting-edge solutions and technological security measures. There is no doubting that the delivery of financial services and the customer experience have both significantly improved thanks to digital banking.

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Consumer Behaviour towards White and Brown Consumer Durables - A Study of Literature Review

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ABSTRACT

Recent development in consumer durables sector have narrowed down consumer goods into brown and white goods. It is utmost importance for the marketers to understand consumer behaviour & attitudes towards purchase of these goods. All marketing activities are directed towards a single destination called customer satisfaction. Consumer behaviour denotes the process of consumer's emotional behavioural and physical responses towards purchase of product and services. Get closer than even to your customer, so close that you tell them what they need well before they realize it them. India has become the hot spot among global retailers to market their goods. In India durable goods has reached in nook and corner of country from urban hyper markets to rural bounds.

Keywords: Life style, emotion, attitudes, households, global markets.

INTRODUCTION

The growing affluent consumer market in India has opened a wider scope for consumer durables industry. The Indian consumer durable industry has undergone a sea change in the last decade. Fast changing life style and sharp increase in disposable income have been instrumental in transforming the Buy8hg pattern and preference of consumers. India, the second most populated country is a potential market for consumer durables. Study of consumers behaviour is a complex concept to understand as the behaviour is subject to change with the moods, perceptions and attitude of consumers. Understanding and analysing consumer behaviour is of much significance for all organisation as the market sustainability depends on consumer behaviour.



**Nagarathinam and Nagesh****Consumer Behaviour**

Consumer behaviour refers to the process of market analysis and decision making by consumers. Today's consumers are rational and do not attach themselves with any product/service unless they are completely and continuously satisfied on the product/service. Consumer's decision is influenced by both internal factors and external factors as well. Internal factors relate to the controllable factors such as preference, availability of money, readiness to afford, friends' and family's influence etc. The external factors refer to price, quality, brand name, availability in the market, offers and discount etc. These internal and external factors can be grouped as personal factors, psychological factors and social factors. In toto, consumer behaviour consists of decision as to what to buy, where to buy, how to buy, how to use and how to respond and react post purchase. Understanding consumer behaviour is understanding the psychology of consumers with respect to their motives and attitudes towards product and services. The increasing competitive and cut throat environment in business arena, necessitates every organisation to be on their heels in their marketing strategies and approaches.

Objectives

- To understand the concept 'Consumer behaviour'
- To study the factors influencing consumer behaviour towards durable brown and white goods through literature survey.
- To identify factors of durables products buying practice by consumers.

White Goods

Business dictionary defines white goods as heavy consumer durables which are generally painted in white traditionally. Examples of such goods are Refrigerators, Washing machines and Air-conditioners. Though, nowadays, they are available in variant colours, they are termed as white goods.

Brown Goods

According to Business dictionary, white goods refer to consumer durables such as TV, Transistors, Cooking range, Chimneys, Mixer grinders, etc.

Indian Consumers Durable Industry

According to a report by India Brand Equity Foundation Indian consumer durable industry has witnessed a growth of 16% CAGR (Compounded Annual Rate Rate) between April 2018 to February 2019. Growing demand among consumers, policy support from government and increasing investment in durables industry are found to be the accelerators for such growth. India is viewed as a market which has bright chances of potential growth by global marketers. The demographic dividend that India possesses along with higher disposable income has brought India into the limelight of global consumer durable industry. The replacement cycle period for durables has been shortened to a significant extent as the consumers are highly keen on replacing their durables with latest ones available in the market. This has resulted in multi fold growth in the industry. India is expected to occupy the fifth position among largest consumer durables market across the world. National policy on electronic of 2012 aimed to transform India as a global hub for Electronic system design and manufacturing. Urban market's major demand accounts for non-essential durables whereas rural and semi urban market contributes towards essential durable goods.

REVIEW OF LITERATURE

- Hemalatha and Parmaladevi (2018) examined the marketing spur in the purchase of brown durable goods in Erode district. The study found that competitive prices and value for money were the two factors that dominated the purchase decision of the consumer. It further suggested companies to offer more credit options to customers as it may increase the sales.



**Nagarathinam and Nagesh**

- Karthika *et al.* (2018) examined the consumer behaviour towards purchase of white goods and the factors influencing such behaviour among consumers of Trichy district. The study found that price, quality, offers and discounts and brand image were the most influencing factors in purchase of consumer white goods. It further suggested that these must be transparency on technical information of the products, so as to ensure rational decision making.
- Mir Javed and Pradeep kumar sharma (2018) investigated the internal and external factors influencing the purchase decision of consumer durables in Bhopal. The study showed that the purchase trend is more among people with higher income. It further suggested manufacturers to produce low cost goods to attract consumers with low income.
- Shuchi Mittal (2016) explored the factors affecting consumer behaviour towards white goods among consumers of Indore. The results revealed that Product features, Social status and family & friends were the most influential factors in decision making in the purchase of consumer Durables.
- Mashao E.T. & Sukdeo N. (2015) in their study titled "Factors that influence consumer behaviour in the purchase of durable household products" found that product features, price of the product and product quality are the most influential determinants of consumer buying attitude towards consumer durable.
- Bhuvaneswari, R and Prakash Babu (2014) attempted to study the behavioural aspects of purchase decision regarding refrigerator, air-conditioner, television and oven. Majority of the respondents were found to make purchase from retail outlets and the major source of information was found to be advertisements. The credit facilities available and price were the influencing factors.
- Pooja Bhatia *et. al.* (2014) analysed the purchasing attitude of urban working women. A close ended structural questionnaire was distributed by 30 women. Functionality, reliability, price, discount, warranty, discounts were the factors considered for the study. It was found that women are more price conscious and their purchasing decision is not influenced by income. It was also found that quality consciousness is high among women.
- Suganthi, V. and Mohan, S. (2014) investigated the factors that influence consumer behaviour towards select brand of washing machines in Udumalpet. Using convenient random sampling method, the data was collected from sixty respondents. Percentage analysis chi-square analyses were used to analyse the data through which it was revealed that brand loyalty, price, quality, guarantee and warranty and durability influence the consumers a lot and their satisfaction was no way related to the demographic profiles such as age, qualification etc.
- Suyash Mishra and Rishi Kant (2014) attempted to find out the factors that influence the purchase behaviour of towards consumer durables among the respondents in Uttar Pradesh. Durability technical progress, discount, electricity consumption, availability of stores, after sales service facility, price, warranty and guarantee, promotional activities was the variables considered for the study. Brand equity, technical aspects, after sales service and appearance were the factor that found to have a dominant influence in the purchase decision and it was suggested to the marketers to concentrate on their factors to escalate sales and customer satisfaction.
- Cramer (1962) found that the demand for white goods is restricted to higher income groups which contradicts with current market trends availability of easy payment options and social factors have created demand for such products among middle income consumers also.
- Mayank Saxena & Suchi Miital (2016) in Asian Research Consortium Asian Journal of Research in Marketing considered Brand, quality, affordability, product features, price, safety, brand loyalty, package, social status, peer pressure and previous experience were the variables that considered for the study.

Suggestions

1. Consumers while purchase consumer durable goods need to focus on product with ISI and ISO standards, checked by authorised authorities.
2. The market should bring frequent updates and bring new models into the market. Hence it will attract more consumers and their frequency of using durable goods.
3. More and more online platforms need to be adopted by marketer to capture today consumers, technology shift the perception of consumer from store purchase to online purchase.
4. The brand value of the product – Quality, Utility and Reliability is the key factor in creating brand loyalty of the product.



**Nagarathinam and Nagesh**

5. Updated durables are the key factor that is technological gazedes like mobile phone, laptop helps the industry to reveals the mind set of the consumers.

CONCLUSION

The analysis of above reviews reveals that Price, Features, Payment options, Security and Discounts were the most influential factors in determining consumer behaviour. Further it is noted that women were the dominating segment in making such purchases. Thus, the researchers stated that the traders can concentrate on these factors to attract more consumers and to sustain in the heavy competitive market. Eminent pricing methods need to be followed in order to attract more and more consumers of durable goods. More encouragement on development platform for online shopping should be focused by marketer.

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A Two-Stage Intrusion Detection System using Machine Learning Approaches for IoT Networks

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ABSTRACT

The implementation of new network technologies and the ongoing development of interconnected computer devices has led to a rapid increase in the number of Internet of Things (IoT) devices. Intrusion Detection Systems (IDS) have attracted a lot of attention in IoT network security-related disciplines. It can be difficult to design an IDS with the highest degree of accuracy and the fewest false alarms. In this paper, a Hybrid two-stage IDS approach (HIDS) that employs machine learning methods to improve accuracy and decrease false rates has been proposed. In the first stage of this work, the Sparse Naive Bayes technique for feature selection has been used, and in the second stage ensemble classifier boosting has been employed to find abnormalities in IoT networks. The suggested model has undergone testing and assessment. The simulation outcomes demonstrate that the suggested model provides greater accuracy than other current models.

Keywords: Network security, Intrusion detection system, Feature selection, Data Classification, Sparse Naive Bayes, Boosting.

INTRODUCTION

Protection of sensitive data from malicious attacks has been a concern for a long time both in the industry and academics. IoT device offers numerous benefits including automatic data collection, monitoring, and control in an



**Logambigai et al.,**

efficient and effective way. But they are also vulnerable to security and privacy threats. These security and privacy concerns restrict the widespread adoption of IoT devices, particularly in critical scenarios involving sensitive data. IoT is rapidly altering everything in our life, including electronic gadgets, toys, and appliances. All the equipment in our environment is becoming internet-enabled with inadequate security setup. To avoid consequences, considerable research in IoT security is essential. To assure uptime and defend network infrastructure against invasion, intelligent systems are required to protect network systems. It is therefore inevitable to design effective IDS. Intrusion Detection has become increasingly important as online applications are used to access massive databases over a network.

In this work, an alternative sparse technique for databases with dependent features has been presented. A variable reduction technique using Naïve Bayes scheme has been implemented to build a sparse version of the classifier. The article's remaining sections are structured as follows. Some of the pertinent work is covered in Section II. Furthermore, the suggested approach is demonstrated in Section III. In Section 4, the experimental design and results are discussed. The summary of this proposed work is presented in Section 5.

Related Works

In the networks of the Internet of Things, network security is a major concern. Network security systems have been the subject of numerous studies. All intrusion detection systems depend on accuracy to work properly, so increasing the detection rate is essential to lowering the number of erroneous alerts. It is challenging to distinguish between malicious and legitimate traffic because of improved attack strategies. To deal with these problems, Rafael Blanquero et al. [1] proposed a sparse version of Naïve Bayes for feature selection. They proposed a smart search with competitive running times while integrating flexibility in terms of classification performance measures. Their results demonstrate that the proposed sparse Naive Bayes achieves competitive results regarding accuracy, sparsity, and running times for balanced datasets when compared against well-referenced feature selection approaches. Alkahtani et al. [2] based on the IoT environment, a reliable conceptual model for detecting intrusions was proposed. Particle swarm optimization (PSO) was used by the authors in their study to choose pertinent features from the network dataset. And in order to categorize intrusions, deep learning techniques like convolution neural networks (CNN), long short-term memories (LSTM), and a hybrid CNN-LSTM model were used. A wrapper feature selection algorithm for IDS was put forth by Hadeel et al. in [3]. For the selection process in their algorithm, a pigeon-inspired optimizer was used. In [4], Ujwala proposed a hybrid approach that combines data mining methods like the K Means clustering algorithm and the RBF kernel function of the Support Vector Machine as a classification module to reduce the number of attributes associated with each data point.

The Bagging Ensemble method is used by Gaikwad et al. in [5] to implement an IDS in their paper. Due to its simplicity, the Partial Decision Tree was used as the foundation classifier. To select features, they then applied a genetic algorithm. Using the unsupervised machine learning algorithm k-means, Duque et al. in [6] proposed a model for an intrusion detection system that has a highly efficient rate, reduced false positives, and false negatives. Dongre et al. in [7] suggested the use of an ensemble boosting approach, a data mining classification technique, together with an adaptive sliding window for intrusion detection systems to maximize the effectiveness in identifying attacks and assist users in building more secure information systems. For the purpose of combining attribute selection algorithms for intrusion detection, Chebroli et al. in [8] proposed a hybrid architecture that combines Bayesian network (BN) and Classification & Regression Tree (CART) as well as an ensemble of BN and CART.

A uniform intrusion detection method was put forth by Yulong et al. [9] for the massive heterogeneous IoT networks based on an automata model to automatically identify and report any potential IoT attacks of the three types—jam attacks, false attacks, and reply attacks. Hakan et al. in [10] to detect intrusions in the Industrial IoT network, three different models were proposed using deep learning architectures of convolutional neural networks (CNN), long short-term memories (LSTM), and CNN + LSTM produced from a hybrid combination of these. To solve problems involving a small number of features authors in [11] created a feature engineering framework that combines feature construction and selection. And also using empirical mode decomposition and Boruta feature selection, new



**Logambigai et al.,**

interesting and insightful features were created and all pertinent features were chosen, respectively. Alhowaide et.al.in [12] suggested an automatic Model Selection Method (MSM)-based ensemble classification model. A wide variety of classifiers with various configurations were taken into account by the suggested MSM. In addition, the suggested MSM chose and evaluated models using new integrated measures.

Prazeres et. al. in [13] suggested an IDS with a distributed architecture that makes use of fog computing to power special-purpose functionalities and deep neural networks to find malicious activity in IoT data flows. For enhancing the performance and reducing the processing time of the IDS, an effective wrapper feature selection method was suggested by the authors in [14]. In their suggested method, the useful features are chosen using a differential evaluation algorithm, and the selected features are then evaluated using an extreme learning machine classifier. Ramana et. al. in [15] proposed the novel Whale Optimized Gate Recurrent Unit (WOGRU) Intrusion Detection System (IDS) for WSN-IoT networks to efficiently identify various attacks. The deep long short-term memory's hyperparameters were tuned using the whale algorithm in the suggested framework to produce low computational overhead and excellent performance.

Tejaswini, et. al. in [16] primarily used Mutual Information (MI) to choose features. In order to select features, the authors implemented 4 distinct mutual information computations such as Empirical (EMP), Miller-Madow (MM), Schurmann-Grassberger (SG), and Shrink. Jain et. al. [17] in their work, three hybrid feature selection techniques were used with ensemble machine learning algorithms to enhance code smell detection. And also three boosting designs, two stacking techniques, bagging, seven machine learning classifiers with various kernel variations were implemented. Chemmakha, et. al. in [18] concentrated on feature selection using embedded-based techniques to reduce ML model complexity and computation time. In their work, in terms of analyzing the significance of features while running the model and their shortened execution times, embedded-based methods combine the benefits of both filter-based and wrapped-based approaches.

Saba et. al. in [19] suggested a two-stage hybrid approach. First, appropriate features are chosen using the genetic algorithm (GA) to increase the proposed framework's accuracy. Then, the widely known machine learning (ML) algorithm, which uses the support vector machine (SVM), ensemble classifier, and decision tree was used in their work. Qiao et. al. in [20] suggested a workable framework using feature selection techniques for predicting building energy consumption that would address issues brought on by the indiscriminate extension of features when dealing with insufficient information. Meteorological data's time information and delay effects were used as initial input features in their work and then the feature selection process was proposed.

Hybrid Two-stage IDS approach

In this section, a Hybrid two-stage IDS approach (HIDS) has been presented. The proposed approach employs machine learning methods to improve accuracy and decrease false rates. In the first stage of this work, the Sparse Naive Bayes technique for feature selection has been used, and in the second stage ensemble classifier boosting technique has been used to find the abnormalities in IoT networks. The proposed HIDS for IoT networks, which is based on machine learning techniques is given in Figure 1. The NSL-KDD dataset is used to model the proposed system. The proposed model incorporates feature selection and training via classifier.

Feature Selection Using Sparse Naive Bayes

There are several parameters that influence the success rate of IDS based on machine learning classifiers in a particular context. One of these aspects is the representation and quality of the data we use to detect intrusions. Having a huge volume of data with more qualities and features should theoretically result in more discriminating power and accuracy. However, several machine learning algorithms have demonstrated that this is not always the case. Many learning algorithms produce a biased estimate of the likelihood of the class label given a set of features. This can be resolved by feature selection or variable selection techniques.

In intrusion detection, feature selection is used to eliminate redundant and irrelevant data. It is the process of selecting a subset of relevant information that completely defines a problem while causing the least amount of





Logambigai et al.,

performance impact. A sparse, computationally tractable NB is obtained by an efficient methodology, where it searches the subsets of features by analyzing only a few of them in terms of their dependence among features. Else, it requires evaluation of $2^p - 1$ set. The Naive Bayes' primary presumption is that the features that are conditioned to a class are independent. Without damaging the predictive power of the classic NB, the variable reduction strategy works by clustering the features made in terms of their dependencies. The variables that are as independent as possible are selected to provide good classification accuracy.

Consider a dependence measure between random variables X and Y , which increases with the degree of dependence between the variables. Consider for $i, j \in \{1, \dots, p\}$ and $k = 1, \dots, K$, the dependence between feature X_i and feature X_j is conditioned on class C_k .

Let M be the matrix whose elements $(M(i, j))$ represent the maximum dependence among all classes, between X_i and X_j .

Maximum dependency is the worst scenario. The dependence measures proposed in other literature are employed like Pearson's correlation coefficient, Spearman's rank-order correlation coefficient, Hoeffding D statistic, the mutual information coefficient, the Maximal Information coefficient, or the distance correlation coefficient, among others.

In this work, similar results are obtained using these measures. The mutual information measure has been chosen since it allowed to work with both continuous and categorical data and is commonly utilized in the literature. The information about one variable X provided by another variable Y is quantified by this coefficient, which is given in equation (1).

$$I(X, Y) = \int_y \int_x p(x, y) \log\left(\frac{p(x, y)}{p(x)p(y)}\right) dx dy \quad (1)$$

Following that, a dissimilarity matrix H of dimension $p \times p$ is defined in terms of matrix M by the elements in order to do a cluster analysis in terms of the degree of linkage among the features is given in equation (2)

$$H(i, j) = \frac{M^* - M(i, j)}{M^*} \quad (2)$$

Where,

$$M^* = \max_{i, j \in \{1, \dots, p\}} M(i, j) \quad (3)$$

The above value of H , bounded below by zero represents the maximum degree of dependence. Thus we arrive at a point, higher the values of $H(i, j)$ are, the less dependence exists between X_i and X_j , according to the selected dependence measure. In terms of the dependence measure, the results obtained are quite reliable. The classifier's performance measure to be maximized in the embedded Variable Selection approach can be chosen from among the previously specified measures based on the user's convenience and the dataset's attributes once the dependent measure has been set.

Usually, the ACC is selected, but in some cases like unbalanced datasets or if there exist critical classes, we select AUC, precision or a certain Recall. The selection of the dependence and the classifier's performance measures is the first step of our algorithm. A hierarchical cluster analysis of features according to the dissimilarity matrix is performed once the dependence measure, and the elements of the matrix H are computed. NB can be implemented, once the set of combinations of features to be evaluated is reduced. Then its performance, feasibility on the constraints considered are evaluated for each combination.

Finally, the viable combination that produces the highest performance metric would be regarded the best, taking into account the entire set of variables in this comparison. According to the results, our model has retained the significant





Logambigai et al.,

properties while only employing half of the whole collection. However, the positive class is the most problematic in this dataset. Pseudocode for Sparse Naive Bayes is given in Algorithm 1

Algorithm 1

Step 1. Select the dependence and the classifier's performance measures.

Step 2. Run a cluster analysis, then create a dendrogram..

Step 3. Variable reduction strategy:

Set specific values for the parameters $\{C, S, q\}$ and initialize $\mathcal{F} = \emptyset$.

for $c = 1, \dots, C$ do

for $s = 1, \dots, \min\{nc(c), S\}$ do

(a) Obtain the S th combination of features. For each cluster only one variable is randomly selected with probability q , and none with probability $1 - q$.

(b) Construct the classifier for the S th combination of features.

(c) Evaluate the selected classifier's performance measure and if feasible, add it to \mathcal{F} .

end

end

Step 4. Variable Selection:

Select the combination of variables leading to the best performance, among those in \mathcal{F} .

Ensemble classifier – Boosting

Boosting is a supervised learning technique developed by machine learning. The majority of boosting techniques result in learning weak classifiers with respect to a distribution, combining them with a final strong classifier, even though boosting is not algorithmically bounded. When they are added, they are normally weighted in some way that is connected to the accuracy of the weak learners. The data is reweighted after a weak learner is added: Misclassified examples gain weight, whereas correctly classified ones lose weight.

Due to Boosting's focus on misclassified tuples, there is a chance that the composite model will be over fit to these types of data. As a result, the "boosted" model may occasionally be less accurate than a single model built from the same data. Model over fitting is less of an issue with bagging. While both can improve accuracy when compared to a single model, boosting is more accurate. The gain in performance is due to the fact that it creates a hypothesis with a small error on the training set by merging multiple hypotheses with high errors. Boosting reduces variance. Boosting algorithm given in Algorithm 2, may lessen the bias of the learning algorithm, unlike bagging.

Algorithm 2

An ensemble set of classifiers $\{C_1, C_2, C_3, \dots, C_m\}_{m \leq M}$

Input: D a set of class labelled training tuples base learning algorithm, hoeffding tree

Output: a composite model

Method:

Step 1. for base model $i = 1$ to m

Step 2. ADWIN (D)

Step 3. for every window k

Step 4. compute error rate on every window err_k

$err_k = \text{misclassified_examples} / \text{total_examples}$

Step 5. if change detected

Step 6. Set new sample weight $W_i = W_k = (1 - err_k) / err_k$

Step 7. else

Step 8. $w_i = 1$

Step 9. end if

Step 10. update weight





Step 11. learn classifier
 Step 12. end for
 Step 13. add next classifier C_{m+1} , drop C_1 , if $m = M$
 Step 14. end for

Adaptive Sliding Window

An adaptive sliding window and hoeffding tree is used in the suggested ensemble boosting method to improve performance. In this suggested work, Adaptive Window (ADWIN) is parameter and assumption-free since it recognizes and adjusts to the current rate of change automatically. It simply has one parameter: a confidence-bound δ . Although the window is not explicitly maintained, it is compressed using a form of the exponential histogram technique. It preserves the window of length W utilizing just $O(\log W)$ memory and $O(\log W)$ processing time per item, instead of the $O(W)$ that a naive implementation would need. It's used as a change detector because it shrinks the window if and only if there's been a significant change in recent examples, and as an estimator for the current average of the sequence it's reading because older parts of the window with a significantly different average are almost certainly automatically dropped. Efficient and Adaptive Classifier As a basic learner, Hoeffding Tree is used. Because of this algorithm, it works faster and performs better. The dynamic weight is assigned using equation (4).

$$W_k = (1 - err_k) / err_k \quad (4)$$

where err_k is Error rate of the window

The major feature of the proposed algorithm is change detection, which ensures that the ensemble can adjust to changes quickly. Every window is subjected to change detection. When the alarm of change is raised, our ensemble technique detects concept change and discards the old classifier.

SIMULATION RESULTS AND DISCUSSIONS

A set of data from the real world has been used to assess how well the proposed model performs. The suggested model's performance has been evaluated and analyzed using the NSL-KDD dataset. There are 41 features in each NSL-KDD database record. The 42nd property contains information on five separate classes (one normal and four attacks). DoS attacks, remote to local (R2L) access, probing attack (Probe), and User to Root (U2R) access are the different types of attacks. Several experiments have been carried out to evaluate the performance.

The proposed approach was tested using reduced features of 17 attributes and 13 attributes for Genetic Algorithm and Sparse Naive Bayes Algorithm respectively and the accuracy is given in Table 1. From the table, it is clear that the Sparse Naive Bayes algorithm gives more accuracy than the Genetic algorithm. The accuracy of various classification techniques such as Decision Tree, SVM, Ensemble Bagging, and Ensemble Boosting are given in Table 2. From the table it is observed that the ensemble classifier boosting resulted in better accuracy. The different types attacks used to assess the proposed model and its accuracy are given in Table 3. It is observed that for various attacks the proposed model gives more accuracy. System performance is carried out using confusion matrix. Table 4 shows the confusion matrix of ensemble bagging and ensemble boosting. Its performance is explained and compared in figure 3. Additionally, the figure shows that the accuracy of the proposed ensemble classifier boosting is significantly higher than bagging.





Logambigai et al.,

CONCLUSION

A Hybrid two-stage IDS approach (HIDS) that employs machine learning methods to improve accuracy and decrease false rates has been proposed in this paper. In the proposed approach machine learning techniques in IDS have been utilized to improve the accuracy in differentiating the malicious and regular traffic. The sparse naive bayes method in the data has been used, where only the most required features are selected from a large dataset (NSL KDD). The proposed technique processes the train data using ensemble boosting classifier. On comparing the train data and test data, the obtained results display accuracies which are better than existing models.

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Table 1: Feature Selection

Methods	No of Attributes	Accuracy
Genetic Algorithm (GA)	17 Attributes	99.80
Sparse Naïve Bayes Algorithm	13 Attributes	99.89

Table 2: Classification Accuracy

Classifiers	Accuracy %
Decision Tree	99.51
SVM	99.23
Ensemble (Bagging)	99.80
Ensemble (Boosting)	99.89

Table 3: System Performance

Type of traffic	Correctly detected	Miss detected	Accuracy
Normal	79636	396	99.50%
Denial of Service	246988	1165	99.53%
Probe	6976	153	97.80%
U2R	78	100	43%
R2L	6785	9872	40.70%
Overall	340459	11686	96.60%

Table 4: Confusion matrix for ensemble Bagging and Boosting

Classifier	True/Predicted	Predicted Class					Accuracy	
		DoS	Probe	R2L	U2R	Normal		
Ensemble Bagging	True Class	DoS	9230				15	99.8
		Probe		2272			17	99.25
		R2L			189		19	90.86
		U2R				3	8	27.27
		Normal	7	9	5		11042	99.81
Ensemble Boosting	True Class	DoS	9233				1	99.91
		Probe		2279			10	99.51
		R2L			198		9	95.65
		U2R				3	8	27.27
		Normal	5	5	2		11040	99.89





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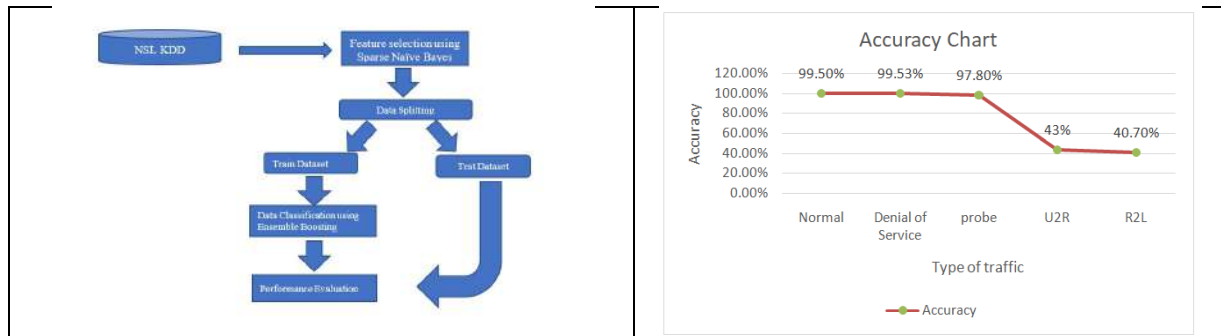


Figure 1. Typical Hybrid Intrusion Detection System Model

Figure 2: Accuracy Chart



Figure 3: Accuracy Chart for Bagging and Boosting





Student Investors Psychological Traits and Investment Pattern – Specific Study on Undergraduate Students

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ABSTRACT

Saving or investment has become the need of the present day, irrespective of whether earning or still a student. The purpose of this paper is to find the saving and investment pattern of young undergraduate students of the present generation. Conventional method of saving and investment options available are - Savings bank account, Fixed deposit, Recurring deposit, and some of the modern methods being opening an D-mat account, making an SIP or investing in mutual funds or shares using digital wallets. The (NSDL) National Securities Depository Ltd. had recently launched an online investment awareness programme for college students to easy to understand concepts of investing. It is an Union government's initiative, which will act as a beginners' guide and will be offered in 8 different languages. It was termed as "Market ka Eklavya – Express", the five-hour programme an initiative to commemorate India's 75 years of Independence. This digital education initiative focused on building a path towards financial freedom for our youth, symbolising the spirit of Atmanirbhar Bharat." The objective is to understand the saving pattern, risk taking capacity of students, their perspective towards growth and liquidity of their investments and their preference towards financial investment. To achieve these objectives the data from primary and secondary sources will be collected by convenience sampling method and analysed using simple statistical tools and represented in the form of graph.

Keywords: Financial investment, undergraduate students.





INTRODUCTION

Under graduates/ young generation are not much educated or aware of the investment avenues available to meet up there expenses. Students are now days are not much depended upon their parent's income. They are getting influenced or getting educated to grow there by investing there pocket money in small investments to meet up there expenses which they are not able to ask their parents or they won't get it from the. The objective of the study is to examine the student's personality traits regarding investment decisions. Psychological traits mean personality characters that describe or determine an individual behaviour. When we observe people around us we just analyse how each of them is different from other. In their character wise, there are differences then how much they differ from inventing or savings. This study aims at personality traits of students to know how they get influenced or practised differ from investing. Interest in young minds influences their investment behaviour (RA. Sista Paramita, July 2018)

REVIEW OF LITERATURE

From this research it is understood that the students should be cultivating the habbit of savings to increase their financial portfolio. (Daga, February - 2019) As per the study there are few variables which will have an effect on individual investors viz. motives for investment, decision types , curiosity in investment, investment designing and supervising, investor risk control. The profitable investment decision is in accordance with the characteristic of investors. (Oktaviani, 25, December 2018) Young investors, who are apparently still hesitant to make a decision to invest inthe stock. Some of them do have securities accounts because of imitating theirfriends or just to fulfill certain subject tasks that being learned using the means ofapplication of stock trading. (RA Sista Paramita, RA Sista Paramita, Yuyunlsbanah, Trias Madanika Kusumaningrum, Musdholifah and UIil 7, July 2018.)

Objectives

1. To find out whether young investors are looking for long-term growth,risk, return on investment or liquidity.
2. To study students saving pattern.
3. To study the preferences of youngsters towards financial investment.

Scope

The study is limited to under-graduate students who are studying in Bengaluru

Statement of the Problem

In this study convenience sampling is used the data may not have accuracy so the conclusions cannot by generalised. The study is restricted to undergraduate students and does not represent the whole population.

Research Design

The data for the research is collected through primary and secondary sources. Structured questionnaire is designed to collect primary data with questions on dichotomy and open-ended questions are included. The sample size is 71 for the study. The sampling method used is convenience sampling. Secondary sources like online journals and articles are referred

Data Analysis and Interpretation

It is analysed and interpreted that majority of the students belong to 18 pluscategory who are eligible to work and earn.





Sharada and Suma

Are you a student and working ?

It is analysed and interpreted that students who are working are in majority.

What is your source of income?

It is analysed and interpreted that students are not earning doing job instead depend on pocket money, but 11.8% and 13.2% are free lancers and professionals who are independent enough to take decision on saving and investing their money.

Monthly income?

It is analysed and interpreted that those who depend on the pocket money for their expenditure are in majority and 6.8% and 15.9% of the sampled students earn 7000 to 9000 and more than 10000 respectively which aids them to think of investment avenues at this early age.

Your Monthly savings?

It is analysed and interpreted that students of different profession which comes up to 42.4% have more interest and habit of saving at least between 1000 to 3000 out of their income and few students will save more than that.

Your monthly investment?

It is analysed and interpreted that students not only show interest in saving but also invest money in various avenues. Around 28.1% of the students save a minimum amount of 1000 to 3000 and the rest more than that

Do you invest at the beginning of the month?

It is analysed and interpreted that students who earn or receive pocket money have the practice of saving at the beginning of the month which is very wise as per financial experts.

Savings or investment avenues of your preference?

It is analysed and interpreted that as the respondents are still not earning as good as full timers they want they don't want to take risk with the money that they have earned and majority of them intend to save it with a financial institution in savings bank account even if the returns are less compared to other avenues, around 23.9% students are ready to take risk with their money to earn good returns, they feel higher the risk higher the returns.

With reference to the above rate the parameters

It is analysed and interpreted that the returns from the above saving and investment are good in all the avenues, good focus is there on liquidity, safety, stability, and lock in period. The risk factor is also less in various avenues except in equity It is analysed and interpreted that students are aware about all the investment portfolio's through their family member and friends as they have the exposure and experience in the same.

Findings and Suggestions

- 11.8% and 13.2% are free lancers and professionals who are independent enough to take decision on saving and investing their money.
- 6.8% and 15.9% of the sampled students earn 7000 to 9000 and more than 10000 respectively which aids them to think of investment avenues at this early age.
- 42.4% have more interest and habit of saving at least between 1000 to 3000 out of their income and few students will save more than that.
- Around 28.1% of the students save a minimum amount of 1000 to 3000 and the rest more than that respondents are still not earning as good as full timers they want they don't want to take risk with the money that they have earned and majority of them intend to save it with a financial institution in savings bank account even if the returns are less compared to other avenues, around 23.9% students are ready to take risk with their money to earn good returns, they feel higher the risk higher the returns.



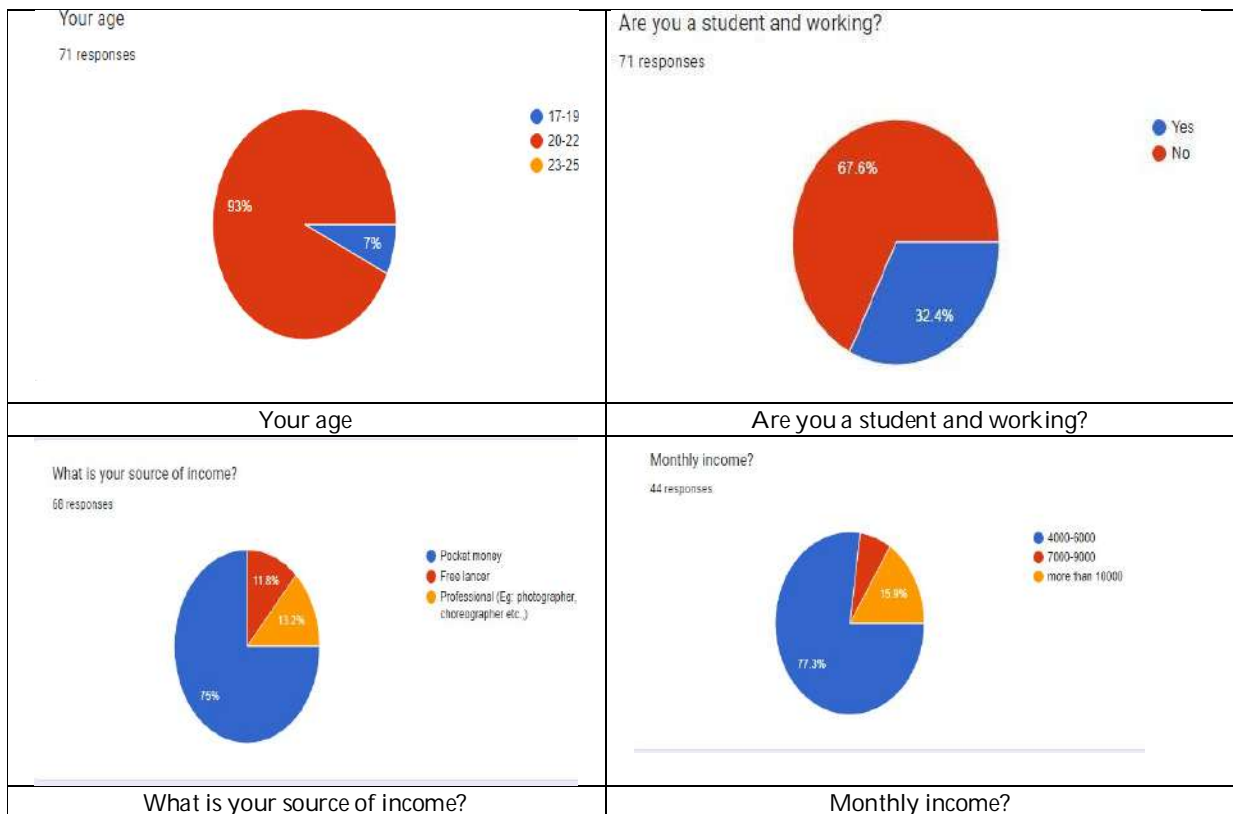


Sharada and Suma

- above saving and investment are good in all the avenues, good focus is there on liquidity, safety, stability, and lock in period. The risk factor is also less in various avenues except in equity.
- students are aware about all the investment portfolio's through their family member and friends as they have the exposure and experience in the same.
- students who earn or receive pocket money have the practice of saving at the beginning of the month which is very wise as per financial experts.
- Investing in right mutual funds gives good Return on investment
- Investing as much as possible for the future and plan for retirement from early years
- Gain proper knowledge before risking your money
- Any amount of money can be invested, so start investing
- High risk high profits
- More programs and workshops
- Start with SIP plan
- Research properly before investing in any company

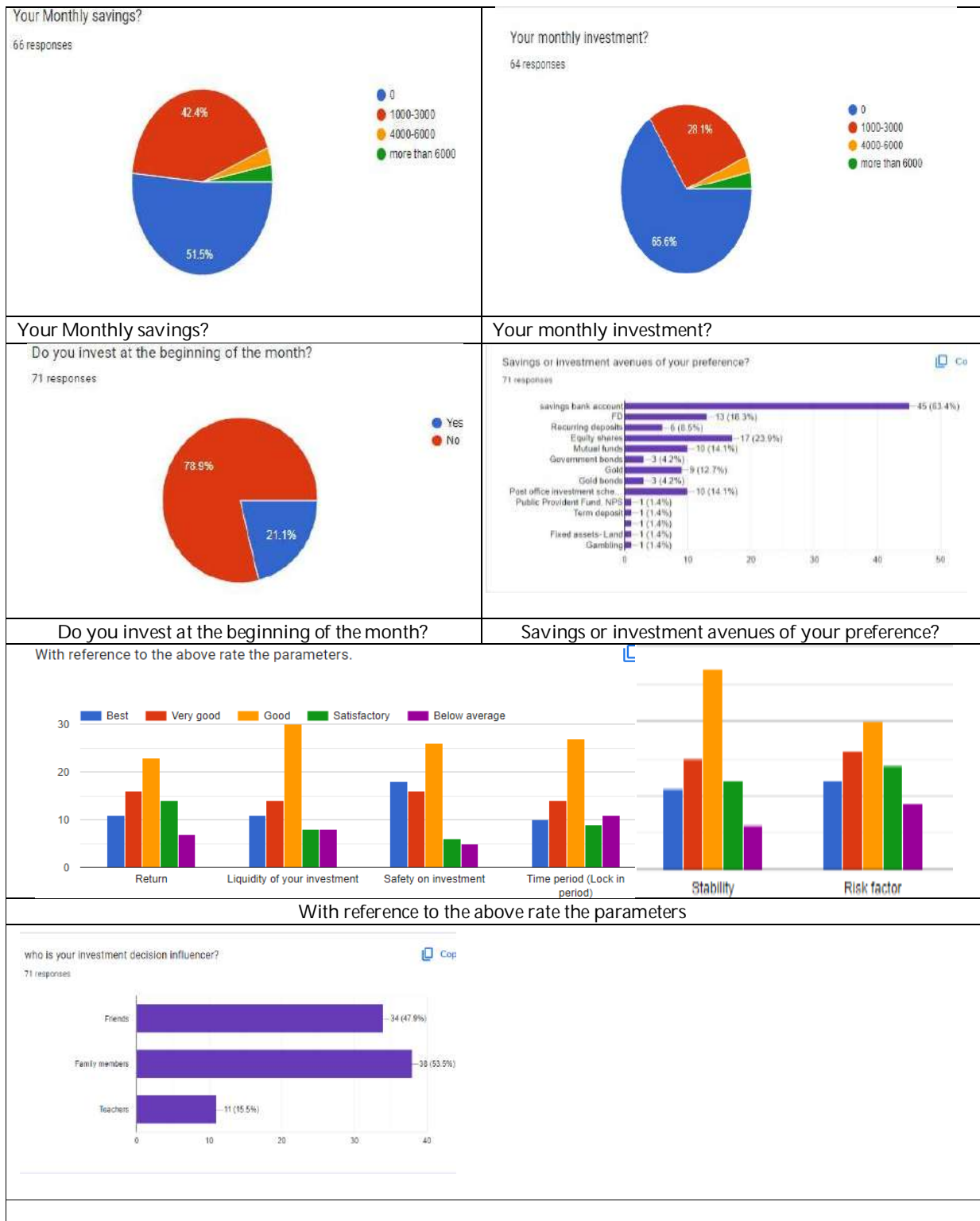
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Sharada and Suma





A Reliability Study of Electrical Feeder System and Customer Oriented Indices

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ABSTRACT

To predict the availability and other relevant indices, reliability plays an important role. As the electric utility industries has developed several performance measures of reliability. In this paper, a series configuration of an electrical feeder system is considered. Reliability evaluation is carried out for such system. Along with customer oriented indices, some reliability indices are also evaluated.

Keywords: Reliability, availability, reliability indices, customer oriented indices.

INTRODUCTION

Reliability assessment plays an important role to forecast the availability of an engineering system or components or elements. Many researchers are involve in finding the different reliability measures and reliability indices of electrical feeder system. [1] evaluated reliability measures and customer oriented indices for electrical feeder system and [2] evaluated the same for meshed power distribution system. Some new indices were produced by [3] to reflect some fuzzy concepts and the integration of probabilistic models. Reliability analysis of electric power system was carried out by using probability distribution [4]. To develop power system reliability index and their distribution [5] develop a comparison simulation methods. [6] discussed some methodology for an electrical power distribution system. Whereas [7] developed it for digital relay protection system. Different methods to find reliability measures have been proposed for weakness in power system [8], for battery energy storage system [9] and of a restructured power system with bilateral market [10].





Deepali Biniwale and Sanjay Chaudhary

For proper working of the distribution system, evaluation of different reliability indices are very important. In this paper, different reliability were studied for every load point and each distribution system. Evaluation of the customer oriented reliability indices along with basic reliability index is done.

REALIBILITY EVALUATION OF SERIES SYSTEM

If a system is in a series configuration, then it fails if a single component fails and it function properly if all the components are functioning properly .

The reliability of the system is evaluated by using the following relation

$$R(t) = e^{-(t/\lambda)^k} \tag{1}$$

Where

$R(t)$: the reliability of each distribution section.

λ : the failure rate

t : time period which is taken as one year

k : the scale parameter

Let $r_1, r_2, r_3, \dots, r_n$ represents the reliability of each component

Then the reliability of the series system is given by

$$R_s = \prod r_i \tag{2}$$

Where r_i represents the reliability of components from $i = 1, 2, 3, \dots, n$

BASIC RELIABILITY INDICES EVALUATION OF SERIES SYSTEM

The three basic reliability parameters for a series system with respect to reliability studies are given below: average failure rate, average outage time and average annual outage time, which are as follows.

$$\lambda_s = \sum \lambda_i \tag{3}$$

$$U_s = \sum \lambda_i r_i \tag{4}$$

$$r_s = \frac{\sum \lambda_i r_i}{\sum \lambda_i} \tag{5}$$

Where λ_i is the failure rate per year

r_i is average repair time, hours

CUSTOMER INDICES EVALUATION OF SERIES SYSTEM:

In a given series system, the customer orientated indices related to reliability studies

System average interruption frequency index

$$SAIFI = \frac{\sum \lambda_i N_i}{\sum N_i} = \frac{\text{total number of customer interruptions}}{\text{total number of customers served}} \tag{6}$$

System average interruption duration index (SAIDI)

$$SAIDI = \frac{\sum U_i N_i}{\sum N_i} = \frac{\text{sum of customer interruptions durations}}{\text{total number of customers}} \tag{7}$$

Customer average interruption duration index (CAIDI)

$$CAIDI = \frac{\sum U_i N_i}{\sum \lambda_i N_i} = \frac{\text{sum of customer interruptions durations}}{\text{total number of customers interruptions}} \tag{8}$$



**Deepali Biniwale and Sanjay Chaudhary****NUMERICAL RESULTS**

In Fig. 1, there are 7 distributor segments in Eight node radial distribution system and 7 load points from LP-2 to LP-8. The initial data for the radial distribution system is provided by Table 1 [3] which consists of failure rate per year and repair time in hours of each distribution section from 1 to 7 of the radial distribution system. The number of customers at each load point LP-2 to LP-8 is given in table 2. Table 3 gives the reliability at each distribution section which is solved by using equation 1. At every load point of the radial distribution system reliability is calculated which is shown in table 4 and every load point is obtained by using the equation 2.

Table 5 presents basic reliability indices at each load point. Customer orientated indices for the radial distribution system are evaluated, where

0.7295 is the system average interruption frequency index (SAIFI)

8.8545 is the system average interruption duration index (SAIDI)

12.1371 is the customer average interruption duration index (CAIDI)

CONCLUSION

A study of reliability parameters is carried out for a radial distribution system. Figure 1 represents the eight load distribution for which reliability at different load points is calculated which is presented in table 4. Table 3 gives the evaluated reliability of each and every distribution section. In figure 2, we can see that how reliability varies for different distribution sections for different shape parameters i.e $k = 0.01$ and $k = 0.02$. Table 4 provides the reliability at different load points for different shape parameters i.e $k = 0.01$ and $k = 0.02$ which is shown in figure 3. Important customer orientated indices are also evaluated for the radial distribution system.

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Deepali Biniwale and Sanjay Chaudhary

Table 1 Initial data for the radial distribution system [3]

Distribution Section	1	2	3	4	5	6	7
λ (failure/year)	0.4	0.2	0.3	0.5	0.2	0.1	0.1
r (average repair time, hours)	10	9	12	20	15	8	12

Table 2 Initial data for the load points [3]

Load Point	2	3	4	5	6	7	8
Number of Customers	1000	800	600	800	500	400	300

Table 3 Evaluated reliability at each distribution section

Distribution Section	Reliability (k=0.01)	Reliability (k=0.02)
1	0.3645	0.3611
2	0.3620	0.3560
3	0.3635	0.3590
4	0.3653	0.3628
5	0.3620	0.3560
6	0.3594	0.3509
7	0.3594	0.3509

Table 4 Evaluated reliability at each load point

Load Points	Reliability (k=0.01)	Reliability (k=0.02)
2	0.3645	0.3611
3	0.3660	0.3641
4	0.3675	0.3671
5	0.3675	0.3671
6	0.3682	0.3686
7	0.3666	0.3653
8	0.3671	0.3662

Table 5. Evaluated Basic reliability indices at each load points

Load Point	2	3	4	5	6	7	8
Average failure rate	0.4	0.6	0.9	0.9	1.1	0.7	0.8
Average outage time	10	9.67	10.4	15.56	15.45	9.42	9.75
Average annual outage time	4	5.8	9.4	14	17	6.6	7.8

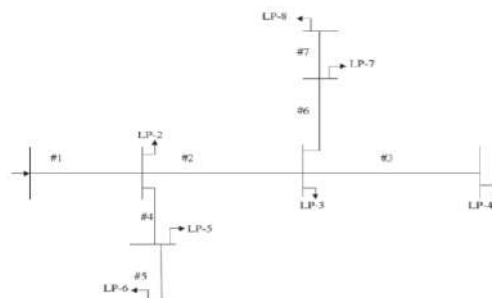


Fig. 1 Eight node distribution system [3]





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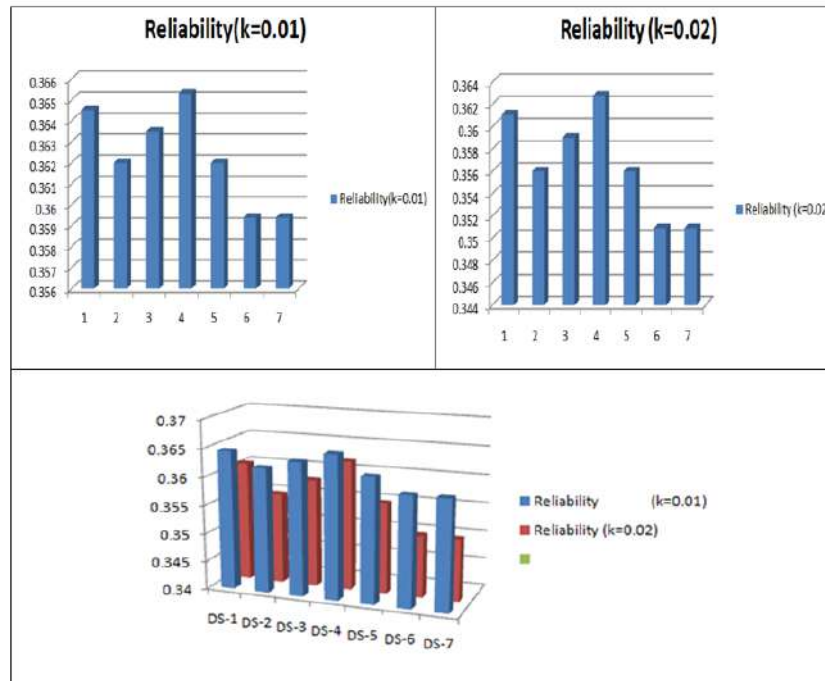


Fig.2 provides magnitude of reliability at different distribution sections.

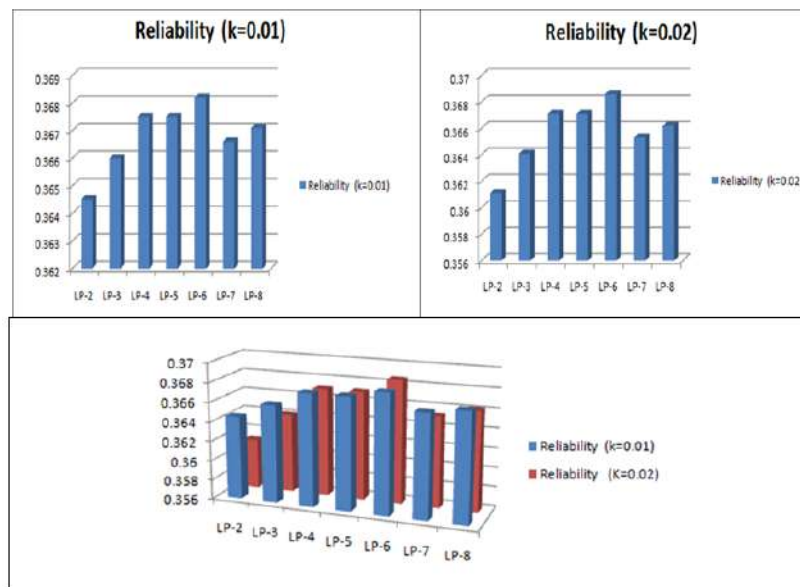


Fig.3 provides magnitude of reliability at different load points of the distribution system.





Currency Derivatives Market and the Factors that Influence the Market Performance : A Study with Reference to Investors in Bengaluru District

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ABSTRACT

This study aims to examine the evolution and current state of the Commodity Derivatives Market in India. The increased risk in the financial market has been observed as a consequence of the emergence and expansion of the derivatives market. The previous decade has experienced significant growth in the magnitude of international trade and business as a result of the global phenomenon of globalization and liberalization. Consequently, there has been a substantial rise in the global demand for international currency and financial instruments. The financial risk faced by corporations has been amplified by fluctuations in exchange rates, interest rates, and stock prices across various financial markets. Commodity derivatives serve as the initial financial instrument employed to safeguard farmers by mitigating their exposure to price volatility. The business world has faced significant challenges that have posed a threat to its very existence. In order to effectively mitigate such risk, financial markets have introduced novel financial instruments commonly referred to as financial derivatives. The primary objective of these instruments is to offer contractual assurances regarding future prices, thereby mitigating potential risks associated with unfavorable price fluctuations and minimizing financial exposure. In contemporary finance, there has been a notable surge in the popularity and widespread utilization of financial derivatives.

Keywords: Currency Derivative Market, Investor Perception, Market Performance





INTRODUCTION AND BACKGROUND OF THE STUDY

A derivative is a financial instrument that obtains its value from the performance of an underlying asset or entity. The underlying entity referred to in this context can encompass various financial instruments such as assets, indices, or interest rates. It is commonly referred to as the "underlying". Derivatives serve various functions, such as mitigating risks associated with price fluctuations (hedging), amplifying exposure to price movements for speculative purposes, or facilitating access to assets or markets that are otherwise difficult to trade. Several commonly used financial instruments in the derivatives market include forwards, futures, options, swaps, as well as various derivatives such as synthetic collateralized debt obligations and credit default swaps. The majority of derivatives are commonly traded off-exchange (over-the-counter) or on established exchanges like the National Stock Exchange. Conversely, insurance contracts have evolved into a distinct industry. In the United States, there has been a growing impetus to shift derivatives trading onto exchanges following the financial crisis of 2007-2009. Derivatives constitute one of the three primary classifications of financial instruments, alongside equities (commonly referred to as stocks) and debt instruments (such as bonds and mortgages). According to Aristotle, the earliest documented instance of a derivative can be traced back to a contract involving the trade of olives, which was undertaken by the renowned ancient Greek philosopher Thales. This transaction resulted in a financial gain for Thales. Bucket shops, which were prohibited in 1936, serve as a notable illustration from more recent history.

Objectives

To examine the factors that influence the currency derivative market with perspective of investors

Hypothesis of the Study

The null hypotheses that have been formulated are aimed at investigating the relationship between the Currency Derivatives Market and its influence on Market Performance.

H01	No Relationship between Designation and impact of stakeholders from trading on the forex market
H02	No Relationship between Gender and impact of stakeholders from trading on the forex market
H03	No Relationship between experience and impact of stakeholders from trading on the forex market
H04	No Relationship between Marital status and impact of stakeholders from trading on the forex market
H05	No Relationship between Age and impact of stakeholders from trading on the forex market
H06	No Relationship between sources of income and impact of stakeholders from trading on the forex market
H07	No Relationship between monthly income and impact of stakeholders from trading on the forex market

REVIEW OF LITERATURE

Conceptual Foundation of Currency Derivatives Market

The currency derivative market holds significant importance within the realm of global trade and investments, leading to the existence of a substantial body of literature on this topic worldwide. The empirical literature on currency derivatives is predominantly focused on developed economies due to their significant contribution to this field. In contrast to prevailing theories on hedging behavior, firms with higher growth prospects and limited financial resources are more inclined to utilize currency derivatives markets in order to distinguish themselves. Companies that have significant exposure to foreign exchange rates and benefit from economies of scale in hedging



Lasya *et al.*,

activities are more inclined to utilize currency derivatives. In their study, Gautami and Bala Kalyan (2018) have examined the financial derivatives in relation to Tata Motors Ltd. Financial derivatives, such as futures and options, have gained significant popularity in recent times. Finance is a vital component of any business enterprise, necessitating a comprehensive understanding of current trends in the field. In comparison to the stock market, derivatives have a higher likelihood of generating greater profits while carrying a reduced level of risk. Investing in Indian financial derivatives offers a more favorable risk-reward profile, characterized by higher potential gains and lower levels of risk.

According to Bindal (2018), an examination was conducted to elucidate the significance of derivative markets in fostering the economic progress of a nation. The volatility of exchange rates, interest rates, and stock prices across various financial markets has amplified the level of financial risk faced by corporations. The business world has faced significant challenges due to adverse fluctuations in macroeconomic factors, which have posed a threat to its survival. Hence, it is imperative to formulate a suite of novel financial instruments, commonly referred to as derivatives, within the Indian financial markets, with the aim of effectively mitigating said risk. The primary purpose of these financial instruments is to establish contractual agreements that guarantee future prices, thereby mitigating the potential negative impact of price fluctuations and minimizing financial risks. The growth and current status of the derivative market in India have been observed to illustrate the expansion and development of financial derivatives on the National Stock Exchange (NSE) in India. According to K. Sarathkumar and Dr. S P Dhandhayothapani (2016), the field of behavioral finance is experiencing growth within the capital market. Certain investors exhibit a preference for risk aversion, opting to allocate their funds to relatively secure investment vehicles such as mutual funds, fixed deposits, and government bonds. Conversely, other investors display a greater inclination towards assuming a certain level of risk, driven by their pursuit of maximum profitability, leading them to consider investments in the derivatives market. The derivative market is characterized by a higher potential for profit relative to a lower level of risk. Investing in the derivative market is more advantageous for investors compared to other markets.

The study conducted by Belghitar, Clark, and Mefteh (2013) examines the impact of foreign currency (FC) derivative utilization on shareholder value. This study examines the efficacy of corporate hedging strategies based on derivatives in generating shareholder value. The provided evidence suggests that hedging strategies do not effectively capitalize on favorable exposures to generate shareholder value, even in cases where there is statistical asymmetry between positive and negative exposures. The intricate connections among various economic and financial variables make it challenging, and in some cases unfeasible, to accurately determine the true extent of exposures. Derivatives can be employed for speculative intentions rather than for the purpose of risk mitigation, thereby potentially amplifying exposure. According to the perspective of Ashutash Vashishtha and Satish Kumar (2010), India is considered to be a highly progressive nation in the realm of derivative exchange, primarily due to its efforts in developing a modern security market. The prices of commodities exhibit unpredictable fluctuations, while the stock market is designed to amplify the risk associated with financial derivatives provided by corporations. Derivatives play a crucial role in the finance industry by facilitating the transfer of risks from one party to another. Given the desire of investors and stockholders to mitigate or eliminate the risks associated with financial activities. The derivative market, which has recently emerged in India, offers a favorable environment for minimizing risk and maximizing gains.

In his study, Subramanian (1998) examines the characteristics and substance of different categories of derivative products. The research additionally emphasizes the macroeconomic advantages that can be obtained from derivatives. The document includes a comprehensive overview of the derivative landscape, encompassing the current state and future potential for the development of derivative products in India. The study highlights that the emergence of derivatives can be attributed to the presence of imperfect or incomplete markets.





Legal Determinants of External Finance

In their study, La Porta et al. (year) conducted an examination of countries characterized by weaker investor protections, as determined by the nature of legal regulations and the effectiveness of law enforcement. The findings revealed that such countries tend to possess smaller and more limited capital markets. Research has revealed that in comparison to several other jurisdictions, both equity and debt markets exhibit relatively weaker investor protections and less developed capital markets. According to Abhishek Kumar Sinha, Soumen Saha, and Gita Madhuri (2019), the objective of their study is to examine the growth and performance of currency derivatives in the Indian market, with a specific emphasis on analyzing the market share of currency traded contracts across various exchanges in India. Derivatives serve as financial instruments that enable investors to mitigate the impact of volatility in relation to the underlying asset. Predicting changes in foreign exchange rates can be quite challenging when considering the underlying asset. Currency derivatives are highly valuable to investors in situations like these. The understanding of the significance and contribution of currency derivatives as hedging and speculative instruments can be enhanced through the analysis of trading contracts and open interest. Derivatives play a crucial role in the management of financial risk and the effective allocation of capital towards productive investment prospects.

In their study, Ravichandran et al. (2010) examined the impact of service quality variables on a multidimensional model of investors' behavioral intentions, with the aim of enhancing their perception of service quality in the currency derivative market. Therefore, it is imperative for managers, service management academics, and practitioners to prioritize the consideration of this relational impact. The variables of tangibility, responsiveness, and empathy within the context of service quality are significant predictors of customer behavioral intentions. The employees possess a comprehension of the specific needs of customers, which subsequently enhances the overall behavioral intentions of investors in the derivative market. In a study conducted by Chakrabarthy (1986), an analysis was performed to evaluate the comparative performance of various bank groups using metrics such as profit, earnings, and expenses. The Herfindahl index was utilized by the author to quantify the level of inequality in the distribution of profits, earnings, and expenses among different groups of banks. Research has indicated that it is advisable for scheduled commercial banks to engage in a process of evaluating the relative performance of their individual offices in order to enhance their profit planning strategies. The Utilization of Financial Derivatives in Emerging Market Economies: Empirical Findings from Non-Financial Firms in Bosnia and Herzegovina.

In their study, Emira Kozarevic et al., Meldina Kokrovic et al., and Beriz Civic (2014) examined the utilization of financial derivatives for the purpose of risk management in portfolio management. The study specifically focused on managing risks associated with interest rates, security and commodity prices, currency fluctuations, creditworthiness, and other related factors. The risk associated with a derivative agreement is mitigated through the trading of the contract itself. Based on a recent survey conducted in 2010, it has been observed that the magnitude and extent of derivative instruments being traded in emerging market economies (EMEs) are consistently expanding, encompassing both exchange-based and over-the-counter markets. The research findings reveal that a quarter of the respondents continue to utilize financial derivatives. Hence, the growth and establishment of the derivatives market relies on the active participation of non-financial corporations, necessitating their comprehension of the significance of derivatives. In the future, the establishment of an organized derivatives market as a segment of the stock market may no longer be necessary.

In their study, Kamau, Inanga, and Rwegasira (2014) examined the extent to which the utilization of currency derivatives for managing currency risk is influenced by the measure of multilateral banks (MBs). An empirical investigation was conducted to explore the potential correlation between the magnitude of multinational banks (MBs) and their utilization of currency derivatives. This study employed a methodology involving observation, speculation, and analysis of fluctuations, with the aim of establishing a connection between these variables. The results indicate a significant positive correlation between the size, as measured by total assets, of multinational banks (MBs) and the total strategic utilization of currency derivatives. The aforementioned results indicate that market participants are experiencing cost advantages resulting from the utilization of currency derivatives to manage currency risk, specifically through economies of scale and scope.



Lasya *et al.*,

According to Darius P. Miller (2011), managers may employ derivatives as a means of risk management to safeguard their interests vis-à-vis shareholders, driven by their marginal risk aversion motivations. Research has revealed that the utilization of currency derivatives by firms exhibits a noteworthy correlation with robust internal firm-level or external country-level governance, thereby yielding substantial advantages for investors.

Options and Futures

In their study, Srivastava and Singh (2015) provided their perspective on the pricing of currency futures and the extent to which existing models can be applied in this context. The primary objective of this research is to examine the existing body of literature pertaining to the pricing of currency futures and gain a comprehensive understanding of the empirical methodologies utilized by different scholars in their analyses. Research has indicated that the pricing of currency futures indicates that the spot prices are equal to the future price at the time of expiry. Furthermore, if the convergence of spot prices can be predicted, this can result in profits for traders who possess sufficient knowledge in this area.

According to Pandey (2012), the utilization of currency futures is of great importance for developing economies as it enables them to enhance their international presence and establish an effective framework for managing their currency. The subsidiary currency provides a more robust measure and assessment of actual and projected volatility figures. Furthermore, it facilitates the long-term disclosure of value and renders treasury operations appropriate for Indian banks, multinational exporters, and shippers. Individuals with high levels of total assets and medium-sized entities play a significant role in the trading of currency futures. Scholars who are interested in the documentation and disclosure of currency derivatives within the context of India may find value in conducting additional research on currency futures.

In a study conducted by Dhananjay Sahu (2012), an analysis was performed to examine the impact of currency futures on the level of unpredictability in the exchange rate of the EURO subsequent to the introduction of currency futures trading in India. The individual arrived at the conclusion that the trading of currency futures did not have any impact on the volatility of the spot exchange rate within the foreign exchange market in India. Moreover, the observed results also indicate that the significance of recent news in influencing spot market volatility has increased, while the persistence effect of past news has decreased in the context of currency futures trading. In their study, Gupta et al. (2012) provided an analysis of the regulatory framework governing the Indian Derivative Market, drawing from the findings of the L.C. Gupta committee report. Additionally, the authors elucidated the accounting adjustment process for Future and Option contracts, specifically focusing on the handling of mark-to-market margin payments and receipts. The study also examines the government policies and regulations pertaining to the Indian derivative market, specifically in relation to the accounting treatments of Future and Option instruments. Understanding the various accounting treatments that occur throughout the lifespan of a Future and Option contract is valuable for individuals seeking knowledge on the accounting aspects of F&O.

Research Gap

A significant number of investors have come to recognize the significance of the derivatives market and are exerting considerable effort to ascertain the performance of the derivative market in India. There has been a limited number of studies conducted in India pertaining to the currency derivative market. The majority of surveys conducted in India are carried out by trade and industry organizations with the purpose of evaluating the immediate effects of fluctuations in the value of the rupee. There has been a lack of comprehensive research conducted in India to examine the currency derivative market. Currently, there is a lack of comprehensive research conducted in India that encompasses diverse aspects of currency exposure, including the evaluation of exposure, strategies for its management, and the role of the government in this context.





RESEARCH METHODOLOGY

The credibility of any research is contingent upon the systematic approach employed for data collection and subsequent logical and sequential analysis. The current study employed a comprehensive utilization of both primary and secondary data.

Area of the Study

The state of Karnataka was selected for this study due to its significant presence of corporate investors in the derivative market, particularly in regions such as Bengaluru. The Bengaluru region is renowned for offering exceptional services to investors in India.

Hypotheses of the Study

The current study aims to examine the analysis of the Indian currency derivatives market from the perspective of investors in Bengaluru. This study investigated the factors that influence the currency derivative market from the perspective of investors. Additionally, it delineates the necessary actions to foster the growth and development of the exchange-traded sector within the currency derivatives market, specifically focusing on currency futures and options. The present study additionally examines the effects of currency derivatives market practices on investors, with a focus on how these practices contribute to the improvement of services offered to investors. Additionally, it examines the potential modifications that can be made to the regulatory framework governing the market for currency derivatives in order to enhance its operational efficiency. Hence the null hypotheses formulated, based on the above points, are as follows:

Data Collection Method

The current investigation primarily utilized a survey methodology. The collection of primary data was conducted through the distribution of questionnaires directly to respondents who have invested in the Indian currency derivatives market. To gather primary data, questionnaires were developed and distributed for administration. Investors participating in the Indian currency derivative market.

RESULTS AND DISCUSSION

OBJECTIVE I: To examine the factors that influence the currency derivative market from the perspective of investor. The data collected from the Investors are analyzed in this section. The details are furnished in the following table:

Impact of stakeholders from trading on the forex market

The assessment of the influence exerted by stakeholders in the context of forex trading within the investor community was conducted through the utilization of specific variables such as The forex market's substantial size contributes to its inherent fairness and efficiency for all stakeholders involved. The trading platform provides a flexible forum for traders due to its continuous operation throughout the day, 24 hours a day, 7 days a week. The foreign exchange market, despite its vast size and operation spanning multiple time zones, provides real-time information on its transactions. Additionally, it is possible to convert export proceeds into the domestic currency. It is important to note that no country or central bank has the ability to monopolize the market or manipulate prices over an extended period of time. There exist five variables that exert influence and provide insights into the impact of stakeholders in forex trading. These variables aid investors in comprehending the diverse Indian Currency Derivative markets that are available. The Likert five-point scaling technique was used to score the responses.



**Descriptive Statistics, Correlation Analysis among the Dependent and Independent Variables:
DESIGNATION AND IMPACT OF STAKEHOLDERS FROM TRADING ON THE FOREX MARKET****H01: There is no relationship between designation and the impact of stakeholders from trading on the forex market.**

Based on the aforementioned analysis, it can be concluded that there is no statistically significant correlation between the designation of stakeholders and the impact they have on trading activities within the forex market, specifically among investors in the currency derivatives market. Hence, it can be concluded that there is no significant correlation between predictor variables such as designation and the dependent variable, namely the impact of stakeholders on the forex market. This finding holds relevance for investors in the currency derivatives market. When the designation fluctuates between employed individuals and business investors, which exhibits a negative correlation, it signifies the involvement of diverse stakeholders engaged in trading activities within the forex market. The forex market's considerable size contributes to its inherent fairness and efficiency for the various stakeholders involved. The trading platform provides traders with a flexible forum due to its continuous operation throughout the day, 24 hours a day, 7 days a week. Despite the vast size of the foreign exchange market and its operation across multiple time zones, real-time information regarding its transactions is readily accessible. The export proceeds have the potential to be converted into the domestic currency. It is widely recognized that no nation or central bank possesses the ability to monopolize the market or manipulate prices over an extended period of time. Such endeavors are subject to fluctuations and adjustments that consistently prevail. Therefore, the acceptance of the null hypothesis, the designation of stakeholders, and the impact of trading on the forex market are acknowledged.

GENDER AND IMPACT OF STAKEHOLDERS FROM TRADING ON THE FOREX MARKET**H02: There is no relationship between gender and the impact of stakeholders from trading on the forex market.**

Based on the aforementioned analysis, it can be concluded that there is no statistically significant correlation between gender and the influence of stakeholders in forex trading among investors in the currency derivative market. Hence, it can be concluded that there is no significant correlation between predictor variables such as gender and the dependent variable, namely the impact of stakeholders in trading on the forex market. This finding holds relevance for investors in the currency derivatives market. When there is a variation in gender between male and female investors, which exhibits a negative correlation, it indicates that the diverse stakeholders involved in trading on the forex market, such as The substantial scale of the foreign exchange (forex) market contributes to its inherent fairness and efficiency for the various stakeholders involved. The trading platform provides a flexible forum for traders due to its continuous operation 24 hours a day, 7 days a week. Despite the vast size of the foreign exchange market and its operation across multiple time zones, real-time information regarding its transactions is readily accessible. The funds generated from exports have the potential to be converted into the domestic currency. It is widely recognized that no nation or central bank possesses the ability to monopolize the market or manipulate prices over an extended period of time. This principle holds true as market conditions naturally fluctuate in response to various factors. Therefore, the null hypothesis regarding the influence of gender and stakeholders' impact on trading in the forex market is deemed to be valid.

NUMBER OF YEARS INTO SERVICES AND IMPACT OF STAKEHOLDERS FROM TRADING ON THE FOREX MARKET**H03: There is no relationship between no of years in service and the impact of stakeholders from trading on the forex market.**

Based on the aforementioned analysis, it can be concluded that there is no statistically significant correlation between the duration of business experience and the influence of stakeholders in forex trading or currency derivative market investments. Hence, there is no significant correlation between the predictor variables, such as the number of years engaged in business services, and the dependent variable, namely the impact of stakeholders from trading on the forex market. This finding holds relevance for investors in the currency derivatives market. When considering the number of years of experience in the business, it is observed that there is a negative correlation between the years of



**Lasya et al.,**

experience (ranging from 0-5 years, 6-10 years, and >10 years) and the investors who engage in trading on the forex market. This implies that stakeholders with different levels of experience in the business are less likely to participate in forex trading. The forex market's substantial size contributes to its inherent fairness and efficiency for all stakeholders involved. The trading platform provides traders with a flexible forum due to its continuous operation throughout the day and night. Despite the vast size of the foreign exchange market and its operation across multiple time zones, real-time information regarding its transactions is readily accessible. The funds generated from exports have the potential to be converted into the domestic currency. It is not feasible for any nation or central bank to monopolize the market or manipulate prices over an extended period of time, as market forces naturally fluctuate and adjust accordingly. This principle consistently remains valid. Therefore, the null hypothesis, which posits that there is no significant relationship between the number of years of experience in business and the influence of stakeholders in trading on the forex market, is supported.

MARITAL STATUS AND IMPACT OF STAKEHOLDERS FROM TRADING ON THE FOREX MARKET

H04 : There is no relationship between the marital status and the impact of stakeholders from trading on the forex market.

Based on the aforementioned analysis, it can be concluded that there is no statistically significant correlation between marital status and the influence of stakeholders in forex trading among investors in the currency derivative market. Hence, it can be concluded that there is no significant correlation between predictor variables such as marital status and the dependent variable, namely the impact of stakeholders in trading on the forex market. This finding holds relevance for investors in the currency derivatives market. When the marital status of investors varies between being married and unmarried, there is a negative correlation observed. This implies that the different stakeholders engaging in forex trading, such as The forex market's substantial size contributes to its inherent fairness and efficiency for all involved stakeholders. The trading platform provides traders with a flexible forum due to its continuous operation throughout the day, seven days a week. The foreign exchange market, commonly referred to as the forex market, is of substantial magnitude and functions across multiple time zones. Pertinent data regarding its transactions is readily accessible in real-time. The export proceeds have the potential to be converted into the domestic currency. It is not feasible for any nation or central bank to monopolize the market or manipulate prices over an extended period of time, as market forces inherently adapt and fluctuate accordingly. This principle remains consistently valid. Therefore, the null hypothesis regarding the acceptance of marital status and the impact of stakeholders on the forex market is affirmed.

AGE AND IMPACT OF STAKEHOLDERS FROM TRADING ON THE FOREX MARKET

H05 : There is no relationship between the age and the impact of stakeholders from trading on the forex market.

Based on the aforementioned analysis, it can be concluded that there exists no statistically significant correlation between the age of stakeholders and the influence they exert on trading activities within the forex market, specifically among investors in the currency derivative market. Hence, it can be concluded that there is no significant correlation between predictor variables such as age and the dependent variable, which pertains to the impact of stakeholders in trading on the forex market. This finding holds relevance for investors in the currency derivatives market. When the age of investors falls within the ranges of 20-30, 31-40, 41-50, and >50 years, there is a negative correlation. This indicates that the different stakeholders involved in trading on the forex market, such as the size of the forex market, contribute to its fairness and efficiency for these stakeholders. The Forex market provides traders with a versatile platform due to its continuous operation throughout the day and night. Additionally, this market is vast and spans multiple time zones, allowing for increased opportunities. Furthermore, real-time information regarding transactions within the Forex market is readily accessible. The funds generated from exports have the potential to be exchanged for the domestic currency. It is not feasible for any nation or central bank to monopolize the market or manipulate prices over an extended period of time, as market forces inherently adapt and fluctuate accordingly. This principle consistently remains valid. Therefore, the null hypothesis regarding the relationship between age and the impact of stakeholders in trading on the forex market is accepted.



**Lasya et al.,****SOURCE OF INCOME AND IMPACT OF STAKEHOLDERS FROM TRADING ON THE FOREX MARKET****H06 : There is no significant relationship between the source of income and the impact of stakeholders from trading on the forex market.**

The aforementioned analysis reveals a noteworthy correlation between the source of income and the influence of stakeholders engaged in forex trading within the currency derivative market for investors. Hence, it can be inferred that the predictor variables, such as the source of income, exhibit a significant relationship with the dependent variable, namely the impact of stakeholders involved in trading on the forex market. This relationship holds particular relevance for investors in the currency derivatives market. When the source of income fluctuates between salary and business investments, which exhibits a positive correlation, it implies that the diverse stakeholders involved in trading on the forex market, including the size of the forex market itself, contribute to its fairness and efficiency. The platform provides traders with a flexible forum due to its continuous operation throughout the day and night. The foreign exchange market, commonly referred to as the forex market, is of significant magnitude and operates seamlessly across multiple time zones. It is worth noting that real-time information regarding its transactions is readily accessible. The export proceeds have the potential to be converted into the domestic currency. It is not feasible for any nation or central bank to monopolize the market or manipulate prices over an extended period of time. Such actions are subject to fluctuations and adjustments, which consistently remain valid. Therefore, the null hypothesis pertaining to the source of income and the impact of stakeholders in forex trading is rejected.

MONTHLY INCOME AND IMPACT OF STAKEHOLDERS FROM TRADING ON THE FOREX MARKET**H07: There is no significant relationship between monthly income and the impact of stakeholders from trading on the forex market.**

The analysis above reveals a noteworthy correlation between monthly income and the influence of stakeholders engaged in forex trading within the currency derivative market for investors. Hence, it can be inferred that the predictor variables, such as monthly income, exhibit a correlation with the dependent variable, namely the impact of stakeholders involved in trading on the forex market. This relationship holds significance for investors in the currency derivatives market. When the monthly income falls within the ranges of <50000, 50000-100000, and >100000, there exists a strong correlation. This correlation indicates that the different stakeholders involved in trading on the forex market, such as the size of the forex market, contribute to its fairness and efficiency. The Forex market provides traders with a versatile platform due to its continuous operation throughout the day and night. This market encompasses a vast scope and operates across multiple time zones. Additionally, real-time information regarding its transactions is readily accessible. The export proceeds have the potential to be converted into the domestic currency. It is not feasible for any nation or central bank to monopolize the market or manipulate prices for an extended period of time. Such actions are subject to fluctuations and adjustments that are inherent to market dynamics. Therefore, the null hypothesis pertaining to the monthly income and the impact of stakeholders in trading on the forex market is rejected.

FINDINGS

- The analysis reveals that there is no discernible correlation between the designation of stakeholders and their impact on trading within the forex market or currency derivatives market. There is no discernible correlation between the classification of investors as either employed or business individuals and their impact on market performance. Despite the vast size and global reach of the forex market, its performance remains independent of the actions and decisions made by individual investors, whether they are employed or engaged in business activities. This characteristic of the market is advantageous in ensuring its stability and reliability.
- The study reveals that the influence of stakeholders in the forex market and currency derivatives market investors is contingent upon the gender composition of the investors, specifically between males and females. In instances where gender exhibits variation between male and female, there is a corresponding variation in the market performance of the currency derivatives market. It has been observed that male investors exhibit a greater



**Lasya et al.,**

level of interest in trading and investing in the currency derivatives market compared to their female counterparts.

- The analysis reveals that there is no statistically significant correlation between the duration of professional experience in the field and the influence of stakeholders in trading on the forex market or currency derivative market. The investment patterns in the currency derivative market vary in accordance with the number of years of service of investors in the stock market, specifically categorized as 0-5 years, 6-10 years, and greater than 10 years. This implies that investors effectively engage in risk management within their investment activities by strategically structuring financial contracts to generate gains or losses that offset the potential losses or gains resulting from fluctuations in financial prices. Hence, a greater number of experiences in investing in the stock market are associated with an increased propensity for taking higher risks, a pattern that consistently applies to the currency derivative market.
- There appears to be no discernible correlation between marital status and the influence exerted by stakeholders in the forex market or currency derivatives market. Hence, it can be observed that the opinions of investors regarding the currency derivative market and their willingness to take risks are influenced by their marital status, specifically whether they are married or unmarried. This relationship remains consistent and valid.
- It has been determined that there is no statistically significant correlation between the age of stakeholders and their impact on trading in the forex market of currency derivatives. Hence, the investment patterns, risk preferences, and transactional efficiency of investors tend to vary based on their age groups, specifically within the ranges of 20-30, 31-40, 41-50, and >50 years.
- There exists a discernible correlation between the source of income and the influence of stakeholders engaged in trading activities within the forex market, specifically pertaining to the currency derivatives market of investors. Hence, it can be observed that the predictor variables, such as the source of income, exhibit a significant association with the dependent variable, namely the impact of stakeholders involved in trading on the forex market. This relationship holds relevance for investors in the currency derivatives market. The currency derivative market is strengthened by the varying levels of risk-taking and transactional efficiency exhibited by investors.
- A correlation has been identified between the monthly income and the influence of stakeholders involved in trading on the forex market, specifically in the currency derivative market of investors. Hence, it can be inferred that the predictor variables, such as monthly income, exhibit a correlation with the dependent variable, namely the impact of stakeholders in trading on the forex market. The currency derivatives market experiences variations in investment patterns, risk-taking behavior, transactional efficiency, outlay of funds, and pricing in response to the monthly income levels of investors. Specifically, when investors' monthly income falls below 50000, between 50000 and 100000, or exceeds 100000, these factors exhibit corresponding changes. This dynamic relationship contributes positively to the currency derivatives market.

SUGGESTIONS

- The Currency Derivatives market has proposed a greater emphasis on catering to investors with less than five years of experience in stock market trading. This can be achieved through the implementation of enhanced training and development programs that cover a wide range of products and features. Typically, individuals with less than five years of professional experience, particularly those who are new to their current positions and possess limited experience, may benefit from increased participation in on-the-job training initiatives. This could involve attending seminars focused on their specific area of expertise, which would provide valuable insights into trading concepts, associated advantages, and diverse product features.
- There has been a suggestion that adopting a talent mindset allows investors to effectively evaluate talent and recognize the requirements within the routine work setting. Furthermore, adopting a "learner's mindset" can assist investors in transforming everyday experiences within the currency derivatives market into valuable learning opportunities.



**Lasya et al.,**

- There has been a suggestion that there should not be any variation between males and females in their participation in the derivative market. Female investors should not exhibit any hesitation when it comes to investing in the currency derivative market, as compared to their male counterparts. The presence of gender-based disparities in mindset pertaining to investment and trading activities within the stock market is unwarranted.

CONCLUSION

The currency derivatives market in India has witnessed significant growth following the introduction of currency futures and options. The increase in volumes and open interest for currency futures and options in the National Stock Exchange (NSE) can be attributed to a positive trend. This trend is indicative of significant progress, which will be elaborated upon in the subsequent analysis. Currency futures have been demonstrated to be an effective instrument for mitigating the inherent risk associated with a country's currency, commonly referred to as currency risk. There is an optimistic outlook regarding the future development of the currency derivatives market, with the anticipation that it will gain momentum and become a favorable option for all market participants in the near future, ultimately integrating into the Indian economy. Currency futures and options are commonly traded through both exchange-traded and over-the-counter platforms.

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Lasya et al.,

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Table 1 – Descriptive statistics –designation and the impact of stakeholders from trading on the forex market

	Mean	Std. Deviation	N
Designation	1.4500	.49812	400
Stakeholders from trading on the forex market	3.7450	.56637	400

Table 2 – Correlations- designation and the impact of stakeholders from trading on the forex market

Correlations			
		Designation	Stakeholders from trading on the forex market
Designation	R val	1	-.036
	P val		.468
	N	400	400
Stakeholders from trading on the forex market	R Val	-.036	1
	P val	.468	
	N	400	400

Table 3 – Descriptive statistics - gender and the impact of stakeholders from trading on the forex market.

	Mean	Std. Deviation	N
Gender	1.1950	.39670	400
Stakeholders from Trading on the forex market	3.7450	.56637	400





Lasya et al.,

Table 4 – Correlation - gender and the impact of stakeholders from trading on the forex market.

Correlations			
		Gender	Stakeholders from trading on the forex market
Gender	R val	1	-.090
	P val		.071
	N	400	400
Stakeholders from trading on the forex market	R val	-.090	1
	P val	.071	
	N	400	400

Table 5 – Descriptive statistics - no of years in service and the impact of stakeholders from trading on the forex market

	Mean	Std. Deviation	N
Number of years into Business	1.8200	.69916	400
Stakeholders from trading on the forex market	3.7450	.56637	400

Table 6- Correlation - no of years in service and the impact of stakeholders from trading on the forex market

Correlations			
		Number of years into Business	Stakeholders from trading on the forex market
Number of years into Business	R val	1	-.002
	P val		.964
	N	400	400
Stakeholders from trading on the forex market	R val	-.002	1
	P val	.964	
	N	400	400

Table 7 – Descriptive statistics - marital status and the impact of stakeholders from trading on the forex market

	Mean	Std.Deviation	N
Marital Status	1.4750	.50000	400
Stakeholders from trading on the forex market	3.7450	.56637	400

Table 8 – Correlations - marital status and the impact of stakeholders from trading on the forex market

Correlations			
		Marital Status	Stakeholders from trading on the forex market
Marital Status	R val	1	-.014
	P val		.784
	N	400	400
Stakeholders from trading on the forex market	R val	-.014	1
	P val	.784	
	N	400	400





Lasya et al.,

Table 9 – Descriptive statistics- age and the impact of stakeholders from trading on the forex market.

	Mean	Std. Deviation	N
Age	1.8600	.97096	400
Stakeholders from trading on the forex market	3.7450	.56637	400

Table 10 – Correlation - age and the impact of stakeholders from trading on the forex market.

Correlations			
		Age	Stakeholders from trading on the forex market
Age	R val	1	-.074
	P val		.139
	N	400	400
Stakeholders from trading on the forex market	R val	-.074	1
	P val	.139	
	N	400	400

Table 11 – Descriptive statistics -source of income and the impact of stakeholders from trading on the forex market.

	Mean	Std. Deviation	N
Source of Income	1.4925	.50057	400
Stakeholders from trading on the forex market	3.7450	.56637	400

Table 12 – Correlation - source of income and the impact of stakeholders from trading on the forex market.

Correlations			
		Source of Income	Stakeholders from trading on the forex market
Source of Income	R val	1	.037
	P val		.455
	N	400	400
Stakeholders from trading on the forex market	R val	.037	1
	P val	.455	
	N	400	400

Table 13 – Descriptive statistics- monthly income and the impact of stakeholders from trading on the forex market

	Mean	Std. Deviation	N
Monthly Income	1.4800	.50521	400
Stakeholders from trading on the forex market	3.7450	.56637	400





Lasya et al.,

Table 14 – Correlation- monthly income and the impact of stakeholders from trading on the forex market

		Monthly Income	Stakeholders from trading on the forex market
Monthly Income	R val	1	-.105*
	P val		.035
Stakeholders from trading on the forex market	N	400	400
	R val	-.105*	1
	P val	.035	
	N	400	400





Is Plant-Forward Eating Patterns are Healthy or Not?"

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ABSTRACT

Dieting is old. It has been around forever. Diets vary by culture and person. Several diets exist. Plant-forward diets contain fibre, healthy fats, protein, vitamins, and minerals. It is healthful and meets all your nutritional needs. Plant-based diets dominate. Fruits, vegetables, whole grains, beans, legumes, nuts, seeds, and oils all fall within this category. Plant-based foods dominate diets. Plant-forward diets benefit most individuals. Plant-forward eating may prevent and treat chronic diseases and reduce prescription drug use, study suggests. Many research on nutrition have examined different plant-based eating plans in addition to vegetarian and Mediterranean diets. The Mediterranean diet includes fish, chicken, eggs, cheese, yoghurt, meats, and desserts, but mostly plants. The Mediterranean diet reduces the risk of heart disease, metabolic syndrome, diabetes, some malignancies, depression, frailty in older persons, and enhanced mental and physical health in large population studies and randomised clinical trials.

Keywords: Immune system, nutrients, Plant- Forward Eating Patterns, Healthy

INTRODUCTION

Plant-based diets are called plant-forward or plant-rich (1- 3). Grains, fruits, nuts, seeds, legumes, and vegetables are plant-based. Plant-based diet [PBD] prohibit animal products and additives. Vegans should avoid or use animal products sparingly (4,5). The concept and definition eliminate the negative connotations of "vegan" (6) and "vegetarian" and are simple. For children, adults, pregnant women, breastfeeding moms, and athletes, the Academy of Nutrition and Dietetics recommends a well-planned plant-based diet. Vegetables, fruits, whole grains, legumes,

58467



**Sivakrishnan and Srinivasan**

nuts, and seeds are the focus of plant-based diets, which limit animal products (7). However, the term "plant-based diet" today applies to vegetarian and vegan diets, which may contain dairy and eggs but no meat, as well as semi-vegetarian and true Mediterranean diets. PBD are becoming more popular due to health benefits, evidence of a lower risk of food-related chronic diseases, and improved control of diabetes, hypertension, and cardiovascular disease. Research suggests that plant-based diets are cheaper than omnivore ones. In the early 21st century, 4 billion people ate mostly plants, some by choice and others owing to crop, water, and energy shortages (9, 10). Due to health, food security, and animal welfare concerns, Europe had 40% of the worldwide plant-based meat replacement market in 2019 and is predicted to reach 60% by 2025. (11).

In 1980, National Institutes of Health nutritionist T. Colin Campbell coined "plant-based diet." (12). "A low-fat, high-fibre, plant-based diet centred on health rather than ethics," he stated (13). "Vegetarian," "vegan," and "plant-based" are commonly interchangeable. According to the AICR and the WCRF, "plant-based diets" "include significant amounts of plant foods and restricted amounts of animal foods." (14-16).

Sustainability

FAO defines a sustainable diet as "low environmental impacts that contribute to food and nutrition security, and to a healthy living for present and future generations," affordable, and resource-efficient (17). Sustainable diets are affordable, culturally acceptable, nutrient-rich, and environmentally friendly (18). Efficiency is the ratio of inputs to outputs needed to create food (19). Food preparation, transport, storage, and service require input energy, not physical human energy. Environmental protection preserves natural systems. PBD reduce greenhouse gas emissions and agricultural water, land, and fertiliser consumption (20). PBD may reduce climate change and biodiversity loss because many crops are fed to cattle rather than humans. Despite being a "significant source of deforestation in the Amazon basin," most soy crops are fed to cattle (21).

According to 2019 research, a PBD is better for the environment than one that emphasises animal products. Pescatarian, vegan, and vegetarian diets had smaller dietary-carbon footprints than omnivore diets, whereas Palaeolithic and ketogenic diets used more animal products and had higher footprints (22). A 2020 study found that moving to a PBD, which uses less land and CO₂ than meat and dairy, might mitigate climate change by offsetting 9 to 16 years' worth of fossil fuel emissions in the countries. (23). "Predominantly plant-based diets" reduce biodiversity loss and human environmental impact, according to 2021 Chatham House research sponsored by the UNEP. The article says livestock raises cattle, sheep, and other animals for human consumption over 80% of Earth. We could free up land, boost biodiversity, and rebuild ecosystems by eating solely plants.

Foods to eat

As research on the benefits of plant-based diets has grown, so has their popularity in the health, wellness, and nutrition industries. Table 1 lists the food groups to prioritise when switching to a plant-based diet.

Foods to avoid and minimize

Just because you eat less meat does not mean you are healthier. Avoid these unhealthy foods on a plant-based diet:

- ✓ Cheese and milk
- ✓ Chicken, beef, and pork
- ✓ Meat, dairy, and eggs
- ✓ Processed animal products: Bacon, lunch meats, sausage, hot dogs, beef jerky, etc.
- ✓ Hot dogs, chicken nuggets, cheeseburgers, French fries, etc.
- ✓ Sweet tea, sugary cereals, pastries, cookies, cakes, and biscuits, sweets and desserts, soda, fruit juice, honey, etc.
- ✓ Artificial sweeteners such as Equal, Splenda, Sweet'N Low, etc.
- ✓ Vegan butter, cheese, and Tofurkey are processed vegan foods.
- ✓ Avoid salty, greasy, and deep-fried foods.



**Sivakrishnan and Srinivasan****Recipes to get started**

People who consume a lot of plants or who follow a diet that is largely composed of plants have longer, higher-quality lives. As shown in Table 2, the following dishes can assist someone in beginning a plant-based diet. Vegetarianism and plant-based eating look comparable. But there are some key differences that may help you choose a plant-based diet. If you eat a lot of meat, there are many reasons to switch to a plant-based diet. Most plant-based diets prioritise plant-based over animal-based meals. Fruits, vegetables, and whole grains are better than animal protein for lunch. Research shows that these colourful, flavourful meals offer many therapeutic benefits, including weight loss and disease control. Seven distinct ways can be used to start a plant-based dinner. Here are some suggestions to get you started on the path to a PBD.

- ✓ Consume a lot of veggies. Half of the dish at lunch and dinner should be made up of vegetables.
- ✓ Change the way you think about meats. Decrease the amount of food you consume. Use this as a complement rather than as the main course.
- ✓ Consuming healthy fats is advised. Walnuts, peanuts, avocado, and virgin olive oil are all high in fat.
- ✓ Make a vegan dinner once a week at the very least. This meal should be built around legumes, whole grains, and vegetables.
- ✓ Whole grains should be a part of breakfast or brunch. Start with a grain like rye, millet, quinoa, or oats. After that, you might incorporate some fruit and vegetables along with a handful of almonds or peanuts.
- ✓ Salads can act as the main course of a meal. You should put lettuce, such as romaine, greens, and red leafy greens, in a big stand mixer. Add some extra vegetables, fresh herbs, beans, peas, or tofu to the mixture in addition to the tofu.
- ✓ Fruit should be a part of desserts. A ripe, juicy peach, a cool slice of watermelon, or a crisp apple will satisfy your sugar craving after a meal.

Health benefits

Benefits of a PBD include:

- ✓ The risk of CHD and hypertension have all been shown to be reduced by vegetarian diets, among other health benefits. A plant-based diet increases longevity and slows down the aging process.
- ✓ Every smallest nutrient has its own effects on body and plant-based diet has many benefits on health as it is rich with phytonutrients and fibres.
- ✓ Plant based food, have higher carbohydrate and water content, increase energy level. Protein rich plant-based diet promotes muscle gain naturally and keep providing energy.
- ✓ Diets based on plants are abundant in fibre, complex carbs, and water from fruit and vegetables. This could prolong satiety and boost calorie expenditure during sleep.
- ✓ In older patient, plant-based diet helps to maintain mental and physical function. Regular consumption of plant-based food promotes free radical destruction and reduces oxidative stress which is the key driver of various inflammatory and metabolic diseases.

Beautiful glowing skin and better memory

Antioxidants and phytonutrients from plants can give you the most beautiful skin and give your eyes a glitter that no amount of cream, lotion, or botox could ever achieve. Less inflammation and more antioxidants improve memory and mental clarity.

Energy and zest for life

Eating a lot of nutrient-dense vegetables will make you feel lighter and give you more energy and confidence, which will put you in a much better position to fulfil all of your goals and aspirations.



**Sivakrishnan and Srinivasan****Immune support**

Boosting immunity. Plants supply nutrients that other foods cannot. Plant-based diets increase immunity and fight infections. Vitamins, minerals, phytochemicals, and antioxidants in plants help balance and protect cells. Because it detects and treats cellular abnormalities before they become cancerous, the immune system reduces cancer risk.

Anti-inflammatory activity

Anti-inflammatory plant-based diets Vegetables provide anti-inflammatory elements. "Plants have antioxidants that catch all these supposed free radicals that can upset our body's equilibrium." "Reducing inflammation requires a plant-based diet and listening to your body." Persistent inflammation can damage cells and tissues and cause cancer and other inflammatory illnesses like arthritis. Plant-based diets reduce risk factors for various diseases.

Aids digestion and metabolism

Fibre-rich food aids digestion, nutrient absorption, and metabolism. Fibre-rich plants. Plant foods contain fibre. Fibre maintains intestinal health and lowers cholesterol and blood sugar. Fibre can prevent colorectal cancer. Plant-based diets minimise risk for heart disease, stroke, diabetes, and some mental health concerns.

Weight control

Overweight causes hormonal imbalance and inflammation. Obesity raises the risk of 12 cancers, including colorectal, postmenopausal breast, uterine, oesophageal, kidney, and pancreatic. Plant-based diets aid weight management. A healthy weight reduces cancer risk. Quitting smoking is more important than maintaining a healthy weight for cancer prevention. Studies found that vegetarians had lower BMIs and higher incidences of heart disease, diabetes, and obesity than meat eaters.

Heart disease prevention and diabetic therapy

Journal of the AHA found that middle-aged adults who ate more plants and fewer animals had a decreased risk of cardiac disease, overweight, NIDDM, hypertension, hypercholesterolaemia, several malignancies, and stroke. Plant-based diets improve insulin sensitivity and reduce insulin resistance, preventing or treating diabetes. Vegetarian and vegan diets may increase metabolism, weight loss, and diabetes prevention.

Aids cognitive deterioration

Plant-based diets reduce cognitive ageing. Some study suggests that a diet heavy in fruits and vegetables may suppress or stop dementia and Alzheimer's in older people. Plant-based diets contain more antioxidants and minerals, which can prevent Alzheimer's disease and potentially reverse its cognitive decline.

CONCLUSION

By being vegan, one can progressively reduce dairy and meat. Plant-based diets are healthy. Beginning with one plant-based meal each week or replacing animal product can be beneficial. Plant-based diets are popular for two reasons. First, because of global warming concerns, consumers are looking for more environmentally friendly options, and plant-based proteins are generally considered better than animal proteins. Second, plant-based, vegan, and vegetarian diet documentaries are becoming more popular. Plant-based diets involve planning, label reading, and self-control. Plant-based diets may reduce cancer, ischemic heart disease, and weight.

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**Sivakrishnan and Srinivasan**

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Determinants of Herding and Market Factors Influencing Investment Decisions and Investment Pattern of Investors and its Impact on Performance of Equity Market.

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ABSTRACT

In today's rapid growth of economy there is a financial requirement for each of every individual for peaceful and clam life which in turn gives financial security and safety for the investors. This demands for better investment avenues on which investment pattern will be followed by individuals to compound their returns to beat the inflation in future. These actions will definitely have an impact on equity market and the effective functioning of such an equity market directly depends on investments and hence the investment decision becomes a significant factor in setting the trend of the market. Generally, investors' are cautious and subtle to both socio-economic and psychological factors and their decision-making process can be largely complicated due to the effect of these factors. This complexity in decision-making affects the equity market's performance that in turn has its impact on the economy. Therefore, the objective of this paper is to identify the behavioural factors like herding and market factors which influence the investment decisions of the investors with their investment pattern and to know its impact on performance of the equity market. This research paper includes only herding and market factor of behavioural finance and its impact on investment pattern of investors and equity market performances. To evaluate this descriptive statistics and inferential statistics with tools like Anova, Chi-square, t-test and regression analysis has been performed. After analysing the results of the research work, to conclude it is proved that behavioural factors like herding and market factor influences the investment decisions and investment pattern of investors in the equity market. Further it has implications on performances of the equity market. Most of the respondents of the research are of male, middle aged with post-graduation

58472



**Rekha and Roopa**

qualification and has investment experience. Further their emotions are related with the selection of investment avenues and to make investments also certain behaviour factors will influence them.

Keywords: Herding and market factors, Investment pattern, decisions, performance of equity market.

INTRODUCTION

Herding is defined as “investor’s tendency to follow to others’ investment and trading actions”. This behaviour helps the investors to avert the feeling of regret if any collective loss occurs. At the same time, this behaviour also causes substantial deviation from fundamental value in the price of the securities, which gives rise to a state of market inefficiency that in turn leads to speculative bubbles of asset prices. Furthermore, the practitioners are generally alert to the presence of herding, because of the fact that investors are more tend to depend on collective information than private information. Waweru et al. (2008) proposed some important elements of herding, including selling, buying, choice of stock, volume of stock to trade and length of time to hold stock, which can produce an impact on the investor’s decisions.

Market factors, such as customer preference, price changes, market information, past trends of stocks and fundamentals of underlying stocks have a certain impact on investors’ decision-making. Generally, changes in the stock price, market information and fundamentals of the underlying stock can become a source of over/under-reaction to the price change and these changes can effectively influence the decision-making behaviour of investors. The studies found out that under-reaction (Lai, 2001) or over-reaction (DeBondt&Thaler, 1985) can lead to various trading strategies by investors, which in turn can influence their investment decisions. Barber and Odean (2000) highlighted the impact of events in the stock exchange on investors, even if they have no clue if these events can yield good investment performance in the future. This is supported by Waweru *et al.* (2008) who indicated the impact of price change of stocks on their investment behaviour. The authors also highlighted that these impacts can lead the investors to buy the popular stocks.

Decision-making is an activity that is implemented after an appropriate evaluation of all alternatives. The connection between investors’ psychological state and their decision-making and its impact on market is studied by Ritter (2003). The author explained the model as an attempt to better understand the suboptimal decisions of investors, which can have the impact on markets and personal wealth. Apart from that, the studies also attempted to link the human decision-making procedure with cognitive illusions and suggested that the human decision processes are influenced by numerous cognitive illusions, such as illusions caused by heuristic decision process and illusions generated due to the acceptance of mental frames grouped in the prospect theory (Waweru *et al.*, 2008).

Investment Pattern is the investment in different investment avenues with vital consideration of risk and return aspects involved in investment avenues.. The relationship between savings and investment has not changed significantly since the reforms in 1991 because of the behavioural tendency of the investors. The temporary pattern of domestic investment rates effectively impacts the equity market through their savings and investment pattern also. Equity markets refer to the venues where equities can bought and sold. Equities are also termed as stocks or shares and hence equity markets are referred as stock markets. Generally there are two types’ equity markets; primary and secondary markets. The selling of new stocks to investors as initial public offerings (IPO) is occurred in Primary markets whereas in secondary markets the liquidity to securities, as allocated in the primary market, is delivered. The secondary stock markets allow the trading and subscription of existing securities among traders and investors through an identified stock exchange. Stock markets and its development is a multifaceted concept, which involves liquidity, market size, concentration, volatility, integration with world capital markets, and institutional development. Volatility, capitalization, and trading volume in the stock market affect its development. The stock



**Rekha and Roopa**

markets are organized bodies with certain rules and managing committees to control the financial exchange. Trading can be done either physically or virtually.

Over a decade, investors behaviour towards the investment in financial system has gained much attention and constantly been used by investors to study the financial market. Again this is in order to focus on the compounding effect the investment made. But the investors' investment decisions will be based on certain behavioural aspects where the normal tendency of individuals will be implemented before investing. The awareness of equity market and market sentiments helps investors to analyze the situation and make profitable decisions. There are multiple factors including market factors and herding factors etc., which influences investment. The study of behavioural finance can offer an insight in predicting the market and thereby prompt to act accordingly to make a positive outcome.

REVIEW OF LITERATURE

Brahmana, Hooy and Ahmad (2012) examined the role of herd Behaviour in determining the investors' irrationality on Monday. The data were gathered from a sample of 846 investors, who were trading shares listed under the Malaysian stock exchange. The findings revealed that herd behaviour played a significant role in determining the investors' decision regarding small cap investments. However, it was found that the influence of herd behaviour was restricted only to investors' decisions made on Mondays and no on other weekdays. Hence, it was concluded that the influence of psychological biases was evident during trades executed on Mondays.

Shekhar and Prasad (2015) investigated the influence of herding behaviour on stock market price volatility and on the decision-making of retail and professional investors. The required data was collected by distributing well-structured questionnaires among a sample population of 100 investors selected through random sampling. The analysis was performed by using chi-square test. The findings revealed mixed outcomes. Around 74% of the respondents admitted that their investment decisions were influenced by expert opinions. A majority of the respondents stated that herding behaviours did not yield favorable outcomes several times. Thus, skepticism about the application of herding Behaviour was created.

Agarwal, Singhal and Swarup (2016) examined the influence of herding behaviour on the investors' decision and the causes for the existence of herding behaviour among investors. The study was conducted in Agra and Mathura region in Uttar Pradesh between March 2016 and August 2016. The data were collected from a sample population of 70 investors. Content analysis and system dynamics modeling (stock flow diagram and causal loop diagram) were used for data analysis. The findings demonstrated that herding behaviour had a substantial impact on the investors' decisions. It was found that this influence was due to the lack of knowledge and financial literacy regarding the stock market functioning.

Javed, Bagh and Razzak (2017) analyzed the influence of behavioural factors, such as herding, overconfidence, availability bias, and representativeness, on the investors' performance and decision-making. The study adopted explanatory research methodology, which explores the cause and effect relationship between variables. Quantitative analysis was conducted among a sample population of 220 investors, who held the shares of companies registered under the Pakistan stock exchange. The data was gathered by administering a well-set questionnaire to the sample population. The findings of regression analysis indicated that herding factor produced a significant and direct impact on the investors' performance.

Kumar and Sharma (2018) explored the impact of herding Behaviour on the decision-making of investors, who traded shares (FMCG, IT, Healthcare, Oil and Gas, etc.) between September 2005 and March 2016. The data from BSE Limited was used for the empirical analysis. No significant proof of market-wide herding was found during the study period, even though certain weak evidences of herding were found during market movements. Further,



**Rekha and Roopa**

herding was not found during the extreme movements in asset price, which reinforced the asymmetric nature of herding.

Saxena and Ahuja (2018) analyzed the effect of herd behaviour in determining the investors' decisions. The study adopted quota sample to select the sample population and a questionnaire was distributed among the respondents. The gathered data was evaluated using logistic regression with the help of Stata software. The findings revealed that herding behaviour and word of mouth had a significant impact on the decision-making of investors.

Quasim *et al.* (2019) studied the influence of herding behaviour and overconfidence on the investors' decision-making. The required data were gathered through questionnaires distributed among 150 investors, who were active in the Pakistan stock market. The study managed to get 100 completed questionnaires. The ordinary least square (OLS) method was used to analyze the association among investors' decision-making and herding behaviour and overconfidence biases. The findings indicated that investors' decisions were significantly influenced by herding behaviour.

Sultana and Pardhasaradhi (2012) investigated the factors that influenced the decision-making of individual equity investors. The study selected 40 items that could have an impact on the investors' decisions. Cronbach's Alpha test was used to test the reliability of these items and factor analysis was conducted to identify 10 attributes that had an impact on investors. The findings revealed that 42% of the investors were influenced by the companies' accounting information. In addition to this, company's image (4%) and general information (4%) had a significant impact on the investors' decisions.

Obamuyi (2013) analyzed the factors influencing the decisions of investors associated with the Nigerian capital market. The findings exhibited that market factors, such as information about the company's past performance, projected earnings, projected security capital bonus, dividend policy, etc., showed a significant impact on the investors' decisions. However, the study highlighted that demographic and socio-economic factors have their own influence on the investment decisions and may work as moderators.

Bashir *et al.* (2013) attempted to identify the factors that have an impact on the decision-making Behaviour of Pakistani investors. The study gathered data from a carefully chosen sample population, which included 55 bank employees, and 40 students and 30 teachers from different finance colleges. A well-structured questionnaire was distributed among the sample of respondents to collect the required data. Statistical tools, such as mean, standard deviation, frequency distribution table of variables (which have significant influence on decision-making) and frequency distribution table of variables (which have least influence on decision-making), were used for data analysis. It was found that all variables have their own impact on the decision-making behaviour of investors, with accounting information category of variables influencing the most and advocate recommendation category influencing the least.

Lam (2014) analyzed the factors that had a significant impact on the decision-making of investors. The study highlighted the past market trends as the pivotal factor that influenced the investment planning. The study also pointed out the influence of expected rate of returns in the choice of investment.

Lodhi (2014) investigated the impact of application of accounting information, financial literacy, importance of analysis of financial statements, vast experience, and age on individual investors' decisions. A well-set questionnaire was used in the survey for gathering the data. The study performed a correlation analysis with the help of SPSS software to determine the association among the above-mentioned variables. The results revealed that factors, such as accounting information and financial literacy, had a significant influence on lowering the information asymmetry and encouraging the investors to opt for risky instruments. However, it was found that preferences of the investors for the investments that have risks decreased with the advancement in their age and experience.



**Rekha and Roopa**

Shabgou and Mousavi (2016) conducted a survey to analyze the influence of behavioural factors in the decision-making of Iranian investors. The study was conducted among a sample of Tabriz city stock exchange traders. Random sampling was used and a well-structured questionnaire was distributed among a sample population of 385 investors to gather the required data. Friedman analysis illustrated that the investors' decision-making was highly correlated with market factors.

Kibegwa, Namiinda and Nzoiki (2017) analyzed the investment patterns and the influence of market information on the investment decisions of groups of young Nairobi stock exchange traders in Kisumu County. The study examined the viewpoints of chairpersons, who knew their group members' investment strategies. The initial sample population was of 380 chairpersons, out of which 79 chairpersons were filtered by using stratified and random sampling method. The primary data was collected by using well-structured questionnaires. Statistical tools, such as mean, mode, frequencies, and percentages, were used to analyze the relationship between decision-making and the various factors. T-statistics was used to determine the relationship among the market factors for two independent samples. The findings of the analysis revealed that market information had a significant influence on the young equity investors' decision-making.

Sarkar and Sahu (2017) investigated the factors that influenced the Behaviour of stock market traders. The data was gathered by using a well-structured questionnaire distributed among a randomly chosen sample of 500 investors from various districts of West Bengal. Statistical tools, including Cronbach's Alpha, Factor Analysis, Correlation and Probit Regression Model, were used to evaluate the data with the help of SPSS and Stata software. It was found that market dimensions played a significant role in determining the individual investment decisions.

Ramkumar (2017) explored the influence of stock market factors in the decision-making of Indian equity investors. The required information was gathered from a randomly selected sample of 90 stock market traders, who invested through institutional brokers in Chennai. Structural equation modeling was used to depict the association between the dependent and independent variables. The result illustrated that market factors substantially affected the investors' perceptions, which in turn, influenced their decision-making.

Ghalandari and Gharemanpour (2013) investigated the extent to which market variables and herding affects decision-making of Iranian investors and the manner in which it affects performance. A sample population of 300 investors was selected out of which 275 respondents returned completely answered questionnaires that were used for the analysis. Structural equation modeling (SEM) was used to analyze the data. The findings indicated that both market variables and herding have a positive influence on the investment decision, with market variables showing a higher influence. Further, the study highlighted that investment decisions have a positive and significant influence on the investment performance of the Tehran stock exchange. The study suggested that investors should choose companies that can provide higher cash or stock dividends.

Research Gap

The present research study is carried out of an extensive review of studies that explored the impact of various factors on the investors' decision-making and its rippling effect on the market performance there was no clarity on the influence of socio-economic factors on the investment decisions. A vital drawback found in the case of the impact of investment decisions on the investment performance was the lack of sufficient studies in the Indian context. Further, contradictory results cast a doubt on whether the relevant factors affect the investment decisions or not. Additionally, lack of clarity in results regarding the nature of impact (positive or negative) has proved to be a major shortcoming.

Statement of Problem

A nation like India, whose economy is embarking upon industrialization need make outlined efforts to develop healthy and organized equity market as there exist a direct correlation between the stock market and industrial economy. A positive trend in the stock market will significantly influence the growth of the economy and vice versa.



**Rekha and Roopa**

This makes the decisions of investors a defining factor, which plays a decisive role in setting the market trend. This context necessitates the exploration of the relationship between investor's behaviour and their investment nature. Considering these results, the present study attempts to extend these researches into the Indian context and trying to understand the influence of the herding and market factors on the investors' decisions and investment pattern which in turn has impact on equity market.

Objectives of the Study

1. To analyse the herding and market factors influencing investment decisions of the investors.
2. To know and analyse the investment decisions influence the investment pattern of the investors.
3. To evaluate the investor's investment decisions and investment pattern influence the performance of equity market

Hypothesis

H0: There is no statistical significant relationship between herding and market factors and investment decisions of the investors.

H1: There is a statistical significant relationship between herding and market factors and investment decisions of the investors.

H0: There is no significant impact of Investment decisions on investment pattern of investors.

H1: There is a significant impact of Investment decisions on investment pattern of investors.

H0: There is no significant impact of investment decisions on the performance of equity market.

H1: There is a significant impact of investment decisions on the performance of equity market.

Research Methodology used for the study**Type of Research adopted**

This research study is purely descriptive and explanatory approach. The descriptive study indicates the precise and major observations made which is with the adoption of scientific methods. The explanatory research study portrays the explanation on the factors that evaluates the investor's investment decisions and investment pattern and its performance on the equity market.

Research Instrument

The study adopted quantitative method as the current study intended to establish the relationships between independent variables such as the investor's herding and market factors independent variables influencing the investors mind set (investment decision) and investment pattern. A well-structured questionnaire with a set of standardized questions was used as the research instrument. The degree of investors' agreement with the questions have been rated on a 5-point Likert scale ranging from strongly disagree (SDA) to strongly agree (SA). The questionnaires were distributed to 350 investors in Bangalore, out of which 300 complete responses were received.

Sampling

The selection of the sample population for the current investigation was carried out in three stages. The investors in and around Bengaluru constituted the general population for the investigations. This sample was selected using a simple random sampling technique.

Data Collection**Primary Data and Secondary Data**

The responses that respondents aptly chose in the questionnaire formed the primary data and the Secondary data were reviewed from journals that relate the objectives of the current investigation.



**Rekha and Roopa****Data Analysis**

For analysing the demographic profile of the respondents the inferential statistics like chi square, Anova and t test were implemented and for relationship between the independent and dependent variable of the research study the linear regression analysis was used to analyze to know whether they are positively correlated with each other.

Limitations of the Study

- ❖ The study has analyzed the influence of Herding and market factors influence on investment decision-making and investment pattern of investors and its impact on equity market in Bengaluru only.
- ❖ Limited and accessible sample has been considered for the research study.
- ❖ Research study is exposed to time and cost constraint.

ANALYSIS AND DISCUSSIONS

The investor's responses are taken measuring through statistical applications to under their behavior in financial market and their decision regarding financial decisions and applications as such. The descriptive analysis of the market and herding factors as per the respondent responses reveal that the investors investment decisions are based on the herding and market factors as the above table tells that the majority of the respondents have agreed to the statement given for herding and market factors. Further the investors are also of opinion that they go with the other opinion when the investing decisions have to be made and further they also look into the market conditions and situations to make investment in equity to earn better returns from it.

Findings

Association and Impacts of Determinants of herding and market Factors in Investment Decision, investment pattern and Investment Performance:

Investment decision, investment pattern and performance of the investors are affected by certain investors behavioural factors. It was found from the analysis that the respondents' behavioural factors, which include herding and market factors, positively influence the investment decision. Herding behaviour has proved and produce the impact of investment on investment decision. Further, the investment decision of the investor affects their investment pattern, which possibly involves the choice of different avenues, such as stocks, bonds, mutual funds, etc. Since the investment pattern involves investing the hard-earned money into different long-term and short-term monetary plans, it was found that the investment performance of portfolios depends on the respondents' choice of investment pattern. The investment decisions were influenced by preferences like long-term benefits than short-term monetary gains and uptake of higher risks to yield higher profits. Market factors were significantly associated with the investment decision. Past trends was relatively found to enhance the influence of market factors in the investment decisions compared to market information. Past trends like closely observing the stock market and companies' financial reports influences the investment decisions.

A significant correlation was found between herding behaviour and investment decision. However, no significant impact of herding behaviour on investment decision was observed. Recommendations like following existing market trends, closely examining the pros and cons and seeking advice of friends and family did not have influence on the investment decisions. Investment on stocks should be made based on guaranteed good yield, increasing value without any drastic fluctuations. Based on guaranteed yield, though lower, bonds can be a part of long-term investments like retirement plans. Stable derivatives such as gold, metals can be a part of the investment but the market should be monitored closely before making any decision. Investors who are willing to take risks can invest in derivatives which might yield higher returns. For getting safe and higher returns in the long-term, the investors should invest in mutual funds and follow the SIP mode of mutual fund investment. Mutual funds should be preferred for financial investments property purchase, travel and wedding.



**Rekha and Roopa****CONCLUSIONS**

On the basis of detailed analysis of the study, the major hypotheses of the study have been proved correct and that there is a significant association between the behavioral factors and investment decisions of the investors, which in turn, has a substantial impact on the investment pattern of the investors. The investment pattern, in turn, significantly affect the investment performance. These are the principal findings of the study and with these insightful conclusions obtained within practical dimensions; the researcher has made significant contribution to the existing body of knowledge regarding the investment decision-making behaviour of investors and the factors, which influence this behaviour. The investors, being the primary customers of the equity market, must have a systematic and robust contemplation to avoid any negative effect on their financial status and harmony. Regular evaluation of pros and cons and review of investment performance is essential to have better outcome. A close observation of the existing market trend should be done to decide on the investment avenue. Investment preferences should be made considering long-term benefits and not short-term gains. Long-term investments should be given emphasis over short-term investments. Short-term investments should also be based on proper market research on the investment performance. Investment on products should be made based on with higher security.

Recommendations

- Thorough analysis of the company stocks, past earnings and financial reports, economic situations at national and global level should be done before making any investment decision.
- Regular evaluation of pros and cons and review of investment performance is essential to have better outcome.
- Long-term investments should be given emphasis over short-term investments.
- Investment on stocks should be made based on guaranteed good yield, increasing value without any drastic fluctuations.
- Investors who are willing to take risks can invest in derivatives which might yield higher returns.
- For a balanced investment, more than one type of avenue should be considered.

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Rekha and Roopa

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Table 15 Descriptive statistics for Market factors

Items	Mean	Std. Deviation
I only invest in stocks whose price has steadily increased over the years	3.856	1.183
I invest in companies who have paid higher dividends to their shareholders in the past	3.940	1.012
I follow the companies' financial reports closely before buying their stocks	3.802	1.002
I only invest in companies whose stocks have performed well in the past	3.902	1.015
I keep a close track of the stock market, which helps me decide where to invest	3.913	1.054
My investment decisions are based on my personal understanding of the global and national economy	3.909	0.985





Rekha and Roopa

Items	Mean	Std. Deviation
I invest in particular company's stocks because I have a good opinion about the company	3.985	1.049

Source: Field survey

Table 16 Descriptive statistics for herding factors

Items	Mean	Std. Deviation
I take the advice of friends and family before investing	3.631	1.211
I follow the existing market trend while making an investment decision	3.707	1.030
I follow what my advisor suggests while making an investment	3.989	1.057
I make my investment decisions on the basis of television advertisements	3.842	1.272
I make an investment after thoroughly examining its pros and cons	3.031	1.082
I follow the other investors advice while buying stocks as I do not have proper knowledge	3.858	1.110

Source: Field survey

Table 17 Descriptive statistics for the impact of market factors on investment decision

Variables	Mean	Std. Deviation
Investment decisions	3.974	0.679
Past trends	3.777	0.799
Market Information	3.633	0.882

Source: Field survey

Table 18 Model summary for the impact of market factors on investment decision

R	R Square	Adjusted Square	R	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. Change F
.451	0.203	0.200		0.607	0.203	69.832	2	547	0.000

Table 19 Descriptive statistics for the impact of herding Behaviour on investment decision

Constructs	Mean	Std. Deviation
Investment decisions	3.974	0.679
Recommendations	3.623	0.879
Other investors decisions	3.330	0.918

Source: Field survey

Table 20 Model summary for the impact of herding Behaviour on investment decision

R	R Square	Adjusted Square	R	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. Change F
.404	0.763	0.760		0.622	0.763	53.404	2	547	0.000

Source: Field survey





Rekha and Roopa

Table 21 Descriptive statistics for Investment Pattern of investors

Items	Mean	Std. Deviation
I buy bonds of companies which given higher dividends in the past	3.549	1.120
Bonds are best investment when you are saving for long-term plans, like retirement	3.962	1.048
I prefer bonds as I have obtained good returns from them in the past	3.444	1.066
I prefer derivatives based on highly stable underlying assets, such as gold	3.371	1.087
MFs are the most profitable as they pool the funds of many investors, hence obtain higher returns	3.705	1.133
I am certain that MFs are the most profitable avenue for investment	3.758	1.048
MFs are the best products if you are planning for expenses, like property purchase, travel and wedding	3.675	1.072
I prefer the SIP mode of MF investment as it requires small amounts of regular investments	3.842	1.048
I prefer mutual fund as they are managed by expert investors	3.818	1.003

Table 22 Descriptive statistics for the impact of investment decision on investment pattern

Constructs	Mean	Std. Deviation
Pattern of Investment	3.495	0.703
Investment decisions	3.974	0.679

Source: Field survey

Table 23 Model summary for the impact of investment decision on investment pattern

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. Change F
0.480 ^a	0.730	0.729	0.617	0.730	163.884	1	548	0.000

Table 24 Descriptive statistics for Equity Performance in stock Market

Items	Mean	Std. Deviation
I give the highest preference to investment yield while measuring investment performance.	3.533	1.075
Stocks of financially sound companies generate better yield compared to new firms.	3.616	0.999
Stocks have generated higher RoR as they benefit from market upswings over a period of time	3.565	1.091
As mutual funds accrue value in the long-term, their RoR increases after a certain period	3.702	0.965
RoR is necessary to measure the long-term sustainability of an investment	3.816	0.943
The capital gain from stocks depends on how well the company as performed	3.835	0.849
The capital gain is a good measure of the actual value of an investment at any given time	3.702	0.953
The capital gain on mutual funds is higher only later a certain period of time as they accrue value in the long run	3.658	0.995
Mutual funds are best suited for those who can wait as they generate higher over a longer period of time	3.831	1.033

Table 25 Descriptive statistics for the impact of investment pattern on investment performance

Constructs	Mean	Std. Deviation
Investment Performance	3.658	0.687
Pattern of Investment	3.495	0.703

Source: Field survey





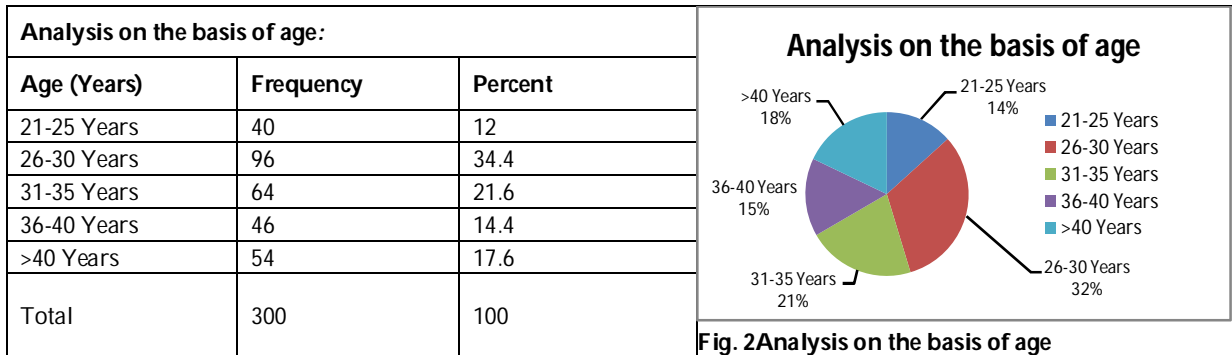
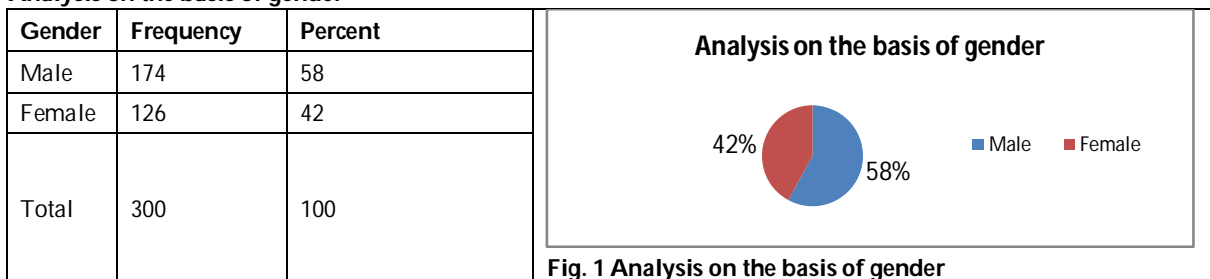
Rekha and Roopa

Table 26 Model Summary for the impact of investment pattern on investment performance

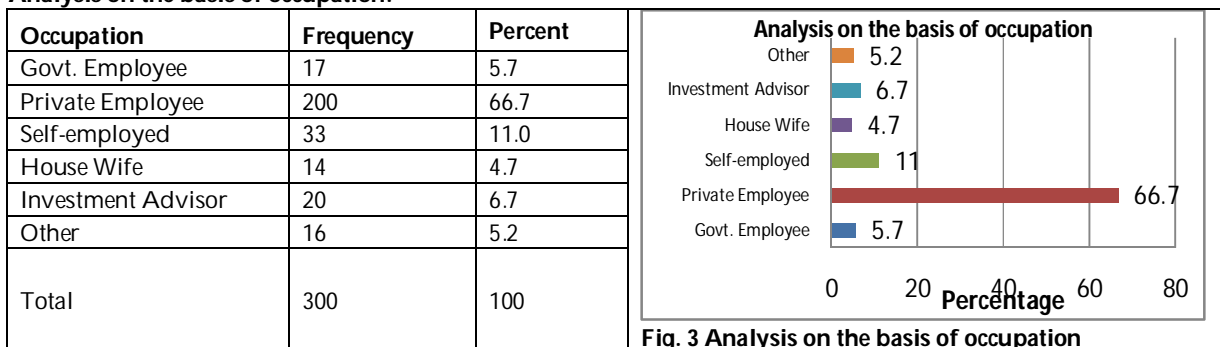
R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. Change F
.870	0.757	0.756	0.339	0.757	1704.354	1	548	0.000

Source: Field survey

Analysis on the basis of gender



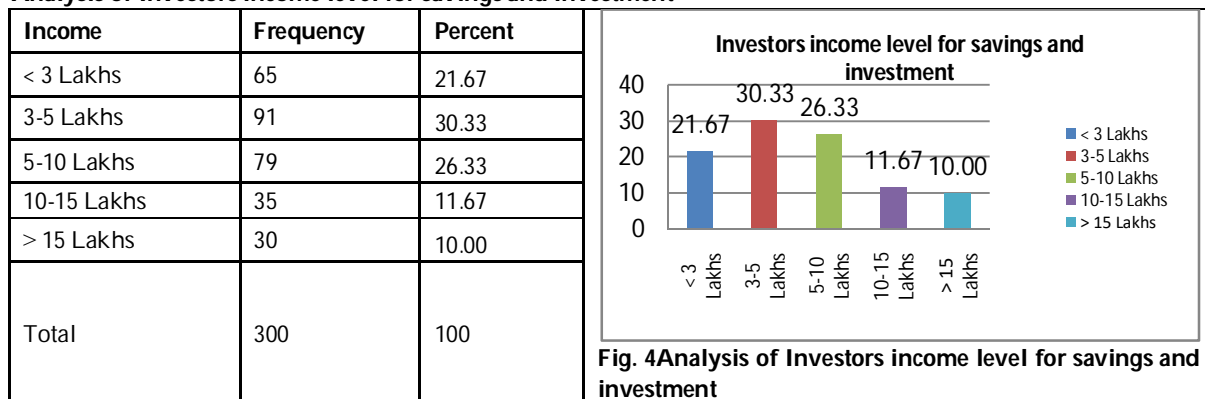
Analysis on the basis of occupation:





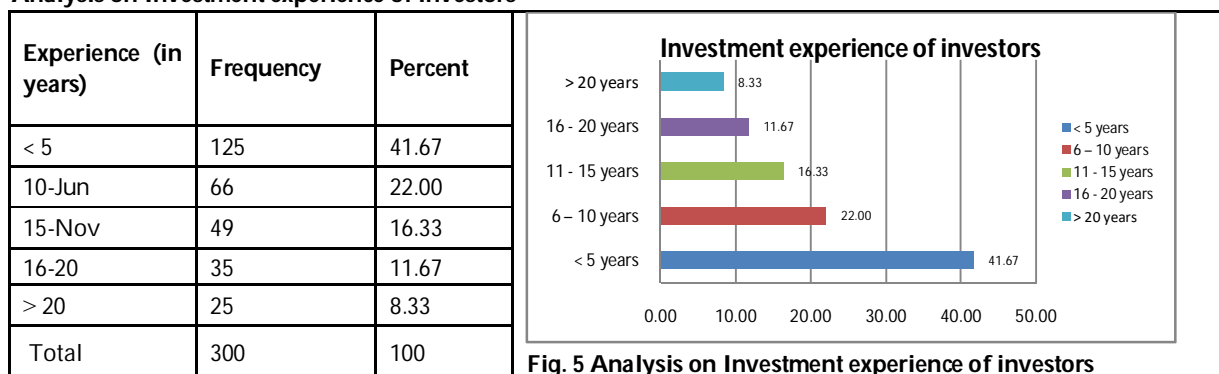
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Analysis of Investors income level for savings and investment

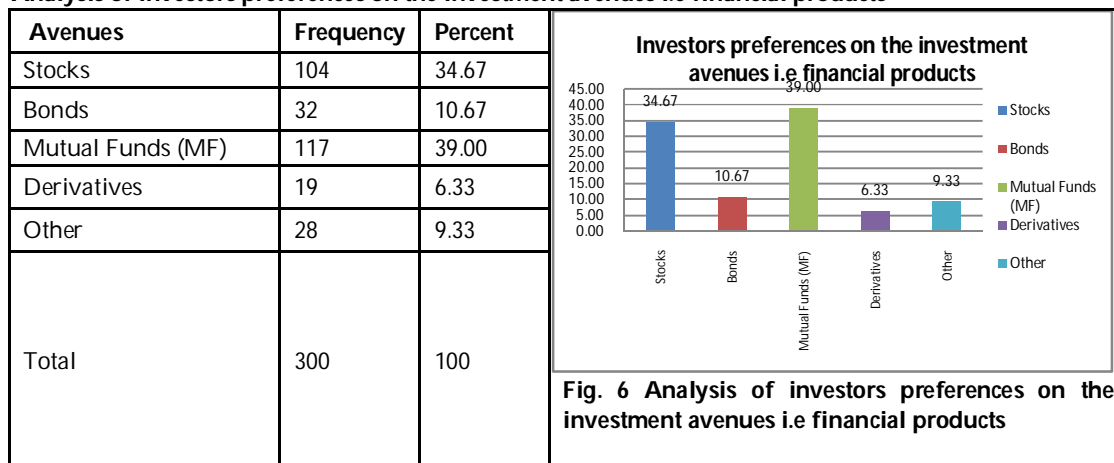


Source: Field survey

Analysis on Investment experience of investors



Analysis of investors preferences on the investment avenues i.e financial products



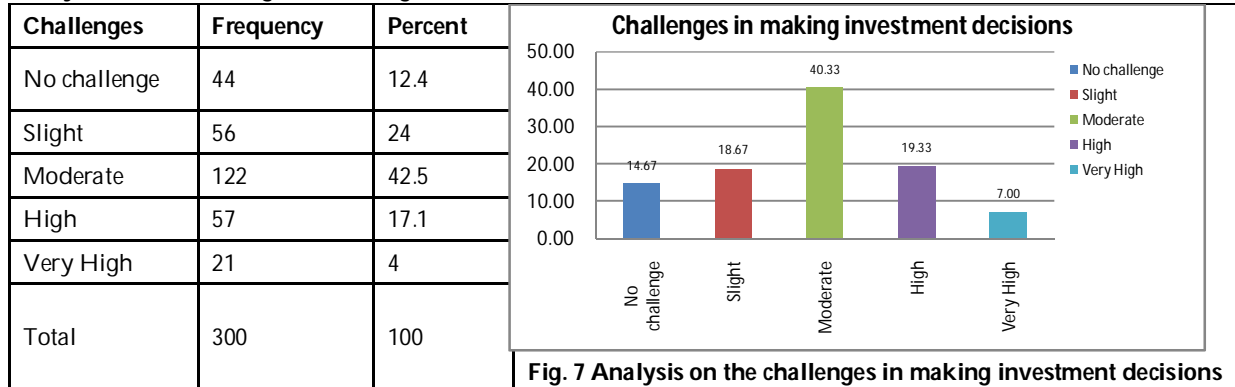
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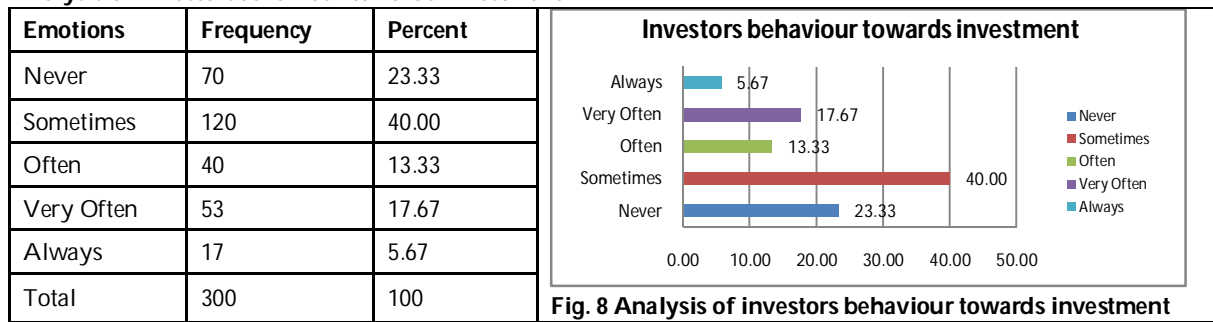
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Analysis on the challenges in making investment decisions



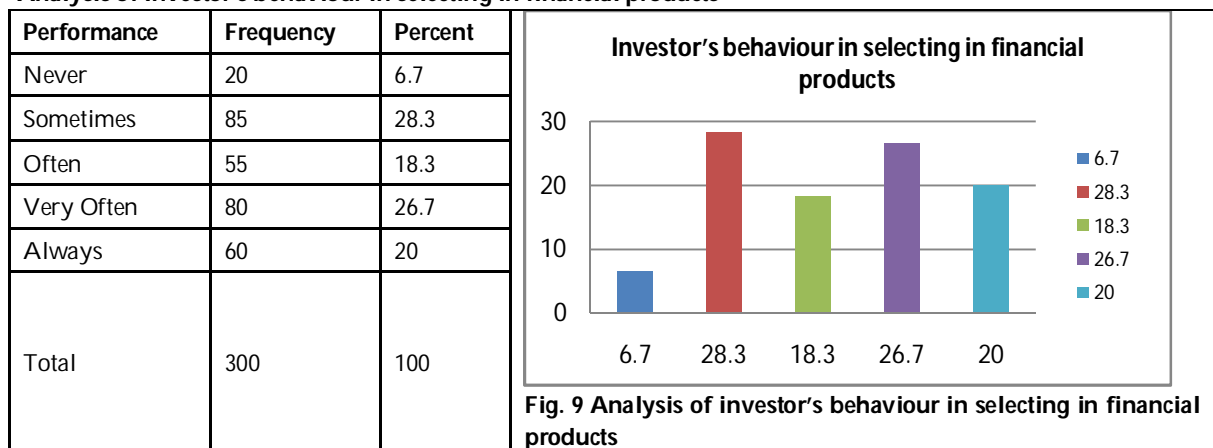
Source: Field survey

Analysis of investors behaviour towards investment



Source: Field survey

Analysis of investor's behaviour in selecting in financial products





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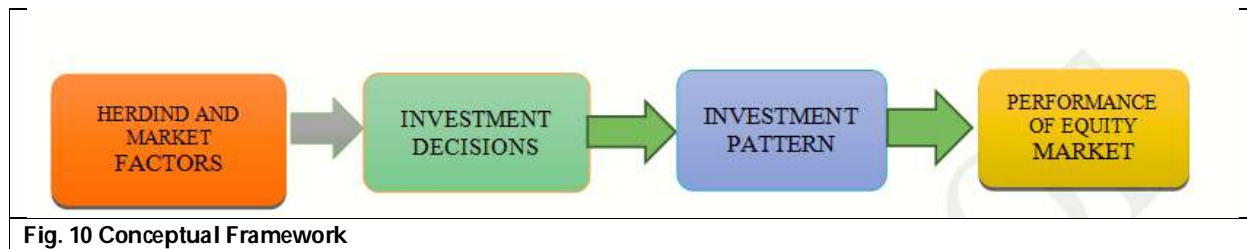


Fig. 10 Conceptual Framework





A Study on Impact of Talent Engagement on Employee Productivity

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ABSTRACT

An organization's success rate increases when more and more involvement opportunity is given to the employees in their jobs. Any job as it is may not be so interesting to the employees. The organization can make it interesting by positive motivational factors like Talent Engagement. This employee involvement will create a more creative and interesting workplace environment which directly contributes to Employee Productivity. Talent Engagement keeps the employees glued to their jobs. Business organization should identify those talent engagement drivers to keep their employees engaged and motivated in their workplace. This will create a positive environment and helps to increase the level of employee productivity.

Keywords: Talent Engagement, Talent Engagement drivers, Employee Productivity.

INTRODUCTION

Talent Engagement

Talent Engagement is the extent of psychological connection the employee feels towards his work, workplace and employer. Talent Engagement refers to the bonding the employee feels towards his/her workplace. Every employee will be connected to his workplace in one way or the other. The extent of psychological and emotional connection the employee feels towards his workplace represents talent engagement. Employees with highly engaged talent will have a close association with their work or employer. This leads to their own professional and personal growth. And also this will make them to stay with the company for a longer duration. It represents the employee involvement and commitment towards the business organization. An engaged employee is totally aware about each and every fact and figure of the organization. Such an employee works with his colleagues with better compatibility. An engaged employee improves his performance for his self growth as well as organizational growth.



**Savitha G Pai**

Talent Engagement is a medium used by the business organization to maintain a healthy relationship with the employees by having a healthy and personalized conversation and interaction. It is a strategy where the organization will learn more about employees and then enable the employees to learn more about the company. Ultimately, employee will develop a brand for his employer and starts remaining loyal to the employer. Engaged employees show greater level of productivity when compared to disengaged employees. Engaged employees are highly motivated both personally and professionally which helps them to do their job more efficiently. Their work is more focused on the organization success. Talent Engagement should be the top priority for every organization. According to Human Resource Professionals and experts, when the talent of the employees is recognized and employees are engaged accordingly in an effective way, the workplace of the business firm becomes more productive and happier place to work. Today a lot of efforts are being done by Human Resource Department of many organizations to find out all possible ways to engage their employees effectively.

Scope of Talent Engagement

The word Engagement has undergone a lot of transition over a period of time. Engagement of employees is not only for the existing employees but also it applies to the newly acquired talent pool. The term 'Employee Engagement' gradually evolved into a new term called 'Talent Engagement'. It is not a short-term process. It involves engaging employees from the beginning of their appointment, induction, placement, training, development, career growth and exit.

Importance of Talent Engagement in the organization

The talent engagement is primarily important for an organization for the following reasons:

Increases Employee Productivity level

Happily engaged employees put their wholehearted efforts in performing their duties and responsibilities in their workplace. This increases their emotional bonding with the firm. This will not only motivate the engaged employees but also encourages other employees to work effectively.

Reduction in Absenteeism

Employee absenteeism is a sign of the fact that probably employees are not satisfied or engaged in their workplace. Because, when an employee is not that happy with his workplace, a small reason is sufficient for him/her to remain absent. When the same workforce is effectively engaged, they feel a sense of happiness and enthusiasm about their job and love coming to the workplace daily.

Increases Creativity level and makes employees innovative

Engaged employees become innovative by nature. They get innovative ideas about their work related concepts. This gives a wide, better and innovative perspective for achievement of organizational objectives and challenges.

Employee Retention

Engaged employees are happy to work in their organizations. They do not think of changing their job as the current workplace has given them their expected growth, reward and recognition. This leads to employee retention for a long term. Thus, Talent Engagement influences the performance of the employees directly. When the employees are engaged in their jobs, it increases their productivity levels, reduces absenteeism, makes them more creative and they will be happy to work with the firm for a longer duration, thus leading to employee retention. In return, the employer should recognize, reward, award and motivate the employees to continue the same zeal in the future. On the other side, it is required for the organization to keep their employees more actively engaged. Talent Engagement is a powerful tool which creates positive experiences among the employees. These effectively engaged employees represent as brand ambassadors of the organization to the outside world. They speak favourable things about the organization and also about employers. They spread a positive note about the workplace culture in the public which attracts new talents to join the organization.



**Savitha G Pai****Steps to create the culture of Talent Engagement**

In an organization, creating a culture of talent engagement is a top-down approach. The top management must have their own strategies to introduce this culture in the organization. The following are the steps to create an employee engaged organization:

Top management should define the job roles: The management should give a clarity with respect to the definition of roles. Authority, responsibility and duties of each job position should be well defined. This ensures clarity to each and every employee with respect to their work individually and also collectively.

Provision of resources: Employees should be provided with proper resources so that they can do their work efficiently. Inadequate resources and facilities reduces the efficiency of the employees

Create an environment of open and honest communication: The organization should encourage open and honest communication between superior and subordinate frequently to boost the employee performance. A well planned training program should be conducted so as to improve the productivity level of employees.

The top performers should be recognized and rewarded: The employees performing well should be recognized first. Then they should be rewarded accordingly. This will further motivate them to work harder.

Talent in the employees should be given opportunity to grow: Organizations should plan for the professional growth of the employees in the organization. They should be guided with a clear career progression path. The employee should be able to fulfil his desire to grow professionally in the organization. That environment should be created by the firm.

REVIEW OF LITERATURE

Gitonga and Egessa(2021) The article focused on various talent engagement drivers in technical vocational training institutions, Kenya. The study was conducted to know how these drivers influenced employee productivity. Job design and leadership style are the talent engagement drivers taken for the study.

Black & Lynch (2001) The authors considered four variables for study namely organizational practices at workplace, technology usage, capital investment, human resource and employee productivity. The study relied on the data collected from Educational Quality of the Workforce National Employers Survey (EQW-NES). Cobb Douglas production function has been used in the study. The author suggested the organizations to practice appropriate human resource management strategies like employee participative decision making and incentive based rewards and recognition to enhance the productivity level of the employees. Non- managerial staff with higher education and computer knowledge led to greater plant productivity.

Belanger Jacques (2000) The article indicated that involvement of employees in the managerial activities of the organization improved their productivity and also organizational performance. A qualitative assessment was conducted. The research showed that non- managerial employees were increasingly involved in workplace decisions. The paper concluded that there was a necessity for social arrangement that enhanced trust between employer and employees. That gave mutual gains to both the parties leading to innovative and economic organizational growth.

Employee Productivity

“Employee Productivity refers to the ability of an employee to perform his duties and responsibilities effectively and efficiently with minimum time, minimum superior assistance and maximum satisfaction to his customers or clients.” Productivity has considered the efficiency of the employees. That is, how effectively they are able to perform their official work. The time taken by the employee also impacts their productivity. Longer the time duration taken by the employee to complete his tasks, lower will be his productivity. Employees should be able to do the work independently without disturbing the superiors for simple doubts. The employees should have the calibre to



**Savitha G Pai**

perform their duties with minimum assistance. Lastly, the customers or clients who are the ultimate stakeholders of any organization should be happy with the job performance of the employees.

Objectives of the Study

To know the various drivers of Talent Engagement.

To study if there is a relationship between Talent Engagement and Employee Productivity.

RESEARCH METHODOLOGY

Diagnostic research design has been adopted. Diagnostic research design is a method that diagnoses the nature of the variables and explains the relationship between the variables. The research work is focused on establishing relationship between Talent Engagement and Employee Productivity. Then researcher has tried to find a link between various components of Talent Engagement and Employee Productivity.

Sources of Data

The study is based mainly on primary data. After a thorough review of literature, questionnaire containing questions relating to the variables was drafted for the purpose of data collection. A self designed structured questionnaire based on Likert's five point scale was distributed among the employees for data collection. Apart from this, data was also collected through some books, articles of national and international journals and various websites.

Population of the Study

The population for the study includes the employees working in various sectors of the economy. The employees working in private and nationalised Commercial Banks, Educational Institutions, Hospitals, Hospitality, Information Technology and Manufacturing Sector were considered. The study considered both male and female employees with various years of work experience. The employees above the age of 22 years and till the age of 58 years were included. Employees with more than one year of experience were given questionnaire. Employees at Entry Level, Executive, Manager, Senior Manager and Team Heads were included.

Sampling Technique

Convenience sampling technique was used to select the respondents for distributing the questionnaire. Employees working in various sectors of the economy were selected randomly and given the questionnaires.

Sample Size

The sample size for the study was determined as 50. Questionnaires were distributed to employees working in various sectors of the economy say Commercial Banks, Educational Institutions, Hospitals, Hospitality, Information Technology and Manufacturing Sector randomly in various areas of Bengaluru.

Tool used for Data Collection

After a thorough review of literature, a structured questionnaire including two variables namely Talent Engagement and Employee Productivity is drafted.

Inference On the analysis of the above table, Talent Engagement achieved the overall mean score of 4.58. Career goals for the employees are set by the management achieved the highest mean score of 4.87. You are able to show excellent efficiency in your allotted job achieved the mean score of 4.81. Your job role is exciting and challenging achieved the mean score of 4.80. Company cares for your health(Both physical and mental health) achieved the mean score of 4.75. Employees are given freedom to express their ideas in the workplace achieved the mean score of 4.70. Organisation provides a platform for your career growth achieved the mean score of 4.65. Workplace environment is positive and motivating and the employee role correlates to the company's success achieved the mean score of 4.64. You are able to complete your job productively achieved the mean score of 4.62. You are



**Savitha G Pai**

able to complete your assigned job on time achieved the mean score of 4.54. You are able to involve yourself to the core for accomplishing your job related work achieved the mean score of 4.50. Your supervisor helped you to succeed in your position achieved the mean score of 4.43. You are able to do your tasks with minimum or no errors achieved the mean score of 4.36. You are recognized fairly for your contribution to team efforts achieved the mean score of 4.20. Personal goals of the employees align with the company goals achieved the mean score of 4.15.

Interpretation: The above graph clearly shows the responses of the respondents. It looks that employees are happy with their management showing genuine interest in the career goals while the employee personal goals alignment with the company goals has got the least score.

Talent Engagement and Employee Productivity

H₀: There is no significant correlation between Talent Engagement and Employee Productivity.

H₁: There is a significant correlation between Talent Engagement and Employee Productivity

Inference: The above table shows the correlation between Talent Engagement and Employee Productivity.

Talent Engagement and Employee Productivity: The significance value for Talent Engagement and Employee Productivity is less than 0.01. As such both the variables Talent Engagement and Employee Productivity are positively related at 1% level of significance. **Thus, Talent Engagement shows a significant positive correlation with Employee Productivity.**

Findings of the Study

The study reveals that when the talent of the employees is engaged in the right direction they become more productive. The productivity level of employees is directly correlated with the extent and degree of talent engagement strategy adopted by the organization. Moreover, the engaged employees work productively keeping in mind the organizational success. Employees engaged rightly work efficiently and productively leading to improved services, reduced employee turnover and increased profitability.

Suggestions

3Cs of Talent Engagement: Career, Competence and Care. An organization should provide the above mentioned C's to its employees for engaging them in the organization effectively. First of all, importance should be given to the career growth of the employees along with the organizational growth. Employee competence should be improved by providing sufficient opportunity for increasing their competency level in the organization. Training program, certification programs, online coaching, mentoring can be provided to improve the competence level of the employees. The last but not the least is the care or concern about the physical and mental wellbeing of the employees. The organization should take sufficient care in seeing to it that employees are mentally and physically fit and happy in delivering their duties and responsibilities in the organization. They are not experiencing any kind of stress or fatigue in performing their duties.

CONCLUSION

The findings of the study revealed that there is a positive relationship between Talent engagement on Employee Productivity in a business organization. The employees should be made felt to align themselves with the company goals. Their role should be correlated to the success of the company. The leader/management should show a genuine interest in the career goals of the employees. The organization should make the job role of its employees more exciting and challenging. The seniors and superiors should help the subordinates to succeed in their position. A career growth oriented workplace environment should be created in the organisation. A regime for caring about the physical and mental wellbeing of the employees should be created. A positive and motivating workplace environment should be created. Employees should be encouraged for participative decision making. They should be encouraged to contribute their ideas and opinions in their job. The employees should be fairly recognized for their





Savitha G Pai

team efforts. A support system and mentoring regime should be created to help the employees to complete their assigned job on time. They should be encouraged to show their excellent efficiency in their allotted job. They should be guided and assisted to do their tasks with zero errors. They should be trained in such a way that they are able to do their job productively. These strategies help the organization to engage their employees in an effective way leading to increased productivity level in the employees.

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Table 1: Measuring Items for Talent Engagement and Employee Productivity

Talent Engagement Drivers	N	Min	Max	Mean
Personal goals of the employees align with the company goals	50	1	5	4.15
The employee role correlates to the company's success	50	1	5	4.64
Career goals for the employees are set by the management	50	1	5	4.87
Your job role is exciting and challenging	50	1	5	4.80
Superior helps subordinate in the job process	50	1	5	4.43
Organization provides a platform for your career growth	50	1	5	4.65
Company cares for your health (Both Physical and Mental health)	50	1	5	4.75
Workplace environment is positive and motivating	50	1	5	4.64
Employees are given freedom to express their ideas in the workplace	50	1	5	4.70
You are recognized fairly for your contribution to team efforts	50	1	5	4.20
You are able to involve yourself to the core for accomplishing your job related work	50	1	5	4.50
You are able to complete your assigned job on time	50	1	5	4.54
You are able to show excellent efficiency in your allotted job	50	1	5	4.81
You are able to do your tasks with minimum or no errors	50	1	5	4.36





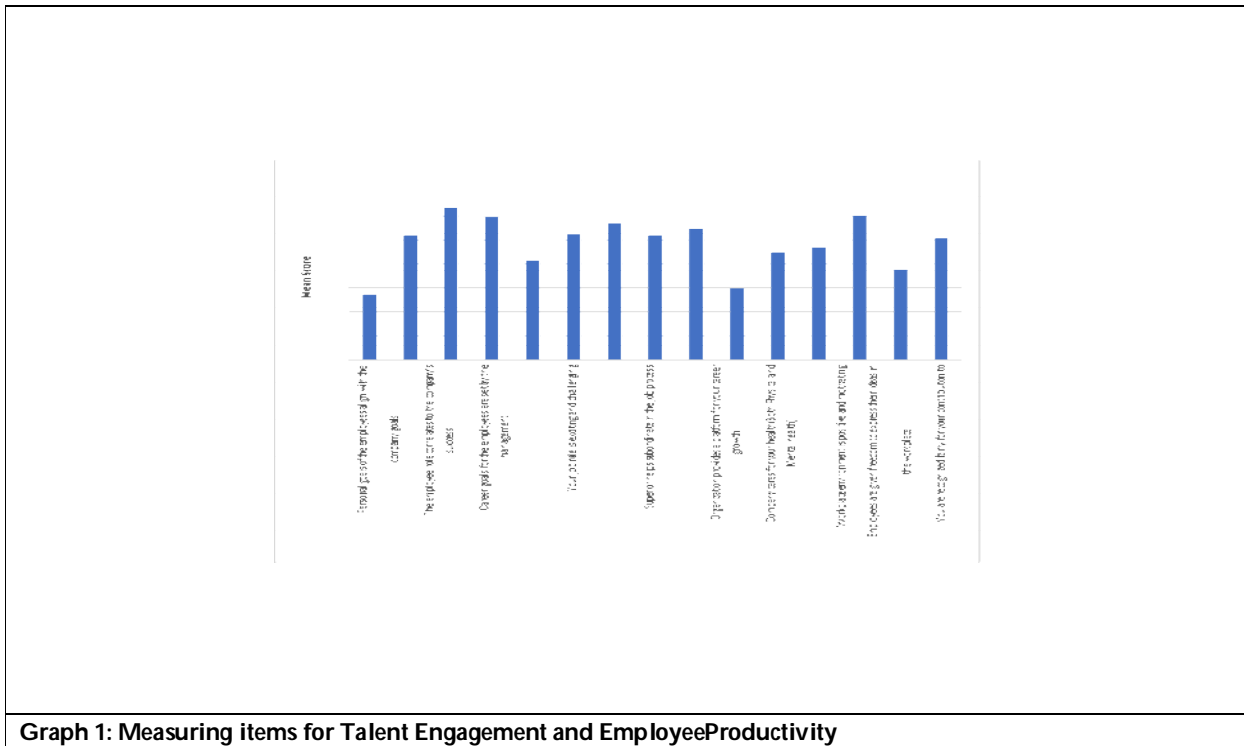
Savitha G Pai

You are able to complete your job productively	50	1	5	4.62
Talent Engagement and Employee Productivity	50	1	5	4.58

Table 2: Correlation among variables

Dimensions	Correlation	Talent	Employee Productivity
Talent Engagement	Pearson Correlation	1	.586**
	Sig. (2-tailed)		0
	N	50	50
Employee Productivity	Pearson Correlation	.586**	1
	Sig. (2-tailed)	0	
	N	50	50

** Correlation is significant at the 0.01 level (2-tailed).



Graph 1: Measuring items for Talent Engagement and Employee Productivity





An Intelligent Air Conditioner Controller using Fuzzy Inference System

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ABSTRACT

The exponential growth of cooling technology has led to air conditioning systems becoming an essential part of our daily lives. As a result, power consumption is also increasing at the same time. The air conditioning loads, which appear to be major electrical energy users in residential and commercial buildings, may result in significant increases in energy consumption. To address this issue, In this paper, a method called Air Conditioning Fuzzy Inference System (ACFIS) has been proposed using a fuzzy controller which is applied to a mathematical model of an air conditioning load with various membership functions (MFs) and membership function numbers. The ACFIS controller has an adaptive nature to regulate the humidity and temperature of the room using mode control for various seasons, which results in less energy consumption. In the proposed ACFIS, the mode, temperature, and humidity of the room are taken as input factors and the system produces power as output. The suggested system has been assessed using different values and contrasted with other existing systems. The simulation results demonstrate that our suggested method outperforms other current systems.

Keywords: Fuzzy Inference System, Air Conditioner, Fuzzy logic, Membership function, temperature control, humidity

INTRODUCTION

The fundamental goal of power system operation is to ensure reliability by maintaining a strict balance between generation and demand. A system operator (SO) is in charge of supplying the load demand through generation scheduling. However, this technique occasionally causes uncertainties in power generation, and the operation may become costly as power generation costs rise. Numerous techniques are presented in the literature to reduce the



**Logambigai et al.,**

power consumption of major electrical loads. Importantly, air conditioning loads dominate the overall shape or pattern of the electrical load curve in a domestic load profile.

Various researchers have attempted to develop direct load control for improving the energy consumption of major energy-consuming loads such as air conditioners, Heating, Ventilation, and Air Conditioning (HVAC), etc. In this regard, there are many control methods reported in the literature, including proportional integral derivative, proportional integral, proportional derivative, adaptive, linear quadratic regulator controller, nonlinear, or fuzzy controllers. These controllers require more time to achieve the desired results in terms of room temperature and humidity, but sometimes human thermal comfort gets disturbed due to the requirement of an ambitious performance from the controller. Thus, there is room for developing a controller with the capability to optimize load management without compromising human comfort. Many authors hypothesized that a fuzzy logic-based controller might be more successful at regulating the power consumption of a load in a desired manner, i.e., energy consumption is enhanced without compromising consumer comfort. Mapping a given input to an output using fuzzy logic is known as fuzzy inference. It involves pieces discussed in fuzzy logic, membership functions, IF-THEN rules, etc. Fuzzy inference systems have been successfully applied in various fields such as automatic control, data classification, decision analysis, expert systems, computer vision, etc. Fuzzification helps convert crisp numbers into fuzzy sets. The inference engine helps determine the degree of match between fuzzy input and the rules. Based on the percentage match, it determines which needs to be implemented according to the given input field.

A typical Fuzzy Logic System (FLS) is shown in Figure 1. FLS predicts approximate results by converting linguistic rules based on an expert's choice when the data is vague. No mathematical model is required to implement FLS, and it may be implemented easily. Fuzzy controller techniques for an air conditioning load have been suggested by numerous authors in the literature. The majority of the proposed techniques are based on fuzzy rule formation. Generally, fuzzy controllers are implemented without considering external parameters and thermal noises affecting the performance of an air conditioning load. As far as power consumption is concerned, most of the papers are based on the implementation of fuzzy controllers only. In a few papers, energy consumption is calculated using mathematical equations or measured after practical implementation with limited features of the controller. Designing a Fuzzy Logic Controller (FLC) and applying it to a mathematical model of a single air conditioning load is the goal of this paper. The designed fuzzy controller (ACFIS) effectively deals with the load consisting of indoor and outdoor parameters in the presence of thermal disturbance, which has not been reported in the literature. Fuzzy rules are based on the user's choice and comfort. FLC is implemented with triangular membership functions using different modes.

Related Works

Zeeshan Ali Shah *et al.* [1] proposed that air conditioning load systems use a fuzzy inference system to design a controller that achieves the required temperature and humidity ratio in order to minimize energy consumption and improve human comfort, despite the fact that a large amount of literature has been published dealing with fuzzy approaches in pattern recognition, cluster analysis, and similar issues. a greater variety of triangle membership operations. The Authors [2] successfully designed and implemented fuzzy logic based on a microcontroller into a microcontroller for controlling the temperature and humidity of the server room. Sobhyand other authors [3] predicted a revolutionary HVAC system's temperature, humidity ratio, and CO₂ concentration-sensitive modeling and control method. Innovative HVAC systems may be developed with linear controllers, pole placement, and Linear Quadratic Regulator (LQR) to stabilize and improve control performance. According to the authors, intended energy consumption is computed using mathematical calculations or monitored after actual implementation using the restricted characteristics of their controller. Chang-Soon Kang *et al.* [4] suggested that the linearized HVAC system might be controlled at the proper set point by employing pole placement and LQR controllers, two different forms of linear controllers.

K. Kee, A. E. Robin, and W. K. Pao [5] developed a load scheduling system for daily-used loads, whereas load curtailment is employed for seasonal loads, such as air conditioning systems, utilizing fuzzy logic. Fanger's model





Logambigai et al.,

and predictive mean vote are used to create air conditioning loads that employ fuzzy rules to manage the temperature. The authors [6] suggested a controller in which fuzzy rules are implemented on the Very Large-Scale Integration (VLSI) chip using the Very high-speed integrated circuit Hardware Description Language (VHDL) from the electronic design automation (EDA) tool to achieve the required temperature and humidity. Y. Yuu and C. Chang [7] state that both a fuzzy logic controller and an air conditioning load are tested. The superiority of fuzzy controllers in terms of performance can be seen in a comparison between ON/OFF and fuzzy controllers.

According to Wang and Lee [8], fuzzy controllers are 1.3 times more effective at regulating the speed of fans and compressors than conventional controllers. The authors' [9] approach to reducing energy usage and expenditures at consumers' homes while maintaining their comfort. When renewable energy sources and energy storage are used, the simulation results show a net savings of 28% with a fuzzy controller, 49% in energy consumption, and 52% in cost. Zadeh *et al.* [10] proposed a modified set theory approach wherein an individual's degree of membership value may range over a continuum grade of values between 0 and 1, as opposed to being exactly 0 or 1. In addition, the authors demonstrated how basic set operations like union and intersection are defined on these "fuzzy sets" and created a unified framework tool to address such issues. His approach makes it possible to consistently and reasonably intuitively manipulate fuzzy sets.

Kandel and others [11] In order to simulate human-centered systems, Zadeh and a few other academics created a fuzzy theoretical approach. Since then, they have used this theory in a variety of scientific and technical fields. It may be possible to get some insight into the general issue of decision-making and fuzzy processes in general from this application of fuzzy sets in pattern recognition and classification. Authors in [12] have created a smart system to analyze the automation of cooling systems for smart buildings using fuzzy logic rules for various parameters of temperature and relative humidity to regulate the air quality and energy use. In [13], authors used fuzzy logic to regulate the HVAC system's set point temperature in order to reduce energy use and costs at customers' locations without compromising the customers' comfort. The authors of [14] created and implemented a fuzzy rule-based controller that can adjust the resistance of ventilation openings in order to minimize deviations from the desired comfort conditions. A novel HVAC control method that is based on the concept of thermal comfort was presented in [15]. The objective of their suggested HVAC control strategy is to maintain consistent indoor thermal comfort. Fuzzy logic was used by authors in [16] and [17] to improve the autonomous room cooling system.

System Model

The temperature and humidity ratio are states that are taken into account in the mathematical model of a traditional HVAC system. Energy conservation principles can be used to derive the various equations [19]-[21] describing the dynamic behavior of the HVAC system are given by equations (1), (2) and (3).

$$T_3 \dot{} = \frac{f}{V_s} (T_2 - T_3) - \frac{hfgf}{CpV_s} (W_s - W_3) + \frac{1}{0.25CpV_s} (Q_o - hfgMo) \quad (1)$$

$$W_3 \dot{} = \frac{f}{V_s} (T_2 - T_3) + \frac{Mo}{\rho V_s} \quad (2)$$

$$T_2 \dot{} = \frac{f}{V_{he}} (T_3 - T_2) + \frac{0.25f}{V_{he}} (T_o - T_3) - \frac{fh_e}{CpV_{he}} ((0.25W_o + 0.75W_3) - W_s) - 6000 \frac{gpm}{\rho CpV_{he}} \quad (3)$$

where

- T_3 - Room temperature
- W_3 - Room humidity ratio
- T_2 - Temperature of supply air
- W_s - Supply air humidity ratio
- T_o - Outdoor air temperature
- W_o - Humidity ratio of outdoor air





Logambigai et al.,

- V_{he} - Heat-exchanger volume
- C_p - Air speci_c heat
- Q_o - Sensible heat load
- V_s - Thermal space volume
- gpm - Gallons per minute
- hw - Liquid water enthalpy
- hfg - Water vapor enthalpy
- ρ - Air mass density

The dynamic system given by the above equations can be converted into state variable form for the purpose of control. Let,

- $u_1 = cfm = f; u_2 = gpm;$
- $x_1 = Room\ Temperature = T_3;$
- $x_2 = Room\ Humidity\ ratio = W_3;$
- $x_3 = Supply\ air\ temperature = T_2;$

$$y_1 = T_3; y_2 = W_3$$

and defining the following parameters

$$\alpha_1 = \frac{1}{V_s}; \alpha_2 = \frac{hfgf}{CpV_s}; \alpha_3 = \frac{1}{\rho CpV_s}; \alpha_4 = \frac{1}{\rho V_s};$$

$$\beta_1 = \frac{1}{V_{he}}; \beta_2 = \frac{1}{\rho CpV_{he}}; \beta_3 = \frac{h_w}{CpV_{he}}$$

The new equations are given in equation (4), (5) and (6)

$$x_1' = u_1\alpha_1 60(x_3 - x_1) - u_1\alpha_2 60(W_s - x_2) + \alpha_3(Q_o - hfgMo)(4)$$

$$x_2' = u_1\alpha_1 60(W_s - x_2) + \alpha_4 Mo(5)$$

$$x_3' = u_1\beta_1 60(x_1 - x_3) + u_1\beta_1 15(T_o - x_1) - u_1\beta_3 60((0.25W_o + 0.75x_2) - W_s) - 6000u_2\beta_2(6)$$

Its inputs are the volumetric air flow rate and the chilled water flow rate, and its outputs are the thermal space's temperature and humidity ratio. All internal and external parameters are included in the system model.

PROPOSED METHODOLOGY

In this proposed work, the fuzzy rules are generated to control the air conditioning system. Fuzzy rules are generated based on the user's preference for thermal comfort, with temperature, humidity error, and various modes as inputs. In this proposed work, a new parameter mode is added as an input to the fuzzy inference system.

The proposed ACFIS model is given in Figure 2. The proposed system selects a temperature and humidity setting, as well as an appropriate operation mode based on the room temperature and humidity detected by an AC sensor (dry, cool, or heat). The Sensors are working efficiently and smoothly to improve and maintain indoor air quality while also slowing virus transmission through the HVAC system. In the proposed work temperature and humidity sensors are used to automatically choose the mode setting in the ACFIS system model. Temperature sensors monitor the temperature of the water and the air, and they change the heating and cooling system to raise or lower the air temperature in accordance with the preprogrammed set point. This saves energy. Additionally, humidity sensors pick up on changes in the air's temperature or electrical currents. Electronic devices known as humidity sensors monitor and record the humidity and air temperature in the environment in which they are installed.





Logambigai et al.,

SIMULATION RESULTS AND DISCUSSIONS

The proposed ACFIS controller is implemented using the data [20] given in Table 1. The fuzzy inference system in the proposed ACFIS takes three factors as its inputs namely, mode, temperature and humidity. The membership values for the input parameters are as follows.

Mode – dry, cool and heat

Temperature – Low, Medium, and High

Humidity – Low, Medium and High

For the output variable power, three linguistic variables namely Less, Medium, and High have been considered. For fuzzification process, the trapezoidal and triangular membership functions are used. The trapezoidal membership function is used for the boundary variables and triangular membership function is used for the intermediate variables. The trapezoidal and triangular membership functions are given in equations (7) and (8).

$$\mu_{Tri}(x) = \begin{cases} 0 & x \leq a1 \\ \frac{x-a1}{b1-a1} & a1 \leq x \leq b1 \\ \frac{c1-x}{c1-b1} & b1 \leq x \leq c1 \\ 0 & c1 \leq x \end{cases} \quad (7)$$

(or)

$$f(x; a, b, c) = \max\left(\min\left(\frac{x-a}{b-a}, \frac{c-x}{c-b}\right), 0\right)$$

$$\mu_{Trap}(x) = \begin{cases} 0, & x \leq a2 \\ \frac{x-a2}{b2-a2}, & a2 \leq x \leq b2 \\ 1, & b2 \leq x \leq c2 \\ \frac{d2-x}{d2-c2}, & c2 \leq x \leq d2 \\ 0, & d2 \leq x \end{cases} \quad (8)$$

(or)

$$f(x; a, b, c, d) = \max\left(\min\left(\frac{x-a}{b-a}, 1, \frac{d-x}{d-c}\right), 0\right)$$

The membership functions for the input and output linguistic variables are given in Figure 3 & Figure 4. The input parameter mode for its each input such as dry, cool and heat, are explained in detail as follows:

Mode - Dry

If the room is humid, sticky, and not very warm, use Dry Mode. When switching the air conditioner to dry mode, the unit will record the room temperature and decide at what temperature it will cycle off. FIS takes dry mode, room temperature and humidity as its input and then it regulates the temperature of the room (return air) and the cooling coil (heat exchanger) and controls the compressor speed as its output. Dry mode removes excess humidity from your room by cycling the compressor on and off for brief periods of time. Meanwhile, the fan is always running at a low speed. When the ACFIS's internal humidity sensor detects a low enough humidity level, the compressor runtime is adjusted so that it is turned off. The Fuzzy rules of the proposed system in dry mode are given in Table 2.

Mode - Cool

The cool mode is used if the room is hot. The ideal temperature for air conditioning is 25 degrees Celsius, but this option starts the AC at 16 or 18 degrees Celsius. If the room temperature is 35 degrees, the time it takes to reach 25 degrees in cool mode will be the same. The proposed ACFIS with the cool mode turns on the compressor and spreads cold air across the space. Only the fan continues to run after the compressor shuts off when the internal





Logambigai et al.,

temperature sensor in the air conditioner determines that the target temperature has been attained. The Fuzzy rules of the proposed system in dry mode are given in Table 2.

Mode - Hot

The heat mode is used when the room is cold and needs heating inside. This setting reverses the airflow within the air conditioner. This indicates that hot air is injected into the space rather than being blown out onto the surroundings. However, cold air is discharged from the outside. The heated air is provided by a compressor that is already in operation. The compressor now produces warm air instead of cold air, which makes it perfect for the winter months. The proposed ACFIS with the Heat mode, and temperature and humidity values it regulates the compressor speed which in turn increases or decreases the energy consumption. The fuzzy rules for the proposed ACFIS in heat mode is given in Table 4.

Energy Consumption Calculation

To determine how the controller affects the load, the energy consumption for the ACFIS load is computed using equation (9).

$$\text{Annual Energy} = \frac{\text{Capacity} * \text{Operating Time}}{\text{EER}} \#(9)$$

Where EER – Energy Efficiency Ratio

Consider the following ACFIS system characteristics are leveraged to determine energy consumption

Capacity = 340650.78 Btu hr

Energy efficiency ratio EER = 11.4

Operating time in a year = 1500hrs

The amount of energy consumed by a conventional power system is 4482kWh.

Conventional loads maximize 4482 kWh of energy throughout the year. The air conditioning load is on for 80% of the time. The air-conditioning system's total operational hours are

$$\frac{80}{100} * 1500 = 1200\text{hrs.}$$

Following the introduction of the ACFIS controller, the average annual energy consumption of the air conditioning load has been estimated to be 3585 kWh, which is 25% less than the usage prior to the controller's physical exertion. ACFIS controller that maintains indoor thermal settings while navigating with thermal disturbances is laid out and the fuzzy rules are based on human comfort preferences, producing outstanding results. To get an efficient outcome in energy consumption, many modes are employed as membership functions.

A fuzzy controller is presented that maintains indoor thermal conditions while dealing with thermal disturbances, and the fuzzy rules are based on human comfort preferences, yielding excellent results. Different modes are used as membership functions to achieve an efficient result in energy consumption.

Temperature and humidity ratio are used as inputs in the proposed system model with a fuzzy controller and triangular membership function in different modes. During the winter, when the humidity is high and the temperature is low, it is preferable to use the dry and heat mode.

The performance of the present ACFIS controller is compared with that of the conventional technique, which is a fuzzy controller. To achieve the appropriate set points, this linearized load model is regulated by a fuzzy controller. A fuzzy controller desires to optimize performance while enhancing thermal comfort for users. Although fuzzy controllers are easy to use and reasonably priced, they require maintenance, which drives up their long-term cost. This work presents an ACFIS controller that keeps the user's selected level of thermal comfort, together with inputs for temperature error, humidity error, and mode, which act as a core component for the development of fuzzy rules. According to the results shown in Figure 5 and Figure 6, the existing work fuzzy controller is still unable to achieve the desired performance when implemented with an increased number of Member Functions. There is an error in estimating the temperature and humidity ratio. The ACFIS controller, however, can maintain the desired results with an error in the temperature and humidity ratios of approximately less than with the help of different modes. Utilizing the developed controller results in a decrease in energy usage. By comparing the ACFIS controller to the existing work fuzzy controller, it is evident from the results that the ACFIS controller produces the desired outcomes.





Logambigai et al.,

CONCLUSION

In this paper, a fuzzy controller called an Air Conditioning Fuzzy Inference System has been proposed which is applied to a mathematical model of an air conditioning load with various membership functions (MFs) and membership function numbers. The ACFIS controller has an adaptive nature to regulate the humidity and temperature of the room using mode control for various seasons, which results in less energy consumption. The developed Fuzzy logic controller is very effective at maintaining consumer comfort while saving a significant amount of energy. The main contribution is the design and implementation of a fuzzy controller with triangular membership functions on a mathematical model of an air conditioning load with various modes of control. The designed controller uses a sensor in the HVAC system to control the different modes based on room temperature and humidity. The ACFIS produces better results when used with appropriate modes for summer and winter to reduce energy consumption while maintaining human thermal comfort. Considering the existing temperature and humidity of the room, the proposed system achieves a better control performance. Therefore, the efficiency of the system can be improved easily by manipulating the parameters of the intelligent air-conditioning system.

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Table 1. Numerical Values and equilibrium conditions

Parameters	Value	Parameters	Value
T_{2ref}	(13°C)55°F	W_s	$0.007 \frac{lb}{lb}$
T_o^e	(29°C)85°F	W_o^e	$0.018 \frac{lb}{lb}$
V_{he}	$65.75 ft^3$	C_p	$0.24 \frac{Btu}{lb \cdot ^\circ F}$
M_o^e	$166.06 \frac{lb}{hr}$	Q_o^e	289897.52
V_s	$58464 ft^3$	f^e	17000 <i>cfm</i>
ρ	$0.074 \frac{lb}{ft^3}$	gpm^e	58 <i>gpm</i>
h_w	$23 \frac{Btu}{lb}$	h_{fg}	$1087.1 \frac{Btu}{lb}$

Table 2: Fuzzy Rules in Dry mode

	Mode	Temperature	Humidity	Power
1	Dry	L	L	High
2	Dry	L	M	Medium
3	Dry	L	H	Less
4	Dry	M	L	High
5	Dry	M	M	High
6	Dry	M	H	Medium
7	Dry	H	L	High
8	Dry	H	M	Medium
9	Dry	H	H	Less

Table3: Fuzzy Rules in Cool mode

	Mode	Temperature	Humidity	Power
1	Cool	L	L	High
2	Cool	L	M	High



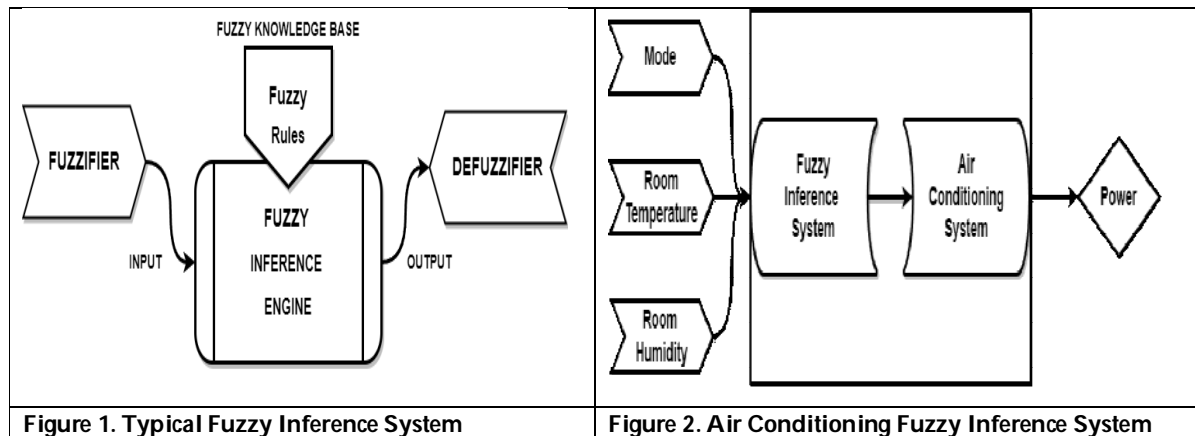


Logambigai et al.,

3	Cool	L	H	High
4	Cool	M	L	High
5	Cool	M	M	Medium
6	Cool	M	H	Medium
7	Cool	H	L	Medium
8	Cool	H	M	Less
9	Cool	H	H	Less

Table 4: Fuzzy Rules in Heat mode

	Mode	Temperature	Humidity	Power
1	Heat	L	L	High
2	Heat	L	M	High
3	Heat	L	H	Medium
4	Heat	M	L	Medium
5	Heat	M	M	Less
6	Heat	M	H	Less
7	Heat	H	L	High
8	Heat	H	M	High
9	Heat	H </td <td>H</td> <td>High</td>	H	High



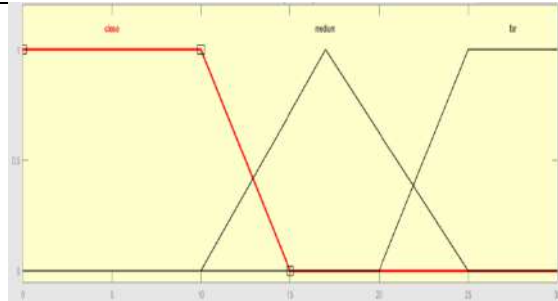
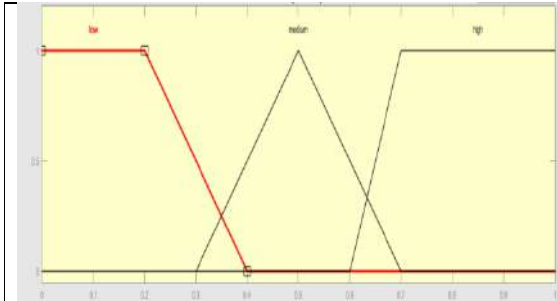


Figure 3 Linguistic values for Temperature

Figure 4 Linguistic values for Humidity

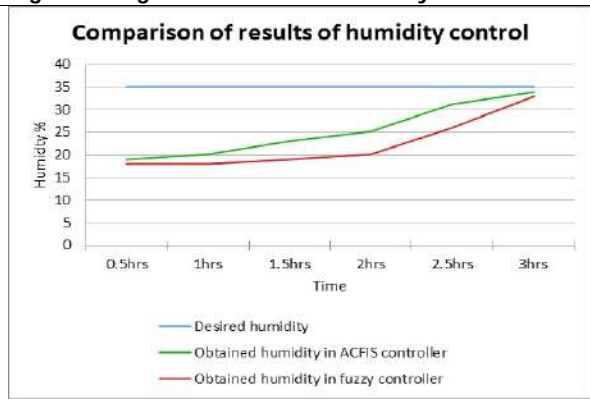
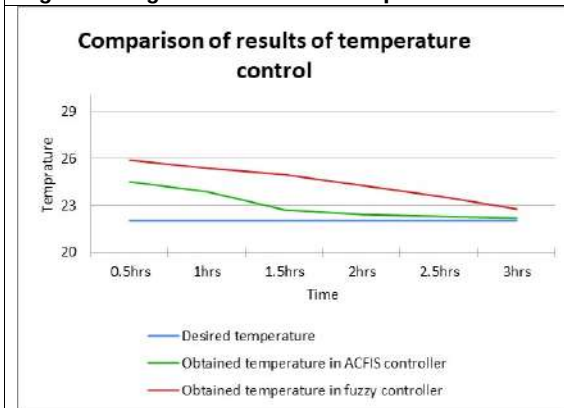


Figure 5. Temperature control over Time

Figure 6. Humidity control over Time





Green Synthesis and Characterization of *Amaranthus spinosus* and to Analyse it's Antimicrobial Activity

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ABSTRACT

The plant *Amaranthus spinosus* Linn. (Family Amaranthaceae), also called "spiny amaranth" or "pig weed," is well-known for its healing properties. In this paper, we talk about making silver nanoparticles from the herb *Amaranthus spinosus*, which has medical uses (AgNPs). For this study, an aqueous leaf extract from *Amaranthus spinosus* is used. Aqueous extracts were used to make silver nanoparticles with the help of a scanning electron microscope, FTIR analysis, X-ray diffraction research, and a UV-visible spectrophotometer. The UV-Vis analysis of the surface plasmon resonance property of the colloidal solution showed that AgNPs had been made. Using X-ray diffraction (XRD), it was found that AgNPs are crystalline and have an average size of 10.74 nm, which is based on the Debye-Equation. Scherrer's. Fourier transform infrared (FT-IR) analysis was done on lyophilized AgNPs and leaf extract to show the presence of different functional groups found in different phytochemicals. After more testing, it was found that the AgNPs made were safe for cancer cell lines and could be used in biomedical settings. The green nanoparticles that were made worked well against many different kinds of bacteria. The goal of this work was to look at all the studies that have been done and are being done on the plant so that it can be used as a medicine as much as possible in the near future. *Amaranthus spinosus* Linn. is a great food because it has a lot of nutrients. Also, research is needed to get the most benefit for the good of all people. (1)

Keywords: Characterisation studies; Silver nanoparticles; *Amaranthus spinosus*; Medicinal plant; Antimicrobial activity.





INTRODUCTION

People have used plants to treat many diseases for a long time and even today. India has 47,000 types of plants, and 15,000 of them are thought to be good for health. In India, a lot of people use these plants as medicines in primary health care. People also say that in India, these herbs have been used to treat and cure a lot of different diseases [2]. Since the beginning of civilization, people have used medicinal plants as a part of their society to fight disease. Medicinal plants can be a good source of chemical compounds that haven't been found yet but may have health benefits. Minerals, plants, and animals were the main sources of medicines for a long time. They were both important medicines and important raw materials for making both traditional and modern medicines. Even though medicine has gotten better and more complex over the years, medicinal plants are still an important part of treating illness [3]. There are a lot of species of plants that have healing properties that haven't been found yet. Every day, a huge number of plants are looked at to see if they could be used as medicines. Herbal medicines have been used for a long time because of their health benefits. This has been roughly realised since local knowledge systems regarding medicinal plants are accessible to about 65% of the world's population. India has a lot of knowledge about herbal medicine that has been recorded over time and is widely used. India is home to 45,000 officially recognised plant species, and it is thought that 7500 types of medicinal plants grow in the country's 16 agroclimatic zones and on the country's 63.7 million hectares of forested land [4].

Amaranthus spinosus is a perennial herb that grows upright, is monoecious, can be up to 100–130 cm tall, has many branches, can be smooth or have a few hairs, and is usually green but can also be purple. The blades are whole, glabrous or slightly hairy on the veins when they are young, ovate-lanceolate to rhomboid, 3.5–11 cm–4.5 cm long, acute and often slightly decurrent at the base, obtuse, rounded or slightly retuse, and often short-mucronate at the tip. The leaves don't have stipules, and they change places and are simple [5]. The inflorescence is made up of dense clusters of flowers. The higher clusters are usually grouped together in an axillary and terminal spike that often splits at the bottom. The clusters at the bottom are axillary. Most of the time, the bottom clusters have 2 cm long, very sharp spines. The bracts and bracteoles are thin, hairy, and shorter than or the same length as the perianth. It has single, unisexual flowers that are held up by two bracteoles in the axil of a bract. Male flowers usually have a spike at the top of the inflorescence, are green, and have five stamens that are about the same length as the tepals. The margins of the male flowers are ovate-oblong to oblong-spatulate, free, subequal, up to 2.5 mm long, very convex. Female flowers have two to three styles, a recurved ovary at the end, and a single-celled, oblong ovary on top [6].

AgNPs can be made in many ways, including through chemical, physical, and biological processes. Also, AgNPs can be made in a way that doesn't hurt the environment. This has advantages since it makes things easier, costs less money, and assures that the procedure is safe for both human and animal health. In general, bacteria [8,21,22], fungi [23], algae [24], or plants [25] are intracellular or extracellular sources for the reduction of Ag⁺ to Ag⁰, which helps in the "green" synthesis of AgNPs (which are currently employed extensively). The three primary elements of the bio-reduction mechanism are the reduction and nucleation of silver ions, the growth phase and aggregation, and the capping and stabilisation in the final phase. Sugars, proteins, phenolic acids, ketones, terpenoids, amides, and polyphenols are just a few examples of the phytochemicals, sometimes referred to as secondary metabolites, that play vital roles in plants. Both a stabilising and a capping agent are typically provided by a reducing agent made from a plant extract [7]. *Amaranthus spinosus*, a plant with significant therapeutic value, was used in the current research to create green nanoparticles. After being characterised, these nanoparticles created by green technology were tested for antimicrobial properties. (8)





Megala et al.,

MATERIALS AND METHODS

Collection of Plant Material

The leaves of *Amaranthus spinosus* were picked up in the area. A sheet for the herbarium was made. The leaves were dried in the shade and then put through a grinder to make a coarse powder.(9)

Preparation of Extract

The powdered leaves of *Amaranthus spinosus* were subjected to soxhlet extraction (Continuous Hot Extraction) using Ethanol as solvent.

Materials

The chemical silver nitrate (AgNO₃) was purchased from SD Fine Chemical Pvt. Ltd., Mumbai. Purchased from HiMedia Laboratories Pvt. Ltd., Mumbai Green synthesis of silver nanoparticles.(10)

Test microorganisms

Clinical isolates of *Staphylococcus aureus*, *Salmonella paratyphi*, *Escherichia coli*, *Bacillus subtilis*, *Streptococcus pyogenes*, and *Klebsiella pneumoniae* were employed as the test organisms. They came from the Bharathiar University in Coimbatore's Department of Microbiology. The bacterial and fungal cultures were maintained on nutritional agar medium and potato dextrose agar (PDA) medium, respectively.(11)

Biosynthesis of silver nanoparticles

Silver nanoparticles were created using extracts from the leaves of *Amaranthus spinosus* in an aqueous solution of silver nitrate (AgNO₃) with a concentration of 0.001M. Ag ions were produced by stirring and adding 950 mL of an aqueous solution of 0.001M AgNO₃ to an aqueous extract of leaves from *Amaranthus spinosus*. A dark brown colour was visible after 1 hour of room temperature incubation, and lambda max was discovered using UV-Visible spectroscopy (JASCO V-670). The silver nanoparticles were then separated from the other bioorganic chemicals in the reaction media by spinning the silver nanoparticle solution at 5,000 rpm for 20 minutes. The resulting particles underwent centrifugation, cleaning in distilled water for ten to fifteen minutes, and drying for two hours in a hot air oven at 70°C.(12)

Characterization techniques

UV-Visible spectroscopy

After 24 hours of letting the solution sit at room temperature, the colour changed, showing that silver particles had formed. A surface plasmon resonance band was found with the help of a UV-Visible spectrophotometer (JASCO, V-670) that worked from 300 to 700 nm and had a resolution of 1 nm.(13)

FTIR analysis

IR-Affinity-1, Shimadzu, and FTIR Spectrometer were used to get the Fourier transform infrared (FTIR) spectra for leaf extract and AgNPs in the range of 4000–500 cm.(14)

X-ray Diffraction spectrum

X-X'Pert Pro X-ray diffractometer (PAN analytical BV, The Netherlands) fitted with Cu/K radiation source and Ni as filter was used to evaluate the ray diffraction (XRD) of the green generated utilising *Amaranthus spinosus* aqueous leaf extract reduced silver particles. All X-ray diffraction data were gathered in the standard angular range under experimental circumstances. The crystalline silver nanoparticle was calculated from the width of the XRD peaks, using a Debye-Scherrer formula,

$$D = \frac{0.94\lambda}{\beta \cos\theta}$$

Where,



**Megala et al.,**

D is the average crystallite domain size perpendicular to the reflecting planes, λ is the X ray wave length, β is the full width at half maximum and θ is the diffraction angle.

Scanning Electron Microscopy with Energy-dispersive X-ray (EDX) analysis

Rotating at 5,000 rpm for 20 minutes separated each colloidal solution containing silver nanoparticles created from an aqueous leaf extract of *Amaranthus spinosus*. In order to dissolve the pellets, 1000 L of deionized water was added after the supernatants were removed and discarded. The pellet was thoroughly combined, placed gently on a glass cover slip, and allowed to air dry. The cover slip itself was used in the study, which was done with scanning electron microscopy (SEM). A scanning electron microscope was used to take pictures of silver nanoparticles (Fb-Quanta 200 SEM machine). The pictures themselves had information about the voltage used, the magnification, and the size of the things in the pictures.(15)

An x-ray technique called EDS, also referred to as energy-dispersive X-ray (EDX) analysis, and is used to ascertain the elemental makeup of materials. *Amaranthus spinosus* was used to create silver nanoparticles using the bio reduction process, and EDX spectroscopy was used to validate the existence of silver in the particles as well as to determine any other elementary components.(16)

Growth and Maintenance of Test Microorganism for Antimicrobial Studies

The bacterial and fungi cultures were kept in nutrient broth (NB) at 37 degrees Celsius and in potato dextrose agar (PDA) at 28 degrees Celsius, respectively.

Preparation of Inoculum

Gram-positive bacteria *Staphylococcus aureus*, *Bacillus subtilis*, and *Streptococcus pyogenes* were cultivated in nutritional broth at 37°C for one night with gram-negative bacteria *E. coli*, *Klebsiella pneumonia*, and *Salmonella paratyphi*. After placing the pellet in double-distilled water, a spectrophotometer was used to measure the cell density (A610 nm). The 5- to 10-day-old culture that was cultivated on Potato dextrose agar medium was used to create the fungus inoculums. *Aspergillus fumigatus*, *Candida albicans*, *Trichoderma viride*, and *Fusarium Sp.* were all present. The conidia were removed from the Petri dishes with a clean spatula after 8 to 10 ml of distilled water had been added. Using an A595nm spectrophotometer, the number of spores in each fungus was changed so that the final concentration was about 105 spores/ml.(17)

Antimicrobial Activity

We tested the samples using the well diffusion method. By adding methanol to the extracts again, different concentrations of 10, 20, and 30 g/ml were made. After 24 hours of growth in nutrient broth, 10 l (10 cells/ml) of the test microorganisms were planted in the right medium using the spread plate method. After the extract-soaked filter paper wells (5 mm in diameter) hardened, they were put on plates with test organisms. 10 g of penicillin is used as a test standard for antibacterials. At 37 °C, the antibacterial assay plates were left to sit for 24 hours. The size of the inhibitory zones was given in millimetres.(18)

RESULTS AND DISCUSSION**Visual observation**

Researchers were able to see the formation of silver nanoparticles utilising the extract of *Amaranthus spinosus* due to the noticeable colour change that occurred after adding leaf extract to an aqueous silver nitrate solution for a period of time. We determined how much extract would be required to turn AgNO₃ (1 mM, 10 ml) into Ag nanoparticles. (19)



**Megala et al.,****UV-Visible spectroscopy**

One of the primary methods for analysing the surface plasmon band of metal nanoparticles created in aqueous solutions is UV-Visible absorption spectroscopy. Figure 1 shows the UV-visible spectrum of biosynthesized silver nanoparticles made from plant extract (2). The Miescattering effect was responsible for the characteristic SPR peak of colloidal Ag nanoparticles, which is 420 nm in size [18]. Since silver nanoparticles were formed, the resultant SPR peak is unambiguous. Maximum absorption at 414 nm determined the ideal volume of extract required for the reduction to be 2 ml. (20)

The reduction of aqueous metal ions following treatment with *Amaranthus spinosus* leaf extract was seen using UV-visible spectroscopy, which was used to gather more knowledge about silver nanoparticles (Figure 1). The characteristic surface plasmon resonance (SPR) is seen in the UV-visible absorption spectra of silver nanoparticles with an absorbance of roughly 350-450 nm and peak maxima of 410 nm, which is indicative of the existence of silver nanoparticles. The plasmon band's almost symmetrical structure indicates that the nanoparticles are not homogeneous and are not dispersed evenly. The significant absorption peak seen at longer wavelengths is caused by the non-uniformity of the silver nanoparticle. The size, shape, and capping agent of a particle all have an impact on where the SPR band is located. (21)

FTIR analysis

Figure 2 shows the FTIR spectra of silver nanoparticles and aqueous leaf extracts from *A. spinosus*. In the former, numerous functional groups showed unique bands. At 3383, 2918, 2850, 2117, 1623, 1395, 1316, 1242, and 1014 cm⁻¹, IR bands were detected. Hydroxyl (-OH) and primary amine salt (-NH₃⁺) are represented by the bands at 3383 cm⁻¹ and 2918 cm⁻¹, respectively. The bands at 2850cm⁻¹ are caused by aromatic -CH₂. The symmetrical bending of the -C(CH₃)₃ and CH symmetric rocks is what causes the 1395cm⁻¹ and 1316cm⁻¹IR bands, respectively. IR bands at 1623 cm⁻¹ and 1242 cm⁻¹ showed amide III bonds with an N-H bend, while the band at 1014 cm⁻¹ showed an aliphatic amine. (22)

Scanning Electron Microscopy with Energy-dispersive X-ray (EDX) analysis

The EDX spot profile(Figure 3) of AgNPs showed a substantial signal for silver at 3KeV along with modest oxygen, carbon, aluminium, phosphorus, calcium, and potassium peaks, indicating that they are sourced from biomolecules bound to the surface of the AgNPs. Figure 3 shows the EDX profile of silver nanoparticles produced using *A. Spinosus aqueous* leaf extract. Characterization of the Electrochemical Spinosus. AgNPA (a) (23)

Under a high resolution microscope, silver nanoparticles have the morphology of tightly packed, strongly aggregated spherical particles. The significant aggregation of biosynthesized AgNPs may have resulted from the dehydration employed to prepare the sample for SEM analysis. (24)

ANTIMICROBIAL ACTIVITY

The six clinically significant pathogens tested for antimicrobial activity of the produced AgNPs from the plant extracts were *Staphylococcus aureus*, *Salmonella enterica*, *Klebsiella pneumonia*, *E. coli*, *Bacillus*, and *Streptococcus*. The six bacterial cultures were cultivated for 24 hours at 37°C in Muller Hinton agar petriplates with varying quantities of silver nanoparticles that contained 20, 40, 60, and 80ul(19). The creation of a zone in the petriplates after incubation served as a gauge for the antibacterial effect. Biosynthesised silver nanoparticles were compared to leaf extract and chemically produced silver nanoparticles for

CONCLUSION

In recent years, interest in medicinal plants has grown significantly on a global scale. A significant therapeutic plant with a broad pharmacological spectrum is *Amaranthus spinosus* Linn. Many pharmacological research using extracts from the various plant sections have been done. The plant is widely used in India's traditional medical system and





Megala et al.,

has been shown to have anti-diabetic, antipyretic, anti-inflammatory, antioxidant, hepatoprotective, antimalarial, antibacterial, antimicrobial, antidiuretic, and antiviral properties. It is also reported to have properties in the treatment of hepatic disorders. It is recognised that the plant's entire structure contains active ingredients with therapeutic potential.

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Table 1: Composition of Nutrient agar medium

Peptone	5.0 g
Beef extract	3.0 g
Agar	15.0 g
Distilled water	1000 ml
pH	7.0

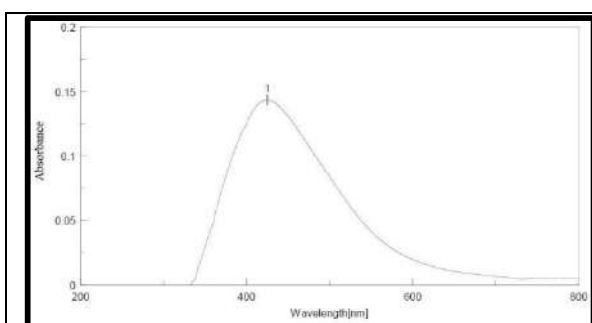


Figure 1: UVabsorption of biogenic AgNPs showing surface plasmon peak at 414 nm

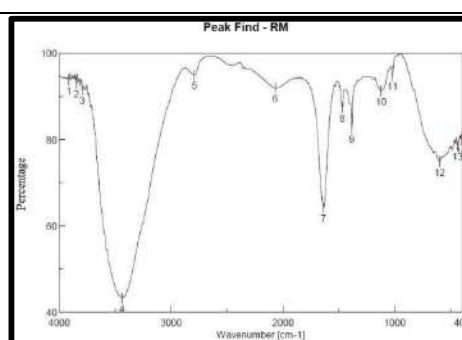


Figure 2: FTIR spectrum of plant extract mediated bio inspired AgNPs

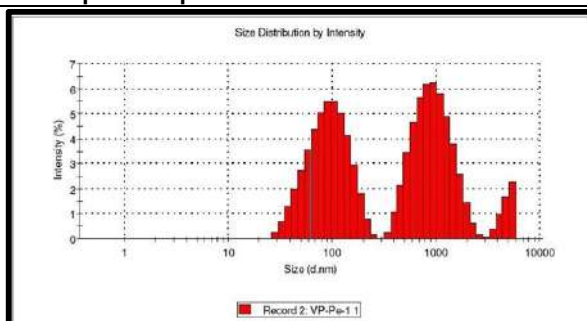


Figure 3: Energy dispersive X-ray spectrometers

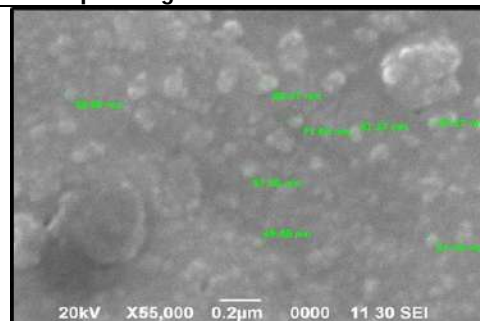


Figure 4: SEM micrograph of silver nanoparticles formed after reaction of plant extract with 1mM AgNO₃





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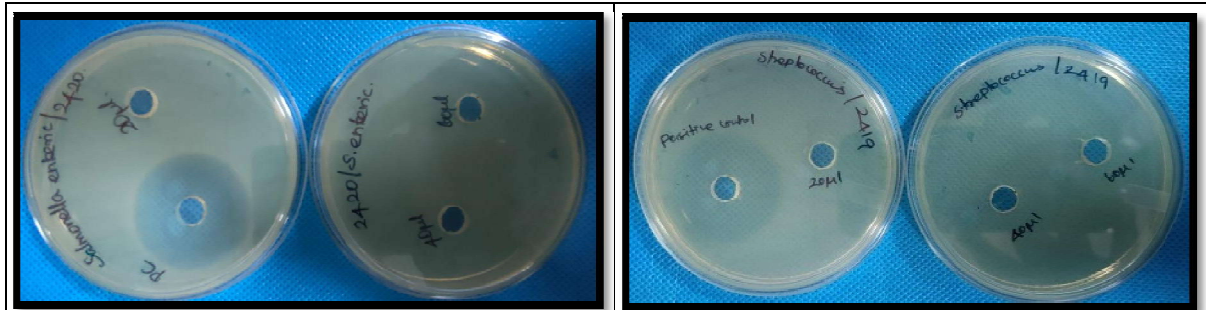


Figure 5: Antimicrobial Activity





Exploring the Evolution of Financial Literacy and Investment: A Bibliometric Analysis of the Past Decades' Academic Literature

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ABSTRACT

Several exploratory, conceptual, and empirical studies on investing behaviour and financial literacy have been undertaken in economics, finance, psychology, business, and management. However, no attempt has been undertaken thus far to offer a full scientific mapping of the area. As a result, the study attempts to elicit the tendency in the scientific sector via the synthesising of information structures. A bibliometric study of 420 papers in the area on financial literacy as well as investments research was conducted using a scientific search method ran on the scopus database from 2002 to 2022. The study made use of Biblioshiny, a web-based application contained in the Bibliometrix package written in R (Ariaa and Cuccurullo, 2017). Using the software's automated process, notable journals, authors, nations, articles, and topics were discovered, and citation, co-citation, and social network analyses were performed. The findings indicate that the topics of financial literacy with investment have grown through time as a multidisciplinary discipline. In addition to the conceptual structure, the present study discloses the domain's intellectual and social structure. This study sheds light on issues that require additional exploration. Because the current study is a bibliometric analysis, the limitations associated with such studies apply. A comprehensive study of the literature might be beneficial for future scholars in developing a robust conceptual framework. The Scopus database was used for this study because it has a greater coverage of high-quality publications in structured forms that are compatible with the Bibliometrix programme. The quality and extent of the current literature limit the scope of the review. The methodology and populations analysed in the papers that make up the review differ, limiting the ability to be generalised of the findings. The current study sheds light on financial literacy, investments, and their interrelationships. It emphasises the most addressed challenges in the field and points to potential study opportunities. It educates future scholars about emerging topics, settings, and



**Sushma and Vinay Joshi**

cooperation opportunities in this field by showing the domain's social and intellectual structure. The review has important social implications, as investment has significant implications for individual and societal welfare. Improving financial literacy and investment behavior can enhance financial well-being, reduce inequality, and promote economic growth. This study gives a detailed summary of existing financial literacy and investment information on global Level. The study synthesises a wide range of studies, finds similar patterns, and offers insights into the variables influencing investing behaviour.

Keywords: Financial literacy, investment, financial education, financial advisors, automated investment platforms.

INTRODUCTION

In today's complicated and fast changing economic scene, financial literacy and investing research are growing increasingly crucial. Individuals, homes, and organisations must be able to make educated financial decisions in order to accomplish their financial objectives and successfully manage financial risks. Furthermore, solid investment research is required for investors to make educated investment selections and optimise their investment portfolios. As a result, knowledge of finance and investment studies has attracted a lot of attention in recent years from academics, policymakers, and practitioners. Financial literacy is described according to the Organisation for Economic Cooperation and Development (OECD) as "the awareness and comprehension of financial ideas and products, as well as the capacity to apply this understanding in order to make intelligent decisions" (OECD, 2020). Financial literacy has a significant impact on financial behaviour and outcomes such as savings, repayment of debt, and retirement planning. Numerous studies, however, have found that financial literacy levels in the general public are low, which can contribute to poor financial decisions and unfavourable financial consequences (Lusardi and Mitchell, 2014; van Rooij et al., 2011). The examination and assessment of investment possibilities, risks, and returns, on the other hand, is referred to as investment research. Investors with personal financial advisors, and institutional investors such as banking institutions, mutual fund companies, and pension funds can do investment research. A thorough grasp of the financial markets, securities, & economic fundamentals is required for sound investing research. Yet the quality and dependability of investing research can vary greatly, resulting in wildly disparate investments suggestions and outcomes. A growing body of work has used bibliometric evaluation to identify major research themes, knowledge shortages, and emerging trends in order to more fully comprehend the growth of knowledge about finances and investment research. Bibliometric assessment is a quantitative tool that maps the conceptual framework of a study topic using citation & publication data (Van Eck & Waltman, 2017). Bibliometric analysis may uncover the most prominent authors, organisations, and publications, in addition to the most significant research issues and knowledge gaps, by analysing patterns of co-citation, bibliographic coupling, or social networks. In this study, we give a bibliographic review of academic papers on financial literacy & investment research during the last decade. Our research will look for important research subjects, knowledge shortages, and current developments in this discipline. This study's findings may be valuable to lawmakers, instructors, and professionals interested in enhancing knowledge about finances and results from investments.

Financial Literacy and Investment

Financial Literacy

Financial literacy has become a popular study issue in recent years, with scientists looking at many elements of the topic, such as its drivers, repercussions, and solutions. Several studies have found that financial literacy is related to better financial outcomes, such as greater savings rates, more diverse portfolios, and better managing debt (Lusardi and Mitchell, 2014; Robb and Woodyard, 2011). Furthermore, financial literacy was linked to improved general health and happiness in life (Drentea and Lavrakas, 2000). Various variables of financial literacy have been found via



**Sushma and Vinay Joshi**

research, including demographic characteristics like gender, age, level of education, income, & ethnicity. Women and people with lower levels of education and income, for example, have lower levels of financial literacy, according to research (Lusardi and Mitchell, 2014; Hilgert et al., 2003). Aside from demographic characteristics, psychological and behavioural components which include financial beliefs, risk perception, and self-control have been identified as major predictors of financial literacy (Hastings et al., 2013). A potential strategy to promote financial literacy has been proposed: financial education. Several research on the impact of financial education programmes upon financial literacy and behaviour have shown conflicting results. Financial education has been shown in certain research to promote financial literacy and behaviour (Fernandes et al., 2014), but not in others (Collins et al., 2016). Furthermore, several research have revealed that the efficacy of financial awareness programmes may be affected by aspects such as programme scheduling, delivery, and content (Mandell and Klein, 2009).

Investments

Investment research is an important step in the investing decision-making process. Investment suggestions and outcomes can be influenced by the quality and dependability of investment research. Several studies have been conducted to assess the accuracy and use of investment studies, with conflicting findings. According to certain studies, investing research is biased, incomplete, and out of date (Korkeamaki & Smythe, 2012; Bollen & Bushee, 2001). Other studies have concluded that investing research, particularly for individual investors, may be helpful and valuable (Barber and Odean, 2008). Several criteria, including the analyst's skill, the declaration of independence, & conflicts of interest, have been identified as predictors regarding investment research quality (Bhojraj and Lee, 2002). Furthermore, business factors such as number, industry, & financial performance might have an impact on the quality and dependability for research on investments (Mikhail et al., 1999).

Financial literacy and investing behaviour are two interconnected issues that have gotten a lot of focus in the finance literature. Financial literacy is referred to as the capacity to comprehend and efficiently use financial information in order to make informed judgements (Lusardi & Mitchell, 2014), whereas investment behaviour refers to the activities that individuals perform in relation to their investment decisions. Several research have found a link between financial literacy and investment behaviour. Individuals with greater levels of financial literacy, for example, possess more diversified investment portfolios, invest more in equities, and perform better in the stock market (Lusardi & Mitchell, 2014; Grable et al., 2011). Furthermore, financial literacy was linked to increased investment optimism & tolerance for risk (Hastings et al., 2013). Several elements, however, have been recognised as impediments to optimal investing behaviour. Behavioural biases like overconfidence, fear of loss, and herding behaviour are examples of these characteristics (Barber & Odean, 2008), as are demographics variables such as gender, educational attainment, and age (Hilgert et al., 2003). A possible intervention to increase investing behaviour has been proposed: financial education. Several research on the efficacy of financial education programmes on investment behaviour have shown conflicting results. Financial education has been shown in certain research to increase investing behaviour and achievement (Fernandes et al., 2014), but not in others (Collins et al., 2016). Furthermore, several research have revealed that the efficacy of financial literacy may be affected by aspects such as programme scheduling, delivery, and content (Mandell and Klein, 2009). Other interventions, such as the employment of financial advisers, automated investing platforms, and financial incentives, have been recommended to enhance investment behaviour in addition to financial education (Choi et al., 2014). However, the efficacy of these treatments in promoting investing behaviour has not been well investigated. Financial literacy & investing behaviour are important subjects in finance research, with several studies suggesting a positive relationship between the two. However, other factors, including behavioural biases & demographic features, may operate as obstacles to optimum investing behaviour. Financial education and other interventions to promote investment behaviour are being proposed, but more research is needed to identify effective approaches to encourage better investment outcomes.

Bibliometric Analysis

Bibliometric analysis refers to a method of quantitative investigation that entails analysing and assessing bibliographic data in order to acquire insights into the features, patterns, and trends of a certain field of study.



**Sushma and Vinay Joshi**

Finding Research Patterns: Bibliometric analysis enables academics to study the evolution of research on a certain topic across time. It assists in identifying new trends, major themes, and the most prominent authors or publications in financial literacy and investing behaviour (Chen, 2017). Mapping Knowledge Structure: Researchers can generate visual representations of a field's intellectual structure by analysing bibliographic data. This aids in comprehending the connections between various ideas, subtopics, and research fields in the investigation of financial literacy & investing behaviour (Zupic & Ater, 2015). Bibliometric analysis allows academics to evaluate research production by examining the quantity of publications, citations, plus partnerships among scholars. It aids in the identification of the most productive investigators and organisations in the area, offering insights into total research production regarding financial literacy and investing behaviour (Rafols et al., 2012).

Discovering Research Gap: Bibliometric analysis can indicate sections of the literature that are under-researched or have gaps. Researchers can **help** bridge gaps in knowledge regarding financial literacy and investing behaviour through discovering areas that have gotten less attention (Chen, 2017). Monitoring Research Impact: By evaluating citation patterns and assessing their effect within the academic community, bibliometric analysis allows scholars to estimate the impact of publications. Researchers may identify significant studies and follow the transmission and effect of research results upon financial literacy and investing behaviour using this technique (Bornmann et al., 2017).

Research Questions

1. Who are the most significant financial literacy and investment publications and authors?
2. What is the research community's intellectual structure?
3. What exactly are the collaboration networks in the financial literacy & investment fields?
4. How has the notion of financial literacy & investments evolved, and what are the most recent challenges addressed?

Research Objectives

1. To identify trends or patterns in the growth of knowledge in the areas of financial literacy and investment.
2. To explore the knowledge structure to produce knowledge synthesis

RESEARCH METHODOLOGY

The selection of the database for this study is followed by data collecting according to the search technique. (Fig 1) After finding and selecting an acceptable source, data for this investigation were retrieved. database (see Figure 1). This followed by a search query employing the appropriate combination of numerous key terms. After the data set has been produced using the relevant inclusion and exclusion criteria, It is assessed using software tools to determine exclusion criteria. At first, a descriptive analysis of the data is performed in terms of sources of information, documents, and authors. The data was subsequently reduced using techniques like principal component evaluation and multiple correspondence analyses. Following this, network maps were created to improve data visualisation by showing conceptual, intellectual, and social aspects of the data (Ariaa & Cucurullo, 2017). The article is comparable to Fahimnia et al. (2015)'s work on green supply chain management, which was done in phases.

Selection of Database

"Scopus was chosen as a repository used in our bibliometric analysis for a number of reasons." To begin, Scopus provides broad coverage of academic literature in a variety of areas, including science, technology, health, the social sciences, & humanities (Scopus Content Coverage Guide, 2021). Its comprehensive indexing comprises an extensive number of academic journals, conferences papers, books, even patents, enabling a thorough examination of the research outputs (Scopus, n.d.). Furthermore, the interdisciplinary character of Scopus makes it particularly appropriate for our investigation, which attempts to investigate the junction of many subjects. Scopus, according to Elsevier, includes several fields and allows for an extensive approach to research analytics (Elsevier, n.d.). This



**Sushma and Vinay Joshi**

interdisciplinary coverage broadens the study's relevance and usefulness by capturing a larger viewpoint on the issue.

Preparing data for analysis

Data were downloaded from Scopus database in CSV format by applying following criteria on 8th May 2023. TITLE-ABS-KEY ("financial literacy" AND "investment") AND (LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "PSYC")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English"))

Keywords: "Financial Literacy" AND "Investment"

Subject Categories: Economics Econometrics & Finance, Business Management & Accounting, Social Science and Psychology.

Document types : Articles

Languages: English

Timespan: 2002-2023

Selection of Bibliometric tool

The study used a bibliometric approach for comprehensive science mapping. It is a time-honored research technique of statistical and quantitative evaluation of scientific literature used in information science and libraries to improve effectiveness and efficiency (Tella & Olabooye, 2014) of the libraries. This work employs the R-package (Bibliometrix) created in R by Ariaa and Cuccurullo (2017). This programme enables extensive bibliometric research, including analysis of data and display. As previously stated, most bibliometric analyses are complicated because to access constraints caused by commercial licences of these programmes and need substantial training of researchers. Bibliometrix, on the opposite hand, is open-source software developed for thorough scientific mapping analysis. It can be continuously upgraded and integrated with other scientific R programmes. As a result, it is well appreciated by users and is becoming increasingly important in the ever-evolving field for bibliometric analysis, for descriptive as well as and network analysis. The data in this study was processed using Biblioshiny, a web-based tool included in the Bibliometrix package.

Data Analysis and Findings

The data was organised into descriptive analysis & scientific mapping.

- (1) Descriptive analysis examines bibliometric information in terms of fundamental data set properties such as (1) sources/journals. (3) documents and (2) Authors
- (2) Scientific mapping uses visualisation to undertake substantial science mapping approaches such as network analysis, three field plots, and thematic maps, and develops knowledge structures to aid in future analysis (Fig 2)

Descriptive analysis

Descriptive Analysis will discuss the following analysis:

The data set spans the years 2002 to 2023, reflecting the time frame during which the articles were gathered. This information aids comprehension of the analysis's time span. Publications from 260 various sources, including as books, journals, and other publications, are included in the data collection. This demonstrates the breadth of the material evaluated for the study and reflects a comprehensive covering of relevant sources. The data collection contains 420 documents that reflect the various units of analysis. These materials might be research papers, papers from conferences, or other intellectual outputs. The yearly increase of 18.61% suggests the quantity of documents has increased significantly over time. This growth rate indicates a considerable expansion in the subject of research or study of interest within the time period under consideration. The average age of 4.22 indicates that the documents in the data collection have been published relatively recently on average. This information gives an idea of how recent the literature under consideration is. Average number of citations per document: It demonstrates the importance and impact of the articles in the data set, with an average level 19.29 citation per document. Higher numbers of citations may indicate that the study has had an impact on the scientific community. There are a total of 18,451 references



**Sushma and Vinay Joshi**

referenced within the documents in the data collection. This data represents the amount to which the analysed articles build on prior research and gives insights into the field's intellectual basis. The existence of 383 Keywords Plus shows that extra relevant phrases were identified in addition to the author-assigned keywords. Those additional keywords would have been collected using specialised approaches to capture crucial topics that the authors did not explicitly disclose. Keywords used by the author in 1,098 author-assigned keywords indicates the precise areas of emphasis or themes discussed in the texts under consideration. These keywords give information about the writers' major research subjects and interests. There are 987 distinct authors in the data set that made contributions to the analysed articles. This data displays the total number of researchers active in the area and offers an overview of the research community's collaboration network. Single-authored papers in 420 documents, 67 were composed by a single author. This shows that the analysed data set contains both single-authored and collaboration outputs. There are 71 single-authored documents in the data set, indicating the contribution of specific writers. Furthermore, each paper has an average number of 2.62 co-authors, demonstrating a tendency to work together within the scholarly community. The proportion of international co-authorships of 20 indicates the extent of international cooperation in the analysed articles. This reflects the level to which scholars from various nations collaborated on scientific initiatives. The total number of articles in the data set is 420, showing that the study focused solely on research papers as the major kind of publishing.

Three field plots

Three field plots use Sankey Plots to show the relationship between three fields, with the size of the part corresponding to the value on the node (Riehmman et al., 2005). (Fig 3) The authors are on the left side in the Sankey Plot, the keywords are in the centre row, and the sources chosen for analysis are on the right side. Each item displayed notable terms such as financial literacy, financial behaviour, and financial capacity, as well as their sources and prolific writers. All 10 important publications covered the issue of "financial literacy," demonstrating its critical significance in moulding "financial behaviour."

According to data this was a period of little or no item manufacturing between 2003 to 2006 (Fig 4). However, there has been a general increasing tendency beginning in 2007, with minor swings. During 2012 to 2015, there was a large growth in article output, followed by rather constant figures in 2016 to 2019. As a result, there was a significant increase in the number of articles created in the years 2020 and 2021. According to the statistics, article output will be lower in 2023 when compared with the previous year (Fig 4).

Average Article Citations Per Year

Figure 5 showing Average Citations per year

Most Cited Sources

These resources include a variety of research papers from many disciplines, emphasising their relevance and possible effect in their respective domains. These journals can be used by scholars interested in the mentioned fields to find relevant and significant articles (Fig 5 & 6).

Source Growth

The data supplied depicts the output of papers for different publications over the years. Here's how we perceive the source production & its growth: Overall, the analysis indicates that FRONTIERS IN PSYCHOLOGY, JOURNAL OF PENSION ECONOMICS AND FINANCE, and INTERNATIONAL JOURNAL OF BANK MARKETING have seen significant increases in article output throughout the years. JOURNAL OF FINANCIAL SERVICES MARKETING and MANAGERIAL FINANCE remained constant, but SUSTAINABILITY (SWITZERLAND) expanded steadily (Fig 7).

Authors

According to the data, Mitchell OS has the author having the most articles, totaling eight. However, when taking into consideration the author's involvement within co-authored publications, Mitchell OS had an average contribution



**Sushma and Vinay Joshi**

that is around 2.83 papers per publication (Fig 8). Lusardi A comes in second with 7 articles & a fractionalized value that is within 2.58 articles per publishing. Zhang Y has five articles with fractionalized values of 1.37, whereas Garca-Santillán A has four articles with fractionalized values of 1.33. Authors such as Adil M, Ansari MS, Kadoya Y, & Fong JH each contributed three publications. Adil M and Ansari MS have fractionalized values in the 0.87 range, whereas Kadoya Y has a value of 1.17 & Fong JH has a higher value of 1.58. (Fig 8). Chatterjee S & Dogra P have also published three papers, each having a fractionalized value of around 1.33. It is crucial to remember that without any more information, such as the subject of research or particular relevant criteria, determining the significance or effect of the work of an author is difficult. The fractionalized numbers provide a little insight regarding the authors' contributions as individuals inside co-authored publications, but they do not represent the research's quality, influence, or larger effect (Fig 8). publications, each of which has earned seven or more citations. The g-index is 8, implying that their top eight articles have garnered at least $8^2 = 64$ citations. The m-index of 0.7 indicates that their publications have garnered 0.7 citation per year on average since their first publishing. Mitchell OS has 1686 total citations (TC) and has authored 8 publications since 2014.

Lusardi A carries an h-index of 6, suggesting that she has at least six papers with six or more citations. Their g-index is 7, implying that their top seven articles have garnered at least $7^2 = 49$ citations. The m-index of 0.352941176 shows that they have received an average of 0.352 citations every year since their initial publication. Lusardi A has received 2709 citations and has authored 7 publications since 2007. Kadoya Y possesses an h-index of 3, indicating that she has at least three papers with three or more citations apiece. The g-index also ranks in the three, indicating that their top three articles have gotten at least nine citations. The m-index of 0.5 shows that they have received an average of 0.5 citations each year after their first publication. Kadoya Y has received 52 citations and has authored three papers since 2018. Zhang Y holds an h-index of 3 as well as a g-index of 5, indicating the existence of at least three articles with three or more citations each, and that their top five articles have garnered at least $5^2 = 25$ citations collectively. The m-index of 0.75 shows that they have received an average of 0.75 citation each year since their initial publication. Zhang Y have a total of 33 citations and has authored 5 papers since 2020.

Adil M has an h-index of 2, suggesting that he has at least two papers with two or more citations. The g-index is also three, indicating that their top three articles have gotten at least nine citations. The m-index of 1 indicates that they have received an average of one citation per year since their first publication. Adil M has a total of ten citations and has authored three publications since 2022. The remaining writers (Ahmed Z and Alshebami AS) exhibit lower impact measurements, such as lower h-indices, m-indices, and citation counts, suggesting that they have published fewer works or earned less citations than the previous authors.

Countries Scientific Production

The United States has the greatest level of scientific production (202), next to India (124), Indonesia (94), Australia (79), & China (74) in that order. These nations have active research settings, but others, such as Germany, the United Kingdom, Pakistan, and Italy, have comparably lower scientific productivity, suggesting a lower research output (Fig 10).

Most Cited Countries

The United States is the most referenced country, with 1476 total citations, demonstrating its enormous research influence. The Netherlands gets an impressive average of 127.8 references per publication, showing that its research is important. With overall citation numbers of 593 and 297, respectively, Australia and Italy indicate strong research influence. India, China, as well as Germany also have significant citation numbers, while the UAE and Singapore have high average citations per article (Fig 11).



**Sushma and Vinay Joshi****Documents**

"LUSARDI A, 2014, J ECON LIT" has received 1456 citations (Fig 12), demonstrating its high effect and influence in the subject of economics. Other articles with high citation counts includes "LUSARDI A, 2007, BUS ECON" having 685 citations, & "VAN ROOIJ MCJ, 2012, ECON J" had 420 citations, proving their significant contributions to their respective fields of study. (Fig 12) These publications have received a great deal of interest and notoriety within the academic world, demonstrating their significance in driving scholarly debates and giving significant insights.

Keywords

The data shown here shows the frequency of specific terms within a particular context. Here are various interpretations according to the keyword frequencies provided: "Investment" appears the most frequently, having a frequency of 34, indicating a strong emphasis on investment-related themes within the context. "Literacy" follows closely behind with a frequency of 25, demonstrating the significance of literacy, especially financial literacy, in the setting under discussion. Both "finance" as well as "financial system" have an average frequency of 12, indicating a significant emphasis on financial issues and the larger financial system. "Investments" & "financial literacy" occur with frequency of 11 and 10, demonstrating their significance and presence in the topic under discussion. Other noteworthy keywords including "education" (7), "human" (7), "decision making" (6), "energy efficiency" (6), "female" (6), & "savings" (6), all of which highlight other themes and issues of interest within the given context (Fig 13 & 14).

Trend Topics

The data shown here (Fig 15) shows the frequency of particular items (keywords) as well as the year quarters when they were noticed. Based on the statistics, below are various interpretations of popular topics: With frequency of 12 and 12, respectively, "finance" & "financial system" have been continuously popular themes over the years. They demonstrate the ongoing interest and significance of financial systems & its components. "Energy efficiency" has shown a progressive increase in popularity, culminating in 2022 with a frequency of 6. This indicates an increasing emphasis on energy conservation and its significance in the current setting. "Financial literacy" as well as "literacy" also have a significant number of 10 and 25, demonstrating a long-standing interest in financial literacy & general literacy. "Investment" occurs the most frequently (34 times), indicating its popularity as a hot subject during the analysed period. It shows a consistent focus on investment-related conversations. "Human" and "female" had modest frequencies of 7 and 6, indicating continued attention to human-related characteristics and gender-specific concerns within the current context. Both "decision making" & "savings" have a frequency of 6, showing ongoing interest in both issues, with decision-making increasing significance in recent years. "Financial market" & "education" have frequency of 5 and 7, indicating that they are relatively new or developing themes. Overall, the data focuses on current and developing developments in finance, energy savings, risk evaluation, financial literacy, investments, knowledge, and a variety of other areas. These patterns reflect the shifting interests and objectives within the setting under consideration.

Data Visualisation

Throughout the last few years, the issue on financial literacy & investment has caused increased attention and study focus. This section depicts the field's thematic progression. Data visualisation employs network analysis to quantify the number of clusters that emerge, the frequency of occurrences and relationships across different levels of analysis, overall link strengths, and the number of citations (Low and Siegel, 2019). To extract the networks, multiple methodologies based on various components for analysis including documents, authors, and keywords are used. These networks are made up of nodes that are linked together through connections. It conducts statistical analysis on produced maps to identify various network metrics (Ariaa and Cuccurullo, 2017). The scientific mapping accomplished by network analysis yields three types of knowledge structures: conceptual structure, intellectual structure, and social structure.

Conceptual structure

Using a co-occurrence network analysis (Fig 16), conceptual structure depicts the relationship between themes, subjects, and trends. It is the only strategy that makes use of research paper material. As a result, the unit to be



**Sushma and Vinay Joshi**

studied is an idea or, more generally, a concept utilised phrases or a common topic discovered in a network (Li et al., 2018). This conceptual framework of the study field is derived by the Bibliometrix programme using multiple correspondence analysis (MCA). MCA may be used to do numeric and graphical analysis on multivariate nominal data (Greenacre and Blasius, 2006). The co-occurrence map depicts the connections between nodes in a particular dataset. The nodes in this scenario are associated with investing, finance, education, and other related issues. Based on their co-occurrence, the map gives insights into the relationships and associations between these nodes.

Looking at the picture (Fig 16), we can see that Cluster 1 includes investment, literacy, finance, financial system, education, decision making, savings, training, financial market, Japan, risk assessment, student, and United States. The degree to which a node is on the shortest pathways between other nodes is measured by betweenness centrality. Investment has the greatest Betweenness rating in this context, indicating that it is crucial in interconnecting additional nodes throughout the cluster. Literacy and the financial system have quite high Betweenness ratings, demonstrating their importance in linking disparate issues. Closeness centrality quantifies a node's closeness to the other nodes in the group. Investment, literacy, finance, and financial system have the greatest Closeness values in this scenario, indicating that they are more closely related to other nodes in the cluster. The degree to which a node is on the shortest pathways between other nodes is measured by betweenness centrality. Investment has the greatest Betweenness rating in this context, indicating that it is crucial in interconnecting additional nodes throughout the cluster. Literacy and the financial system have quite high Betweenness ratings, demonstrating their importance in linking disparate issues. Closeness centrality quantifies a node's closeness to the other nodes in the group. Investment, literacy, finance, & financial system have the greatest Closeness values in this scenario, indicating that they are more closely related to other nodes in the cluster (Fig 16).

Thematic Map

Thematic maps are two-dimensional plots that depict typological motifs (Cobo et al., 2011). Keyword clusters are generated based on co-word analysis, resulting in themes in the study topic. These themes may be categorised into four quadrants on a two-dimensional graph based on their density & centrality, with centrality and density serving as the two dimensions.

The offered theme map (Fig 17) is a co-occurrence analysis determined by a specific set of criteria and data. Knowing the clusters, centrality measurements, and cluster frequencies is required for map interpretation. Here's a quick explanation:

1. Interpretation of Clusters: Several clusters are identified on the map, including "investment," "conceptual framework," "gender," "investments," "human," "electronic commerce," "risk aversion," and "climate change." Each cluster is a collection of terms that commonly co-occur in the dataset.
 2. Centrality Measures: Centrality measures, such as Callon Centrality and Rank Centrality, give information on the significance and prominence of each cluster in the dataset. Higher centrality ratings indicate greater impact or significance. For instance, the "investment" cluster has elevated Callon Centrality and Rank Centrality values, indicating that it is a significant and important cluster within the dataset.
 3. Cluster Frequencies: The cluster frequencies show the number of times each cluster appears or is mentioned in the dataset. It indicates the predominance or prominence of a specific theme or issue. For example, the "investment" cluster contains the most occurrences (230), showing that the notion of investment is often addressed in the dataset.
- Overall, the thematic map aids in identifying and comprehending the correlations and patterns that exist between various words or concepts in the data collection. It enables researchers and analysts to get insights into co-occurrence trends and the relative value of different groups within the data.

The analysis generated two separate dimensions (Dim.1 and Dim.2) & allocated each word to one of two groups. These are interpretations depending on the factorial space coordinates of the words: Financial system, investments, financial literacy, education, savings, training, financial market, Japan, risk assessment: In terms of meaning or context, these phrases are closely related to one another. They are grouped along in the factorial region to emphasise their commonality. Human, choice making, female, male, retirement: all of these words are connected to human



**Sushma and Vinay Joshi**

elements, decision making, and retirement. Energy efficiency: The term is placed individually in the factorial area to distinguish it from other words. It represents a novel approach to energy efficiency. The factorial analysis identifies clusters & patterns within a given dataset, demonstrating links among words based on co-occurrence and context similarity (Fig 18).

Intellectual structure

By researching interactions between authors and countries, intellectual structure remarks on how diverse writers affect the scientific community. It displays the extent to which research groups and the research fraternity collaborate, as well as their links with different institutions (Cobo et al., 2011; Mendes et al., 2017). The intellectual structure shown by reference and co-citation analysis exposes several views and schools of thinking that have evolved through time.

Citation Analysis and Co-citation analysis

The graph above (Fig 19) looks to be the outcome of citation and co-citation analysis, with information on nodes, clusters, betweenness centrality, closeness centrality, and PageRank included. Based on this data, here are various interpretations:

Analysis of Citations

High betweenness centrality scores for nodes (Fig 19) such as "van rooij m. 2011-1," "lusardi a. 2014-1," and "lusardi a. 2007-1" indicate that they serve as essential intermediates in the citation network. These nodes are most likely important references in the topic of research. Nodes such as "dohmen t. 2011," "lusardi a. 2009-2," and "stango v. 2009" have lower betweenness centrality ratings, indicating that they have less citation links or are less significant in the network.

Analysis of Co-Citation

Cluster 1 nodes, such as "lusardi a. 2014-2," "calcagno r. 2015," & "cocco j.f. 2005," have lower betweenness and PageRank scores, suggesting that they are less important or prominent in the co-citation network. Cluster 2 nodes, including "huston s.j. 2010," "ajzen i. 1991," & "fernandes d. 2014," have greater importance in both betweenness and PageRank scores, implying that they play major roles in linking distinct works or concepts within the co-citation network. The nodes "lusardi a. 2014-3," "van rooij m. 2011-3," and "lusardi a. 2009-1" are classified as clusters (5, 6, and 3, respectively) and have high proximity centrality values. This suggests that they are heavily linked inside each of their clusters and are most likely core or significant works inside those clusters.

Social Network Analysis

Low and Siegel (2019) used Social network analysis to elicit connections within the research domain. Nodes represent players such as writers, institutions, or publication sources, and a set of nodes represents the social network's associated relationships. The network dynamics are represented by the links that interconnect these domains (Fig 20 & 21).

Collaboration Network Analysis

Nodes with cluster assignments of 1 and betweenness centrality values of 0 such as "thorp s," "bird r," "foster fd," and "grey j" indicate that they are not central in terms of linking other authors in the cooperation network. Node "mitchell os" is in Cluster 2 and has a considerably higher betweenness centrality score of 2, indicating that this author is more central in linking other authors in the cooperation network. Nodes such as "chatterjee s" (Cluster 3) and "zhang y" (Cluster 4) have cluster assignments of 3 and 4, respectively, and a closeness centrality score of 1, showing that they are well related to other authors in their respective clusters (Fig 20).

Country's Collaboration world Map

(Fig 21) Australia works with China, Ghana, Luxembourg, the Netherlands, New Zealand, Nigeria, Thailand, and the United Kingdom, with the United Kingdom having the most (4 partnerships). Austria works along with Poland and



**Sushma and Vinay Joshi**

Slovakia. Bangladesh is working with the Philippines. Cameroon is working with Chad. Chile is working with Honduras. China works with Bangladesh, Malaysia, the Netherlands, New Zealand, and Pakistan, with Pakistan having the most collaborations (2 collaborations). Colombia is working with Peru. Germany works with France, Italy, Japan, the Netherlands, New Zealand, South Africa, Switzerland, and the United Kingdom, with Italy having the most (3 partnerships). Ghana works with South Africa. Australia, Bangladesh, China, Malaysia, Oman, Thailand, and the United Kingdom are all partners with India. Indonesia has partnerships with China, Georgia, and Malaysia. Italy works in partnership with Canada, New Zealand, Spain, and Sweden. Japan is working with Bangladesh. Malaysia works in partnership with Georgia, Pakistan, and Saudi Arabia. The Netherlands works with Belgium. Nigeria works with Luxembourg. Pakistan works in partnership with Nepal, Saudi Arabia, and Thailand. Slovakia works along with Poland. Switzerland works with Norway. Thailand is working with Belgium. Turkey works along with Lebanon. The UK works with Ghana, Italy, New Zealand, South Africa, and Thailand. Australia, Austria, Canada, China, Germany, India, Iran, Italy, the Netherlands, the Philippines, Poland, Singapore, Slovakia, Spain, and the United Kingdom work together.

CONCLUSIONS

This article examines the progression of the "financial literacy" and "Investment" research conduct domains from 2002 to 2023. It also provides a complete examination of the study topic's conceptual intellectual and social structure. The study's major contribution is the synthesis of scattered literature in the subject, identifying notable sources, authors, and documents. Because of its versatility and user friendliness, the Bibliometrix R-package, a tool beneficial for bibliometrics, was employed. Considering its formal framework, quality research sources, and software compatibility, the information set for the study was derived from the scopus database. During 2003 to 2006, article output climbed considerably, with more increases expected in the years 2020 and 2021. In 2023, nonetheless article production will be smaller. The most significant information are the average citations for every year's annual article production, in an average of 41 citations in 2002, 416.5 in 2007, 20 in 2008, 58.4 in 2010, 39.8 in 2011, 53.83 in 2014, 25.47 in 2015, 36.55 in 2016, 20.08 in 2018, 9.35 in 2019 and 2021. Article output has increased in Journals like Frontiers, Journals, Financial Services Marketing, and Sustainable Switzerland. The most papers were written by Mitchell OS, who was followed by Lusardi A, Zhang Y, Garca-Santillán A, Adil M, Kadoya Y, and Fong JH. Since their debut publication, Mitchell OS, Lusardi A, Kadoya Y, Zhang Y, Adil M, and Ahmed Z have all garnered an average of 0.5 citations each year. The United States has the greatest level of scientific output, followed by India, Indonesia, Australia, and China. With 1476 total citations, the United States, the Netherlands, Australia, Italy, India, China, Germany, the United Arab Emirates, and Singapore have significant scientific influence. These articles have earned several citations, suggesting their relevance in advancing scholarly discussions and giving insights. The most commonly used keywords in a given context are investment, literacy, finance, financial system, investments, financial literacy, education, human, decision making, energy efficiency, female, and savings, showing a high emphasis on investment-related issues. In conclusion, the study reveals the increasing demand for financial literacy and then investment, identifies key writers and publications, and emphasises the importance of certain nations in this subject. The findings also highlight the importance of investment-related subjects and the importance of financial education.

Future Research Directions

Longitudinal analysis, comparative studies, impact assessment, intersectionality, behavioural finance, technological advancements, cross-disciplinary approaches, policy as well as regulation, financial knowledge delivery, and sustainable finance are some future research directions in the field of financial literacy and investment. These study directions will assist academics in developing effective methods, policies, and interventions to increase financial literacy, make investment choices, and empower individuals to attain better financial outcomes. Longitudinal analysis entails performing studies over an extended period to track the advancement of knowledge about finances and investing research beyond the present timeframe. Comparative studies entail doing research across nations, regions, or demography to investigate differences in financial literacy as well as investment levels, variables



**Sushma and Vinay Joshi**

influencing financial behaviour, and the efficacy of treatments. The examination of the real-world impact on financial literacy programmes and interventions to determine their success in increasing financial knowledge, behaviours, and results is known as impact assessment. Exploring how financial literacy and investing connect with other areas such as gender, socioeconomic position, culture, and ethnicity is what intersectionality is all about. Behavioural finance is the use of behavioural finance insights to acquire a greater awareness about the psychological biases, Heuristics, and decision-making processes that impact financial decisions and technological innovation.

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Sushma and Vinay Joshi

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Table 1. Data Set

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2002:2023
Sources (Journals, Books, etc)	260
Documents	420
Annual Growth Rate %	18.61
Document Average Age	4.22
Average citations per doc	19.29
References	18451
DOCUMENT CONTENTS	
Keywords Plus (ID)	383
Author's Keywords (DE)	1098
AUTHORS	
Authors	987
Authors of single-authored docs	67
AUTHORS COLLABORATION	
Single-authored docs	71
Co-Authors per Doc	2.62
International co-authorships %	20
DOCUMENT TYPES	
Article	420





Sushma and Vinay Joshi

Table 2. Showing Countries Scientific Production

Country	Frequency
USA	202
INDIA	124
INDONESIA	94
AUSTRALIA	79
CHINA	74
MALAYSIA	54
GERMANY	39
UK	34
PAKISTAN	30
ITALY	28

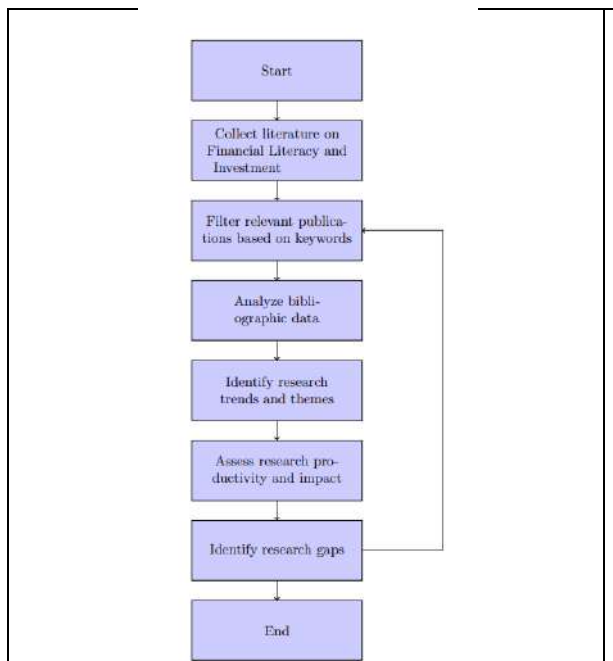


Figure 1. Flowchart illustrating bibliometric analysis on financial literacy and investment Behavior

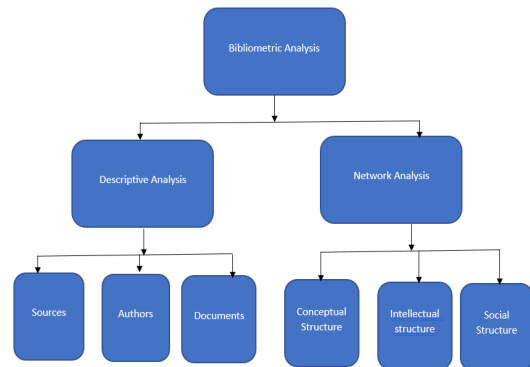


Figure 2. showing Data analysis

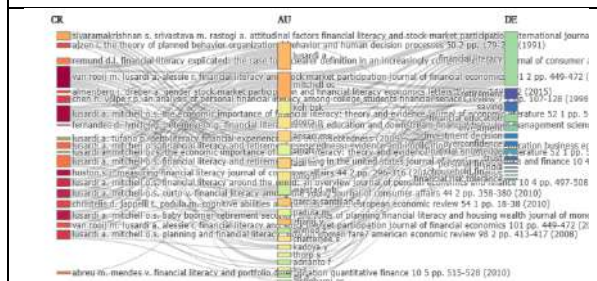


Figure 3. showing Three field plot analysis

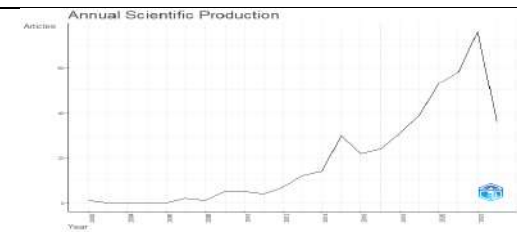


Figure 4 showing Annual Scientific Production





Sushma and Vinay Joshi

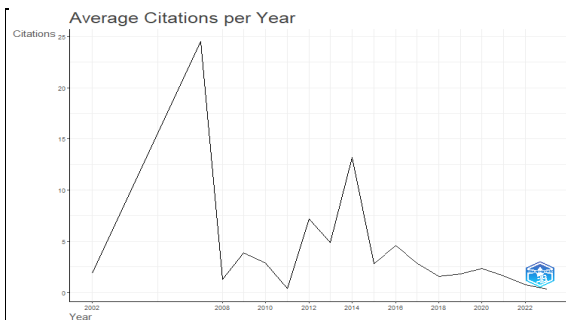


Figure 5 showing Average Citations per year

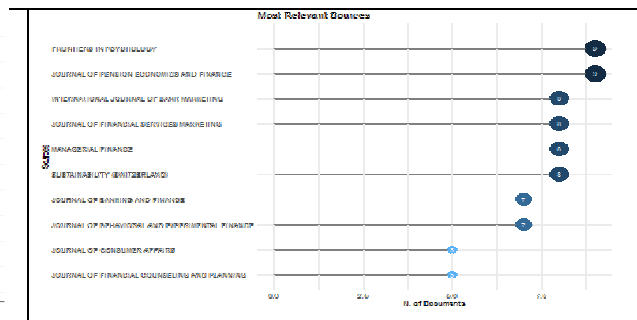


Figure 6 showing Most cited sources

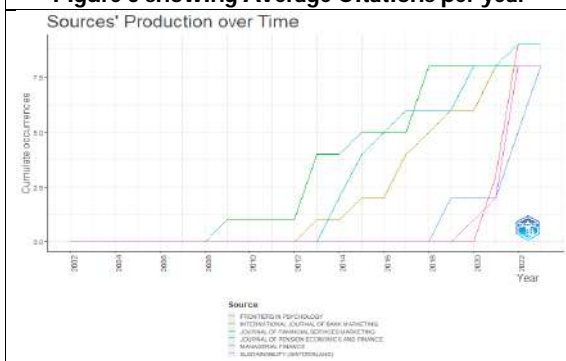


Figure 7 showing Source Production over time

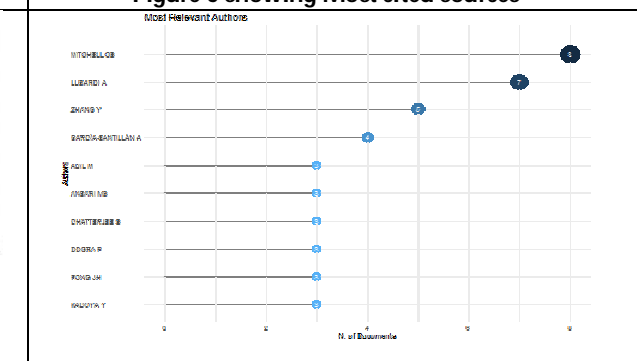


Figure 8 showing Most Relevant Authors

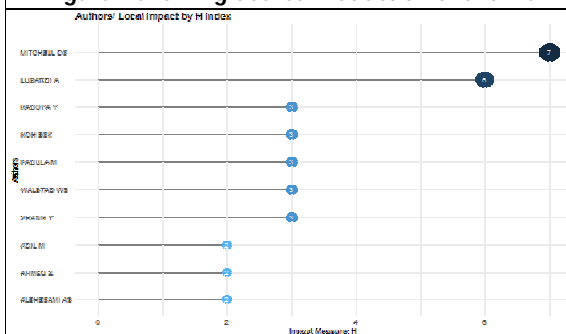


Figure 9 showing Authors Local Impact

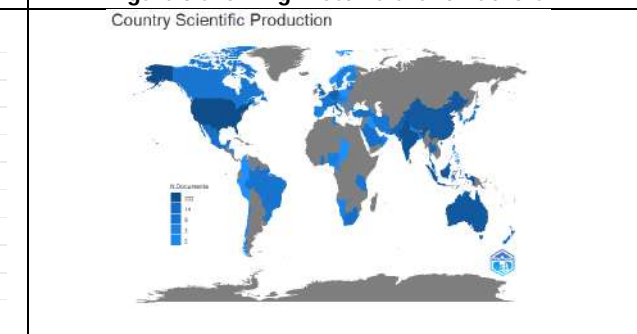


Figure 10 showing Countries Scientific Production

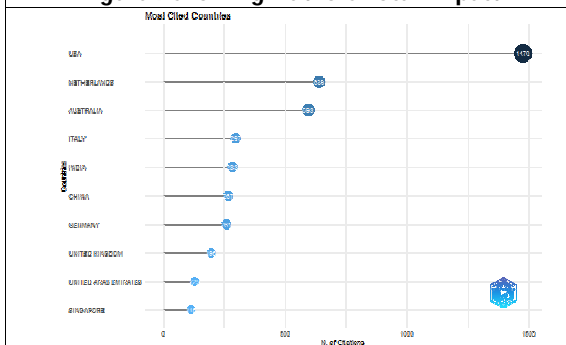


Figure 11 showing Most Cited Countries

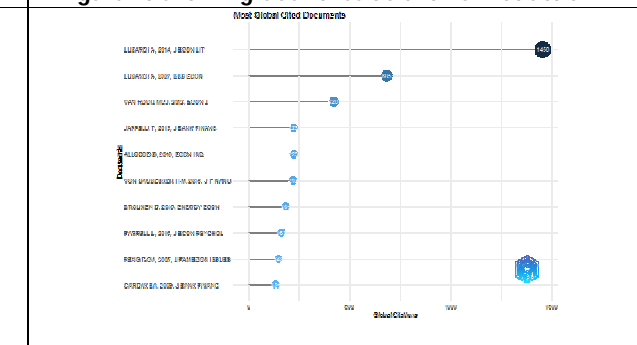
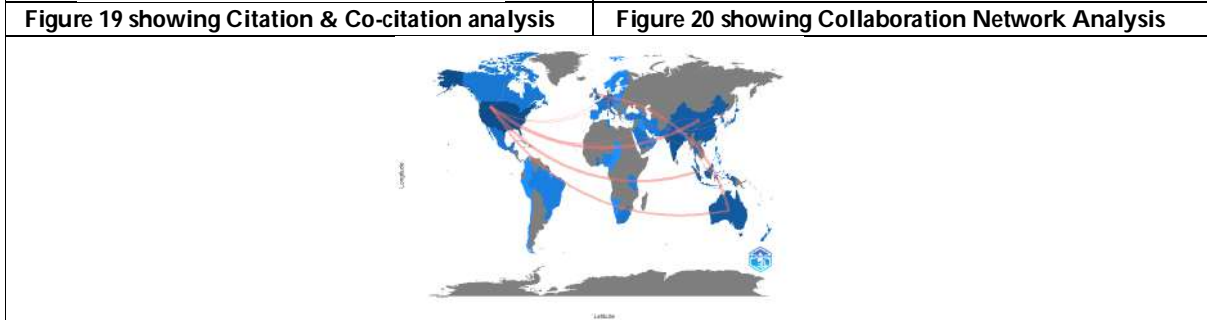
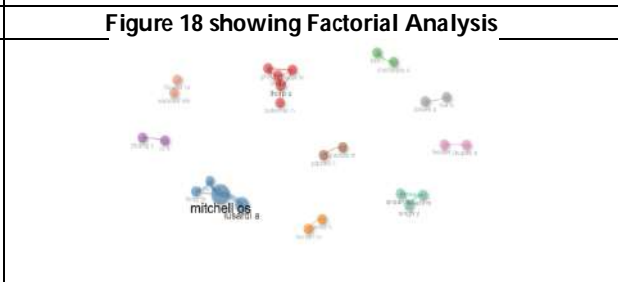
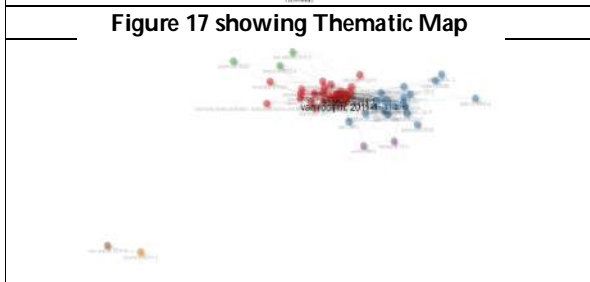
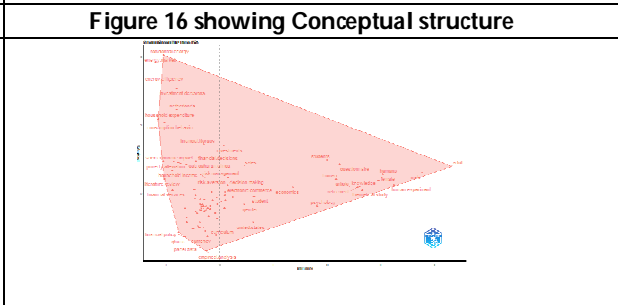
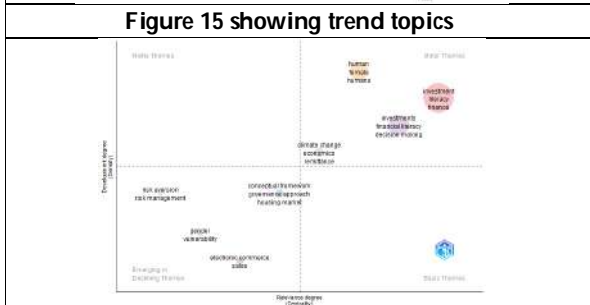
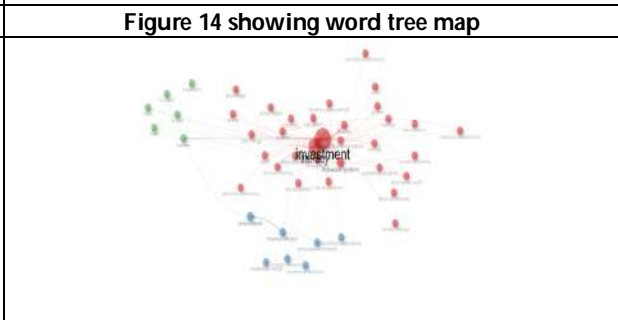
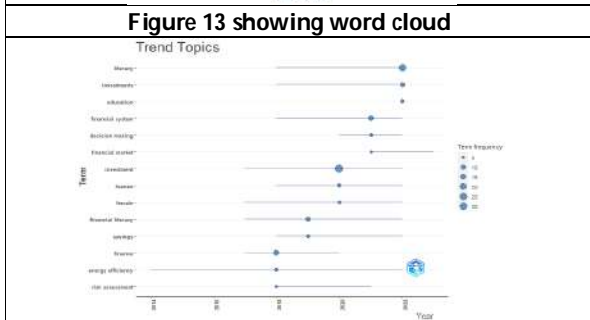
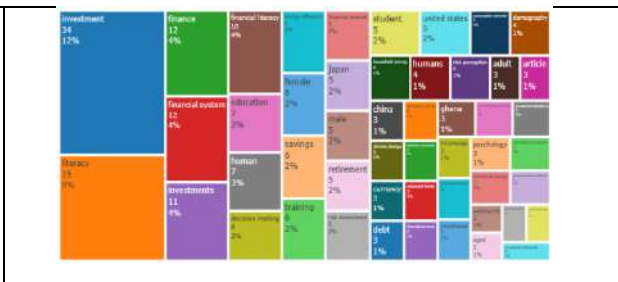
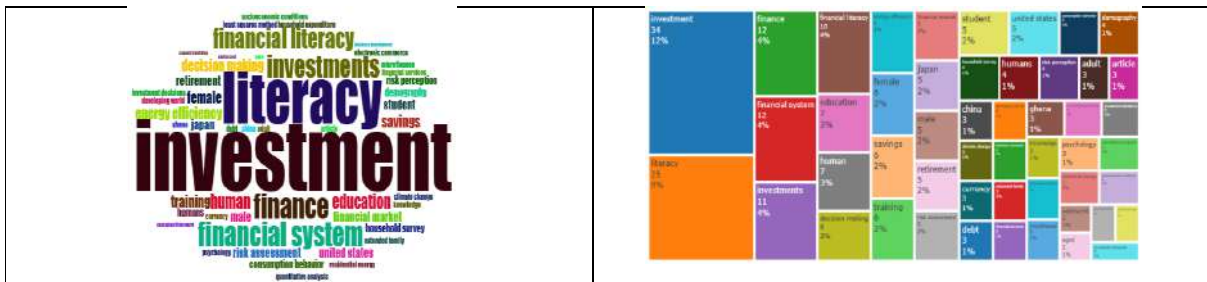


Figure 12 showing Most Cited Global Documents





Sushma and Vinay Joshi





A Novel Text-Braille-Text Converting Communication Device for Communication Impaired People

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ABSTRACT

Communication is the essential process of the human mankind. Human communicates with other, to express their need, wish, thoughts etc. Due to the genetic impairment or by means of accidents, some human being lags in performing communication and is identified as the communication impaired patients who cannot speak or hear to and from other persons. Braille communication is considered as the biggest gift for such communication impaired patients/human being enabling them to communicate with other persons. In spite of using braille system for oral communication process, the communication impaired persons feels hard in using mobile phones and other communication devices as the braille system is not implemented in the technical format. To overcome this challenge, the proposed work introduces a novel text to braille converting system which assists the visual and hearing impaired people to communicate using the technological braille communication system. This system employs the usage of motors to convert the text to its equivalent braille characters such that it can be communicated over the channel using communication devices. In turn, in the receiver side, the received message is converted from braille to text and vice versa wherever necessary. The analysis of the proposed work exhibits a better level of accuracy in converting text to braille and vice versa process. The proposed system is analyzed in terms of accuracy, precision; recall and F1 score to compare with the existing methodologies.

Keywords: Text-Braille conversion, communication system, GSM, Short message service



**Kanimozhi et al.,**

INTRODUCTION

In present scenario, the communication among the people plays a vital role. This communication assists the people in expressing their wish, thoughts, requirements, and necessities and above all to maintain a better level of relationships among others. But due to the birth or by major accidents, some people experiences a major setback because of communication impairedness like blind, deaf and dumb. The people with these impair experiences a major setback in performing communication with others. The major communication tool for the people with the communication impair employs sign language for their communication. According to the report, over 285 million of the world's population are visually impaired, 39 million are blind, and over 12 million are from India, making India home to one-third of the world's blind population. The visually impaired utilize the Braille language to read any form of data with their sense of touch, however there are significant difficulties in accessing text that is not in Braille script. The introduction of Braille system acts as the major horizon light for the communication impaired people, which is a dotted format of the letters and numbers. Braille is a touching system to read and write the data, which is in the raised dotted form as shown in the Figure 1. The Braille system for the various letters and numbering system is depicted in Figure 1, which is a raised dotted format. The Braille system is composed of six dots arranged in two columns and 6 rows, which can be applied to use punctuation marks, letters, symbols and numerical. The communicative impaired people touch these raised dots to feel the letter pattern and understand the content. This acts as the default communication process of the impaired people. The communication era had developed from paper based communication to the device based communication using mobile phone, computing device like computers, laptop etc by sending text messages like SMS, email, voice over telephone line etc. These communication methods cannot be employed by the communication impaired people, as they face a major setback in implementing Braille system in the communication process. The major objective of this proposed work is to design and implement an efficient text-to-braille converting communication device with a better level of accuracy and it will be readily used by the communication impaired people.

LITERATURE REVIEW

Multiple models have been offered by researchers that encourage conversation between a capable person and a deaf-blind person. A model that utilizes a USB keyboard for entering texts that are subsequently handled by a Raspberry Pi controller. A 16-cell refreshable Braille representation is employed to display the text entered by the user in Braille language, enabling the disabled person to comprehend the message. This device additionally features a speaker, so that a person who is simply blind can understand the message by hearing it. A vibration motor is used to tell deaf and hard of hearing people that a message has been delivered. A Saxena and *et al.* (2022) had introduced a prototype to convert the speech to text and from text to Braille system using Raspberry pi 4B module [1]. The decoder is composed of with logic gates and n-type and p-type MOSFETs. The proposed gadget generates output in a sequence of braille symbols corresponding to each letter, which are implemented using LEDs.

P.Kaur and *et al.* (2020) had designed a model for hindi text to Braille conversion process using the deep learning model [2]. The speech samples are integrated together to perform the Braille conversion process. The conversion process is performed using the image process technique, in which the hindi text is converted to the image and the image is converted to the Braille system. S.Kumari and *et al.* (2020) had proposed a text to Braille system conversion process using the digital image processing and conversion process [3]. The text is scanned to image and is processed using the raspberry pi to convert the scanned image to the Braille text system. P.Sawant and *et al.* (2021) had introduced a conversion process of text to Braille for the visually impaired people. The entered text is converted to the Braille text in a real time system using the raspberry bi module [4]. Y.Vijay and *et al.* (2022) proposed a system that uses a microcontroller and a PC to convert text to braille format [5] for communication between an average person and a visually impaired person. The results suggest that the proposed approach is efficient and accurate. S.Shetty and *et al.* (2020) outlines an instant algorithm for converting Kannada text to Braille script [6] and





Kanimozhi et al.,

Braille script to Kannada. The authors used information from the Kannada online website "Kendasampige" and the Kannada online newspaper "Udayavani." It has no mapping mistakes and functions for all Kannada compound characters.

M.A.Hussain and *et al.* (2022) proposes a technique that will assist visually impaired persons in beginning their very basic schooling by using technology capable of recognizing Bangla characters. When a person says a Bangla character, our system converts that letter into a braille patterns. Following that, a person can readily recognize the corresponding Braille for that character with a finger touch. The Visual Geometry Group's (VGG-16) model [7] of Convolutional Neural Network (CNN) and Arduino Uno are used for voice recognition. The braille pattern for the recognized character is generated using a 16x4 LCD display. We achieved 98% train accuracy and 92.42% test accuracy from the test data after learning the model with 50 epochs.

PROPOSED METHODOLOGY

The proposed work is intended to design a portable device to convert the text one by one to the corresponding Braille system using the vibrators [8]. The architecture of the proposed work is depicted in Figure 2. The proposed model is composed of up of two components: a Text to Braille converter unit and a vibration band. The text to Braille converters transforms[9] the alphanumeric text received via the GSM module to Braille format and delivers the output impulses to the vibration motor to generate the pattern.This converter module is composed of up of a GSM module for SMS reception, a mobile network [10], and six sets of relays linked to six vibration motors that form the Braille display. A communication impaired individual may transmit a message from the mobile phone to the Text to Braille converter unit. The GSM SIM 800C module receives incoming SMS messages via the SIM card that is inserted. This modem has an RS232 interface that can be linked to a PC or microcontroller, allowing functions such as calls, SMS reading, and so on to be accomplished using simple AT instructions. The GSM module is linked to the UART pin of the PIC 16F877A microcontroller in this Text to Braille converter unit.For processing and execution, a PIC 16F877A microcontroller [11] is employed in this Text to Braille converter. When an SMS is received by the GSM module, it is routed to the PIC microcontroller for processing and conversion. Each character in the received text message will be translated to its relevant braille format and sent to the Braille Display unit. The PIC microcontroller prompts the transmitter module to transmit a signal to the Vibration Band as soon as an SMS is received.

This model develops and proposes a portable gadget for visually impaired people to read letters in order, one by one, with the use of Braille symbols and vibrators. A capable individual can send SMS messages using GSM, which is linked to the Arduino Controller. The PIC microcontroller interprets the received SMS and moves the vibrators in accordance with the letters so that blind people can understand.The second category is for deaf people who can hear. The proposed work adopts a sound bite hearing technology to assist deaf people in hearing the audios. The deaf person can use the call switch to make a GSM call and also hear the audio from the other person by applying the sound bite hearing technology.

Power Supply

The AC power employing the step down transformer and a rectifier to convert the AC to DC is employed in the proposed work. Figure 3 represents the process involved in the regulated power supply. The transformer accepts the 230V AC power supply which is stepped down using the transformer and is converted to the DC using the rectifier. The mathematical relationship among the rectified DC and the input AC power is illustrated in equation 1.

$$V_{o(R)} = \alpha^{-1}(V_i) \quad (1)$$

Where, $V_{o(R)}$ is the regulated output voltage, while the α is the factor by the which the input voltage is stepped down. The α is determined by the number of turns in the transformer and is represented in equations 2 and 3 respectively.

$$\alpha = \frac{V_p}{V_s} = \frac{N_p}{N_s} \quad (2)$$

$$\alpha = V_p I_p = V_s I_s \quad (3)$$





Kanimozhi et al.,

The bridge rectifier can be built from four individual diodes, but it is also available in special packages that include all four diodes. A full-wave rectifier [12] is so named because it employs the entire alternating current wave (including positive and negative regions). The smoothing process is performed using the capacitor to remove the ripples in the produced DC supply and is shown in the equation 4.

$$C = 5 * \frac{10}{V_s} * f_c \quad (4)$$

Where, C is the smoothing capacitor value, V_s is the secondary voltage and f_c is the cut off frequency. The output 5V DC current is given to the controller of the proposed work and to the vibrator motor to convert the text to the braille system.

Text-to-Braille Conversion Process

The vibration motors [13] play a vital role in the text to the braille language conversion process. An array of 6 vibration motors are employed for the conversion process and the text are converted to the six segment format using the six segment encoding process. The array of 6 vibration motors are connected with the six segment encoding process and the motors are controlled by the voltage produced by these corresponding encoders. The algorithm employed in the text to braille conversion process is illustrated in Table 1. The algorithm illustrated in the Table 1 demonstrates the relationship between the text encoder to the activation of the vibration motors. The vibration motor in turn, drives the push up operation in the screen so that the relevant braille letter/character is created in accordance to the input text.

Communication through GSM Module

The text to braille conversion system shall be applied to the communication process, such that the voltage corresponding to the text created by the encoder is communicated over the channel in the form of digital '0' and '1'. The received signal is then converted to analog voltage, which is fed to the vibration sensor. The vibration sensor drives the braille screen, creating the corresponding braille character or letter in accordance to the transmitted text. GSM networks operate in a variety of carrier frequency ranges (divided into GSM frequency ranges for 2G [14] and UMTS frequency bands for 3G), with the majority of 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands had previously been assigned, the 850 MHz and 1900 MHz bands were utilised in their place. In some nations, the 400 and 450 MHz frequency bands [15] are still allotted since they were previously utilised for first-generation systems. The total channel data rate is 270.833kbit/s, and the frame duration is 4.615ms. The handset's transmission power is limited to a maximum of 2 watts in GSM850/900 and 1 watt in GSM1800/1900.

The network is divided into multiple different sections:

The Base Station Subsystem (base stations and controllers).

The Network and Switching Subsystem (the network component that is most akin to a fixed network). This is sometimes referred to as the core network.

The GPRS Core Network (an optional component that enables packet-based Internet connections).

The operations support system (OSS) [16] for network maintenance.

RESEARCH MODULE RESULT AND ANALYSIS

The proposed method of employing Vibration motor, PIC controller to perform the text to braille system conversion process is very simple when compared to the existing methodologies. The converted braille character shall be communicated via GSM module [17] and shall be displayed in the screen. This feature, enables the system shall be employed in the real time communication system, thus assisting the communication impaired people to make use of communication device effectively for the communication purposes. The overview of the proposed work is depicted in the Figure 3.



**Kanimozhi et al.,**

The prototype depicted in Figure 3 is composed of the vibration motors, step down transformer and a regulator circuit as a part of power supply unit. The input text shall be viewed with the help of LCD screen [18] and the corresponding braille character shall be viewed using the braille output unit at the top right corner. A GSM module is connected to this prototype, which assists in communicating the braille character to the receiver end. The proposed model has been put to the test by transmitting messages from a mobile phone [19], and the vibration pattern produced by the Braille display unit was validated in terms of universal braille code format. Consider sending the text "GOOD" as SMS in the Text to Braille converter device [20], as shown in the Figure 4. When sending a text message, there is a precise format that must be followed. The message must begin with an asterisk (*) and end with a hash (#). Its purpose is to mark the beginning and conclusion of the message, which will help the processor understand from which character the conversion process should begin and where it should terminate. The sent text is encoded and is converted into its equivalent braille character using the proposed work. A sample of letter "D" is depicted here in Figure 5.

Analysis of the Proposed Work

The proposed work of converting the text to braille system is analyzed for its accuracy in conversion and the error rate during the data communication. This section describes the comparative analysis of the proposed work with the existing methodologies in terms of accuracy and the error rate. The comparison of the accuracy with various set of text characters are compared with the existing methods of converting text to the braille system. On an example, the 5000 number of text characters on conversion using various strategies experiences an accuracy of 55.68%, 65.02%, 69.11% when compared with the 71.01% for the proposed work. This proves that the accuracy of the proposed work is ahead of the existing methodologies in terms of the conversion of text to the braille characters. The graphical representation of the above mentioned comparison is depicted in Figure 6.

The converted text to braille characters are communicated over the medium to another device of the communication impaired person. The error rate is a predominant factor to be measured, which indirectly influences the accuracy of the proposed work. The error rate is measured and is summarized in the Table 3. The error is created due to multiple factors like, dissimilarities in the threshold voltage created in the encoding process, the communication environment and the external additive noises. The average error rate for a 5000 number of text characters are 44.32%, 34.98%, 30.89% and 28.99 for the proposed work when compared with the existing methodologies. With this analysis, it is clear that the proposed work stands ahead in terms of accuracy during the conversion of the text to the braille character systems.

CONCLUSION

The braille system is the biggest solution for the communication impaired person to communicate with other persons. This braille system is applicable only at the level of paper format and is not extended to any of the advanced communication devices. Due to the major setback in implementing the braille system in the communication device, the communication impaired persons are unable to step forward to the present advanced technologies. To overcome this concern, this research work was proposed. The proposed work employs PIC controller, vibration motor and relays to perform the text to braille character conversion process. This proposed work shall be used between any two disabled person or between a normal person and the disable person. The level of accuracy is determined and is found to be 80.11% for 1000 input text characters with a minimal error rate of 19.89%. This error rate could be further minimized by the introduction of novel and lossless encoding system, such that the threshold voltage shall be generated without any misconception. This proposed work shall also be enhanced by connecting it to the hearing aid and by pronouncing the incoming text with a proper set of trained database.



**Kanimozhi et al.,****REFERENCES**

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Table 1: Algorithm for Text-to-Braille conversion

Algorithm: Text-to-Braille conversion Input: Text (T) Output: Braille System (B) Processes: Initialize the text encoding process t[n] Initialize the array of Vibration motors V[n] If (t[n] _{1&&2} >V _{th}); then, (V[n] _{1&&2} =V _{th}) else return, "no text entered" If (t[n] _{3&&4} >V _{th}); then, (V[n] _{3&&4} =V _{th}) else return, "no text entered" If (t[n] _{5&&6} >V _{th}); then, (V[n] _{5&&6} =V _{th}) else return, "no text entered" end if end if return, V[n]=V _{th} end process
--

Table 2: Comparison of Accuracy

No. of Characters	A.Saxena [1]	P.Kaur [2]	S.Kumari [3]	Proposed Work
1000	66.21	72.59	75.02	80.11
2000	64.58	69.62	74.95	78.51
3000	61.25	68.15	72.65	77.54
4000	59.75	66.75	70.65	74.20
5000	55.68	65.02	69.11	71.01

Table 3: Comparison of Error Rate

No. of Characters	A.Saxena [1]	P.Kaur [2]	S.Kumari [3]	Proposed Work
1000	33.79	27.41	24.98	19.89





Kanimozhi et al.,

2000	35.42	30.38	25.05	21.49
3000	38.75	31.85	27.35	22.46
4000	40.25	33.25	29.35	25.8
5000	44.32	34.98	30.89	28.99

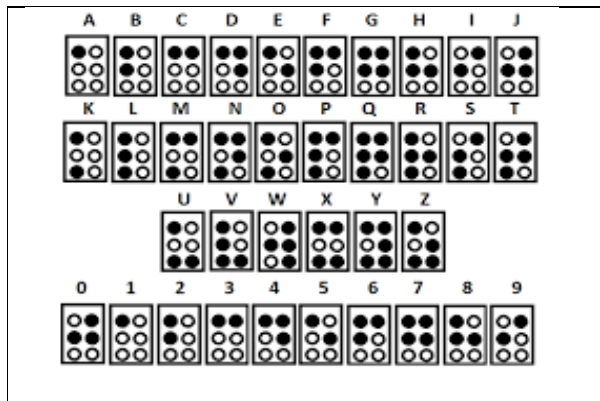


Figure 1: Braille System (Source: Google)

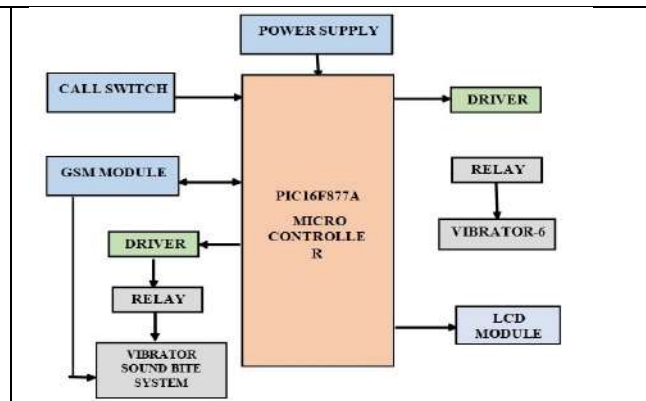


Fig 2: Architecture of the proposed work

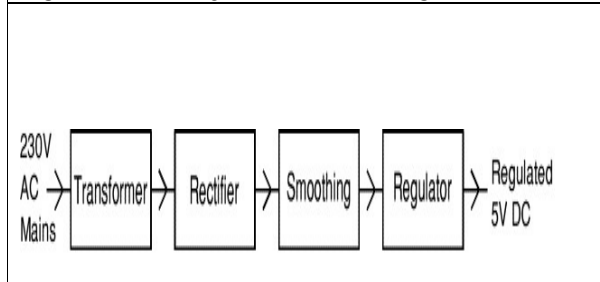


Fig 3: Regulated Power Supply

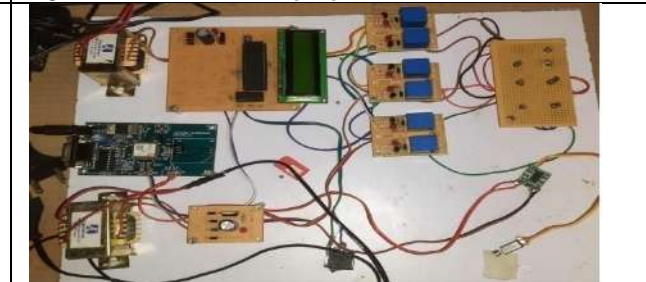


Fig 3: Prototype view of the proposed work

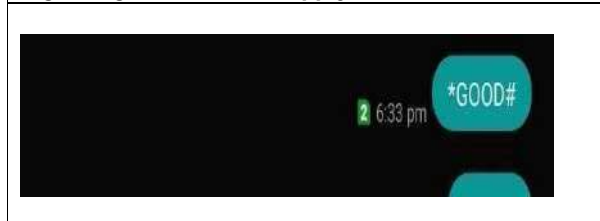


Fig 4: Prototype view of the proposed work

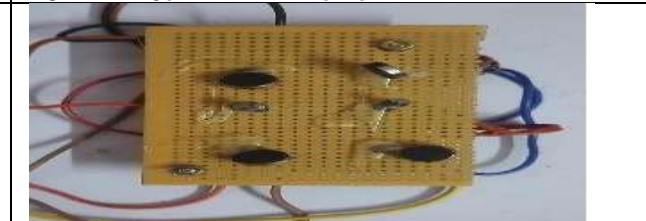


Fig 5: Prototype view displaying the letter "D"

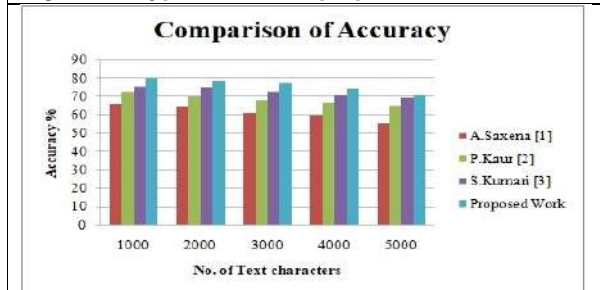


Fig 6: Comparison of Accuracy in conversion

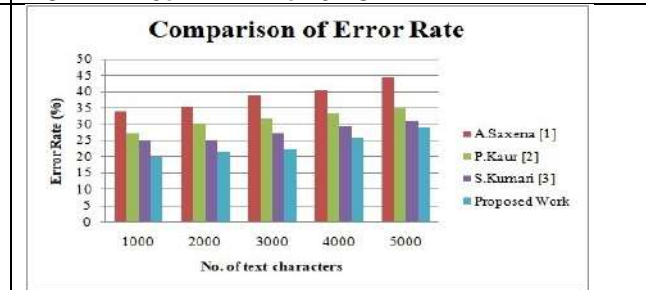


Fig 7: Comparison of Error Rate in conversion





Translation as Recreation: On the Experience of Translating Kannada Vachanas to English.

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ABSTRACT

Working within the framework of Translation Studies, this paper attempts to examine the problems faced by a practitioner of translation whilst translating modern Kannada *vachanas* to English. The paper is based on the practical experience of translating around fifty modern Kannada *vachanas* to English. The fundamental question that this paper raises is - what are the issues that a translator has to grapple with, in the dialogue between the source language and the target language while attempting to locate meaning, vis-à-vis the translation of Kannada *vachanas* to English. The paper attempts to examine the lexical, morphological, syntactic, stylistic and semantic issues that arise while translating Kannada *vachanas* to English owing to the unique structural artifact that *vachanas* are. The paper argues that the obligation for equivalence in lexicon, syntax, style and semantics pose an equally unique challenge to the translator. The translator, in such a context, finds recreation rather than transliteration as a mode of locating and conveying meaning.

Keywords: translation, dialogue, meaning, equivalence, recreation

INTRODUCTION

Translation Studies forms an important area of intercultural inquiry in the post- modern scenario. Translation recognizes the diversities in languages and cultures that constitute our world. The translation of a work from one language to another not only makes that work accessible to a new culture but also forms a cultural bridge between two cultures. In the post- global space, there has been a surge in people's interest to know other languages and

58536





Sojan

literatures. In this context, translation as praxis, translation as theory and translation studies as discipline, have assumed great significance. Most writers of prose, poetry, novel, plays and other genres would argue that writing is a difficult task. On the other hand, practitioners of translation too would state that translation is an even more complex activity as the translator is bound by the obligation of faithfulness to the original text. A few definitions on translation could help one understand what translation does or what it is supposed to do. Nida Eugene and Taber (1969:12) have observed that "Translation consists in reproducing in the receptor language the closest natural equivalent of the source language message, first in terms of meaning and secondly in terms of style." In the words of Catford (1965:20) "Translation is the replacement of textual material in one language by equivalent textual material in another language." Nord Christiane (2007: 182) defines translation as "the production of a functional target text maintaining a relationship with a given source text that is specified according to the intended or demanded function of the target text." The quintessence of good translation, as we understand through the above definitions, is to reproduce or recreate textual material in the target language (TL) with adherence to equivalence in the source language (SL), both structurally and semantically.

Vachanas The twelfth century has been a milestone in the history of Kannada Literature for it was during this period that the literary world witnessed the genesis of a new brand of poetry called the vachanas. The credit for this new form of literature should go to Basava and the other "sharanas" (devotees) who during their lifetime embarked on a socio-religious revolution in society. The sharanas of the Veerashaiva movement have chronicled their experiences and the path towards divinity in this unique form of literature. The vachanas are basically short poems that are epigrammatic in nature with unique qualities of poetic values and nobility of thought. According to Chandrashekarayya (1996:02) "Vachanas, a form of literature in Kannada, are termed as cryptic sayings or musings. They also are pithy sayings couched in thoughts and actions subime, emotions and experience divine." E. P Rice (1982: 04) characterizes vachanas as "brief parallelistic allusive poems, each ending with one of the popular local names of the god Shiva and preaching the common-folk detachment from worldly pleasure and adherence to devotion to the god Shiva (*shivabhakti*)." The hallmarks of vachanas are its sublimity, exquisite beauty, didactic value and fine strains of poetry. The vachanas have permeated the society insuch an encompassing way that they are on the lips of the literate and illiterate alike. They appealto the erudite because of profundity of thought and to the laymen because of their simplicity of diction, meaning and appeal. Since vachanas epitomize the pressing problems – social, philosophical, religious, and economic – their educative value and importance has remained undiminished.

Vachanas and the Terrain of Translation There have been considerable attempts to translate Kannada vachanas to English in the past, the most significant being *Speaking of Siva* by A. K. Ramanujan (Penguin Classics, 1973). The Basava Samiti (the Committee on Basava) has translated 2500 vachanas from Kannada into English, Marathi, Tamil, Telugu, Sanskrit, Urdu, Punjabi and Bengali (The Hindu, Oct 20, 2012). The vachanas of Allama Prabhu have been translated by H. S. Shivaprakash under the title *I Keep Vigil of Rudra: The Vachanas* (Penguin Classics, 2011). Translators like Vijaya Guttal, Laxmi Chandrashekar, Tharakeshwar V. B and

O. L. Nagabhushana Swamy have translated the 12th Century Kannada vachanas into English.

On the other hand, the vachanas of the 12th Century have also been a source of inspiration for many Kannada poets, who have strived to keep the vachana tradition alive and thriving. S. V. Parameshwara Bhatta's *Uppu Kadal*, *Pamara* and *Umbara*, S. V. Ranganna's *Ranga Binnapa*, Gundmi Chandrashekar Aithal's *Matrusamhite*, Siddaiah Puranik's *Vachanoddhana* and *Vachana Nandana* and Amrutha Someshwara's *Hrudaya Vachana* are some of the prominent examples of vachanas in the modern period. Chandraiah Naidu, a prolific *vachanakara* (composer of vachanas), who wrote 1658 vachanas in Kannada, passed away in the year 2011. The complete Vachanas of Naidu titled *Vachana Vallari* was published posthumously in November 2012 (The Indian Express, 12th November 2012). Some of the major anthologies of Naidu are *Vachana Veechi* (1991), *Vachana Veene* (1994), *Vachana Vani* (1996), *Vachana Hrudaya* (2003), *Vachana Darshana* (2003) and *Vachanabhinandana* (2004).





Sojan

Problematizing Translation This article is based on the experience of translation of about fifty vachanas of Naidu¹ from Kannada (SL) to English (TL). The attempt has been to examine the “experience” of translation vis-à-vis the vachanas translated from the source language to the target language. A meaningful translation can be said to take place between two cognate languages like, say Telugu and Kannada, where the syntax, idioms and expressions are quite similar. With fairly good command over the source and target languages, their idiomatic expressions, an appreciation of the socio-cultural nuances, the subtleties and peculiarities of syntax, one can claim fairness to art of “translation.”

In this backdrop, this article attempts to raise the following questions:

The problem of obligation to equivalence

The lexical, syntactic morphological, stylistic and semantic issues that arise while translating Kannada vachanas to English.

The issues of a translator while dealing with two non-cognate languages.

The questions of faithfulness to the original.

The Ankitanama or the Signature Line A fundamental issue that had to be addressed at the outset was the question of the *ankitanama* or the signature line. Each writer of Vachanas invokes, usually at the end, Lord Shiva through one of his diverse names. As C. S. Nanjundiah (2000: 82-83) observes “...for him/her that name carries the power and spirit of the original deity. This personal god is subsumed under the original god and hence both of them become one and the same.” Basavanna’s *Kudala Sangama*, Akka Mahadevi’s *Chennamallikarjuna*, Allama Prabhu’s *Guheshwara*, S. V. Parameshwara Bhatta’s *Sadashiva Guru*, Siddaiah Puranik’s *Swatantra Dheera Siddeshwara* are all examples of the poet’s personal manifestations of Lord Shiva, the signature line. Naidu has used “*Satyapriya*” as the signature line of a majority of his vachanas. The signature line or the *ankitanama* in the vachanas has been contentious among scholars, and, there has been no complete resolution of this debate. A. K. Ramanujan in his translation of the Kannada vachanas goes with an anglicized version of the Kannada signature line. For him, *Kudala Sangama Deva* becomes „Lord of the Meeting Rivers,” *Chennamallikarjuna* becomes „Lord, White as Jasmine” and Allama’s *Guheshwara* the „Lord of the Caves.” The trend perceptible here is to provide a summation of the *ankitanama* in English with adherence to its nearest equivalent. Therefore „*guhe*” (caves) and *Eshwara* (Lord) metamorphose into “Lord of the Caves.”

In the course of my translation, I did not succumb to the temptation of translating “*Satyapriya*” as “*Lover of Truth*”, although such a translation would in my view be adequate. I have stuck to “*Satyapriya*”² going by the view that names of gods in the source language cannot be presented in summation in the target language. The stand herein was that the „compulsion of nearest equivalence” does not hold water in the case of names. Naidu uses three different invocations of *Satyapriya*. For instance in the verses “Free them, O Lord, from the shackles of reservation/For, can the sun be monopolized?/O Lord, *Satyapriya*.” (Vachana Vani, 06) he addresses invokes Shiva as “*Deva*” translated above as „O Lord.” Elsewhere in the verses “Widen, O Master *Satyapriya*/The horizons of human mind.” (Vachana Vani, 61) he invokes his personal god as “*Guru*” translated above as „O Master.” Also, in the verses “Show me to value the riches of virtue/O my father *Satyapriya*!” (Vachana Vani, 71) he invokes Shiva as his “*thande*” translated into English as „father.” Whatever the variation in invocation, in the translation of Naidu’s Vachanas I have stuck to the original *ankitanama* and not to the verbatim, as I felt that that the essence and luster of the original would be lost in translation.

The Question of Equivalence Another question this article raises is the question of “equivalence.” A translator has an obligation to reproduce in the receptor language “the closest natural equivalent of the source language” The vachanas of Naidu makes regular use of the word “*ayya*.” In fact, of the fifty Vachanas that I translated, nearly forty vachanas have the word “*ayya*” suffixed to another word at the end of the line. “*Ayya*” is used to mean “father” or “master” by the people of some regions in Karnataka but it is generally an honorific term, as in the case of “*yenayya*” (what) or “*barayya*” (come). This is a good example of morphological synthesis in the source language that does not have natural equivalence in the target language. This deficit, naturally, affects the output in the source language. The example given below would demonstrate this “deficit of a closest natural equivalent” and its corollary impact on the translation:





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Yesu Krista Christiannarige meesalenayya? (SL)/ Is Christ reserved for the Christians? (TL) Pagaimbararu Muslimarige meesalenayya? (SL)/ Is Paigamber reserved for the Muslims? (TL) Ramakrishnaru Hindugalige meesalenayya? (SL)/Are Rama-Krishna reserved for the Hindus? (TL)

Firstly, we see how the economy of words gets affected. While "*Muslimarige*" is one word in the source language, it has been translated with three words in the target language – "for the Muslims." It is due to the difference in the morphological patterns of the two languages. Secondly, while "*meesalu*" has been translated as "reserved," the honorific *enayya* has been lost in translation. On the one hand, this deficit of equivalence has altered the syntactic arrangement of the verse. On the other, the untranslatability of "*meesalenayya*" has rendered the translation of the vachana more prosaic than poetic. While in Kannada the verse oozes poetry, the same verse in English sounds more like a rhetorical question rather than a verse of poetry. Similarly day-to-day terms like "Akashavani" or "Dooradarshan", have been retained in its original form as its translations like "the voice from the sky" for "Akashavani" "distant vision" for "Dooradarshan" would render the translation meaningless.

The lexical, morphological, syntactic, stylistic and semantic issues: A question that this article intends to raise is the lexical, morphological, syntactic, stylistic and semantic issues that arise while translating Kannada vachanas to English. The Kannada vachanas are known for its terseness. Its terse structure is one of the prime reasons for the elegance, the sweetness and the lucidity of the Vachanas. E. P. Rice had drawn attention to the "parallelistic" structure of the Vachanas. Let us consider the example of the forty ninth vachana from *Vachana Vecchi*. The first line of the vachana consisting of just two words: "*Vaadisona, vicharavadigalodane*" was transcreated as "Let's argue, with the rationalists." In terms of lexicon, whereas in Kannada two words would suffice to create meaning, it needed five words in English for a semantic equivalence! Syntactically, though the bipartite structure of the verse had been maintained, the terseness of the Vachana was inadequately captured in translation. The solution was to be as economic as possible in the use of words without compromising the meaning of the original.

It is also pertinent to note the culture-specificity in the use of the verbs in the Vachanas of Naidu. The Kannada verbs such as "*kaanu*" or "*nodu*," (see) "*kelu*" (hear), "*thorisu*" (show). "*hechchisu*" (increase) "*madu*" (make) etc are easily inflected as "*kaana*", "*nodaa*", "*kelaa*", "*thorisa*", "*hechchisaa*", or "*maada*" as in the example "*Ee mrugagalinda sajjanara, paaru maada Prabhuve Satyapriya*." Naidu inflects the word "*maada*" both as a verb and as a gender denoting term; a morphological synthesis possible in Kannada but not possible in English. The translation of the above sentence in English was "Save the righteous, O Lord Satyapriya, from these perilous beasts." Here again we seen an inevitable constraint of changing the syntactic order of the original to achieve meaning in the translation.

The question of faithfulness to the original: An effective translation strives for "the closest natural equivalent of the source language message, first in terms of meaning and secondly in terms of style" (Nida Eugene and Taber, 12). One of the central arguments of this paper is that "transcreation" is acceptable, even inevitable, while dealing with two non-cognate languages like English and Kannada as long as it does not semantically impact faithfulness to the original. Consider the following example: In the target language, the question "what is the use of" has been supplanted as equivalent for the oft-repeated "*doddadiddarenu*." While the style has been disrupted in the target language, the tenverse structure has been maintained in both the SL and the TL. Though there is a slight alteration in structure and style, the nearest equivalent in meaning (semantics) has been reasonably retained.

Conclusion: Translation theory recognizes that different languages encode meaning in different ways. However, translation theory also guides practitioners of translation to find appropriate ways of preserving meaning. Through an examination of the translation of Kannada vachanas to English, this article has attempted to explore the problems of finding closest natural equivalence, especially in the terrain of cross-cultural translation. The process of a cross-cultural transmission is an ongoing transcreational exercise in which alterations, omissions, approximations and subversions are permissible as long as the harmony between the signifier and signified is not disrupted and the substance of meaning reaches the target audience.





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Notes

1. I have translated fifty vachanas of Chandraiah Naidu from Kannada to English.
2. It has been published under the title *Nudi Nade*.
3. Naidu preferred retention of the *ankitanama* „Satyapriya“ rather than „Lover of Truth.“

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Source Language (Kannada)	Target Language (English)
<i>Desha doddadiddarenu Deha doddadiddarenu Mane doddadiddarenu</i>	What's the use of An expansive nation A study physique
<i>Mandira doddadiddarenu Igarji doddadiddarenu Masidi doddadiddarenu</i>	A palatial bungalow A huge temple A big church A big mosque, if
<i>Manasu doddadaaguva tanaka Ivugalige Mahatvavilla nodaa Manushyanalliruva manasugalannu Doddadaagisaa Satyapriya Guruve</i>	The mind be narrow, parochial Widen, O Master Satyapriya The horizons of human mind





A Study on Consumer Attitude towards Eco-Friendly Products in Chennai City

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ABSTRACT

Actually ecological change issues have come to the extremely front. The challenge of environmental change is global. It poses a threat to social and financial stability as well as viable human life. There is no doubt that ecological change impacts the significant need for prosperity - clean air, safe drinking water, sufficient green food and got cover. When adapting to changes in the environment, numerous measures must be anticipated and considered. According to the survey, customers are a great deal of tricky in two or three components. These variables include the customer's steadfastness regarding a green product, a hazardous atmospheric deviance and natural well-being, the nature of the product, concern regarding additional cost and extravagance, and ecological consciousness. The devotion of the customer is the primary factor in the buyer's decision to purchase a green product. Therefore, the time has come to introduce the concept of green marketing to children. We ought to find an opportunity to work on thing's display and support our client's dedication to green thing.

Keywords: Green product, Green consumer, Corporate Social responsibility, Green marketing.

INTRODUCTION

"Green" is the outflow of the day and "Green Advancing" and "Green Things" are destiny of the current creators and sponsors. Rapidly changing environment is by and by a central concern for people generally through world, making them progressively more stressed over the environment. To have a plausible, defilement free environment, it is principal to execute green advancing, so people are shown in such way whatever amount as could be anticipated. Along these lines, it might be genuinely declared that today people are beginning to figure out their work and commitments towards the environment. But this change isn't continuing quickly, it is working. Associations are looking towards getting an edge in the green market industry by endeavoring to repackage their things into a more environmental cheerful thing. They are dispensing with extra things and wasted materials and changing their

58541





Narmadha

errands into more capable and green movement. Associations are in like manner starting to show the larger part with a development in advancing that puts highlight on green things and how they are more valuable for the purchasers.

LITERATURE SURVEY

The subject of green exhibiting is gigantic, having critical consequences for business technique and public system. Clearly, green publicizing is a vital piece of the all around corporate procedure (Menon and Menon, 1997). Green exhibiting moreover ties personally with issues of present day science and regular reasonability, for instance, extended creators commitment, life-cycle examination, material use and resource streams, and eco-efficiency. In the ongoing circumstance, the extraordinary concentrate now-a-days is to keep the clients as well as customers in wrinkle and even gatekeeper our standard territory Which is the best need of the time. In general evidence shows people are stressed over the environment and are significantly impacting their approach to acting. Associations could lose various dependable and helpful clients due to nonattendance of green organization. In the present leading industry of high advancement on account of creating neighborhood purchaser interests in green and socially proficient things, squeezed associations to consolidate externalities, for instance, clinical issues, neighborhood comfort, ecological change; regular and authoritative endorses and drives; inventive progressions and approaches of overseeing tainting, further created resource and energy adequacy, and to hold old (relentless and useful) clients and buyers, it is especially critical to complete green showcasing. As a result, green organization gives new environment warm clients which lead to augment in arrangements and advantages of an affiliation that further prompts improvement and advancement of business. This works on the public image of the association. There are various off track decisions about Green Things that hurt the assumptions for green things like that such things are of lower quality or don't really finish their biological promises (Bloom, 2004, p. 79).

Understood from one side of the planet to the other people are stressed over the environment and are altering their approach to acting. Different managerial bodies and acts are set to ensure regular security and confirmation, some of which consolidate, OSHA (Work related Prosperity and prosperity Act), CERCLA (Intensive natural Response Pay liability Act), TSCA (Noxious Substance Control Act), HMTA (the Perilous Material Transportation Act), FIFRA (Government Bug toxic substance, Fungicide and Rodenticide Act), FFDCA (Administrative food, Drug and Restorative Exhibit, Clean Air Act, Clean Water Act, GHS (Overall Organized Game plan of Request and naming of Chemicals). Worldwide evidence shows people are stressed over the environment and are significantly impacting their approach to acting. The examinations show the associations between air poisons and low birth weight, unfavorable birth, really birth and infant youngster passing. As resources are confined and human requirements are boundless, the sponsors truly should totally utilize the resources for achieve the various leveled targets. There is extending interest among the clients across the globe with respect to the question of protection of environment. Accordingly, green exhibiting is certain. Accordingly, green publicizing has emerged which addresses creating business area for plausible and socially careful things and organization

Research Gap

The researcher has reviewed so many articles. Based on the previous studies, the researcher found research gap. Very limited studies only carried out in this topic in Chennai city in the recent times. The researcher has taken and connected different variables for the analytical part of the study.

Need and Significance of Green marketing

The subject of green showcasing is tremendous, having significant ramifications for business procedure and public strategy. Obviously, green advertising is an integral part of the by and large corporate technique (Menon and Menon, 1997). Green showcasing likewise ties intimately with issues of modern biology and natural manageability, for example, expanded makers obligation, life-cycle investigation, material use and asset streams, and eco-productivity. In the current situation, the great concentrate now-a-days is to keep the clients as well as shoppers in crease and





Narmadha

even guard our regular habitat Which is the greatest need of the time. Overall proof shows individuals are worried about the climate and are changing their way of behaving. Organizations might lose numerous reliable and beneficial clients because of nonattendance of green administration. In the present spearheading industry of high innovation because of developing local area and buyer intrigues in green and socially capable items, pressed organizations to incorporate externalities, for example, medical problems, neighborhood convenience, environmental change; natural and legislative sanctions and drives; imaginative advancements and approaches of managing contamination, further developed asset and energy effectiveness, and to hold old (steadfast and productive) clients and purchasers, carrying out green marketing is particularly dire. As an outcome, green administration gives new climate cordial clients which lead to increment in deals and benefits of an association that further prompts development and development of business. This improves the public picture of the organization. There are numerous misguided judgments about Green Items that hurt the expectations for green items like that such items are of lower quality or don't actually follow through on their ecological promises (Blossom, 2004, p. 79).

Realized all around the world individuals are worried about the climate and are changing their way of behaving. Different administrative bodies and acts are set to guarantee natural security and assurance, some of which incorporate, OSHA (Work related Wellbeing and wellbeing Act), CERCLA (Thorough ecological Answer Pay responsibility Act), TSCA (Poisonous Substance Control Act), HMTA (the Unsafe Material Transportation Act), FIFRA (Government Insect poison, Fungicide and Rodenticide Act), FFDC (Bureaucratic food, Medication and Corrective Demonstration, Clean Air Act, Clean Water Act, GHS (Worldwide Orchestrated Arrangement of Order and naming of Chemicals). Worldwide proof shows individuals are worried about the climate and are changing their way of behaving. The investigations show the connections between air toxins and low birth weight, untimely birth, actually birth and newborn child passing. As assets are restricted and human needs are limitless, the advertisers really must completely use the assets to accomplish the hierarchical targets. There is expanding interest among the customers across the globe regarding the matter of insurance of climate. Thus, green showcasing is undeniable. Thus, green advertising has arisen which represents developing business sector for feasible and socially mindful items and administration

Objectives of the Study

- To study the consumer attitude for Eco-friendly products.
- To identify the factor that influences consumer to purchase green product.
- To know the opinion about the price of Eco-friendly product.
- To identify the attractive media of advertisement of Eco-friendly products.

Sample Size

The researcher has taken 120 respondents for the present study.

Limitations of the Study

- The study is limited to Chennai City Only.
- The study is restricted to 120 respondents only.

RESEARCH DESIGN AND METHODOLOGY

The research design is useful for conducting the research work. The research design adopted for this study is empirical. Primary data is the chief source for the research work. In this study, questionnaire method has been used to collect the primary data. Secondary data collected from journals, books, other projects and websites. The sampling design of the study was conducted by convenient sampling method.





Narmadha

Interpretation

It is inferred from the above table that, out of 120 respondents, 17% of them comes under the qualification of school level. 38% of the respondents falls under the qualification of UG Degree. 27% of the respondents comes under the qualification of PG Degree and 18% of the respondents are Others.

Interpretation

It is inferred from the above table that, out of 120 respondents, 7% of them are having 1 to 2 members in a family. 53% of the respondent's family include 3 to 4 members. 27% of the respondent's family include 4 to 6 members and 13% of the respondents of family include Above 6 members.

Interpretation

It is inferred from the above table that, out of 120 respondents, 12% of the respondents awareness is very high. 20% of the respondent's awareness are high. 50% of the respondents Awareness is Moderate of and 27% of the respondent's awareness are too low.

Interpretation

It is inferred from the above table that, out of 120 respondents, 70% of the people are influenced by the media of Television. 11% of the respondents are influenced by the media of Radio. 13% of the respondents are influenced by the media of Newspaper and 6% of the respondents are influenced by the media of Trade fair and exhibitions.

Correlation: Cross Table between the Occupations with Opinion about Reason for Purchasing Eco-Friendly Products

$$r = \frac{\sum XY}{\sqrt{\sum X^2 \sum Y^2}}$$

$$r = \frac{210}{\sqrt{2520 \times 846}}$$

$$r = \frac{210}{\sqrt{2131920}}$$

$$r = \frac{210}{1460.10}$$

$$r = 0.143$$

Interpretation

From the above table, it could be clearly observed that the 0.143% of the respondents between the occupation and opinion on about the reason for purchasing eco-friendly products.

CONCLUSION AND RECOMMENDATIONS

This take a look at changed into performed to apprehend the customer mindset in the direction of inexperienced advertising and to discover the elements associated with the notion and motivation to buy inexperienced product with the aid of using the customer in Chennai City. Majority of the human beings aren't aware about inexperienced product and their uses. Consumer's loyalty is the maximum essential issue used to take choice for buying inexperienced product with the aid of using the customer. Though it isn't clean to the overall human beings what type of advantage are related to in environmental pleasant merchandise however the take a look at display that because of worldwide warming customer are fascinated to buy inexperienced product. The different elements are best of product, more price, use as luxurious or displaying off nature and environmental attention etc. We can





Narmadha

encourage our customers in the direction of inexperienced advertising with the aid of using distinctive attention program. For inexperienced advertising to be powerful we should keep 3 things; be genuine, train our clients and deliver them possibility to practice. Marketers want to apprehend the consequences of inexperienced advertising. If we assume clients aren't involved approximately environmental troubles or will now no longer pay a top class for merchandise which might be greater eco responsible, assume again. We have to locate an possibility to decorate product's overall performance and fortify our customer's loyalty. Green advertising continues to be in its infancy and there's an adequate scope to behavior take a look at in addition on any other institution of human beings to discover greater influencing elements on this regard.

Scope for Further Research

- The study may be conducted in other cities
- The researcher may cover a greater number of respondents.
- The researcher may add more variables for the analytical part of the study.

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Table 1: Educational Qualification of the Respondents

Educational Qualification	Respondents	Percentage
School Level	21	17
UG Degree	45	38
PG Degree	33	27
Others	21	18
Total	120	100

Source: Primary Data

Table 2: The Family Members of the Respondents

Family Members	Respondents	Percentage
1 to 2 members	8	7
3 to 4 members	64	53
4 to 6 members	32	27
Above 6 members	16	13
Total	120	100

Source: Primary Data





Narmadha

Table 3: Reason for Selecting the Particular Brand by the Respondents

Level of awareness	Respondents	Percentage
Very High	14	12
High	24	20
Moderate	50	41
Low	32	27
Total	120	100

Source: Primary Data

Table 4: Influencing Media by the Respondents

Media of awareness	Respondents	Percentage
Television	72	60
Radio	18	15
Newspaper	24	20
Trade Fair/Exhibitions	6	5
Total	120	100

Correlation: Cross Table between the Occupations with Opinion about Reason for Purchasing Eco-Friendly Products

X	Y	X	Y	XY	X ²	Y ²
72	29	42	-1	-42	1764	1
18	50	-12	20	-240	144	400
24	32	-6	2	-12	36	4
6	9	-24	-21	504	576	441
120	120	0	0	210	2520	846





A Study on Work Life Balance with Special Referencetowards Hinduja Global Solution Ltd.

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ABSTRACT

In an organization, work-life balance refers to the sense of balancing professional and personal life among employees. It is also one of the most challenging tasks for people who are able to meet their obligations in both places while giving time to their own personal engagements. The objective of this paper is to study the existing system of work-life balance for employees in HGS Ltd and to know the various factors that influence work-life balance through a survey of around 50 employees responding to questionnaires. This study found the majority of the employees feel stressed, and they engage themselves in entertainment activities to reduce the stress level. The study concluded that companies need to make efforts to conduct more activities and programs to balance work and life. This paper attempts to identify policies that require employees to balance their personal and professional lives.

Keywords: Work life, Personal, Professional, Employee

INTRODUCTION

Human resource management plays a vital role in providing various aspects for the overall improvement of an employee in an organization, especially training, opportunity, appraisal, safety, and security, with the main aim of achieving an organization's goal. It leads to professional growth and creates opportunities to build a better relationship between the union and management. Employee personal and organizational wellbeing always depends upon how they balance their work and personal lives. Now a days, it's the most essential part, which can also impact the organizational goal. So, in order to avoid risk management, employees should be involved in various



**Lakshmi and Nandini**

work-life balance activities like relaxation exercises, meditation practices, and building supportive work cultures among themselves to improve productivity.

LITERATURE REVIEW

Here the author made efforts to study the employee work-life balance on three different satisfaction levels (Saleh, 2015) The author identified that a poor organizational culture will also have a bad effect on work life balance practices (Ngozi, 2015). The author used the snowball sampling technique to collect data from the millennial generation to study the factors influencing the work-life balance of the employee (Capnary *et al.*, 2018). According to research by V Madhusudhan *et al.* (2013), the following characteristics contribute to work-life balance: dependents, time flexibility, role clarity, coworker support, family culture, working hours, and leadership support. To manage work-life balance, management must focus on time flexibility, clear roles, team support, and working hours. According to Eikhofet *et al.* (2007), re conceptualization is necessary to examine both the relationship between work and life and the work-life balance. This suggests that present work-life balance strategies are naive in how they handle the needs and goals of employees. According to Jawaharani (2011) and Rania.S *et.al* (2011), work-life balance is an important factor in employee happiness, as it contributes to the hiring and retention of skilled labour, decreased absenteeism, decreased employee stress, access to health benefits, job satisfaction, and better life balance. Interpreting data It is obvious that managing both job and family is important for achieving a better balance.

Statement of the Problem

To study the work-life imbalance among the IT professionals in India, identify the problems that it brings into their lives, both personal and professional, and suggest a few ways by which the organizations can help bring back the balance in work and in family life In this generation, the organization desires to find many ways to improve performance. One of the ways to increase employee performance by the job characteristics is to increase employee motivation, satisfaction, and commitment. A study has been done with a sample of 50 employees of HGS for the purposes of validating the concept and arriving at conclusions.

Objectives of the Study

To study the existing system of work-life balance of Employees at HGS

To find out

This study is mainly empirical in nature. Analysis of primary and secondary data combined with the researcher's knowledge and taught towards work-life balance provides a strong base for descriptive analysis. Data was mainly collected from 50 respondents using questionnaire techniques.

Sources of Data Collection Tools**Primary Data**

It is original and first-hand data collected by employees working at HGS Ltd through questionnaire techniques.

Secondary Data

It is second-hand data collected through books, articles, journals, and online sites.

Sample Size

The total sample size is 50 employees working at HGS Ltd.

Sampling Technique

For the study, no probability sampling techniques were used and data was collected from employees who were conveniently available to collect data.



**Lakshmi and Nandini****Techniques for analyzing data**

Data analysis is done through the use of graphs, tables, and percentile analysis.

Limitations of the study

The findings are based on data gathered by HGS employees only. Due to time constraints, the study was restricted to 50 respondents.

Table Graph Interpretation**Analysis and Interpretation**

Table 1 It can be analyzed from the above table that, 34% of employees are between the ages of 18-25, 42% of employees are between 25-35, 24 % of employees are between the ages of 35-45.

Analysis and Interpretation

Table 2 It can be analyzed from the above table that out of 50 respondents, 30% of employees are Male, 70% of employees are Female.

Analysis and Interpretation

Table 3 It can be analyzed from the above table that out of 50 respondents 4% of employees are PU/diploma, 90% of the employees are Graduates, and 6% of the employees are Others.

Analysis and Interpretation

Table 4 According to the above table, out of 50 respondents, 6% work in the HR department, 54% work in the Operations Department, 10% work in the Training Department, 4% work in the Quality Department, and 26% work in other departments.

Analysis and Interpretation

Table 5 As can be seen from the above table, out of 50 respondents, 64% of employees work for 5 days in a week, 34% of employees work for 6 days in a week, and 2% of employees work for 7 days in a week.

Analysis and Interpretation

Table 6 According to the above table, 70% of the employees confirmed that they work on weekends and holidays, while 30% of the employees do not work on weekends and holidays.

Analysis and Interpretation

Table 7 From the above table, we see that out of 50 respondents, 2% of the employees always used to lose temper at work, 6% of the employees usually used to lose temper at work, 12% of the employees often used to lose temper at work, 46% of the employees sometimes used to lose temper at work, and 34% of the employees never used to lose temper at work.

Analysis and Interpretation

Table 8 According to the above table, 30% of respondents work on general shifts/day shifts, 12% work on night shifts, and 58% work on both shifts.

Analysis and Interpretation

Table 9 The above table shows that, out of 50 respondents, 36% of the employees work for their personal satisfaction, 32% work for financial independence, 10% work with support from family, and 22% work to learn new things.

The above graph shows that 37.3% of the employees work for their personal satisfaction.



**Lakshmi and Nandini****Analysis and Interpretation**

Table 10 From the above table, we see that, out of 50 respondents, 20% of the employees responded that they never felt tired or depressed about their work, 28% of the employees responded that they rarely felt tired or depressed about their work, 44% of the employees responded that they sometimes felt tired or depressed about their work, 6% of the employees responded that they often felt tired or depressed about their work, and 2% of the employees responded that they always felt tired or depressed about their work. From the above graph, it is clear that 44% of the employees said that sometimes they felt tired or depressed about their work.

Analysis and Interpretation

Table 11 From the above table, it is clear that out of 50 respondents, 10% of the employees responded that they do yoga to manage their stress, 6% responded that they do meditation to manage their stress, 70% of the employees responded that they do entertainment to manage their stress, and 14% responded to others. The above graph shows that 70% of the employees have responded to entertainment to manage stress arising from their work.

Analysis and Interpretation

Table 12 From the above table, it can be seen that out of 50 respondents, 24% of the employees strongly agree that work-life balance policies in organizations should be customized to individual needs. 68% of the employees have agreed that work-life balance policies in organizations should be customized to individual needs, 6% of the employees disagree that work-life balance policies in organizations should not be customized to individual needs. 2% of employees strongly agree that work-life balance policies in organizations should be customized to individual needs. The graph shows that 68% of the employees agree that work-life policies in organizations must be customized to individual needs.

Findings

1. The majority of the employees are female.
2. The majority of the workforce is between the ages of 25 and 35.
3. The majority of the employees are from the operations department.
4. It was found that 58% of the employees work on both the general/day shift and the nightshift.
5. The majority of employees educational qualifications are graduates.
6. It was found that 36% of the employees work to motivate themselves for their personal
7. The majority of the employees sometimes felt tired or depressed about their
8. The majority of the employees chose entertainment to manage their work.
9. The majority of the employees had the time and energy to fulfill their responsibilities outside of work to their satisfaction
10. It was found that 68% of the employees agree that work-life balance policies in the organization must be customized to individual needs.
11. It was found that the partners or children of the employees never complained about not spending quality time with them.
12. The majority of the employees have not suffered from stress related diseases and do not engage themselves in stress-relieving programs.
13. It was found that 84% of the employees find their job exciting and
14. The majority of employees are pleased with how management recognizes them.
15. It was found that 70% of the employees work on weekends and
16. Employees of HGS work for five days in a
17. It was found that the company provides work-life programs for the
18. The majority of the employees sometimes used to lose their temper at work.



**Lakshmi and Nandini****Suggestions**

1. The company must provide more stress-related programs to overcome their problems.
2. Employees should take part in more activities to manage their stress from work.
3. The company can also provide gaming facilities to employees so they don't get tired or depressed from their work.
4. The company can provide more motivational programs to work for their organizational goals.

CONCLUSION

From the analysis and interpretation drawn, we can come to the conclusion that working 24/7 and the stress involved with work affect mental ability, which is a prime concern for employees. The sector is working on balancing work-life balance and employee's commitment to the organization. Through work-life balance, the individual will feel relaxed and organized. It will improve relationships with families and friends, we will be able to make priorities and sacrifices. Leisure time is also added for work-life balance. This research can also assist the organization in balancing work and life. So, companies need to make efforts to develop work-life balance programs to motivate employees. In general, it can be concluded that motivation can significantly impact employee commitment to the organization.

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Lakshmi and Nandini

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Table 1 Showing Age Group Of Respondents

AGE	NO. OF RESPONDANTS	PERCENTAGE %
18-25	17	34%
25-35	21	42%
35-45	12	24%
ABOVE-45	NIL	NIL
TOTAL	50	100%

Table 2 Showing Genders Of Respondents

GENDER	NO. OF RESPONDANTS	PERCENTAGE %
MALE	15	30%
FEMALE	35	70%
TOTAL	50	100%

Table 3 Showing Educational Qualifications Of The Respondents

EDUCATIONAL QUALIFICATION	NO. OF RESPONDANTS	PERCENTAGE %
SSLC	NIL	NIL
PU/DIPLOMA	2	4%
GRADUATE	45	90%
OTHER	3	6%
TOTAL	50	100%

Table 4 Showing Working Departments Of The Respondents

DEPARTMENT	NO. OF RESPONDANTS	PERCENTAGE %
HR	3	6%
OPERATIONS	27	54%
TRAINING	5	10%
QUALITY	2	4%
OTHERS	13	26%
TOTAL	50	100%

Table 5 Showing That No Of Days Employees Works In A Week

WORKING DAYS	NO. OF RESPONDENTS	PERCENTAGE %
LESS THAN 5 DAYS	NIL	NIL
5 DAYS	32	64%
6 DAYS	17	34%
7 DAYS	1	2%
TOTAL	50	100%





Lakshmi and Nandini

Table 6 Showing Working Of Employees During Weekends And Holidays

OPINION	NO. OF RESPONDENTS	PERCENTAGE %
YES	35	70%
NO	15	30%
TOTAL	50	100%

Table 7 Showing Employees Lost Temper At Workplace

OPINION	NO. OF RESPONDENTS	PERCENTAGE %
ALWAYS	1	2%
USUALLY	3	6%
OFTEN	6	12%
SOMETIMES	23	46%
NEVER	17	34%
TOTAL	52	100%

Table 8 Showing Work Shifts Of The Employees At The Company

WORKING SHIFTS	NO. OF RESPONDENTS	PERCENTAGE %
GENERAL/DAY SHIFT	15	30%
NIGHT SHIFT	6	12%
BOTH	29	58%
TOTAL	50	100%

Table 9 Graph showing the factors that Motivates Employees to work

FACTORS	NO. OF RESPONDENTS	PERCENTAGE %
PERSONAL SATISFACTION	18	36%
FINANCIAL INDEPENDENCE	16	32%
SUPPORT FROM FAMILY	5	10%
LEARNING NEW THINGS	11	22%
TOTAL	50	100%

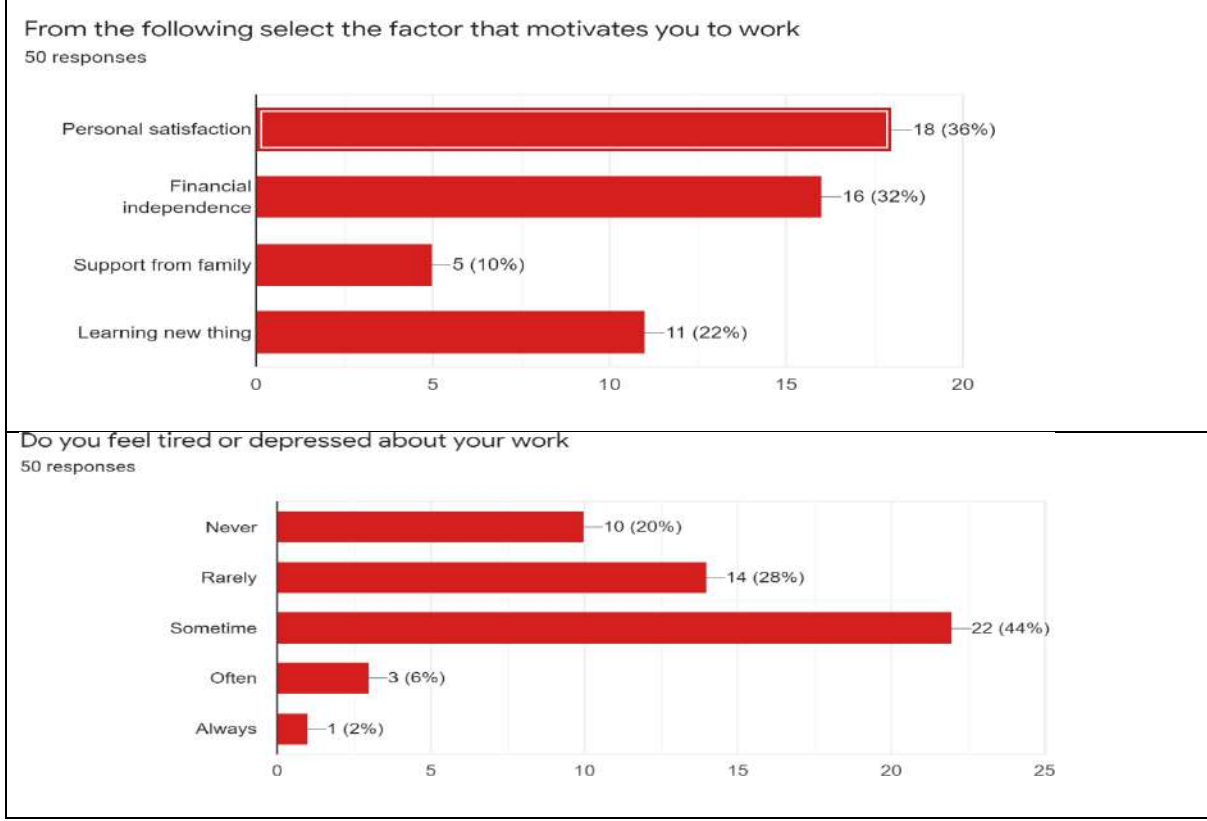
Table 10 And Graph Showing Employees Opinion Towards Depression During Work

OPINION	NO OF RESPONDANTS	PERCENTAGE %
NEVER	10	20%
RARELY	14	28%
SOMETIME	22	44%
OFTEN	3	6%
ALWAYS	1	2%
TOTAL	50	100%





Lakshmi and Nandini





A Novel Hybrid AlexNet-Gated Recurrent Unit (AlexNet-GRU) Model to Detect Lung Cancer

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ABSTRACT

Lung cancer is one of the most dangerous and potentially deadly disease and it is possible to diagnose the lung cancer, by observing the existence of pulmonary nodules in the lungs. The uncontrolled reproduction of lung cells is the primary contributor to this condition. The detection of lung nodules in computed tomography (CT) scan images is an extremely significant step in both the diagnostic process and the screening process for lung cancer. By detecting lung cancer at an earlier stage, patients have a far better chance of surviving the disease and responding well to therapy. Deep learning (DL), on the other hand, excels in feature extraction and has been more popular for applications such as categorization and detection in recent years. In this work, a novel hybrid AlexNet-gated recurrent unit (AlexNet-GRU) model was used for the identification and classification of breast cancer that has spread to the lymph nodes (LN). We classified LN cancer samples by using a well-known Kaggle (PCam) data set. In this research, three models are evaluated and compared: convolutional neural network GRU (CNN-GRU), CNN long short-term memory (CNN-LSTM), and the recommended AlexNet-GRU are all examples of these types of neural networks. According to the findings of the experiments, the performance metrics of the proposed model have significantly better performance than CNGRU and CNN-LSTM models. This means that the proposed model has the potential to reduce the number of pathologist errors that occur during the incorrect classification phase of the diagnostic process. In order to determine whether or not the AlexNet-GRU model is an efficient use of computing resources, it is compared to a large number of other contemporary machine learning and deep learning methods. Based on the findings of the comparison, it can be concluded that the AlexNet-GRU model that was provided makes efficient use of the available computational resources. In addition, the model that has been provided demonstrates its superiority over the approaches that are presently being used for the detection and categorization of LN breast cancer.

Key words: Hybrid Alexnet-Gated Recurrent Unit, Lung cancer, CNN long short-term memory (CNN-LSTM), LN breast cancer.



**Aakash Gupta and Ravi Dhandhukiya**

INTRODUCTION

Cancer is characterized by the uncontrolled growth of cells inside the body, which has the ability to swiftly spread to any organ [1, 2]. Cancer may also be characterized by the fact that it can affect any organ. There are numerous distinct forms of cancer; nevertheless, lung cancer, breast cancer (BC), and skin cancer are the most prevalent types. According to the World Health Organization (WHO), the death ratio for cancer is expected to be as high as 9.2 million for lung cancer, 1.7 million for skin cancer, and 627,000 for breast cancer [3, 4]. 70% of breast cancer cases are identified when the tumour is 30 mm in size [5] Consequently, the size of a breast tumour has a significant influence on a patient's discovery and survival. Several imaging modalities, including X-ray [6], ultrasound [7], and CT scan [8], are used for the identification and categorization of BC. Many techniques, such as early-phase screening, are used by scientists to identify various types of cancer and its symptoms (EPS). In addition to this, they have created ground-breaking methods for the early diagnosis of the prognosis of cancer therapy. Because of the rapid advancement in medical technology, enormous amounts of data relating to cancer have been compiled and made accessible to the field of bioinformatics as well as the wider scientific community for the purposes of testing and analysis. In spite of this, determining the likelihood of a patient developing breast cancer is one of the most intriguing and difficult tasks facing the healthcare industry. This challenge includes the wrong classification that may occur when using these studied diagnostic methods.

The use of medical imaging algorithms is a crucial part of the early stage lung cancer detection strategy, which helps to increase the overall survival rate. On the other hand, these methods have a few drawbacks, such as a high rate of false positives and the inability to automatically identify lesions. There have been many CAD systems created for the purpose of detecting lung cancer [8,9]. The typical structure of a CAD-based lung nodule identification system [10] may be broken down into the following three basic steps, as seen in Figure 1: data collection and pre-processing, training, and testing. There are two distinct kinds of CAD systems: the detection system pinpoints abnormalities in accordance with interest areas, and the diagnostic system evaluates information about lesions, such as their kind, severity, stage, and progression.

LITERATURE REVIEW

The IoMT enables operational and effective patient health monitoring, has the potential to make early sickness detection, and even has the potential to save a person's life by rapidly initiating pharmacological treatment (Awotunde, J.B.; 2021). IoMT facilities have seen an increase in their capabilities as a result of the increased availability of sophisticated sensors, which make it feasible to collect a person's physiological data in a precise and timely manner. Nevertheless, the accuracy of the diagnostic system is dependent not only on the image analysis technique but also on the accurate data in addition to both of those factors. In addition to this, researchers have created DL-based strategies for the scheduling and sequencing of work for IoMT-centered health systems (Lakhan, A.; 2022). The treatments that are required for the traditional method of diagnosing illness are extremely pricey and time demanding. Pathologists today use a computer-aided diagnostic system to help them keep an eye on their patients' health and figure out what's wrong with them. In order to get the abnormal material from the system, an experienced professional is needed.

As a consequence of the dramatic increase in the prevalence of AL and ML, there has been a lot of recent interest in the study of sick images. Because of the rise in the number of people affected by major illnesses all over the globe, there is an increasing need for accurate computer-assisted disease diagnosis. Because the cellular structure in photographs can be different in terms of color, shape, size, and other functional factors, it is difficult to automatically analyze digital images of a tissue sample. This is because the analysis is being performed on a computer. Computer-based analysis using DL has been linked to a significant improvement in the accuracy of disease screening. It is now possible to diagnose diseases by analysing images of histological tissue, as stated in [Tao, X.; 2018]. This is made possible by the development of learning networks that are unusually accurate, such as ConvNet/CNN and Recurrent



**Aakash Gupta and Ravi Dhandhukiya**

Neural Network (RNN). Recent years have seen great achievements in computer vision, especially in biomedical image processing, thanks to DL techniques [Adegun, A.A.; 2021]. This is mostly because to their potential to invariably learn complicated and nuanced patterns from pictures. Thus, many scientists have been motivated to include these methods into their BCH image classification work. CNN in particular is often used in image-associated projects because of its tendency to competently convey parameters transversely over various layers of DL techniques. The Guo et al (2022). developed a CNN-based, hybrid attention mechanism and residual link-based automated lung cancer diagnosis system. The system offered a complete and comprehensive classification network that was built on convolutional neural networks. This network automatically retrieved data, translated them into high-level classifications, and grouped the features into the appropriate classes. Images obtained from clinical scintigraphy were used in the classification process of the multi-class classification network.

Using DL, Shah et al. 2020 created a NoduleNet model for lung nodule classification. This model was used to classify lung nodules. Use of the NoduleNet model in combination with the specialised Visual geometry group (VGG16) and the VGG19 architecture. LDNNET, developed by Chen et al., 2021, is a method for identifying and categorizing lung nodules for the purpose of screening for cancer. A substantial neural network was used to construct this system. The design of the LDNNET system is flexible, and it is composed of three distinct parts: dense block, batch normalisation, and dropout. When evaluated on the LUNA16 dataset as well as the Kaggle DSB 2017 dataset, this network demonstrated satisfactory performance. Another investigation into the segmentation and categorization of lung cancer was carried out by Bansal et al. [2020], and it was based on the LUNA16 dataset. Using ensemble learning, Xu et al. [2022] presented a model for the categorization of lung nodules from CT scans. The YOLOv3 network was trained to recognise lung nodules using a dataset that was made accessible to the public. In contrast, CNN was trained on the same dataset to distinguish between benign and malignant lung nodules. After that, the YOLOv3 and CNN models' data characteristics were used to construct the confidence probability, which was in the form of an ensemble learning. Both publicly available and privately held datasets were analysed, and the results of the confidence probability were included into the logistic regression model. This was done in order to assess whether or not lung nodules are malignant or benign.

In order to categorise lung nodules, Naik et al. [2021] developed an intricate classification method based on fractal networks. For the LUNA16 dataset, the Fractalnet model was used for system training and assessment. The model obtained 94.7% accuracy in its predictions.

RESEARCH METHODOLOGY

In the method that we have developed, the first stage in the process of converting 4D photos to 2D images is called pre-processing. The pictures of the patients are preprocessed, and only three axial slices are taken from each patient. These slices include important data since the centre CT scans contain the greatest quantity of information. In addition, the step of preprocessing that we undertake is important in order to utilise the complete dataset. The LUNA16 dataset was originally 66.3GB in size and can be obtained from the official website of the LUNA16 challenge. After preprocessing, the size of the dataset was reduced to 347MB. After the completion of the preprocessing step, the SSD network was used to perform the localization of the lung cancer lesion. We conducted an analysis of the performance of SSD by altering the backbone network in order to determine which network is most suited for the identification of nodules in the lungs. As our backbone network, we have used the following convolutional networks: MobilenetV1, MobilenetV2, InceptionV2, resnet50, and resnet101. Figure 2 depicts the structure of the suggested methodological approach.



**Aakash Gupta and Ravi Dhandhukiya****Data Collection and Analysis**

Kaggle was used to collect the information on cancer. This dataset is an improved version of the original PCam data set, and it does not include any rows or columns with duplicate data. This collection has a total of 220,901 photographs of lymph node cancer, with patches taken from a total of 400 scanned pictures of slide slides. These photos were collected from 162 women who had cancer and had it detected and tested at the University Medical Center in the Netherlands. The cancer was found in all of these women. Both data sets were used for the purpose of developing an artificial intelligence model. Images of a high quality (2,040 x 1,536 pixels) are included in this batch of data. In order to guarantee uniformity, each slide was scanned using the same scanner at a resolution of 0.25 micro/pr. Pictures of a lesser quality were downsampled to a size of 50 pixels by 50 pixels before being scaled. Eighty percent of the Kaggle dataset has been allocated to a training set, while twenty percent has been allocated to a testing set. This was done to avoid overfitting. According to the findings of empirical study, the best results may be obtained by testing using just 20–30% of the data and then testing using 70–80% of the data. Both the RGB colour space and the PNG file format are used for the picture files.

Data Preprocessing

The importance of preprocessing cannot be overstated in terms of correct classification performance. In most cases, it is performed on the data before it is categorised. Preprocessing steps are needed for the "cancer data set" to improve the model's classification accuracy. Class labeling, image scaling, data augmentation, random cropping, and sliding with the crop are typical preprocessing techniques employed in cancer diagnosis.

Feature extraction

Learning about features is an essential part of the categorization process, and this is true for both humans and computer algorithms. According to the findings of a recent research, the human brain is more attuned to the perception of forms, while computers are more attuned to the perception of patterns and texture. Due of this distinction, the process of learning features manually vs automatically is fundamentally different. When seen under a microscope, malignant tumours often feature nuclei that are big and irregular in shape, or they may have many nuclear structures. Alterations take place in the cytoplasm as well, which results in the formation of novel structures and the disappearance of typical ones. Malignant cells often contain a little quantity of cytoplasm, which is often filled with vacuoles. In this situation, there is a reduction in the proportion of cytoplasm to nucleus. Either specialists evaluate each of these traits, or algorithms are built to quantify each of these features in order to automate the identification process. This method is challenging and inaccurate because the selection and quantification processes entail a variety of unknown flaws that are difficult to account for. When it comes to learning via supervision, it is not necessary for us to convey these characteristics in an explicit manner. In this scenario, photos coupled with a label indicating the image's classification are sent to an architecture such as CNN (Benign or Malignant). The computational features are possible to be extracted using CNN thanks to the automatic updating of filter values that occurs throughout the training phase. In a nutshell, the features that are employed during the testing phase of the model assessment process are dependent on the design of the CNN filters and the weights that are associated with them.

RESULTS AND DISCUSSION

For the purpose of analysing and contrasting cancer picture classification, this research presented three models: CNN-GRU, CNN-LSTM, and the suggested AlexNet-GRU model. Every model is made up of two different classes, for instance 0 and 1, as an example. As shown in Figure 3, the suggested model has the highest levels of performance metrics, whereas the CNN-GRU model has the lowest levels of all of these performance parameters. The findings indicate that the suggested model has the highest levels of all of these performance parameters. Figures 4 and 5 provide the accuracy and loss graphs for each of the DTL techniques that were put into practise.



**Aakash Gupta and Ravi Dhandhukiya**

The outcomes of the updated AlexNet model that was suggested for the detection of lung cancer are shown in Figure 6. The findings are categorized into benign and malignant categories. Since the suggested LungNet-SVM model accurately predicted that the first three photos were free of any pathology, we are presenting them here as examples of "true negatives." The following three pictures are being shown as false positives, which indicates that the LungNet-SVM model made an error and incorrectly identified them as being malignant while in fact they are not. The first three photos are displayed as false negatives for malignant, and the suggested LungNet-SVM model states they are benign, while in reality they are malignant. These images have been misclassified. The last three images are shown as "true positives," which means that the proposed LungNet-SVM model predicts that they are cancerous because they are cancerous.

CONCLUSION

To accurately segment and classify lung nodules in CT images, a LungNet-SVM is described. The AlexNet framework has been expanded upon to create the LungNet-SVM model. Before the classification is done using a support vector machine approach, the suggested model has a total of seven convolutional layers, three pooling layers, and two fully connected layers. These layers are stacked one on top of the other. According to the findings of the experiments, the suggested model functions superior to both the CNN-GRU and CNN-LSTM models. This means that it can help reduce the number of mistakes made by pathologists during the diagnosis process. The recommended AlexNet-GRU model was shown to be both computationally efficient and superior to the other models, which provided insight into the model's effectiveness via comparisons with the recent machine learning and deep learning algorithms. The proposed approach has also shown its superiority over the methods that are presently considered to be the most effective in identifying and categorising cancer. The AlexNet-GRU model was proposed, and it attained the best accuracy and other performance metrics of around 3%. As a result, the AlexNet-GRU model that was described here is an encouraging strategy for identifying and categorising lung cancer that has reached to the lymph nodes. This investigation will not be limited to only binary identification tasks; rather, it will focus on the detection of lung cancer using many classifications.

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Aakash Gupta and Ravi Dhandhukiya

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Table 1 The experimental results

Performance metrics (%)		Classification	CNN-GRU (%)	CNN-LSTM (%)	Proposed model (%)	Data set	Other parameters
Accuracy (%)		Binary class	97.10	97.90	99.10	Kaggle	Batch size = 100, epoch = 100, optimizer = Adam
Precision (%)			96.90	97.70	98.70		
Sensitivity (%)			96.87	97.60	98.71		
Specificity (%)			96.59	97.10	98.51		





Aakash Gupta and Ravi Dhandhukiya

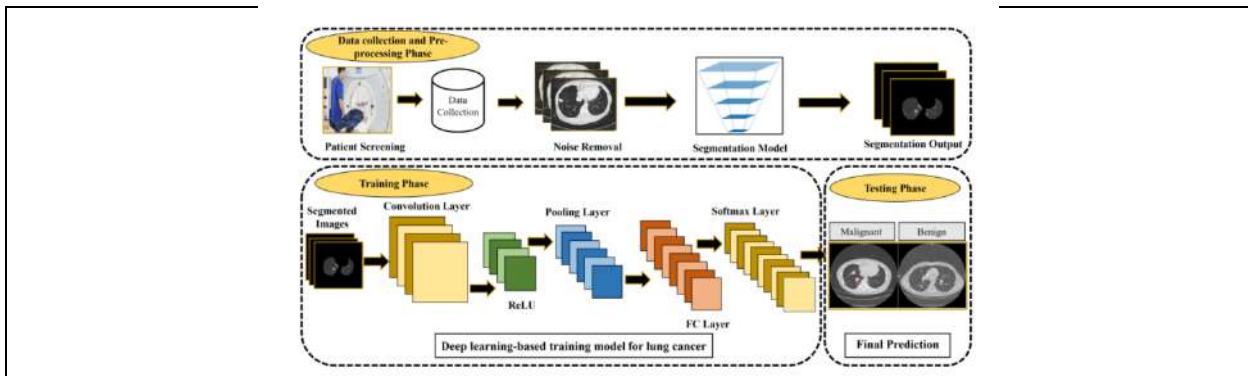


Figure 1. CAD-based system to find lung cancer

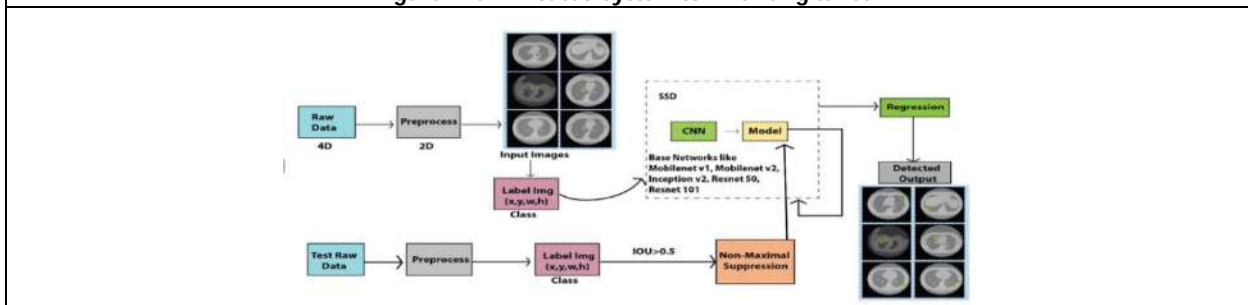


Figure 2 Proposed lung cancer detection method

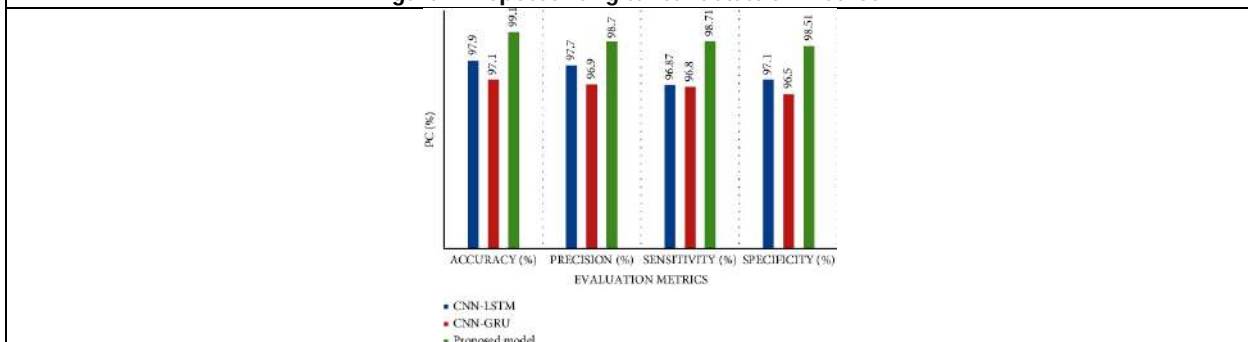


Figure 3 AlexNet-GRU, CNN-GRU, and CNN-LSTM BC detection binary recognition test classification performance.

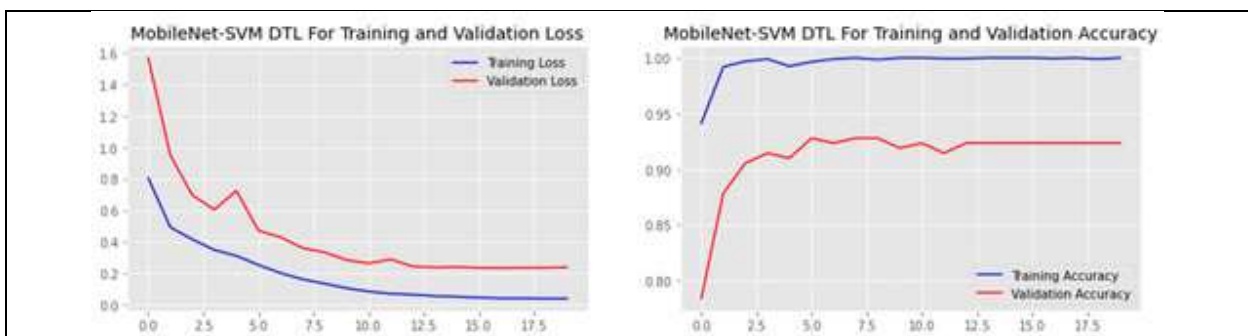


Figure 4. MobileNet-SVM accuracy-loss graph.





Aakash Gupta and Ravi Dhandhukiya



Figure 5. Dense Net121 accuracy-loss graph.

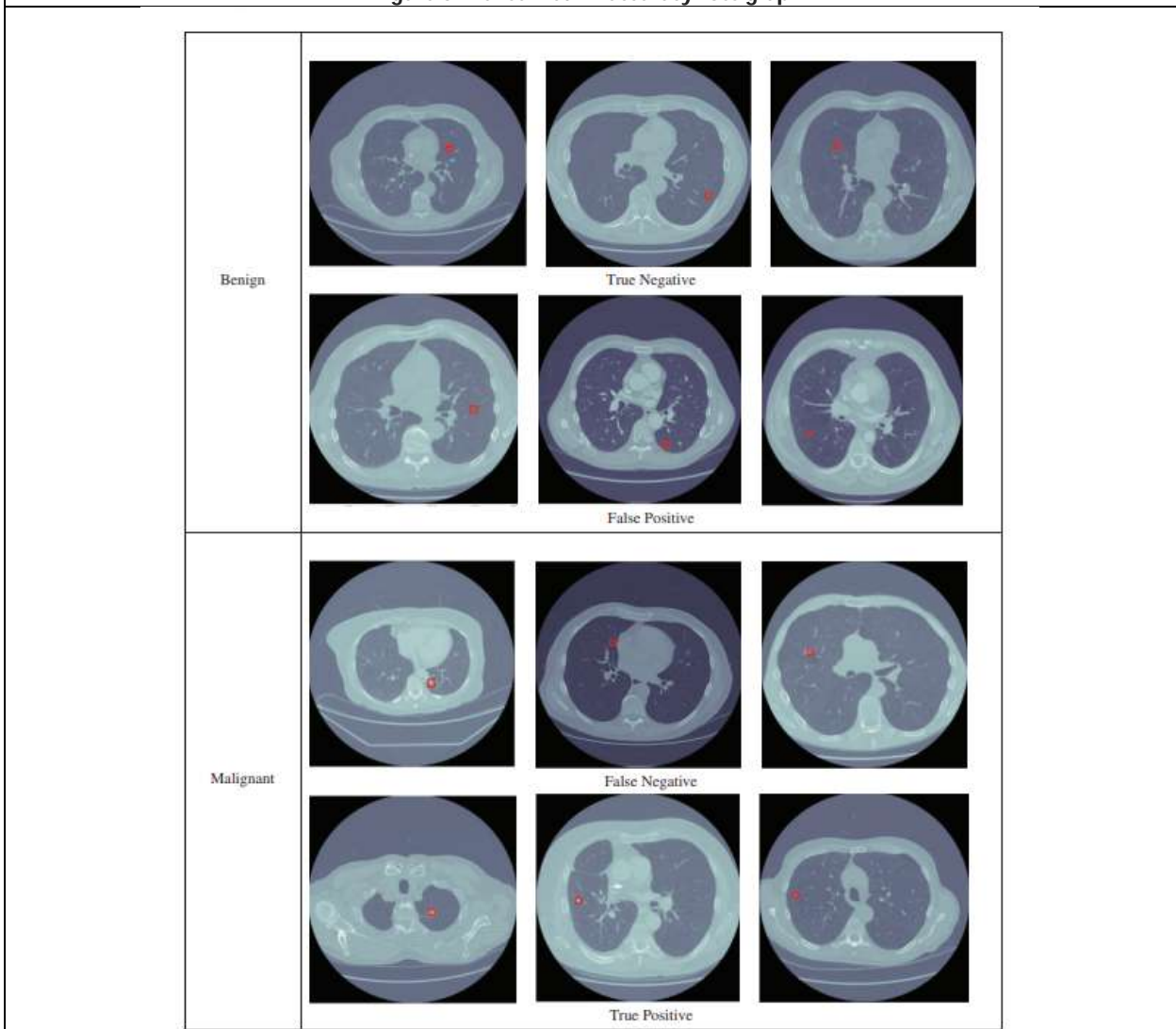


Figure 6: LungNet-SVM





ICT's Impact on Center-State Relations in India.

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ABSTRACT

ICT is currently trending in center-state relations, with increasing emphasis on its use to enhance communication, coordination, and collaboration between the central government and state governments in India. The adoption of ICT tools and technologies is being explored as a means to streamline governance processes, improve service delivery, promote transparency, and foster cooperative federalism. The integration of ICT in center-state relations has the potential to transform the way governments interact and work together, leading to more efficient and effective governance at all levels. The study explores the impact of the increasing ICT network on Centre-State relations in India. The study examines how the advancements in Information and Communication Technology (ICT) have altered the dynamics of the relationship between the Central and State Governments in India. The research employs a qualitative approach and uses a case study method to analyze the impact of ICT on Centre-State relations in India. The study finds that the increasing use of ICT has facilitated the sharing of information, communication, and coordination between the Central and State Governments. The use of ICT has also led to the development of e-governance, which has reduced bureaucratic delays and improved transparency in decision-making. However, the study also highlights the challenges in implementing ICT initiatives in the Indian federal system, such as varying levels of technological infrastructure across different States, lack of financial resources, and the need for greater collaboration between the Central and State Governments. The study concludes that while the increasing ICT network has positively impacted Centre-State relations, there is a need for continued efforts to address the challenges and ensure that the benefits of ICT are realized across all States in India.

Keywords: ICT, central government, state government, communication, information sharing



**Aadil Ahmad Shairgojri and Subramanian**

INTRODUCTION

ICT stands for Information and Communication Technology. It refers to the broad range of technologies, tools, and applications that facilitate the collection, storage, processing, and communication of information. ICT encompasses various electronic devices, networks, software, and services that enable the creation, sharing, and utilization of data and knowledge. It includes technologies such as computers, the internet, telecommunications systems, digital databases, software applications, and mobile devices. ICT plays a crucial role in facilitating communication, improving efficiency, enhancing decision-making processes, and promoting connectivity and collaboration in various sectors, including government, education, healthcare, business, and entertainment. In recent years, there has been a significant increase in the use of Information and Communication Technologies (ICTs) in various sectors in India. The government has been actively promoting the use of ICTs in various sectors, including governance and public service delivery. This has led to a transformation in the way government and citizens interact with each other, with ICTs serving as a key facilitator in this process. The impact of ICTs on various aspects of society has been widely studied in the literature. However, the impact of increasing ICT network on centre-state relations in India has not been explored extensively. This is an important research gap as centre-state relations are a critical aspect of the federal system of governance in India. In this research article, we aim to study the impact of increasing ICT network on center-state relations in India. We will examine how the use of ICTs has affected the relationship between the central government and state governments in India. We will also explore the challenges and opportunities that arise from the use of ICTs in centre-state relations in India. To frame our study, we draw on the work of Mahendra Prasad Singh, a noted scholar of federalism in India. Singh has written extensively on center-state relations and federalism in India and his work provides a valuable framework for our study. Singh (2004) argues that federalism in India is characterized by a strong central government that exercises significant control over the states. He notes that the central government has often used its constitutional powers to intervene in the affairs of the states, which has led to tensions between the center and the states. Singh also highlights the role of information technology in transforming the relationship between the center and the states. He notes that the use of ICTs can help to reduce information asymmetry between the center and the states, leading to more effective coordination and collaboration.

Singh's work highlights the importance of studying the impact of ICTs on center-state relations in India. Our research article seeks to build on his insights and examine how the use of ICTs has transformed the relationship between the center and the states in India. Our study is particularly relevant in the current context, where there is increasing pressure on governments to use ICTs to improve governance and public service delivery. With the COVID-19 pandemic highlighting the need for digital solutions, there has been a renewed focus on the use of ICTs in various sectors. The Indian government has launched several initiatives, such as the Digital India program, to promote the use of ICTs in governance and public service delivery. As such, our study has important implications for policymakers and practitioners. By understanding the impact of increasing ICT network on center-state relations in India, policymakers can design more effective strategies for leveraging ICTs in governance and public service delivery. Our study will also provide insights into the challenges and opportunities that arise from the use of ICTs in center-state relations, which can help to inform policy and practice in this area. In the rest of this research article, we will first provide an overview of the literature on center-state relations and federalism in India. We will then describe the data and methods used in our study. Next, we will present our findings, focusing on the impact of ICTs on center-state relations in India. Finally, we will discuss the implications of our study and suggest avenues for future research.

REVIEW OF LITERATURE

Singh's work provides a valuable framework for our study, as he highlights the challenges and opportunities that arise from the federal system of governance in India. He notes that federalism in India is characterized by a strong central government that exercises significant control over the states, leading to tensions between the center and the states. Singh argues that the use of ICTs can help to reduce information asymmetry between the center and the states,



**Aadil Ahmad Shairgojri and Subramanian**

leading to more effective coordination and collaboration. Bhattacharyya and Pal's study examines the impact of ICTs on public service delivery in Indian states. They find that the use of ICTs has led to improvements in service delivery, including faster processing times and reduced corruption. However, they also note that the success of ICT initiatives depends on several factors, including the availability of infrastructure, human resources, and political will. Jha et al.'s study provides a comprehensive review of the Digital India program, a key initiative launched by the Indian government to promote the use of ICTs in governance and public service delivery. They note that the program has led to significant improvements in access to services, but also highlight the need for better coordination between different government departments and the private sector.

Bhatnagar's study examines the role of ICTs in development in India, including in the areas of governance and public service delivery. He notes that while there have been significant improvements in the availability of ICT infrastructure, there are still several challenges that need to be addressed, including the need for better connectivity in rural areas and the development of human resources. Kshetri's study examines the impact of information sharing on innovation and performance in supply chains. While not specific to center-state relations in India, the study provides valuable insights into the role of information sharing in improving coordination and collaboration. The findings suggest that the use of ICTs to facilitate information sharing can lead to improvements in innovation and performance.

Scope of the Study

The scope of this study revolves around examining the impact of Information and Communication Technologies (ICT) on the dynamics of center-state relations in India. It aims to analyze how the adoption and utilization of ICTs by various government entities at the central and state levels have influenced the distribution of power, decision-making processes, and intergovernmental collaborations. The study will explore the potential effects of ICTs on policy formulation, implementation, and monitoring, as well as the transformation of governance structures and citizen engagement. Additionally, it will investigate the challenges and opportunities presented by ICTs in promoting cooperative federalism, strengthening administrative efficiency, and addressing regional disparities. By investigating the multifaceted dimensions of ICT's impact on center-state relations, this study seeks to provide valuable insights into the evolving dynamics of governance in India's federal structure.

Statement of Problem

The use of information and communication technologies (ICTs) has increased significantly in India in recent years, with the government launching several initiatives to promote their use in governance and public service delivery. However, there is limited research on the impact of these initiatives on center-state relations, which are often characterized by tensions and a lack of coordination. This study aims to fill this gap by examining the impact of increasing ICT network on center-state relations in India. Specifically, the study will explore how the use of ICTs has affected coordination, collaboration, and decision-making between the center and the states, and how these changes have affected governance and public service delivery at the state level.

Research Objectives

The major objectives of the study are to analyze and assess the role of ICT networks in transforming the nature of Centre-State relations in India. It seeks to understand the impact of ICT networks on inter-governmental cooperation and coordination, while also identifying the key factors that influence the adoption and effective utilization of these networks. Ultimately, the study aims to provide recommendations for improving the use of ICT networks in Centre-State relations, thus contributing to the enhancement of governance and decision-making processes in India.

METHODOLOGY

The research is a combination of descriptive and documentary methods to examine the Impact of Increasing ICT Network on Centre-State Relations in India. The research methodology employed in this study enables a



**Aadil Ahmad Shairgojri and Subramanian**

comprehensive examination of the impact of the ICT network on the relationship between the central and state governments in India. The study draws on a variety of data sources, including academic studies published in books and journals, official reports from the Indian government and newspaper stories. These sources provide a wealth of information that allows for a more complete understanding of the research area.

RESULT AND DISCUSSION**Role of ICT networks in transforming the nature of Centre-State relations**

The adoption and increased usage of Information and Communication Technology (ICT) networks have brought about significant changes in the relationship between the central and state governments in India. The purpose of this research is to analyze the role of ICT networks in transforming the nature of Centre-State relations in India. Specifically, this research aims to examine how the adoption and increased usage of ICT networks have influenced the power dynamics between the central and state governments in India, with a focus on understanding the extent to which ICT networks have facilitated decentralization of power and decision-making, leading to greater autonomy for the states. The Constitution of India lays out a federal system of government, with power divided between the central government and the state governments. However, historically, the central government has held a dominant position, with the state governments having limited autonomy in decision-making. This has led to various challenges and tensions between the central and state governments, with issues such as resource allocation, policy implementation, and administrative control being key points of contention.

The adoption and increased usage of ICT networks have had a significant impact on the power dynamics between the central and state governments. With the availability of advanced communication technologies, information sharing and coordination have become easier, faster, and more efficient. This has led to the development of new models of governance, with greater emphasis on decentralization and empowerment of the state governments. The use of ICT networks has enabled the state governments to exercise greater autonomy in decision-making, leading to more efficient and effective governance. The adoption of e-governance systems has helped in the delivery of public services, ensuring transparency and accountability in the system. ICT networks have also facilitated the sharing of best practices, knowledge, and expertise between the central and state governments, leading to the development of a collaborative approach to governance.

The impact of ICT networks on Centre-State relations can be seen in various sectors, including education, healthcare, agriculture, and infrastructure development. For instance, in the education sector, the use of ICT networks has enabled the state governments to implement innovative teaching methods, provide access to online resources, and monitor the performance of schools. Similarly, in the healthcare sector, the use of telemedicine has enabled the state governments to provide healthcare services to remote areas, improving access and reducing costs. The role of ICT networks in transforming the nature of Centre-State relations in India has not been without challenges. One of the main challenges has been the digital divide between urban and rural areas, with the latter having limited access to ICT infrastructure and resources. The lack of digital literacy among the population has also posed a challenge, with many people unable to take advantage of the benefits of ICT networks.

The adoption and increased usage of ICT networks have had a significant impact on the power dynamics between the central and state governments in India. The use of ICT networks has facilitated decentralization of power and decision-making, leading to greater autonomy for the state governments. However, there are still challenges to be addressed in ensuring equitable access to ICT infrastructure and resources, and in promoting digital literacy among the population. The research on the role of ICT networks in transforming Centre-State relations in India is an important area of study, as it offers insights into the potential benefits and challenges of using technology to promote decentralization and empowerment in governance.



**Aadil Ahmad Shaingoji and Subramanian****Factors Influencing Effective Utilization of ICT in Centre-State Relations**

The adoption of Information and Communication Technology (ICT) networks has transformed the nature of governance in India. The use of ICT networks has facilitated the sharing of information and coordination between different levels of government. The objective of this research is to assess the impact of ICT networks on inter-governmental cooperation and coordination. The research aims to investigate how the use of ICT networks has affected the level of cooperation and coordination between the central and state governments in India. Inter-governmental cooperation and coordination are essential for effective governance in a federal system. The Constitution of India provides for a division of powers between the central and state governments, with each level of government having its own sphere of authority. However, effective governance requires collaboration and cooperation between different levels of government, with each level of government working towards a common goal.

The use of ICT networks has provided new opportunities for inter-governmental cooperation and coordination. With the availability of advanced communication technologies, information sharing and coordination have become easier, faster, and more efficient. This has led to the development of new models of governance, with greater emphasis on collaboration and cooperation between different levels of government. ICT networks have had a significant impact on inter-governmental cooperation and coordination in India. The adoption of e-governance systems has enabled the central and state governments to share information and coordinate their activities more effectively. The use of ICT networks has also facilitated the development of new policy initiatives, with the central and state governments working together to address common challenges. The impact of ICT networks on inter-governmental cooperation and coordination can be seen in various sectors, including education, healthcare, and infrastructure development. For instance, the use of ICT networks has enabled the central and state governments to coordinate their efforts in implementing national-level schemes, such as the Swachh Bharat Abhiyan and the Ayushman Bharat scheme. In the education sector, the use of ICT networks has facilitated the sharing of best practices and resources between the central and state governments, leading to the development of a collaborative approach to education policy.

Despite the benefits of ICT networks in promoting inter-governmental cooperation and coordination, there are also challenges to be addressed. One of the main challenges is the digital divide between urban and rural areas, with the latter having limited access to ICT infrastructure and resources. This has led to a disparity in the level of cooperation and coordination between different regions of the country. The use of ICT networks has had a significant impact on inter-governmental cooperation and coordination in India. The adoption of e-governance systems has facilitated the sharing of information and coordination between different levels of government. The impact of ICT networks on inter-governmental relations offers new opportunities for collaboration and cooperation between the central and state governments. However, there are still challenges to be addressed in ensuring equitable access to ICT infrastructure and resources, particularly in rural areas. The research on the impact of ICT networks on inter-governmental cooperation and coordination is an important area of study, as it offers insights into the potential benefits and challenges of using technology to promote collaboration and cooperation in governance.

Implications of Study

The study on the impact of increasing ICT network on Centre-State relations in India has significant implications for the future of governance in the country. The study highlights the importance of establishing a standardized ICT infrastructure, promoting digital literacy, and strengthening cybersecurity measures to enhance the use of ICT networks in Centre-State relations. The study also emphasizes the need to promote citizen engagement and participation in governance through the use of social media and e-governance services. The recommendations provided by the study can help in promoting transparency, accountability, and efficiency in governance, which is essential for the sustainable development of the country. By implementing the recommendations, Centre-State relations in India can be transformed for the better, and governance can become more citizen-centric.



**Aadil Ahmad Shairgojri and Subramanian****Recommendations for Enhancing ICT Networks in Centre-State Relations in India**

Improving the use of ICT networks in Centre-State relations in India can have a significant impact on promoting transparency, efficiency, and accountability in governance. To enhance the use of ICT networks in Centre-State relations in India, the following practical recommendations can be considered:

Establish a standardized ICT infrastructure: To improve the use of ICT networks, a standardized ICT infrastructure needs to be established which is accessible and interoperable across all government departments and levels. This will enable smooth and seamless communication between the Centre and States.

Encourage the use of open-source software: The use of open-source software can help in reducing costs, promoting interoperability, and enhancing security. The government should encourage the use of open-source software to reduce dependency on proprietary software and to promote a more inclusive approach to ICT.

Promote digital literacy: Digital literacy programs should be initiated to promote the use of ICT networks among government officials and citizens. This will help in building the capacity of the government officials to effectively utilize the available ICT tools and services.

Strengthen cybersecurity measures: With the increasing use of ICT networks, cybersecurity risks are also on the rise. It is essential to strengthen cybersecurity measures and establish robust mechanisms to ensure the security of data and networks.

Enhance the use of social media: The use of social media can help in promoting citizen engagement and participation in governance. The government should consider using social media platforms to disseminate information and seek feedback from citizens.

Promote the use of e-governance services: E-governance services can significantly enhance the efficiency and transparency of governance. The government should promote the use of e-governance services to streamline processes and make governance more citizen-centric.

Establish a robust legal and regulatory framework: To ensure the effective use of ICT networks, a robust legal and regulatory framework needs to be established. This should include data protection laws, cybersecurity laws, and regulations governing the use of ICT networks in governance.

The use of ICT networks can significantly enhance Centre-State relations in India. To maximize the opportunities offered by ICT networks, it is essential to establish a standardized ICT infrastructure, promote digital literacy, strengthen cybersecurity measures, enhance the use of social media, promote e-governance services, and establish a robust legal and regulatory framework.

Implications of the Study

The study on ICT's impact on center-state relations in India has significant implications for various aspects of governance and federalism in the country. Firstly, it highlights the potential of Information and Communication Technology (ICT) to bridge the gap between the central government and state governments, enabling better communication, coordination, and collaboration. ICT tools such as e-governance platforms, digital databases, and online portals can streamline information sharing, decision-making processes, and service delivery, thereby enhancing the efficiency and effectiveness of governance across different levels. Secondly, the study underscores the need for a robust digital infrastructure and connectivity across all states to ensure equal access to ICT resources, minimizing regional disparities and promoting inclusive development. It emphasizes the importance of capacity building and digital literacy programs for both policymakers and citizens to fully harness the benefits of ICT in governance. Furthermore, the study highlights the potential of ICT in enhancing transparency, accountability, and citizen participation by enabling real-time monitoring, feedback mechanisms, and public engagement in policy formulation and implementation. This can contribute to a more decentralized and participatory governance system in India. The findings of the study emphasize the transformative role of ICT in center-state relations, urging policymakers to prioritize digitalization efforts, invest in infrastructure, and strengthen institutional mechanisms to harness the full potential of technology for effective and inclusive governance.

Major Findings

1. ICT adoption facilitates better communication and collaboration between the central and state governments, leading to improved coordination in policy implementation and service delivery.



**Aadil Ahmad Shairgojri and Subramanian**

2. E-governance platforms and digital databases enhance information sharing, enabling quick and efficient decision-making processes.
3. ICT tools promote transparency in center-state relations by providing real-time monitoring of government initiatives and expenditures.
4. Digital infrastructure and connectivity play a crucial role in reducing regional disparities and ensuring equal access to ICT resources across all states.
5. Capacity building programs are necessary to equip policymakers and citizens with the necessary skills to effectively utilize ICT tools for governance purposes.
6. ICT enables citizen participation and engagement in policy formulation and implementation, promoting a more inclusive and participatory governance system.
7. The use of ICT can lead to improved efficiency and effectiveness in the delivery of public services, benefiting citizens across the country.
8. Digitalization can help streamline administrative processes, reducing bureaucratic hurdles and enhancing the overall efficiency of center-state interactions.
9. ICT can contribute to the decentralization of power by empowering state governments with the necessary tools to independently manage and implement policies.
10. The integration of ICT in center-state relations has the potential to foster cooperative federalism, strengthening collaboration and trust between the central and state governments.

CONCLUSION

The increasing use of ICT networks has had a significant impact on Centre-State relations in India. ICT networks have enabled seamless communication, enhanced transparency, and improved the efficiency of governance. The use of ICT networks has also helped in promoting citizen engagement and participation in governance, which has resulted in better outcomes. The establishment of a standardized ICT infrastructure, the promotion of digital literacy, and the strengthening of cybersecurity measures are some of the key measures that can help in enhancing the use of ICT networks in Centre-State relations in India. The use of social media and e-governance services can also significantly enhance the efficiency and transparency of governance. The implementation of these measures will require a concerted effort from both the Centre and States. It is essential to establish a robust legal and regulatory framework to ensure the effective use of ICT networks in governance. This will include data protection laws, cybersecurity laws, and regulations governing the use of ICT networks in governance. While there are several challenges in the effective use of ICT networks in Centre-State relations in India, there are also significant opportunities. The increasing use of ICT networks can help in promoting transparency, accountability, and efficiency in governance. The use of ICT networks can also help in promoting citizen engagement and participation in governance, which is essential for the sustainable development of the country. In conclusion, the effective use of ICT networks can significantly enhance Centre-State relations in India. It is essential to establish a standardized ICT infrastructure, promote digital literacy, strengthen cybersecurity measures, enhance the use of social media and e-governance services, and establish a robust legal and regulatory framework. The effective implementation of these measures will require a concerted effort from both the Centre and States. By embracing the opportunities offered by ICT networks, Centre-State relations in India can be transformed for the better. The future scope of research on ICT's impact on center-state relations in India includes exploring emerging technologies, assessing their potential for further enhancing governance, studying the long-term effects of digitalization on decision-making processes and policy outcomes, and examining the role of ICT in promoting cooperative federalism and strengthening intergovernmental relations.

Conflict of Interest and Funding

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Effect of Exogenous Application of Hexaconazole and Melatonin on Physiological Changes in *Eleusine coracana* L.(Finger millet) Under Salinity Stress

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ABSTRACT

Salt stress caused by high soil salinity is one of the most serious limiting factors threatening crop production in many parts of the world. Salt stress is one of the most prevailing abiotic stress imposing threats for agriculture food crops along with increasing world population and limited natural resources. Finger millet [*Eleusine coracana* L.] is a valuable cereal crop cultivated in arid and semi-arid regions of Asia and Africa. The crop is well adapted to heat, drought and degraded soils. Triazole are a group of compounds that are the chemicals belonging to a class of compounds known as ergosterol biosynthesis inhibitors. Melatonin has been regarded as a promising substance that enhances the abiotic stress tolerance of plants. However, few studies have devoted attention to the role of melatonin in improving salt tolerance in finger millet. Its cereals have comparatively better antioxidant, nutraceutical properties and storage qualities than other cereals. To alleviate stressful conditions such as salinity, various plant growth regulators, such as hexaconazole and melatonin, are involved. In the present study, the effect of exogenously applied by soil drenching hexaconazole (HEX) [50mg/L], melatonin [MT] [100µm/L], on physiological and yield traits of finger millet under NaCl stress [200Mm] in pot culture. For determination of physiological traits fresh plant leaves were plucked from each treatment randomly on 40th, 50th, 60th and 70th DAS respectively, and seed harvest was done at maturity of seeds. The NaCl stress results decline in leaf area, relative water content and membrane stability index and a tremendous increase in ion leakage. Similarly, NaCl stress in finger millet also caused highly reduction in grain yield. Salinity may be a serious problem for the cultivation and production of higher plants. The majorities of



**Kathiravan et al.,**

crop plants are susceptible and cannot survive under conditions of high salinity or can survive only with decreased yields.

Keywords: Salt stress, Physiological attributes, Yield traits, *Eleusine coracana* L.

INTRODUCTION

Salinity is known to reduce the growth and development of glycophytic. The extent of this inhibition is correlated to the extent of NaCl salinity, the plant species sensitivity and the environment. The term stress was conceptualized as “any environmental factor which is potentially unfavorable to the living organisms by Levitt in 1980 [1]. Salinity is the major environmental factor limiting plant growth and productivity. The detrimental effects of high salinity on plants can be observed at the whole-plant level as the death of plants and or decreases in productivity. Many plants develop mechanisms either to exclude salt from their cells or to tolerate its presence within the cells. During the onset and development of salt stress within a plant, all the major processes such as photosynthesis, protein synthesis, and energy and lipid metabolism are affected[2]. Salt stress can be generally viewed as the toxicity to the plants due to development of salinity [3]. The presence of high amount of external and internal salt ions concentration in plant cells are toxic, and the presence of these high number of ions in cells actually inhibits the plant growth[4]. Salinity leads to extensive accumulation of ions (Na⁺ and Cl⁻) and inhibits K⁺ and Ca²⁺ uptake and results in ionic imbalance[5]. In response to salinity stress, the production of ROS, such as singlet oxygen, superoxide, hydroxyl radical, and hydrogen peroxide, is enhanced [6]. Most salinity adaptive mechanisms in plants are accompanied by certain morphological and anatomical changes[7]. Depending on the ability of plants to grow in saline environments, they are classified as either glycophytic or EU halophytes and their response to salt stress differs in terms of toxic ion uptake, ion compartmentation and/or exclusion, osmotic regulation, CO₂ assimilation, photosynthetic electron transport, chlorophyll content and fluorescence, reactive oxygen species (ROS) generation, and antioxidant defense [8]. Finger millet [*Eleusine coracana* L.] is a valuable cereal crop cultivated in arid and semi-arid regions of Asia and Africa [9]. Understanding these responses in finger millet is therefore of great importance for breeding salt resistant and tolerant crops. Owing to the wide disparity in agroecological regions across finger millet growing regions, several finger millet landraces exhibit an adaptation to a large range of environmental conditions. Triazoles are a group of compounds, which have both fungi toxic and plant growth-regulating properties [10]. In addition, they can also protect plants against various environmental stresses. Triazoles affect the isoprenoid pathway, and alter the levels of certain plant hormones by inhibiting gibberellin synthesis, reducing ethylene evolution, and increasing cytokinin levels [11]. Melatonin widely participates in nature as a ubiquitous molecule, and its biological activity occurs in unicellular organisms, fungi, animals, and plants [12,13]. Melatonin can enhance the tolerance of plants to abiotic stresses, such as low chilling, drought, herbicides, heavy metals, and salt [14,15,16]. Under salt conditions, exogenous application of melatonin regulates a variety of genes and physiological processes involved in resistance to salt stress in plants [17,18,19]. However, these effects of melatonin vary depending on the method of application and the species of plant.

MATERIALS AND METHODS

Plant Material

Finger millet (*Eleusine coracana* L.) seeds (CO-15 variety) were purchased from Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Growth Regulators and NaCl Salt

The growth regulators Hexaconazole and Melatonin and analytical reagent NaCl were purchased from Sisco Research Laboratories [SRL]- Chennai-600117





Experimental Setup

The seeds selected were planted in plastic pots filled with 8 kg of homogenous mixture of red soil, sand and farmyard manure in the ratio (1:1:1) for sowing purpose. Subsequently, NaCl salt treatment 500ml L⁻¹ was imposed on 15th days after sowing (DAS). The salt stress was given in increments to achieve the desired concentration (200mM) and avoid salt shock. Thereafter salt concentration required was maintained through soil EC and last up to end of the experiment. In addition, drenching supply of HEX and MT solutions were made ready. However, drenching was done twice a week and uniformly drenched on both the surfaces of leaves, using Tween-20 (0.05%) as a wetting agent. However, control plants were irrigated with tap water. The pot culture arranged was in a Completely Randomized Block (CRB) manner. Plants were taken into six groups (T1-T6) with three replicates (n=3) each group. The samples were collected for observations on 40th, 50th, 60th and 70th DAS respectively. The treatments used in the experiment are as follows.

Total leaf Area

The total leaf area was measured using LICOR Photo Electric Area Meter (Model LI-3100, Lincoln, USA) and expressed in cm² plant⁻¹.

Relative water content

For determination of RWC, fresh leaves were detached from each treatment, replicate, and genotype and weighed immediately to record fresh weight (FW), followed by dipping half of their portion in distilled water for 12 h. The leaves were blotted to wipe off excess water, weighed to record fully turgid weight (TW), and subject to oven drying at 70°C for 24 h to record the dry weight (DW). The RWC were determined by the equation proposed by Turner (1986). RWC (%) =

$$RWC(\%) = \frac{[FW - DW]}{[TW - DW]} \times 100$$

Membrane Stability Index

MSI was determined according to the method of Sullivan (1972). For this purpose, a fully expanded young leaf (5th leaf) was selected from each genotype, treatment and replication. Twenty pieces (1 cm diameter) cut from these leaves were submerged into distilled water contained in test tubes. The tubes were kept at 10°C in a cooled incubator for 24 h, followed by warming at 25°C and measuring the electrical conductivity N(C1) of the contents. The leaf samples were then heated by autoclaving for 15 min and electrical conductivity of the medium measured again (C2). Cellular injury was determined by using the equation:

$$1 - \left[\frac{\frac{T1}{C1}}{1 - \frac{T2}{C2}} \right] \times 100$$

(Where T and C refer to treatment and control, respectively, and 1 and 2 refer to conductivity one and two.)

Electrolyte Leakage

The total inorganic ions leaked out in the leaves were estimated by the method of Sullivan, 1979. Leaf discs 20 in number were taken in a boiling test tube of 10 ml deionized water and electrical conductivity (ECa) was measured. The content was heated at 45°C and 55°C for 30 min each in a water bath and electrical conductivity (ECb) was measured. Later the content was again boiled at 100 °C for 10 min and electrical conductivity (ECc) recorded. The electrolyte leakage was calculated by using the formula: Electrolytic leakage (EL) was calculated as,

$$\text{Electrolyte leakage (\%)} = \frac{ECa - ECb}{ECc} \times 100$$

Yield

For determination of yield and other related characters fully matured pods were harvested from each plant separately. Afterwards, pod length, pod number and number of seeds per pod were determined and recorded.





Kathiravan et al.,

Subsequently, the seeds were separated from each pod and dried in order to quantify the 100-seed weight and yield per plant.

Statistical Analysis

The data were analysed statistically using SPSS software (version 22.0) followed by one-way ANOVA. The obtained data represented in bars are mean values of three replicates ($n=3$), and (\pm) standard error (SE). The 0.05 % was chosen as significance using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Total Leaf Area

Salt stress is a reduction in total leaf area. Indeed, decreased leaf growth is the earliest response of glycophytic exposed to salt stress [20]. The observed reduction in the leaf area may be considered as an avoidance mechanism, which minimises water loss by transpiration when the stomata are closed [21,22]. The leaf area of NaCl+HEX and NaCl+MT have the higher leaf area respectively compare to the NaCl treatments. The leaf area decreased in triazole treated plants (Table 1). Triazoles have several morphological effects on leaves. They reduce leaf area, but increase epicuticular wax, width, and thickness [23]. Though the leaf area was decreased in hexaconazole-treated plants, the leaf dry weight increased. The MT treated plants are having higher total leaf area compare to 'Control' plants (Fig. 3). Various studies have shown that one of the roles of melatonin under salinity conditions is promoting growth by increasing leaf area [24,25,26,27].

Relative Water Content (RWC)

The NaCl stress given at 200mM level significantly declined relative water content (RWC) when compared to control [Fig. 2]. The water potential of leaves progressively decreased with the increasing salinity when compared to control plant leaves. The plants of NaCl+HEX and NaCl+MT shows slightly reduction than the control plants. Relative water content significantly decreased with the increasing salinity in rice *Oryza sativa* L. [28]. Similar results were also reported in wheat *Triticum aestivum* L. [29], pepper *Capsicum annuum* L. [30]. RWC was also reduced and water deficit increased in roots and leaves of the seedlings of milky iris *lacteal* Pall. under NaCl stress [30]. Relative water content declined by 3.79 % and 5.77 %, respectively due to water deficit at R3 and R8. By contrast, the hexaconazole application increased the relative water content in water stressed plants (1.49 % and 2.81 %), however, it had no significant effect on well-watered plants. MT function in relative water content (RWC) represents a loss of turgor with limited water availability for cell expansion processes. Variation in RWC between plants growing in salt stress is related to the different capacity of plants to absorb water or ability of stomata to reduce the loss of water [31]. In our study salinity decreased RWC in plants. In melon, the decrease of RWC in stressed plants has been reported [32]. The improvement in RWC under melatonin treatment (Fig. 4, F) appears to be related to better water absorption capacity, as was reported by Jiang et al. (2016) [33].

Membrane Stability Index (MSI)

The reduction in membrane stability index of finger millet plants treated with NaCl treated plants. Membrane stability index (MSI) decreased under salt stress in all the tested pea genotypes at all NaCl treatments but maximum reduction was noted. Since, membranes damage increased with increase in salinity level so MSI can be considered as very significant tool for evaluating the salt tolerance [34]. NaCl+HEX and NaCl+MT treated plants show reduced MSI than NaCl treatment alone. The increase in MSI values after NaCl treated plants combined with HEX and MT of respectively. It represents that external application of HEX and MT have made tolerance in finger millet plant against NaCl stress and displays maximum enhancement of growth of finger millet plant. Moreover, HEX and MT treated plants under non-stressed conditions provides further increase in membrane stability of finger millet on compared to control one. Hexaconazole altered the membrane properties and facilitated the removal of damaged areas in the membranes of maize [35]. Disruption of cell membrane integrity is an inherent feature of senescence in plants, as observed in wheat leaves [36]. Triazole altered the sterol biosynthesis and changed the composition of sterol in the



**Kathiravan et al.,**

plasma membrane [37]. This change in sterol composition may induce changes in cell membrane that may be reflected in increased membrane stability, acclimatization, and frost hardiness, as observed in white spruce [38].

Electrolyte Leakage (EL)

The EL of finger millet plants treated with 200mM NaCl shown a significant role in membrane leakage compared to control (Figure 4). The highest rate of electrolyte leakage was evident in plants exposed to 200mM NaCl. Electrolyte leakage is a common indicator of membrane damage and this leakage is closely related to the loss of water potential [39]. Several authors worked on various crops [40,41,42] reported increase in the amount of EL when plants are treated with increased NaCl concentrations and would be related to chain reactions initialized by free radicals [43]. The NaCl+HEX and NaCl+MT plants shows comparatively high EL values than the control plants. Electrolyte leakage is an indicator of membrane injury. Plasma membranes are the primary site of ion specific salt injury [44]. Therefore, electrolyte leakage from plasma membranes is reported as one of the most important selection criteria for identification of salt-tolerant plants canola *Brassica napus*L. [45]. Changes in membrane leakage and injury can be measured by the extent of EL in tissues [46]. Triazole treatments inhibited the EL in carrot [47]. Paclobutrazol treated wheat seedlings maintained a high degree of membrane integrity under heat stress [48,49] and uniconazole treatment inhibited the EL in soybean [50]. To further know the influence of the applied melatonin on resistance to salt stress in cucumber seedlings, the electrolyte leakage concentration, acts as an indicator in assessing the extent of membrane damage, were determined in leaves. Compared with the control, especially those with 100 µM melatonin treatment. Under salt stress condition, the plants watered with melatonin significantly had lower indexes than the control [51].

Yield

The results of the pot culture experiment showed that NaCl stress (200mM) significantly reduced the grain yield and reduction noted and also found variations in other yield parameters of finger millet compared to control (Fig.5a and Fig.5b). The values noted under stressed conditions were compared to Saline stress (200mM). Salinity stress affects the yield and quality of the plant negatively by changing the soil structure [52]. Our results of decreased yield and yield traits are in line with those of [53,54] in cowpea and [55,56] in barley reported tremendous decrease of yield when plants are subjected to increased NaCl salt stress concentrations. Under high salinity stress conditions, the plant displayed lower grain weight, and fewer spikelets per panicle, all of which contributed to a decrease in harvest index and grain yield of rice *Oryza sativa*L. [57]. From fig. 13, the plants of NaCl treatment shows higher reduction in yield attributes than other plants. Salt stress has recently been identified as the most harmful environmental stress, resulting in a significant reduction in agricultural productivity and quality [58]. NaCl+HEX and NaCl+MT treated plants show reduction in yield attributes than control plants. However, exogenous applied HEX and MT both under non-saline as well as saline conditions showed increased yield attributes i.e., pod length, seed no. per pod, pod no. per plant, and yield per plant respectively. In addition, coating soybean seeds with MT significantly increased plant growth and seed yield [59].

CONCLUSION

The results showed that application of HEX and MT can actively regulate the physiological changes such as Leaf area, RWC, MSI in order to ameliorate the negative effect of salinity by minimizing the ROS induced EL. These adjustments are the key mechanisms for finger millet to improve NaCl stress tolerance and maintain yield of the plant.

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Kathiravan et al.,

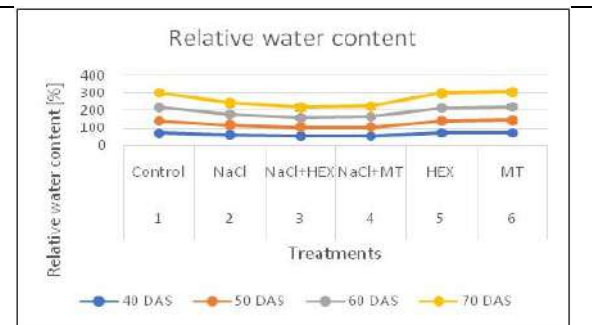
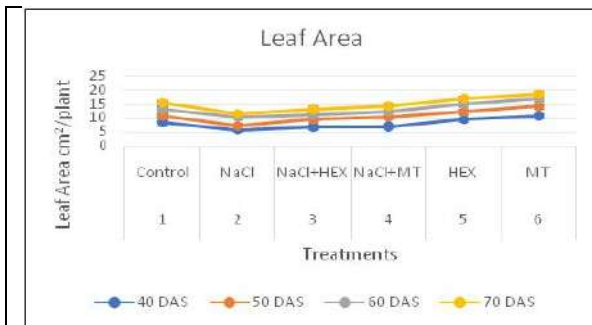


Fig. 1. Effect of exogenous application of HEX and MT on leaf area of finger millet [CO- 15 variety] under 200mM NaCl stress. Values represented in Bars are mean of three replicates [n=3] and \pm standard error

Fig. 2. Effect of exogenous application of HEX and MT on relative water content of finger millet [CO- 15 variety] under 200mM NaCl stress. Values represented in Bars are mean of three replicates [n=3] and \pm standard error

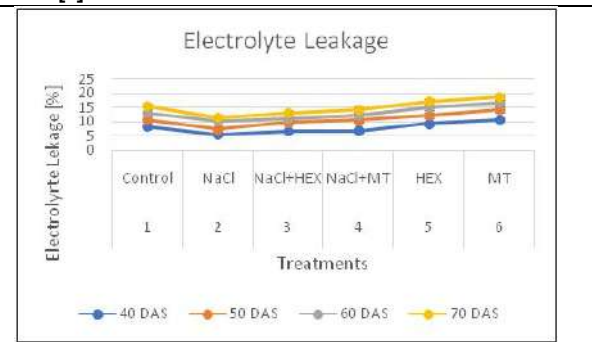
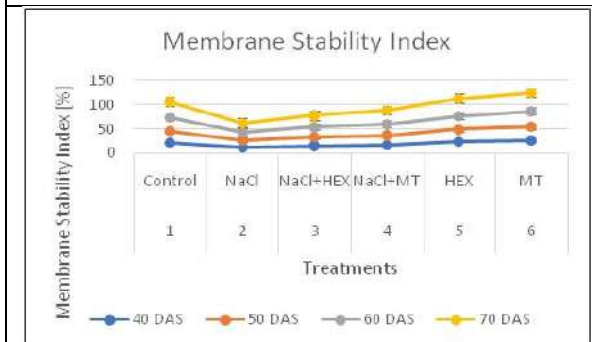


Fig. 3. Effect of exogenous application of HEX and MT on membrane stability index of finger millet [CO- 15 variety] under 200mM NaCl stress. Values represented in Bars are mean of three replicates [n=3] and \pm standard error

Fig. 4. Effect of exogenous application of HEX and MT on electrolyte leakage of finger millet [CO- 15 variety] under 200mM NaCl stress. Values represented in Bars are mean of three replicates [n=3] and \pm standard error

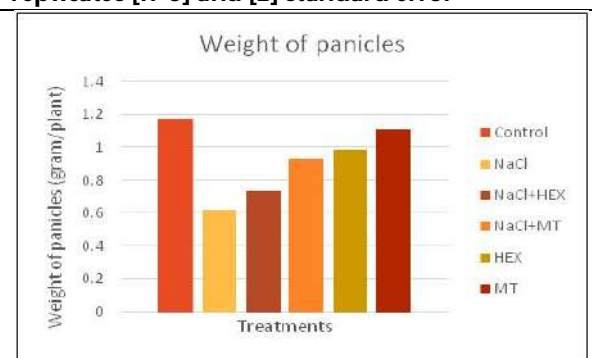
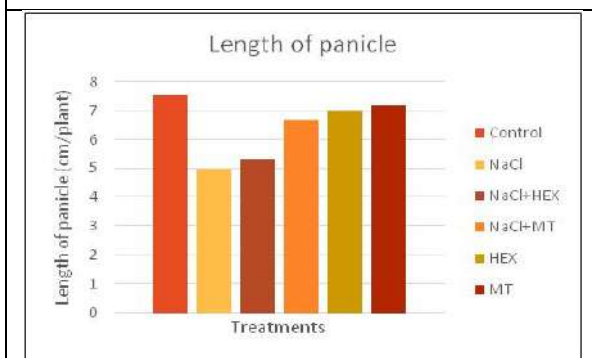


Fig. 5a. Effect of exogenous application of HEX and MT on length of panicle of finger millet [CO- 15 variety] under 200mM NaCl stress. Values represented in Bars are mean of three replicates [n=3] and \pm standard error

Fig. 5b. Effect of exogenous application of HEX and MT on weight of panicle of finger millet [CO- 15 variety] under 200mM NaCl stress. Values represented in Bars are mean of three replicates [n=3] and \pm standard error





A Review on Siddha in Consuming Rice Flakes Varieties during Seasonal Variation

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ABSTRACT

Rice flakes or 'flattened rice' or 'beaten rice', is a famous processed rice product used as a breakfast cereal, a substitute for cereal in weaning ingredients and snack food. About one-fifth of the rice produced is transformed into flakes. Rice flakes are used as a base ingredient, which is transformed into many sorts of completed merchandise such as an item for breakfast or as a snack food. In the siddha system of medicinal drug rice flakes [aval] consists of greater nutritional benefits than other rice varieties. Hence the types can be taken into six divisions (perumpozhuthu) of seasonal variations. The intention of this find out about is to eat the rice flakes sorts during several seasons with the rearrangement of kutrams. It is a review of literature from a siddha perspective. The ordinary disciplines of food and action as referred to for each season are observed as strictly as viable so that we could keep away from the occurrences of ailments due to the seasonal divergence.

Keywords: Flattened rice, Rice flakes, Perumpozhuthu, seasonal divergence.

INTRODUCTION

Siddha medicine is one of the earliest regular medication structures in the world which treats no longer only the physique but also the thinking and the soul.





Priyadharshini et al.,

'FOOD IS MEDICINE AND MEDICINE IS FOOD

This is the high precept in the siddha medicine of medication which means if the eating meals are pure and appropriate there will be no bodily or mental illness. Siddha practitioners believe that five basic principles which include Earth, water, fire, air, and sky are in food. Human body, pathology of disease, therapeutic cure and meal regimen all have an identical composition of those five elements. The ancient Tamils divided the year into seasons (Perumpozhuthu) and days (Sirupozhuthu). The native seasons are Kaar, Koothir, Munpani, Pinpani, Ilavenil and Mudhuvani kaalam. Human characteristics change with seasonal fluctuations. Rice flakes, a rice product made from un hulled rice, is an average source of iron and can be considered a good source of calcium. It has higher levels of iron and calcium and has better bioavailability than other rice products. Among Rice Flakes, it has much lower anti-nutritional factors, thus allowing higher absorption of calcium and iron. Therefore, thinner ones are higher [2]. Because rice flakes are made from rice, they are easy to digest. Most preparations can be made in a short period of time, so they are common practice in most households. Rice flakes are brown rice that has been flattened into flat, lightly dried flakes. The rice flakes are added to water, milk, or other liquids, whether warm or bloody, when imbibed. Rice, rice flakes, and puffed rice were the preferred semi-solid foods, and mothers strongly believed in hot and cold foods [3]. This paper offers the siddha concept of food associated with its seasonal divergence and attributes characteristics of rice flakes with its adjuvant varieties which can be taken at some point of actual rhythmic condition.

MATERIALS AND METHODS

Processing rice flakes is slightly different than processing cornflakes and wheat flakes. Recipe Rice flakes can be made from head rice (whole grain) or 2dhead (broken piece of wholegrain). [4]. Paddy is boiled using adding double its quantum of water. It is cooled for one night, adding an adequate quantity of water and then filtered and fried in a pan. It is pounded with warmth and the husks are removed. Milk and ghee are added to it and consumed.

'Paaneiserth thunnir balamaam thathikanmandhath
Thaneithu moraaivu thagameri-venirukku
Mampuliyu manjungaa laagumirai yoliyu
Mempuliyum pithi lavalil'.

-Patharthagunasinthaamani.

Organoleptic character [5]:

Tamil name : Aval
English name : Rice flakes
Taste : Sweet
Character : Coolant
Actions : Demulcent
Refrigerant
Type : Sathuvagunporul (carbohydrate)-Kabaportal.
Uses : It offers eight times more energy than the six distinct tastes (arusuvaiunavu).

CHARACTERISTICS OF ADJUVANTS[7]:

Characters of milk:

- It removes fatigue and increases body heat.

Characters of curd:

- It suppresses the increased vathakutram
- It reduces swelling





Priyadharshini et al.,

- It reduces abdominal pain
- It cures anaemia
- It clears pitham
- It stops diarrhoea
- It reduces the thirst and burning sensation
- It nullifies the effect of idumarunthu.

Characters of ghee:

- If the ghee can be taken in the required amount it balances the food in our stomach and gives more stamina and strength.

Characters of water:

- It reduces the body heat
- It purifies the blood
- It gives firm teeth and enhances sperm production.

Characters of sour food:

- It promotes gastric secretion and brings food assimilation very easier.
- Consuming sour foods produces heat inside our stomachs.
- It excretes the faeces.

DISCUSSION

Among the six seasons kaar , koothir, munpanikaalam naturally gives physical strength to the body. Hence rice flakes with milk and ghee can be consumed in entire seasons.

Kaar(early rainy season)

During this season the digestive fire decreases. The three humours are rearranged. Hence rice flakes given with curd and buttermilk are avoided. It causes indigestion.

Koothir (Latter rainy season)

The day is very hot owing to the severity of the sun. During this season Pitham is increased and affects the other humor. Hence rice flakes given with curd are avoided.

Munpani (Early winter season)

Humanity becomes healthy during this season. The internal body temperature rises and his appetite increases. Therefore, milk, curd, buttermilk and water will be promoted with rice flakes.

Pinpani (Latter winter season)

During the last winter, Kapam increases and dry conditions remains stagnant. Therefore, avoid eating rice flakes soaked in water and buttermilk.

Ilavenil (early summer season)

Kapham acquired last winter is aggravated by pitam involvement, causing kapha disorders and anorexia. Therefore, avoid rice flakes with a combination of quark, buttermilk and sour foods.

Mudhuenil (Latter summer season)

The flowering of lotus is due to the sun. The climate is getting hotter, water resources are depleting, Kapham is declining, Vasam is rising, and humanity is responsible for all diseases, diseases caused by Vasam disease predominate. Therefore, acidic foods and rice flakes taken with water should be avoided as they enhance vatakutram.



**Priyadharshini et al.,**

Diseases due to the derangement of Vatham take place predominantly. Hence rice flakes taken with sour meals and water ought to be avoided because it enhances the vathakutram. Wild rice flakes were found to be a major contributor to significant dietary intake levels of pyridoxine, niacin, thiamine, pantothenic acid, folic acid, manganese, phosphorus, chromium, magnesium, manganese, phosphorus, molybdenum, iron, zinc and copper. Consuming buttermilk is a natural way to control blood stress and blood lipids in healthy people. It generally suggests that it can be used as Cornflakes, which turned out to be the richest source of Na, had been the least valuable in phrases of the content material of the macroelements, in which they resembled rice flakes. All breakfast cereals, while now not being mainly prosperous in Na, K, Ca and Mg, when organized with milk have a substantially higher value for school-age young people and make sure a higher consumption of milk.[11].

CONCLUSION

Food is an important source for serving dietary needs. The types of Riceflakes can improve physical power and stamina and even good nutritious meals or snacks for adults and children. Through this study, we have highlighted the rice flake sorts fantastic for seasonal divergence. This learning about in turn will be beneficial to enhance the fitness of the indigenous people.

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Table 1- Rice Flakes Varieties And Their Uses[6]

S.NO	RICE FLAKES	ADDED INGREDIENT	USES
1.	Aval	Milk	Physical strength and stamina
2.	Aval	Curd	Indigestion
3.	Aval	Water	It increases vatham
4.	Aval	Buttermilk	It cures thirst and burning sensation
5.	Aval	Sour foods	It cures pitha diseases.

Table -2 Rice Flakes Preferred For Different Seasons[6]

RICE FLAKES VARIETIES	KAAR KALAM	KOOTHIR KAALAM	MUNPANI	PINPANI	ILAVENIL	MUTHUVENIL
Aval+Milk+Ghee	Yes	Yes	Yes	Yes	Yes	Yes
Aval+curd	No	No	Yes	Yes	Yes	No
Flakes soaked in water	Yes	Yes	Yes	Yes	No	Yes
Flakes with buttermilk	No	Yes	Yes	Yes	No	No
Flakes with sour foods	Yes	Yes	Yes	Yes	No	No

Table -3 Tastes Preferred for Different Season[8]

Kaalam	Season	Tastes & nature of food
Kaar	Early rainy season	Sweet, sour, salt, oily and warm food
Koothir	Latter rainy season	Sweet, bitter, astringent, dry and cold food
Munpani	Early winter season	Sweet, sour, salt tastes oily and cold food
Pinpani	Latter winter season	Sweet, sour, astringent oily and cold food
Ilavenil	Early summer season	Bitter, pungent, astringent, dry and warm food
Mudhuvnil	Latter summer season	Sweet, oily and cold food

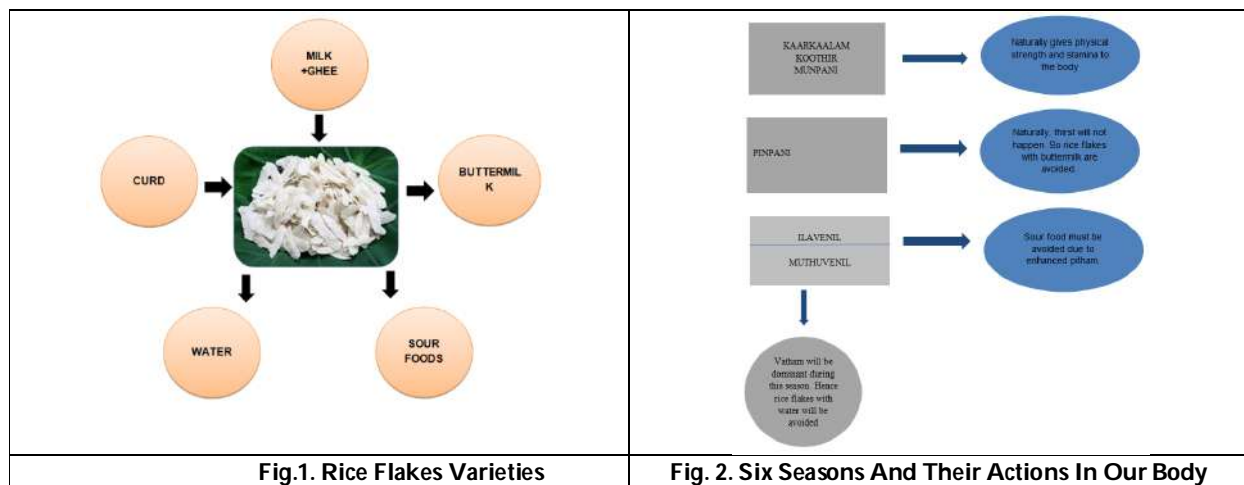


Fig.1. Rice Flakes Varieties

Fig. 2. Six Seasons And Their Actions In Our Body





Spiritual Intelligence and Yoga : Exploring the Synergy for Inner Transformation

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ABSTRACT

The purpose of this study work is to examine how yoga practice and spiritual intelligence are related. Yoga is a holistic practice that incorporates physical postures, breath control, meditation, and ethical precepts. Spiritual intelligence is the ability of a person to connect with and understand deeper parts of reality. This research intends to investigate how the practice of yoga can improve spiritual intelligence and promote inner transformation by looking at the confluence between spiritual intelligence and yoga. The paper will examine pertinent research, examine case studies, and offer insights into how yoga might help people develop their spiritual intelligence. The research will advance knowledge of the relationship between spiritual intelligence and yoga and provide useful advice for those looking to progress on their spiritual path.

Keywords: Spiritual intelligence, yoga, inner transformation, holistic practice, meditation





Deepak Bangari *et al.*,

INTRODUCTION

Yoga and spiritual intelligence are based on long-practiced concepts and practices from antiquity. Both ideas present means for people to discover their inner selves, communicate with a greater awareness or power, and pursue personal development and fulfillment. The ability to access and incorporate spiritual and transcendent parts of life into one's daily experiences is referred to as spiritual intelligence. Self-awareness, empathy, compassion, wisdom, and a sense of connection are among the traits it incorporates. A deeper knowledge of one's purpose, values, and relationship with the rest of the world entails moving beyond religious affiliations or views. Yoga is a classic Indian practice that incorporates physical postures (asanas), breath control (pranayama), meditation, and ethical principles. There is also a physical element. The benefits and potential for personal transformation that studying the relationship between spiritual intelligence and yoga can offer make it crucial:

1. Self-Awareness and Inner Growth: Both yoga and spiritual intelligence offer methods and exercises to develop self-awareness, enabling people to examine their ideas, feelings, and beliefs. Personal development, emotional stamina, and a better understanding of oneself are all facilitated by this introspection and self-reflection.
2. Connection and Interconnectedness: Yoga and spiritual intelligence place a strong emphasis on the universe's and all living things' connections with one another. People can gain a wider perspective, improve their relationships, and contribute to the welfare of others and the wider world by encouraging a sense of oneness, empathy, and compassion.
3. Transcendence and higher realms of awareness: Breath control and meditation are two yoga practices that can assist practitioners reach transcendence and higher planes of consciousness. These experiences can lead to a deeper connection with the divine or universal awareness, spiritual insights, and a sense of oneness.
4. Emotional and Mental Wellness: Yoga poses have been shown to reduce stress, anxiety, and depression symptoms while promoting emotional balance and mental clarity. Spiritual intelligence fosters emotional intelligence and resilience by enabling people to understand and control their emotions.
5. Integrating Ethics and Values: The Yamas and Niyamas, or ethical principles of yoga, provide a framework for ethical action and moral growth. By matching their actions with these beliefs, people can cultivate spiritual intelligence traits like integrity, honesty, and kindness.

Examining the history and relevance of spiritual intelligence and yoga brings forth their potential for promoting wellbeing, inner transformation, and personal progress. People can improve their spiritual intelligence and gain a better understanding of who they are, what they are here for, and how they fit into the world by incorporating the practices and ideas of yoga.

Conceptual Framework

It is necessary to take into account a number of theories and dimensions in order to define spiritual intelligence. Although there isn't a single description that applies to everyone, a number of significant ideas and frameworks offer insights into the idea of spiritual intelligence. Following are some well-known concepts and dimensions related to spiritual intelligence:

Marshall's and Zohar's Theory

The four dimensions of spiritual intelligence are described by Danah Zohar and Ian Marshall as follows:

1. Critical Existential Thinking, or a.c.e.t., is the ability to critically examine one's beliefs and values and to mull over serious existential issues like the meaning and purpose of life.
2. The capacity to infuse daily actions with one's morals, ethics, and spirituality in order to derive personal meaning from events.
3. Transcendental Awareness: recognizing the interconnectedness of all things and having access to higher realms of consciousness, also known as transcendence.





Deepak Bangari et al.,

4. Conscious State Expansion: Conscious state expansion is the ability to change consciousness and perception in order to get a more comprehensive understanding of oneself, other people, and the outside environment.

As per the King's Theory

An elaborate three-dimensional model of spiritual intelligence was proposed by Roger W. King.

- a. Personal Spiritual Quotient (PSQ): The PSQ (Personal Spiritual Quotient) measures an individual's unique spiritual experiences, values, and beliefs.
- b. Transcendental Awareness Quotient (TAQ): The ability to access transcendental or higher states of consciousness is measured by the Transcendental Awareness Quotient (TAQ).
- c. Universal Spiritual Quotient (USQ): The ability to recognize interconnectivity and to behave in accordance with universal principles and values is represented by the USQ (Universal Spiritual Quotient)..

Emmons' Theory

Robert Emmons put up a five-dimensional model of spiritual intelligence.

- a. The Capacity for Transcendence: The capacity for transcendence is the power to rise above commonplace perceptions and enter deeper realms of reality..
- b. The Ability to Exercise Free Will: The capacity to make decisions in accordance with moral standards and higher ideals.
- c. The Ability to Initiate Positive Change: The propensity to proactively bring about positive change in oneself and the world.
- d. The Capacity for Spiritual Growth: The capacity for spiritual development is the desire and readiness to advance spiritually.
- e. The Capacity for Virtue: The development of virtues including compassion, forgiveness, and thankfulness.

Other Dimensions

Self-awareness, mindfulness, empathy, compassion, wisdom, moral reasoning, and the capacity to discover meaning and purpose in life are other traits that are frequently linked to spiritual intelligence. It's crucial to remember that various ideas and dimensions do not contradict one another and that other academics may place a different focus on specific features of spiritual intelligence. However, when taken as a whole, they offer a framework for comprehending and examining the complex nature of spiritual intelligence, which includes elements of self-awareness, existential reflection, transcendence, moral development, and the awareness of interconnectedness.

Balance of the body, mind, and spirit is the aim of the comprehensive and age-old discipline of yoga, which includes a range of methods, notions, and philosophical foundations. Originating in ancient India, the practice of yoga has developed through thousands of years and is currently very well-liked.

Here is a summary of yoga's philosophy, values, and techniques:

- Yoga philosophy: Patanjali's Yoga Sutras and the Bhagavad Gita serve as the cornerstones of yoga philosophy. Key concepts include:
 - Integration or unification is what the Sanskrit word "yuj," from which yoga is derived, refers to. It emphasizes the intertwining of the individual ego (jivatman) with the supreme consciousness (Brahman).
 - The eight limbs, or phases, of Ashtanga Yoga are described in Patanjali's Yoga Sutras. These comprise the Yamas and Niyamas (moral and ethical rules), Asanas (physical postures), Pranayama (breath control), Pratyahara (withdrawal of senses), Dharana (concentration), Dhyana (meditation), and Samadhi (absorption or illumination).
 - Karma and Reincarnation: The notions of karma (the law of cause and effect) and reincarnation (the cycle of birth and rebirth) are recognized in yoga philosophy. It implies that our present-day choices have an impact on our experiences in the future.

Philosophy of yoga

- Ahimsa is the practice of non-violence and kindness to oneself and others.
- Satya embodies honesty, sincerity, and genuineness.



**Deepak Bangari et al.,**

- Asteya: Refraining from stealing, both material and immaterial.
- Brahmacharya: Self-control and moderation; sometimes associated with restraint in sexual activities.
- A lack of conceit and greed is referred to as aparigraha.

Yoga practices

- Asanas: Postures that help develop flexibility, balance, strength, and body awareness. Asanas are designed to improve physical health and prepare the body for meditation.
- Pranayama: Breathing exercises that control and broaden the breath, directing the body's life force energy (prana) throughout. Pranayama improves brain clarity, energy balance, and breath awareness.
- Meditation is the practice of concentrating the mind to bring about a profound level of relaxation, calm, and increased awareness. Meditation fosters present-moment awareness, clarity, and connection.
- Chanting and Mantra: Sacred sounds, words, or phrases are repeated in order to enter a meditative state and establish a connection with higher consciousness.
- Yoga Nidra: A technique for guided relaxation and meditation that encourages restful sleep and regeneration.
- Karma Yoga: Selfless action and service carried out without attachment to the results, with the purpose of assisting others.
- Bhakti Yoga: A path of love and devotion that entails worshiping and submitting to a higher force or deity.
- Jnana Yoga: A path of knowledge and insight that entails meditation, self-reflection, and the study of spiritual literature.
- Raja Yoga: The regal path of yoga, emphasizing meditation and mental control while incorporating all of Patanjali's eight limbs of yoga.

The needs and tastes of each person can be catered to using yoga because it is a flexible discipline. With pathways to physical health, cerebral clarity, emotional balance, and spiritual revelation, it offers a holistic approach to self-discovery, wellbeing, and spiritual progress.

Yoga and Spiritual Intelligence: A Connection

Spiritual intelligence and yoga have many benefits for one another. Spiritual intelligence can be developed and expressed via yoga practices, and spiritual intelligence deepens and expands yoga experiences and understanding.

The following are the key components of the relationship between yoga and spiritual intelligence:

1. Self-awareness and Self-Reflection: Meditation and yoga asanas (physical postures) promote self-awareness and self-reflection. Yoga exercises give people a place to examine their thoughts, feelings, and sensations, which promotes self-awareness and the development of spiritual intelligence. Self-awareness and the capacity for critical thought about one's experiences, values, and beliefs are components of spiritual intelligence.
2. Spiritual intelligence and yoga both lay a lot of emphasis on mindfulness and present-moment awareness. A talent that can be cultivated through yoga techniques like breath-focused meditation and mindful movement is the ability to be totally present. Being in the now, recognizing and appreciating the depth of one's experiences, and understanding the interconnectedness of all things are all characteristics of spiritual intelligence.
3. Transcendence and Connection: Yoga practices provide a way to achieve transcendental states and a connection to something bigger than oneself. Recognizing and experiencing a sense of connection and interconnectedness with a world bigger than oneself is a requirement for spiritual intelligence. Yoga techniques that promote transcendence and strengthen a person's connection to the divine or universal awareness include meditation and the investigation of higher states of consciousness.
4. Ethical Living and Moral Development: • The Yamas and Niyamas, or ethical precepts of yoga, direct people toward righteous and ethical behavior. The development of moral judgment, integrity, and a dedication to values and principles are all components of spiritual intelligence. Yoga practices offer a framework for moral judgment and the growth of attributes related to spiritual intelligence, such as compassion, kindness, and non-harming.



**Deepak Bangari et al.,**

5. Self-Realization and Inner Transformation: Yoga practices are meant to promote self-realization and inner transformation. The discovery of one's higher self or spiritual essence is a component of spiritual intelligence. Individuals can acquire and express spiritual intelligence through yoga practices, which can result in shifts in consciousness, expanded awareness, and the letting go of constricting beliefs and identities.
6. Integration of Body, Mind, and Spirit: Yoga places a strong emphasis on the fusion of the body, mind, and spirit, bringing these three facets of the self into a comprehensive and peaceful alignment. Spiritual intelligence is aware of how these aspects of the human experience are related and dependent on one another. Yoga techniques offer a way to harmonize and balance one's physical, mental, and spiritual well-being, promoting the growth of spiritual intelligence.

The link between spiritual intelligence and yoga is a dynamic and transformative process. Engaging in yoga practices with a mindful and introspective approach deepens the development of spiritual intelligence, while cultivating spiritual intelligence enriches the experience and understanding of yoga. Together, they support individuals in their journey of self-discovery, personal growth, and the realization of their spiritual potential.

Yoga Practices for Cultivating Spiritual Intelligence

Numerous yoga techniques can aid in the development of spiritual intelligence. Asanas (physical postures), pranayama (breath control), meditation, and ethical precepts are all included in these practices.

The following are some essential yoga asanas for developing spiritual intelligence:

1. Asanas (Physical Postures): Asanas encourage physical strength, flexibility, and balance while also helping to develop body-mind awareness. Asana practice that is attentive and attention-focused cultivates present-moment awareness and improves self-awareness. Asana practice can be seen of as a sort of moving meditation that unites the body, mind, and spirit in harmony.
2. Pranayama (Breath Control): Pranayama techniques entail the deliberate expansion and regulation of the breath. Deep and controlled breathing exercises improve mental focus and clarity while raising vital energy (prana). Pranayama exercises help to center and relax the body and mind while calming the mind and regulating the neurological system.
3. Meditation: In yoga, meditation is a fundamental practice for developing spiritual understanding. Self-awareness, focus, and inner calm are improved by a variety of meditation approaches, including mantra, loving-kindness, and mindfulness. Through the impartial observation of one's thoughts, feelings, and sensations during meditation, one can gain insights and a greater comprehension of oneself and the nature of reality.
4. Yamas and Niyamas: The Yamas and Niyamas are ethical precepts in yoga that direct people toward righteous and moral behavior. Moral integrity is developed via the practice of non-violence (ahimsa), truthfulness (satya), non-stealing (asteya), moderation (brahmacharya), and non-possessiveness (aparigraha). Cleanliness, contentment, self-discipline, self-study, and surrender to a higher power are practices that promote human development and alignment with loftier ideals.
5. Self-Inquiry and Contemplation: Yoga promotes self-inquiry and introspection in order to increase self-awareness and delve deeper into existential issues. The exploration of one's views, values, and life purpose can be aided by engaging in reflective practices, journaling, and contemplative activities. Greater self-awareness, insights, and the growth of wisdom result through self-inquiry practice.
6. Service and Karma Yoga: Karma yoga and selfless service (seva) are two practices that help people develop their spirituality and spiritual intelligence. Empathy, compassion, and a sense of interconnectivity are fostered by serving others without attaching oneself to the results. People find more meaning and fulfillment when they dedicate their activities and labor to a higher cause and use their gifts and talents to help others.

The interconnectedness and mutual support of yoga's practices must be noted. The incorporation of these techniques into one's yoga practice makes it easier to develop spiritual intelligence and promotes overall wellbeing. To ensure safe and efficient application, it is advised to approach these techniques with assistance from knowledgeable yoga teachers or practitioners.





Deepak Bangari et al.,

Empirical Evidence and Case Studies

According to Seena et al. (2017), yoga practitioners significantly outperformed non-practitioners in terms of variable Spiritual Intelligence. According to Abdul et al. (2019), yoga has a considerable and beneficial effect on spiritual intelligence. Yoga supports spiritual development, spiritual practice, and spiritual intelligence in addition to mental health. Theoretically and conceptually, yoga and spiritual intelligence are complementary to one another. Internal thoughts that are impacted by yoga help people have more spiritual wisdom. Yoga helps a person connect with their spiritual side. Yoga as a self-help method for a person's spiritual and psychological growth. According to a study by A. Mittal et al. (2011), those who have high emotional and spiritual intelligence are happier than the other three groups. Yoga poses have a strengthening influence on specific characteristics, such as improving precision and focus as explanatory variables for expanding consciousness (Khalsa, 2004). Theoretically and conceptually, yoga and spiritual intelligence are closely related, and yoga induces introspective contemplation that raises personal spiritual intelligence. By encouraging in-depth thinking about daily issues, yoga activities help people become more aware of themselves and realize that one of the characteristics of spiritual intelligence is higher meaning production. Yoga may have an impact on the transcendental awareness of spiritual intelligence, according to several brain functions that are affected by the practice (Ameram & Dryer, 2007).

Benefits and Implications

The combination of yoga and spiritual intelligence has many advantages and ramifications for both individuals and society. Here are some significant advantages and implications to think about:

1. **Personal development and wellbeing:** Yoga practices that cultivate spiritual intelligence help people manage stress, cope with challenges, and maintain their mental and emotional well-being. They also help people develop self-awareness, self-acceptance, and emotional resilience. They can also help people find meaning and fulfillment in life.
2. **Interpersonal Relationships:** Yoga practice and spiritual intelligence development promote empathy, compassion, and the capacity to establish genuine connections with people. Better interpersonal skills, communication, and comprehension lead to happier, more rewarding relationships. Kindness, forgiveness, and cooperation are more likely to be displayed by those who have developed spiritual intelligence.
3. **Ethical Living and Moral Development:** The Yamas and Niyamas of yoga provide guidelines for leading a morally upright life. Yoga and spiritual intelligence combined encourages moral judgment, honesty, and a dedication to values and beliefs. It improves people's capacity to make moral decisions and take actions that are advantageous to both oneself and the larger community.
4. **Resilience and Coping Mechanisms:** Spiritual intelligence and yoga give people the skills they need to handle hardship and deal with life's obstacles. Yoga techniques like meditation and breath control encourage rest, stress reduction, and improved emotional regulation. Through the practice of yoga, people can increase their resilience, adaptability, and capacity to deal with change.
5. **Expanded Consciousness and Transcendence:** Yoga practices help people have experiences of transcendence and transcendental states of consciousness, as well as a connection to something more than themselves. People can gain a wider perspective, a sense of unity, and a deeper comprehension of how intertwined all living things are through these encounters. Exploring the nature of reality, existential issues, and the deeper purpose of life are made possible by the fusion of spiritual intelligence and yoga.
6. **Professional and Educational Contexts:** Yoga and spiritual intelligence practices can enhance employee well-being, job satisfaction, and productivity in professional environments including offices and educational facilities. Leadership abilities, emotional intelligence, and moral judgment can all be improved with training programs and interventions based on spiritual intelligence and yoga. Yoga and spiritual intelligence can help kids develop holistically and build strong characters while also improving their general wellbeing when they are integrated into the classroom.
7. **Societal Implications:** Yoga's promotion of spiritual intelligence can lead to a more altruistic, moral, and peaceful society. Spiritually intelligent people are more prone to take up social duty, environmental stewardship, and



**Deepak Bangari et al.,**

charitable deeds. Yoga and spiritual intelligence can be combined to promote better harmony, empathy, and understanding between people of all backgrounds.

People can improve their personal development, wellbeing, interpersonal relationships, and ethical behavior by embracing the advantages and implications of spiritual intelligence and yoga. A more kind and connected world may result from the wider acceptance of these ideas and methods in diverse contexts.

Challenges and Future Directions

When studying spiritual intelligence and yoga, researchers need to be aware of a variety of limitations and challenges. Some of the most significant problems and difficulties are as follows:

1. **Subjectivity:** Individual experiences and interpretations are a part of both yoga and spiritual intelligence. It could be challenging to quantify and measure these constructs objectively because they are influenced by individual beliefs, experiences, and inner changes.
2. **Lack of Agreements:** Spiritual intelligence is not defined or governed by any accepted paradigm. Scholars and researchers may have different definitions and conceptualizations of it, which makes it challenging to compare and integrate findings and may result in conflicts.
3. **Assessment Methods:** A number of scales and questionnaires have been developed to measure spiritual acuity, but they may be unreliable and insensitive to cultural differences. Because various assessment instruments' validity and reliability can vary, it can be difficult to arrive at definitive results.
4. **A Variety of Practices:** Yoga uses a range of methods, strategies, and exercises. Due of the variety of yoga techniques, it might be challenging to assess how different yoga practices affect spiritual intelligence or to make generalizations.
5. **Contextual variables:** Social, cultural, and environmental factors may affect how well yoga and spiritual intelligence work. The cultural specificity and application of study findings must be considered because they may differ across many different cultures.
6. **Research Design Restrictions:** It might be challenging to conduct thorough research in the disciplines of spiritual intelligence and yoga due to the richness and diversity of these conceptions. Problems include small sample sizes, a lack of control groups, and the need for extensive investigations may limit the robustness and generalizability of study findings.
7. **Self-Selection Bias:** Research on yoga and spiritual intelligence usually uses self-selected samples, such as people who are already enthusiastic about or involved in yoga. This could lead to bias and limit the findings' applicability to a larger sample.
8. **Ethical Considerations:** It's crucial to consider ethical issues including participant safety, privacy protection, and respect for religious and cultural traditions when doing research on spiritual practices.
9. **Researcher Bias:** Personal beliefs or biases about yoga and spiritual intelligence that researchers themselves have may have an effect on the design of the study, how the data are interpreted, and the findings. Researchers must be aware of and honest about their personal biases in order to achieve neutrality.
10. **Few longitudinal research** have examined the long-term effects of yoga on spiritual intelligence. Such studies would provide in-depth insights into the long-term impacts of yoga practices on spiritual growth.

Researchers can approach the study of spiritual intelligence and yoga with greater clarity and rigor by acknowledging and resolving these constraints and difficulties, which will enhance the caliber and usefulness of research findings in this area.

Future investigation and study in the areas of yoga and spiritual intelligence may increase our knowledge and offer insightful information. Here are some ideas for next research:

1. **Longitudinal Studies:** Conduct long-term studies to look at how yoga affects spiritual intelligence and personal development over time. Follow people for an extended period of time to monitor changes in their psychological and general quality of life, as well as their spiritual wellbeing.



**Deepak Bangari et al.,**

2. Comparative studies: Evaluate the effects of various yoga forms on spiritual intelligence. Examine how various facets of spiritual intelligence are affected by various yoga practices (such as Hatha, Ashtanga, and Kundalini) in order to spot any potential variances and advantages.
3. Examine the impact of cultural variables on the connection between spiritual intelligence and yoga. Conduct cross-cultural research to learn how cultural practices, beliefs, and values affect yoga and have an impact on spiritual development.
4. Mindfulness and Spiritual Intelligence: Look at how yoga's mindfulness techniques relate to the growth of spiritual intelligence. Examine how self-awareness, emotional control, and spiritual development are impacted by mindfulness meditation and other contemplative activities.
5. Educational Applications: Investigate the incorporation of yoga techniques and spiritual intelligence in educational contexts. Look into the ways that combining yoga and spiritual intelligence into educational curricula or programs can improve students' academic achievement, character development, and overall well-being.
6. Workplace Well-being: Examine the effects of introducing yoga and practices for spiritual intelligence in the workplace. Examine the potential benefits of yoga therapies and training in spiritual intelligence for stress reduction, employee wellbeing, job satisfaction, and productivity.
7. Mechanisms and neuronal Correlates: Investigate the neuronal bases of yoga's impact on spiritual intelligence using neuroscience methods. Examine how yoga practices affect the neural networks, neurotransmitter systems, and brain activity that are connected to spiritual experiences and wellbeing.
8. Controlled intervention studies should be carried out to determine the effectiveness of yoga-based therapies in fostering spiritual intelligence and wellbeing. To identify how yoga interventions differ from other types of interventions (like mindfulness-based interventions), compare the outcomes of the two types of interventions.
9. Technology Integration: Investigate how to combine yoga techniques with technological tools (such as virtual reality or biofeedback) to improve training in spiritual intelligence and offer individualized experiences. Look at the ways that technology can help people reflect on themselves, become more self-aware, and develop their spiritual practices.
10. Experiential Studies: Promote qualitative research strategies that document the stories and living experiences of people practicing yoga. Examine your own experiences, observations, and life-changing revelations that have to do with how yoga and spiritual intelligence interact.

By pursuing these research directions, we can better understand the connection between spiritual intelligence and yoga, investigate their applications in various contexts, and contribute to the creation of practices and evidence-based interventions that promote spiritual well-being and individual development.

CONCLUSION

We may sum up the main results after examining the ideas of spiritual intelligence and yoga as follows:

First, spiritual sagacity: In addition to transcendence and a sense of oneness, spiritual intelligence includes self-awareness, empathy, wisdom, transcendence, and the ability to connect with and understand deeper aspects of reality. Frameworks for comprehending and assessing spiritual intelligence are provided by the theories of the Zohar as well as Marshall, King, and Emmons. Yoga is a comprehensive system that originated in ancient India. It combines physical postures (asanas), breath control (pranayama), meditation, and ethical principles. Yoga philosophy includes concepts of union, ethical principles (Yamas and Niyamas), and the eight limbs of yoga as described in Patanjali's Yoga Sutras.

Relationship between Yoga and Spiritual Intelligence: By fostering self-awareness, mindfulness, emotional intelligence, and moral development, yoga practice can improve spiritual intelligence. Yoga also gives practitioners the means to enter higher realms of consciousness or transcendence. Yoga's ethical guidelines help people match their behavior with higher ideals and promote characteristics related to spiritual intelligence.

Benefits and Consequences: Yoga and spiritual intelligence can be combined to promote personal development, emotional stability, improved health, and a stronger feeling of connectedness and purpose. Physical well-being,





Deepak Bangari et al.,

mental acuity, and spiritual enlightenment are all influenced by yoga's asanas, pranayama, meditation, and ethical living. Yoga and spiritual intelligence can be integrated in a variety of settings, including learning environments, professional environments, and therapeutic settings. Future Directions: More investigation is required to determine the underlying mechanisms underpinning the long-term effects of yoga on spiritual intelligence. Further understanding of the connection between spiritual intelligence and yoga may result from research into the environmental and cultural influences on that relationship. Both individuals and society can gain from further study of practical applications and the creation of particular solutions fusing yoga and spiritual intelligence.

People can use the transforming power of yoga to increase their self-awareness, promote personal growth, and build a closer connection with both themselves and the world around them by recognizing the synergistic relationship between spiritual intelligence and yoga. This study work seeks to clarify the complex connection between spiritual intelligence and yoga by performing a thorough analysis of the literature, looking at empirical data, and taking into account personal experiences. The conclusions drawn from this study can serve as a springboard for additional investigation and open doors for incorporating yoga practices into private and public settings in order to promote spiritual development and internal transformation.

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Phytochemical Analysis of *Rhizophora apiculata* Leaf and Root Extract and Its Inhibitory Action against *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli*

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ABSTRACT

Tropical shorelines usually support the growth of the mangrove species *Rhizophora apiculata*. *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli* are a few pathogenic bacteria that live in coastal habitats. The main objective of this study is to find out the chemical composition of the leaf and root extract of the mangrove species *Rhizophora apiculata* and its inhibitory action against the three pathogenic bacteria: *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli*. Using a completely randomised blocked design (CRBD), a leaf and root extract were made for this experiment at concentrations of 25% (T1), 50% (T2), and 100% (T3), as well as a positive control (T4) and a negative control (T0). According to their class, secondary metabolites of plants were found using phytochemical assays. Phytochemical studies have revealed that *Rhizophora apiculata* leaf and root extract contains saponins, tannins, flavonoids, steroids, and terpenoids. The extract stopped the pathogenic bacteria from growing larger.

Keywords: *Rhizophora apiculata*, pathogenic, phytochemicals, antibacterial activity, mangroves.





INTRODUCTION

The coast of Tamil Nadu, India, are home to the mangroves including species *Rhizophora apiculata*. Because of the presence of bioactive secondary metabolites, these plants are appropriate for medicinal application. Plants are suitable for use as medicines because of the secondary metabolite substances present in it, which are bioactive molecules[1,2]. Endophytic fungi isolated from *Rhizophora apiculata* leaves have the ability to inhibit *Pseudomonas aeruginosa* and *Staphylococcus aureus* [3]. *Pseudomonas aeruginosa* is the cause of frequent tilapia diseases, such as *Oreochromis mossambicus*. In a study on silver catfish (*Schilbe intermedius*) infected with *P. aeruginosa*, myeloperoxidase activity and blood-brain barrier degradation were examined[4]. Other researchers investigated how dietary grape pomace flour affected grass carp that had been artificially infected with *P. aeruginosa* in terms of purinergic signalling and inflammatory response [5].

Some fish are susceptible to the harmful bacteria *S. aureus*. Aquaculture has experienced financial losses as a result of Staphylococcus infections on fish. The North African catfish (*Clarias gariepinus*) and the zebrafish (*Danio rerio*) have both been the subject of reports and studies on fish infectious illnesses[6,7]. A study on *S. aureus* infection in the amphioxus *Branchiostoma belcheri* was conducted [8], and a grouper antibacterial that controls *S. aureus* in macrophage cells was also explored [9]. Staphylococcal infections of various cultured marine fish were researched on a larger scale in Turkey [10]. *Escherichia coli*, one of the most prevalent Gram-negative foodborne pathogens, is frequently used as an indicator-bacteria in tests for faecal contamination of food. Numerous problems, including diarrhoea and gastroenteritis, may result from it. In order to identify the chemical components of mangrove *R. apiculata* leaf and root extracts and to investigate how they affect the growth of *S. aureus*, *E. coli*, and *P. aeruginosa*, this study set out to identify these chemicals.

MATERIALS AND METHODS

Sampling and experimental design

The leaves and roots of *Rhizophora apiculata* were gathered from Pichavaram mangrove forest, Tamil Nadu, India. The collected plant materials were cleaned with distilled water, which were then air dried, thinly chopped, and dried once more, eventually grinded into coarse powder. Indoor Aeration was used to dry the plant materials. Pure cultures of the harmful pathogenic microorganisms *S. aureus*, *P. aeruginosa*, and *E. coli* were obtained from the microbiology department laboratory at Annamalai University. A completely randomised block design (CRBD) was used in this experiment [11]. using three repetitions of a 25% (T1), 50% (T2), 100% (T3), positive control (T4), and negative control (T0) concentration level for leaf and root extract.

Preparation of sample for the phytochemical test

Using a blender, the shade-dried leaves were crushed into a coarse powder. The organic solvent used for the Soxhlet extraction was methanol. The proportions of the solvent to the leaves and roots of *R. apiculata* were 1:3 and 1:5, respectively. Mangrove root and leaf flour weighing 100g each were extracted using 500ml and 300ml of solvent, respectively. The solvent present with the crude extract was separated from the extract using a rotary vacuum evaporator at a temperature of 60°C until the solvent had evaporated completely. Eventually obtaining a fine extract of *R. apiculata* mangrove roots and leaves. The extract was transferred into a 500 ml beaker glass that already held a 100 ml solution of ethanol. Until it boiled, this mixture was heated and stirred with a stirring rod. Reheating the extract helped it to become more homogeneous in a 500 ml beaker glass. After adding enough distilled water and stirring to create two layers, ammonia chloroform was poured to the beaker glass until cracks started to develop. Chloroform extract was in the lower layer and water extract was in the upper layer. When particular colourants or reagents were added to the extract, the phytochemical test came to an end[12].



**Topi Karga and Venkatesan****Yield of extract (%)**

After the Soxhlet extraction method, the crude extracts were concentrated by allowing the solvents to completely evaporate in rotary evaporation (Heidolph) to obtain the real yield of extraction. To assess the standard extraction efficiency for a specific plant, different portions of the same plant, or different solvents utilised, the percentage yield of extraction is crucial in phytochemical extraction[13].

$$\text{Percentage yield} = \frac{\text{weight of the extract}}{\text{Weight of dry plant powder}} \times 100$$

Preliminary qualitative phytochemical screening

The crude methanolic leaf and root extract of *R. apiculata* underwent through a series of routine phytochemical assessments to identify various phytoconstituents.

Test for Alkaloids (Wagner's Test):

2ml of Wagner's reagent was combined with a small quantity of *R. apiculata* methanolic leaf and root extract. Alkaloids are present when a precipitate is reddish-brown in appearance.

Test for Cardiac Glycosides (Keller-Kiliani Test)

A 2ml solution of glacial acetic acid containing one drop of ferric chloride solution was added to 5ml of the methanolic root and leaf extract of *R. apiculata*. With one millilitre of concentrated H₂SO₄, this was underplayed. A deoxy sugar characteristic of cardenolides is indicated by a brown ring at the contact. The brown ring might be followed by a violet ring, while a greenish ring may gradually grow throughout the thin coating of acetic acid.

Test for saponins (Frothing Test)

A test tube containing 5ml of distilled water and almost 1ml of leaf and root extract was rapidly shaken. Add a few olive oil drips. It was considered that the appearance of honeycomb-like froth or foam indicates of saponins.

Test for Phenols (Bromine Water Test)

A quantity of the leaf and root extract in methanol was diluted in 2 ml of glacial acetic acid, then freshly made bromine water solution was added dropwise. Bromine disappears and turns brown, indicating the presence of phenol.

Test for Tannins (Ferric Chloride Test)

In a test tube containing 0.02 M potassium ferrocyanide, 1ml of the methanolic *R. apiculata* leaf and root extract was added. Following that, 1ml of 0.02 M ferric chloride containing 0.1 M HCl was added. The colour of the mixture was then checked for the presence of a blackish-blue or blackish-green hue.

Test for Flavonoids (Alkaline Reagent Test)

A fraction of crude methanolic leaf and root extract was combined with 5ml of a diluted ammonia solution and then concentrated H₂SO₄. When standing, the yellow coloration that was initially seen vanished. This outcome demonstrated the existence of flavonoids.

Test for Steroids (Salkowski Test)

About 0.5ml of leaf and root extract was combined with 2ml of concentrated H₂SO₄ along with 2ml of concentrated anhydrous acetic acid. When the colour changes from violet to blue or green, steroids are present.

Test for Terpenoids (Salkowski Test)

In order to create a layer, 5ml of the methanolic leaf and root extract was carefully combined with 2ml of chloroform and 3ml of concentrated H₂SO₄. To confirm that terpenoids were present, a reddish-brown colour of the inner face was created.



**Topi Karga and Venkatesan****Inhibitory Test (CRBD)**

A positive control (T4), negative control (T0), 25% (T1), 50% (T2), and 100% (T3), and an extract solution were all prepared. Ceftriaxone, the positive control solution, had a concentration of 30 g/ml, and DMSO, the negative control, was chosen. Pathogenic bacteria (*P. aeruginosa*, *E. coli*, and *S. aureus*) were grown in a subculture on nutrient agar[14]. Using the agar well diffusion method, pathogenic microorganisms were tested for inhibitory effects. In Muller-Hinton agar plates, the agar well diffusion technique was performed^[17]. A cotton swab was used to apply a standardised bacterial suspension to the plate, and a standard well borer was used to create wells that were 6 mm in diameter. 50µl of each extract were added to the well containing the drugs DMSO and Ceftriaxone, which served as the corresponding negative and positive drugs[15]. For 24 hours, these inoculated plates were incubated at 37°C. The inhibitory zone (measured in mm) was recorded in triplicate for each trial.

Statistical analysis

Statistical software was used to analyse the data. Any significant variations between the samples and the solvents were compared using Duncan's multiple range approach and analysis of variance (ANOVA). Standard deviations and the mean were used to express values.

RESULTS AND DISCUSSION**Phytochemical tests**

According to their class, secondary metabolites of plants were found using phytochemical assays. As demonstrated in (Table 1-2), alkaloid, saponin, phenol, tannin, flavonoid, and terpenoid were found in the leaf and root extract of *R. apiculata*. An approach used to ascertain whether secondary metabolite chemicals are present in plants is called a phytochemical test. Several phytochemical test reagents are used to qualitatively determine the classes of secondary metabolites. According to the reagents used, the secondary metabolites present in the extract were identified by a change in colour and the deposition or development of foam[16, 17]. The results of phytochemical testing revealed the presence of the following secondary metabolites in the extracts of *R. apiculata* leaves and roots: The formation of a reddish-brown coloured precipitate indicates the presence of an alkaloid; the formation of a honeycomb-like froth or stable foam indicates the presence of a saponin; the disappearance of brown colour indicates the presence of phenol; the appearance of blue-black colour indicates the presence of tannin; the disappearance of yellow colour indicates the presence of flavonoid; and the reddish brown coloration of the test indicates the presence of terpenoid[18, 19].

Inhibitory test

The leaf and root extracts of *R. apiculata* mangrove showed an inhibitory effect against pathogenic bacteria *S. aureus*, *E. coli* and *P. aeruginosa* as shown in Figure 1 and 2. The zone of inhibition in leaves extract ranged between 21.5-18.12mm (*S. aureus*), followed by 19.5-18.37mm (*P. aeruginosa*), then 8.75-5mm (*E. coli*). Furthermore, in roots extract it is 21.5-18.12mm (*S. aureus*), followed by 9.62-7mm (*E. coli*), and lastly 6.75-4.25mm (*P. aeruginosa*). It was also noted that the higher the concentration of the extract used, the higher the inhibitory effect generated on all types of test pathogens (Table 3 and Table 4). Numerous florals and some marine organisms, including sea cucumbers^[20] and brittle stars [21], contain saponin compounds. Saponins are found in plants in equal amounts in the roots, stems, tubers, leaves, seeds, and fruits. The fact that plants vulnerable to attack by insects, fungi, or bacteria have the largest concentration of saponin in their tissue demonstrates that this substance can serve as a defence mechanism for plant bodies [22].

Tannin compounds, which are categorised as polyphenolic compounds, have the ability to kill and prevent the growth of the fungus *Candida albicans* as well as bacteria. Tannin thus has antifungal and antibacterial properties. Tannin chemicals in *Rhizophora* sp. leaves and roots extract have the ability to alter a cell's natural permeability by shrinking the cell wall or cell membrane. Cells as a result experience stunted growth or even death since they are unable to perform life tasks. Tannins have been shown to have antibacterial properties through interactions with cell membranes, enzyme deactivation, and destruction or inactivation of genetic material functions.



**Topi Karga and Venkatesan**

Green plants often include flavonoids, which are also present in their leaves, roots, wood, bark, pollen, flowers, fruits, and seeds, among other plant components. Flavonoids exhibit biological action, are easily dissolved in water, are cytotoxic to cancer cells, prevent the release of histamine, are anti-inflammatory, anti-fungal, and anti-bacterial. It is mentioned that flavonoids' impacts can also stop bacterial cell proliferation and build intricate compounds against extracellular proteins, causing damage to cell membrane integrity. Steroid molecules are known to have bio-insecticidal, antibacterial, antifungal, and anti-diabetes properties as secondary metabolites. Steroid inhibitory mechanism weakens bacterial cell walls by making them more permeable, which causes cell leakage and the subsequent release of intracellular substances.

As antibacterial substances, terpenoid is excellent at preventing the development of bacteria, fungus, viruses, and protozoa. Terpenoids typically slow down bacterial growth by irritating the cell wall, coagulating bacterial protein, and inducing hydrolysis and dispersion of the cell fluid as a result of variations in osmotic pressure. Gram-negative microorganisms include *Pseudomonas aeruginosa* and *Escherichia coli*, while Gram-positive bacteria include *Staphylococcus aureus*. The highest inhibitory zone was discovered in *P. aeruginosa*, followed by *S. aureus* and *E. coli*, and was present in each species at a concentration of 100%. The peptidoglycan layer of Gram-negative bacteria is thinner than that of Gram-positive bacteria. Gram-negative bacteria are hence more vulnerable to antibacterial agents. According to the study's findings, a larger inhibition zone is formed at higher concentrations, which is supported by earlier research showing that the inhibitory impact grows with inhibitory concentration. According to the results of the current study, *R. apiculata* mangrove leaf and root extract includes secondary metabolites such as alkaloids, saponins, phenols, tannins, flavonoids, and terpenoids that may be able to stop microorganism growth. Therefore, more investigation is required to identify the components in this plant extract that can be employed as a natural remedy for human pathogenic diseases.

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Topi Karga and Venkatesan

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Table 1: Phytochemical test results of methanol extract of *R. apiculata* leaves

Active compound	Colour indicator	Result
Alkaloid	Reddish brown colour precipitate	+
Cardiac Glycosides	Brown ring, violet ring, greenish ring	-
Saponin	Honeycomb like froth or foam	+
Phenol	Disappearance in brown colour	++
Tannin	Blue-black coloration	+++
Flavonoid	Disappearance of yellow colour	+++
Steroid	Violet to blue or green	-
Terpenoid	Reddish brown	+





Topi Karga and Venkatesan

Table 2: Phytochemical test results of methanol extract of *R. apiculata* roots

Active compound	Colour indicator	Result
Alkaloid	Reddish brown colour precipitate	++
Cardiac Glycosides	Brown ring, violet ring, greenish ring	-
Saponin	Honeycomb like froth or foam	+
Phenol	Disappearance in brown colour	+++
Tannin	Blue-black coloration	+++
Flavonoid	Disappearance of yellow colour	++
Steroid	Violet to blue or green	-
Terpenoid	Reddish brown	+++

(+++)**highly present, (++) moderately present, (+) low, (-) Absent, (*R. apiculata*)*Rhizophora apiculata***

Table 3: Inhibition of *R. apiculata* mangrove leaf extracts against pathogenic bacteria

Pathogenic bacteria	Experimental units	Clear zone (mm) ± standard deviation
<i>Staphylococcus aureus</i>	T ₁	18.12±0.72
	T ₂	20 ± 0.66
	T ₃	21.5 ± 1.66
	T ₄	22.5 ± 1.66
	T ₀	0 ± 0.00
<i>Pseudomonas aeruginosa</i>	T ₁	18.37 ± 1.22
	T ₂	18.37 ± 1.22
	T ₃	19.5 ± 1.66
	T ₄	19.75 ± 0.91
	T ₀	0 ± 0.00
<i>Escherichia coli</i>	T ₁	5 ± 0.66
	T ₂	7 ± 0.66
	T ₃	8.75 ± 0.91
	T ₄	10.5 ± 1.66
	T ₀	0 ± 0.00

Table 4: Inhibition of *R. apiculata* mangrove root extracts against pathogenic bacteria

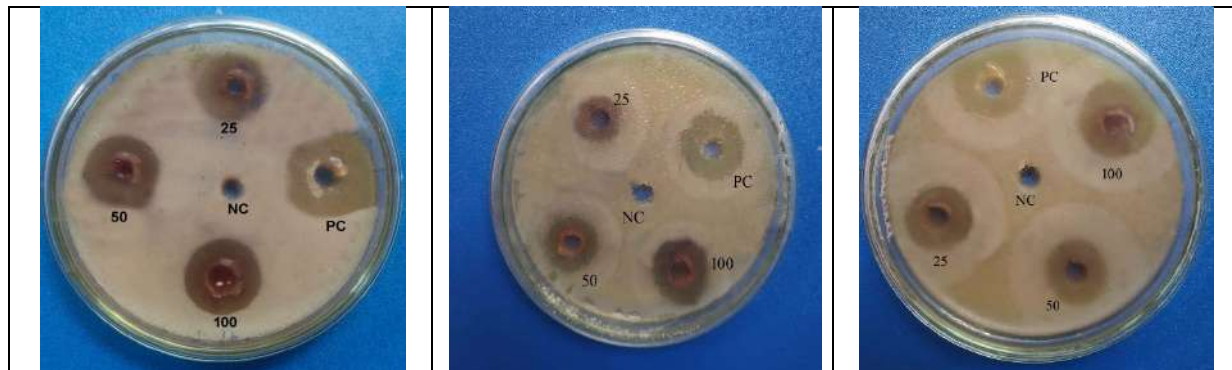
Pathogenic bacteria	Experimental units	Clear zone (mm) ± standard deviation
<i>Staphylococcus aureus</i>	T ₁	18.12 ± 0.72
	T ₂	20 ± 0.66
	T ₃	21.5 ± 1.66
	T ₄	22.5 ± 1.66
	T ₀	0 ± 0.00
<i>Escherichia coli</i>	T ₁	7 ± 0.83
	T ₂	8.25 ± 0.41
	T ₃	9.62 ± 1.22
	T ₄	16.37 ± 1.22
	T ₀	0 ± 0.00
<i>Pseudomonas aeruginosa</i>	T ₁	4.25 ± 0.41
	T ₂	5.87 ± 0.72
	T ₃	6.75 ± 1.08
	T ₄	8.25 ± 0.41
	T ₀	0 ± 0.00

T₁: 25%, T₂: 50%, T₃: 100%, T₄: Positive control, T₀: negative control, *R. apiculata*: *Rhizophora apiculata*





Topi Karga and Venkatesan

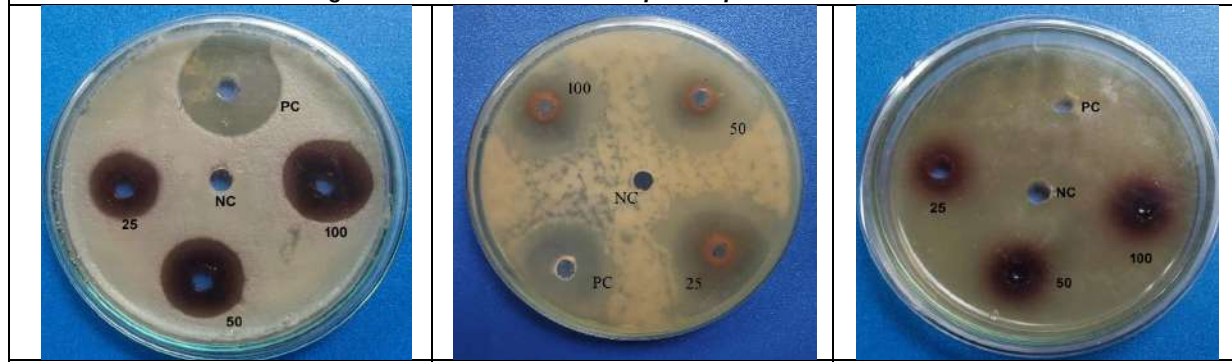


Escherichia coli

Pseudomonas aeruginosa

Staphylococcus aureus

Fig 1. Inhibition zones of *Rhizophora apiculata* leaf extract



Escherichia coli

Staphylococcus aureus

Pseudomonas aeruginosa

Fig 2. Inhibition zones of *Rhizophora apiculata* root extract





To Predict the Life Span of Selected Indian Fruits through MATLAB Segmentation and Deep Learning Techniques

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ABSTRACT

The fruit's shelf life (also known as its lifetime or how long it lasts) is the period of time during which it may be kept for use or consumption by the consumer in good condition, or the period during which the retailer may sell it until it is deemed unsuitable or contaminated by mould, yeast, or other bacteria. We created a model in the suggested study that can forecast the typical shelf life of picky Indian fruits. The snapshots from both the training set and the validation set will be included in the data set for the model. The chosen fruits will be examined in two distinct environments: one at ambient temperature (28°C–32°C) and the other at 4°C in the refrigerator. Upon supplying a picture of a fruit, specific characteristics will be retrieved and compared with a program-preloaded training set of snapshots of fruits. From the loaded image at any given moment, the suggested model will forecast the fruit's shelf life. There are two phases to the current work. By enhancing segmentation techniques, the fruit's characteristics are initially extracted. In the next phase the model was created and trained using Google Teachable Machine, a deep learning classification training approach. This technique allowed us to acquire an accuracy rate of the fruit shelf life.

Keywords - Shelf Life, Feature Extraction, Optimizing Segmentation Technique, Google Teachable Machine, Deep Learning Techniques.



**Aruna Arumugam and Mohamed Divan Masood**

INTRODUCTION

In general, the fruits and vegetables which are bought from the supermarkets or any other local shops can be stored in the refrigerator for longer use. It can be stored and used within the expired date might be for certain days or weeks depending upon the condition of the product[1]. It is better to wash the fruits and vegetables only before or at the time we are going to consume them (i.e. until they are ready to eat). As we all know at the time of ripening some of the fruits and vegetables produce and discharge ethylene gas which makes other nearby product items also mature faster[2]. So it is constantly good practice to keep or store the fruits and vegetables separately which produces ethylene gas. Some products will be good in storing refrigerators and other items will be good in storing at room temperature[3]. To ensure that we eat all that healthy product before it goes bad, we need to know how long it will last and where to store it for the maximum shelf life of fruits and vegetables. In this present work, we flourish the deep learning classification models that would foresee the average shelf life of selective five Indian fruits[4]. The classification models developed would predict the average shelf life of apple, banana, lemon, orange, and papaya. Two classification models for each of the fruits were developed. One model would predict the average shelf life of the fruit[5] stored under room temperature and the other model would predict the average shelf life of the fruit stored under refrigerator temperature. The dataset of the present work contained the images of the chosen Indian fruits captured from different angles[6]. The dataset contains both the training model data and the validation data set. The images in the data set were segmented using the Image Segmenter app in the image processing toolbar in MATLAB[7]. The model was generated and trained using Google Teachable Machine which is an open-source web-based resource for developing and training machine learning and deep learning models[8]. Providing an image of the chosen fruit as an input to the classification model would predict the remaining average shelf life of the fruit. The image provided as the input may be taken at any time. The model would extract features from the input image and compare it with the extracted features of the images in the dataset and would predict the average shelf life of the fruit whose image is given as the input. According to the prediction, we can keep the fruits and vegetables in the proper storage area as well as we can consume them in good condition with all its sustenance and benefits.

Tools and Technologies Used

The tools and technologies used in the development of the deep learning classification models for predicting the average shelf life[9] of the chosen Indian fruits are given below.

OnePlus Nord (Mobile Device with 48MP Quad Camera)

The Nord launch is the primary OnePlus tool to trait a complete of six cameras. It consists of 4 cameras at the back aspect and 2 cameras at the front. The quad cameras at the rear aspect consist of a 48MP primary camera that incorporates a Sony IMX586 sensor. The 48MP primary camera sensor is coupled with an f/1.75 aperture lens. The second one is an 8MP ultra-wide-attitude camera with an area of view that measures throughout 119° wide. The 8MP secondary camera sensor is re-curved to an f/2.25 aperture lens. In inclusion to those, the OnePlus Nord features a 2MP macro camera with an f/2.5 aperture lens and a 5MP intensity sensor with an f/2.4 aperture lens. The primary camera at the OnePlus Nord reinforces OIS (Optical Image Stabilization) in conjunction with EIS (Electronic Image Stabilization).

MATLAB (Image Processing and Computer Vision)

MATLAB is a programming platform that supports a wide variety of applications including computer vision, deep learning, machine learning, image and video processing, signal and communication processing, and so on[10]. It is a matrix-based language used to perform the natural expression of computational mathematics. It is very helpful in investigating data, generating algorithms, and creating applications and models. MATLAB combines a desktop environment tuned for iterative analysis and design processes with a programming language that expresses matrix and array mathematics directly. MATLAB Live Editor is used for generating scripts that integrate code, output, and formatted textual content in an executable notebook. MATLAB apps help to identify and learn how different



**Aruna Arumugam and Mohamed Divan Masood**

algorithms work with our data. Iterate the process until we obtain the results with accuracy, and then automatically generate a MATLAB program to reproduce or automate our work.

Image Processing Toolbox

Image Processing Toolbox contributes a set of standard algorithms and workflow apps for image processing, analysis, visualization, and algorithm development[11]. It helps to obtain image segmentation and enhancement, geometric transformations, reduction of noise, and image registration using deep learning and conventional image processing techniques. The toolbox assists the image processing of 2D, 3D, and arbitrarily large images. It automates the workflows of image processing. With this toolbox we can compare image registration techniques, interactively segment image data, and batch-process on the large datasets. Visualization functions allow us to investigate images and videos, 3D volumes, adjust contrast, create histograms, and manipulate regions of interest (ROIs).

MATLAB Image Segmenter App

The image segmenter app is used to generate automatic algorithms such as flood fill, semi automatic algorithms like graph cut, and manual techniques such as drawing Region of Interest (ROIs) with segmentation mask[12]. It provides several ways to segment an image and that can be iterative process. With this technique certain sort of images can be better segment than others. Once the segmentation of image is done we can save the binary mask and the code can also be retrieve to create the mask. To refine the mask we can use morphology or an iterative approach such as active contours.

Google Teachable Machine

Teachable Machine is a web tool by Google that enable used to train a model very quickly[13]. No prior knowledge or experience with AI is required. Anyone with the webcam and browser can train the model. The biggest benefit of Google Teachable Machine is that it does not requisite any code to train the model. Training can be done by the few simple steps as follows.

Step 1: Gathering the Image Samples

Capture a live image using webcam, sounds with microphone or upload your own image from your device. The sample images will automatically store in your computer device until you save it into the Google drive. The model is generated by Tensorflow.js, an open-source library for machine learning from Google. Teachable Machine is now widely used for image classification, sound Classification and pose classification.

Step 2: Training the Model

Based on the samples provided, the Teachable Machine will start to train the machine by just clicking the "Training" button. The entire training process will happen in your browser so the data will get stored in your computer device.

Step 3: Test the model

In the site you can test the model to see how it works. If it is not reasonable you can make the adjustments required and retest the model to get the accurate result

System Architecture

The figure above represents the architecture of the developed classification models.

Dataset

The chosen five Indian fruits for this proposed work are Apple, Banana, Lemon, Orange, and Papaya. The chosen fruits were bought from local store and were divided into two sets. One set was stored and analyzed under room temperature (28°C - 32°C) and the other set was stored and analyzed under refrigerator temperature (4°C). Images of the fruits were captured every day using OnePlus Nord (48MP Quad Camera) and the dataset was created.



**Aruna Arumugam and Mohamed Divan Masood****Segmentation in MATLAB**

The images in the dataset were segmented using many different techniques available in Image Segmenter app in MATLAB. Segmentation techniques were then optimized by identifying the right technique that best suited for the prediction of the shelf life of fruits .

Classification Model Training

The segmented images were organized and the classes for the classification model were identified. The images were then fed and the classification models were developed and trained using Google Teachable Machine.

Dataset creation

Fresh fruits were bought from a local store and the fruits were divided into 2 sets. Each set had 10 apples, 10 yellow bananas, 10 lemons, 10 oranges and 10 papayas. One of the sets were stored and analyzed under room temperature and the other set under refrigerator temperature. Photos of the fruits were captured every day from the day the fruits were bought from the store using OnePlus Nord 48MP Quad camera. For capturing the photos of the fruits, a plain solid black background was used. The fruits were captured from all sides so that the entire surface of the fruits was covered. The fruits were analyzed for almost two months and the average shelf life of each fruit was identified under the two different temperatures. Based on the identified shelf life, the classes for each classification model were identified and the images were divided and organised into different classes (i.e. 1 Days Shelf Life, 2 Days Shelf Life, 3 Days Shelf Life and 4 Days Shelf Life for the classification model that would predict the shelf life of apple under room temperature). Thus, the dataset was created. After the dataset was created, the training and the validation set were identified and organised.

Optimizing segmentation Techniques

Segmentation of the image is the procedure by which a digital image is divided into several subgroups (of pixels) called Image Objects, which can minimize the convolution of the image, and thus analyzing the image becomes simpler and straightforward. Segmentation was performed on the images in the dataset using the different techniques available in the Image Segmenter app in MATLAB Image Processing Toolbox. The various techniques includes automatic algorithm like flood fill, semi-automatic algorithm like graph- cut and manual segmentation, auto clustering are used for segmenting the images in the dataset and the optimization of those techniques are discussed in detail below.

Manual Segmentation

In manual segmentation, the region or the portion (i.e. the region of interest (ROI)) of the image that you need to filter was outlined manually in order to segment it[14]. Manual Segmentation was very time consuming and the outline drawn manually was not very smooth and hence the ROI was not accurately segmented from the background. The following figure displays the results of manual segmentation performed over an image of an apple

Flood Fill

The Flood Fill segmentation technique uses the flood fill or the seed fill algorithm that determines the area connected to a specific point and alters it to segment the images[15]. So, on choosing a particular point in the ROI in the image, the flood fill algorithm determines the connection region and masks it for segmenting. This technique was very slow and hence was very time consuming. The following figure shows the result of flood fill segmentation technique performed over an image of an apple.

Graph-Cut

It is a graph-based segmentation technique that enables us to mark the foreground and the background and then segment the foreground from the background[16]. The Graph Cut technique applies graph theory to image processing to achieve fast segmentation. The segmentation can further be refined by repeating the process. The segmentation using this technique was fast and the results of the segmentation were with required accuracy. So, this technique was chosen to segment all the images in the dataset. The results of Graph- cut segmentation technique



**Aruna Arumugam and Mohamed Divan Masood**

performed over an image of an apple is displayed in the following figure

Auto Clustering

Auto clustering is an automatic segmentation technique. This technique segments the foreground from the background automatically[17]. This segmentation techniques automatically clusters the ROI and masks it for segmentation within seconds and hence is very fast. The only drawback of this technique was that it was not able to segment the images of apple and papaya with required accuracy. The following figure shows the results of auto clustering performed over an image of a banana.

Deep Learning Classification Model Training

The model was developed and trained using Google Teachable Machine which is an open - source web- based tool for developing and training machine learning and deep learning classification training models[18]. In this proposed work there are ten classification models were generated and trained, five model for the five chosen Indian fruits to predict their average shelf life under room temperature (28°C -32°C) and five models for predicting the average shelf life of the five chosen Indian fruits under refrigerator temperature(4°C)[19]. Training can be accomplished by the following three steps. Data feeding, Feature extraction and Optimizing classification accuracy.

Data Feeding

For developing the classification model, the classes identified for the model was first created and named accordingly in Google Teachable Machine for Image Classification project[20]. Then, the respective images organized in the dataset were loaded/fed into the respective classes. After the data is fed through the system, the model was trained to classify the image of the fruit to predict its average shelf life.

Feature Extraction

The convolution layer of the Google Teachable Machine's pre - trained model does the feature extraction and extracts thousands of features from the images in the training dataset[21]. Filters are applied continuously over the images in the training set by the convolution layer to create the Feature Map. The feature map indicates the locations and the strengths of the detected features. The feature map is further used to learn several other features of the images.

Optimizing Classification Accuracy

The classification accuracy of the models was optimized by increasing the Epoch. 1Epoch means that each sample in the training set was fed through the model at least once. By default, the epoch was set to 50 in Google Teachable Machine. The epoch was adjusted until the required classification accuracy was obtained. Once the classification accuracy was optimized, the accuracy of each of the developed model was calculated using confusion matrix.

Confusion Matrix

A Confusion matrix is a table used for evaluating the fulfilment performance of a classification model[22]. The matrix compares the actual target values with those predicted by the model. This gives us a view of how well our classification model is performing and what kinds of errors and inaccuracy it is making[23].

Accuracy of Models that Predict the Average Shelf Life of Fruits under Room Temperature (28°C - 32°C)

Table i. Confusion matrix of model 1- apple, Table ii. Confusion matrix of model 2- banana, Table iii. Confusion matrix of model 3- lemon, Table iv. Confusion matrix of model 4- orange, Table v. Confusion matrix of model 5- papaya

Accuracy of Models that Predict the Average Shelf Life of Fruits under Refrigerator Temperature (4°C)

Table vi. Confusion matrix of model 6- apple, Table vii. Confusion matrix of model 7- banana, Table viii. Confusion matrix of model 8- lemon, Table ix. Confusion matrix of model 9- orange, table x. Confusion matrix of model 10- papaya



**Aruna Arumugam and Mohamed Divan Masood****Experimental Output****Deep learning Classification Model for Fruits analysed under Room Temperature**

Model 1: Apple Fig.10. Accuracy rate of shelf life prediction of Apple under room temperature: 0.70 ,Model 2: Banana Accuracy rate of shelf life prediction of Banana under room temperature: 0.97, Model 3: Lemon Accuracy rate of shelf life prediction of Lemon under room temperature: 0.87, Model 4: Orange Accuracy rate of shelf life prediction of Orange under room temperature: 0.54, Model 5: Papaya Accuracy rate of shelf life prediction of Papaya under room temperature: 0.91,

Deep learning Classification Model for Fruits analysed under Refrigerator Temperature (4°C)

Model 6: Apple Accuracy rate of shelf life prediction of Apple under refrigerator temperature: 0.67, Model 7: Banana, Accuracy rate of shelf life prediction of Banana under refrigerator temperature: 0.76, Model 8: Lemon, Accuracy rate of shelf life prediction of Lemon under refrigerator temperature: 0.84, Model 9: Orange, Accuracy rate of shelf life prediction of Orange under refrigerator temperature: 0.73, Model 10: Papaya, Accuracy rate of shelf life prediction of Papaya under refrigerator temperature: 0.87

Models Accuracy Comparison Table

Table i. Accuracy comparison of shelf life prediction of fruits under room and refrigerator temperature.

CONCLUSION

This proposed work resulted in the development of ten deep learning classification models that predicted the average shelf life of selective Indian fruits (Apple, Banana, Lemon, Orange, Papaya) under room temperature (28°C - 32°C) and refrigerator temperature (4°C). These models could be used to predict the shelf life of fruits in home. Teachable Machine Learning was used successfully to develop the models for selective Indian fruits. Graph-cut segmentation showed the highest accuracy in segmenting the surface of each fruit. The model could further be optimized to achieve highest classification accuracy. And the optimized model could also be installed in fruit processing lines and industries for accurate detection of shelf life. Further it could also be used as a web-based tool so that consumers can also be benefited.

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Aruna Arumugam and Mohamed Divan Masood

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Table I. Confusion Matrix of Model 1- Apple

CLASSES	1 Days Shelf Life	2 Days Shelf Life	3 Days Shelf Life	4 Days Shelf Life
1 Days Shelf Life	84	15	1	0
2 Days Shelf Life	7	33	26	33
3 Days Shelf Life	1	37	60	1
4 Days Shelf Life	0	0	0	100

$$\text{Accuracy} = \frac{84+33+60+100}{4} = 70\%$$

Table II. Confusion Matrix of Model 2- Banana

CLASSES	1 Days Shelf Life	2 Days Shelf Life	3 Days Shelf Life
1 Days Shelf Life	97	2	0
2 Days Shelf Life	3	94	2
3 Days Shelf Life	0	0	100

$$\text{Accuracy} = \frac{97+94+100}{3} = 97\%$$





Aruna Arumugam and Mohamed Divan Masood

Table III. Confusion Matrix of Model 3- Lemon

CLASSES	1 Days Shelf Life	2 Days Shelf Life	3 Days Shelf Life
1 Days Shelf Life	79	3	17
2 Days Shelf Life	13	83	3
3 Days Shelf Life	1	0	99

$$\text{Accuracy} = \frac{79+83+99}{3} = 87\%$$

Table IV. Confusion Matrix of Model 4- Orange

CLASSES	1 Days Shelf Life	2 Days Shelf Life	3 Days Shelf Life	4 Days Shelf Life	5 Days Shelf Life
1 Days Shelf Life	85	6	1	4	3
2 Days Shelf Life	1	55	17	1	25
3 Days Shelf Life	25	12	32	1	18
4 Days Shelf Life	1	0	49	49	0
5 Days Shelf Life	0	51	6	0	42

$$\text{Accuracy} = \frac{85+55+32+49+42}{5} = 54\%$$

Table V. Confusion Matrix of Model 5- Papaya

CLASSES	1 Days Shelf Life	2 Days Shelf Life	3 Days Shelf Life
1 Days Shelf Life	77	22	1
2 Days Shelf Life	2	98	0
3 Days Shelf Life	0	0	100

$$\text{Accuracy} = \frac{77+98+100}{3} = 91\%$$

Table VII. Confusion Matrix of Model 7- Banana

CLASSES	1 Days Shelf Life	2 Days Shelf Life	3 Days Shelf Life
1 Days Shelf Life	94	5	0
2 Days Shelf Life	13	85	1
3 Days Shelf Life	25	27	47

$$\text{Accuracy} = \frac{94+85+47}{3} = 76\%$$





Aruna Arumugam and Mohamed Divan Masood

Table VIII. Confusion Matrix of Model 8- Lemon

CLASSES	1 Days Shelf Life	2 Days Shelf Life	3 Days Shelf Life	4 Days Shelf Life	5 Days Shelf Life	6 Days Shelf Life	7 Days Shelf Life	8 Days Shelf Life	9 Days Shelf Life
1 Days Shelf Life	80	15	4	0	0	0	0	0	0
2 Days Shelf Life	1	67	0	29	0	1	0	0	0
3 Days Shelf Life	1	0	86	0	5	6	0	1	0
4 Days Shelf Life	0	0	0	92	6	0	0	0	0
5 Days Shelf Life	0	2	11	0	78	3	2	1	0
6 Days Shelf Life	2	0	16	3	5	70	0	2	0
7 Days Shelf Life	0	0	0	0	3	0	95	1	0
8 Days Shelf Life	1	1	4	0	6	3	2	82	0
9 Days Shelf Life	0	0	0	0	0	0	0	0	100

$$\text{Accuracy} = \frac{80+67+86+92+78+70+95+82+100}{9} = 84\%$$

Table IX. Confusion Matrix of Model 9- orange

CLASSES	1 Weeks Shelf Life	2 Weeks Shelf Life	3 Weeks Shelf Life	4 Weeks Shelf Life
1 Weeks Shelf Life	49	4	1	44
2 Weeks Shelf Life	2	90	6	0
3 Weeks Shelf Life	6	0	64	29
4 Weeks Shelf Life	0	4	8	86

$$\text{Accuracy} = \frac{49+90+64+86}{4} = 73\%$$

Table X. Confusion Matrix of Model 10- Papaya

CLASSES	1 Weeks Shelf Life	2 Weeks Shelf Life
1 Weeks Shelf Life	75	25
2 Weeks Shelf Life	0	99

$$\text{Accuracy} = \frac{49+90+64+86}{4} = 87\%$$

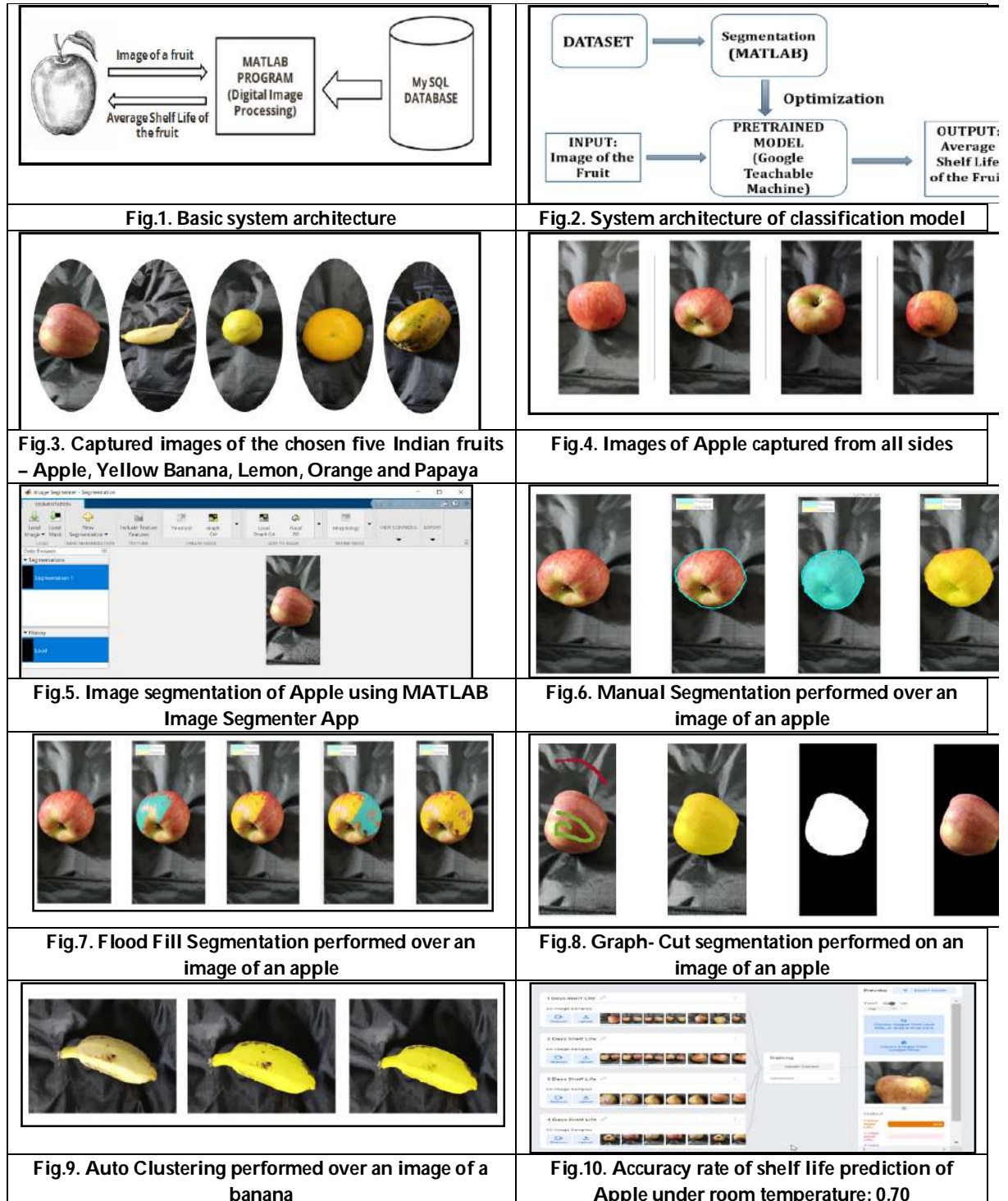
Table XI. Accuracy COMPARISON OF SHELF LIFE PREDICTION OF FRUITS UNDER ROOM AND REFRIGERATOR TEMPERATURE

FRUITS	ROOM TEMPERATURE	REFRIGERATOR TEMPERATURE
Apple	(4 Classes) 70%	(4 Classes) 67%
Banana	(3 Classes) 97%	(3 Classes) 76%
Lemon	(3 Classes) 87%	(9 Classes) 84%
Orange	(5 Classes) 54%	(4 Classes) 73%
Papaya	(3 Classes) 91%	(2 Classes) 87%



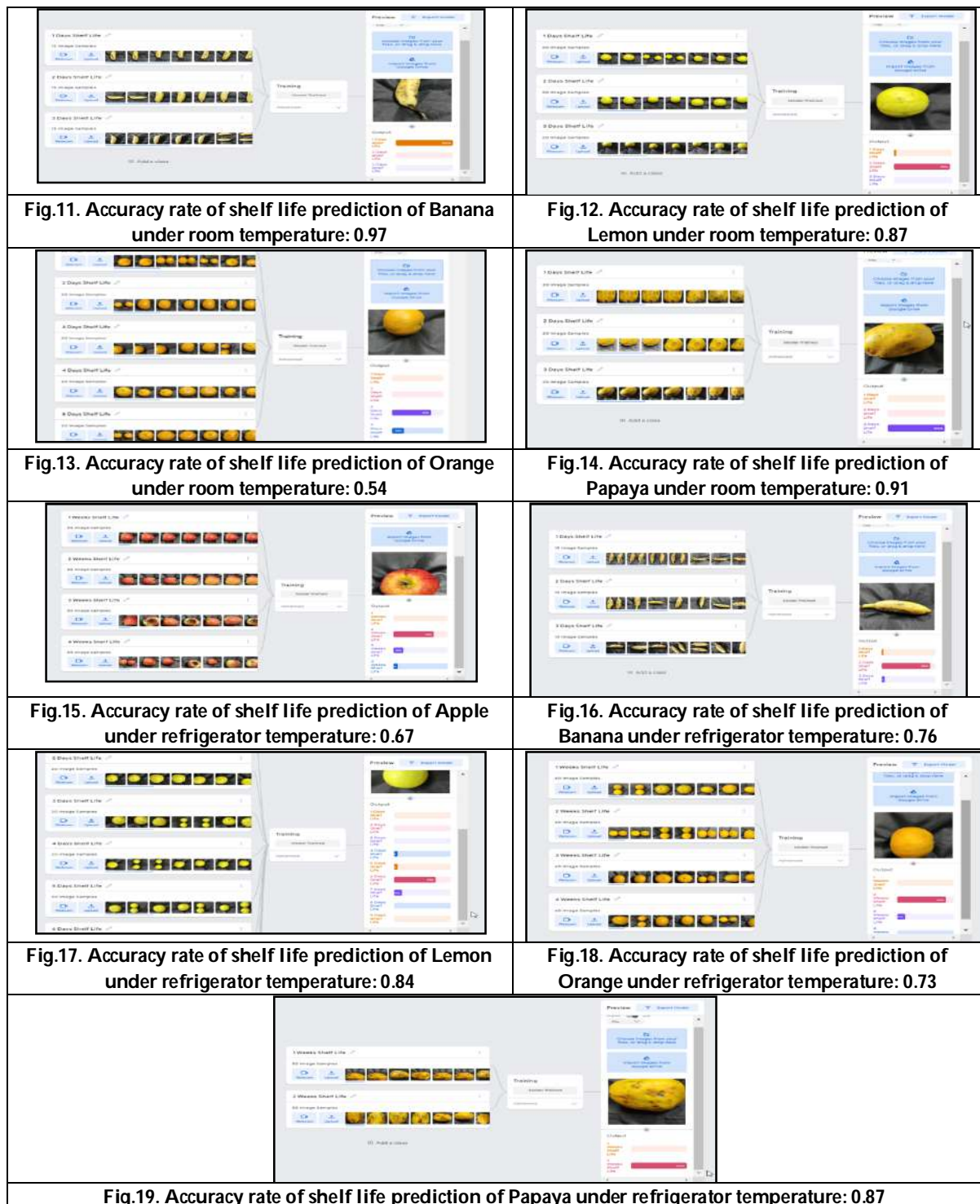


Aruna Arumugam and Mohamed Divan Masood





Aruna Arumugam and Mohamed Divan Masood





A Matlab-Based Method for Solving Fuzzy Transportation Problems

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ABSTRACT

One of the earliest and most important uses of linear programming is for transportation problems. A new strategy for resolving fuzzy transportation problems is proposed, based on the assumption that the decision maker is unsure of the exact values of the transportation cost, availability, and demand of the goods. Transportation costs, availability, and demand for the goods are all represented by generalized triangular fuzzy numbers and trapezoidal fuzzy numbers in the proposed approach. **This article proposes a new algorithm for using MATLAB to solve fuzzy transport problems and compares the results with existing methods.** It shows that the proposed method gave the best solution.

Keywords: Fuzzy Transportation problem (FTP), Triangular Fuzzy Number, Trapezoidal Fuzzy Number, MATLAB, Defuzzification.

INTRODUCTION

The pressure on businesses to develop better methods to produce and deliver value to customers is increasing in today's highly competitive market. It's becoming increasingly difficult to figure out how and when to get things to customers in the amounts they desire in a cost-effective manner. Models of transportation give a valuable foundation for addressing this issue. They ensure the efficient transfer of raw materials and finished items, as well as their timely availability. The basic transportation problem was originally developed by Hitchcock [4]. A new strategy for resolving fuzzy transportation problems is proposed, based on the assumption that the decision maker is unsure of the exact values of the transportation cost, availability, and demand of the goods. Transportation costs, availability,





Rajkumar et al.,

and demand for the goods are all represented by generalized triangular fuzzy numbers in the proposed approach. **This article proposes** a new algorithm **for using MATLAB** to solve fuzzy **transport problems** and compares the **results** with existing **methods**. It shows that the proposed method gives the same solution. In this paper, we are going to define the Triangular Fuzzy Number and the Trapezoidal Fuzzy Number in MATLAB and execute the data by the code of the North West Corner Rule of Transportation Problem.

MATERIALS AND METHODS

Definition 1

A fuzzy number is a convex, normalized fuzzy set defined in, \mathbb{R} whose membership function is piecewise continuous. As indicated by \bar{F} .

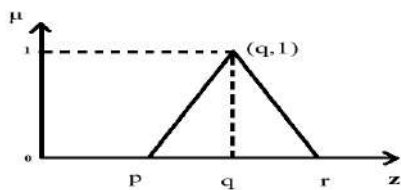
Then, $\mu_{\bar{F}}(z): \mathbb{R} \rightarrow [0,1], \forall z \in \mathbb{R}$

Where $\mu_{\bar{F}}(z)$ = membership function of the fuzzy set.

Definition 2

A fuzzy number \bar{F} on \mathbb{R} is said to be a triangular fuzzy number if its membership function $\bar{F}: \mathbb{R} \rightarrow [0,1]$.

It characterized by (p, q, r) or $p < q < r$.

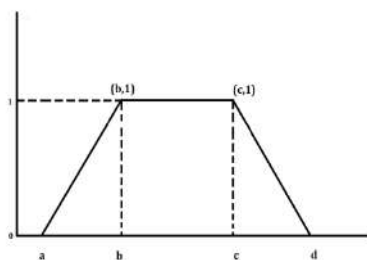


$$\mu_{\bar{F}}(z) = \begin{cases} 0 & \text{if } z \leq p \\ \frac{z-p}{q-p} & \text{if } p \leq z \leq q \\ \frac{r-z}{r-q} & \text{if } q \leq z \leq r \\ 0 & \text{if } z \geq r \end{cases}$$

Definition 3

A fuzzy number $\bar{F} = (a, b, c, d), a < b < c < d$ Trapezoidal fuzzy number.

Its membership function is



$$\mu_{\bar{F}}(p) = \begin{cases} \frac{p-a}{b-a}, & \text{if } a \leq p \leq b \\ 1, & \text{if } b \leq p \leq c \\ \frac{d-p}{d-c}, & \text{if } c \leq p \leq d \\ 0, & \text{otherwise} \end{cases}$$





Rajkumar et al.,

Mathematical Formulation

The mathematical formulation of fuzzy transportation problem

$$\text{Min } \mathcal{C} = \sum_{i=1}^m \sum_{j=1}^n c_{ij} p_{ij}$$

Subject to

$$\sum_{j=1}^n p_{ij} = a_i, i = 1, 2, \dots, m$$

$$\sum_{i=1}^m p_{ij} = b_j, j = 1, 2, \dots, n$$

And $p_{ij} \geq 0$, for all i & j

Where,

m = number of supply points

n = number of demand points

p_{ij} = number of units sent from supply point i to demand point j

a_i = supply at supply point i

b_j = demand at demand point j

If $\sum_{i=1}^m a_i = \sum_{j=1}^n b_j$, then the fuzzy transportation problem is called the balanced fuzzy transportation problem. If not, then it is called an unbalanced fuzzy transportation problem.

Algorithm for Proposed Method:

The proposed method's algorithm solves the fuzzy transportation problem by using MATLAB.

Step: 1 Define the variables of the Triangular membership function.

Step: 2 Defuzzification of the value by using the method centroid or bisector

Step: 3 Next, assign the values in the array as a matrix.

Step: 4 Apply the matrix value in the NWC Transportation Problem Code

Step: 5 Execute the code to get a better optimal solution.

Similarly, we can write about the trapezoidal membership function.

Numerical Example

Example: 1

To illustrate the Fuzzy Transportation Problem with a numerical example.

Example:2

To illustrate the Fuzzy Transportation Problem with a numerical example.

NUMERICAL RESULTS

Result output of the MATLAB program

M-file: 1

>> The cost of NORTH WEST CORNER (Triangular) model after model is: Rs.112

M-file: 2

>> The cost of NORTH WEST CORNER (Trapezoidal) model after model is: Rs.112





Rajkumar et al.,

RESULT

Examples		Existing method	Proposed Method
Example1(Triangular Number)	Fuzzy	Rs.112	Rs.112
Example2(Trapezoidal Number)	Fuzzy	Rs.112	Rs.112

Suggestion

Run the m-file through MATLAB version R2021a.

CONCLUSION

A new MATLAB-based method to find the best feasible solution to a fuzzy transportation problem is approached. Compare the existing method's feasible solution with the proposed method. From the results, the proposed method gives the same feasible solution. In future we built more programs for different dimension of matrix.

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MATLAB CODE FOR THE NUMERICAL EXAMPLE

M-file: 1

```
%%Fuzzy Transportation Model problem of North West Corner
x = -30:0.1:30;
mf1 = trimf(x,[4 5 6]);
A1 = defuzz(x,mf1,'centroid')
mf2 = trimf(x,[1 2 3]);
A2 = defuzz(x,mf2,'centroid')
```





Rajkumar et al.,

```

mf3 = trimf(x,[2 4 6]);
A3 = defuzz(x,mf3,'centroid')
mf4 = trimf(x,[1 3 5]);
A4 = defuzz(x,mf4,'centroid')
mf5 = trimf(x,[2 4 6]);
A5 = defuzz(x,mf5,'centroid')
mf6 = trimf(x,[4 8 12]);
A6 = defuzz(x,mf6,'centroid')
mf7 = trimf(x,[0 1 2]);
A7 = defuzz(x,mf7,'centroid')
mf8 = trimf(x,[2 6 10]);
A8 = defuzz(x,mf8,'centroid')
mf9 = trimf(x,[2 4 6]);
A9 = defuzz(x,mf9,'centroid')
mf10 = trimf(x,[2 6 10]);
A10 = defuzz(x,mf10,'centroid')
mf11 = trimf(x,[5 7 9]);
A11 = defuzz(x,mf11,'centroid')
mf12 = trimf(x,[4 5 6]);
A12 = defuzz(x,mf12,'centroid')
mf13 = trimf(x,[0 0 0]);
A13 = defuzz(x,mf13,'centroid')
mf14 = trimf(x,[0 0 0]);
A14 = defuzz(x,mf14,'centroid')
mf15 = trimf(x,[0 0 0]);
A15 = defuzz(x,mf15,'centroid')
mf16 = trimf(x,[0 0 0]);
A16 = defuzz(x,mf16,'centroid')
C=[ A1 A2 A3 A4;A5 A6 A7 A8;A9 A10 A11 A12; A13 A14 A15 A16];
d1 = trimf(x,[5 7 9]);
D1 = defuzz(x,d1,'centroid')
d2 = trimf(x,[10 12 14]);
D2 = defuzz(x,d2,'centroid')
d3 = trimf(x,[5 7 9]);
D3 = defuzz(x,d3,'centroid')
d4 = trimf(x,[16 19 22]);
D4 = defuzz(x,d4,'centroid')
demand= [D1 D2 D3 D4];
s1 = trimf(x,[20 22 24]);
S1 = defuzz(x,s1,'centroid')
s2 = trimf(x,[2 6 10]);
S2 = defuzz(x,s2,'centroid')
s3 = trimf(x,[4 5 6]);
S3 = defuzz(x,s3,'centroid')
s4 = trimf(x,[10 12 14]);
S4 = defuzz(x,s4,'centroid')
supply=[ S1 S2 S3 S4];
sum=0;
k=zeros(4,4);
i=1;

```





Rajkumar et al.,

```

j=1;
while i<=4 && j<=4
min1 = min(demand(j)& supply(i));
%sum with cost element *maybe supply of demand
sum = sum + C(i,j)*min1;
demand(j)=demand(j)-min1;
supply(i)=supply(i)-min1;
%%Cost of demand
if demand(j)==0
j=j+1;
end
%%Cost of supply
if supply(i)==0
i=i+1;
end
end
%%output of the model
disp(['The cost of NORTH WEST CORNER(Triangular) model after model is :Rs.' num2str(sum)])

```

M-file: 2

```

x = -30:0.1:30;
mf1 = trapmf(x,[2 4 5 9]);
A1 = defuzz(x,mf1,'bisector')
mf2 = trapmf(x,[0 1 2 5]);
A2 = defuzz(x,mf2,'bisector')
mf3 = trapmf(x,[1 3 4 8]);
A3 = defuzz(x,mf3,'bisector')
mf4 = trapmf(x,[0 2 3 7]);
A4 = defuzz(x,mf4,'bisector')
mf5 = trapmf(x,[1 3 4 8]);
A5 = defuzz(x,mf5,'bisector')
mf6 = trapmf(x,[4 6 8 14]);
A6 = defuzz(x,mf6,'bisector')
mf7 = trapmf(x,[-2 0 1 5]);
A7 = defuzz(x,mf7,'bisector')
mf8 = trapmf(x,[2 4 6 12]);
A8 = defuzz(x,mf8,'bisector')
mf9 = trapmf(x,[1 3 4 8]);
A9 = defuzz(x,mf9,'bisector')
mf10 = trapmf(x,[2 4 6 12]);
A10 = defuzz(x,mf10,'bisector')
mf11 = trapmf(x,[1 5 7 15]);
A11 = defuzz(x,mf11,'bisector')
mf12 = trapmf(x,[2 4 5 9]);
A12 = defuzz(x,mf12,'bisector')
mf13 = trapmf(x,[0 0 0 0]);
A13 = defuzz(x,mf13,'bisector')
mf14 = trapmf(x,[0 0 0 0]);
A14 = defuzz(x,mf14,'bisector')
mf15 = trapmf(x,[0 0 0 0]);
A15 = defuzz(x,mf15,'bisector')

```





Rajkumar et al.,

```

mf16 = trapmf(x,[0 0 0 0]);
A16 = defuzz(x,mf16,'bisector')
C=[ A1 A2 A3 A4;A5 A6 A7 A8;A9 A10 A11 A12;A13 A14 A15 A16];
d1 = trapmf(x,[1 5 7 15]);
D1 = defuzz(x,d1,'bisector')
d2 = trapmf(x,[8 10 12 18]);
D2 = defuzz(x,d2,'bisector')
d3 = trapmf(x,[1 5 7 15]);
D3 = defuzz(x,d3,'bisector')
d4 = trapmf(x,[15 17 19 25]);
D4 = defuzz(x,d4,'bisector')
demand= [D1 D2 D3 D4];
s1 = trapmf(x,[15 20 22 31]);
S1 = defuzz(x,s1,'bisector')
s2 = trapmf(x,[2 4 6 12]);
S2 = defuzz(x,s2,'bisector')
s3 = trapmf(x,[2 4 5 9]);
S3 = defuzz(x,s3,'bisector')
s4 = trapmf(x,[8 10 12 18]);
S4 = defuzz(x,s4,'bisector')
supply=[S1 S2 S3 S4];
sum=0;
k=zeros(4,4);
i=1;
j=1;
while i<=4 && j<=4
min1 = min(demand(j)& supply(i));
%sum with cost element *maybe supply of demand
sum = sum + C(i,j)*min1;
demand(j)=demand(j)-min1;
supply(i)=supply(i)-min1;
%%Cost of demand
if demand(j)==0
j=j+1;
end
%%Cost of supply
if supply(i)==0
i=i+1;
end
end
%%output of the model
disp(['The cost of NORTH WEST CORNER (Trapezoidal) model after model is :Rs.' num2str(sum)])

```





Rajkumar et al.,

Table-1

Sources	Destination				Supply
	D_1	D_2	D_3	D_4	
S_1	(4,5,6)	(1,2,3)	(2,4,6)	(1,3,5)	(20,22,24)
S_2	(2,4,6)	(4,8,12)	(0,1,2)	(2,6,10)	(2,6,10)
S_3	(2,4,6)	(2,6,10)	(5,7,9)	(4,5,6)	(4,5,6)
S_4	(0,0,0)	(0,0,0)	(0,0,0)	(0,0,0)	(10,12,14)
Demand	(5,7,9)	(10,12,14)	(5,7,9)	(16,19,22)	

Table-2

Sources	Destination				Supply
	D_1	D_2	D_3	D_4	
S_1	(2,4,5,9)	(0,1,2,5)	(1,3,4,8)	(0,2,3,7)	(15,20,22,31)
S_2	(1,3,4,8)	(4,6,8,14)	(-2,0,1,5)	(2,4,6,12)	(2,4,6,12)
S_3	(1,3,4,8)	(2,4,6,12)	(1,5,7,15)	(2,4,5,9)	(2,4,5,9)
S_4	(0,0,0,0)	(0,0,0,0)	(0,0,0,0)	(0,0,0,0)	(8,10,12,18)
Demand	(1,5,7,15)	(8,10,12,18)	(1,5,7,15)	(15,17,19,25)	





Immediate Effect of Plantar Flexors Kinesio Taping on Reactive Postural Control in Post Stroke Subjects- A Randomized Controlled Trial

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ABSTRACT

The most common after effect of stroke is spasticity which exhibits mainly in the antigravity group of muscles. It is found peculiarly in the extensor muscle group of lower limb among which Plantar flexors is the most common. Spasticity of the muscle leads to disturbances in postural control. It has been recommended that using Kinesiotaping can improve sensory by providing feedback from mechanoreceptors and by reducing abnormal postural tone. To evaluate the immediate effect of Kinesiotaping on Reactive Postural Control in Post Stroke subjects. The study recruited 60 stroke subjects; who were randomly divided into two groups: Sham taping (ST) Group (n=30) and Kinesiotaping (KT) group (n=30). All the participants were applied taping for 48 hours. Modified Modified Ashworth Scale (MMAS) and Mini BESTest were used as an outcome measures for pre and post evaluation of spasticity and reactive postural control respectively. Intra group differences in both the groups were evaluated using Wilcoxon signed rank test and intergroup differences were evaluated using Mann Whitney-U test. Both the groups showed significant improvements in spasticity and reactive postural control after the intervention ($p < 0.05$). The level of improvement in the KT group was significantly higher in alleviating spasticity and improving reactive postural control compared to the ST group ($p < 0.05$). The results of the study demonstrated that the proper application of Plantarflexors Kinesiotaping is effective in improving reactive postural control in post stroke subjects.

Keywords: Stroke, Plantarflexors Kinesiotaping, Reactive postural control, Sham taping.



**Drashti Kotak and Mansi Patel**

INTRODUCTION

The rapid loss of neurological function brought on by an interruption in vascular supply to the brain is known as a stroke (cerebrovascular accident [CVA]) [1]. Following a stroke, spasticity is frequently accompanied by discomfort, soft tissue stiffness, and joint contracture and may result in incorrect limb posture. With a frequency of 30% to 80% in stroke survivors, spasticity is typical following a stroke. The extensor muscles of the lower limb characteristically Plantarflexors are most frequently affected by spasticity [2]. Spasticity is caused by regional activation of muscle spindles, but the central nervous system must be engaged for it to spread and manifest [3]. Damage to top motor neurons prevents the spinal cord and brain from communicating, which leads to a cumulative dissociation of the spinal reflexes [4]. Alpha-motoneurons are engaged and supra-spinal inhibitory control is lost during passive muscular stretching of a patient because muscle spindles provide sensory information to the spinal cord through main group Ia afferent fibres [4]. This results in excessive muscle activation. Furthermore, Renshaw cell, Ia and Ib interneurons, and spinal interneurons may lack descending central nervous system facilitation or inhibition influences. Interrupting the effects of spinal interneuron-mediated influences may result in an excessive amount of muscle activation by decreasing antagonist muscle inhibition and ramping up action potentials in sensory neurons.⁴ Reactive Postural Control are those intricate muscle activation patterns that aids to keep centre of mass within base of support in reaction to a disturbance in equilibrium. The CNS operates two essential mechanisms to control balance: anticipatory or proactive mechanisms and compensatory or reactive mechanisms [5]. compensatory mechanisms are automatic or reflex responses to unexpected external disturbances or failures of anticipatory adjustments which occurs following a stroke and spasticity is the major contributing factor. The body cannot be stabilised by spasticity of plantarflexor muscles, indicating that muscles and sensory receptors are crucial for regulating postural control [6].

In recent years, Kinesiotaping emerges as a mechanism of neuromuscular control and influences the structural rigidity of the joints [7]. It is effective in minimizing the excessive stretch reflex contraction of spastic muscles by allowing cutaneous afferent receptor signals to affect the excitability of motor units and control the activity of the proprioceptive reflex loops when administered from insertion to origin [7]. In literature, there are no studies examining the immediate effect of Plantarflexors Kinesiotaping on reactive postural control in stroke. Thus, the aim of the study is to evaluate immediate effectiveness of Plantarflexors Kinesiotaping on reactive postural control in post stroke subjects. The hypothesis of this study was that subjects engaging in KT treatment would have better improvement in reactive postural control and reduction in spasticity.

MATERIALS AND METHODS

Study Design, Study Population and Screening

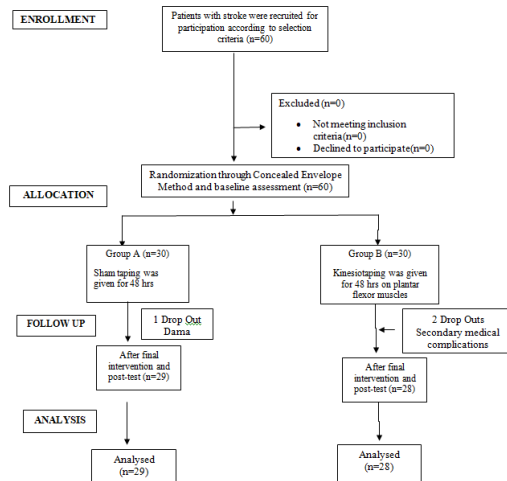
This study, which has been a single blinded randomized controlled design, was conducted from December 2021 to September 2022 in Neurological Rehabilitation Department of Parul Sevashram hospital, Parul University. 60 post stroke subjects were enrolled in the study based on convenience sampling. The selection criteria stated as follows: Patients with duration of Stroke: ≤ 3 months; Age of subjects between 35-62 years; Plantarflexors spasticity based on MMAS grading; including both male and female in the study. In this study, subjects with lower limb bone anomalies, fractures, dislocations, or prior trauma; Neuropathy in the periphery; Skin lesions in the area where the intervention will be applied that are ulcers; Vascular disease of the periphery; Impairments in cognition, communication, and sensation and Subsequent strokes were excluded. Among the subjects who met the selection criteria, the current study included those who received sufficient information and explanation regarding the study and consented to participate in the same. In the act of research consists of human subjects, ethical clearance for this study was acquired from ethical committee of Parul University Institutional Committee for human research. (IRB No. PUIECHR/PIMSR/00/081734/4503).





Procedure

The patients accepting to participate in this study were randomly assigned to 2 treatment groups Experimental (Kinesiotaping) group and control (Shamtaping) group using concealed envelope method. The current study encountered 3 dropouts – one from shamtaping (ST) group and two from Kinesiotaping (KT) group. Thus, a total of 57 subjects were included for post treatment evaluation. Spasticity and Reactive postural control were assessed before and after intervention.



Intervention

Patients from both group underwent taping for 48 hours. Sham taping application: The Sham taping was applied by placing three short 'I' bands onto edges of usual kinesio taping application on plantarflexor muscles from base of heel to Achilles tendon, and medial and lateral heads of gastrocnemius muscles. The discontinuity of taping on ineffective parts of Plantarflexors was maintained. Administration of shamtaping was done for 48 hours. Kinesiotaping application: The gastrocnemius and soleus muscles comprise the majority of the plantarflexors. According to Dr. Kenzo Kase instructions, each muscle was taped. The gastrocnemius was taped in manner described below:

- The length of Kinesio Tape is then measured from the proximal gastrocnemius muscle insertion to the calcaneus bone to enable the tape to adhere adequately to the heel.
- The gastrocnemius muscle was actively stretched with the participant in the prone position, with the lower leg projecting off the bed. This strip was divided into three sections and put directly on the skin without unnecessary stress from the proximal end of the tape to Plantarflexors myotendinous junction.
- The ankle joint was in neutral position, and the tape was secured at the heel. The gastrocnemius was actively stretched, and the medial and lateral heads of the gastrocnemius were each linked to the tape's split proximal end (the Y shape).

The soleus muscle was taped in the following order:

- While the muscle was completely stretched, another I-shaped piece of same tape was measured from the heel to the popliteal fold.
- The ankle joint was in a neutral posture, and base of tape was pulled off and affixed distally to the heel.
- The remainder of the "I" shape tape was put to lateral aspect of gastrocnemius muscle to cover the soleus muscle, and the participant's ankles were fully dorsiflexed to stretch the muscle. Administration of Kinesiotaping was done for 48 hours.



**Drashti Kotak and Mansi Patel****Outcome measurements:**

The present study used Modified Modified Ashworth Scale (MMAS) assess Plantarflexor Spasticity. The MMAS is an ordinal level measure of spasticity, which grades intensity of 0–4 spasticity scale. 85. For assessment, the patient was placed in Supine, with the head in the middle and the arms on the side. Lower limbs extended out in posture. The therapist on side being evaluated, positions one hand beneath the ball of the foot while the other hand stabilises the leg at the ankle joint. Maximal plantarflexion of the ankle was changed to maximum dorsiflexion. In a test-retest research on spasticity in the knee extensors, ankle plantar flexors, and hip adductors. For the knee extensors, the weighted kappa was good (weighted kappa = 0.62, SE = 0.12, p 0.001), intermediate for the hip adductors (weighted kappa = 0.45, SE = 0.16, p = 0.007), and very high (weighted kappa = 0.85, SE = 0.05, p 0.001) for the ankle plantar flexors. The ankle plantar flexors' consistency was substantially higher than hip adductors [8].

The second section of Mini BESTest was used for assessment of Reactive Postural Control. 3 tests were used for assessment of Reactive Postural Control: 1) Compensatory Step-Forward Corrections; 2) Compensatory Stepping Correction – Backward; 3) Compensatory Stepping Correction- Lateral with a total subscore of 6. Interrater reliability (intraclass correlation coefficient [2,1]=.96), intrarater consistency (intraclass correlation coefficient [3,1]=.97), and internal consistency (Cronbach alpha=.89-.94) were all very high for Mini-BESTest [9].

Statistical analysis

The statistical analysis in this study was performed using IBM SPSS Version 27.0.1 program. The normal distribution of variables was analyzed using Shapiro-Wilk Test. The pre-treatment and post-treatment measurements for spasticity and reactive postural control performed in both groups (Shamtaping group and Kinesiotaping group) were compared using the Wilcoxon signed rank Test and Mann-Whitney U test was used to analyze the differences between the two groups.

RESULTS

Table 1. and Figure 1. shows changes in spasticity and Reactive Postural Control in Shamtaping Group. The pre and post analysis for within group comparison was done using Wilcoxon signed rank test. There was significant improvement in reactive postural control and reduction in spasticity in shamtaping group. ($p < 0.05$). Table 2. and Figure 2 shows changes in spasticity and Reactive Postural Control in Kinesiotaping Group. Using Wilcoxon signed rank test, intragroup differences were evaluated in Kinesiotaping group. There was significant reduction in spasticity and improvement in reactive postural control after the application of intervention. ($p < 0.05$). Table 3 and Figure 3. shows changes in Spasticity and Reactive Postural Control between ST and KT group. The intergroup differences were evaluated using Mann Whitney- U test. This study observed significant changes with regard to pre- and post-intervention MMAS and Mini BESTest scores in both groups ($p < 0.05$). The KT group showed a greater improvement compared to the ST group, and the difference was observed to be statistically significant ($p < 0.05$)

DISCUSSION

The present study examined the immediate effectiveness of Plantarflexors Kinesiotaping on reactive postural control in post stroke subjects. Our results showed significant reduction in MMAS score and improvement in Mini BESTest scores in Kinesiotaping group as compared to Shamtaping group. It might require a while before the impacts of Kinesiotaping on reactive postural control can be measurable. Within the first 48 hours, mechanoreceptors may adapt to KT, which could lead to improved sensory stimulus and postural regulation. Kinesio taping can affect alterations by giving patients' nervous systems input and promoting motion through the mechanic stimulation of soft tissues. Symmetrical weight bearing, enhanced proprioceptive input, and enhanced interlimb temporal synchronisation provided by KT may all help reduce spasticity, which will improve reactive postural control. Because of this, it can be said that afferent input and reflexes have an important impact in the control of synchronisation between limbs even though monosynaptic stretching reflexes do not have an essential function



**Drashti Kotak and Mansi Patel**

during postural disturbances [10] This was also supported by Dietz et al. who suggested that to enable the brain to handle real demands for postural control and to send efferent signals when necessary, afferent signals are transmitted to the motor cortex centres [11]. Continuous skin stretching caused by KT promotes sensory receptors, enhancing sensory perception information reaching the central nervous system. As a result, joint position awareness will increase, which will also increase the neuromuscular system's ability to regulate reactive postural control. The cutaneous activation of the sensory neurons present in the skin caused by the application of the tape is another option for increasing the healing rate for the Kinesiotaping group. Kinesio Tape can activate sensory receptors, which lowers the nerve cell sensitivity and encourages both external muscle contraction and motor cortex activity through the muscle spindle response [7].

Subjects with stroke uses hip synergy instead of ankle synergy which subjected against reactive postural demands. The postural control system cannot effectively control the body's position and motion in space because it lacks ability to generate appropriate muscular force and to coordinate and integrate sensory information received from various receptors throughout the body. Kinesiotaping thereby stimulating proprioceptors and inhibiting spasticity aids in the use of ankle synergy to enhance reactive postural control. In a previous study by Hashimoto et al. they suggested that the physiological change brought by KT may affect muscle and myofascia functions after application of neuromuscular taping helping to generate the necessary force required for the function [12]. Increased proprioceptive sensation provided by KT improves motor function by increasing the recruitment of motor units. In addition, by pulling the muscular belly and causing the actin and myosin filaments to overlap more, taping enhances the likelihood of a cross-bridge. In the previous study conducted by Kim et al.; they found that ankle KT in conjunction with 8 weeks of routine physical therapy including exercise resulted in more improvements in postural control compared to routine physical therapy alone [13]. It is worth pointing out that in our study improvement in reactive postural control was observed after 48 hours of Kinesiotaping alone.

In the present study, Plantarflexors kinesiotaping was done to improve reactive postural control by reducing spasticity and enhancing proprioceptive feedback in post stroke subjects. Although the Kinesiotaping group yielded more significant improvement in reactive postural control but the placebo effect caused by taping in sham taping group cannot be excluded. The study has following limitations. Firstly, as sample was small, generalizations of findings may be limited. Secondly we recruited both male and female in study, It is clear in literature that male and female will response differently in regards of Kinesio tape application. Thirdly, Even though, efforts were made to standardize all the encouragement that has been given to the participants and the researcher tried to design the tests as uniform and objective as possible, there was a risk of measurement bias as the researcher who took measurements was not not blinded in regards of the presence of the sham taping or the Kinesiotaping. Fourthly, The main limitation of our study is relatively short duration of follow-up. A future clinical trial will be required to address the questions regarding whether the immediate effect of KT are sustained for long term in improving reactive postural control in post stroke subjects.

CONCLUSION

The results of this study demonstrated that proper application of Plantarflexors Kinesiotaping is effective in improving reactive postural control in post stroke subjects. As there was improvement in our study when the immediate effect of KT was evaluated, it can be suggested that Taping can be applied easily and simply without the burden of time and cost and may be helpful for therapists in management of patients who are not cooperative in adhering to all parts of the rehabilitation program.

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Drashti Kotak and Mansi Patel

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Table 1. Changes in spasticity and Reactive Postural Control in Shamtaping Group.

	PRE	POST	z- value	p- value
MMAS Score	1.70±0.651	1.214±0.689	-3.464	0.01
Mini BESTest Score	2.70±0.749	3.103±0.900	-3.317	0.01

Table 2. Changes in spasticity and Reactive Postural Control in Kinesiotaping Group.

	PRE	POST	z- value	p- value
MMAS Score	1.833±0.698	1.142±0.705	-4.472	0.01
Mini BESTest Score	3.033±0.927	3.821±0.862	-4.234	0.01

Table 3. Changes in Spasticity and Reactive Postural Control between ST and KT group.

	ST GROUP	KT GROUP	U- value	P- value
MMAS Score	0.41±0.501	0.71±0.460	-2.265	0.02
Mini BESTest Score	0.38±0.494	0.82±0.612	-2.745	0.006





Drashti Kotak and Mansi Patel

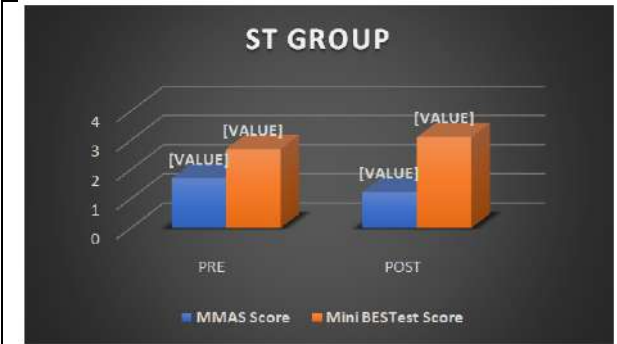


Figure 1. Difference of MMAS score and Mini BESTest scores pre and post intervention in ST Group.

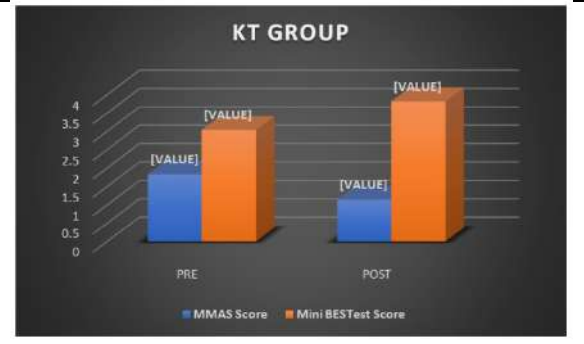


Figure 2. Difference of MMAS score and Mini BESTest scores pre and post intervention in KT Group.

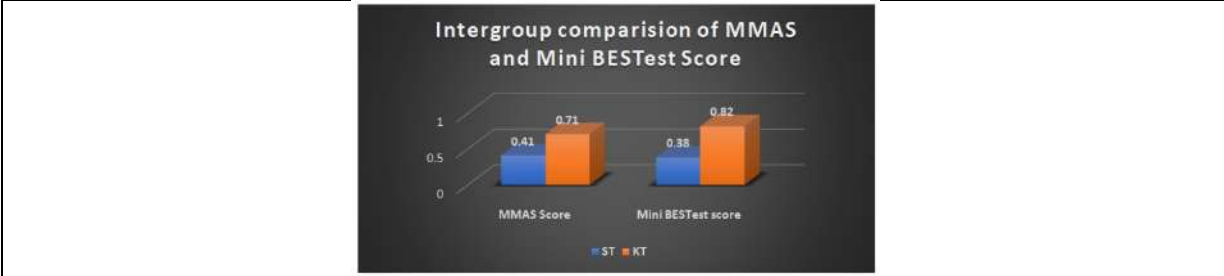


Figure 3. Difference of MMAS score and Mini BESTest scores between ST group and KT group.





Ethnomedical Translation as an Avenue for Converging Ethnomedicine with Biomedicine to Construct a Plausible Integrative Medical Approach

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ABSTRACT

Ethnomedicine regards how the non-mainstream medical behaviour of an exclusive population fits within and is shaped by its encompassing social system and cultural context. If lesser known, yet, efficient ethnomedical cultures are to be exposed to the larger medical world, along with their various viable functionalities, there should be a modulating vessel which acts as the cornerstone and the linchpin instrument identified here is Ethnomedical Translation. This paper completely focuses on how Ethnomedical Translation carried out through the intersection of the 'emic' explanatory models of illnesses (expressed in the indigenous language) with the universally acknowledged 'etic' medical vantages (expressed in a globally comprehensible moderating language, with the 'etic' biomedicine itself as the touchstone to assess the relativity), serves a significant role in creating a potential scope for an ethnomedicine to be combined with biomedicine, as a 'Complementary and Integrative Medicine' and at the same time, be made available as a feasible alternative in other medical cultures (after establishing its validity). The ethnomedical translation was undertaken through the convergence of the 'emic' explanatory model of illness, got through interviews with the Irula tribal community and a Tribal Vaidyar (conducted and expressed in the regional language), with the internationally affirmed and widely comprehensible 'etic' standpoints, by adopting a communicative translation approach. Moreover, this entire process is supported by an exemplary model, where the Irula ethnomedical system is presented with confines to the disease cancer. The process of ethnomedical translation provides a scope for the lesser known, yet, efficient ethnomedical cultures to be combined as a viable medical approach with conventional healthcare and nursing, after the necessary substantiation. Studying ethnomedicines



**Monisa and David Arputha Raj**

of the world, through ethnomedical translation, contributes in a way to have a look at the exotic other's medical culture and distinctive identity.

Keywords: Ethnomedical Translation, Biomedicine, Ethnomedicine, Integrative Oncology, Irula tribal community

INTRODUCTION AND BACKGROUND TO THE STUDY

'Medicine' as a subset of 'Culture'

Every society has its own exclusive ethnicity, linguistic dialect, economic and political hierarchy, education structure, healthcare and nursing system, customary practices, festivals, cuisines, performing arts and literature, myths, legends, etc. There is the presence of an established order of beliefs, norms, and values shared among a community that has been passed down across generations and may be loosely termed as the 'community's culture.' So then, a community's culture may be said to be a distinctive structure in existence, which is constantly rethought, reconstructed and restrengthened through social communion. In other words, it would be right to say that a culture's remodeling over its aspects is the reason for its uniqueness. Broadly speaking, communities differ from one another in many of the above mentioned cultural facets because of the variations in the origination factors affecting their formation, endowments passed on in their evolution, imperfect duplication of legendary practices, and the closely knit lifestyles calling for an amalgamation. Positively, this has resulted in the field of Cultural Anthropology where explorations are done about transformations in the various dimensions of a specific culture over a period of time and about different societies varying in their cultural constructions. Among many of the above specified strands that weave a distinct culture, medical system occupies a significant place. Quinlan (2011) points out to 'Medicine' being undoubtedly a subset of 'Culture.' She adds that "One can neatly assume that there might be as many unique culture-oriented medical perspectives, as there are distinctive cultures and singular practices" (381). This is where the study of Medical Anthropology and Ethnomedicine comes in handy.

Various Approaches in the Medical Field

Ethnomedicine

Ethnomedicine is an offshoot of medical anthropology. Quinlan (2011) loosely defines Ethnomedicine as the medical culture practiced by a particular society, which includes the natives' understanding of human body, knowledge of mental health, idea of well-being, definition of diseases, investigation of symptoms of illnesses, explanatory models of examining ailments, and practices of treating, curing and providing reliefs. In other words, ethnomedicine perceives medicine and healthcare setup of a specific community as cultural knowledge systems. Ethnomedical researchers delve into the study of social inceptions of a disease, the cultural explication of its symptoms and treatments, and the kind of interplay between medicine, society and culture. Moreover, it is to be noted that the interrelated perceptions, the members of a community hold towards holistic health or any disease and its treatment would be largely in cultural and indigenous terms. Since ethnomedicine almost always deals with primitive or folk medicine, Panigrahi (1970) puts forward that the 'emic' as well as the 'etic' perspectives play quite a significant role in understanding ethnomedicine. Ethnomedicine also focuses on the additions and modifications such traditional medical cultures would undergo or have undergone by practical usage. This shows that the ethnomedical knowledge is not static but dynamic as well as pragmatic. It is dynamic in the sense that it gets plenty of updates, when it is constantly practised during actual situations of human illnesses.

Biomedicine

Browner *et al.* (1988) define biomedicine as an accumulation of knowledge got through empirically supported understandings and a bunch of standardized appropriate procedures, about the structure and anatomy of human



**Monisa and David Arputha Raj**

physiological approaches, their proper and disturbed functioning of organ systems, and the diseases that transpire because of disoriented homeostasis and other external agents. This is considered to be the mainstream medicine in most of the countries.

Complementary and Integrative Medicine

Complementary and Integrative medicine amalgamates mainstream biomedical approaches with non-mainstream alternative medical therapies that have practical usage with benefits but may or may not be supported by scientific credibility. Integrative medicine advocates that while palliative drugs and medical procedures still heal multitudes of patients, balanced diet and nutrition, natural herbal curatives, and responsible lifestyle behaviours can make a direct impact to drive away the disease. This particular approach being open to new medical avenues is being largely embraced these days, since it incorporates all suitable therapeutic practices from both the conventional and non-conventional streams with an objective of focusing on wholesome health, wellness, prevention of illness, psychiatry, trauma management, etc. Complementary use of both conventional and alternative approaches - which are natural and less invasive - enhances the body's innate and acquired healing response. Ramamoorthy (2015) highlights that integrative medical approach does not entirely reject conventional medicine nor accept alternative medicine uncritically, but filters out the best from the two medical worlds and concocts them to give qualitative as well as effective treatment practices for any disease.

Disposition and Significance of 'Ethnomedicine' in the Medical Field

Quinlan (2011, 381) puts forward that ethnomedical studies investigate and predominantly translate health concomitant knowledge and associated theories, which natives of a particular ethnic community inherit from their predecessors as a prized possession by living together in their indigenous culture. Most of the rural and tribal communities in India live in the deep forests and foothills of mountains. They have their own specific explanatory models about the definition, causation, prevention, and treatment of diseases they counteract. As Panigrahi (1970) says, the indigenous communities believe that most of the illnesses are because of an imbalanced and undernourished diet, hostile environmental conditions, climatic changes, lifestyle routines, and supernatural factors. They almost always attach some sort of logical explanation towards the cause and effect relationship of a disease. When looking at the methods of treatment they practice, it is usually the traditional medicinal system coupled with spiritual healing and biomedicine. He adds that among the indigenous population, there would be a couple of community recognised Traditional Healers or Vaidyars, who are competent enough to offer herbal curatives, sometimes mixed with animal and mineral substances, in accordance with the cultural and religious legacy they carry for generations together. Joshi (2019) points out that most of these traditional medical knowledge are experience based, got through cultural transmission. However, all these traditional medicinal practices are not backed up by scientific evidence but traditionally followed by the society through oral literature. Though the medical practices may be non-scientific, it cannot be entirely dismissed as quack. This is because the healing output is justification to the idea that the ethnomedical system holds some logic within the context of cultural knowledge that the society possesses at a specific point of time.

Consolidating all these inputs, ethnomedicine can be largely found to befit traditional medicine, which in most cases synonymously inclines towards herbal therapies. Moreover, since ethnomedicine is agreed to be a non-scientific and non-conventional medical approach with considerable healing efficacy, it has to be forcibly placed in the category of 'Alternative Medicine.' Yet another point to be noted is that, ethnomedical cultures mostly being indigenous traditional medical systems, when they are followed as a choice within the original communal context or outside of the original communal context, they have to be termed alternative medicine. For such non-mainstream ethnomedical cultures which are mostly expressed through the indigenous tongue, to be exposed - as an alternative to or an integrative with biomedicine - to a larger world outside of the original native milieu, Ethnomedical Translation is thought to act as the cornerstone.



**Monisa and David Arputha Raj****Ethnomedical Translation**

Quinlan (2011) says that ethnomedical researchers usually undertake fieldwork among medical experts and individuals of a particular culture, to collect the 'emic' perspectives regarding their health care system or gather the necessary 'emic' medical views of the culture under discussion, from existing literature. Basically, ethnomedical study has two processes. The first step is the examination and documentation of the long practised, generationally transferred traditional medical knowledge, refined by improvisations that is followed in a particular ethnic population. This data collected possibly in the regional language will now form the foundation to arrive at a wholesome comprehension of how the community decodes human health; defines a specific disease; describes its causation, symptoms, prevention; and delineates the curative measures for healing. The second step, as Browner *et al.* (1988) say, is the medical translation of the 'emic' health views in the regional language to an external 'etic' vantage in the internationally adopted medical language, backed up by the universally referred categorization of diseases. Through this, Ethnomedical Translation as a process by itself, is assumed to bridge ethnomedicine with biomedicine. Also, they argue that, "if ethnographic interpretations are explicated through subjective lens (emic perspective), then an objective cum reliable method (etic perspective) is required for credibly decoding the viewpoints" (683). So then, it is presupposed that, ethnomedical translation is done solely to exhibit a specific ethnomedical culture for a global comprehension and to make it a viable alternative healthcare system for other ethnomedical cultures, as well as a potential integrative medical system for biomedicine, after examining its validity.

REVIEW OF LITERATURE

Anna Waldstein and Cameron Adams (2006) in their article, "The Interface between Medical Anthropology and Medical Ethnobiology," give a detailed overview about medical anthropology and the four major approaches to embracing medical anthropology, among which one is the ethnomedical approach. A major part of the discussion slants towards the history of ethnomedical approach in medical anthropology giving the various common causations for diseases within the ethnomedical systems of the world. Two important etiologies for ethnomedical systems to be understood have been described, parallelly taking into account few offshoots of ethnomedicine such as ethnophysiology and medical ethnobotany, which ultimately in turn contribute to the survival of the lesser known ethnomedical systems. Overall, more emphasis is given onto the naturalistic system of medicine, which serves as the foundation for most of the ethnomedical systems of the world to exist. Ann McElroy and Patricia K Townsend, in their book, *Medical Anthropology in Ecological Perspective* (2009), analyze the field of medical anthropology and the many raw materials that pillar the field. Discussions about how the ecology of health and disease form the basis for medical anthropology find a place in the introduction. Thoughts on ethnomedicine and its related 'emic' and 'etic' perspectives have been briefed about as the work progresses. A detailing about how cultural adaptations to diseases, changing patterns of disease and health in cultures, health resources in changing cultures have been offered, along with a scope for medical pluralism to be the future of the medical field. Finally, the book ends with a conclusion about the challenges the medical anthropologists face during the twenty-first century.

Marsha B Quinlan (2011) in her book chapter, "Ethnomedicine," gives an all-round cognizance about ethnomedicine. She talks about the prevalence of various ethnomedical systems used by many indigenous ethnic communities for the treatment of diseases and the significance of their utility. The article goes on to focus on the definition of ethnomedicine and the 'emic' and 'etic' perspectives which are seen as its accompaniments. Then it explicates the idea of ethnomedical translation and the importance cum contribution of the same from many angles, especially towards the field of medicine. Next, it logically lists out the steps involved in the process of ethnomedical translation and how as a process it can yield valuable products in the medical field. Followed by this, a well-structured outline called 'explanatory model of illnesses' comes in the form of methodology to carry out this process. Plenty of other essential elements for carrying out ethnomedical translation, with the help of an 'explanatory model of illness' have been discussed too, which include studying 'body and mental images' formed through ethnophysiology and ethnopsychiatry, determining the causations of illnesses, looking into health-seeking behaviour and



**Monisa and David Arputha Raj**

ethnopharmacology, etc. It concludes with putting forward the challenges and issues the researcher would face, if he/she gets lost in translation.

Cramer Holger *et al.* (2013) in their article, "Integrative Oncology: Best of Both Worlds—Theoretical, Practical and Research Issues," and Ramamoorthy *et al.* (2015) in their article, "Integrative Oncology in Indian Sub-Continent: An Overview," bring out how cancer patients in order to attain a satisfaction about their cancer therapy and to obtain a relief from the aftermath of conventional cancer treatments, take up integrative oncological treatment practices. The papers also talk about the space for Integrative Oncology in the medical field, by displaying various workable clinical models for the approach and highlight the availability of various types of Complementary Oncological therapies. Most importantly, they focus on the challenges Integrative Oncology needs to face for its survival, by underlining the idea of Comparative Effectiveness Research (CER).

METHODOLOGY AND CONCEPTUAL FRAMEWORK

The Logical Process of Ethnomedical Translation

The task of ethnomedical translation is carried out as a step by step logical process and it has been outlined by Waldstein and Adams (2006). In the first place, documentation has to be done focusing on a particular community's indigenous views about their medical culture, their culture specific perceptions giving an all-round coverage for the disease to be studied, and their healing practices to counter the illness. Documentation, requires fieldwork among the population for whose medical culture, the ethnomedical translation is done. In the second place, the ethnomedical researcher having gathered the 'emic' medical views from the specific population, which may be in the community's language, needs to translate them (through a communicative approach if the 'emic' views are in the regional language) to the widely acknowledged and linguistically comprehensible 'etic' vantage, by looking for congruencies and digressions between the collected 'emic' and already established 'etic' medical standpoints.

Interviewing the Irulas of the Marudhamalai Hills of Coimbatore about their indigenous perceptions on cancer

For the construction of an exemplary model supporting the study, the ethnomedical system and the disease to be probed was zeroed in on as looking at cancer through the ethnomedical lens of the Irula tribal community of the Marudhamalai Hills, Coimbatore. An elaborate background study about the Irula community was done, covering the details of origin and demographic location, language, literature, arts, settlements and shelters, occupation, politics, education, religion, food, health, medicinal practices, familial setup, dress code, significant events and ceremonial practices, etc. At the same time, existing 'etic' medical perspectives about cancer was thoroughly researched. With the available data in hand, the ethnomedical researcher proceeded for an interview with the Irulas of the Marudhamalai hills. Questions were posed to community representatives, in such a way that 'emic' views about their medical culture, indigenous explanatory descriptions about cancer and native standpoints about the disease's ethnomedical treatments, were extracted. The participants were asked to answer a set of questions about cancer. The questions ran like this:

- Cancer is a disease that anybody can counteract nowadays. How do you perceive and define cancer?
- Cancers have been classified into various types. But then what is your basis for categorizing cancer?
- What are the symptoms of cancer in your perception?
- What do you think are the causes for cancer?
- How do you diagnose the attack of cancer?
- In your opinion, what are the ways to prevent the disease of cancer?
- Is there any herbal medicinal formulation that you adopt in your community to control or treat cancer?
- If so, list down the herbs, their medicinal parts, their form for usage, method and frequency of consumption?

The above mentioned questions were posed to the participants in the regional language and they too responded in the same language. Quite a bit of information, much enough for constructing the 'explanatory model on cancer' to perform the ethnomedical translation was procured.





Interviewing a Tribal Vaidyar who practices Herbal Medicine

The ethnomedical researcher proceeded to undertake yet another field work for data substantiation. A tribal medical expert also called a Vaidyar, who practices herbal therapeutic healing was selected for this study. A Tribal Adivasi Herbal Medical Practitioner, agreed to have a discussion with the researcher, on the tribal 'emic' perceptions on cancer as well as on the herbal formulations, the tribals widely use for the treatment of cancer. The same set of questions that were posed to the Irula tribal participants, were discussed with the practitioner and a few expert 'emic' oncological views regarding cancer were sought from the practitioner. The standpoints that were obtained were very similar to that of the Irula participants, with a few additions. Most importantly, in order to verify the lay natives' idiosyncratic information about the cancer treatment practices followed by their community and to get an expert touch, the herbs already documented were reiterated to the Vaidyar. The practitioner then verified the validity of it among the tribal circles and was able to give a fresh herbal formulation for the healing of cancerous tumors from the herbs provided for checking their credibility. Though the Vaidyar was not fluent with written documents, the Vaidyar did take the strain of providing the researcher, the botanical and Ayurvedic names of the medicinal plants, along with their parts, form and quantity required for preparation.

'Emic' and 'Etic' Perspectives

Ethnomedical Translation relies much on the 'emic' and 'etic' phenomena for ethnomedicine to be comprehended and interpreted in the right way and be made available as a non-mainstream alternative medicine. The terms 'emic' and 'etic' are derived as clipped variations of 'phonemics' and 'phonetics' in linguistics (Pollock "Ethnoscience and Medical Anthropology"). McElroy and Townsend (2009) underscore that ethnomedical translation, initially, looks for an 'emic' perspective, (i.e.) an idiosyncratic view from a native of the community under study. Such descriptions and explications of a community's insider are extracted by the ethnomedical researcher through an ethnosemantic study. Emic medical views about illnesses can exclusively be given only by an insider of a particular culture because those views, unlike other perspectives, carry a raw development experienced by the inbred, while living within the specific societal framework. However, oddly, as Quinlan (2011) emphasizes, it takes an external standpoint or an outsider's 'etic' vantage to meticulously look for notable medical models in the 'disease' catalogue for the 'emic' viewpoints put across, because a representative of the culture may oversee his/ her medical system's specialties or take them for granted. In short, the 'emic' catalogue gives the folk or culture specific perceptions of 'illnesses' whereas the 'etic' catalogue gives the universal understanding of 'diseases' (Pollock "Ethnoscience and Medical Anthropology"). On the whole, an ethnomedical investigation is complete, when a translation is done from the 'emic' perspective (mostly in the regional language) to the 'etic' perspective propagated through the medical terminologies. The medical anthropologist, here, often serves as the mediator bridge for biomedicine and ethnomedicine through the mode of translation. Perhaps, much of the 'illnesses' are consolidated into the nosology of 'diseases' (i.e.) the ethnomedical cultures are integrated into the conventional medicine, through translation and further amalgamative interpretations.

Explanatory Models (EMs) and Internal Logic

A systematic way of doing ethnomedical translation is incorporating the explanatory model of disease and treatment description. Arthur Kleinman's principle of using the 'explanatory model' for ethnomedical translation is of utmost importance to achieve the desired output. An explanatory model about a particular illness comprises of the description of the sickness, details of its causation, list of its preventive measures if any, account of its symptoms, 'emic' experiences of trauma, and explication of treatments and curative strategies for its abatement from the indigenous stand. Formation of a reliable explanatory model of an illness is usually done by the consolidation of similar idiosyncratic or individualistic 'emic' viewpoints, perceptions and circumstances that fall in line with the existing illness theories of their medical culture. Quinlan (2011) strongly opines that a cultural impact or cultural convergence is shoved on the construction of the explanatory models through ethnographic ideologies, theories, themes, and pictures; cultural builds on body images, mental images, health, illnesses; and cultural dogmas on ethics, responsibility, beliefs, powers, etc. To be precise, the convergence of such cultural conceptions is what provides the so called system of 'internal logic' for coming up with emic explanatory models for illnesses. This is the reason why, what may sound a logical medical investigation in one ethnomedical culture, may seem absurd in the



**Monisa and David Arputha Raj**

logic of another ethnomedical system, as there are differences in the internal logic of each system, due to differences in cultures.

Communicative Approach to Translation

The main objective of ethnomedical translation is to translate the crux of the medical meaning of a matter, with language being an instrument rather than a barrier. Communicative approach to translation extends its hand to a great extent to materialize this job. Zheng Wang (2018) highlights that communicative approach to translation, tries to duplicate the absolute meaning of a context expressed in the source language, in a way that the subject matter as well as the language becomes satisfactorily comprehensible to the target readers. In the process of ethnomedical translation, the primary text for executing ethnomedical translation will be obtained through the documented 'emic' explanatory model garnered from the standpoint of a particular community about their medical culture about a specific illness under investigation, and about the healing practices adopted to combat the sickness. Now, communicative approach to ethnomedical translation, seeks to translate (by taking into account only one ethnomedical culture and a single illness) the indigenously expressed 'emic' medical vantages (which will be in the native language of the society under study) to globally acknowledged 'etic' medical perspectives (which is usually in the internationally moderating and comprehensible medical language), by identifying the intersection between the 'emic' and 'etic' viewpoints (or in other words, the relativity of an ethnomedicine to biomedicine, has to be determined with biomedicine itself being the 'etic' touchstone), simply through the transfer of 'relative meaning' alone from one vantage to another, without spoiling the essence of information transmission from the source language to the target language.

FINDINGS OF THE STUDY

Ethnomedicine is a sensitive subject for many, as the study of varied ethnic medical systems interests some and disgusts others. This is because outlandish healthcare and nursing practices, for certain unexplainable reasons, seem to wallop the core of the reader's ethnocentrism and make him/her strongly feel eccentric, false, repulsive, and intriguing about them. But through medical translation, offering an 'etic' perspective with much relatability to biomedicine on these otherwise strange and ridiculous 'emic' views about a specific ethnomedical culture, can help the readers feel less offensive and more comprehensible to an alternative medical system. Moreover, it is done to weigh the congruencies and digressions between the emic and etic assessments and simultaneously offer comprehensible exposition of a culturally unique alternative non-mainstream ethnomedicine, after determining the extent to which the emic outlook about the 'sickness', has supporting 'etic' efficacy.

Knowledge gained through ethnomedical translation is helpful for the utility of a larger public health under different scenarios. Ethnomedical translation easily helps people with their respective acquainted ethnomedical systems, to settle in areas where biomedicine is largely followed. It gives an idea about illnesses that are new to a particular population but which have already been counteracted with by some other community. Translated illness narratives and discourses of a specific population give an idea as to how they interpret and cope with illnesses. Also, it helps in introducing biomedicine to the communities where ethnic medicines are religiously practiced and this could promisingly provide cures for some of their intractable 'emic' illnesses (Quinlan 2011). Ethnomedicine, being culture bound, is yet another facet that provides a particular community its distinctive identity. Studying ethnomedicines of the world, through ethnomedical translation, contributes in a way to have a look at the 'exotic other.' Thus ethnomedical translation is helpful in attaining a culture's traditional medical knowledge.

DISCUSSION**A Model for Ethnomedical Translation**

A systematic model of conducting ethnomedical translation in a logical order has been discussed below. A step by step look out is as follows:



**Monisa and David Arputha Raj****Acquiring 'emic' vantages about the medical culture of a particular society**

Since the ethnomedical system selected for this exemplary model of ethnomedical translation, is that of the Irula community of the Marudhamalai hills of Coimbatore, gathering the 'emic' views from the Irulas about their medical culture through fieldwork and from existing literature is appropriate. The essence of such 'emic' ethnomedical views garnered, have been recorded here. The Irula medical system uses herbs available in the forests that possess medicinal properties for the treatment of any health issue counteracted. As per the statistics of an article, the Irulas are specialists in practising traditional herbal medicine and giving effective cures ("Giving Irula Healing Practices a Place in Modern Medicine: A New Source of Livelihood for 'One among the Six Oldest Adivasi Tribes' – Puducherry & Tamil Nadu," taken from the *Tribal Cultural Heritage in India Foundation*). Their internal healing practices supported by religious beliefs are almost successfully sufficient for their community to get over ill health. Dhivya and Kalaichelvi (2015) discuss that the Irulas have effective herbal healing for cough, cold, headache, fever, throat infections, asthma, vomiting, indigestion, dysentery, dehydration, high blood pressure, body heat, headache, eye infections, ear pain, toothache, stomach ache, leucorrhoea, rheumatism, psoriasis, jaundice, diabetes, paralysis, epilepsy, ulcers, kidney stones, worm infestation, organ bleeding, fractured bones, swellings and sprains, genital disorders, abortion issues, hair fall and dandruff, burns, cuts and wounds, snake & scorpion bites, dog bites. It has to be noted that Irula Vaidyars well versed in traditional healing science have a place in modern complementary medicine. The Irula Tribal Women's Welfare Society (ITWWS), established in 1986, empowers Irula women Vaidyars to promote their medicinal products, which accounts for over 300 herbs ("Giving Irula Healing Practices a Place in Modern Medicine: A New Source of Livelihood for 'One among the Six Oldest Adivasi Tribes' – Puducherry & Tamil Nadu," taken from the *Tribal Cultural Heritage in India Foundation*). When such a traditional healing system is brought to light, it can surprisingly provide cures for deadly illnesses on a larger public health and at the same time exhibit their unique identity. The article, moreover, adds that all of the Irula settlements have one or two Vaidyars, who carry an intricate knowledge of the medicinal values of various plant species, their healing properties and their curative powers, passed on orally for generations together. People those who have had a first-hand taste of the tribal medicine, approach the Irula Vaidyars frequently to get their counsel for tormenting sicknesses. One can see how the Irulas living near the Marudhamalai temple, at Coimbatore, offer herbal cures to visiting Hindu pilgrims.

Thus, these indigenous views about their medical culture from the Irulas of the Marudhamalai Hills of Coimbatore has provided a fundamental idea about the ethnomedical system they follow, which mostly identifies many of the diseases in their 'emic' catalogue with the 'etic' disease nosology and slants towards the traditional medicine of herbal healing, as far as the treatment practices are concerned. A background knowledge about the medical culture followed by the particular community chosen for the research study, is quite necessary to form an overall idea about the kind of ethnomedicine, the ethnomedical investigator is dealing with for his/her ethnomedical translation. Moreover, being equipped with such data proves greatly useful to come up with a quality 'explanatory model of the disease chosen for study', which forms the major functional unit of ethnomedical translation.

Looking into the 'Etic' perspectives of the disease selected for the ethnomedical investigation

The entire medical culture of the Irula tribes of Marudhamalai hills of Coimbatore offering treatment to various illnesses cannot be brought under a single ethnomedical study. So a single disease has been zeroed in on, which can act as a microcosmic sample to represent the larger medical culture of the community, as well as, illustrate the ethnomedical translation carried out on a smaller scale, by way of handling a particular disease. The disease that has been opted for working on is Cancer and its related field of Oncology. Below is given an overview about the definition, classification, symptoms, causes, prevention, diagnosis, staging methods and conventional treatments of cancer. This gives an overview about the disease of cancer, simultaneously, presenting at the reader's disposal the 'etic' medical perspectives about cancer and how it is perceived as a whole in the field of mainstream conventional biomedicine.

The word 'cancer' comes from the Greek word 'karkinos,' which means a crab or crayfish. Hippocrates, a Greek physician and the 'Father of Medicine,' first used this term to describe various types of cancer and tumors. Lumps arise when damage occurs to the genes in the DNA involved in cell division but mostly the cell is able to detect and





Monisa and David Arputha Raj

set right the blemish. And if that is not possible due to advanced impairment, the cell on its own undergoes programmed cell death or apoptosis. But disaster occurs, as explained by Dhanamani, Lakshmi and Kannan (2011), when such an affected cell continues to exist, with its severely mutated genes modified by various internal (genetically altered malignant cells with less immune conditions) and external (repeated impact of carcinogens, viruses, radiations and chemicals etc.,) causal agents and starts to multiply uncontrollably, ending up with a swell of tissues called tumor in the particular region. Tumors for their reproduction engage in encroachment of oxygen and nourishment, available to other healthy cells which may destruct the immune system and normal functioning of the body. Tumors can be cancerous or non-cancerous. Cancerous tumors after invading the nearby tissues at the sight of origin break away from the parent mass of cells, diffuse through the blood and lymph stream by infiltrating normal body tissues and lodge in different locations or organs of the body, where they again repeat the uncontrolled malignant multiplication to form new metastatic tumors. Benign tumors do not disseminate to nearby tissues or distant organs in the body and remain localized.

Cancers are classified on the basis of the type of cell that the tumor cells resemble and their site of origin. They are carcinomas, sarcomas, leukemias, lymphomas, myelomas, central nervous system cancers, germ cell tumors, blastomas and metastatic cancers. According to the National Cancer Institute, the general symptoms experienced by patients during the initial stage of any type of cancer which are also useful in the diagnosis of the disease are consistent loss or increase in appetite; unexplained loss or gain of weight; persistent discomfort while and after eating leading to indigestion; persistent fatigue, nausea, or vomiting; changes in bowel, bladder habits and passage of bloody stools; unexplained fevers, night sweats and sore throat; persistent muscle pain or joint aches; recurring allergies and infections that do not get resolved through usual treatment; hardening or thickening of skin on the affected area leading to a lump; changes in the skin such as yellowing or darkening of patches; and redness of the affected skin with existing sores that do not heal. Davis (2021) lists some causal agents that can be directly linked to the development of cancer namely pathogens, environmental and occupational exposure to ionizing radiations, unhealthy lifestyle, immune-suppressant medications and other genetic factors. Imaging studies such as X-rays, CT and MRI scans, ultrasound, endoscopy, radionuclide scanning, commonly help physicians, surgeons and oncologists to recognize cancerous tumors in the body. There are several methods to mark stages for tumors. Davis adds that the most commonly used staging method uses categorization in terms of size, number, and dissemination of the tumor (T), the degree of regional spread to nearby tissues or nodes (N), and the level of distant metastasis (M). This is known as TNM staging. The treatment of cancer in the current scenario is carried out by surgery, chemotherapy, radiotherapy, hormone therapy, immunotherapy, stem cell transplant, precision medicine but any treatment practice followed has its therapeutic efficiency to be low, since the primary mode of action is on the damaged DNA (Nall "Cancer: Overview, Causes, Treatments, and Types").

Performing the Ethnomedical Translation of the 'Emic Explanatory Model of Illness'

The ethnomedical translation of the 'emic explanatory model of illness' can be carried out by intersecting the garnered 'emic' medical views (in the regional language) with the widely established 'etic' medical vantages (in a globally moderating and understandable language - where the 'etic' standpoint itself serves as the touchstone to parallel the relativity with ethnomedicine and biomedicine) by incorporating a communicative approach to ethnomedical translation, which focuses on transmitting the 'relative meaning' and the 'essence of information' without much variation from the source language to the target language. A sample version of executing the ethnomedical translation to the 'emic explanatory model on cancer' that will be constructed parallelly has been given below:

Name of the disease under study: The Irulas in their emic outlook term the disease cancer as 'புற்றுநோய்.'

Definition of the disease: The Irulas loosely define cancer as 'tumorous swellings' that characterize the disease as 'கட்டிகள்.' From the 'etic' perspective, it is understood that what the Irulas call 'கட்டிகள்', in the 'emic' medical view, is translated to be 'tumorous swellings' that characterise the disease of cancer.

Classification of the disease: On the basis of the region where the benign tumors occur, the Irulas name the tumors after the localized organ part. மூளைப்புற்றுநோய்- Brain Tumor, வாய்புற்றுநோய்- Mouth Cancer, மாம்பகப்புற்றுநோய் - Breast Cancer, தோல்புற்றுநோய்- Skin Cancer, கல்லீரல்புற்றுநோய்- Liver Cancer, நுரையீரல்புற்றுநோய்- Lung

58636





Monisa and David Arputha Raj

Cancer, கணையப்புற்றுநோய்– Pancreatic Cancer, குடல்ப்புற்றுநோய்– Intestinal Cancer. From this, it is understood that the Irulas have a similar classification of cancer types – pertaining to the site of occurrence of the tumor - to the conventional system of medicine. A look from the 'etic' perspective will present the types of cancer, as tumors having growth in the localized regions of the body such as brain tumor, mouth cancer, breast cancer, skin cancer, liver cancer, lung cancer, pancreatic cancer, intestinal cancer, etc.

Symptoms of the disease: The Irulas identify the symptoms of 'Cancer' to be: பசி இன்மை– Consistent loss of appetite, எடை கூடுதல்– Unexplained gain of weight, தசைவலி– Persistent muscle pain or joint aches, ஒவ்வாமை– Recurring allergies, கட்டி இருக்கும் இடத்தில் கடினமான தோல்– Hardening or thickening of skin can be felt on the affected area leading to a lump, கட்டி இருக்கும் இடத்தில் தோல் தடிப்புகள் - Redness of the affected skin. By converging the Irula 'emic' medical views about the symptoms of cancer with the 'etic' perspectives of biomedicine - the conventional system of medicine being the yardstick - the ethnomedical translation has been done. The ethnomedically translated symptoms of cancer seems to be consistent loss of appetite, unexplained gain of weight, persistent muscle pain or joint aches, recurring allergies, hardening or thickening of skin on the affected area leading to a lump, redness of the affected skin, etc.

Causes for the disease: The Irulas believe that the benign tumors are caused due to: கட்டுக்கடங்காத உயிரணு பெருக்கம் – Unprogrammed cell death or apoptosis, புகைபிடித்தல்– Intake of tobacco, மது அருந்துதல்– Consumption of alcohol, அதிக உடல் எடை– Obesity, உடல் உழைப்பு இல்லாமை– Lack of physical exercise, பெற்றோரிடமிருந்து பிள்ளைகளுக்கு பரவுதல்– Hereditary transmission. By intersecting the Irula 'emic' medical views about the causal agents of cancer with the 'etic' perspectives of biomedicine - the conventional system of medicine being the gauge - the ethnomedical translation has been done. The ethnomedically translated causes of cancer accounts to be unprogrammed cell death or apoptosis, intake of tobacco, consumption of alcohol, obesity, lack of physical exercise, hereditary transmission of the illness, supernatural punishment, etc. *Diagnosis of the disease:* The Irulas diagnose the benignity of the cancerous tumors on the basis of the rate of the tumor enlargement - கட்டிகளின் வீக்க அளவு.

Prevention of the disease: The preventive measures considered by the Irulas to control cancer include: புகைபிடிக்காமல் இருத்தல்– Avoiding the smoking of tobacco, மது அருந்தாது இருத்தல்– Avoiding the consumption of alcohol, உடல் உழைப்பு செய்வது– Exercising daily, உடல்எடையை குறைப்பது– Maintaining a healthy weight. By relating the Irula 'emic' medical views about the preventive measures of cancer with the 'etic' perspectives of biomedicine - the conventional system of medicine being the benchmark - the ethnomedical translation has been performed. The ethnomedically translated preventive measures of cancer appears to be avoiding the smoking of tobacco, avoiding the consumption of alcohol, exercising daily, maintaining a healthy weight, etc. *Ethnomedical treatment for the disease:* The Irulas of the Marudhamalai hills of Coimbatore have their medical system pinned to the traditional medical practices of herbal healing. Thus, they stick to மூலிகைமருந்து - herbal medicine for the treatment of any sort of disease and similar is the case with the disease of 'Cancer'. 'Some of the herbal medicinal intakes and applications, the Irulas and certain other tribal communities use for 'Cancer are as follows:

கடுக்காயின் விழுது, நெல்லிக்காயின் விழுது, பட்டையின் பொடி, ஏலக்காயின் பொடி, கோரப்பூல் வேரின் பொடி, மஞ்சள்பொடி, திப்பிலியின் பொடி, சந்தனத்தின் பொடி, நாகபுஷ்பத்தின் பொடி, சங்கபுஷ்பசெடியின் பொடி, அதிமதுரவேரின் பொடி, வாய்விலங்கக்காயின் பொடி, வல்லாரை செடியின் பொடி, குடைபோல் இருக்கும் கோரப்பூல் வேரின் பொடி - அனைத்தையும் எடுத்துக்கொண்டு, நெய், தேன், சர்க்கரை, தண்ணீருடன் நன்குகலந்து, உருண்டை பிடித்து உட்கொள்ள வேண்டும். இதனையே மலைவாழ் மக்கள் புற்றுநோயை கட்டுப்படுத்தும் மருந்தாக பார்க்கின்றனர்.

The paste of Gallnut, the paste of Indian gooseberry, Cinnamon Powder, Cardamom Powder, Powder of the roots of Nutgrass, Turmeric Powder, Powder of Long Pepper, Sandalwood Powder, Powder of the flowers of the Ceylon Ironwood tree, Powder of the whole plant of Morning Glory, Powder of the Licorice roots, Powder of False Black Pepper, Powder of the whole plant of Indian Pennywort and Powder of the roots of Umbrella Sedgears mixed with some ghee, honey, sugar, and a little of water. The mixture is then shaped into nice fine balls and consumed. The tribals consume these herbal balls to keep the tumorous growths under control. It is also important to see all the



**Monisa and David Arputha Raj**

above herbal therapeutic plants with their botanical name and family classification, for correct labeling and identification. It is obvious that the 'emic' herbal medicines are in the regional language and they have been translated into an 'etic' biomedical standpoint, supported by a commonly perceivable language (through comparing the relativity between the two vantages, with biomedicine ironically being the yardstick), in order for a larger audience to get to know the ethno-oncological system better. Moreover, the essence of the meaning has been neatly recreated from the source language to the target language, without any damage to the authenticity by applying the approach of communicative translation. This is only a microcosm for the ethnomedically translated herbal medicines used by the Irulas of Marudhamalai Hills of Coimbatore for cancer, which in a way would contribute to the mini explanatory model on cancer and the mini model of ethnomedical translation. It is important to note that certain components of an explanatory model of illness such as definition, classification, symptoms, causes, diagnosis, prevention of the disease, apart from giving an insider's views about his/her medical culture and emic opinions about the disease under study, serve as clues in rightly matching the disease in the 'emic' catalogue with a replicate disease in the 'etic' nosology, through intersecting the 'emic' and 'etic' medical vantages. Thus, this entire exemplary model has brought to light that ethnomedical translation as a process can open up avenues for ethnomedicines to be exposed as practicable alternatives to other medical systems and at the same time be made available for a potential integration with the conventional mainstream biomedicine, after verifying their validity.

The Scope of translated Ethno-oncological Herbal Practices to function as Complementary and Integrative Oncological Medicine

Besides the exclusive adoption of all the conventional biomedical methods for effective cancer treatment, complementary and integrative approaches rather than conventional or alternative oncological treatments have made significant contributions to cancer therapy. One of the alternative medical practices is ethnomedical phytotherapeutic approach. Almost all the medical cultures to a great extent make use of herbal medicines. It is because of this, in recent years, ethnomedicine has played a significant role in the development of anti-cancer herbal drugs with milder side effects in varied regions of the world (Nisa *et al.* 2013). Whole plants and plant parts individually and in combination with other medicinal plants have been used as a viable curative remedy for a number of diseases down the ages because of the presence of naturally sourced therapeutic pharmacological compounds in them. On a report given by the World Health Organization, many of the developing and developed countries still depend on phytotherapy and herbal formulations for their primary source of treatment. Ethnomedical researchers in order to identify regional medical cultures collect data from the particular native residents, where plenty of 'emic' medical research material is documented but this is always not reliable or valid, so an ethnomedical translation to 'etic' perspective is required to prove their credibility through further clinical and lab trails. Therefore, ethnomedical researchers offer a much essential hand, to identify, determine, characterize, and offer solid biochemical evidence for the investigated indigenous medicinal plants, so that practical applications of the same would be possible in cancer treatment. Ethnomedical herbal medicines for cancer relatively have more efficacy and are better tolerant than inorganic chemical drugs, but patients must have adequate knowledge about their formulation methods, dosage administration procedures, and possible aftermath, failing which the repercussions may outweigh the benefits. Cancers treated by traditional healers and regional herbalists include skin, breast, colon, uterus, cervical, prostate, stomach, intestinal, mouth, lung, blood cancers etc., A more recent approach is to consolidate the conventional and alternative ethnomedical cancer therapies, so that both of them complement and work in tandem with each other. This medical approach is termed as complementary and integrative medicine and more specifically in the field of cancer treatment, integrative oncology.

Heydarirad and Rezaeizadeh (2016) put forward that integrative oncology provides a wholesome care for the cancer affected, as it complements the every stage of conventional treatment a patient undergoes with integrative alternative medical practices, which find favor in the eyes of the patient as well as the medical expert. Moreover Holger *et al.* (2013) point out that conventional as well as integrative medicine oncologists are more inclined towards the use of complementary approaches than alternative therapies, as in the latter, people are required to forgo treatments with clinical backing up, scientific evidence and proven benefits, but then that is not the case with integrative medicine which serves as an added suffrage to conventional cancer treatments. Most cancer affected



**Monisa and David Arputha Raj**

patients wish to do everything within their power to fight the disease, minimize its symptoms, drift through the painful journey of treatment, improve the efficacy of the conventional treatment, and cope with the aftermath. In order to achieve this, cancer patients very commonly take up complementary and integrative health approaches, in any form, herbal medicine being the most sought after. Heydarirad and Rezaeizadeh (2016) add that traditional medicines of various cultures are usually composed of herbal medications and these indigenous turned alternative medicines are greatly suggested by integrative oncology practitioners. Cancer patients from all cultures consume herbal supplements to improve the overall wellbeing and to deal with post-treatment trauma. Even the ancient alternative whole medical systems or tribal ethnomedicine used in India has its basis to be herbal medicine.

All said and done, one may definitely consider the risk involved in simultaneous administration of both conventional and complementary medical approaches for cancer treatment. There is a common perception that alternative medical practices such as herbal medicine, when used as a complement to conventional cancer treatment, might interfere with the efficacy of the conventional targeted cancer therapies leading to unfavorable outcomes. But then, integrative oncology looks into these kinds of issues, taking into account the Comparative Effective Research (CER) factor because this particular phenomenon looks out for complementary or alternative treatment practices, drugs or medicines, which may negatively interfere with the conventional cancer therapies and rejects them. It consolidates any traditional, alternative or complementary medical practices into integrative oncology, only if they work in concord with the conventional treatments, leading to enhanced effective results. Thus, as Holger et al (2013) say appropriate conventional and complementary therapies are united into a single eclectic patient-oriented approach in integrative oncology, so that efficacy can be maximized without compromising on compatibility.

CONCLUSION

Ethnomedicine looks into the medical behaviours practiced by specific ethnic societies along with the 'internal logic' they carry to guide their medical cultures. Ethnomedical knowledge possessed by various indigenous communities is something which is generationally and orally passed on and this stands in the danger of being easily lost, if proper documentation and translation does not take place. Suchita Tripathi (2019) opines that usually most of the ethnomedical cultures depend on natural resources for their medical systems to thrive, meaning most of them adopt the approach of herbal medicine. She goes on to say that, since ethnomedical systems are almost always naturalistic, the indigenous communities depend much on nature and if the ethnomedical systems can be made available to the larger world through ethnomedical translation, then it can bring about a neat coexistence with nature for the globe too, which appears to be the burning issue of the hour.

Through Ethnomedical Translation, the idea of medical pluralism or synonymously health pluralism arises. Medical pluralism usually comes into place, when traditional and ethnomedical systems coexist as complementary and alternative medical practices with contemporary and modern biomedicine. McElroy and Townsend (2009) come up with the idea that health pluralism often denotes the integration of mainstream (biomedicine) and non-mainstream (complementary and alternative medicine) medical cultures for health maintenance, psychological care, and nursing. Globally and in India too, medical pluralism as well as complementary and integrative medical approach is being welcomed extensively in recent times. So, if the hazards that ethnomedical systems encounter for their survival are properly done away with, then ethnomedicines can easily fetch a place under medical pluralism. Thus through ethnomedical translation, the age-old traditional and ethnomedical healing systems can be preserved and at the same time used for combating dreadful diseases.

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Table - 1 Ethnomedicines collected from the Irula tribal community for the treatment of cancer

Local Name/ Common Name	Botanical Name (Family)	Habit	Parts used and Form
Kadukkai/ Gallnut	<i>Terminalia chebula</i> (Combretaceae)	Tree	Fruit paste
Nellikai/ Indian Gooseberry	<i>Emblica officinalis</i> (Phyllanthaceae)	Shrub	Fruit paste
Pattai/ Cinnamon	<i>Cinnamomum zeylanicum</i> (Lauraceae)	Tree	Bark powder
Elakkai/ Cardamom	<i>Elettaria cardamomum</i> (Zingiberaceae)	Herb	Fruit powder
Korrappul/ Nutgrass	<i>Cyperus rotundus</i> (Cyperaceae)	Herb	Root powder
Manjal/ Turmeric	<i>Curcuma longa</i> (Zingiberaceae)	Rhizome	Rhizome powder
Thippili/ Long Pepper	<i>Piper longum</i> (Piperaceae)	Climber	Fruit powder
Sandhanam/ Sandalwood	<i>Santalum album</i> (Santalaceae)	Tree	Wood powder
Nagapushpam/ Ceylon Ironwood	<i>Messua ferrea</i> (Calophyllaceae)	Tree	Flower powder
Sangapushpam/ Morning Glory	<i>Convolvulus pluricaulis</i> (Convolvulaceae)	Herb	Whole plant powder
Adhimadhuram/ Licorice	<i>Glycyrrhiza glabra</i> (Fabaceae)	Shrub	Root powder
Vaivilangam/ False Black Pepper	<i>Embelia ribes</i> (Primulaceae)	Climber	Fruit powder
Vallarai/ Indian Pennywort	<i>Centella asiatica</i> (Apiaceae)	Trailing herb	Whole plant powder
Korrappul/ Umbrella Sedge	<i>Cyperus scariosus</i> (Cyperaceae)	Herb	Root powder

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Psoriasis: Nutritional Management for Patients with Psoriasis”

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ABSTRACT

Psoriasis is a chronic inflammatory skin disease. Immunological, inheritable and environmental factors, including diet, play a part in the pathogenesis of psoriasis. Metabolic syndrome and its components are common comorbidities in patients with psoriasis. Dietary changes and improve a patient's quality of life by alleviating skin damage and reducing the risk of other diseases. A low-calorie diet is recommended for patients who are overweight. People with psoriasis should limit their intake of saturated fatty acids and replace them with polyunsaturated fatty acids from the omega-3 family, which are anti-inflammatory. The introduction of antioxidants such as vitamin A, vitamin C, vitamin E, carotenoids, flavonoids and selenium is extremely important in the dietary treatment of patients with psoriasis. Vitamin D supplementation is also recommended. Some authors suggest that alternative diets have a positive effect on the evolution of psoriasis. These diets include: gluten-free, vegetarian, and Mediterranean dietary therapy for patients with psoriasis must also be compatible with drug therapy. For example, people who take methotrexate start taking folic acid supplements. The purpose of this article is to discuss in detail the nutritional recommendations for people with psoriasis.

Keywords: Obesity, Diet, Carbohydrates, Calories.



**Kalyani U. Chande and Nikhil S. Ekhande**

INTRODUCTION

Psoriasis is one of the most common seditious skin conditions [1]. According to the WHO, the impact of this skin disease is nil. 9 to 11.43% of the world's population, ranging from 1.5% to 5.00% in developed countries [2], derived from abnormal proliferation of keratinocytes (epidermal cells), resulting in the formation of psoriatic plaques [3]. This is a chronic disease in which we observe periods of spontaneous regression and relapse [1]. The complaint affects the skin but is also a systemic condition [3]. Immune disturbances leading to increased production of pro-inflammatory cytokines contribute to the pathogenesis of psoriasis. The increased activity of Th1, Th17 and Th22 lymphocytes leads to excessive production of pro-inflammatory cytokines. These factors include: C reactive protein (CRP), interleukins 1, 2, 6, 8, 12, 17, 22, 23 (IL), interferon gamma (IFN- gamma), tumor necrosis factor (TNF- α), plasma ceruloplasmin, α 2- macroglobulin, α 1- antitrypsin, etc. The concentrations of these factors are high in the acute and remission phases of psoriasis [1, 3, 4]. Through its stimulating effect on keratinocyte proliferation, TNF- α plays a key role in the pathogenesis of psoriasis [5].

In addition to immune disturbances, genetic and environmental factors also play a role in disease pathogenesis [1]. Among other things, a link has been shown between the development of psoriasis and the genes of the HLA complex, in particular HLA-Cw6. However, people who carry genes associated with psoriasis usually do not develop the disease [1,6]. Environmental factors that can lead to manifestations or worsening of psoriasis include the; physical as well as chemical factors, skin diseases, infections, stress, medications, diet, tobacco smoking, alcohol consumption, etc. Despite extensive research, the Pathogenesis of psoriasis has not been fully explained [1,7]. It is complex and ambiguous. The aforementioned factors (immune, genetic and environmental) influence to varying degrees the development and severity of this skin disease. Also, it is worth noting the relationship between psoriasis and other diseases [8,9]. Psoriasis is a systemic disease often associated with other conditions such as, for example, metabolic syndrome and cardiovascular disease [5, 8, 10, 11]. It is estimated that people with psoriasis live an average of five years less than healthy people. The most common cause of death in patients with psoriasis includes thromboembolic events and myocardial infarction [10,11].

Metabolic syndrome

In the group study, metabolic syndrome was diagnosed in 32% of patients with mild psoriasis, 36% of patients with moderate psoriasis, and up to 40% of patients with severe psoriasis [16]. Thus, metabolic syndrome is more likely to affect patients with moderate to severe psoriasis, especially those who appear at a young age [1, 16]. Pro-inflammatory cytokines and Th1 and Th17 lymphocytes play an important role in psoriasis. Cytokines such as IL-6, TNF- α , angiogenic factors and adhesion molecules are elevated in obesity, psoriasis and ischemic heart disease. Additionally, these inflammatory mediators have been shown to affect fat deposition, insulin action and lipid metabolism. Thus, the chronic inflammation of psoriasis can lead to diabetes, atherosclerosis and obesity. On the other hand, the production of inflammatory mediators accomplished by metabolic disturbances can trigger the manifestation of psoriatic lesions or exacerbate existing psoriatic symptoms [10, 17]. In patients with psoriasis, TNF- α is present in serum and skin lesions but not in healthy skin. TNF- α is also secreted in adipocytes and plays a role in the development of insulin resistance. Additionally, the presence of TNF- α leads to elevated blood concentrations of free fatty acids and triglycerides, which can cause atherogenic dyslipidemia [10, 18]. The elevated concentrations of IL-6 found in psoriatic lesions also play an important role in metabolic disturbances. It is produced three times more in visceral adipose tissue than in subcutaneous adipose tissue and is associated with the likelihood of developing type 2 diabetes. In addition, elevated levels of IL-6 have also been found in patients with unstable coronary artery disease [10, 18].

Obesity

Patients with psoriasis are more often overweight or obese than the general population [1, 19, 20]. In a meta-analysis of studies by Armstrong et al. [19], covering over 2,00,000 patients with psoriasis, it was calculated that those with psoriasis have a more than 50% higher risk of obesity than those without.



**Kalyani U. Chande and Nikhil S. Ekhande**

Among patients with more severe forms of psoriasis, the risk of obesity was higher compared to milder forms of the disease. Additionally, psoriasis patients with normal weight are at higher risk of developing obesity in the future [19]. Obesity promotes the development of psoriasis and aggravates its evolution. Psoriasis, on the other hand, increases the risk of obesity. Additionally, the risk of obesity increases with more severe disease; the risk of psoriatic arthritis increases with increasing BMI [1, 6, 10, 11, 14, 20]. A body mass index (BMI) >29 kg/m² has been observed to be associated with a more than doubled risk of psoriasis. In addition, the severity of psoriatic symptoms is correlated with the increase in BMI [1, 20]. BMI is not an ideal indicator to assess a patient's nutritional status because it does not take into account body composition and body fat distribution. Such parameters can be assessed, for example, using bioelectrical impedance (BIA) or dual energy X- ray absorptiometry (DXA). A study by Galluzzo et al. [21], performed a body composition analysis by bioelectrical impedance analysis on a group of 164 patients with psoriasis [22]. In this study, based on body fat percentage, BMI of 50% of men and 5.5% indicates normal weight and a BMI of 50% of men and 50% indicates obesity or overweight women. This suggests that the BIA approach has a much greater diagnostic value than BMI alone.

Similar results were obtained by Diniz et al. [22]; still, in this study of 42 cases with psoriasis and 41 controls, body weight was measured by DXA. In both group studies, DEXA showed a higher prevalence of obesity relative to BMI and waist circumference.

Low energy diets in psoriasis

Obesity is responsible for systemic inflammation in the body, which exacerbates psoriasis symptoms [3]. However, it is unclear whether obesity is a consequence of psoriasis or a risk factor for the development of this skin condition. It is suggested that this relationship is a two-way street. Obesity is a predisposing factor for psoriasis and its exacerbation, and psoriasis promotes the development of obesity [3, 29]. It has been observed that a BMI>29 kg/m² more than doubles the risk of developing the disease, and weight loss helps to reduce serum inflammatory factors, significantly improving the evolution of the disease compared to subjects not following this diet at a faster regression of psoriatic lesions [1, 14, 30]. A randomized study by Jensen et al. [31] demonstrated that a low- calorie diet (800-1000 kcal/day) for up to 8 weeks contributed to weight loss (average of 15 kg) and to the reduction of lesions and even to the improvement of dermatology life quality index (DLQI) [31]. Additionally, in the following publication, Jensen et al. [32] presented the results of continuing the program for the next 48 weeks after stopping the low- calorie diet. The PASI (Psoriasis Area and Severity Index) was further reduced compared to the results obtained with an average of 90 kg immediately after the implementation of a hypocaloric diet [32]. Thus, in patients with psoriasis, a low calorie diet associated with regular physical activity and possibly psychological support aimed at motivating the patient that can complement their treatment [3, 4, 30, 34].

Choice of fatty acids

Choosing the right type of fat plays an important part in the diet of cases with psoriasis. A diet high in saturated fatty acids of animal origin increases the risk of cardiovascular disease. Conversely, intake of unsaturated fatty acids may help reduce the risk of neurometabolic diseases [11]. Monounsaturated fatty acids (MUFA), including oleic acid, protect lipoproteins and cell membranes from oxidative damage. Redundant abecedarian oil is a good source of oleic acid [29]. Polyunsaturated fatty acids (PUFA) cannot be synthesized by the body and must therefore come from food. This group of adipose acids is divided into omega-3 and omega-6 acids. Omega-3 fatty acids include: alpha-linoleic acid (ALA), eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA). Linoleic acid (LA) and arachidonic acid (AA) fall under the group of omega-6 acids [35].

Polyunsaturated adipose acids are involved in the conflation of anti-inflammatory or proinflammatory composites. Omega-3 acids are anti-inflammatory, while omega-6 family acids are pro-inflammatory [6, 14]. For example, eicosapentaenoic acid competes with arachidonic acid for binding to COX-2 (cyclooxygenase-2), which is a substrate for the synthesis of PGE₃ (3-series prostaglandins) and LTB₅ (series- 5 leukotrienes), they have anti-inflammatory effect. Omega-6 fatty acids have a stimulating effect on the synthesis of pro-inflammatory TNF α , IL-1 and IL-8 [14, 34, 36, 37]. Gamma-linoleic acid also belongs to the omega-6 family. However, it is the only drug in this group with



**Kalyani U. Chande and Nikhil S. Ekhande**

anti-inflammatory effects [14,34]. Patients with psoriasis should have a diet rich in omega-3 fatty acids and limited in omega-6 fatty acids [4]. The ratio of fatty acids consumed from the omega-3 and omega-6 families of acids should be balanced at 1:1:80 according to the national institutes of health group [38]. Other reports suggest that the ratio should be 1:3 to 1:5 [11, 14, 35].

Also in people with psoriasis, increased concentrations of EPA in the serum have been observed after the start of the consumption of large quantities of marine fish (salmon, mackerel, herring, sardines) and after improvement of the psoriatic lesions. Similar effects have been shown with EPA and DHA-rich fish oils, corn oil, and omega-3 acid supplementation [14, 34, 35]. Fish is a good source of omega-3 acids: eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and docosapentaenoic acid. Due to their beneficial anti-inflammatory, immunomodulatory and antioxidant effects, they should be included in the diet of patients with psoriasis [42, 43, 44]. Advise patients with psoriasis to consume products rich in omega-3 fatty acids. The daily intake of these fatty acids should be around 1-2 grams. These products include: fatty marine fish (herring, sardines, salmon, tuna, mackerel), seafood, vegetable oils (canola, flaxseed, nut oils) and tree nuts (mainly walnuts). In contrast, animal fats (saturated fatty acids) and industrial (trans) fats, such as those found in stick margarines, highly processed foods, and confectionery products, should be avoided [6, 14, 34, 35].

Choice of carbohydrate products

Excess consumption of simple sugars (glucose, fructose, sucrose) has been reported to lead to an exacerbation of psoriasis symptoms [9]. Additionally, the combination of simple sugars and omega-3 acids may reduce the beneficial health effects of these types of fats [35]. A high intake of simple carbohydrates can lead to increased oxidative stress and exacerbate the course of psoriasis [4, 9, 29]. Dietary fibre has intestinal and systemic anti-inflammatory effects, has a favourable effect on the intestinal microbiota and also contributes to weight loss due to the lower energy density of high-fibre diets [9]. Foods with a low glycemic index or load (whole grains, unprocessed vegetables, and selected fruits) are recommended, primarily because people with psoriasis are more prone to metabolic diseases (eg, diabetes, resistance to insulin) [9]. Carbohydrate products with a high glycemic index (such as refined sugar, sweets, honey, sugary drinks, fruit preparations, certain fruits, white bread, plain pasta, white rice, and potatoes) should be limited in the diet of cases with psoriasis [9, 14].

Diet and use of medication

The diet of patients with psoriasis must also be adapted to their treatment. The use of methotrexate helps to increase the concentration of toxic homocysteine and lower blood levels of folic acid. Additionally, a deficiency in this vitamin has also been linked to high levels of homocysteine. Patients taking methotrexate should start folic acid supplementation, usually at a dose of 10 to 15 mg/week. Supplementation regimens vary, but vitamins should always be given at least 12 or 24 hours after methotrexate due to the risk of reducing drug efficacy [30]. This is possible because methotrexate is administered once a week. It should be kept in mind that the bioavailability of folate is reduced when taken with food. Supplementation of this vitamin in people taking methotrexate may also help alleviate other adverse drug effects related to the bone marrow, gastrointestinal tract, and liver. Cyclosporine may increase the risk of high blood pressure. In one study, patients who started treatment with this drug followed a low-sodium diet and a high-sodium diet. After four months of treatment with a low sodium diet, there was no increase in blood pressure, whereas, during the subsequent period when patients were treated with a high sodium diet, blood pressure was increased significantly [30]. The administration of cyclosporine with grapefruit juice increases the bioavailability of the drug by up to 60%. Therefore, patients taking this medication should avoid grapefruit juice, grapefruit, and other citrus fruits [6, 14, 30].

Vitamin A derivatives are also used in the treatment of psoriasis. It should be kept in mind that this can lead to hypervitaminosis, especially in patients who decide to supplement with vitamins and take large amounts of products rich in vitamin A. Retinoids also cause an increase in serum levels of cholesterol and triglycerides. It is therefore recommended to consume products rich in polyunsaturated fatty acids and omega-3 families and to limit the consumption of simple sugars and alcohol [14].



**Kalyani U. Chande and Nikhil S. Ekhande****Alcohol and exacerbation of psoriatic lesions**

Studies have shown that people with psoriasis tend to drink alcohol more frequently. However, it has not been definitively determined whether the prevalence of psoriasis is associated with the prevalence of alcohol dependence [1, 6, 14]. Furthermore, it is unclear whether the reduced quality of life of patients with psoriasis leads to excessive alcohol consumption or whether alcohol consumption triggers psoriasis symptoms [1, 5]. However, it has been noted that alcohol consumption can exacerbate psoriatic lesions [6, 14]. The mechanisms by which alcohol negatively affects the course of psoriasis are not fully understood. This effect may be the result of oxidative stress. Another hypothesis points to the effects of the overproduction of histamine, as well as vasodilation and therefore increased migration of inflammatory cells. Additionally, alcohol can increase susceptibility to skin infections such as infection of streptococcus bacteria, which can cause the appearance of psoriatic skin symptoms [9, 14]. It should also be noted that alcohol consumption is often accomplished by meals rich in saturated fatty acids and low consumption of vegetables and fruits. This diet can lead to the worsening of disease symptoms [6, 14].

CONCLUSION

Unfortunately, no specific nutritional regimen for psoriasis has been established. However, numerous studies have confirmed the positive effects of consuming or eliminating the above nutrients and foods. When planning the diet of patients with psoriasis, it is also important to consider commodities and take steps to prevent diseases to which these individuals are predisposed [29]. The diet of a patient with psoriasis must be varied and adapted to each patient. Eat plenty of vegetables and fruits, which are sources of antioxidants as well as vegetable oils, nuts and sea fish, which provide omega-3 fatty acids. They should choose whole-grain cereal products and increase their consumption of legumes. In some cases, patients should consider a gluten-free diet and vitamin D supplementation [14, 29, 34]. Patients choosing correct and consistent dieting have a positive impact not only on the course and prognosis of psoriasis but also on comorbidities. [3, 14, 29]

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**Kalyani U. Chande and Nikhil S. Ekhande**

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**Kalyani U. Chande and Nikhil S. Ekhande**

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Machine Learning Algorithms for Healthcare Data Analysis

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ABSTRACT

Machine learning plays a vital role in healthcare domain, especially in cases where deficiencies are incurable. However, various learning approaches taken in machine learning have several issues like domain-specificity model, class imbalanced data sets, voluminous datasets, missing values, outliers, etc. for developing an efficient in healthcare data analysis. In the context of medical domain, some standard supervised learning algorithms used for healthcare data analysis are presented in this paper. The primary aim of this research work is to briefly discussed about the Machine Learning algorithms in healthcare data analysis, its advantages, disadvantages, and performance metrics for analysis.

Keywords:KNN, Random Forest, Logistic Regression, SVM, Naïve Bayes, Neural Network

INTRODUCTION

Machine learning provides tools for intelligent data analysis. It is feasible to develop models that accurately diagnose a person suffering from a specific mistake. To be intelligent, a model must learn in the same way as humans do, because intelligence is impossible without learning. In general, all that is required is a series of well-classified diagnosis cases, and the algorithms will provide, for example, a classifier that may be used to assist physicians in identifying a patient's problems. ML is a procedure that when applied to clinical datasets assists with identifying and analyzing infections powerfully. Machine Learning (ML)[1] has seen an unprecedented increase in applications that solve issues and automate in many fields. This is mainly owing to the expansion in available information, substantial advances in ML methods, and progress in computer capacities. There is no question that ML has been used to several





Sheeba et al.,

worldly and sophisticated network operation and management issues. Different ML surveys have been conducted for particular networking sectors or specific network technologies. ML allows a system to screen and infer data. It extends beyond only learning or extracting information to the use and improvement of knowledge through time and experience. Essentially, the objective of ML is to discover and use hidden patterns in "training" data. The learned patterns are utilized to evaluate new data to categorize or map it to the known groupings [14]. One of the most essential emerging technologies nowadays is machine learning. Algorithms that can learn from data are called machine learning algorithms. To improve machine learning, need to spend a small amount of time and money. Based on the machine's previous experiences, machine learning is all about creating new algorithms. The goal of ML is to make more accurate predictions that lead to better results. Machine learning techniques use a lot of computing power. Effective machine learning implementation allows healthcare workers to make better decisions, spot trends, and innovations, and improve the efficiency of research and clinical trials [16].

MACHINE LEARNING IN HEALTH CARE

Deep learning, neural networks, and machine learning are all subfields of artificial intelligence, but they aren't the whole thing. Applying artificial intelligence to a system so that it will be able to learn and improve itself, without having to be pre-programmed.

Supervised Learning (SL):

This type of machine learning takes what it has learned in the past and applies it to a new set of data. It looks at labelled examples to help it figure out how to do this. Outputs of an algorithm must already be known for this to work. The data that is being used to train the model must also be marked with correct answers. It looks at these answers to see how well the algorithm is doing. If it isn't doing well, the algorithm will learn from this and become more efficient. Supervised learning can take the form of classification or regression, respectively [3]. The prediction of outcomes can be obtained through classification "Yes" or "No". Regression answers "How much" and "How many".

Unsupervised Learning (UL)

In unsupervised learning, you use data that doesn't have any labels from the past. A correct answer won't be given to the model. During execution, the algorithm should be able to learn new things on the fly. Clustering, anomaly detection, NN, and more are examples of unsupervised learning algorithms. In unsupervised learning, cluster analysis is by far the most typical approach. When conducting this kind of analysis, the goal is to search the data for patterns or groups [3].

Semi-supervised Learning

During this type of learning, you don't have to be told what to do. This is used when the problems need both supervised and unsupervised learning to be solved at the same time. There are two types of learning: one that uses data with labels, and the other that doesn't. Semi-supervised learning is the middle one. It uses both data with and without labels.

Reinforcement Learning

A reward and punishment system were used to help train the algorithm in this type of learning, and it worked. In this learning, the model will get points for doing things right and get points for doing things wrong, so it will learn the most by getting the most points and the least points. In a contrast to human intelligence, artificial intelligence is the intelligence of machines, not the intelligence of people. Artificial Intelligence is when machines act like humans when they analyze and learn. A person who has this kind of intelligence is called a machine learner. It's like AI is made up of algorithms. An artificial neural network is a type of conceptual framework that runs AI algorithms [18]. There will be weighted communication between the channels in the same way that the human brain is a network of neurons, and it will work in the same way. They use AI to look for connections between techniques for treating or preventing diseases and the health of patients. AI is mostly used for things like diagnosis procedures, treatment protocol expansion, drug progress, modified medicine and it can also be used for other things. Over the past few



**Sheeba et al.,**

years, there has been an increase in the number of applications of machine learning in the field of medicine. In a diverse array of sub-fields within the medical industry, ML is currently supplying a wealth of diagnostic aids and approaches [5].

MACHINE LEARNING TECHNIQUES IN HEALTH CARE DATA ANALYSIS

Machine learning relies on data. Relevant data will lead to more accurate clinical decisions in healthcare [17]. It is the foundation of any model. The algorithms of machine learning are used to mine actionable insights from healthcare data in order to make excellent clinical diagnostic decision. In this regard, till date several standard learning methods like Naïve Bayes, Support Vector Machine, K-Nearest Neighbour, Neural Network, Decision Trees, Logistic Regression, Random Forests, etc. have been developed.

Naïve Bayes (NB)

NB is a classification learning method based on Bayes theorem. The Bayes theorem works on the principle of probability theory and mathematical statistics. That is the reason why Bayesian classifiers are known as probabilistic learning classifiers. In fact, it is a form of statistical classifiers. NB deals with both type of classification problems namely, binary and multiclass problems. Naïve Bayes (NB) classifier determine the class membership probabilities on the basis of given class label. The main limitation of Naïve Bayes is the assumption of independent predictor. This method does not hold any dependency between any two features (attributes) having the same class [20]. Naïve Bayes is somewhat similar to Support Vector Machine (SVM) however, it takes advantages of statistical methods.

Advantages

- This classifier is easy for fast prediction.
- Naïve Bayes (NB) perform well in multiclass problem.
- It is better suited for categorical data in comparison to numeric data.

Disadvantages

- NB fails to find a relationship between feature.
- This technique is unable to handle continuous data.

Support Vector Machine (SVM)

SVM is a supervised learning technique used in classification and prediction. This method is mostly suitable for those classification problems which are of linear as well as non-linear nature. Non-linear data are generally classified using this approach. Specifically, SVM employs a non-linear function (kernel function) to convert the original training data from low dimensional space to higher dimensional space. Then, it identifies the linear optimal hyperplane as a decision boundary [9] to separate the training set into two classes. Kernel function can be considered as a tuning parameter in the support vector machine model. The kernel function is used to transform the non-linear separable problem into a separable problem. With the help of the kernel function, data from two classes can always be separated by a hyperplane. The SVM finds this hyperplane for data separation using small subset of the training data (feature vector) called support vectors [11]. The SVMs classifiers are linear, binary and non-probabilistic in nature that divides the unseen data instances into two classes. As a binary classifier, pair-wise classifications are useful for dealing with the multiclass problem, but it takes a lot of time. SVM is considered as a black box technique since there are many unknown parameters which are difficult to analyse, interpret and predict.

Advantages

- Overfitting is less observed compared to other models.
- SVM classifier predictive power is fast.
- The accuracy of SVM is usually quite high.
- Small datasets are the best candidates for SVM.





Sheeba et al.,

Disadvantages

- It suffers from a lack of transparency of results due to black box approach.
- Handling multiclass problem is time consuming.
- Training time is more while computing large datasets

Decision Tree (DT)

In the family of supervised machine, DT make use of an inductive inference mechanism for predictions [13]. Decision Tree learning is a technique for estimating complicated target functions wherein the learned function is defined by a decision tree. Decision tree learning is applicable for both classification and regression tasks in data analytics. The term "Classification and Regression Tree" (CART) can represent both the tasks. In the healthcare industry, the decision tree is applied to an enormous range of medical applications like predicting the disease, building a clinical decision support system, medical image diagnosis using deep learning techniques, etc.

Neural Networks (NN)

Neural Network (NN) is based on the principle of supervised learning process. In Machine Learning, neural networks are artificial networks that act similar to human nervous system. In this model, the input nodes are present in an input layer whereas the output nodes are in an output layer. The other nodes appear in one or more hidden layers. The edge indicates the activation value. In simple words, the three different neural network layers are the input layer, the hidden layer and the output layer [8]. Typically, neural network performs three types of function namely, error-function, search-function and update-function. For a given set of inputs, the error-function is used to evaluate the output quality (excellent or poor). The search function identifies the regions where changes can be made to reduce error rates. This is an iterative process that will improve the performance of the algorithm [8]. The learning algorithms based on Neural Network (NNs) are remarkably useful to address those problems whose solutions are hard to define, and which are difficult to model using logical analysis and standard software. Several neural network models are designed for supervised classification. Most neural networks (NNs) take advantages of the back propagation multilayer feed forward method.

Advantages

- Neural networks are very good for classification and regression tasks
- It also gives good results when the attribute values are categorical in nature.
- Neural network learning methods are quite robust to noise in the training data.
- They can handle well with incomplete/missing data

Disadvantages

- Training times can be excessive and tedious in functioning neural network.
- Neural computing usually requires large amounts of training and test data.
- The knowledge is implicit.

Logistic Regression (LR)

Logistic regression widely used in classification problems [15] and it can be applied with multiclass classification. In logistic regression, the likelihood P of dichotomous occurrence can be thought of as arising from the Bernoulli experiment and can be correlated with investigating the event. In healthcare, logistic regression was mainly used as a disease prediction model for heart failure disease, chronic disease and diabetes disease. The relationship between two variables, one being independent and the other being dependent, can be modelled and predicted using regression analysis [19]. Regression can be classified as logistic or linear. The Logistic Regression (LR) requires a discrete value whereas linear regression requires a continuous value.

Advantages

- The training of logistic regression is quite efficient as well as simple to implement and analyse.
- It efficiently classifies records that are unknown.





Sheeba et al.,

Disadvantages

- The assumption that the dependent variable and the independent variables are linear relationships is the main drawback of logistic regression.
- If there are fewer data than features, it shouldn't be used because overfitting might occur.
- It only functions to predict discrete functions.
- It cannot address non-linear problems since it has a linear decision surface.

K-Nearest Neighbour (KNN)

KNN algorithm is a basic supervised learning approach which used in both regression and classification predictive problems. The fundamental concept behind the KNN technique is very simple. As a matter of fact, instances are classified according to the class of their closest neighbours. In this case, taking more than one immediate neighbour (say K) is often advantageous, and that is why the technique is known as KNN. However, it is computationally expensive to run KNN because it requires high memory storage for testing and training data set [19]. Specifically, the distance between the seen and unseen examples is calculated with the help of distance measure method. The most common method used for calculating distance measures is Euclidean distance criterion. To classify unseen examples (based on distance measure), the seen examples that result in minimum distance from the unseen example are selected. Basically, two stages have been implemented in K-Nearest Neighbour. The selection of the excellent neighbours is done in the first stage, whereas the next stage is used to determine the class based on distances between those selected neighbours. Notably, mode value can be used for classification and mean value for regression purposes.

Advantages

- The classification and regression problem has no training time.
- Tuning hyperparameters is simple.

Disadvantages

- Sensitive to outliers.
- KNN assumes equal importance to all features.
- The performance of KNN is poor for large datasets.

Random Forest (RF)

RF are ensemble learning techniques that are used for grouping and relapse. These techniques function through the construction of a multi-hub of DT at the time of preparation, as well as through the method of the classes or mean expectation of the particular trees. A tendency toward overfitting the preparation set is addressed by randomizing the order of the components. The RF calculation is a type of supervised calculation known as characterization. A remarkable character calculation that can order a great deal of information with high precision is called the Random Forests calculation. Random Forest is a gathering learning strategy (it's a type of the closest neighbour indicator) for arrangement and relapse that develops a few numbers of decision trees during the time spent preparing, and then, after everything was said and done, the category that had the greatest number of votes will be considered as the indicator's result. Random Forest is a type of the closest neighbor indicator [2].

Advantages

- It lessens decision tree over fitting and enhances accuracy.
- It can handle classification and regression issues with ease.
- It functions effectively with both continuous and categorical variables.

Disadvantages

- It uses a lot of resources and computer power to create several trees and integrate the results of those trees.
- The ensemble of decision trees causes it to have interpretability problems as well as the inability to determine the relative relevance of each variable.





Sheeba et al.,

HEALTHCARE DATA COLLECTION

The medical data in healthcare are different forms (i.e.text, numeric, image and video)and heterogeneous (sensor data, clinical reports, EHR, radiology notes, doctorprescription, etc.) in nature and analysis on each form of health data have theirlimitations and challenges. In the sensor data analysis, the data are numeric and themajor problem in analyzing these sensor data is the presence of redundant data, outliersand lack of semantic interoperability. In the process of disease diagnosis using EHR,machine learning-based predictive models are deployed but missing values andirrelevant data in EHR degrade the performance of predictive models. The CT scanimages are major contributions in the detection of liver cancer but variable sizes andshapes of tumors are difficult to identify. Video-based human activity recognitionsystems in healthcare are facing the issue of recognizing minor actions of the people [4].

PERFORMANCE METRICS

The evaluation of the learned classifiers is an important stage in machine learning. There are many measures [6] available for assessing the success of learning systems. They essentially assess how accurately a classifier predicts the outcome. These metrics are, in order, precision, accuracy, sensitivity, and accuracy. From the experimental data taken from a confusion matrix, the learners' performance may be evaluated. To display the precision of a result to a specific classification problem, a confusion matrix is utilized.

Precision and Accuracy

The degree to which a value obtained is reasonably close to its true value is referred to as accuracy. How closely all of the measured values are related to one another is referred to as precision. To phrase this another way, accuracy refers to the proportion of correct categories relative to the total number of classifications [8].

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

$$\text{Accuracy} = \frac{\text{True Positive} + \text{True Negative}}{\text{True Positive} + \text{True Negative} + \text{False Positive} + \text{False Negative}}$$

Recall/Sensitivity

The term "sensitivity" refers to the proportion of genuine positive results relative to the overall number of positive outcomes. In a similar vein, specificity, also referred to as the true negative rate, is the ratio of authentic negatives to the sum of all negatives. Simply put, if one hundred pictures of pneumonia and expect that ninety of them will be pneumonia(true positives), then can say that the sensitivity is ninety percent [10].

$$\text{Recall/Sensitivity} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}$$

F1-Score

When the accuracy of a model is greater than 90%, that model is regarded as being accurate. However, the results of the pneumonia tests for 10% of patients are incorrect, which results in an excessive cost. As a consequence of this, include the F1-score, which is a statistic that offers a more accurate representation of the number of instances that have beenincorrectly classified. In order to compute this, the harmonic mean of the precision and recall values is utilized. Accuracy is utilized when both true positives and true negatives are considered to be more significant. The F1-score is a superior statistic to use when the class distribution is unequal and when the importance of minimizing false positives and false negatives is increased.

$$\text{F1 Score} = \frac{(2 \times \text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}}$$

ROC Curve

A receiver operating characteristics curve, also known as a ROC curve, is a graphical representation of the sensitivity (TP rate) in comparison to the false positive rate (FP rate) (1 - specificity). The numbers that are found above and below the line, respectively, indicatethe classification results with the highest and lowest scores [11].



**Sheeba et al.,****Confusion Matrix**

A Confusion Matrix is a tabular representation of predicted outcomes with count values broken down by class in a classification problem. As the name suggests, it shows how a categorization model functions while making predictions. Both the faults themselves and the categories of errors the classifier committed are disclosed.

COMPARATIVE ANALYSIS OF ML ALGORITHMS**PIMA Diabetes Dataset**

The National Institute of Diabetes and Digestive and Kidney Diseases is the original source of this dataset. A single goal (dependent) variable and a number of medical predictor (independent) variables constitute the datasets. Independent variables include the number of pregnancies the patient has had, their BMI, insulin level, age, diabetes pedigree, skin thickness, plasma glucose, blood pressure and number of times pregnancies.

Heart Disease Dataset

The Heart Disease dataset in the UCI repository database contains 76 attributes, but only a subset of 14 of them are used in all published research works and experiments. The subset of the heart disease dataset consists of age, sex, chest pain, serum cholesterol, fasting blood sugar, rest ECG and so on.

Kidney Disease Dataset

The chronic Kidney data set in the UCI repository is commonly used to predict chronic kidney disease. This data includes the patient's primary health information and it was collected from the hospital for nearly 2 months of period. The dataset consists of 24 attributes and one class variable. It contains a total instance of 400 rows.

Table 1 depicts the classification results for PIMA Diabetes Dataset. From this table, it is observed that the neural network achieves 0.89% accuracy. Figure 2 illustrates the pictorial representation of classification results of PIMA diabetes dataset. Table 2 depicts the classification results for heart disease dataset. From this table, it is observed that the neural network achieves 0.92% accuracy. Figure 3 illustrates the pictorial representation of classification results of heart disease dataset. Table 3 depicts the classification results for kidney disease dataset. From this table, it is observed that the neural network achieves 0.94% accuracy. Figure 4 illustrates the pictorial representation of classification results of kidney disease dataset. This paper presents a comprehensive review of medical data analysis using the machine learning techniques over the recent decades with their merits and limitations. It demonstrates the potential and significance of machine learning in healthcare data analysis. Additionally, this paper compared the machine learning algorithms such as Naïve Bayes, Support Vector Machine, K-Nearest Neighbour, Neural Network, Decision Trees, Logistic Regression, and Random Forests. The comparative analysis shows the performance of each algorithm with various parameters. The algorithms are performed well and have very slight difference of each other. This research work will be useful for the researchers who are working under healthcare data mining and machine learning.

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Table 1 Comparison of Machine Learning Algorithms using PIMA Diabetes Dataset

Algorithm	Accuracy	Precision	Recall	F1score	Specificity	Sensitivity	ROC
NB	0.85	0.85	0.93	0.92	0.90	0.93	89.15
SVM	0.86	0.86	0.92	0.87	0.87	0.92	88.30
KNN	0.88	0.88	0.97	0.83	0.87	0.97	90
NN	0.89	0.89	0.93	0.96	0.90	0.93	90.83
DT	0.85	0.85	0.89	0.91	0.89	0.89	85.71
LR	0.84	0.84	0.80	0.85	0.85	0.80	84.71
RF	0.82	0.82	0.77	0.80	0.81	0.77	0.80

Table 2. Comparison of Machine Learning Algorithms using heart disease dataset

Algorithm	Accuracy	Precision	Recall	F1score	Specificity	Sensitivity	ROC
NB	0.88	0.88	0.96	0.95	0.93	0.96	0.92
SVM	0.89	0.89	0.95	0.9	0.9	0.95	0.91
KNN	0.91	0.91	0.95	0.86	0.9	0.95	0.93





Sheeba et al.,

NN	0.92	0.92	0.96	0.95	0.93	0.96	0.93
DT	0.88	0.88	0.92	0.94	0.92	0.92	0.88
LR	0.87	0.87	0.83	0.88	0.88	0.83	0.87
RF	0.85	0.85	0.8	0.83	0.84	0.8	0.83

Table 6.3 Comparison of Machine Learning Algorithms using Kidney dataset

Algorithm	Accuracy	Precision	Recall	F1score	Specificity	Sensitivity	ROC
NB	0.9	0.9	0.98	0.97	0.95	0.98	0.94
SVM	0.91	0.91	0.97	0.92	0.92	0.97	0.93
KNN	0.93	0.93	0.97	0.88	0.92	0.97	0.95
NN	0.94	0.94	0.98	0.97	0.95	0.98	0.95
DT	0.9	0.9	0.94	0.96	0.94	0.94	0.9
LR	0.89	0.89	0.85	0.9	0.9	0.85	0.89
RF	0.87	0.87	0.82	0.85	0.86	0.82	0.85

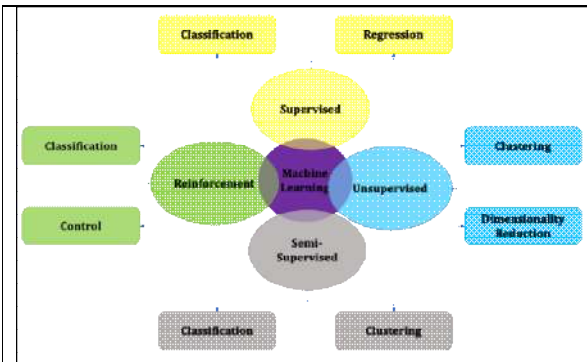


Figure 1. Machine Learning Techniques

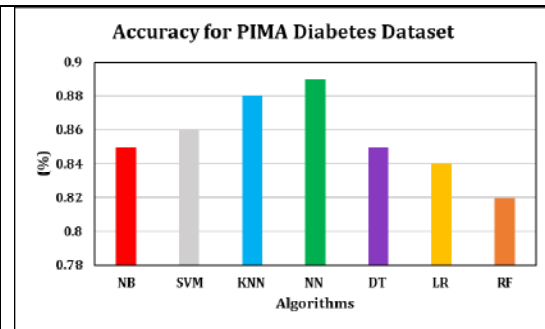


Figure 2. Accuracy for PIMA Diabetes Dataset

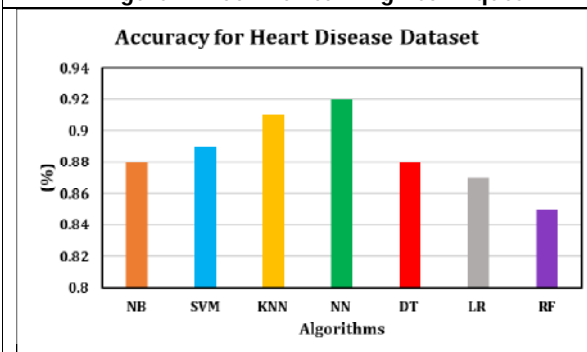


Figure 3 Accuracy for Heart Disease Dataset

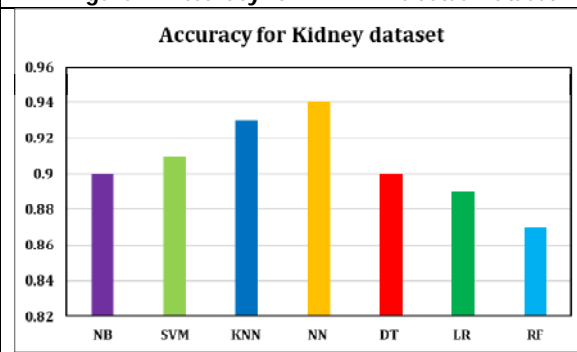


Figure 4. Accuracy for Kidney Dataset





A New Extension of Quasi Suja Distribution with Properties and Applications

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ABSTRACT

In this paper, a new version of quasi Suja distribution called as length biased quasi Suja distribution has been proposed. Its various statistical properties including moments, survival analysis, order statistics, bonferroni and Lorenz curves have been discussed. For estimating its parameters, the method of maximum likelihood estimation has been used. Finally, a real life data set has been analysed for investigating the usefulness of a new distribution.

Keywords: Weighted distribution, Quasi Suja distribution, Survival analysis, Order statistics, Maximum likelihood estimation.

INTRODUCTION

The concept of weighted distributions provide a technique for fitting model to the unknown weight function when the samples can be taken both from original and developed distribution. The concept of weighted distribution arise when the observations are recorded by an investigator in the nature according to certain stochastic model, the distribution of recorded observation will not have the original distribution unless each and every observation is given an equal chance of being recorded instead they are recorded according to some weight function. The concept of weighted distribution was proposed firstly by Fisher (1934) to study how the method of ascertainment can influence the form of distribution of recorded observation and later Rao (1965) formalized it in general terms in connection with modeling statistical data when the usual practice of using standard distributions was found to be





Rekha Radhakrishn and Venkatesan

unsuitable. The weighted distributions reduce to length biased distribution when the weight function considers only the length of units of interest. Length biased distributions is a special case of weighted distributions. The practical significance of weighted distributions were some types of bias occur in a density function, i.e., probability is proportional to the size of the variate that's why the proposed version of length biased distribution is designed for such situation more reasonably and more precisely. The concept of length biased sampling was first introduced by Cox (1969) and Zelen (1974). The statistical interpretation of weighted and size biased distributions was originally identified by Buckland and Cox (1964) in the context of renewal theory.

Many authors have studied and developed some important weighted probability models along with their applications in different fields. Subramanian, Kumar and Jenson (2019) studied the length biased Odoma distribution with properties and applications. Mudasir and Ahmad (2015) discussed on the structural properties of length biased Nakagami distribution. Das and Roy (2011) introduced the length biased weighted weibull distribution. Subramanian and Shenbagaraja (2019) studies length biased Rama distribution with bladder cancer data. Al-omari et al. (2019) proposed size biased Ishita distribution and application to real data. Atikankul et al. (2020) executed the length biased weighted Lindley distribution with applications. Saghir et al. (2016) investigated the length biased weighted exponentiated inverted Weibull distribution for lifetime data. Ganaie and Rajagopalan (2020) studies the length biased weighted quasi gamma distribution with characterizations and applications. Reyad, Othman and Moussa (2017) studies the length biased weighted erlang distribution. Recently, Chaito et al. (2022) introduced the length biased Gamma-Rayleigh distribution with applications.

Quasi Suja distribution is a two parametric lifetime probability model introduced by Shanker et al. (2022) which is a particular case of one parameter Suja distribution. Its different statistical properties including moments, skewness, kurtosis, hazard rate function, mean residual life function, stochastic ordering, mean deviations, Bonferroni and Lorenz curves, Renyi entropy measure and stress strength reliability have been derived and studied. The method of moments and maximum likelihood estimation has been used for estimating the parameters of proposed quasi Suja distribution. Suja distribution is a one parametric lifetime distribution proposed by Shanker (2017) introduced its various statistical properties and estimate its parameters through the method of moments and maximum likelihood estimation.

Length Biased Quasi Suja (LBQS) Distribution

The probability density function of quasi Suja distribution is given by

$$f(x; \theta, \alpha) = \frac{\theta^4}{\alpha\theta^3 + 24} \left(\alpha + \theta x^4 \right) e^{-\theta x}; \quad x > 0, \theta > 0, \alpha > 0 \quad (1)$$

and the cumulative distribution function of quasi Suja distribution is given by

$$F(x; \theta, \alpha) = 1 - \left(1 + \frac{\theta^4 x^4 + 4\theta^3 x^3 + 12\theta^2 x^2 + 24\theta x}{\alpha\theta^3 + 24} \right) e^{-\theta x}; \quad x > 0, \theta > 0, \alpha > 0 \quad (2)$$

Suppose X is a non-negative random variable with probability density function $f(x)$. Let $w(x)$ be its non-negative weight function, then the probability density function of weighted random variable X_w is given by

$$f_w(x) = \frac{w(x)f(x)}{E(w(x))}, \quad x > 0.$$

Where $w(x)$ be the non - negative weight function and $E(w(x)) = \int w(x)f(x)dx < \infty$.

Weighted models are of various choices when $w(x) = x^c$, the resulting distribution is called weighted distribution. In this paper, we have to obtain the length biased version of quasi Suja distribution. Consequently at $w(x) = x$, resulting distribution is called length biased distribution with probability density function given by





Rekha Radhakrishn and Venkatesan

$$f_l(x) = \frac{xf(x)}{E(x)} \tag{3}$$

Where $E(x) = \int_0^{\infty} xf(x; \theta, \alpha) dx$

$$E(x) = \frac{\alpha\theta^3 + 120}{\theta(\alpha\theta^3 + 24)} \tag{4}$$

Substituting the equations (1) and (4) in equation (3), we will obtain the probability density function of length biased quasi Suja distribution as

$$f_l(x) = \frac{x\theta^5}{\alpha\theta^3 + 120} (\alpha + \theta x^4) e^{-\theta x} \tag{5}$$

and the cumulative distribution function of length biased quasi Suja distribution can be obtained as

$$F_l(x) = \int_0^x f_l(x) dx$$

$$F_l(x) = \int_0^x \frac{x\theta^5}{\alpha\theta^3 + 120} (\alpha + \theta x^4) e^{-\theta x} dx$$

$$F_l(x) = \frac{1}{\alpha\theta^3 + 120} \int_0^x x\theta^5 (\alpha + \theta x^4) e^{-\theta x} dx$$

$$F_l(x) = \frac{1}{\alpha\theta^3 + 120} \left(\alpha\theta^5 \int_0^x x e^{-\theta x} dx + \theta^6 \int_0^x x^5 e^{-\theta x} dx \right) \tag{6}$$

After the simplification of equation (6), we will obtain the cumulative distribution function of length biased quasi Suja distribution as

$$F_l(x) = \frac{1}{\alpha\theta^3 + 120} (\alpha\theta^3 \gamma(2, \theta x) + \gamma(6, \theta x)) \tag{7}$$

Survival Analysis

In this section, we will discuss about the survival function, hazard rate and reverse hazard rate functions of length biased quasi Suja distribution.

Survival function

The survival function of length biased quasi Suja distribution can be obtained as

$$S(x) = 1 - F_l(x)$$

$$S(x) = 1 - \frac{1}{\alpha\theta^3 + 120} (\alpha\theta^3 \gamma(2, \theta x) + \gamma(6, \theta x))$$





Hazard function

The hazard function is also known as failure rate or force of mortality and is given by

$$h(x) = \frac{f_l(x)}{1 - F_l(x)}$$

$$h(x) = \frac{x\theta^5(\alpha + \theta x^4)e^{-\theta x}}{(\alpha\theta^3 + 120) - (\alpha\theta^3\gamma(2, \theta x) + \gamma(6, \theta x))}$$

Reverse hazard function

The reverse hazard function is given by

$$h_r(x) = \frac{f_l(x)}{F_l(x)}$$

$$h_r(x) = \frac{x\theta^5(\alpha + \theta x^4)e^{-\theta x}}{(\alpha\theta^3\gamma(2, \theta x) + \gamma(6, \theta x))}$$

Statistical Properties

In this section, we will discuss various statistical properties of length biased quasi Suja distribution including moments, harmonic mean, MGF and characteristic function.

Moments

Let X be the random variable following length biased quasi Suja distribution with parameters θ and α , then the r^{th} order moment of proposed model can be obtained as

$$E(X^r) = \mu_r' = \int_0^\infty x^r f_l(x) dx$$

$$E(X^r) = \int_0^\infty x^r \frac{x\theta^5}{\alpha\theta^3 + 120} (\alpha + \theta x^4) e^{-\theta x} dx$$

$$E(X^r) = \frac{\theta^5}{\alpha\theta^3 + 120} \int_0^\infty x^{r+1} (\alpha + \theta x^4) e^{-\theta x} dx$$

$$E(X^r) = \frac{\theta^5}{\alpha\theta^3 + 120} \left(\alpha \int_0^\infty x^{(r+2)-1} e^{-\theta x} dx + \theta \int_0^\infty x^{(r+6)-1} e^{-\theta x} dx \right) \tag{8}$$

After the simplification of equation (8), we obtain

$$E(X^r) = \mu_r' = \frac{\alpha\theta^3\Gamma(r+2) + \Gamma(r+6)}{\theta^r(\alpha\theta^3 + 120)} \tag{9}$$

By putting $r = 1, 2, 3$ and 4 in equation (9), we will obtain the first four moments of length biased quasi Suja distribution as

$$E(X) = \mu_1' = \frac{2\alpha\theta^3 + 720}{\theta(\alpha\theta^3 + 120)}$$





Rekha Radhakrishn and Venkatesan

$$E(X^2) = \mu_2' = \frac{6\alpha\theta^3 + 5040}{\theta^2(\alpha\theta^3 + 120)}$$

$$E(X^3) = \mu_3' = \frac{24\alpha\theta^3 + 40320}{\theta^3(\alpha\theta^3 + 120)}$$

$$E(X^4) = \mu_4' = \frac{120\alpha\theta^3 + 362880}{\theta^4(\alpha\theta^3 + 120)}$$

$$\text{Variance} = \frac{6\alpha\theta^3 + 5040}{\theta^2(\alpha\theta^3 + 120)} - \left(\frac{2\alpha\theta^3 + 720}{\theta(\alpha\theta^3 + 120)} \right)^2$$

$$S.D(\sigma) = \sqrt{\frac{6\alpha\theta^3 + 5040}{\theta^2(\alpha\theta^3 + 120)} - \left(\frac{2\alpha\theta^3 + 720}{\theta(\alpha\theta^3 + 120)} \right)^2}$$

Harmonic mean

The harmonic mean of proposed distribution can be obtained as

$$H.M = E\left(\frac{1}{x}\right) = \int_0^\infty \frac{1}{x} f_l(x) dx$$

$$H.M = \int_0^\infty \frac{\theta^5}{\alpha\theta^3 + 120} (\alpha + \theta x^4) e^{-\theta x} dx$$

$$H.M = \frac{\theta^5}{\alpha\theta^3 + 120} \int_0^\infty (\alpha + \theta x^4) e^{-\theta x} dx$$

$$H.M = \frac{\theta^5}{\alpha\theta^3 + 120} \left(\alpha \int_0^\infty e^{-\theta x} dx + \theta \int_0^\infty x^{5-1} e^{-\theta x} dx \right)$$

After simplification, we obtain

$$H.M = \frac{\theta(\alpha\theta^2 + 24)}{\alpha\theta^3 + 120}$$

Moment Generating Function and Characteristic Function

Let X be a random variable following length biased quasi Suja distribution with parameters θ and α , then the MGF of X can be obtained as

$$M_X(t) = E(e^{tx}) = \int_0^\infty e^{tx} f_l(x) dx$$

Using Taylor series, we get

$$M_X(t) = \int_0^\infty \left(1 + tx + \frac{(tx)^2}{2!} + \dots \right) f_l(x) dx$$





$$M_X(t) = \int_0^\infty \sum_{j=0}^\infty \frac{t^j}{j!} x^j f_1(x) dx$$

$$M_X(t) = \sum_{j=0}^\infty \frac{t^j}{j!} \mu_j$$

$$M_X(t) = \sum_{j=0}^\infty \frac{t^j}{j!} \left(\frac{\alpha\theta^3\Gamma(j+2) + \Gamma(j+6)}{\theta^j(\alpha\theta^3 + 120)} \right)$$

$$M_X(t) = \frac{1}{(\alpha\theta^3 + 120)} \sum_{j=0}^\infty \frac{t^j}{j!\theta^j} (\alpha\theta^3\Gamma(j+2) + \Gamma(j+6))$$

Similarly, the characteristic function of length biased quasi Suja distribution can be obtained as

$$\varphi_X(t) = M_X(it)$$

$$M_X(it) = \frac{1}{(\alpha\theta^3 + 120)} \sum_{j=0}^\infty \frac{it^j}{j!\theta^j} (\alpha\theta^3\Gamma(j+2) + \Gamma(j+6))$$

Order Statistics

Let $X_{(1)}, X_{(2)}, \dots, X_{(n)}$ denote the order statistics of a random sample X_1, X_2, \dots, X_n drawn from a continuous population with probability density function $f_X(x)$ and cumulative distribution function $F_X(x)$, then the probability density function of r^{th} order statistics $X_{(r)}$ is given by

$$f_{X_{(r)}}(x) = \frac{n!}{(r-1)!(n-r)!} f_X(x) (F_X(x))^{r-1} (1 - F_X(x))^{n-r} \tag{10}$$

By using the equations (5) and (7) in equation (10), we will obtain the probability density function of r^{th} order statistics of length biased quasi Suja distribution as

$$f_{X_{(r)}}(x) = \frac{n!}{(r-1)!(n-r)!} \left(\frac{x\theta^5}{\alpha\theta^3 + 24} (\alpha + \theta x^4) e^{-\theta x} \right)$$

$$\times \left(\frac{1}{\alpha\theta^3 + 120} (\alpha\theta^3\gamma(2, \theta x) + \gamma(6, \theta x)) \right)^{r-1}$$

$$\times \left(1 - \frac{1}{\alpha\theta^3 + 120} (\alpha\theta^3\gamma(2, \theta x) + \gamma(6, \theta x)) \right)^{n-r}$$

Therefore, the probability density function of higher order statistic $X_{(n)}$ of length biased quasi Suja distribution can be obtained as





Rekha Radhakrishn and Venkatesan

$$f_{x(n)}(x) = \frac{nx\theta^5}{\alpha\theta^3 + 24}(\alpha + \theta x^4)e^{-\theta x} \times \left(\frac{1}{\alpha\theta^3 + 120}(\alpha\theta^3\gamma(2, \theta x) + \gamma(6, \theta x)) \right)^{n-1}$$

and the probability density function of first order statistic $X_{(1)}$ of length biased quasi Suja distribution can be obtained as

$$f_{x(1)}(x) = \frac{nx\theta^5}{\alpha\theta^3 + 24}(\alpha + \theta x^4)e^{-\theta x} \times \left(1 - \frac{1}{\alpha\theta^3 + 120}(\alpha\theta^3\gamma(2, \theta x) + \gamma(6, \theta x)) \right)^{n-1}$$

Likelihood Ratio Test

Let X_1, X_2, \dots, X_n be the random sample of size n drawn from the length biased quasi Suja distribution. To test the hypothesis

$$H_0 : f(x) = f(x; \theta, \alpha) \quad \text{against} \quad H_1 : f(x) = f_l(x; \theta, \alpha)$$

In order to examine, whether the random sample of size n comes from the quasi Suja distribution or length biased quasi Suja distribution, the following test statistic is to be used.

$$\Delta = \frac{L_1}{L_0} = \prod_{i=1}^n \frac{f_l(x_i; \theta, \alpha)}{f(x_i; \theta, \alpha)}$$

$$\Delta = \frac{L_1}{L_0} = \prod_{i=1}^n \left(\frac{x_i \theta(\alpha\theta^3 + 24)}{\alpha\theta^3 + 120} \right)$$

$$\Delta = \frac{L_1}{L_0} = \left(\frac{\theta(\alpha\theta^3 + 24)}{\alpha\theta^3 + 120} \right)^n \prod_{i=1}^n x_i$$

We should reject the null hypothesis, if

$$\Delta = \left(\frac{\theta(\alpha\theta^3 + 24)}{\alpha\theta^3 + 120} \right)^n \prod_{i=1}^n x_i > k$$

Equivalently, we should also reject the null hypothesis

$$\Delta^* = \prod_{i=1}^n x_i > k \left(\frac{\alpha\theta^3 + 120}{\theta(\alpha\theta^3 + 24)} \right)^n$$





Rekha Radhakrishn and Venkatesan

$$\Delta^* = \prod_{i=1}^n x_i > k^*, \text{ Where } k^* = k \left(\frac{\alpha\theta^3 + 120}{\theta(\alpha\theta^3 + 24)} \right)^n$$

For large sample of size n , $2\log \Delta$ is distributed as chi-square distribution with one degree of freedom and also chi-square distribution is used for obtaining the p value. Thus, we reject the null hypothesis, when the probability value is given by

$p(\Delta^* > \beta^*)$, Where $\beta^* = \prod_{i=1}^n x_i$ is less than a specified level of significance. Where $\prod_{i=1}^n x_i$ is the observed value of the statistic Δ^* .

Bonferroni and Lorenz Curves

The bonferroni and Lorenz curves are used in economics to study the distribution of inequality in income or poverty. The bonferroni and Lorenz curves are given by

$$B(p) = \frac{1}{p\mu_1'} \int_0^q xf(x)dx$$

$$L(p) = pB(p) = \frac{1}{\mu_1'} \int_0^q xf(x)dx$$

Where $\mu_1' = \frac{2\alpha\theta^3 + 720}{\theta(\alpha\theta^3 + 120)}$ and $q = F^{-1}(p)$

$$B(p) = \frac{\theta(\alpha\theta^3 + 120)}{p(2\alpha\theta^3 + 720)} \int_0^q \frac{x^2\theta^5}{\alpha\theta^3 + 120} (\alpha + \theta x^4) e^{-\theta x} dx$$

$$B(p) = \frac{\theta^6}{p(2\alpha\theta^3 + 720)} \int_0^q x^2 (\alpha + \theta x^4) e^{-\theta x} dx$$

$$B(p) = \frac{\theta^6}{p(2\alpha\theta^3 + 720)} \left(\alpha \int_0^q x^{3-1} e^{-\theta x} dx + \theta \int_0^q x^{7-1} e^{-\theta x} dx \right)$$

After simplification, we obtain

$$B(p) = \frac{\theta^6}{p(2\alpha\theta^3 + 720)} (\alpha \gamma(3, \theta q) + \theta \gamma(7, \theta q))$$

$$L(p) = \frac{\theta^6}{(2\alpha\theta^3 + 720)} (\alpha \gamma(3, \theta q) + \theta \gamma(7, \theta q))$$

Maximum Likelihood Estimation and Fisher's Information Matrix

In this section, we will discuss the maximum likelihood estimation method to estimate the parameters of length biased quasi Suja distribution. Let X_1, X_2, \dots, X_n be a random sample of size n from the length biased quasi Suja distribution, then the likelihood function can be written as





Rekha Radhakrishn and Venkatesan

$$L(x) = \prod_{i=1}^n f_i(x)$$

$$L(x) = \prod_{i=1}^n \left(\frac{x_i \theta^5}{(\alpha \theta^3 + 120)} (\alpha + \theta x_i^4) e^{-\theta x_i} \right)$$

$$L(x) = \frac{\theta^{5n}}{(\alpha \theta^3 + 120)^n} \prod_{i=1}^n (x_i (\alpha + \theta x_i^4) e^{-\theta x_i})$$

The log likelihood function is given by

$$\log L = 5n \log \theta - n \log(\alpha \theta^3 + 120) + \sum_{i=1}^n \log x_i + \sum_{i=1}^n \log(\alpha + \theta x_i^4) - \theta \sum_{i=1}^n x_i \tag{11}$$

By differentiating the log likelihood equation (11) with respect to parameters θ and α . We must satisfy the normal

equations as

$$\frac{\partial \log L}{\partial \theta} = \frac{5n}{\theta} - n \left(\frac{3\alpha \theta^2}{(\alpha \theta^3 + 120)} \right) + \sum_{i=1}^n \left(\frac{x_i^4}{(\alpha + \theta x_i^4)} \right) - \sum_{i=1}^n x_i = 0$$

$$\frac{\partial \log L}{\partial \alpha} = -n \left(\frac{\theta^3}{(\alpha \theta^3 + 120)} \right) + \sum_{i=1}^n \left(\frac{1}{(\alpha + \theta x_i^4)} \right) = 0$$

The above likelihood equations are too complicated to solve it algebraically, therefore we use R and wolfram mathematics for estimating the required parameters of the proposed distribution.

To obtain the confidence interval, we use the asymptotic normality results. We have that if $\hat{\beta} = (\hat{\theta}, \hat{\alpha})$ denotes the MLE of $\beta = (\theta, \alpha)$. We can state the results as follows.

$$\sqrt{n}(\hat{\beta} - \beta) \rightarrow N_2(0, I^{-1}(\beta))$$

Where $I^{-1}(\beta)$ is Fisher's information matrix. i.e.,

$$I(\beta) = -\frac{1}{n} \begin{pmatrix} E\left(\frac{\partial^2 \log L}{\partial \theta^2}\right) & E\left(\frac{\partial^2 \log L}{\partial \theta \partial \alpha}\right) \\ E\left(\frac{\partial^2 \log L}{\partial \alpha \partial \theta}\right) & E\left(\frac{\partial^2 \log L}{\partial \alpha^2}\right) \end{pmatrix}$$

Where

$$E\left(\frac{\partial^2 \log L}{\partial \theta^2}\right) = -\frac{5n}{\theta^2} - n \left(\frac{(\alpha \theta^3 + 120)(6\alpha \theta) - (3\alpha \theta^2)^2}{(\alpha \theta^3 + 120)^2} \right) - \sum_{i=1}^n \left(\frac{E(x_i^4)^2}{(\alpha + \theta x_i^4)^2} \right)$$





Rekha Radhakrishn and Venkatesan

$$E\left(\frac{\partial^2 \log L}{\partial \alpha^2}\right) = n\left(\frac{(\theta^3)^2}{(\alpha\theta^3 + 120)^2}\right) - \sum_{i=1}^n \left(\frac{1}{(\alpha + \theta x_i^4)^2}\right)$$

$$E\left(\frac{\partial^2 \log L}{\partial \theta \partial \alpha}\right) = -n\left(\frac{(\alpha\theta^3 + 120)(3\theta^2) - (\theta^3)(3\alpha\theta^2)}{(\alpha\theta^3 + 120)^2}\right) - \sum_{i=1}^n \left(\frac{E(x_i^4)}{(\alpha + \theta x_i^4)^2}\right)$$

Since β being unknown, we estimate $I^{-1}(\beta)$ by $I^{-1}(\hat{\beta})$ and this can be used to obtain asymptotic confidence intervals for θ and α .

Data Analysis

In this section, we have used real life data set for fitting length biased quasi Suja distribution in order to show that the length biased quasi Suja distribution fits better than the quasi Suja and Suja distributions. The real data set is given below in table 1 as. The following data set in table 1 represents the relief times (in minutes) of 20 patients receiving an analgesic reported by Gross and Clarke (1975) and the data set is given below as. In order to estimate the unknown parameters along with the model comparison criterion values, the R software technique is used. In order to compare the length biased quasi Suja distribution with quasi Suja and Suja distributions, we consider the criterions *AIC* (Akaike Information Criterion), *BIC* (Bayesian Information Criterion), *AICC* (Akaike Information Criterion Corrected) and $-2\log L$. The better distribution is which corresponds to the lesser values of *AIC*, *BIC*, *AICC* and $-2\log L$. For calculating the criterions following formulas are used.

$$AIC = 2k - 2\log L, \quad BIC = k \log n - 2\log L \quad \text{and} \quad AICC = AIC + \frac{2k(k+1)}{n-k-1}$$

Where k is the number of parameters in the statistical model, n is the sample size and $-2\log L$ is the maximized value of log-likelihood function under the considered model.

From results given above in table 2, it has been observed that the length biased quasi Suja distribution have the lesser *AIC*, *BIC*, *AICC* and $-2\log L$ values as compared to the quasi Suja and Suja distributions. Hence, it can be concluded that the length biased quasi Suja distribution leads to a better fit than the quasi Suja and Suja distributions.

CONCLUSION

In the present paper, a new generalization of quasi Suja distribution called as length biased quasi Suja distribution has been proposed. The proposed new distribution is generated by using the length biased technique to the baseline distribution. Its various structural properties including shape of the pdf and cdf, moments, harmonic mean, survival function, hazard function, moment generating function, order statistics, bonferroni and Lorenz curves have been discussed. For estimating its parameters, the technique of maximum likelihood estimation has been used. Finally, the newly proposed distribution has been demonstrated by using a real life data set and it is found from the results that the proposed length biased quasi Suja distribution provides a better fit over quasi Suja and Suja distributions.

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Rekha Radhakrishn and Venkatesan

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Table 1: Data regarding the relief times (in minutes) of 20 patients receiving an analgesic

1.1	1.4	1.3	1.7	1.9	1.8	1.6	2.2	1.7	2.7
4.1	1.8	1.5	1.2	1.4	3.0	1.7	2.3	1.6	2.0

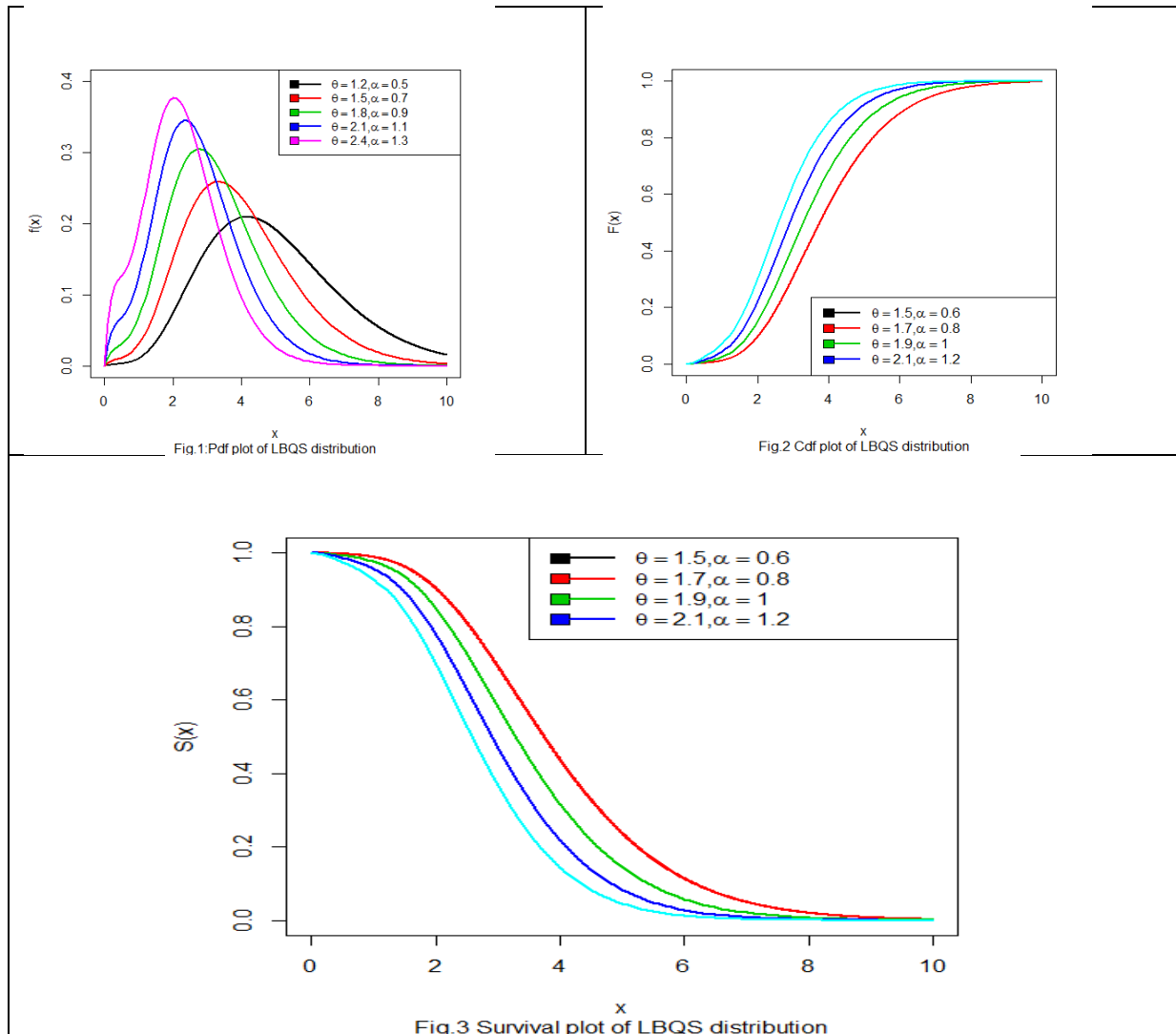
Table 2: Performance of the fitted distributions

Distributions	MLE	S.E	-2logL	AIC	BIC	AICC
Length Biased Quasi Suja	$\hat{\alpha} = 0.0010000$	$\hat{\alpha} = 0.0109650$	37.67981	41.67981	43.67128	42.3856
	$\hat{\theta} = 3.1574529$	$\hat{\theta} = 0.1704576$				
Quasi Suja	$\hat{\alpha} = 0.0010000$	$\hat{\alpha} = 0.0001023$	39.35243	43.35243	45.3439	44.0583
	$\hat{\theta} = 2.6303493$	$\hat{\theta} = 0.1537424$				
Suja	$\hat{\theta} = 1.895379$	$\hat{\theta} = 0.157514$	60.40204	62.40204	63.39778	62.6242





Rekha Radhakrishn and Venkatesan





Kashmir's Medicinal Heritage: A Historical Perspective of Traditional Healing Systems

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ABSTRACT

The study aims to explore the medicinal history of Kashmir since ancient times. To achieve this objective, the study reviews and analyses ancient texts, including the Charaka Samhita, and Susruta Samhita, among others, as well as other historical sources. The study also examines the different systems of medicine that have been practiced in Kashmir over the centuries, such as Ayurveda, Unani, and Tibetan medicine, among others. The Himalayan region of Kashmir is known for its rich variety of medicinal plants, with a history of traditional medicine dating back to ancient times. Prominent figures like Acharya Charaka made significant contributions to the field of Ayurveda, documenting their knowledge of medicinal plants and advocating for a holistic approach to healthcare. Over time, various systems of medicine, including Unani and Tibetan, were introduced to the region. The British colonization period saw the introduction of Western medicine, which coexisted with traditional practices. Christian missionaries played a pivotal role in establishing medical institutions and providing healthcare services to the population. The study documents the medicinal plants that have been used in Kashmir throughout its history, including their properties and uses in traditional medicine. This involves conducting field surveys and interviewing traditional healers to identify and document these plants. The study also analyses the social and cultural context of traditional medicine in Kashmir, including the beliefs, attitudes, and practices of the people who use it, and the cultural significance of traditional medicine in the region. The study explores the contemporary relevance of traditional medicine in Kashmir, its





Rashid Manzoor Bhat et al.,

integration into the modern healthcare system, and the challenges facing its preservation and sustainable use. The study aims to contribute to the understanding of the medicinal history of Kashmir and provide valuable insights into the development and evolution of traditional medicine in the region.

Keywords: Kashmir, traditional medicine, Ayurveda, Unani, medicinal plants, ancient texts.

INTRODUCTION

Kashmir, a region in the Indian subcontinent, has a rich tradition of medicinal knowledge that has been passed down for centuries. The medicinal history of Kashmir is an important aspect of the region's cultural heritage, as it reflects the influence of different cultures, religions, and historical events. Ayurveda, Unani, and Tibetan medicine are among the traditional medicines of Kashmir. The region's traditional medicine relies on medicinal plants. The Indo-Aryans, Greeks, and Persians molded Kashmir's medical history. Kashmir has practiced Ayurveda for millennia, influencing Unani and Tibetan medicine. The Charaka and Sushruta Samhitas describe how various systems of medicine employ medicinal herbs. The medicinal knowledge of Kashmir has been passed down through generations of traditional healers, who have acquired their knowledge through apprenticeship and practice. The cultural and social context of traditional medicine in Kashmir is deeply embedded in the region's religious and spiritual beliefs, as well as its social customs and practices. The use of medicinal plants in traditional medicine is also influenced by the region's biodiversity and geography, as it is home to a variety of medicinal plants that are used for treating various ailments.

Traditional medicine in Kashmir is in risk of being lost due to rapid modernization and globalisation despite its rich history and cultural value. As a result, it is crucial to record and safeguard Kashmir's medicinal heritage for the benefit of future generations. The purpose of this research is to learn more about the long and rich heritage of medicine in Kashmir by looking at how it has changed through time, what plants have been used for treatment, and what role society has had. The results of this research will aid in preserving Kashmir's ancient medical practises while also providing important insights into their efficacy and cultural importance.

RESEARCH OBJECTIVES

The study aims to explore the medicinal history of Kashmir, spanning several centuries and encompassing rich traditional knowledge and practices. The objectives are to trace the evolution of traditional medicine in Kashmir from ancient times to the present day, documenting the region's medicinal plants, exploring the cultural and social context of traditional medicine, and promoting its preservation and integration into the modern healthcare system. Through this study, we seek to understand the historical development, biodiversity, cultural significance, and sustainable utilisation of traditional medicine in Kashmir, while advocating for its recognition and incorporation into mainstream healthcare practices.

MATERIALS AND METHODS

The study involves a thorough review of the literature on traditional medicine in the region, including ancient texts, scientific articles, and books. The study also included field surveys to identify and document the medicinal plants used in traditional medicine in the region. The survey was conducted in different regions of Kashmir, including rural and urban areas, and involved interviewing traditional healers and other knowledgeable persons on the traditional medicine practices in the region. The data obtained from the survey were analysed to identify the most commonly used medicinal plants, their properties, and their uses. The study employed a multidisciplinary approach to



**Rashid Manzoor Bhat et al.,**

investigate the medicinal history of Kashmir since ancient period, combining historical, ethnobotanical, and pharmacological perspectives.

FINDINGS AND DISCUSSION

The use of medicinal plants in conventional healthcare systems has a long history, with many civilisations throughout the world turning to plants as their main source of healing. The usage of plant-based health products has significantly increased as a result of recent developments in plant sciences, both in developed and developing countries. According to reports, 70–80 percent of the world's population rely on medicinal plants for their basic healthcare (Singh, 2002). Millions of people make their living off of medicinal herbs. The World Health Organisation (WHO) acknowledges that ethnomedicine continues to be prominent in underdeveloped areas and is expanding quickly in developed nations. Herbal medicine is the primary therapy for 60% of children with malaria in Ghana, Nigeria, and Zambia, whereas traditional herbal treatments make up 30–50% of all medicines consumed in China (WHO, 2002). Due to its few adverse effects and inexpensive cost, developing nations like “Bangladesh (90%), Myanmar (85%), India (80%), Nepal (75%), Sri Lanka (65%), and Indonesia (60%)” actively support this medical system (Bhat, 2003). “The World Health Organisation (WHO) estimates that the yearly global demand for ethnomedicinal plants is about \$14 billion USD (Sharma, 2010). The market for raw materials derived from medicinal plants is anticipated to increase by 15 to 25% annually and surpass \$5 trillion by 2050. The trade in medicinal plants is thought to be worth over US \$1 billion yearly in India alone (Malik, 2011). More than 20,000 species of medicinal plants have been categorised by the World Health Organisation, which has made great efforts to do so” (Pandey, 2008). The Kashmir Himalaya region is home to a wide range of medicinal plants because of its diverse topography. The people of this area have learned and used knowledge of the therapeutic use of plants over the years. Through oral traditions, this priceless antiquity has been passed down through the years.

The earliest records of traditional medicine in Kashmir date back to the ancient period. The Charaka Samhita, an ancient Ayurvedic text, contains references to medicinal plants found in the region. The text also describes various medicinal preparations used in the treatment of diseases, including fevers, skin diseases, and digestive disorders (Gairola *et al.*, 2014). During the medieval period, traditional medicine in Kashmir was influenced by the Islamic system of medicine known as Unani. The Unani system of medicine was introduced to the region by the Mughals and became popular among the people (Singh *et al.*, 2020). Special mentioned is to be made to Acharya Charaka, a prominent figure in the history of Indian medicine, a revered wandering scholar, physician, and author. Known as the Father of Indian Medicine, he played a significant role in the development of Ayurveda, the traditional system of medicine in ancient India. Charaka was born in Kashmir around 600 BCE, and according to the research of Gerrit Jan Meulenbeld, a specialist in the history of Indian medicine, he likely lived between 100 BCE and 150-200 CE. Charaka's contributions to the medical field include his editorship of the Charaka Samhita, an authoritative text on Ayurveda that serves as an encyclopedia in the field (Nation, 2021). As a practitioner of Ayurveda, Charaka traveled throughout different regions of India, imparting his knowledge and documenting his experiences. Belonging to the Yayavara School, one of the educational systems prevalent in ancient India, Charaka embraced a philosophy of wandering from place to place with his students to disseminate knowledge and serve society. He made groundbreaking contributions to the understanding of digestion, metabolism, and immunity, displaying an awareness of the fundamentals of genetics and fetal development. Charaka emphasised the importance of prevention over cure, advocating for a holistic approach that considers all factors contributing to ill health before treating a disease.

The Charaka Samhita, edited by Acharya Charaka, stands as his most significant contribution to the medical field. Comprising 120 chapters across 8 books, this comprehensive work explores the causes of diseases, ethical principles of medical practice, physician training, human anatomy and embryology, diagnosis and treatment of diseases, as well as hygiene and healthy living (Nation, 2021). Charaka's exploration of human anatomy led him to propose a body with 360 bones, considering the heart as the central control organ interconnected with other body parts through



**Rashid Manzoor Bhat et al.,**

13 channels. He conceptualised doshas, three fundamental energies influenced by elements and food, attributing imbalances in these doshas to ailments that could be rectified through the use of prescribed medicines. Charaka recognised the relationship between health, diseases, and seasons, advocating for dietary practices aligned with seasonal changes. In addition to his comprehensive understanding of disease classification, Charaka possessed extensive knowledge of medicinal plants, with over 500 species identified. He also explored the subjects of diet, nutrition, and alcohol consumption, addressing them in the Charaka Samhita (Nation, 2021). He believed in the holistic nature of Ayurveda, considering it a comprehensive system of healthcare. Acharya Charaka, also known as Maharshi Charaka, left an indelible mark with his seminal work, the Charaka Samhita, which remains the oldest and most influential text on Ayurveda. His remarkable life and contributions continue to inspire and his insights on health and well-being remain relevant in contemporary times.

During the period of Mughal emperor Baadshah Jalaludeen Muhammed Akbar (1556-1606 CE), the Unani medicine was introduced and developed in Kashmir (Studocu, 2022). The first Kashmiri physician who was expert in Unani medicine was Kwaja Abdullah Ghazi. He learned medicine under Hakeem Danish Mandh from Delhi. He has gained his knowledge in both practical and theoretical areas. Practically his suggestions and diagnosis was ideal. He taught all his knowledge about medicine to his student Baba Majnoon Naarvadi, who was famous for his generous and kind heart. He treated poor and needy people on free of cost. Unani medicine emphasises the use of natural substances, including herbs and minerals, in the treatment of diseases. In the 17th century, the Tibetan system of medicine was introduced to Kashmir by Tibetan scholars and physicians (Samuel, 2001). Tibetan medicine is based on the principles of balance and harmony, and emphasises the use of herbal medicines, acupuncture, and moxibustion in the treatment of diseases. During the reign of Maharaja Ranjit Singh, with Lahore as his capital, Muhammed Ghazam served as his court physician. Ghazam possessed extensive knowledge in Arabic, Persian, and medicine. Notably, he possessed the ability to diagnose diseases by observing a person's facial features.

In the nineteenth century, under the rule of Maharaja Ranveer Singh, the Bakhodokar family governed Kashmir. During this period, a renowned physician named Muhammed Bakr gained popularity. Recognizing his expertise, the king appointed him as the medical officer and established Darul Tharjama, a translation institution for Arabic books into Persian and Tokri languages. Bakr served as the president of this institution, fulfilling his duties diligently. Kashmir, known for its abundant natural resources, such as Musk, Amber, and Zafran, holds significance in the field of Unani medicine. One notable example of a widely used Unani medicine exclusive to Kashmir is Ghul Banafsha Kashmiri. This medicine holds significant importance and is prominently employed in the region.

During the colonial period, the British introduced Western medicine to Kashmir, which began to compete with traditional medicine practices (Kaul, 1997). However, traditional medicine continued to be widely practiced in the region, especially in rural areas. The development of modern healthcare in pre-independence Kashmir can be attributed to the efforts of Christian missionaries. The Reverend Robert Clark was a trailblazer in bringing Western medicine to the region when he established the Kashmir Medical Mission. The mission was founded with a budget of 14,000 rupees thanks to the help of notable people and British officers including Lieutenant-Governor Sir Robert Montgomery. In 1865, the Church Missionary Society (CMS) sent its first medical missionary, Dr. William J. Elmslie, to Kashmir. Dr. Elmslie treated many patients during his excursions to the valley, including victims of a cholera epidemic in 1867, despite objections to the missionary side of the CMS's efforts. The Reverend W. T. Storrs took over the Kashmir Medical Mission in 1870, and the following year, Dr. Theodore Maxwell took over from Dr. Elmslie (Directorate of Health Services Kashmir). Dr. Maxwell was able to resume the mission's activities under more favorable conditions, with support from Maharaja Pratap Singh and the allocation of a hospital site in Drugjan. Dr. Edmund Downes succeeded Dr. Maxwell in 1877, and through personal contributions and donations, he established the Mission Hospital, which could accommodate over a hundred in-patients. He also obtained permission to stay in Kashmir during the winter.

During this period, the mission faced numerous challenges, including natural disasters and disease outbreaks. Earthquakes, cholera epidemics, and a severe smallpox outbreak affected the region, with high mortality rates. Dr.



**Rashid Manzoor Bhat et al.,**

Arthur Neve, joined by his brother Dr. Ernest F. Neve and their sister Miss Nora Neve, played significant roles in the mission's work. Dr. Arthur Neve received the Kaisar-i-Hind gold medal for his public service after nineteen years of service in Kashmir. The mission also expanded its efforts to combat plague and started the CEZMS (Church of England Zenana Missionary Society) activities in Kashmir. Dr. Fanny Butler, the first woman medical missionary sent to India, arrived in Srinagar in 1888 and established the Zenana Shifa Khana, a dispensary for women. The CEZMS received a generous donation from Mrs. Isabella Bishop, which led to the construction of the John Bishop Memorial Hospital in memory of her late husband. Despite challenges such as floods damaging the hospital, the mission continued its work in temporary premises near the Dal Gate (Directorate of Health Services Kashmir). These missionary activities played a crucial role in providing healthcare services to the population of Kashmir during a time when modern medicine was not widely accessible. The contributions of these dedicated individuals in addressing health challenges and establishing medical institutions left a lasting impact on the region.

After the John Bishop Memorial Hospital was destroyed by a flood in 1892, it was reconstructed in Anantnag at the behest of "Lord Frederick Roberts, the Commander in Chief of the British Army". By June of 1902, under the direction of M.D. candidate Minnie Gomery and Nursing Sister Kate Nownham, the hospital had reopened. In 1908, "the Church of England Zenana Missionary Society (CEZMS) Hospital opened in Rainawari" as another important medical facility. Tyndale-Biscoe called Elizabeth Mary Newman the "Florence Nightingale of Kashmir" for her work in the hospital. In 1936, the "CEZMS Hospital" underwent extensive renovations. In addition, in 1891, with initial finance and assistance from the Maharaja, the State created a separate leper hospital on a peninsula in Nagin Lake. The Mill Hill Missionaries established "St. Joseph's Mission Hospital in Baramulla" in the 1930s. Furthermore, in 1891, the Maharaja of Kashmir provided land and finances to create a Visitors Cottage Hospital at the foot of Shankaracharya Hill for the white people alone (Directorate of Health Services Kashmir). The State Medical Service's forerunner, the Kashmir State Dispensary, was founded in the late 1860s, perhaps in response to the efforts of the Kashmir Medical Mission. According to Walter Lawrence's account from 1895, the state maintained one excellent hospital in Srinagar in addition to six clinics, three of which were located in the districts.

Hazuri Bagh is home to what was formerly called the Maharaja's Hospital but is now known as the Sadar or State Hospital. Initially led by Chief Medical Officer Rai Bahadur Dr. A. Mitra, it was afterwards overseen by British Residency Surgeons in the role of Superintending Surgeons. "Fever, syphilis, rheumatic affections, nervous system disorders, eye diseases, respiratory diseases, dyspepsia, digestive tract diseases, connective tissue diseases, and skin diseases" were among the most frequently treated conditions at the State Hospital and clinics. The percentage of surgical procedures including venereal disease was 25%. When it comes to medical progress, Kashmir has seen the production of high-quality surgical tools. In 1891–1992, the State Medical Services cared for 122,960 patients, both in and out, and performed 2,188 surgical procedures, including 283 significant ones. In 1892 and 1893, 146 inmates at the Srinagar Jail's affiliated mental health institution were cared for. "The Diamond Jubilee Zenana Hospital in Nawakadal was built in 1897 to celebrate Queen Victoria's Diamond Jubilee". The State Hospital's obstetrics and gynaecology services were transferred here. The Diamond Jubilee Zenana Hospital in Nawakadal has been demolished and replaced by the Government Girls College for Women.

In the years 1913–14, an X-ray equipment was installed at the State Hospital, and in 1930, a dentistry wing was opened. In 1929, the Tangmarg (Directorate of Health Services Kashmir) sanatorium opened its doors to those suffering from TB. The establishment of a large hospital on par with other prestigious medical facilities was one of the important measures made in 1940 to improve healthcare in Kashmir. On October 15, 1940, the Marquis of Linlithgow, the then Viceroy of India, lay the foundation stone of the State Hospital (SMHS) on land that had formerly housed the Hadow Mills Carpet Factory. His successor, Lord Wavell, dedicated the hospital on October 11, 1945. The State Hospital's opening was a watershed moment in the history of healthcare in Kashmir, ushering in a new era of cutting-edge medical care for the locals.

The construction of this new hospital reflected the growing recognition of the need for improved healthcare infrastructure and facilities in the region. It aimed to meet the standards set by renowned medical institutions and



**Rashid Manzoor Bhat et al.,**

offer comprehensive medical care to the people of Kashmir. The laying of the foundation stone by the Marquis of Linlithgow, followed by its inauguration by Lord Wavell, underscored the importance of this project in the eyes of the British colonial administration. The State Hospital, also known as SMHS Hospital, was designed to cater to a wide range of medical needs and specialties. With its modern facilities and equipment, including the newly installed X-ray plant and dental wing, the hospital aimed to provide diagnostic, therapeutic, and surgical services to the population of Kashmir. The establishment of specialised departments and the availability of trained medical professionals further enhanced the hospital's capabilities. As a result of these ongoing developments in healthcare infrastructure and medical services, the region witnessed a significant improvement in its ability to address various health issues. The State Hospital, along with other medical institutions and dispensaries, played a crucial role in tackling prevalent diseases such as fevers, syphilis, rheumatic disorders, and respiratory ailments. Furthermore, the hospital's emphasis on surgical interventions and its success in handling a considerable number of major surgeries showcased its commitment to advanced medical care. The State Hospital's expansion and upgrades paralleled the growing awareness of public health concerns in Kashmir. Efforts to address mental health issues through the establishment of a specialised asylum, as well as the provision of tuberculosis treatment through the Tangmarg Sanatorium, demonstrated the commitment to addressing specific health challenges prevalent in the region.

In recent times, there has been a renewed interest in traditional medicine in Kashmir, with efforts being made to document traditional knowledge and promote the integration of traditional medicine into modern healthcare practices (Gairola *et.al.*, 2014). Ethnobotanical surveys have identified a large number of medicinal plants used in traditional medicine in the region, highlighting the importance of preserving the region's biodiversity (Arshad & Bibi, 2012). Traditional medicine in Kashmir has evolved over time, with various systems of medicine being practiced in the region. The evolution of traditional medicine can be traced through historical records, ethnobotanical surveys, and scientific studies. Despite the challenges posed by modernisation and globalisation, traditional medicine continues to play an important role in the healthcare practices of the region. The preservation and integration of traditional medicine into modern healthcare can provide valuable insights into the region's cultural and social context while also meeting modern scientific standards.

Medicinal plants are known to thrive in various altitudinal ranges, particularly in the alpine regions of Kashmir. Several key areas in the region are recognised for their abundant growth of medicinal herbs. These areas include Gurez and Tilail Valley, Lolab Valley, Karnah Valley, Gulmarg and Khillenmarg region, and the Pir Panjal Range and Kolahai Mountains. Gurez and Tilail Valley, located in the northeastern part of Kashmir within Baramulla district, encompass a range of 34°30' to 34°38' N latitude and 74°37' to 75°11' E longitude (Directorate of Environment and Remote Sensing). This valley serves as a repository of temperate medicinal herbs. The local population resides along the Kishenganga river and benefits from the availability of important medicinal plants such as Aconitum, Artemisia, Atropa, Datura, Dioscorea, Inula, and Rheum. Lolab Valley, also situated in the northeast of Kashmir within Kupwara district, spans from 34°26' to 34°40' N latitude and 74°13' to 74°32' E longitude. The hill communities in this region possess expertise in collecting wild medicinal plants. The dense forests of Lolab Valley are renowned, and pastoral communities migrate to higher altitudes during the summer months to gather medicinal plants for domestic use. Commonly collected medicinal plants from the higher reaches of this region include Aconitum, Ajuga, Amoebia, Bergenia, Colchicum, Delphinium, Fritillaria, Onganum, Rheum, Saussurea, and Valerians. Karnah Valley, which is part of Kupwara district, is situated between latitudes 34°24' and 34°42' N and longitudes 73°23' and 74°05' E. The high altitudes of this region are often inaccessible and covered with snow. Despite the challenges, some rare and lesser-known medicinal plants have been collected from this area, including Gentian, Juniperus, Polygonum, Tribulus, and Taxus.

The Gulmarg and Khillenmarg region is another significant site for medicinal plants; however, tourist activities have led to environmental degradation and disruption of the forest ecosystem in this area. Nevertheless, higher reaches such as Aporwat, Toshmaidan, and others are still considered valuable sources of medicinal plants. Traditionally, medicinal plants collected from this region include Aconitum, Atropa, Colchicum, Ferula, Fritillaria, Inula, Lavatera, Podophyllum, Taxus, and Valerian (Directorate of Environment and Remote Sensing). The Pir Panjal Range and



**Rashid Manzoor Bhat et al.,**

Kolahai Mountains, located in the Kashmir Himalayas, also harbor important medicinal plants. Some plants are unique to this region, and their abundance allows for large-scale collection. Examples of medicinal plants extensively collected from this area include *Amoebia*, *Bergenia*, *Colchicum*, *Ferula*, *Inula*, *Origanum*, *Valeriana*, and *Viola*. These diverse regions of Kashmir serve as valuable repositories of medicinal plants, providing a rich resource for traditional healing practices and the development of modern healthcare interventions. The preservation and sustainable management of these plant populations are essential for the continued availability of medicinal herbs in the region.

Kashmir has been a centre of traditional medicine for ages and is well-known for its abundance of plant and animal life. Treatment using medicinal plants dates back to ancient times in the area. The second goal of this study is to catalogue and describe the Kashmiri medicinal plants, their attributes, and their traditional medical use. Over 3,500 plant species have been identified in the area by the Department of Botany at the University of Kashmir, and roughly 1200 of these have been studied for their potential medicinal uses (Khan et al., 2012). "*Aconitum heterophyllum* (*Atis*), *Picrorhiza kurroa* (*Kutki*), *Saussurea lappa* (*Kuth*), *Valeriana wallichii* (*Tagar*), and *Withania somnifera* (*Ashwagandha*)" are only few of the extensively utilised medicinal herbs in the region (Ishtiyak & Hussain, 2017). Fever, cough, cold, arthritis, and liver diseases are just some of the conditions that have been treated with these herbs.

The medicinal plants of Kashmir have been the subject of several research documenting their efficacy. Rather and Baba (2015) undertook research to record the Gujjar people of Kashmir's traditional knowledge of therapeutic herbs. The research team pinpointed 81 plant species that locals traditionally utilise to treat a wide range of illnesses. The traditional usage of medicinal herbs in Kashmir for the treatment of liver problems was also highlighted in a research by Ishtiyak & Hussain (2012). Eleven plant species were shown to be effective in treating liver diseases. Kashmir's diverse plant life has supplied a multitude of options for traditional medicine that may be traced back generations. In order to preserve and promote traditional medicine in the region, it is essential to identify and document these plants, their qualities, and their usage in traditional medicine. The field research, in-depth conversations with traditional healers, and review of ancient manuscripts have all contributed significantly to this end.

Traditional medicine in Kashmir has a deep-rooted cultural and social context, as it has been used for centuries to treat various ailments and diseases. Understanding the beliefs, attitudes, and practices associated with traditional medicine is essential to appreciate its significance and promote its integration with modern healthcare systems. In this section, we will explore the cultural and social context of traditional medicine in Kashmir, drawing on primary and secondary sources to support our analysis. Kashmiri society is diverse, with different communities practicing different forms of traditional medicine. One of the most prominent forms is Unani medicine, which originated in Greece and was brought to Kashmir by Arab scholars. Unani medicine is based on the concept of balance between four humors of the body, and its treatments involve the use of herbs, diet, and lifestyle changes (Rather & Baba, 2015). Ayurveda is another form of traditional medicine that has been practiced in Kashmir since ancient times. It is based on the concept of three doshas - Vata, Pitta, and Kapha - and uses herbs, minerals, and animal products to treat diseases (Kaul, 1997).

The use of traditional medicine in Kashmir is deeply rooted in the culture and religion of the region. The practice of traditional medicine is often accompanied by religious and spiritual rituals, such as reciting prayers, making offerings, and performing certain rites. For instance, during the harvesting season, farmers in Kashmir perform a ritual called Navreh, which involves making a decoction of nine different herbs and consuming it to ward off evil spirits and ensure a good harvest (Kaul, 1997). The cultural and social context of traditional medicine in Kashmir also involves the transmission of knowledge from one generation to the next. Traditional healers often come from families with a history of practicing traditional medicine, and the knowledge is passed down orally. This has led to the preservation of traditional knowledge, which has been refined and developed over centuries (Rather & Baba, 2015). The cultural and social context of traditional medicine in Kashmir is complex and deeply embedded in the history, culture, and religion of the region. Understanding the beliefs, attitudes, and practices associated with



**Rashid Manzoor Bhat et al.,**

traditional medicine is crucial to promote its integration with modern healthcare systems and preserve its legacy for future generations.

Promoting the preservation and integration of traditional medicine into the modern healthcare system is crucial in ensuring that the valuable knowledge and practices of traditional healers are not lost, while also providing alternative healthcare options to people in need. Several actions may be made to accomplish this, including supporting the sustainable use of medicinal plants and traditional knowledge as well as arguing for the acceptance and inclusion of traditional medicine in modern healthcare. Traditional healers, legislators, and healthcare professionals must work together to promote the acceptance of and integration of traditional medicine into modern healthcare. This collaboration can help create a more comprehensive healthcare system that combines the best of traditional and modern medicine. In many countries, traditional medicine is often viewed as inferior or outdated compared to modern medicine. This negative perception of traditional medicine can lead to its marginalization, and the knowledge and practices of traditional healers can be lost over time. For this reason, it is crucial to inform politicians and medical practitioners about traditional medicine's benefits and effectiveness and to advocate for its incorporation into conventional medical practise. The sustainable use of medicinal plants and traditional knowledge is just as important as lobbying for the acknowledgment and integration of traditional medicine into modern healthcare. Many medicinal plants in Kashmir are endangered due to over-harvesting and deforestation, which can lead to the loss of valuable plant-based remedies (Rather & Baba, 2015). Therefore, it is important to promote the sustainable use of these plants, and to ensure that traditional healers are aware of sustainable harvesting practices. This can be achieved through training programs and community outreach initiatives that educate traditional healers about the importance of sustainability.

The rising demand from pharmaceutical enterprises and traditional healing systems has made the conservation and management of traditional medicinal plants a global problem, especially in developing nations. Because of this increased demand, natural populations have decreased due to overexploitation and habitat destruction brought about by human activities. Many species are in danger of disappearing entirely if we do nothing to stop the loss of their natural habitats (Kaul, 1997). The Conservation Assessment and Management Prioritisation (CAMP) workshop is the main source of Jammu and Kashmir medicinal plant data. Thus, it is crucial to examine medicinal plant diversity, distribution, and use patterns, including folklore uses, native and endemic species, and conservation and management approaches. Implementing the rules established in Section 8 of the Biodiversity Act 2002 would necessitate a coordinated work plan comprising scientists, government agencies, NGOs, and farmers. In order to meet consumer demands while protecting endangered and economically significant plant biodiversity in the state of Jammu and Kashmir, these rules have been enacted to: preserve biological diversity; guarantee the sustainable use of its components; and promote the fair and equitable sharing of benefits derived from biological resources and knowledge. It is important to collect plants in a way that guarantees their survival in their native habitats and elsewhere in the landscape. Loss of habitat, climate change, and invasive species are the primary dangers to Kashmir's medicinal plants. Assigning species with legal protected status requires caution. Because of the threat of the region's medical resources being depleted, several groups, both government and non-government, are working to preserve them in the Himalayas, where Jammu and Kashmir is located. Many institutions in Jammu and Kashmir are working to improve conservation methods. The variety, geographic distribution, use patterns, and folklore knowledge of these endangered medicinal plants are, however, little understood. Therefore, it is crucial to distinguish between protected and unprotected regions and to define economically important plant protection zones (EIPAZs) at different elevations, with the help of local communities and a wide range of organisations (including government, central, and non-governmental entities). Herbal gardens and nurseries are examples of urgently needed conservation repositories, and farmers should be encouraged to grow endangered medicinal plants. Despite the efforts of many governmental and non-governmental groups, there is still a pressing need to standardise conservation technologies for many economically valuable plants. In addition to facilitating large-scale farming, these technological advancements will reduce human interference with natural populations.



**Rashid Manzoor Bhat et al.,**

CONCLUSION

The study explored the medicinal history of Kashmir, focusing on traditional medicine practices and the contributions of various systems of medicine. The study highlights the significance of medicinal plants in traditional healthcare systems, which have been relied upon by a large percentage of the global population for primary healthcare. The demand for ethnomedicinal plants is projected to grow rapidly in the coming years, emphasising the importance of preserving traditional knowledge and resources. The study explored the ancient texts and historical records that mention the use of medicinal plants in the region, with particular emphasis on the Charaka Samhita and the contributions of Acharya Charaka. The study recognises Charaka as the Father of Indian Medicine and highlights his understanding of human anatomy, disease classification, and medicinal plants. The study analysed the introduction and development of different systems of medicine in Kashmir, such as Unani and Tibetan medicine, as well as the influence of Western medicine during the colonial period. It acknowledges the efforts of missionaries and medical practitioners in establishing medical institutions and providing healthcare services to the population.

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Formulation and Quality Control Evaluation of *Nilavaagai kiyazham* - A Siddha Polyherbal Formulation

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ABSTRACT

In recent days, the influence of herbal medicine has grown. Herbal medicine is a vast field that has yet to be fully studied. Every culture in the world has its own conventional therapeutic procedures. The majority of traditional remedies are based on locally accessible natural sources. Siddha is a traditional medicine followed over a decade in Tamil Nadu. *Nilavagai Kiyazham* is a polyherbal composition including 26 herbal ingredients prescribed by Kanya Kumari's *varmam* practitioners for osteoarthritis of the knee joint. *varmam* was a therapeutic treatment practiced for millennia that has lately gained popularity. This has been practiced in the southern region of Tamil Nadu, mainly in and around the Kanya Kumari district. Because of the area's great biodiversity, individuals seek herbal remedies for all their ailments. Recently there has been a resurgence of interest in bioactive natural products driven both by a very productive development in the field of traditional medicine as well as the dry discovery. There is a need for drug discoveries from natural sources which results in a more diversified medicine portfolio



**Nivetha et al.,**

for human uses. Hence this study focused on the standardization of the polyherbal formulation to affirm its purity and quality.

Keywords: Siddha, Varmam, Standardization, *Nilavaagai kiyazham*, Osteoarthritis.

INTRODUCTION

Recent days the impact on herbal treatment has been increasing. The subject of herbal treatment is massively wide and yet to be explored. Throughout the world each culture has their own unique traditional treatment methods. Most of the traditional treatments are based on the natural source available locally. *Nilavagai Kiyazham*[1] is a polyherbal formulation which contains 26 herbal ingredients given for osteoarthritis of knee joint by the *varmam* practitioners of Kanya Kumari. *Varmam*[2] was a healing procedure followed over a millennium which recently got attention from the people. This has been practiced in the southern part of the Tamil Nadu particularly in an around Kanya Kumari district. Due to the rich biodiversity of the area, people follow herbal treatment for all their ailments. The herbs used for the formulations are mentioned in the local names which makes it hard for us to identify the drug. Every single herb has its unique therapeutic effect. There is little understanding or appreciation of the fact that these "all natural" preparations are a combination of potentially biologically active compounds already existing in marketed products in unknown quantities [3]. The combination of various herbs with similar or dissimilar activities will give a desirable therapeutic effect. Likewise, each herb present in this formulation has various properties and in combination wholesomely it has an anti-inflammatory and analgesic activity. According to the siddha system certain drug interactions have a desirable effect and it is called *sathrusarakugal* and certain drug interactions have undesirable effect, and it is mentioned as *mithru*. The local traditional healers used their classical knowledge to frame a formulation. This study focused on the standardization of the polyherbal formulation in *Nilavaagaikiyazham*. In recent era people believe in the standard parameters to assess one's quality than classical knowledge. There is a need for drug discoveries from natural sources which results in a more diversified medicine portfolio for human uses. Hence Standardization of this formulation is pursued to affirm its purity and quality.

METHODOLOGY

Plant Material

The polyherbal formulation NK consists of 26 raw drugs. Each ingredient was collected from different districts of Tamil Nadu. Some of the raw drugs were collected from the reputed raw drug stores in Kanyakumari and Chennai. Some of them were collected directly from the field. *Nilavaagai* which was abundantly found in Tirunelveli so, the plant was collected, its root was cut off, cleaned, washed and shade dried. *Kottivaer* was collected in the month of May and its tuber was cut off, peeled and dried in the sun for the period of 3 weeks. The source plants were authenticated by a botanist, Department of medicinal botany, Government Siddha Medical college, Chennai. The herbarium was preserved for future reference.

Preparation of *Nilavagaichooranam*

All the procured and authenticated individual drugs were dried in shade and purified as per literature. The individual drugs were then coarsely crushed using willing grinder and weighed as per quantity required. Then all the drugs were mixed as per literature. The *kudineerchooranam* was then made into a decoction.

Standardization of *Nilavaagaikiyazham*

Standardization and quality assurance of the drugs in the pharmacological industry in the early centuries were crucial steps in ensuring safe and effective medications. Ayush has framed a guideline to ensure the qualities of



**Nivetha et al.,**

herbal medicine. The guideline, known as the Ayush Quality Assurance and Standardization Protocol⁴¹, requires all herbal medicine products to be tested for quality, purity and safety in laboratory settings. As per guidelines the following tests to be done for *kiyazham*: phytochemical analysis, physicochemical analysis, Pesticidal residue, test for aflatoxin, Particle size determination, HPTLC were done. Physicochemical analysis test includes organoleptic characteristic, solubility, Loss on drying, total ash, acid insoluble ash, water soluble extractive and alcohol soluble extractive. Phytochemical analysis includes tests for alkaloid, flavonoid, terpenoids, coumarin, phenol, saponin, sugar, anthocyanin and betacyanin. HPTLC was used for the identification and quantification of secondary metabolites present in the sample [42,43]. The purpose of Particle size determination was to determine whether there was any impurity in *kiyazham* or not.

RESULT AND DISCUSSION

Varmam is one of the unique branches in the Siddha system of medicine. *Varmam* deals with the *vaasi* flow, which is the life energy responsible for the physiological activities of the human body. The obstruction in this flow may lead to the pathological condition. These flows can be corrected by both external force and internal medication. *Nilavaagaikiyazham* is one of the polyherbal formulation presented in *varmam* literature indicated for osteoarthritis. While assessing the effectiveness of this formulation, it was found that the various herbs in this polyherbal formulation possess anti-inflammatory, analgesic and antioxidant activity. So, this traditional medicinal formulation of *Nilavaagaikiyazham* can prove to be an effective treatment for osteoarthritis as it has properties which can reduce inflammation, alleviate pain and improve the body's resistance to oxidative stress. Before drawing any conclusions, it is important to assess the quality and safety of this traditional medicinal formulation in clinical studies to ensure that it is safe for use as a treatment for osteoarthritis.

Organoleptic analysis is the preliminary test to evaluate the appraisal of a product. Hence the organoleptic parameter of *Nilavaagaikiyazham* were analyzed. As a preliminary quality check which revealed that in a solid state it was coarse fibrous, strong characteristic, hard texture, non – free flowing and pale brownish green in color in liquid state it was non – viscous, strong characteristic, slightly greasy, free flowing and dark brownish in color. Solubility is one of the important parameters to achieve desired concentration of drug in systemic circulation for achieving required pharmacological response. Poorly water-soluble drugs often require high doses in order to reach therapeutic plasma concentrations after oral administration. The drug *Nilavaagaikiyazham* is soluble in ethanol, water and DMSO which means the small dosage is sufficient to reach therapeutic plasma concentration.

Loss on drying is used to determine the amount of volatile matter present in the formulation. The LOD of *Nilavaagaikiyazham* was 1.4 ± 0.8185 . Ash values are one of the important indices to illustrate quality as well as the purity of the herbal medicine. The total ash value and acid insoluble ash value of *Nilavaagaikiyazham* were 0.8167 ± 0.02517 and 0.8167 ± 0.02517 . Extractive values help to indicate the nature of the chemical constituents present in the drug and help in the identification of the adulteration. The water-soluble extractive and alcohol soluble extractive of *Nilavaagaikiyazham* were 42.1 ± 7.252 and 39.83 ± 6.626 Microscopic observation of the particle size analysis reveals that the average particle size of the *Nilavaagaikiyazham* was found to be $37.35 \pm 12.27 \mu\text{m}$ further the sample NK has particle with the size range of lowest $18 \mu\text{m}$ to highest $65 \mu\text{m}$. The phytochemical analysis of *Nilavaagaikiyazham* shows the presence of Alkaloid, steroid, phenol, saponin and sugar. Plants are rich in Alkaloids and steroids. Both alkaloids and steroids were the natural source which has anti-inflammatory activity. The result shows that the formulation *Nilavaagaikiyazham* contains alkaloid, which is the natural, less toxic and most effective alternate source for other anti – inflammatory drugs like NSAID. This reveals that this drug may have a positive effect in treating osteoarthritis.

Due to lack of knowledge many of the farmers use pesticide to protect their crops. Pesticides are the major concern globally to accept the herbal product. Even a smaller quantity of Highly hazardous pesticides can produce disproportionate harm to the environment and the health of human being. Pesticides may enter the body through the



**Nivetha et al.,**

digestive system, even little doses can be toxic if consumed over an extended period of time and they have potential to be allergenic, mutagenic, teratogenic and even carcinogenic. Hence, the quality of an herbal product varies depending on the amount of pesticide it contains, and it should be below quantification limits. The results showed that there were no traces of pesticides residues such as Organochlorine, Organo-phosphorus, Organo-carbamates and pyrethroids in the sample provided for analysis.

Aflatoxins are metabolites produced by toxigenic strains of molds, mainly *Aspergillus flavus* and *A. parasiticus*, which grow in soil, hay, decaying vegetation, and grains. Aflatoxins form one of the major groupings of mycotoxins. Aflatoxin is produced by fungal action during production, harvest, storage, and processing of food and feed. The FDA considers it to be an unavoidable contaminant of foods. Hence, it is mandatory to evaluate the presence of aflatoxin in every drug with natural origin. The result showed that there were no spots being identified in the test sample loaded on TLC plates when compared to the standard which indicates that the sample were free from Aflatoxin B1, Aflatoxin B2, Aflatoxin G1, Aflatoxin G2.

HPTLC finger printing analysis of the sample reveals the presence of four prominent peaks corresponds to the presence of four versatile phytochemicals present within it. The Rf value of the peaks ranges from 0.03 to 0.87. Further peak 1 occupies the major percentage of area of 94.85 which denotes the abundant existence of such compound.

CONCLUSION

There is a need for drug discoveries from natural sources, which results in a more diversified medicine portfolio for human uses. This study focused on the standardization of the polyherbal formulation to affirm its purity and quality. To ensure the accuracy of our results, we used quality control measures that conformed to international standards. Since the Siddha system of medicine has gained popularity, some have encouraged it, while others have spread fabricated information that it may damage the internal organs. To clear this misinformation, we conducted this study in an effort to authenticate the safety and efficacy of Siddha medicines. It is a need of the hour to accurately assess the potential risks and benefits associated with Siddha medicines. This will pave the way for improved awareness and further research on the use of Siddha medicines in modern healthcare practices. Further clinical trials should be done to assess its effectiveness in the management of osteoarthritis since each herb of this formulation has anti-inflammatory, analgesic, and anti-arthritis activities.

Conflict Of Interest

None

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Table 1. Shows the list of ingredients presented in NK with its botanical name and parts used.

Ingredients	Botanical name	Parts used	Activities
Nilavaagai	<i>Cassia senna</i>	Root	laxative [5]
Sitramutti	<i>Sida cordifolia</i>	Root	Anti-inflammatory, Analgesic [6]
Arugu	<i>Cynodondactylon</i>	Root	Anti-inflammatory [7]
Vellarugu	<i>Enicostem maaxillare</i>	Whole plant	Anti-inflammatory [8]
Paathiri	<i>Stereospermu mchelonoides</i>	Root	
Isangu	<i>Clerodendrum inerme</i>	Root	Anti-inflammatory [9,10]
Mudakatran	<i>Cardiospermum halicababum</i>	Root	Anti-arthritic [11], Anti-inflammatory [12], Antioxidant [13]
Ilanthai	<i>Zizyphusmauritiania</i>	Root bark	Anti-inflammatory [14], Antioxidant [15], Analgesic [16]
Senthatti	<i>Triagia involucrate</i>	Whole plant	Anti-inflammatory, Analgesic [17]
Maanchi	<i>Nardostachys Jatamansi</i>	Dried rizhome	Anti-inflammatory [18]
Karkadagasingi	<i>Rhus succedanea</i>	Fruit and Gall	
Seenthilthandu	<i>Tinospora cordifolia</i>	Stem	Anti-inflammatory [19,20], Analgesic [21]
Elam	<i>Elattaria cardamomum</i>	Dry fruit	Anti-inflammatory [22]
Thandri	<i>Terminalia bellarica</i>	Dry fruit	Anti-inflammatory [23],
Kadukaai	<i>Terminalia chebula</i>	Dry fruit without seed	Anti-inflammatory [24], Antioxidant [25]
Nellikai	<i>Phyllanthus emblica</i>	Dry fruit without seed	Anti-inflammatory [23], Analgesic [26] Anti-arthritis [27]
Kacholam	<i>Curcuma zedoaria</i>	Rhizome	Anti-inflammatory, Analgesic [28]
Athimadhuram	<i>Glycyrrhiza glabra</i>	Root	Anti-arthritis [29] Anti-inflammatory [30]
Saathipathiri	<i>Mystica fragrans</i>	Aril	Anti-inflammatory [31]
Maasikai	<i>Quercus infectoria</i>	Gall	Anti-inflammatory [32]
Chukku	<i>Zingiber officinale</i>	Rhizome	Anti-inflammatory [33] Anti-arthritis [34]
Narseeragam	<i>Cuminum cyminum</i>	Seed	Anti-inflammatory [35] Antioxidant [36]
Thippili	<i>Piper longum</i>	Fruit	Anti-inflammatory, Anti arthritis [37], Antioxidant [38]
Thamaraivalayam	<i>Nelumbo nucifera</i>	Fruit	Anti-inflammatory, Anti-oxidant [39]
Thennai malar	<i>Cocus nucifera</i>	Flower	Anti-inflammatory [40]
Kottiver	<i>Aponogetonmonostachyon</i>	Dried rizhome	





Nivetha et al.,

Table 2. Shows the organoleptic characteristic of NK

State	Solid	Liquid
Nature	Coarse Fibrous	Non – viscous
Odor	Strong characteristic	Strong characteristic
Touch	Hard Texture	Slightly Greasy
Flow Property	Non free flowing	Free flowing
Appearance	Pale brownish green	Dark Brownish

Table 3. Shows the solubility / dispersibility of NK in various solvents

S.No	Solvent Used	Solubility / Dispersibility
1	Chloroform	Insoluble
2	Ethanol	Soluble
3	Water	Soluble
4	Ethyl acetate	Insoluble
5	Hexane	Insoluble
6	DMSO	Soluble

Table 4. shows Loss on drying, total ash, acid insoluble ash, water soluble extractive and alcohol soluble extractive of NV.

S.No	Parameter	Mean (n=3) SD
1.	Loss on Drying at 105 °C (%)	1.4 ± 0.8185
2.	Total Ash (%)	0.8167 ± 0.02517
3.	Acid insoluble Ash (%)	1.007 ± 0.3202
4.	Water soluble Extractive (%)	42.1 ± 7.252
5.	Alcohol Soluble Extractive (%)	39.83 ± 6.626

Table 5. Shows the presence of alkaloid, steroids, phenol, tannin, saponins and sugar.

S.NO	TEST	OBSERVATION
1	Alkaloid	+
2	Flavonoids	-
3	Glycosides	-
4	Steroids	+
5	Triterpenoids	-
6	Coumarin	-
7	Phenol	+
8	Tannin	+
9	Protein	-
10	Saponins	+
11	Sugar	+
12	Anthocyanin	-
13	Betacyanin	-





Nivetha et al.,

Table 6. shows the test result for the pesticide residue of the sample NK

Pesticide Residue		
Organo Chlorine Pesticides		
Alpha BHC	BQL	0.1 mg/kg
Beta BHC	BQL	0.1 mg/kg
Gamma BHC	BQL	0.1 mg/kg
Delta BHC	BQL	0.1 mg/kg
DDT	BQL	1 mg/kg
Endosulphan	BQL	3 mg/kg
Organo Phosphorus Pesticides		
Malathion	BQL	1 mg/kg
Chlorpyriphos	BQL	0.2 mg/kg
Dichlorovos	BQL	1 mg/kg
Organo carbamates		
Carbofuran	BQL	0.1 mg/kg
Pyrethroid		
Cypermethrin	BQL	1 mg/kg

BQL – Below Quantification Limit

Table.7 . shows the test result for Aflatoxin in NK

Aflatoxin	Sample NK	AYUSH Specification Limit
B1	Not detected - Absent	0.5 ppm
B2	Not detected - Absent	0.1 ppm
G1	Not detected - Absent	0.5 ppm
G2	Not detected - Absent	0.1 ppm

peak	Start Rf	Start height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area%
1	-0.03	3.2	0.01	778.7	75.06	0.09	24.8	41876.7	94.85
2	0.28	6.3	0.30	1.74	1.74	0.31	3.2	327.4	0.74
3	0.57	9.0	0.60	1.85	1.85	11.2	11.2	573.6	1.30
4	0.87	8.8	0.88	21.35	21.35	3.2	3.2	1371.0	3.11

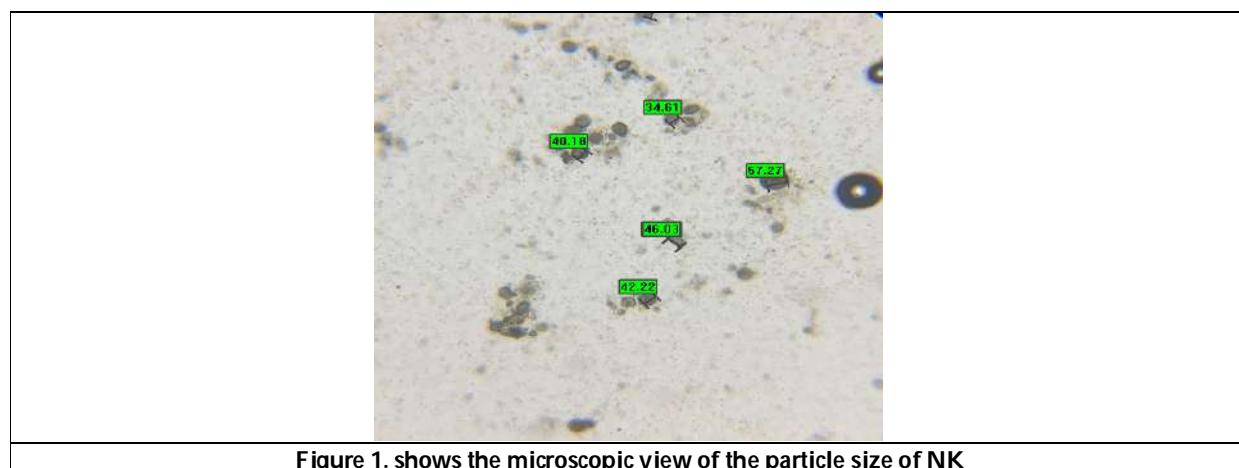


Figure 1. shows the microscopic view of the particle size of NK





Nivetha et al.,

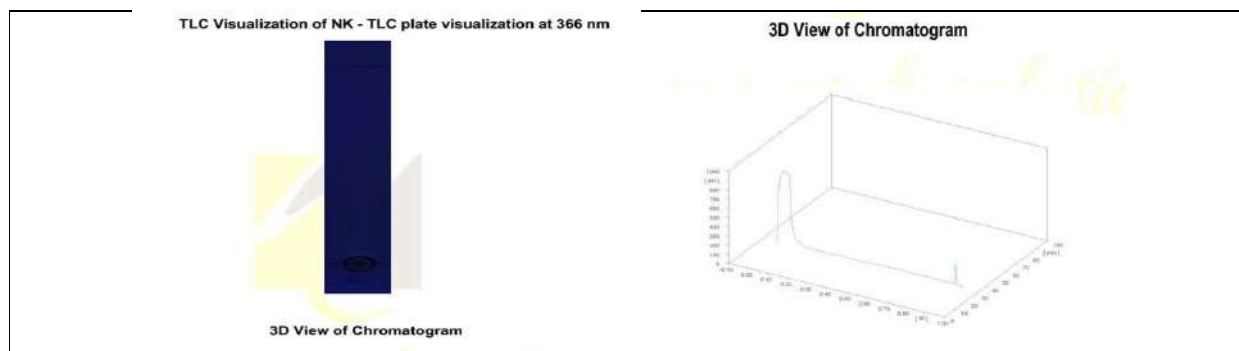


Figure 2. Shows the TLC visualization of NK and 3-D view of Chromatogram.

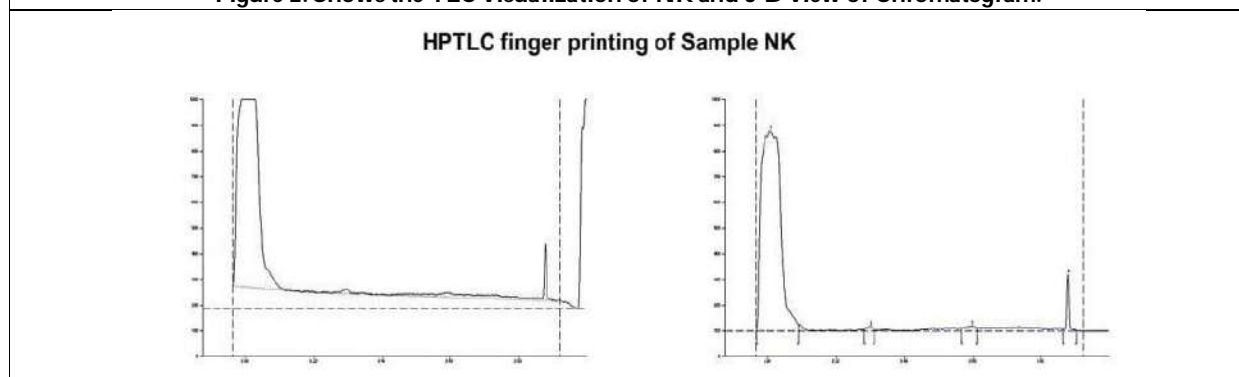


Figure 3. Shows the HPTLC figure printing of Sample NK





Translation and Validation of Gujarati Version of Caregiver Burden Scale- Indian Population in Cerebral Palsy : A Cross Sectional Study

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ABSTRACT

Caregiving of Cerebral Palsy (CP) children can be challenging and stressful for parents or caregivers. The caregiver burden scale-Indian population (CBS-IP), is a relatively new, well-designed, simple, self-administered instrument developed to assess both subjective and objective burden in caregivers. The objective of this study was to translate CBS-IP into Gujarati (GCBS-IP) and validate it in caregivers of CP children. Total 144 caregivers of CP children were included and a team of 10 rehabilitation experts was created for content validity index (CVI) calculation using Item wise CVI (I-CVI) and scale level CVI (S-CVI). 30 caregivers' responses were taken for face validity estimation. Inter class correlation coefficient (ICC) was used for test-retest reliability while Parental stress scale- Gujarati (PSS-G) was used for calculating convergent validity. Based on I-CVI and S-CVI/Ave value, GCBS-IP was found to have satisfactory levels of content validity. Face validity of the GCBS-IP was established when all the 30 caregivers questioned about the relevance of the scale answered 'YES' e.g., 100%. The ICC for all domain of GCBS-IP were good. Calculation for convergent validity demonstrated a weak positive correlation ($r=0.484$) among psychological subscale of GCBS-IP and PSS-G. So, GCBS-IP is a valid and reliable measure to assess caregiver burden in caregivers of children with CP in Gujarati population.

Keywords: Burden, caregiver, cerebral palsy, India, stress, validity.

INTRODUCTION

According to World Health Organization (WHO), 10% of children globally (approximately 200 million) suffer physical disability, mental deficiencies or developmental delay and that an even larger number suffer from





Priyanshi R. Patel et al.,

diminished learning capabilities [1,2]. In India, commonest cause of disability among the children of age group 0-19 years is CP, with a prevalence of 2.95 per 1000 live births [3]. Children with CP have significant impairments in motor, sensory, cognitive and verbal functions [4]. Disturbances of sensation, perception, cognition, communication and behaviour often accompany motor disorders in CP children [5]. So, the current management of CP is based on a multidisciplinary team approach [6]. Educating the family and receiving their support are of critical importance for a family centred caregiving approach, where parents or caregivers play an important role in screening and observing the growth and developmental patterns of children with CP [7,8]. Caregivers of the children with CP are vital members of the professional team due to their lifelong interest and commitment to their children. Disabilities of children are reported to disrupt the routine and reduce social participation of the primary caregiver [9,10]. In 2001, International Classification of Functioning, Disability and Health (ICF) given by WHO acknowledges caregiver strain as a third-party disability [11]. The caregiving burden can be classified in two types, one is objective and another one is perceived. Recently, 'Caregiver Burden Scale-Indian Population (CBS-IP)' was developed for Indian population and includes 25 items evaluating the role of caregivers and the both subjective and objective burden involved in it [12].

As Gujarati is one of the largest spoken language, translation of CBS-IP into Gujarati language can help better understanding of nature and extent of burden among caregivers of CP children in Gujarat. Therefore, this study intended to produce Gujarati version of CBS-IP, i.e., GCBS-IP, through translation of the original questionnaire. Also, measurement of the reliability and validity of GCBS-IP for use in caregivers of CP children.

METHODS

This study was conducted in two phases: first translation phase and second validation phase between April-2021 to January-2022. After receiving the Ethical approval, from Institutional Ethical committee, translation process was undertaken using standard guidelines suggested by WHO [13]. A written letter of permission for translation of CBS-IP and initial psychometric evaluation in Gujarati language was obtained from the original author and was sanctioned by the study guide. Implementation of this method included, forward translation; expert panel back-translation; pre-testing and cognitive interviewing, and final version of the scale in Gujarati language by linguistic experts and rehabilitation specialists (Figure 1).

For validation phase, 10 experts were invited as the members of review and suggestion committee based upon their expertise and experience. 4 physiotherapists, 2 occupational therapists, 1 paediatrician, 1 paediatric neuro physician, 1 paediatric orthopaedic surgeon, and 1 psychiatrist with minimum 5-year experience in treatment and rehabilitation of paediatric patients were included. Total 184 caregivers were screened on basis of inclusion and exclusion criteria following purposive sampling. 144 parents and caregivers of children who were clinically diagnosed as CP and having age between 2-18 years and can read or understand Gujarati language were included after receiving informed consent for participation [14]. Parents and caregivers of children who were diagnosed as having neurological conditions other than CP such as autism, myopathy, muscle dystrophy etc and who were known case of chronic medical, psychological and cognitive-behavioural illness and were not able to understand and co-operate for the study were excluded (Figure 2).

For assessment of face validity, each of the caregivers were asked a question, 'Do you think this scale is relevant to your condition?' The answer noted as 'yes' or 'no'. Face validity of the CBS-IP was established when all the patients questioned about the relevance of the scale to their condition [15]. Content validity is the degree to which an instrument has an appropriate sample of items for the construct being measured. This was assessed by an expert panel and they assessed the CBS-IP Gujarati version for content equivalence and content relevance on 5-point ordinal scale [16]. For quantification purpose, Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated. The expert panel members (n=10) were requested to rate questionnaire items from GCBS-IP in terms of relevance and clarity on a 5-point ordinal scale (1= strongly agree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree) [16,17]. For





Priyanshi R. Patel et al.,

this study 10 experts were included, therefore item with CVI value at 0.78 was accepted. For relevance, CVI was calculated both for item level and the scale-level. For all individual items item CVI was calculated using following formula [18],

$I-CVI = (\text{Agreed item}) / (\text{Number of experts})$

Scale content validity index(S-CVI) was measured in terms of S-CVI/Ave using formula [18],

$S-CVI/Ave = (\text{Sum of I-CVI scores}) / (\text{Number of item})$

Validity

Construct validity was measured as convergent and discriminant validity. Convergent validity evaluated by using a similar questionnaire examining the psychological domain of parenting a CP child, i.e., Parental stress scale (PSS). As the baseline data was not distributed normally, Spearman's rho was used for ordinal data [19]. Test-retest reliability of the questionnaire was evaluated by requesting the subjects for completing the questionnaire twice with an interval of 1 week to reduce any memory of previous answers and any variations in clinical status [20]. Test-retest reliability was determined by intra class coefficient (ICC). Internal consistency of Gujarati version of CBS-IP was assessed by Cronbach's α coefficient [20].

RESULT AND DISCUSSION

Total 144 participants with mean age 34.18 ± 6.37 years participated, out of which majority, i.e., 92% were female and only 8% were male caregivers. Most of the children with CP were male (i.e., 60.42%) and belonged to spastic type of CP (i.e., 71.53%). When classified by GMFCS levels, it was seen that more than 50% (i.e., 52.08%) children were having at least level-3 as the functional level. Expert committee members' mean experience in the field of paediatric rehabilitation was 9.15 ± 3.40 years. In this study, the final version of CBS-IP was completed by 144 caregivers of CP children between the age group 18-66 years. This sample size was larger than the original study, which included 125 subjects [12]. The sample of current study included majority female caregivers, which is a finding similar to almost all studies done in the caregivers of CP children [6,21]. As majority of the caregivers were in the age group of 30-35 years, it can be inferred that the responsibility of caregiving was largely borne by mothers which was also found in many previous studies.

Translation of CBS-IP

Translation of the CBS-IP in Gujarati followed standard procedure and was possible without major socio-cultural or language barriers therefore no significant changes or adaptations were required for in GCBS-IP. Being a newly developed outcome measure specific to Indian socio-cultural context CBS-IP is a promising tool to evaluate burden of caregiving in caregivers of CP children. This study included a survey of parents and caregivers of children with CP to determine its validity for measuring caregiver burden experienced by caregivers of children with CP. Although, the process of translation and validation of an outcome measure is a lengthy and complicated process involving many people including experts and subjects from the population of interest.

Estimation of Validity

Face validity

Face validity was established when all the 30 Caregivers questioned about the relevance of the scale answered YES e.g., 100%. In the current study, while filling GCBS-IP caregivers were asked about any difficulties faced and the total time for the completion was recorded. It took 10-15 minutes to respond and there was very low percentage of missing responses for items. So, it can be said that the acceptability of GCBS-IP was in general very good. These facts also indirectly confirm the absence of problems related to translation. By having acceptable levels of face validity chances of use by the rehabilitation professionals and rate of response by respondents can be increased, thereby improving reach and usefulness of GCBS-IP in measuring both subjective and objective burdens on caregivers and parents.





Priyanshi R. Patel et al.,

Content validity

The proportion of agreement among the panel members on the relevance and clarity of 25 items was calculated. e.g., for item-1 total 8 experts agreed that the item was relevant to the context so, I-CVI= 8/10 = 0.8

Average S-CVI calculated as,

S-CVI/Ave = Sum of I-CVI scores/ number of total items = 0.908

On the basis above calculation, we can conclude that I-CVI and S-CVI/Ave meet satisfactory level, and thus the Gujarati version of CBS-IP questionnaire has achieved satisfactory level of content validity. For validity, CVI was used and as per the literature CVI is a more robust method and is more reliable for validity estimation as compared to CVR, therefore in present study CVI was implemented for content validity [22].

Construct validity

Construct validity is frequently measured as convergent and divergent validity. In this study, convergent validity was evaluated by comparison of psychological domain scores of GCBS-IP with a Gujarati validated version of PSS (PSS-G). Spearman's rho was used for correlating the scores of GCBS-IP and PSS-G (Table 1).

Construct validity of GCBS-IP can be determined by comparing the subscale of CBS-IP with gold standard scale relevant to the individual construct domain as no such comprehensive scale is available which measures all five domains of CBS-IP. In this study, comparing the psychological domain of CBS-IP scale with gold standard Gujarati version of PSS (PSS-G). Construct validity was supported by the presence of low positive correlation (0.30-0.50) between psychological domain of CBS-IP and PSS establishing convergent validity. This is most likely due to only partial similarity between the constructs in the two sub-scale [23].

Estimation of Reliability

Based on the 95% confidence interval of the ICC estimate, values < 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and > 0.90 are indicative of poor, moderate, good, and excellent reliability, respectively[24]. As shown in table 2, the GCBS-IP scale showed excellent internal consistency in all the subscales.

CONCLUSION

The study suggests that the CBS-IP was successfully translated in to Gujarati language without losing the psychometric properties of original version. The preliminary evidence generated by the psychometric testing shows that GCBS-IP has good reproducibility, internal consistency and validity same as the English version. So, it is a useful instrument to evaluate caregiver burden in all aspects.

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Table 1: Spearman Correlation between GCBS-IP and PSS-G

Spearman Correlation Co-efficient (r _s)	p- value	2- tailed Significance
0.484	<0.05	Significant

Table 2: Test- retest reliability and internal consistency for GCBS-IP

GCBS-IP Domain	Baseline score	Retest score	Cronbach's alpha	ICC (95% CI)	Sig.
					p- value
Physical	11.33	11.35	0.983	0.983(0.977-0.988)	< 0.05
Financial	11.02	11.07	0.977	0.977(0.968-0.983)	< 0.05
Time	10.79	10.73	0.983	0.983(0.976-0.988)	< 0.05
Social	10.6	10.46	0.965	0.963(0.948-0.973)	< 0.05
Psychological	12.57	12.95	0.906	0.885(0.840-0.917)	< 0.05
Total	56.03	56.57	0.966	0.964(0.950-0.974)	< 0.05





Priyanshi R. Patel et al.,

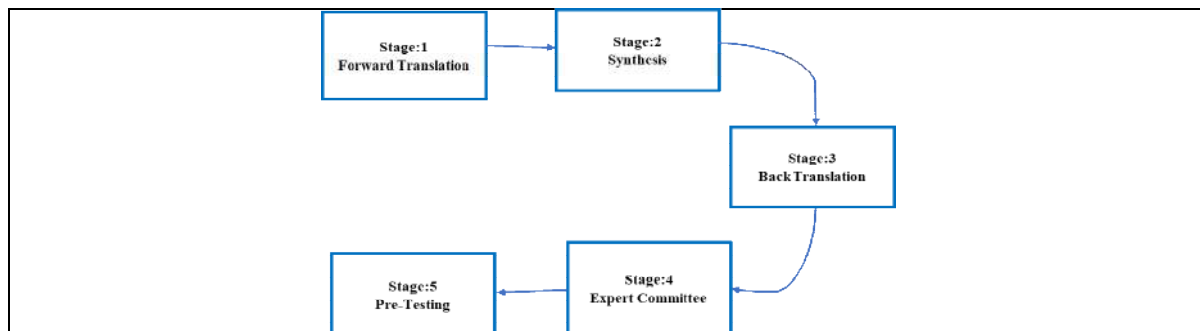


Figure 1. Process of Translation of the Questionnaire

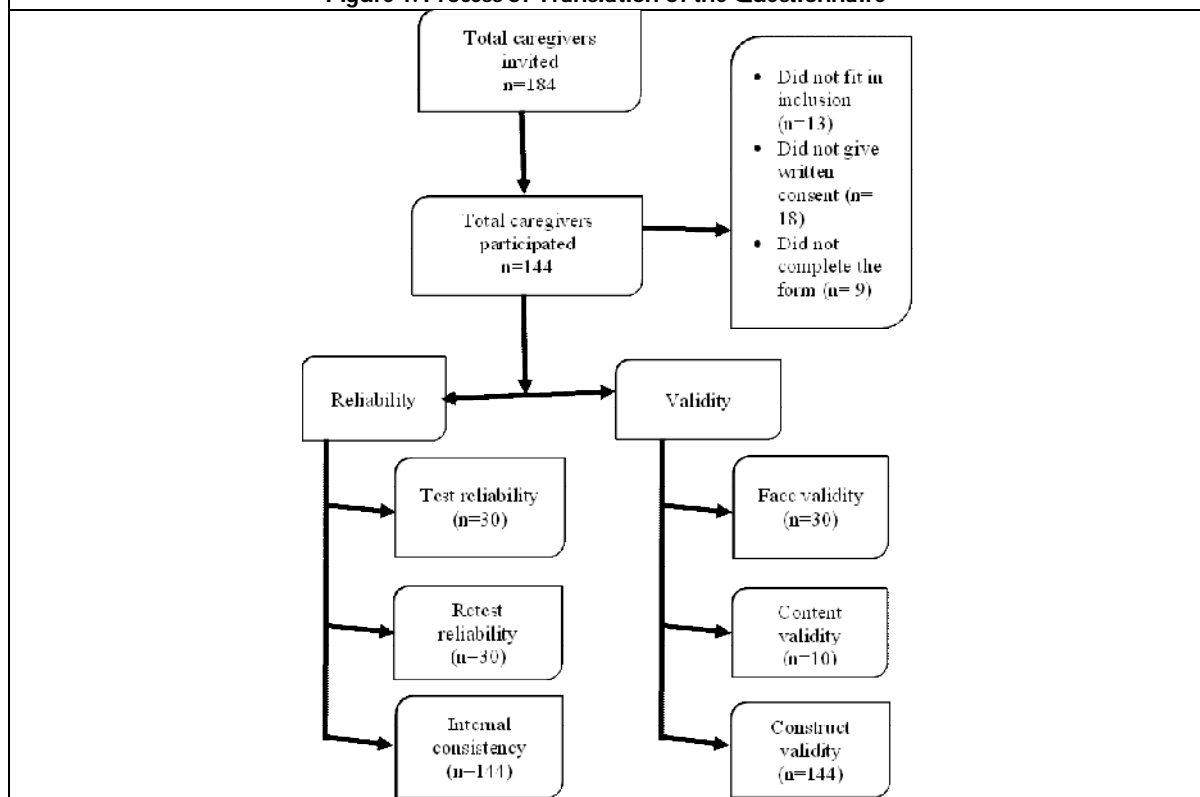


Figure 2. Participant Flow





An Evaluation of Irrigation System of Performance in Metacriteria Decision Making using Fuzzy Logic

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ABSTRACT

On the study of deals with the performance evaluation in five irrigation subsystems by considering eight different criteria. Two metacriterion Decision making (MCDM) methods, namely, Stochastic extension of PROMETHEE – 2 (STOPROM) and Multi – Attribute Utility Theory (MAUT) are employed to select the best one among the five irrigation subsystems. Taguchi methodology is an employed to the minimize in computational burden arising in the sensitivity analysis studies of STOPROM – 2 Methods. to the proposed methodology can serve as a model to choose the best one for formulating guidelines for improving the efficiency and performance of similar other irrigation subsystems.

Keywords: irrigation, Taguchi, studies, extension, MCDM, MAUT, STOPROM.

INTRODUCTION

Metacriterion Decision Making (MCDM) methods are acquire importance was conceivable tools for analyzing complex real – world problems due to their inherent ability to judge different alternatives (Choice, strategy, new policy, scenario can be also used in synonymously) on the various criteria is possible selection of the best / suitable alternatives. On alternatives may be further traverse in – depth for their final implementation. Metacriterion Decision – Making (MCDM) analysis has some unique characteristics such as the presence of multiple non - commensurable and conflicting criteria, different units of measurement among the criteria, and the presence of quite different





Rajkumar et al.,

alternatives. Stewart (1992) reviewed in MCDM methods and point out to needs of future MCDM methods as (1) the empirical validation and testing of the various available approaches (2) Prolongation of MCDM into group decision – making Posture and (3) the analysis of uncertainty.

Problem Description and Case Study

Five irrigation subsystems (D1 to D5) of Aringer Anna Sugar Mills (AASM) are evaluated on eight criteria, namely (1) on farm development work (2) adequacy of water (3) supply of inputs (4) surface water and groundwater (5) fecundity (6) farmers involvement (7) economic implications (8) social implications to select suitable irrigation subsystem that can be made a pilot to formulate guidelines so that the efficiency and performance of the other irrigation subsystem can also be improved accordingly. Even though productivity and economic impact are correlated to some extent, these are assumed to be independent to assess their effect on the overall planning scenario. Brief description of criteria (represented by c1 to c8) is presented below.

C1: on farm development work include mainly land levelling and shaping.

C2: Adequacy of water represents sufficient water at right time.

C3: supply of inputs such as seeds, fertilizers, credit from banks are essential for effective irrigation management.

C4: surface water and groundwater is essential to provide more reliable supply of water to crops when needed as well as to reduce waterlogging effect.

C5: fecundity of various crops for various seasons for various landholdings.

C6: Farmer's participation is essential for optimum utilization of resources. It is the way in which farmers use the irrigation water that determines the success of an irrigation project.

C7: Economic implications includes farmers income and revenue collected for supply of irrigation water.

C8: Social impact includes labour employment, which is measured in terms of Man – Days employed per hectare for each crop grown.

METHODOLOGY

SKEWNESS

Skewness means lack of harmony. In mathematics, a figure is called symmetric if there exists a point in it through which if a vertical is drawn on the X-axis, it divides the figure into two harmonious corridors i.e., identical in all respect or one part can be superimposed on the other. Glass images of each other. Mode coincides. else, the distribution becomes asymmetric. However, we get an appreciatively disposed distribution for which mean > standard > mode while if the left tail is longer, we get a negatively slanted distribution for which mean < standard < mode Measures of skewness help us to know to what degree and in which direction (positive or negative) the frequency distribution has a departure from harmony, If the right tail is longer. either, frame cases between harmony and asymmetry may be delicate to descry graphically. Hence some statistical measures are needed to find the magnitude of lack of harmony. A good measure of skewness should retain three criteria. It should be a unit free number so that the shapes of different distributions, so far as harmony is concerned, can be compared indeed if the unit of the underpinning variables are different, still, the value of the measure should be zero, If the distribution is symmetric. also, the measure should give positive or negative values according as the distribution has positive or negative skewness independently.

Since in a symmetrical distribution mean, standard and mode are identical further the mean moves down from the mode, the larger the asymmetry or skewness. An absolute measure of skewness can't be used for purposes of comparison because of the same quantum of skewness has different meanings in distribution with small variation and in distribution with large variation.





Rajkumar et al.,

KURTOSIS

If we have the knowledge of the measures of central tendency, dispersion and skewness, even then we cannot get a complete idea of a distribution. In addition to these measures, we need to know another measure to get the complete idea about the shape of the distribution which can be studied with the help of Kurtosis. Prof. Karl Pearson has called it the "Convexity of a Curve". Kurtosis gives a measure of flatness of distribution.

$$\text{Skewness} = \beta_1 = \frac{\mu_3}{\mu_2} \quad \text{Kurtosis} = \beta_2 = \frac{\mu_4}{\mu_2^2}$$

PROMETHEE- 2 (Preference Ranking Organisation Method of Enrichment Evaluation) is also of overweighing nature. When two alternatives a and b are to be compared for any criterion j, they can be expressed in terms of preference function $P_j(a, b)$ which is a function of the divergence between the two alternatives a and b and type of criterion function. Brans et al. (1986) proposed six types of criterion functions i.e., usual criterion, quasi criterion, criterion with direct preference, position criterion, criterion with direct preference and intolerance area and Gaussian criterion. Indifference and preference thresholds are also defined. Metacriterion preference indicator (laden average of the preference functions $P_j(a, b)$) can be calculated from which ranking of the alternatives are attained.

EXPROM- 2 is the Muddled and extended interpretation of PROMETHEE- 2 where the relative performance of one volition over the other is defined by two preference indicators, one by weak preference indicator (grounded on outranking, i.e., metacriterion preference indicator in PROMETHEE-2) and the other by strict preference indicator (grounded on the notion of the ideal and tetani-ideal). The total preference indicator, i.e., totality of strict and weak (metacriterion) preference indicators in the fuzzy terrain gives an accurate measure of the intensity of preference of one volition over the other for all criteria (Diakoulaki and Koumoutsos, 1991). Analytic Hierarchy Process (AHP) is a system grounded on the precedence proposition. It's able of breaking down a complex unshaped situation into its element corridor. Arranging these corridors in a hierarchical order and assigning numerical values grounded on private judgements and the relative significance on a numerical scale of 1 ± 9 , the judgements are synthesised to determine the overall precedence of each volition (Saaty and Golbarnejhad, 1982). concession Programming defines the stylish as the one, whose point is at the least distance from an ideal point in the set of e client results.

The distance measure used in Compromise Programming is the family of L_p - criteria and is given as, where $L_p(a)$ is the L_p - metric for volition a, $f_j(a)$ is the value of volition a for criterion j; M_j and m_j are the outside and minimum values of criterion j in set A; f_j^* is the ideal value of criterion j; p is the parameter reacting the station of the decision maker. Indispensable with minimal L_p - metric value is considered as the stylish (Gershon and Dickstein,). Ideal and analysis. The Chaliyar is one of the major gutters of the State of Kerala, India. The swash has a length of about 170 km. It has nine important feeders. The swash receptacle has 93276 ha of cultivable land. The only irrigation installations in the receptacle are those handed by minor lift irrigation schemes, which serve only a limited area of the paddy lands that too for a part of the crop period. further civilization of paddy and other crops is possible if acceptable irrigation installations are handed. The ideal of the study is to be the most suitable con duration of the budgets for the development of the receptacle. The criteria with nota 250 K.S. Rajic's. Pillai/ European Journal of functional exploration 112(1999) 249 ± 257 tion and corresponding weights are irrigation (IR, 10), power product (PO, 8), drinking water force (DW, 5), environmental quality (EQ, 8), protection (FL, 6) and the design (BE, 7), independently. Weights for the below six criteria are grounded on the conversations with the elderly social who acted as the decision maker (DM) and grounded on the numerical scale of 0 ± 10 . Irrigation is the most important occupation in the receptacle. The situations given to the deferent systems were calculated grounded upon the ayacut area under each force system. The position for Power product was determined considering the water head available and the inowes. The charts showing the population viscosity were available and they are used to loot the qualitative situations to the criterion of Drinking water force. At the downstream, there is the specie need of the minimal discharge to help the intrusion of swab water which was considered at the time of allotment of qualitative situations



**Rajkumar et al.,**

to the criterion, Environmental quality. The probable adverse due to the perpetration of force schemes was also considered to formulate the situations for this criterion. A scale of 1 ± 2 , 2 for good and 1 for average) for Drinking water force was assigned. In view of the relative significance in weightage of environmental quality, a scale of 1 ± 3 (3 for good, 2 for average and 1 for satisfactory) was assigned. These were espoused after series of conversations with decision maker. For the citronwood's, the frequency of goods and anticipated losses in the vicinity of force were given due consideration for nailing the situations. Bene from different force con gyrations were espoused from the report published by Kerala State Public Works Department. Detailed information on above six criterion values for each indispensable con gyrations were available from Chaliyar River Basin Report (1987). An aggregate of 27 indispensable con gyrations is proposed. Each volition being either a system of budgets or varied combination of individual budgets. In the original analysis eight druthers were named by ELECTRE- 1 (Mohan and Raipure, 1991) for the posterior use in MCDM styles. Table 1 shows the force combinations as well as payao matrix for the eight druthers. The budgets are shown as R1 to R9 in 1. It's observed from Table 1 that druthers 5 and 7 are having same trait values. Indeed, though these are indie rent, the con gyrations of budgets for both are die rent. Indispensable 5 has R2, R4, R5, R8 whereas indispensable 7 has R4, R5, R8, R9. It's likely that these druthers may deer when some impalpable and/ or unaccounted criteria like Employment Generation EG) and design A acted Persons (PAP) are considered. These are targeted for farther study. Due to this reason, druthers5 and 7 are kept independently in the payoff matrix without grouping into a single volition. The decision maker will have the choice between the two while making further in-depth studies at the time of perpetration.

Pay off matrix formulation

Three officials who are monitoring the project for the last few years are requested to formulate the payoff matrix. They were provided with summarized information, outcome of interviews conducted in the project with farmers and officials. Relevant information that is available from irrigation, groundwater and agricultural departments also helped them to formulate the payoff matrix. In the present study, all the criteria are assumed to be subjective. All the above criteria are evaluated against each irrigation subsystem in the form of payoff matrix by each official. A numerical scale of (100 (0 for the worst and 100 for the excellent) is used to convert qualitative values into quantitative values. The values of the mean and standard deviation for the three payoff matrices provided by the vast experience in metacriterion Decision – making (MCDM) and allied fields and their acquaintance with the planning problem.

Estimation of Weights of Criteria by Analytic Hierarchy Process

It was requested to fill in the pairwise comparison matrix based on Saaty's nine – point scale. Filled up pairwise comparison matrix as presented in table 1 is solved using power method (saaty and Golbarnejhad, 1982). Maximum eigenvalue (λ_{max}) and Consistency Index (CI) are found to be 7.1125 and 0.0908. Consistency Ratio (CR) which is the ratio of 0.012 and found to be less than 0.1 indicating that judgements given by are satisfactory. Weights of the criteria, on – farm development works, adequacy of water, supply of inputs, conjunctive use of water resources, productivity, farmer's participation, economic impact, social impact are 0.9174, 0.88, 0.9523, 0.9177, 0.8217, 0.9522, 0.7212, 0.8375 respectively and presented in **Table 3**. These are 0.9551, 0.9565, 0.8999, 0.929, 0.7912, 0.7912, 0.8491, 0.7909 and 0.8244. It is observed that economic impact, productivity and social impact are given top priorities by both the experts.

CONCLUSIONS

Grounded on the analysis of the results of a real-world problem involving the operation of Multicriteria Decision – Making (MCDM) styles in performance evaluation studies as applied to five subsystems of the Arringar Anna Sugar Project, kurungulam, Thanjavur, Tamil Nadu, India. The following conclusions are drawn. profitable Impact, productivity and social impact are the three criteria that are given the top precedences by experts. It's set up that the station of both the experts is threat aversive as apparent from negative value of overall scaling constant. The ranking pattern is relatively robust to the effect of spanning constants in MAUT system as far as the first position is





Rajkumar et al.,

concerned. The ranking pattern is relatively robust to the criterion function type as far as the first position is concerned. The ranking pattern is relatively robust to the criterion function type as far as the first position is concerned in **STOPROM – 2** system and Taguchi methodology is set up to be effective to circumvent the computational complexity arising in the perceptivity analysis studies. Group decision making conception can be effectively incorporated in the decision – timber process using the presently developed methodology.

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Rajkumar et al.,

Table :1 Payoff matrix (mean of three payoff matrices provided by three officials)

Criteria \ Irrigation subsystem	C1	C2	C3	C4	C5	C6	C7	C8
D1	92.22	85.66	92.22	25.66	85.66	92.22	92.22	92.22
D2	59.59	72.22	72.22	12.22	85.66	65.66	52.22	72.22
D3	52.22	92.22	65.66	5.66	72.22	32.22	85.66	65.66
D4	52.22	45.66	45.66	39.59	52.22	45.66	72.22	72.22
D5	52.22	25.66	52.22	65.66	85.66	89.59	72.22	72.22

Payoff matrix (mean of three payoff matrices provided by three officials)									
		1	2	3	4	5	6	7	V8
N	Valid	5	5	5	5	5	5	5	5
	Missing	0	0	0	0	0	0	0	0
Skewness		2.061	-.607	.609	.844	-1.526	-.181	-.607	1.762
Std. Error of Skewness		.913	.913	.913	.913	.913	.913	.913	.913
Kurtosis		4.282	-1.570	-.139	.015	1.718	-2.337	.256	3.752
Std. Error of Kurtosis		2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000

Payoff matrix (mean of three payoff matrices provided by three officials)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	52.22	3	60.0	60.0	60.0
	59.59	1	20.0	20.0	80.0
	92.22	1	20.0	20.0	100.0
Total		5	100.0	100.0	

Table 2:Standard deviation values of three payoff matrices

Criteria \ Irrigation subsystem	C1	C2	C3	C4	C5	C6	C7	C8
D1	11.44	11.44	11.44	11.44	11.44	11.44	11.44	11.44
D2	19.59	11.44	11.44	11.44	11.44	11.44	11.44	11.44
D3	22.08	11.44	22.08	11.44	22.08	29.44	11.44	11.44
D4	10.44	11.44	22.08	19.59	11.44	11.44	11.44	11.44
D5	10.44	11.44	22.08	11.44	11.44	21.59	11.44	11.44

Standard deviation values of three payoff matrices									
		1	2	3	4	5	6	7	8
N	Valid	5	5	5	5	5	5	5	5
	Missing	0	0	0	0	0	0	0	0
Skewness		.696		-.609	2.236	2.236	1.098		
Std. Error of Skewness		.913	.913	.913	.913	.913	.913	.913	.913
Kurtosis		-2.661		-3.333	5.000	5.000	-.555		
Std. Error of Kurtosis		2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000

Standard deviation values of three payoff matrices					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	11.44	1	11.1	11.1	11.1





Rajkumar et al.,

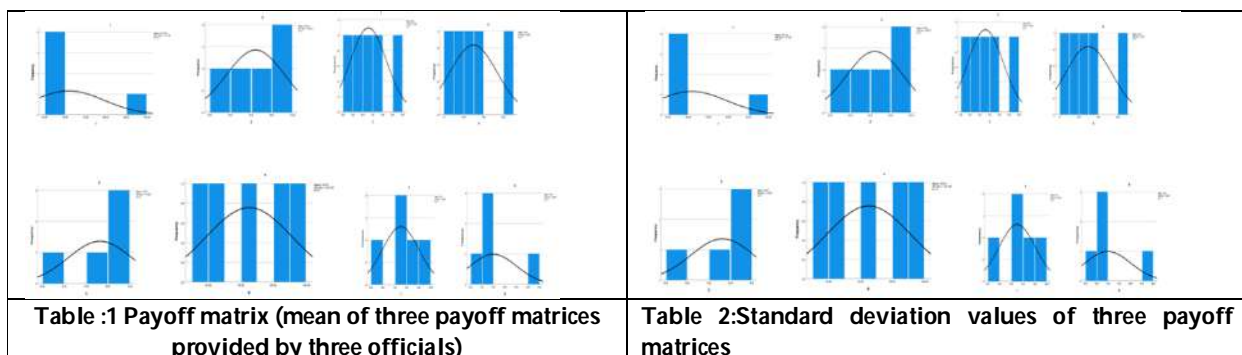
	19.59	1	11.1	11.1	22.2
	22.08	1	11.1	11.1	33.3
	C1	0	00.0	00.0	00.0
	10.44	2	22.2	22.2	66.7
		3	33.3	33.3	100.0
	Total	8	100.0	100.0	

Table 3. Pairwise comparison of criteria and weights of criteria

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	Weights
C1	1.00	0.5	1.00	0.00	0.5	1.00	0.67	0.5	0.9174
C2	1.00	1.00	1.00	2.00	0.5	1.00	0.67	0.5	0.88
C3	0.5	0.5	1.00	0.5	0.75	0.00	0.8	0.67	0.9523
C4	0.00	0.67	1.00	1.00	0.67	2.00	0.67	0.5	0.9177
C5	1.00	1.00	3.00	2.00	1.00	2.00	0.5	0.00	0.8217
C6	0.5	0.5	0.00	0.67	0.67	1.00	0.8	0.67	0.9522
C7	2.00	2.00	4.00	2.00	1.00	4.00	1.00	1.00	0.7212
C8	1.00	1.00	2.00	1.00	0.00	2.00	0.67	0.00	0.8375

Pairwise comparison of criteria and weights of criteria										
		1	2	3	4	5	6	7	8	Weights
N	Valid	8	8	8	8	8	8	8	8	8
	Missing	0	0	0	0	0	0	0	0	0
Skewness		.633	1.718	.929	-.010	-.948	.970	.653	-.327	-1.076
Std. Error of Skewness		.752	.752	.752	.752	.752	.752	.752	.752	.752
Kurtosis		1.737	3.445	.222	-1.502	1.541	1.872	1.472	-.180	.852
Std. Error of Kurtosis		1.481	1.481	1.481	1.481	1.481	1.481	1.481	1.481	1.481

Pairwise comparison of criteria and weights of criteria					
	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	.00	1	12.5	12.5	12.5
	.50	2	25.0	25.0	37.5
	1.00	4	50.0	50.0	87.5
	2.00	1	12.5	12.5	100.0
	Total	8	100.0	100.0	





Rajkumar et al.,

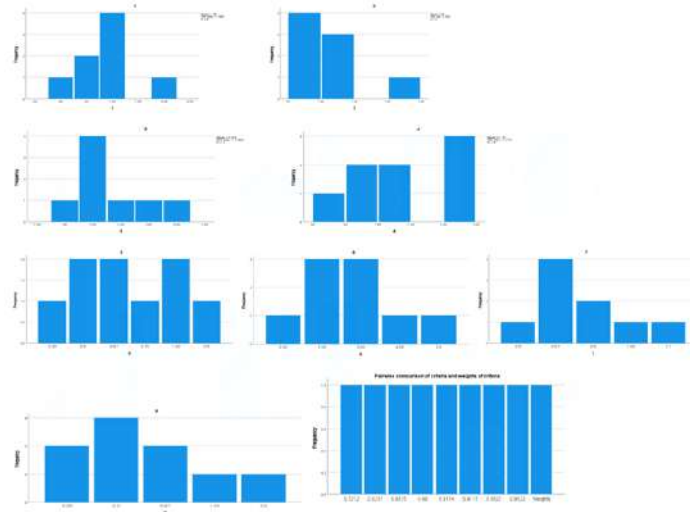


Table 3. Pairwise comparison of criteria and weights of criteria





Enhancing Understanding of Abstract Concepts through OLABS : A Pathway towards Quality Experimentation in Science

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ABSTRACT

The shift in learning from traditional to digital has led many teachers scrambling to find effective ways to deliver instructions, thereby allowing students to collaborate. With the rise of digital learning, many higher education institutions are now substituting traditional learning resources with educational technologies in an attempt to keep up with their digital learning population. Experimentation is one of the key aspects in the science stream as it helps in gaining laboratory experiences and development of critical thinking and problem-solving attitude. Modern technology provides a variety of digital tools that allow teachers to teach experimentation with a viewpoint to work smarter, not harder thereby improving quality of learning and achieving better learning outcomes. The present paper is thus an attempt made to study the role of 'O labs' on transforming the elements of educational space by providing the basic understanding of how this technology has been designed to assist the process of teaching-learning in science by providing real life experiences and how it can be implemented to the fullest. The idea behind 'O labs' is that lab experiments can also be demonstrated and performed in less expensive manner using the Internet. A real-world lab environment is created making use of simulation. These labs are a boon to students who have no access to physical labs or where equipment are not available due to high cost or scarcity. This helps the students to compete with schools with better lab facilities, thus reducing the digital divide and overcoming geographical distances. Another advantage is experiments can be accessed anytime anywhere, overcoming the constraints of time.

Keywords:- Digital tools, Experimentation, Classroom setup, O labs, Learning Outcomes, Quality Education





Priyanka Sharma and Aman

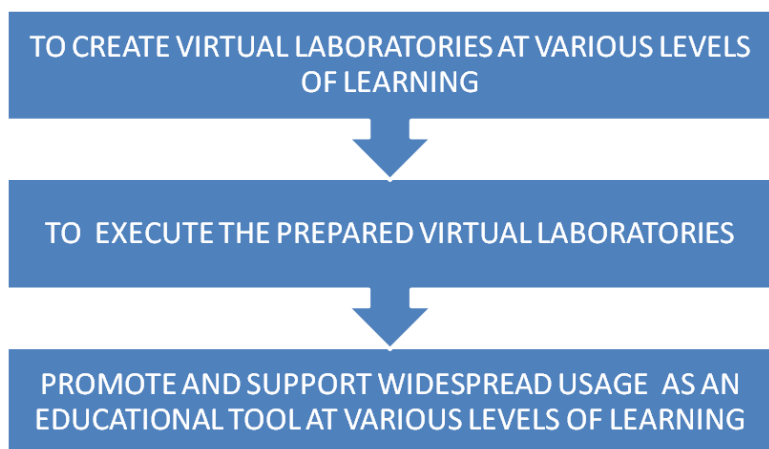
INTRODUCTION

Technological advancements in the field of Education have brought drastic changes in how we perceive education. Technology has provided us with a variety of tools and technologies that have brought a shift from the traditional methods of teaching and learning to online methodology of teaching. From origin of eighteenth century till date, researchers and scientists have been studying the importance of laboratory experiences of theory and its importance in the field of Science. Science education is concerned with developing understanding of how and why things work. Science is founded on observational methods for gaining new knowledge. Science uses experimentation for learning how to convey new knowledge and clarifying concepts which students usually find difficult to grasp. Experimentation in particular, allows a group to learn collectively and quickly and allows students to build new ideas quickly and collaboratively. To clarify the role of experimentation in the discipline of scientific fields, Roberts wrote: "Students achieve a deeper level of understanding by finding out things for themselves and by experimenting with techniques and methods that have enabled the secrets of our bodies, our environment, and the whole universe – to be discovered".(Okam and Zakari (2017)noted that practical activity supports the development of positive attitude in students and hence increasing motivation for effective science learning. As a result, positive attitude towards practical work has a significant impact on student's science achievement (Hinne, 2017). Laboratories can be utilised in the educational process to generate scientific notations and models that can be used to check ideas. Lab work also helps in comprehending the distinction among data observation and presented data (Lawson, 1995). Laboratory activities assist students to study with understanding while also engaging in a process of developing knowledge by getting practical experiences, according to the evidence (Tobin, 1990). The importance of practical learning in science education cannot be overstated (Hofstein & Lunetta, 1982; Hofstein & Mamlok-Naaman,2007). Furthermore, practical work helps to encourage and inculcate students' likelihood towards science and fosters engagement in practical work. For example, when students perform chemistry experiments in a laboratory setup, they discover that the field of chemistry is applied and not merely rules and theoretical principles as simply stated in their textbooks.

CONCEPT OF OLABS (OLABS)

Since 1985, India's government body, the Ministry of Education, has been making efforts to improve educational opportunities for Indians. Early in 2009, the then Cabinet Committee on Economic Affairs approved the MoE's National Mission on Education via Information and Communication Technology. Some goals had been specified which are as under:

GOALS OF NME-ICT



**Priyanka Sharma and Aman**

The Sakshat Portal Project established in 2006 is another education portal for inscribing the needs of those connected with the learning process including students, teachers, scholars and those interested in lifelong learning. The Sakshat Portal is another pillar of the NME-ICT and is developed with the purpose of being the only web-based portal for providing access to e-learning initiatives introduced by MoE. In the recent years, with the advancement in the field of communication and technology, there has been an evolution of eLearning combined with simulation is called online labs or O labs. (Achutan, 2011).

The concept of "virtual labs" is one of the recent advancements in the field of science. Virtual laboratories offer interactive environments and provide digital replicas of operations that are typically carried out in physical laboratories setup. Virtual labs simulate the tools, equipment, tests, and methods used in chemistry, biochemistry, physics, biology, and other related fields. Virtual labs allow students to learn in accordance with their own needs and foster an eagerness to perform experiments. Virtual Labs also include a comprehensive learning management system that allows students to quickly find extra web materials, video-based lectures, demonstration via animations, and tools to evaluate oneself. Students can now perform virtual experiments that imitate the functioning of real-life experimentation and thus help in achieving better learning outcomes.

- The objectives of this project that focuses on virtual labs, according to Section 3.14.1 of the NME-ICT mission Document, are:
- To crystallise the idea of a Virtual Lab setup, that would mainly consist of a handy visual front-end functioning in synchronization with a backend, which may consist of a simulated engine that runs on a server or a real experiment performed on screen.
- To determine which topics would be most appropriate for visualization in virtual labs for providing maximum benefit to students.
- To design Virtual labs in such a way that they complement NPTEL by educating students about the fundamental ideas while also stimulating their imaginative ideas and foster curiosity.

In 2009, a board of 12 institutions met with the objective of identifying the academic areas that will require the development of virtual labs, to discuss how virtual labs interfaces would look like, what would it feel like to be in a virtual lab setup, and to decide what institutions would provide what contribution to the development of which particular virtual lab. The educational areas that were chosen for implementation were as following:

- Electronics & Communications
- Computer Science & Engineering
- Electrical Engineering
- Mechanical Engineering
- Chemical Engineering
- Biotechnology Engineering
- Civil Engineering
- Physical Sciences
- Chemical Sciences

The Online Labs is an educational technology effort named Amrita CREATE, was started by Centre for Research in Analytics, Technologies & Education at Amrita Vishwa Vidyapeetham in cooperation with CDAC, Mumbai. It was developed as a result of research grant from the Department of Information Technology, Government of India. Amrita University contributed in development of virtual labs for Biotechnology, Engineering students, the field of Sciences. Amrita University's is committed to provide virtual laboratories experiences to students pursuing higher education within India with to experiment, to find out new things, and have learning experiences in similar manner as the students gain in real laboratories. The labs provide experiments related to Physics, Chemistry and Biology for students from grades 9th to 12th, with content prescribed according to NCERT/CBSE. O Labs has received formal approval from the Central Board of Secondary Education (CBSE) to be used in all of its schools as a teaching tool. Additionally, it will be offered in both urban and rural schools and be available in Hindi, Malayalam, and Marathi. "It provides students experience of virtual experiments that will stimulate their interests and learning by giving them





Priyanka Sharma and Aman

the virtual experience of doing lab work, by graphically resembling with laboratory equipment and simulating a virtual medium," the board stated in a circular posted on the CBSE website. However, it is available on the website for free and is open to all students and schools in India as a free resource for all schools (teachers and students). Additionally, a DVD version is accessible and can be ordered on demand. It would train CBSE teachers to use and administer digital resources under the name "Roll Out of Labs." All schools linked with the Board are urged to support their teachers' attendance at the O labs training programme. The circular said.

There are no constraints of time and space as students can access such laboratories anytime irrespective of the place where they are sitting. This is an economical step as it saves cost of setting big laboratories and purchasing expensive instruments. Simulated environment has another advantage as it permits safety and security from dangerous chemical substances. For example, exposing students to acids such as H_2SO_4 , HNO_3 can be dangerous and can result in the occurrence of serious accidents. The O Labs is based on the idea that lab experiments can be transacted or instructed using the Internet, more efficiently and in a less expensive manner. These labs can be efficiently used to support students who lack physical labs facilities or used in situations where equipments are unavailable due to scarcity or high cost. O labs can also assist the students who live-in far-flung areas by helping them to compete with peers studying in better facilitated schools, there by reduce the inequalities in the distribution of digital resources and geographical distances.

In view of the above discussion, the features of O labs include the following:

- Content as prescribed according to NCERT/CBSE and State Board Syllabus.
- Physics, Chemistry, Biology Labs from Class 9 to Class 12.
- English and Maths lessons for Class 9 and 10.
- Interactive simulations, animated lab videos.
- To clarify concepts and to develop understanding of the experiment through conceptual clarity.
- Helps in developing skills and abilities required to perform, record and learn experiments - anywhere, anytime.
- to foster individual practice in all areas of experimentation.
- The 'learning-enabled assessment' through O Labs helps in facilitating the assessment of; developed procedure and manipulation skills of the experiment
- Develops the conceptual understanding of the experiment and help in assessing student's reporting and interpretation skills.

WHY INDIA NEEDS AN OLABS-STYLE SETUP

- Physical Lab Issues
- Limited Infrastructure
- Minimal or no lab time
- Limited access to the lab
- Safety restrictions and delicate equipments
- Higher level cognitive skills are not sufficient.
- Evaluation of experiments is challenging
- A dearth of competent educators

HOW TEACHERS CAN USE OLABS PLATFORM AS AN EFFECTIVE TEACHING AID

The technology behind Online Labs includes an offline tablet-based component, which will eventually allow teachers who have been trained to take the Labs into remote villages where Internet connectivity may not be available. The creation of O Labs entails the use of mathematical techniques to demonstrate abstract functions in various branches of science. To simulate real-world procedures, the labs use cutting-edge simulation technology. Real lab scenarios are simulated by displaying a live demonstration of the experiment on the screen, simulating a real experiment. An introductory portion to each experiment is provided in O Labs via a theory tab, where a learner can access the





Priyanka Sharma and Aman

content related to the specific experiment. The procedure that will be used is displayed under the procedure tab. This tab contains step-by-step instructions for the experiment's procedure. The "Animations" have a basic understanding of how the instrument works and how to perform experiments with it. The 'Video' tab demonstrates how the experiment is carried out in a traditional lab setting. By selecting the Simulation tab, you can run the experiment in real time. There are also facilities onboard to check the results.

Each experiment is divided into sections that cover the following:

- Theory - the conceptual background of the experiment, concepts, related laws, proofs, and principles, etc.
- Animation - for the teacher to demonstrate the experiment in the classroom or laboratory.
- Simulation - a simulated laboratory environment with all of the necessary equipment to run the experiment online.
- Viva Voice - Self-assessment questions on related lab

Effective usage of OLabs by teachers can be done in the following ways:

- At most, use it in class for demonstration
- to prepare students for the physical lab.
- To reflect on the laboratory activities

More can be obtained by ensuring that students actively participate in the activity.

- Active learning strategies can be combined with traditional lecture.
- As homework, assign inquiry-based activities; encourage self-evaluation by utilising the "Viva-Voice" section of each lab.
- Teachers can use it in class or laboratories
- To explain labs before conducting an environment
- To explain a procedure
- for demonstration purposes
- Set expectation about a lab
- frame Can review questions with the lab as the backdrop (after Lab Session)

PROPOSED ACTIVE LEARNING STRATEGY FOR OLABS

- **Recommended time:** 5-15 min
- **Predict Outcome** - Ask students to make prediction: "What will happen if ..."
- **Calculate Output** - Ask students to calculate nextstep or output.
- **Devise explanation** - Ask students to devise reason for process Choose activity based on pedagogical purpose and learning objective of the Lab

HOW OLABS CAN BENEFIT STUDENTS:

- Familiarizing about lab environment before entering a lab
- to try variations within a lab setup
- To revise
- Using labs for reinforcing the content
- To accommodate different learning preferences and styles, the O Labs provide lessons, animations, videos, visuals, simulations, and summaries with detailed information. Each lab is designed to give students hands-on experience that will help them learn and understand each experiment.
- Better understanding of the practical aspects the curriculum
- Assists in teaching complex concepts visually
- Promotes Student Safety
- Learner's Participation
- Instant Feedback To Students
- Learning Flexibility
- Affordable Option To Physical Labs



**Priyanka Sharma and Aman****EDUCATORS PERCEPTION ON OLABS INITIATIVE BY GOVERNMENT OF INDIA**

Online laboratories are highly regarded by educators across the country.

"Online Labs by Amrita CREATE is a very useful application for science students in classes IX to XII." It will not only provide them with first-hand experience performing experiments, which will strengthen their scientific temper, but it will also help to clarify scientific concepts," said Dr Sasi Banerji, Principal of Bhavan Vidyalaya in Panchkula, Haryana. "Amrita University's O Labs is a fantastic educational initiative." "When compared to other educational software such as Smart Classes and websites developed by the government as well as private companies, Online Labs stands out for its creativity and originality," said Gnaa Gowri, Chief Education Officer, Government of Tamil Nadu, at the launch of a workshop for Tamil Nadu school teachers. Amrita University has taken a commendable initiative. "We need to include Odisha Government Schools in this as well," said MS Padhi, IAS, Commissioner-cum-Secretary, Government of Odisha, at a workshop in Bhubaneswar. "O labs will help students better understand complex science concepts and develop a scientific temperament," said Dr Venkat Rangan, Vice Chancellor of Amrita University.

CURRENT STATUS OF OLABS IN INDIA

A review meeting ahead of the launch of 200 OLABs, as part of the second anniversary of NEP 2020, was held at the NCERT office in Delhi On 25th July 2022. The panel of NCERT experts includes Prof. Dinesh Prasad Saklani, Director; Shri. Amarendra P Behera, Joint Director; Prof. Indu Kumar, Professor and Head of CIET; and Mr. Arvind Gupta, Program Lead. The AmritaCREATE team comprised Dr. Prema Nedungadi, Director, Amrita CREATE, and Chairperson, School of Computing. Amritapuri; Ms. Sreekala, Project Manager; and Ms. Ashima Vijayan, Marketing Executive. The NCERT experts reviewed several OLABs experiments, including the 3D Simple Pendulum simulation video in Hindi and Ohms Law experiment. They emphasized further collaborations and adding content for more classes in the near future to fulfill the educational needs of students. Moreover, the experts emphasized the development of critical thinking and innovation in the experiments to improve conceptual understanding. The meeting drew to a close on a positive note in the spirit of forging a way forward to realize the vision of NEP 2020 through active collaborations and partnerships.

RECOMMENDATIONS

1. Policy planners/Administrators/Institutional heads must promote and encourage the usage of such applications and recognize similar platforms that bring out best in the learner and bring conceptual clarity with the development of scientific attitudes. Apps like 3d anatomy available on play store can prove useful in delivering the abstract concepts. Principles and heads must provide full fledged support for making these platforms functional and success.
2. Proper orientation courses and refresher courses should be organized by schools so that concerned stakeholders (teachers and administrators) benefit. Also, teachers must try to update her knowledge and involve recent innovations in her pedagogy.
3. Despite the biggest advantages of online laboratories discussed above, it has been noticed that students feel bored and monotonous due to constant exposure to screens and this in turn creates learning gaps. It is therefore recommended that they should be used on alternate basis.
4. Due to unfavourable geographical distribution, internet connectivity acts as a barrier in learning. Also, incompetencies related to usage of technologies develop anxiety, inferiority complexes in learning that further obstruct from the advantages of online learning. Thus, blended mode of learning over pure online or traditional method of learning will prove to be more fruitful.
5. Experiments such as cutting of section or extraction of a peel cannot be fully learned via demonstration from online laboratories. These processes require skill that can only be achieved under the setup of a physical laboratories. Similarly dealing with chemicals and the precautions to be taken under a laboratory environment can be obtained only by real lab experiences.



**Priyanka Sharma and Aman**

6. The concepts like this can be used efficiently under pandemic situations like COVID etc. Online learning will support in situations when is not possible to give real lab experiences to the students.
7. There is need to convey such knowledge at lower level of hierarchy because marginalized section is still unaware of its usage.
8. The Olabs need to be introduced in more schools as currently only 20 schools are registered with O labs.
9. Concepts like this can be used to give pre lab exposure to children to avoid wastage of lab material, to teach appropriate lab behaviour and safety measures.

CONCLUSIONS

On view of the above discussion and recommendations it is concluded that Online labs ,which are a innovation in the field of education, is an initiative taken by Ministry of Education, Govt. of India with a viewpoint to develop conceptual clarity and promote scientific attitude in the field of experimentation related to various disciplines of education. In the present paper we discussed the government goals behind the creation of such application. It was also pointed out how online labs can be used in various disciplines and specifically in Sciences to give conceptual clarity of experiments by virtual laboratory settings.

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Effect of Self-Developed E-Content Modules in Biology to Enhance Learning Agility : An Experimental Analysis

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ABSTRACT

The study aimed to develop e-content in the biology discipline and assess its effectiveness on the achievement of students of the ninth class. The study was a two-phased process with the objectives (i) To develop and validate e-learning modules of Biology and (ii) To assess the effectiveness of developed e-learning modules of Biology. The first objective study was carried out as part of the Developmental phase, where e-content in Biology on Cell structure was developed. To meet the quality criteria of e-content development, instructional design as the "ADDIE (Analysis, Design, Development, Implementation, and Evaluation)" model was adopted for the e-modules. To fulfill the study's second objective as an Experimental phase, the experimental research design of a "randomized control group pre-test and post-test" was employed. A standardized achievement test for the e-module of Biology was administered before and after the experiment. Statistical techniques of calculating means and standard deviations were employed to compare the means of pre-measure and post-measure scores of non-treatment and treatment groups. The study's positive results established the effectiveness of e-modules of Biology and the product of the study as the website www.learning-afresh.com continues to serve the instructional needs of learners and educators.

Keywords: e-content, Instructional Design, Learning Agility, Experimental Analysis.



**Neha Rawat et al.,**

INTRODUCTION

The arrival of the new digital and multimedia devices and their fascinating applications that add value to the teaching-learning process seems to be growing beyond the classroom walls. This academic approach is a culmination of melding information technology with educational materials and has drawn attention to many e-content and e-learning tools (Jain & Singh, 2020). Therefore, E-content is a medium that has flourished in recent decades and has documented almost every moment of human life (Muruganatham, 2015). It has sparked an e-revolution where everyone, from celebrities to ordinary people, may share open online blogging forums, opinions, discussions, comments, debates, social awareness videos, pictures, and headlines, stories to bring attitudinal transformation on a massive scale. In recent years, concerns about 'the quality, not quantity,' of e-content have risen (Mishra, Patel & Doshi, 2017). Designing & developing qualitative e-content is a systematic and scientific process. It involves thinking of an innovative idea, converting it into a storyline, putting characters into it, making choices of the right media components like text, audio, and animation, and deciding interaction points to achieve instructional goals (Jain & Singh, 2020; Mishra, Patel & Doshi, 2017). Self-instructional, engaging, imaginative, and reusable are all required qualities of quality e-content. Together with these central tenants of quality e-content, it should prompt the desirable behavioral changes to transform users' attitudes and make them more knowledgeable (Prabakaran & Saravanakumar, 2020).

Today is the modern age of e-content, which has evolved with the advent of Information and Communication Technology (ICT). E-content has accomplished a lot with emerging communication devices and technologies (Meena & Pareek, 2020). It is currently widely and freely available and accessible in its most convenient format, such as text, audio, video, visual effects, animation, and info graphics. The historical account of the evolution of e-content involves three generations of ICT;

- (i) the Birth of wired telecommunication,
- (ii) Wireless satellite and mobile telephony, and
- (iii) the Advancement of Internet technology.

Concerns over the quality of e-content have increased along with the development of its platforms and delivery mechanisms. Only with an effective instructional design is the development of high-quality e-content practicable. The dissemination of information, content analysis, required resources, and support activities are all explained in the instructional design of Faryadi (2007) with learning unit, a systematic, scientific way to hold information about how e-learning functions.

In light of the elements that must be considered while selecting a model, the ADDIE instructional system design model was deemed the most appropriate. The ADDIE model has been used to develop e-content (Kaur, Jyoti & Raskirat, 2020). The ADDIE model, which outlines the lens design process in greater depth, has become the most prevalent and versatile model for everybody (Muruganatham, 2015; Hamid et al., 2021). The idea of e-content has undergone a paradigm shift, moving from the assumption that technology can assist in creating desirable learning outcomes through e-content in the direction of the quality of the e-content that was employed to develop it. E-content is initially defined primarily based on its technological component. Because of this narrow perspective, e-content was evaluated solely based on the media and transmission method used to create it (Mishra, Patel & Doshi, 2017; Nachimuthu, 2018). This approach concentrated on the quantitative component of e-content digital information because more advanced media and technology can quickly produce and disseminate enormous amounts of e-material (Mishra, Patel & Doshi, 2017). But today, e-content has a tremendous impact on society and its allies, including education, government, entertainment, media, and others, pushing us towards a broader perspective to comprehend and define the new era of evolutionary Change of quality e-content (Orero & Tor-Carroggio, 2018).



Neha Rawat *et al.*,

REVIEW OF LITERATURE

In the study of Choudhuri and Husain (2022), the effect of the digital classroom on learning biology concepts was investigated. The sample from secondary school learners of Delhi's primary and government schools was included. The study was an attempted quasi-experimental method. Results showed that digital classrooms (interactive whiteboard facilities, computers, digital projectors) positively impacted the learners' learning process in biology. Findings revealed that the multi-media aspect of digital technology boosts the attention and engagement of the learners. Prabhakaran (2021) examined the effectiveness of the mathematics E- content modules on the learning of ninth-standard students of Tamil Nādu. Eighty students as a sample were selected to conduct the experiment in which a quasi-experimental design with Solomon four group method was used. The mathematics achievement was measured through the "Achievement test in the mathematics (unit Set Language —A branch of mathematics)." The results revealed that online activities in the blended mode learning environment significantly improve the student's learning outcomes in mathematics. The study recommends adopting e-content modules of teaching and learning methods as a sign of modern pedagogical methods to equip quality education for students.

In another study by Prabakaran & Saravanakumar (2021) examined the effect of e-content on retention ability and academic achievement in mathematics learning among high school students. Twenty students from ninth standard were chosen to conduct the study. The result showed that e-content-based instructional modules incorporated various forms such as animated pictures, audio-visuals, video formats, PPT, etc., significantly improved the retention ability and the academic achievement in mathematics of the students. In the Indian context, Meena & Pareek (2020) researched the e-content impact on science teaching-learning. A total of the fifty in-service teachers participated in the capacity-building program to promote ICT/e-contents in science teaching at the secondary level. The result showed that training in ICT /digital materials or developing an e-content program positively impacted teachers' perception of ICT. Findings expose that based on electronic devices using electronic networks or ICT-based approaches for teaching science are more effective than the usual teaching method. The study carried out by İlyas & Akyuz (2020) investigated the effect of student-content interaction (interactive and non-interactive PowerPoint presentation) on the student's academic achievement and science attitude. The semi-structured experiment research design was employed on 65 students from the sixth standard of secondary school. The study concluded that interactive PowerPoint presentations positively impacted the student's achievement but did not influence their attitude toward science. Rana & Singh (2020) stated the importance of e-content and e-learning and their significant role in the Indian educational system over the last decade.

Soroya & Ameen (2020) noted how Pakistani millennials engage in the digital age while attending university. The 515 postgraduate students were recruited for a cross-sectional survey. Despite their affinity for print material, teenagers enjoyed reading "electronic literature that was freely accessible online and in the public domain and open access." The findings showed that with greater use of e-Content, the student's reading behavior is significantly impacted by the digital world, such as web-based social media platforms and search engines such as Google. Ünal & Hasturk (2019) investigated the effect of the E-learning method on the student's science achievement by using the example of an acid-base topic. The experimental research design opted to carry out the research from Turkey. The study result showed that the experimental group who received the treatment of the e-content-based instruction significantly improved their achievement in the acid-base topic compared to the control group. This study recommends that teachers training to prepare e-content and its integration into science increase students' achievement. Nachimuthu, K. (2018) designed and developed the e-content using the ADDIE Model and examined its effects on the 174 eleventh-standard students in botany. The study showed a positive impact on science achievement. And recommends that application of e-content may significantly impact teaching and learning in botany in higher education. Gupta & Lata (2017) inspected the effect of "IT-enabled instructional package (ITEIP)" on science (biology) achievement. 140 students in 10th grade were taken as samples for the experiment research. The study had proven that IT-enabled instructional packages provoke the radical change in the student's science (biology) achievement and provide a multisensory learning experience. According to Jazeel (2016), an investigation



**Neha Rawat et al.,**

through the heutagogy technique coupled with the e-content on science on the topic of osmosis revealed its effectiveness on the science students studying in the college of Sri Lanka. In the study, four quadrants; Web resources, e-tutorials, e-content, and self-assessment were taken on the content generation level. Findings showed that e-content was found to significantly affect the learner's achievement. A study was designed by Samikwo (2016) to study the "effect of computer-assisted learning (CAL) on the achievement of biology students". With this purpose, 274 students from twelve secondary schools in Kenya were selected as a subject. The findings showed that CAL positively improved the retention power of the students in biological knowledge. In conclusion, it was observed that the experimental group showed a more positive attitude and self-efficacy in terms of CAL.

Thus, all the above-mentioned studies have also shown that e-Content-based learning can be accomplished using websites. ICT, E-content can act as a catalyst to bring about a radical shift in pedagogy, which is the core of education in the twenty-first century. Hence E-learning in any way has a positive impact on learning by overcoming individual differences. Apart from the above studies, freely available e-content from various government and private stakeholders providing e-content of secondary-level science has been explored. It is found that most of the e-content lacks incorporation of principles of instruction, namely simple to the complex presentation of concepts, constructivist approach of learning, use of linear programming, immediate reinforcement, and formative assessment. Therefore, it is justified to work on developing e-content in Biology to bring quality.

AIM AND OBJECTIVES

The study has aimed to develop qualitative e-modules in biology and assess them through experimental study. For this purpose, the following two objectives are formulated

1. To develop e-content modules in biology topics for students of the ninth class.
2. To assess the effectiveness of e-content modules of Biology content for students of the ninth class.

Hypotheses

The following hypotheses are formulated against the objectives.

1. The mean scores of pre-measures of treatment and the non-treatment group of Biology e-modules are insignificant.
2. The mean scores of the pre and post-measures of the non-treatment group Biology e-modules are insignificant.
3. The mean scores of the pre and post-measures of the treatment group of Biology e-modules are insignificant.
4. The mean scores of post-measures of the treatment and non-treatment groups of Biology e-modules are insignificant.
5. The difference between the achievements of the two groups, namely conventionally taught (=non-treatment group) and e-content instructed (=treatment group) on controlling means of pre-test scores in Biology e-modules, is insignificant.

METHODOLOGY

Research Method and Design

An experimental research method was adopted, and a "randomized control group pre-test and post-test design" were assigned to assess the e-modules developed.

Sampling Technique and Sample Size

Probability, a Simple random sampling technique, has been employed for the present study. A sample size of 56 students from the ninth class has been selected. Out of 56 students, 28 have been assigned to the control and experimental group. For making equivalent groups for the experiment, they have been administered the Group Verbal Intelligence test by Dr. Srinivasan. Based on similar IQ levels, which range from Average (IQ range of 90-109) to superior (IQ range of 110-124), participants were assigned randomly to control and experimental groups of Biology based on the lottery system.





Neha Rawat et al.,

E-Content and Tools Used for Experiment and Data Collection

The tools and e-content used for the experiment and collection of data for the study were:

- (1) Verbal Intelligence test by Dr. P.Srinivasan,
- (2) e-modules of Biology (self-developed based on the ADDIE model) and
- (3) Achievement test in Biology (self-developed and standardized).

Plan of the Study

Due to the unique nature of the study, research work has been carried out in two distinct phases; namely, the developmental phase as the first phase of the study, where in e-content was developed and validated, and the experimental phase, wherein research experiment was conducted to assess the effectiveness of the developed e-content of Biology on students' achievement.

First Phase: Developmental Phase

The foremost consideration for the e-content development was to select an appropriate instructional design model. Due to the availability of more than 100 models of instructional designs for the development of e-learning resources, the ADDIE model was chosen because of its five well-defined steps, high flexibility, and generic applicability in all e-learning systems. The acronym "ADDIE" stands for "Analyze, Design, Develop, Implement and Evaluate," which proposes the stages for developing e-content for any level. ("ADDIE Model", n.d.). Making the ADDIE model as a basis, central sub-processes during the research work have been carried out. Discussing the process of e-content development in terms of sub-processes is essential as it provides us with a more realistic picture of the flow of research work. The following **figure 1** gives an overview of the sub-processes involved and activities carried out further in the developmental and experimental phases of e-content development and assessment.

As depicted in the above figure 1, the study has followed the above processes and sub-processes of the ADDIE model for developing qualitative e-content. During the development phase, preparations for the experimental phase by validating e-modules of Biology were also made. To validate the e-content of Biology, an expert opinion survey was conducted with Subject Matter Experts (SME).

The courseware for the study has been developed as a website (www.learning-afresh.com) that launches e-content modules of Biology.

There were 77 screens developed for the story boards of Biology, with 20 screens for Module 1, 20 screens for Module 2, 19 screens for Module 3, and 18 screens for Module 4. An example of the storyboards has shown in figure 2.

Second Phase: Experimental Phase

During implementation, the course is put into action. For the study, e-content modules were introduced to the students of experimental groups. They were shown the website and various tabs and informed that the website is computer and Smartphone enabled. Afterward, participants were administered a self-developed and standardized achievement test in Biology before the training (pretest) and after training (posttest) to determine the amount of learning that had occurred through the e-modules. Also, results have been objectively measured through statistical treatment of pre and post-measures data of treatment and non-treatment groups and their comparison. The evaluation process outcomes are requirements for the real-time implementation of e-content courseware and suggestions for e-content enhancement.

Analysis of Data

To accomplish objective 2, under the experimental phase of the study, data were analyzed and interpreted using suitable statistical techniques.





Neha Rawat et al.,

The mean scores of pre-measures of treatment and the non-treatment group of Biology e-modules are insignificant.

The critical ratio (t-value) has been calculated to determine the mean scores' differences between the two groups. The details are given in table 1. and figure 3. The value of obtained t is 1.21 for N=56, which is less than the p-value at 0.05 level (obtained $t < p$ -value at 0.05). Therefore, null hypothesis 1 is accepted. The mean scores of the pre and post-measures of the non-treatment and treatment groups are insignificant. Therefore, it is interpreted that the two groups were almost at equal achievement levels before giving treatment.

The mean scores of the pre and post-measures of the non-treatment group Biology e-modules are insignificant.

The critical ratio (t-value) has been calculated to determine the mean scores' differences between the two measures. The details are given in table 2. and figure 4. The value of obtained t for N=56 is 1.97, which is less than the p-value at 0.05 level (obtained $t < p$ -value at 0.05). Therefore, null hypothesis 2 is accepted. The mean scores of the pre and post-measures in the non-treatment group of the biology e-module are insignificant. It can be interpreted that the non-treatment group remains at the same achievement level because of the absence of experimental treatment.

The mean scores of the pre and post-measures of the treatment group of Biology e-modules are insignificant.

The critical ratio (t-value) has been calculated to determine the mean scores' differences between the two groups. The details are given in table 3 and figure 5. The value of obtained t for N=56 is 3.33, which is more than the p-value at 0.05 level (obtained $t < p$ -value at 0.01 and 0.05). Therefore, null hypothesis 3 is rejected. The meanscores of the pre and post-measures in the treatment group of the biology e-module are significantly different. It implies that the treatment group shows a significant rise in achievement due to the administration of treatment as instruction through Biology e-modules during an experiment.

The mean scores of post-measures of the treatment and non-treatment groups of Biology e-modules are insignificant.

The mean differences mean scores between the two groups were tested for significance by determining the critical ratio (t-value). The details are given in table 4 and figure 6. The value of obtained t is 2.7 for N=56, which is more than the p-value at 0.05 level (obtained $t < p$ -value at 0.05). Therefore, null hypothesis 4 is rejected. The means of the post-test scores of pupils in the treatment and non-treatment groups are significant. This means that the two groups differ significantly in their achievement after the experiment. This can be attributed to the experimental group's treatment increasing its achievement compared to the non-treatment group, which did not receive any treatment.

The difference between the achievements of the two groups, namely conventionally taught (=non-treatment group) and e-content instructed (=treatment group) on controlling means of pre-measured in Biology e-modules, is insignificant.

The investigators performed further data analysis through XLstat and SPSS to arrive at more reliable results and thus increase the robustness of the analysis process. For this effect, pre-measures and post-measures scores were analyzed through a one-way ANCOVA technique. After controlling the impact of the pre-measures, the means of post-measures scores were examined for significance. The data and results as sum of squares, mean squares variance, and 'f' ratio and p-value for the Biology group are presented in tables 5.0a & b. Above table 5a, the p-value is less than 0.05, so the null hypothesis is rejected. This means that there is a significant difference in the achievement of the pupils who were taught conventionally (=non-treatment group) and those who were instructed through e-content (=Treatment group) on controlling means of pre-measure scores in Biology e-modules.

Also, the null hypothesis was again rejected by conducting an interaction analysis between the independent and dependent variables. Table 5b of the results is as follows:

From above table 5.0.b, it is further verified that the p-value is less than 0.05, so the null hypothesis is rejected. Hence there is a significant difference in the achievement of the pupils who were taught conventionally (=non-treatment group) and those who were instructed through e-content (=Treatment group) on controlling means of pre-measures scores in Biology e-modules.





Neha Rawat et al.,

From figure 7. the line shows the estimated marginal means of post-test scores obtained by the treatment group (=t) and non-treatment (=c). It can be seen that the post-measure scores of the treatment group are higher than the non-treatment group. It also indicates linear regression between treatment and pupils' scores. It implies that as treatment increases, student achievement is increased in Biology e-modules.

Findings of the Study

The study has two major phases- (i) the Developmental phase and (ii) the Experimental phase. The first phase being qualitative in nature, had outcomes in the forms of various responses from the participants, experts, developers, and others involved in the developmental process. Following are the significant findings that are obtained by answering the research questions qualitatively: -

Developmental Phase-findings of qualitative nature

- The design of the courseware as the website www.learning-afresh.com drew the target group's attention successfully as multimedia components text, audio and images were effectively integrated into the modules. It kept users actively engaged during the implementation of the e-modules of Biology.
- Learning objectives related to the development of e-content of Biology are achievable.
- All the sub-processes and processes ("Analysis, Design, Development, Implementation and Evaluation") of the "ADDIE" instructional design model can be effectively implemented to develop qualitative e-content.
- Teachers can quickly develop e-content of their own by following the steps of the ADDIE model of instructional design adopted for the development of e-content.
- Story board can be meticulously developed with details of each screen.
- Pedagogues of various fields can be educated on how to evaluate their students objectively using e-content of Biology through an appropriate achievement test based on it.

Experimental Phase-Findings of quantitative nature

The second phase, quantitative in nature, involved the assessment of e-modules of Biology through experimental research design. Following are the significant findings that are obtained by testing the hypotheses quantitatively about the experimental phase:

- Treatment and non-treatment groups of Biology groups were of the same ability in the achievement level of their students before the experiment.
- Further, when pre-measures scores as covariates were controlled to run the ANCOVA test there was found a significant difference between the achievements of two groups, namely conventionally taught (=non-treatment group) and e-content instructed (=treatment group). This means that the two groups differ significantly in their achievement after the experiment. This can only be attributed to the treatment received by the experimental group increasing the achievement of pupils in comparison to the control group, which did not receive any treatment.

CONCLUSION

In light of the research findings, the present research may alleviate the difficulties of science learners of ninth class on specific topics of Biology by assessing freely available e-content of the website www.learning-afresh.com. The study also suggests teachers' path to e-content development through the intricate detailing of each process and sub-process of instructional design based on the ADDIE model.

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Neha Rawat et al.,

Table 1: Test of the significance for treatment and the non-treatment group of Biology e-modules

Group	Sample	Mean	Standard Deviation	Calculated t value	p-value
Non-Treatment Group	28	42.04	6.10	1.21	2.01 (At the level of significance 0.05 for df=56)
Treatment Group	28	44.11	6.62		

Table 2: Test of significance for the non-treatment group of Biology e-modules

Measures	No. of pupils	Mean	Standard Deviation	Calculated t value	p-value
Pre-measures	28	42.04	6.10	1.97	2.01 (at the level of significance 0.05 for df=56)
Post-measures	28	45.36	6.53		

Table 3: Test of the significance for the treatment group of Biology e-modules

Measures	No. of pupils	Mean	Standard Deviation	Calculated t value	p-value
Pre-measures	28	44.11	6.10	3.33	2.01 (at the level of significance 0.05 for df=56)
Post-measures	28	50.18	7.02		

Table 4: Test of the significance for treatment and non-treatment groups of Biology e-modules

Group	No. of pupils	Mean	Standard Deviation	Calculated t value	p-value
Non-treatment Group	28	45.36	6.53	2.7	2.01 (At the level of significance 0.05 for df=56)
Treatment group	28	50.18	7.02		

Table 5. a: Analysis of variance (at 0.05 level of significance)

Source	DF	Sum of squares	Mean squares	F	Pr > F
Model	2	1336.861	668.430	22.606	< 0.0001
Error	53	1567.121	29.568		
Corrected Total	55	2903.982			

Table 5. b: Interaction Analysis: Tests of Between-Subjects Effects

Dependent Variable: Post-test					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1343.551 ^a	3	447.850	14.924	.000
Intercept	425.502	1	425.502	14.179	.000
Group	19.681	1	19.681	.656	.422
Pre	1018.104	1	1018.104	33.927	.000
Group * Pre	6.690	1	6.690	.223	.639
Error	1560.431	52	30.008		
Total	130683.000	56			
Corrected Total	2903.982	55			

a. R Squared = .463 (Adjusted R Squared = .432)





Neha Rawat et al.,

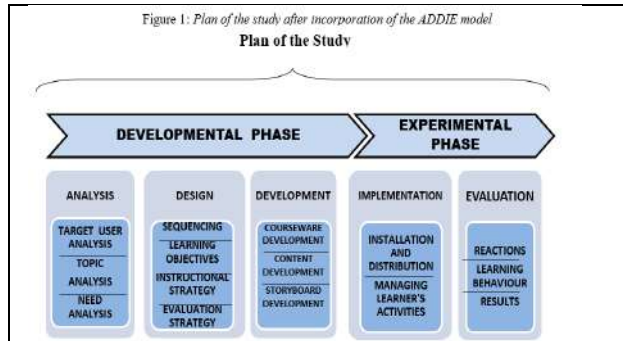


Figure1. Plan of the study after incorporation of the ADDIE model

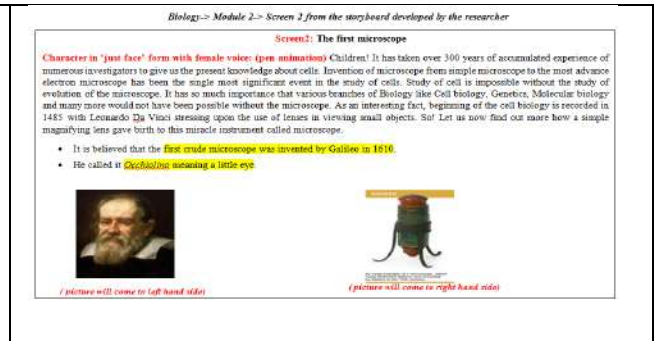


Figure 2: A sample storyboard of the biology e-module prepared in MSWord

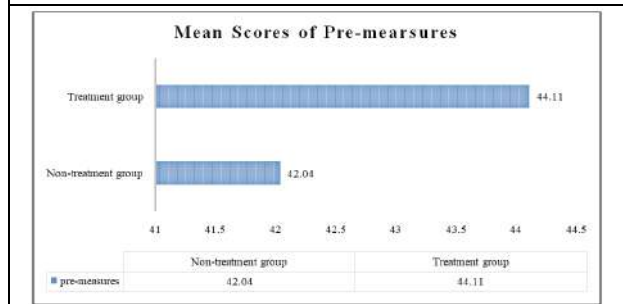


Figure 3. Graphical representation of the mean scores in Experimental and Control groups

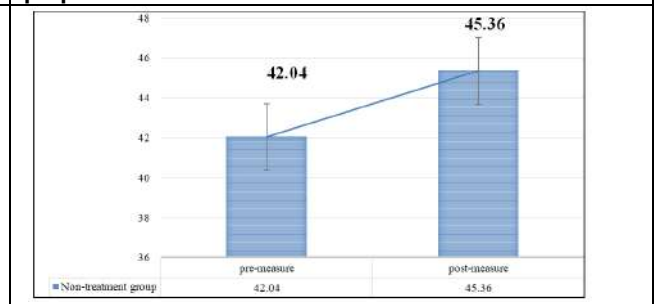


Figure 4: Graphical representation of the mean scores' differences in the non-treatment group

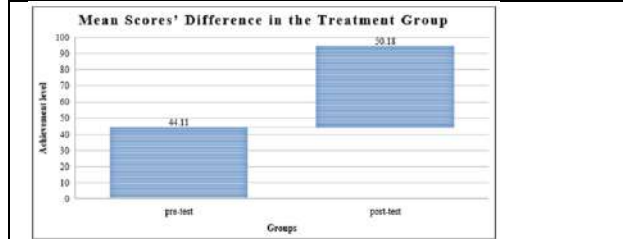


Figure 5: Graphical representation of the mean scores' difference in the treatment group

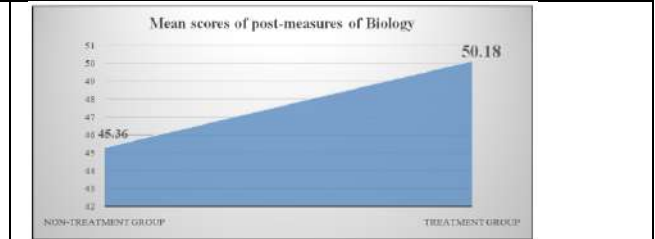


Figure 6: Graphical representation of the differences in the mean scores in treatment and non-treatment groups

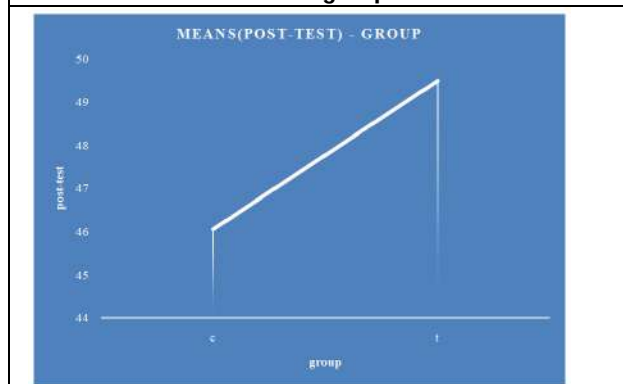


Figure 7: Means of post-test scores obtained by treatment group (=t) and control (=c) group

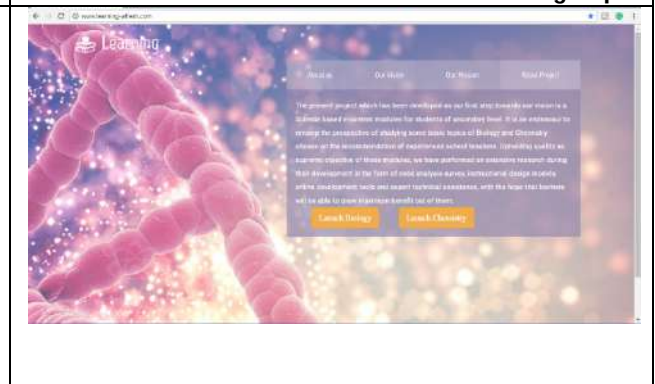


Figure 8: e-content modules of Biology.





Multiple Feature Analysis for the Early Detection of Parkinson's Disease Extraction of Voice Data through Deep Learning

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ABSTRACT

Parkinson's disease is a central nervous system neurodegenerative disease. PD prediction, a difficult task, has been studied more recently. Sleep, speech, olfactory, and autonomic disorders will result from central nervous system disorders. Doctors struggle to diagnose PD early. Symptom and disorder measurement can predict PD. Prediction saves a million lives. Using machine learning and feature selection, this article diagnoses PD early. Parkinson's disease data is preprocessed first. MFEA extracts features in stage two. A comparison between the proposed deep learning and ensemble learning methods based on relatively small data including 183 healthy individuals and 401 early Parkinson disease patients shows the superior detection performance of the designed model, which achieved the highest accuracy 96.45% on average. Dark NetCNN classifies PD patients. Additionally, DNetCNN outperforms other methods in early PD detection. DNetCNN detects PD early at 98.87%. The result evaluation compares other performance metrics, showing that the proposed model outperforms all other models.

Keywords: Parkinson's Disease, Machine Learning, Deep Learning, Deep Neural Network, Darknet Convolutional Neural Network, Feature Selection.

INTRODUCTION

Parkinson's Disease (PD) is a neural disorder disease which can damage the health of different age group people around the world. PD is classified into various types which are based on different abnormalities. It mostly damages the activities of neurons and body movements [1]. The worst part is that the disease is not curable and not reversible [3], so all efforts have been made to its early detection and preventive measures to suppress its adverse effects. Medical science reveals that Parkinson's disease mainly causes a gradual reduction of the dopamine hormone in the human brain as this hormone acts as the transmitter of signals among various neurons [4]. Insufficient amount of



**Repudi Pitchiah and Sasi Rooba**

dopamine hormone leads to non-transmission of signals and various neuro-related disorders and symptoms being started in human beings, and Parkinson's disease is one of them. Symptoms of PD can be nonmotor and motor-related. Non motor symptoms include sleep disorder, speech variation, problems in swallowing, and loss of smell, whereas motor symptoms were connected to slow movement, e.g., bradykinesia, tremor, rigidity, and postural instability [5].

These symptoms also vary from patient to patient over different time periods, and the appearance of symptoms is often lately observed by the patient due to the casual ignorance of early symptoms. The effect of Parkinson's disease varies from person to person, and all the symptoms may not be evident to every PD patient and even may not appear in the same order and same combination. To predict PD symptoms in the initial stage, the medical research work collaborates with computational intelligence techniques. The researchers are evolved their research on PD using Machine Learning (ML) approach to predict PD at an early stage in recent years [5]. Speech changes are the first motor symptom that appears ten years before the diagnosis starts [6]. Therefore, assessing speech signals provides a better scope for detecting chances of Parkinson's in the early stage. Many researchers have developed PD prediction systems based on various types of data sets. The data sets include images, text, video, and audio content of PD patients. These data sets are diagnosed and used by appropriate feature detection methods [6]. The researchers can deal with sensor data, motion detection, vocal data, and pictorial data. Many researchers concentrated on ML-based prediction techniques to predict PD on these data sets only but not on multi-type data sets [7]. To present PD abnormalities, the researchers can use any type of data set. The proposed techniques are used in predicting PD accurately when compared to the other methods in machine learning techniques. The final detection results are used to compare the performance of both selection algorithms and classifying algorithms. Mainly, this work is focused on voice attribute-based PD. The manuscript is organized as follows. Section "Materials and methods" elaborates on the dataset and discusses the automatic PD detection model, with classifier validation methods and evaluation metrics. In the section "Results," experimental results are given in detail. Section "Discussion" makes a discussion about the results. Some concluding remarks are given in the section "Conclusion."

Related Work

PD prediction has been studied using medical and computational biology methods. R.M. Sadek *et al.* [9] proposed predicting early PD using Back Propagation and ANN techniques. These methods detect patient motion. Registering and training patient activity patterns improves disease evaluation. The authors examined acceptable PD results on homogeneous medical features. Better performance. James Wingate *et al.* [10] proposed using Convolutional Recurrent Network to predict early-stage PD. This method analyses dopamine transporter scans and magnetic resonance images. The framework predicts PD across medical settings. The experimental study showed the authors how to predict PD using real-world medical image data sets. The proposed approach introduced an error criterion that trains with DaTscans and MRIs using domain adaptation.

MATERIALS AND METHODS

First, data are noise reduced. Two static vector features are retrieved from the noise-reduced speech sample. All recordings were normalized before analysis to eliminate inter-experimental variations like mouth-microphone distance. Filter extracted features to compare the best selection algorithm for the feature selection module. DCNN tests and selects features for model embedding [11].

Dataset

The proposed method detects Parkinson's illness through feature collaboration. Baseline Features (BF), Vocal Fold Features (VFF), and Time-Frequency Features (TFF) concerning Parkinson's and control patients' auditory signals were investigated for feature collaboration. The UCI machine learning repository [12] contains all the BF, VFF, and TFF from a recent Parkinson's detection database created at the Department of Neurology in Cerrahpas, Faculty of Medicine, Istanbul. 252 control and Parkinson's participants have 752 acoustic characteristics in the database. A 44.1





Repudi Pitchiah and Sasi Rooba

kHz microphone and medical inspection prepare data. Each subject sustained /a/ three times.*e vast 752 features also include 22 VFF, 11 TFF, and 21BF. These features are extracted using acoustic analysis. Using a Rode NT-USB microphone 10 cm from the mouth, realistic speech recordings were made. Data sampling was 96 kHz. Data is in.wav format. Phonatory and articulation analyses included sustained vowels and running speech tests. Spectral subtraction (SS) cleans up noisy speech [13].

Feature Selection

The proposed fusion of DWT and MFCC uses the features taken from each separately and calculates distances using Euclidean distance. The log of power was calculated for each Mel frequency. Mel frequencies were discretely cosine transformed to obtain MFCC coefficients. Three-layer DWT. Decompose the sampled input speech signal into approximate and detailed coefficients. Increasing discrete wavelet standardized vectors projected onto the second Mel-scale. MFCC approximates human system reactions better than any other system because its frequency bands are logarithmic. Speech recognition systems often normalize MFCC data to reduce noise [14]. Speech feature extraction using wavelet transform has replaced Mel-filtered sub band energies with wavelet decomposed sub and energies. Wavelets separate signal details well. DWT provides time-frequency localization. Small wavelets can isolate fine signal details, while large wavelets can identify coarse details. Wavelet Transforms model unvoiced sound better [14].

Darknet Convolutional Neural Network (DNetCNN)

Artificial neural networks and deep learning are important in classification and regression research today. The convolutional neural network was proven to be the best classifier among the various deep learning models. The classification by CNN was hampered if the quality of the speech signal was poor. The DNetCNN [15] structure was added as the first layer of CNN in the proposed work to improve the classification accuracy of Parkinson's disease prediction. The activation function activates the darknet structure's 19 convolutional layers and five pooling layers. The sigmoid activation function is used for binary classification. The Softmax activation function is used for multi-classification. The 2D convolutional operation is performed using Equation for the input data X and kernel K[16].

$$C(X,K)_{(i,j)} = \sum_r \sum_c K(r,c) \times X \times (i-r, j-c) \quad (1)$$

$$\text{Sigmoid}(h) = \frac{1}{1 + e^{-X_i}} \quad (2)$$

DNetCNN proposed 16 convolution layers. Each darknet layer had one convolutional layer for convolution and activation. The four convolution layers had the same three-form follow-up. The convolution layer normalized the input image, reducing training time. Maxpool was 2*2 in the pooling layer. It maximizes the filter region. From the darknet to the convolution layer, the filter

RESULT AND DISCUSSION

For all the classification problems, the performance metrics such as accuracy, sensitivity, specificity, F-1 Score, and Precision were calculated so as to prove the accuracy of classification.

Accuracy (Acc) refers to the total number of correct predictions divided by the total number of predictions and multiplied by 100 [18].

$$\text{Recall} = \frac{(\text{TruePositive})}{(\text{TruePositive} + \text{FalseNegative})} \quad (4)$$





Repudi Pitchiah and Sasi Rooba

Precision: It refers to the number of correct positive results divided by the number of correct positive results. It can be denoted as [19]:

$$\text{Precision} = \frac{(\text{TruePositive})}{(\text{TruePositive} + \text{FalsePositive})} \quad (5)$$

Specificity: It refers to the number of correct negative results divided by the addition of correct negative and incorrect positive results. It can be denoted as:

$$\text{Specificity} = \frac{(\text{TrueNegative})}{(\text{TrueNegative} + \text{FalsePositive})} \quad (6)$$

F1-Score: It is used for measuring accuracy of the tested data. It refers to as harmonic mean of recall and precision. It can be denoted as [20]:

$$\text{F1-Score} = \frac{2 * (\text{Precision} * \text{Recall})}{\text{Precision} + \text{Recall}} \quad (7)$$

From Table 2, the proposed feature extraction when applied to DNetCNN classifier provides an improvement in accuracy by 96.11%, 98.87%, 95.06%, and 94.28% compared with CNN and DNN, for 80-20, 70-30, 60-40 and 50-50 training and testing data respectively. In comparison with MFCC alone and DWT alone, the proposed feature extraction using DNetCNN classifier gives an increase of 96.13%, 95.38%, and 93.51% in accuracy for Vocal Fold, Time Frequency, and Baseline Features respectively. Therefore, the MFCC and DWT features applied to the DNetCNN classifier outperformed well when compared to the various machine learning techniques and can be implemented at its early stage for diagnosing PD.

CONCLUSION

This article proposes a collaborative PDD model. The model uses to control Parkinson's subjects' vocal fold, time-frequency, and baseline features. Our PD detection model outperformed other function-based detection models. Finally, the Parkinson's detection model's shortcomings and future have been extensively discussed.

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Repudi Pitchiah and Sasi Rooba

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Table1. Features of Sample Acoustic Parkinson Disease Dataset

Features	No. of. Features in the Dataset
Baseline Features	
The entropy of recurrence period density	1
Detrended fluctuation	1
The entropy of the pitch period	1
Harmonica	2
Variants of jitter	5
Variants of shimmer	6
Time-Frequency Features	
Voice intensity	3
Bandwidth	4
Formant Frequencies	4
Vocal Fold Features	
Glottis Quotient	3
Glottal to Noise Excitation	6
Empirical Mode Decomposition	6
Vocal fold excitation ratio	7





Repudi Pitchiah and Sasi Rooba

Table2. Performance Evaluation of Proposed Work

Training & Test Data	Classifiers	Performance Parameters				
		Precision	Recall	Specificity	Accuracy	F1-Score
Training and Test Data (80-20)	CNN	89.23	88.13	92.34	95.72	87.35
	DNN	89.46	88.76	92.89	95.81	88.13
	DNetCNN	89.94	89.12	93.42	96.11	88.67
Training and Test Data(70-30)	CNN	91.18	90.08	94.29	97.67	89.39
	DNN	91.41	90.71	94.84	97.76	90.08
	DNetCNN	91.89	91.07	95.37	98.87	90.62
Training and Test Data(60-40)	CNN	88.18	87.08	91.29	94.67	86.37
	DNN	88.41	87.71	91.84	94.76	87.08
	DNetCNN	88.89	88.07	92.37	95.06	87.62
Training and Test Data (50-50)	CNN	87.42	86.32	90.51	93.89	85.52
	DNN	87.63	86.93	91.06	93.98	86.31
	DNetCNN	88.11	87.29	91.59	94.28	86.84

Table3. Feature Comparison of Vocal Fold Features

Feature Extraction Methods	Accuracy	Sensitivity	Specificity
MFCC	89.25	78.45	94.78
DWT	78.32	99.23	56.14
Proposed Multi-Variate Vocal Data	96.13	88.45	95.86

Table4. Feature Comparison of Time-Frequency Features

Feature Extraction Methods	Accuracy	Sensitivity	Specificity
MFCC	88.5	77.7	94.03
DWT	77.57	98.48	55.39
Proposed Multi-Variate Vocal Data	95.38	87.7	95.11

Table5. Feature Comparison of Baseline Features

Feature Extraction Methods	Accuracy	Sensitivity	Specificity
MFCC	86.63	75.83	92.16
DWT	75.7	96.61	53.52
Proposed Multi-Variate Vocal Data	93.51	85.83	93.24





Repudi Pitchiah and Sasi Rooba

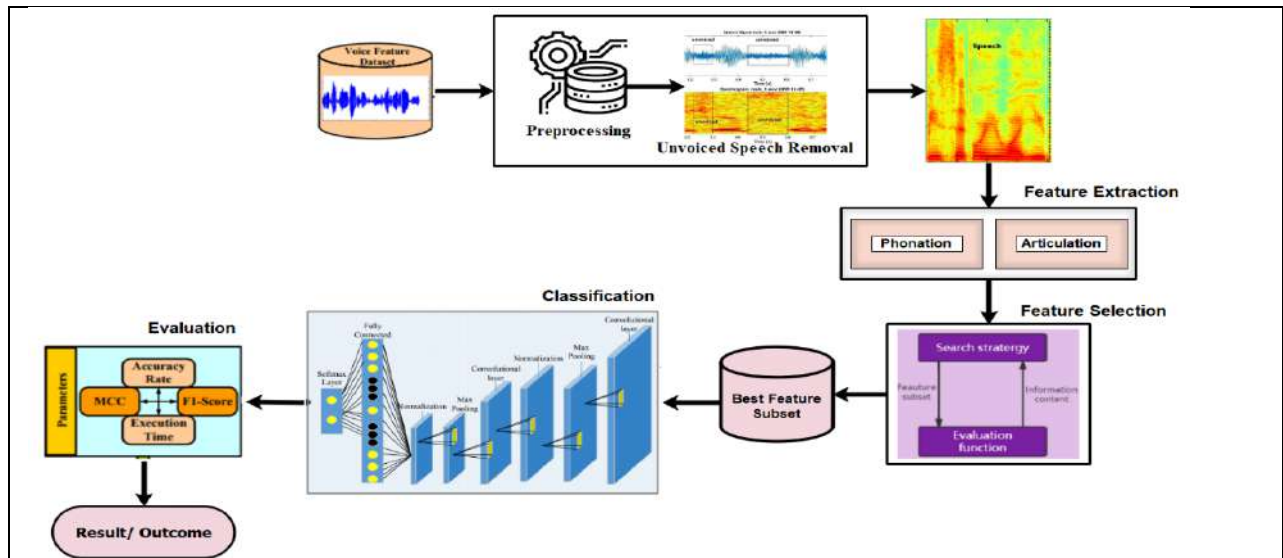


Figure 1. Methodology of Parkinson's Disease Detection Model.

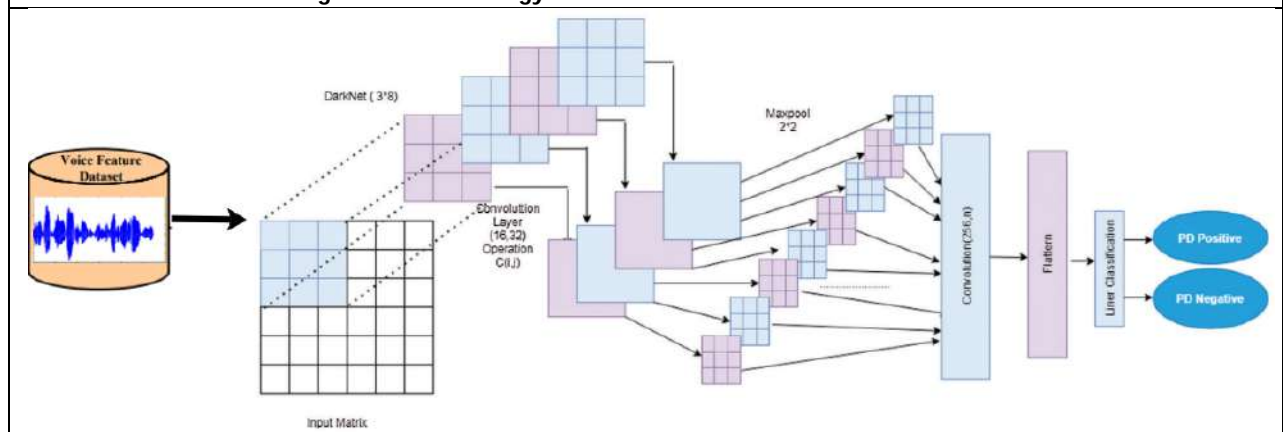


Figure 2. Structure of proposed Darknet Convolutional Neural Network

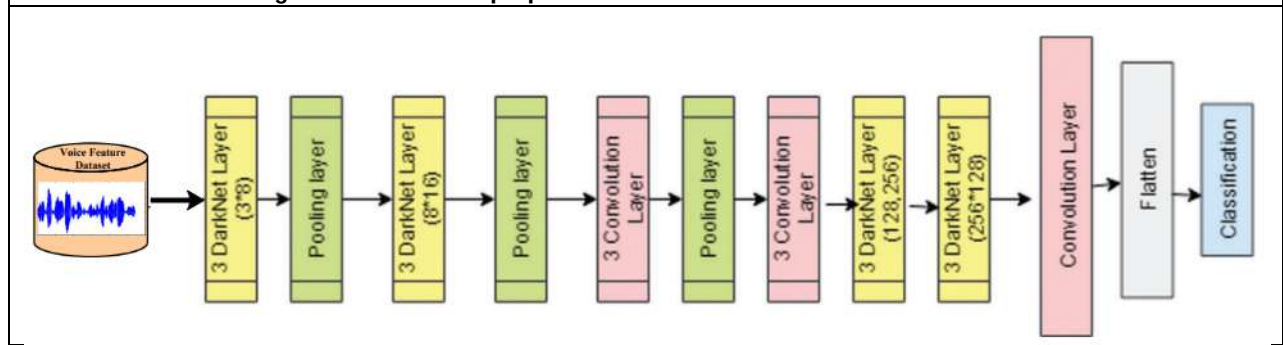


Figure 3. The layered structure of the proposed Darknet Convolutional Neural Network





Repudi Pitchiah and Sasi Rooba

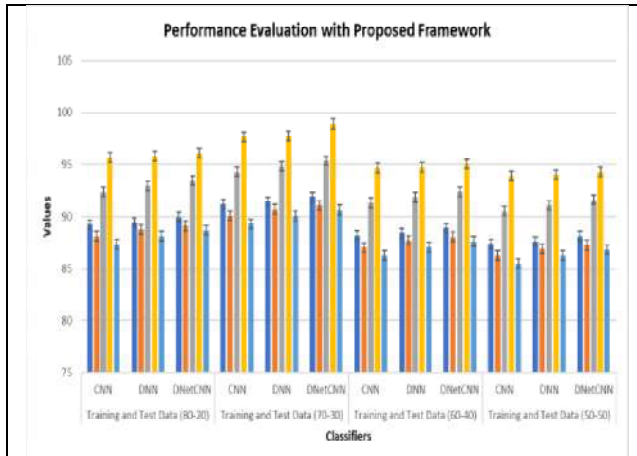


Figure 4. Performance Evaluation of different classifiers

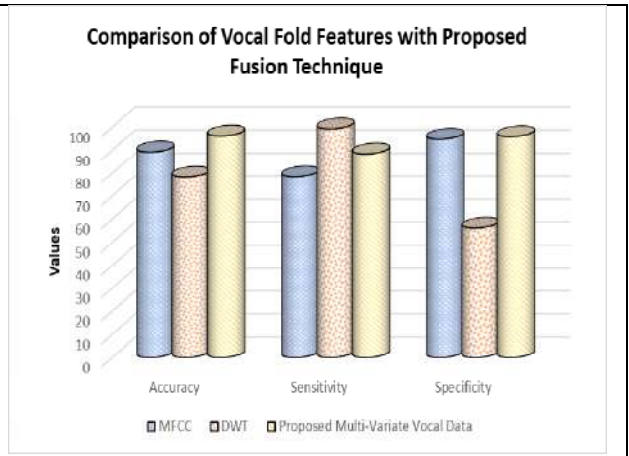


Figure 5. Feature Comparison of Vocal Fold Features

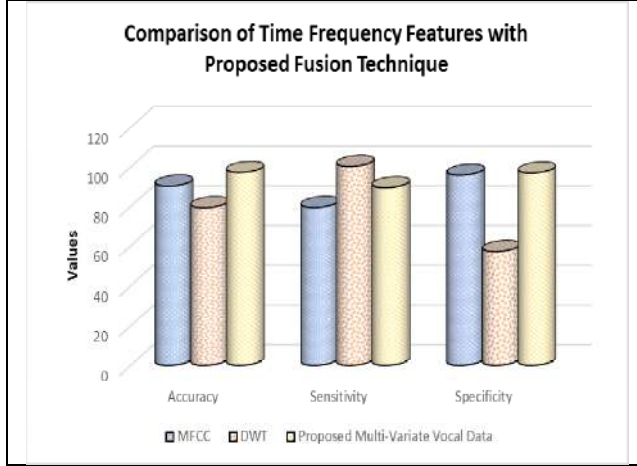


Figure 6. Feature Comparison of Time-Frequency Features

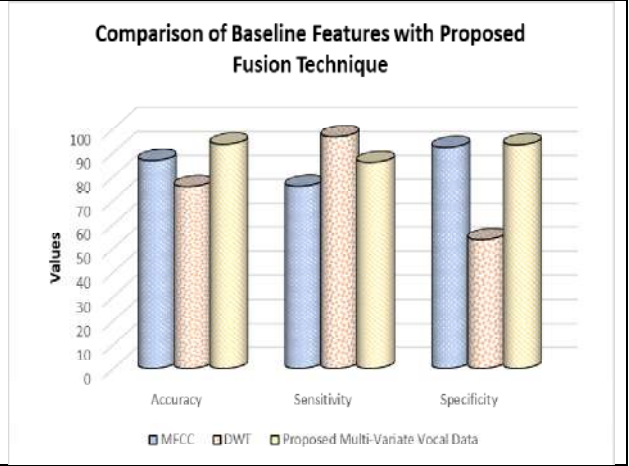


Figure 7. Feature Comparison of Baseline Features





Reflections of University Teachers over Online Teaching and Assessment during Covid 19: an Empirical Study

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ABSTRACT

Covid 19 has an adverse effect on our whole education system. There was a speedy move from in person mode to online mode of teaching-learning. At the beginning of the pandemic, the MHRD had taken initiatives which help a lot to promote online teaching-learning process during COVID-19 such as Web of Active-Learning for Young Aspiring Minds (SWAYAM), Massive Open Online Courses (MOOC), and Annual Refresher Program in Teaching (ARPIT). The Universal Grant Commission (UGC) a top figure of higher education has taken the COVID situation seriously. A panel of UGC (May 22, 2021) recommended that 40% of the syllabus should be completed through online mode of teaching while 60% by physical mode and also made it mandatory for all the universities in India. Although, all higher educational institutions tried to perform, there are some unavoidable problems & challenges took place as an obstacle in the area of teaching learning process. The current study made an attempt to understand the sort of experiences gained through online teaching during the pandemic. For executing the undertaken study, a total of sixty (60) Assistant Professors purposively as the sample of the study. The descriptive survey method was adopted and a self-constructed structured questionnaire had been employed to accumulate the required data. The study exposed that 93% of university teachers (i.e. Assistant professors) declared that offline courses were more effective than online courses because the psychological attributes played a vital role for an effective teaching-learning environment. Further, it observed that the majority (85%) of the teachers demanded some training to conduct an online assessment as they were partially aware of online assessment platforms. The study found that 59% university teachers reported that the



**Rama Verma and Ravi Vanguri**

inaccessibility of the internet and digital divide were the major challenges while adopting online assessment at university level.

Keywords: Online Teaching, Assessment, Reflections, University Teachers, Covid 19.

INTRODUCTION

Education is a major expedient that acts as a booster both for the nation and its citizens. It has its greatest impact on individual and helps to bring desirable changes in the behavior of an individual. Inevitably the behavior of an individual impacts the nation as a great extent. "Education which will offer the tools whereby one can live for the divine, for the country, for oneself and for others and this must be the ideal of every school which calls itself national"-Sri Aurobindo. After a long time, the Government of India has made some policies for bringing improvements in the field of education, such as the National Education Policy (NEP) 1968, National Education Policy 1986, POA 1992 (Modification of NPE-1986). Recently the Government of India introduced NEP-2020 after a long period of 34 years. All policies are different from one to one and evolved with considering the rapid changes of the society and needs of stakeholders (at locally & globally). The COVID-19 has disturbed the whole education system without former information. It has not given time to any educational institution to make prior planning to continue the teaching learning process smoothly. The effect of the pandemic situation on our education system could be seen in both ways positively and negatively. In order to continue the teaching learning process during COVID-19, the need was realized that there should be a quick shift from in person mode of learning (face to face) to online modalities and platforms. The strong believers of face to face mode of teaching also seem to be helpless as they have had no alternate of offline mode except online. The smooth functioning of online teaching-learning is possible only if challenges like non-availability of electronic devices, instability of the internet, the digital divide will abolish. Mishra, et.al. (2020) revealed that digital divide, instable internet connection, lack of motivation as immediate feedback were the challenges that comes under the way of online teaching and learning. NEP-2020 and COVID-19 both come about at the same time. NEP-2020 also laid emphasis on online teaching-learning and assessment in order to build up the teaching-learning environment more suitable as per the requirement of the contemporary world. But, the COVID-19 circumstances also played a vital role in bringing online teaching-learning in the lap of different levels of education, such as Primary, Secondary and Higher education. Now, the question arises at the higher at the higher level of education, what kind of issues and challenges do the teachers encounter? What opinion did they possess towards learning and assessment during COVID-19? The proposed study made an attempt to know the reflections of university teachers regarding online teaching-learning and assessment based on their experience gained (online teaching)during Covid-19.

Need and Significance of the Study

After reviewing the related literature, the investigators found that many researches were conducted in the area of online teaching during COVID-19, but a very few studies were conducted with university teachers. The present study tried to pinpoint the experiences of university teachers that they have met with during online teaching in COVID-19 lockdown. How university teachers without prior training, lack of proper preparation and without a stable internet struggled in the world of digital education. What kind of opinions do they possess after conducting classes through online mode? What kind of obstacles was responsible for the uneven functioning of their classes through online mode of assessment at university level? At present, whether they are interested to teach courses through online mode? Do they prefer to teach through online mode, offline mode, or blended mode of teaching? As the majority of the studies revealed the technical literacy, digital divide, lack of training and unstable internet, etc. were major issues and challenges. Do the university teachers also encounter the similar challenges and problems? Even before COVID-19 also, there was already a great agreement in integrating Information and Communication



**Rama Verma and Ravi Vanguri**

Technology (ICT) in the field of education. To explore the answers of such kind of questions, the researchers have contributed their strong efforts by collecting data in physical settings.

Research Questions

- What opinion do the university teachers possess on the basis of teaching experiences through online teaching-learning during COVID-19?
- What are the reflections of university teachers for conducting online assessments during COVID-19?
- What challenges did university teachers encounter while practicing online teaching-learning and assessment in the classroom during Covid-19?

Objective of the Study

- To understand the reflections of university teachers about online teaching-learning and Assessment during Covid-19.
- To identify the challenges encountered by the university teachers while imparting online teaching-learning and assessments during COVID-19.

Explanation of the term used

In the present study, reflection means what thoughtful opinion does university teachers possess after having an experience or observation about online teaching and assessment at university level COVID-19.

- **Delimitation of the Study**

The present study was delimited to university teachers (Assistant Professors) of Central University of Jammu only.

METHODOLOGY OF THE STUDY

The present study adopted the descriptive survey method.

Sample of the Study

The Central University of Jammu was established in the year 2011. Presently the University is functioning with 16 departments under different disciplines-Humanities, Sciences and Social-Sciences. A total of 97 Assistant Professors are working in various departments of Central University of Jammu. In the present study the investigators collected data (purposively) from 60 Assistant Professors who are teaching in various departments of the University.

Tools employed for the data collection

For achieving the formulated objectives of the study, the researchers employed a self-constructed questionnaire which focused on online teaching-learning and online assessment and the data were also collected in physical settings and analyzed by using Frequency and Percentage Count.

From Table no.1 it can be understood that more than half of the university teachers (62%) thought online courses were effective to offer at university level, but 38% were against in this regard. On the other hand, 60% participants were interested to teach courses through online mode. The majority of the respondents (62%) thought that the understanding of students would not be great through online courses whereas 38 % were against in this regard. Widely 93% participants expressed that teaching through offline mode (face to face) was more effective than online mode. The reason behind this finding that in face to face mode (offline teaching) physical interaction between teacher and students and among peer group was more and connecting them psychologically which leads to effective teaching - learning process in the classroom. It also noticed from the teacher's preference regarding mode of teaching at university level, only 12 % participants gave their preference to online teaching, while 38% preferred blended mode, and 50% were interested offline mode.



**Rama Verma and Ravi Vanguri**

From Table 2, it can be observed that, the majority of the participants (88%) were aware of online assessment tools out of which only 40 % have complete awareness and the rest were partially aware in terms of assessment tools. The majority (85%) of respondents felt the need of training to conduct an online assessment at university level. It also understood from the above table that, 57% participants stated that they were lack of training to teach through online, 59% participants encountered inaccessibility of internet some time for teachers as well as for the students too. More than half of the participants (55%) assumed digital divide was a challenge which obstructs teachers as well as students while adopting online assessment. Technical literacy was also a big challenge faced by 53% teachers during COVID-19.

Along with the Semi-Structured Questionnaire, a three-point Likert type scale was also employed for collecting the data pertaining to opinion of the University teachers about online teaching and assessment. The following Table.3 shows the responses regarding it. Table 3 shows that the majority of the participants believed that online teaching was not effective unless and until digital divides will abolish (83%) and also they demanded rigorous training on integrating technology for teaching through online (80%). It was reported by 59% participants that traditional teaching was much better than online teaching. Further, it understood from the above that 70% perceived that online assessment worked effectively only for multiple choice examination and it was not a suitable strategy for judging the learners' development. Forty percent of the participants also voiced that online assessment was not improving critical and creative thinking skills of the students. Nearly fifty (48%) percentage of the university teachers' said that digital feedbacks decreases the motivational level of the learners.

Major findings of the study

- The present study revealed that the majority of the university teachers (Assistant Professors) (93%) believed offline mode of teaching was more effective over online mode.
- Although university teachers strongly believed in offline mode, 60% of the participants were found to have an interest towards teaching through online mode.
- When the participants were investigated with regard to their preference for teaching mode at university, the study revealed that 50% preferred offline mode, 38% said blended mode and only 12 % chosen online mode.
- The study reported that 88% of participants were found to have awareness about online assessment tools out of which only 40% were having complete awareness while 60% were found to have partial awareness.
- The present study understood that the majority of participants (80%) demanded the rigorous training on integrating technology for teaching through online mode.
- The study revealed that more than half of the participants expressed that technical literacy, inaccessibility of internet and lack of training were the challenges for online teaching and assessment. Further, the study report that the digital divide was a major challenge to teach through online for both university teachers and students.

Educational implications of the Study

- After COVID-19 the contemporary study made an effort to understand the reactions of University teachers. The results of study shown the actual experiences of university teachers with respect to infrastructure, awareness, digital literacy, instability of internet services and digital divide, etc. during online teaching. This would help the departments/university to bring requisite changes in terms of technological equipments wherever required.
- The study findings may also help other higher education institutions for organizing requisite training and awareness programs in order to make continuous development in the field of online teaching- learning.
- The outcomes of the study helps the policy makers to come up with a better plan to eradicate the barriers that obstruct the smooth functioning of the online teaching-learning process.

Suggestions for further research

- The sample for conducting the existing study was taken from the Central University of Jammu only. A similar study may also be conducted in the rest of the higher education institutions of UT-J&K.



**Rama Verma and Ravi Vanguri**

- In the present study, the investigators have concentrated to explore the reflections of Central University Teachers about online teaching and assessment during COVID-19 only. A similar study may be carried out on the other types of universities of India.
- Since the present study conducted with small sample size, it is suggested that this research may be replicated by taking large samples across the different universities.

CONCLUSION

The researchers tried to sum up the present paper with major findings as the offline (face to face) mode of teaching has no comparison with other kind of alternates, but due to the current circumstances every teacher was ready to swing from the in-person mode of teaching to online mode. It is accepted by everyone that Face to face interaction is the soul of teaching learning process. If the soul is missing in the body, may body will work, but emotions, eye contact, gestures, face reading, motivation as an immediate feedback will remain missing. The present study found that the majority of the participants were in favor of a face to face mode of teaching, but what noticed that 62% teachers were found to show their interest to teach through online mode. More than half of the participants declared Lack of training, Accessibility of the internet, Digital divide, Technical literacy were major challenges in the way of online teaching. The study advised that the policy makers must pay their strong efforts in order to encounter such kind of challenges in the future. NEP-2020 also laid emphasis on online learning and assessment; it will be possible only after taking such kind of challenges into consideration. If the challenges will remove automatically the University teachers will prefer online teaching and assessment at a great extent. In India, the online learning has started to set up their feet in the field of education before COVID-19, but a strong need to shift from traditional modes of learning the online felt only during COVID-19. Each and every one has tried to do their best as it was the only single medium by which one can make contact with their students and continue the teaching learning process ahead. The current study suggests that awareness for all digital platforms, online courses and assessment platforms among teachers and students must be created through various programs such as trainings workshops and orientation, etc. to overcome the weaknesses in the field of digital education.

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Rama Verma and Ravi Vanguri

Table No. 1. Reflections of University Teachers about Online Teaching (N=60)

S. No.	Items	Yes	No
1.	Offering online courses are effective at university level	37 (62%)	23 (38%)
2.	Interested to teach courses through online mode	36 (60%)	24(40%)
3.	Understanding of students would be effective through online teaching	23(38%)	37(62%)
4.	offline mode is more effective than online mode	56 (93%)	4 (7%)
5.	Preference of mode of teaching at university level a. Offline mode b. Online mode c. Blended mode	30 (50%) 7(12%) 23(38%)	-

Table No. 2. Reflections of University Teachers with respect to Online Assessment (N=60)

S. No.	Items	Agree	Disagree
1.	Awareness about online assessment tools.	53 (88%)	7 (12%)
2.	Aware of online assessment platforms	21(40%)	32(60%)
3.	Requirement of training to conduct the online assessment.	51 (85%)	9 (15%)
4.	Challenges encountered while adopting online assessment at university level.	Yes 34 (57%)	-----
	• Lack of training		
	• Accessibility of internet		
	• Digital divide		
	• Technical literacy	Yes 32 (53%)	-----

Table.3 Responses related to opinion of university teachers about online teaching and assessment.

S.No.	Items	Agree	Neutral	Disagree
1.	I think online teaching is not affected unless and until digital divides will abolish.	50(83%)	6(10%)	4(7%)
2.	I felt that teaching through online mode may not be suitable in the country like India.	23 (38%)	16 (27%)	21(35%)
3.	I believe that teaching through online mode requires rigorous training on the part of teachers.	48(80%)	8 (13%)	4 (7%)
4.	In my point of view, traditional teaching is much better than online teaching.	35 (59%)	15 (24%)	10 (17%)
5.	I perceived that online assessments are effective only for multiple choices Questions Examination.	42 (70%)	8 (13%)	10 (17%)
6.	I believe that online assessment will not be suitable for effective judgment pertaining to the individual learner development.	42(70%)	8 (13%)	10(17%)
7.	I opined that digital feedbacks decrease the motivational level of the learners.	18(30%)	29(48%)	13(22%)
8.	Online assessment enhances both creative and critical thinking skills of the students.	14 (23%)	22 (37%)	24(40%)





Formulation and Evaluation of Antifungal Herbal Soaps using Natural Ingredients by Melt and Pour Method

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ABSTRACT

People are most frequently affected by microbial skin infections, which necessitate intensive care both for treatment and to preserve healthy skin. The purpose of the current study is to develop antifungal formulations using some herbal plant extracts that show antifungal activity. The extraction was performed using Melt and Pour Method. Since, most commercial soaps which are available in market contain chemicals that can be harmful to the skin and usage of a natural herbal soap can be a good alternative. The herbal soap was formulated by using *Macroptilium Lathyroides* and *Acalypha Indica* by using melt and pour method. The prepared formulations were evaluated for various physicochemical parameters and were found satisfactory. Also, the evaluation tests showed that the herbal soap has satisfactory antifungal results.

Keywords: Antifungal, *Macroptilium lathyroides*, *Acalypha indica*, Herbal soap, antifungal, *Candida albicans* & Non *Albican candida* sps.

INTRODUCTION

Soap has a long history, dating back thousands of years to Ancient Babylon. In the early 2800 BC Archaeologists have discovered soap like material in historic clay cylinders dating from this period. They used to make soap by boiling the fats with ashes. From the prehistoric time personal cleaning has been done regularly to scrap of the oil and dirt.





Joan Vijetha et al.,

From 17th century that cleanliness and bathing started and come into fashion in Europe [1]. From 19th century soap were taxed very heavily in many countries. Soaps were produced in large scale from the year 1791 by a French chemist, Nicholas Leblanc. There was a scarcity of Animal, vegetable fats and oils used in soap production during World War I and again during World War II. Chemists were forced to use alternative raw materials, which were "synthesised" into chemicals with similar properties. Since, then most commercial soaps contain chemicals that are harmful to the skin. Hence, using a natural herbal soap can be a good alternative like back days. Herbal soaps have been found to be extremely beneficial to the skin. The herbs used in these soaps have therapeutic and healing properties that provide specific skin benefits such as nourishment, strength, healing, and moisturizing [2]. The exterior surface of the body is covered by the skin/cutaneous membrane. In terms of weight and surface area, it is the largest organ in the body. The skin's functions include controlling body temperature, serving as a blood reservoir, and providing protection from the environment [3]. Since, skin is the most exposed area to the environment it's more prone to skin infection and to avoid any infectious microorganisms from spreading hygiene plays an important role. Hence, soap plays a major role to maintain the skin hygiene by protecting and to control the microbe growth. A pharmaceutical or medication that contains antibacterial and antifungal ingredients is known as an "herbal soap preparation"⁴. It's made up of plant parts including leaves, stems, roots, and fruits, and it's used to treat damage, disease, and keep people healthy. In the present study, *Macroptilium Lathyroides* and *Acalypha Indica* were used to prepare the antimicrobial herbal soaps and their physicochemical characteristics were evaluated.

MATERIALS AND METHODS

Collection of plant sample

Macroptilium lathyroides and *Acalypha Indica* were collected from the ground of Sathyabama Institute of Science And Technology, Chennai.

Macroptilium lathyroides [5]

Macroptilium Lathyroides is an herbaceous annual or short-lived perennial growing up to 1 meter high, it is native to the tropical and subtropical areas. Its taxonomical classification is shown in Table 1 and its image is shown in Figure 1.

Acalypha indica [6]

Acalypha indica is an annual to sometimes short-lived perennial herb that usually grows up to 1.5 metre tall. It is an important medicinal plant in the Indian Ocean islands as well as in India. Its taxonomical classification is shown in Table 2 and its image is shown in Figure 2.

METHODOLOGY

Preparation of extracts

Leaves, flowers and seeds were dried, powdered and was passed though #40 mesh size. The extraction was done with ethanol as solvent by Maceration technique. The extraction was concentrated and stored for further use [10].

Formulation of herbal Soap

Double heat method was used to melt the glycerine soap base [7]. To this the obtained extract of *Macroptilium lathyroides*, *Acalypha indica* & Lemongrass essential oil were added. This mixture was continuous agitated until mixture became homogeneous. The mixture was poured into a mould and was allowed to solidify. Figure 3 shows the formulated soap. Final soap was ready and was packed in the aluminium cover until further evaluation.





Joan Vijetha et al.,

EVALUATIONS

1. Organoleptic evaluation [8]

Using only our eyes and nose, we evaluated the soaps colour, clarity, and odour against a white background.

2. Physical evaluation:

The formulated soaps were evaluated for the following properties:

Measurement of pH [11]

1 gm of soap sample was taken & was dissolved in 10mL of water. Using a digital pH metre, the pH of each of the generated formulations was assessed.

Foam Retention [11]

A 100 mL graduated measuring cylinder was filled with 25 mL of the 1% soap solution. The cylinder was shaken ten times with one hand covering it. For four minutes, the volume of foam was measured at one-minute intervals.

Foam Height [11]

In 25 mL of distilled water, 0.5 gm of soap sample was dispersed. The volume was then increased to 50 mL with water in a 100 mL measuring cylinder. Twenty-five strokes were given and left to stand until the aqueous volume reached 50 mL and the foam height above the aqueous volume was measured.

Determination of percentage of free alkali [16]

Measure 10g of soap sample and place it in a beaker with 150 ml of distilled water. Warm the beaker for 30 to 40 minutes to dissolve the soap, then transfer the solution, along with the washings, to the 250 ml conical flask. To reach the 250 ml mark, add more distilled water. If you shake the flask, foam will form, which could lead to incorrect results. Fill the titration flask with 10 mL of the soap solution. In the titration flask, add two drops of phenolphthalein indicator; the colour will change to pink. Titrate it against the burette's 0.01M HCl until the solution becomes colourless.

Alcohol insoluble matter [11]

A 5 g sample was placed in a conical flask. 50 mL of warm ethanol was added to this, and it was vigorously shaken until the sample was completely dissolved. The solution was filtered through a tared filter paper with 20 mL warm ethanol and dried at 105°C for 1 hour. The weight of dried paper was measured.

Total Fatty Matter [11]

TFM was calculated by reacting soap with acid in hot water and calculating the fatty acids obtained. 10 g of the formulated soap was heated in 150 ml of distilled water. 20 ml of 15% H₂SO₄ was added to this and heated until a clear solution was obtained. The fatty acids on the surface of the resulting solution are solidified by adding 7 g beeswax and heating it again. It was then allowed to cake. The cake was removed, blotted dry, and weighed to determine the TFM using the formula

$$\%TFM = \frac{\text{Weight of the cake (g)} - \text{Weight of the wax(g)}}{\text{Weight of soap(g)}} * 100$$

Moisture content [11]

5 g soap sample was weighed into a tarred moisture dish after it had been dried at 105°C for 2 hours and chilled to room temperature. Following an hour of heating, successive attainments of constant weight revealed losses of no more than 0.1%.





Joan Vijetha et al.,

$$\text{Moisture content}\% = \frac{\text{loss in weight}}{\text{Weight of sample}} * 100$$

Saponification [11,15]

Titration of potassium oxide with 0.5N sulfuric acid in the presence of phenolphthalein indicator can be used to determine it. After mixing the sample with 25 ml of an alcoholic KOH solution, it is placed in a steam bath for an hour to react.

Saponification value

$$= (\text{Titre value of blank in ml} - \text{titer value of sample in ml}) * \text{normality of KOH} * \text{equivalent}$$

Foam forming ability [11]

To test the ability of the herbal soap to form foam, place about 1.0 g of 50 ml in a 100 ml graduated measuring cylinder. The measuring cylinder was then shaken for about 2-3 minutes before being left for about 10 minutes. After 10 minutes, the foam height was measured.

Skin Irritation test [11]

Wash your skin thoroughly, then apply the soap sample to your skin and look for any irritation, burning, itching, or any other symptoms.

Antifungal activity**Well diffusion method [17]****Sample preparation**

1g of soap sample was dissolved in 10 mL of distilled water.

Preparation of bacterial inoculums [9]

A loopful of fresh test pathogens (*Candida albicans* & *Non albican Candida sps.*) were inoculated in SDB respectively and adjusted to 0.5 McFarland standards.

Procedure

- ▶ Using sterile cotton swab, the test fungal inoculum was seeded on the SDA plates at Sathyabama Institute of Science & Technology Centre for Drug Discovery and Development
- ▶ The wells were cutted using cork borer.
- ▶ 100 µl of sample were pipetted out in respective wells.
- ▶ Control wells were maintained: CC – Carrier Solvent control PC – Positive control (Fluconazole)
- ▶ Incubate the plates at 30 °C for 48 hrs.
- ▶ After incubation, zone of inhibition (ZOI) around the wells were measured in diameter (mm).
- ▶ All the assays were performed in triplicate.

RESULTS AND DISCUSSION

The anti-fungal herbal soap evaluation was completed successfully and the results are shown in table 4. The physicochemical parameters for herbal soap formulations F1, F2, F3, F4, F5 and F6 such as color, appearance, pH Foam retention, Foam height, Percentage free alkali, Alcohol insoluble matter, Total fatty matter, Moisture content and Foam forming ability and Skin irritation were determined. From the 6 formulations, F4 has the best physicochemical parameters. The formulations have a mild green color with an aromatic odor and had a good appearance as well as the pH was found to be in the range and doesn't cause any irritation or sensitization to the skin. Other parameters like foam height, foam retention were also performed and showed good results, the prepared soaps produced good lather, and retained time was found satisfactory. Alcohol insoluble matter was also evaluated successfully which was found to be in limit hence, its shows that non-soap substances were not used in the





Joan Vijetha et al.,

manufactured soaps. Anti-fungal activity was studied on *Candida albicans* & *Non albican Candida sps* and showed around 16 – 22 mm in diameter of zone of inhibition as shown in Figure 4.

SUMMARY AND CONCLUSION

The current work on Anti-fungal herbal soap was prepared using melt and pour method and all the parameters were studied for all formulation F1 to F6 and F4 had satisfactory result such as colour(mild green), odour (pleasant), pH(9.2), foam height (2.7cm), foam retention(3min), percentage free alkali(2.2), alcohol insoluble matter(17%), total fatty matter (65%), moisture content (12.4%), foam forming ability (3), skin irritation (no) and anti-fungal(yes). Based on the study it can be concluded that the herbal soap has an effective Anti-fungal activity and can be used.

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Joan Vijetha et al.,

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Table 1: Taxonomical classification of *Macroptilium lathyroides*

Biological name	<i>Macroptilium lathyroides</i>
Taxonomical classification	
Kingdom	Plantae
Class	Equisetopsida C. Agardh
Family	Fabaceae
Subfamily	Faboideae
Order	Fabales
Genus	<i>Macroptilium</i>
Species	<i>M. lathyroides</i>
Commonly name	phasey bean, wild bean, One-leaf clover, Cow pea (English) Kattu avara(Tamil)
Distribution	Andhra Pradesh : Chittoor district Odisha : Cuttack district Tamil Nadu : Kanchipuram (Changalpattu-CGP) district

Table 2: Taxonomical classification of *Acalypha indica*

Biological name	<i>Acalypha indica</i>
Taxonomical classification	
Kingdom	Plantae
Class	Dicotyledons
Family	Euphorbiaceae
Subfamily	<u>Acalyphoideae</u>
Order	Malpighiales
Genus	<i>Acalypha</i>
Species	<i>A. indica</i>
Commonly name	Indian acalypha, Indian nettle, Kuppameni
Distribution	Throughout the Old World tropics

Table 3: Formulation of Anti-fungal herbal soap

Sr. No	Ingredients	Quantity						
		F1	F2	F3	F4	F5	F6	
1	Glycerine soap base:	20g	20g	20g	20g	20g	20g	
	Glycerine							Humectant
	Coconut oil							Anti-aging & Moisturizer
	Castor Oil							Lather & Moisturizer
	Olive oil							Gentle cleansing, Softens & For long lasting of soap
	Nourishing &							





Joan Vijetha et al.,

	Vitamin E	Moisturizer						
	Sodium Hydroxide	Lye						
	Potassium Hydroxide	Lye						
2	<i>Macroptilium lathyroides</i>	Antifungal	1 mL	2 mL	3 mL	4 mL	5 mL	6 mL
3	<i>Acalypha indica</i>	Antifungal	1 mL	2 mL	3 mL	4 mL	5 mL	6 mL
4	Lemongrass essential oil	perfume	5 drops	5 drops	5 drops	5 drops	5 drops	5 drops

Table 4: Physicochemical Parameters of Herbal Soap Formulations

Parameters	F1	F2	F3	F4	F5	F6
Color	Transparent	Transparent	Mild green	Mild green	Dark green	Very dark green
Odour	Very mild	Very mild	Pleasant	Pleasant	Pungent	Pungent
pH	5.6	6.8	7.6	9.2	10.57	11.19
Foam retention (cm)	3.5	3.0	3.2	3.0	3.5	3.2
Foam height (cm)	3	2.7	3.2	2.7	3	3.2
Percentage free alkali (%)	2	2.1	2	2.2	2.3	2.3
Alcohol insoluble matter (%)	26	25.9	27	27	27.6	26.5
Total fatty matter (%)	65.4	65	64.8	65	64.7	64.6
Moisture content (%)	11.9	12	11.8	12.4	12.3	12.5
Foam forming ability	3	3	2.8	3	2.9	3
Skin irritation	No	No	No	No	No	No



Figure 1: *Macroptilium lathyroides*



Figure 2: *Acalypha indica*





Joan Vijetha et al.,



Figure 3: Prepared Anti-fungal Herbal soap (F4)



Figure 4: Zone of inhibition for F4 formulation





The Laplacian and Distance Energies of \tilde{n} - Graph Along with its Bounds

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ABSTRACT

In this paper, for any finite positive integer n , \tilde{n} graph $G(Z(\tilde{n}))$ is defined and the properties of such graphs are studied. The laplacian energy and distance energies of $G(Z(\tilde{n}))$ along with its bounds are obtained by the corresponding laplacian matrix and distance matrix of $G(Z(\tilde{n}))$. The defined concepts are illustrated through examples.

Keywords: Adjacency matrix, Graph energy, Laplacian energy, D eigenvalues, Distance matrix.

INTRODUCTION

Rough set theory is the study of incomplete information and knowledge[1]. In [2]-[4] various graph energies and their bounds are found. In [5] Ivan Gutman defined the energy of π electron as the sum of absolute values of eigen values. S.Burcu Bozkurt, A. Dilek et al. [6] present the bounds for the distance energy of connected graphs of diameter 2. G.Indulal et al. [7] obtain bounds for the distance spectral radius and D energy of graphs of diameter 2. In [8] I.Gutman and Bo Zhou discussed the dissimilarities between the energy and laplacian energy. Sridhara.G, M.R.Rajesh kanna present the upper bounds in terms of largest eigen value in [11].

This work concentrates on finding the distance energy and laplacian energies of an \tilde{n} graph $G(Z(\tilde{n}))$ along with its bounds. This paper is arranged as follows. Section 2 is about Preliminaries. In section 3 we define the \tilde{n} graph $G(Z(\tilde{n}))$. Section 4 and 5 is about distance energy and laplacian energy with its bounds. Conclude in section 6.





Praba and Sudha

Now let us recall some definitions.

DISTANCE ENERGY

Definition 2.1. For a given graph G , the distance matrix is defined as $D(G) = [d_{ij}]$. Here d_{ij} denotes the distance between the vertices v_i and v_j . The D eigenvalues of G are the eigenvalues of $D(G)$. The distance energy of a simple, connected graph is defined as $E_D = E_D(G) = \sum_{i=1}^n |\mu_i|$

Lemma[9] Let G be a connected n - vertex graph and let $\{\mu_1, \mu_2, \dots, \mu_n\}$ be its D -eigenvalues. Then

$$\sum_{i=1}^n \mu_i^2 = 2 \sum_{i < j} (d_{ij})^2$$

Lemma [10] Let $\{a_1, a_2, a_3, \dots, a_n\}$ be nonnegative numbers. Then

$$n \left(\frac{1}{n} \sum_{i=1}^n a_i - \left(\prod_{i=1}^n a_i \right)^{\frac{1}{n}} \right) \leq n(n-1) \left(\frac{1}{n} \sum_{i=1}^n a_i - \left(\prod_{i=1}^n a_i \right)^{\frac{1}{n}} \right)$$

Lemma [8] Let G be an (n,m) -graph and its laplacian eigen values are $(\mu_1, \mu_2, \mu_3, \dots, \mu_n)$ then

$$2\sqrt{M} \leq LE(G) \leq 2M \text{ Where } d_i \text{ be the degree of the } i^{\text{th}} \text{ vertex of } G, i = 1, 2, \dots, n.$$

\tilde{n} -GRAPH

Definition 3.1. \tilde{n} -graph

For any finite positive integer n , let $\tilde{n} = \{1, 2, 3, \dots, n\}$, $\wp(\tilde{n})$ is the power set of \tilde{n} and $\wp^1(\tilde{n}) = \wp(\tilde{n}) - \{\tilde{n}, \phi\}$. Define an \tilde{n} -graph $G(Z(\tilde{n})) = (V(\tilde{n}), E(\tilde{n}))$ where $V(\tilde{n}) = \wp^1(\tilde{n})$ and 2 elements $a, b \in V(\tilde{n})$ are adjacent if $a \cap b = \phi$.

Definition 3.2. The adjacency matrix of an \tilde{n} -graph $A(G(Z(\tilde{n})))$ is defined as $(A(\tilde{n}))_{(ab)}$ where

$$A(\tilde{n})_{(ab)} = \begin{cases} 1 & \text{if } a \cap b = \phi \\ 0 & \text{if } a \cap b \neq \phi \end{cases}$$

for every $a, b \in V(\tilde{n})$

- Note:** 1. $G(Z(\tilde{n}))$ is a simple, undirected graph
 2. $A(G(Z(\tilde{n})))$ is a square matrix of order $2^n - 2$.

Definition 3.3. Energy of \tilde{n} -graph

The energy $E(G(Z(\tilde{n})))$ of an \tilde{n} - graph $G(Z(\tilde{n}))$ is defined by $E(G(Z(\tilde{n}))) = \sum_{i=1}^{2^n-2} |\omega_i|$ where ω_i are the eigenvalues of $A(G(Z(\tilde{n})))$.

Lemma 3.1. For any $a = \{i_1, i_2, \dots, i_r\} \in V(\tilde{n})$, the degree of $a \in V(\tilde{n})$ is $2^{n-r}-1$.

Proof. Let $a = \{i_1, i_2, \dots, i_r\} \in V(\tilde{n})$ then $|a| = r$ and by the definition 3.1, a is connected to $\wp(\tilde{n} - a) - \phi$. Hence $\text{deg}(a) = 2^{n-r}-1$.

Lemma 3.2. The number of edges in $G(Z(\tilde{n}))$ is $\frac{1}{2} (3^n - 2^{n+1} + 1)$

Proof. $\frac{1}{2} (\text{sum of the degrees of the vertices in } G(Z(\tilde{n}))) = \frac{1}{2} \sum_{r=1}^{n-1} nC_r (2^{n-r} - 1)$

$$= \frac{1}{2} (\sum_{r=1}^{n-1} nC_r 2^{n-r} - \sum_{r=1}^{n-1} nC_r)$$

$$= \frac{1}{2} \{2^n ((1 + \frac{1}{2})^n - 1 - \frac{1}{2^n}) - 2^n + 2\}$$





Praba and Sudha

$$= \frac{1}{2} \left\{ 2^n \left(\frac{3^n}{2^n} - 1 - \frac{1}{2^n} \right) - 2^n + 2 \right\}$$

$$= \frac{1}{2} (3^n - 2^n - 1 - 2^n + 2)$$

Hence the number of edges in $G(Z(\tilde{n}))$ is $\frac{1}{2} (3^n - 2^{n+1} + 1)$

Theorem 3.1. Let $(\omega_1, \omega_2, \omega_3, \dots, \omega_{2^n-2})$ be the eigenvalues of $A(G(Z(\tilde{n})))$. Then

1. $\sum_{i=1}^{2^n-2} \omega_i = 0$
2. $\sum_{i=1}^{2^n-2} \omega_i^2 = (3^n - 2^{n+1} + 1)$

Proof.

Since the sum of eigenvalues of $A(G(Z(\tilde{n})))$ is the trace of $A(G(Z(\tilde{n})))$, we have

$$\sum_{i=1}^{2^n-2} \omega_i = \sum_{i=1}^{2^n-2} A_{ii} = 0$$

The sum of the squares of eigenvalues of $A(G(Z(\tilde{n})))$ is the trace of $A(G(Z(\tilde{n})))^2$

$$\sum_{i=1}^{2^n-2} \omega_i^2 = \sum_{i=1}^{2^n-2} A_{ij} \sum_{j=1}^{2^n-2} A_{ji}$$

$$\sum_{i=1}^{2^n-2} \omega_i^2 = \sum A_{ii}^2 + \sum_{i \neq j} A_{ij} A_{ji}$$

$$\sum_{i=1}^{2^n-2} \omega_i^2 = 0 + 2 \sum_{i < j} A_{ij}^2$$

$$\sum_{i=1}^{2^n-2} \omega_i^2 = (3^n - 2^{n+1} + 1)$$

Hence

$$\sum_{i=1}^{2^n-2} \omega_i^2 = (3^n - 2^{n+1} + 1)$$

Theorem 3.2. Let $G(Z(\tilde{n}))$ be \tilde{n} graph then

$$\sqrt{(3^n - 2^{n+1} + 1) + (2^n - 2)(2^n - 3)D^{\frac{2}{(2^n-2)}}} \leq E(G(Z(\tilde{n}))) \leq \sqrt{(2^n - 2)(3^n - 2^{n+1} + 1)}$$

where $D = |\det A(G(Z(\tilde{n})))|$

Proof. By Cauchy Schwarz inequality and Theorem 3.1 we have

$$(E(G(Z(\tilde{n}))))^2 = \left(\sum_{i=1}^{2^n-2} |\omega_i| \right)^2$$

$$\leq \sum_{i=1}^{2^n-2} 1 \sum_{i=1}^{2^n-2} \omega_i^2$$





Praba and Sudha

$$\leq (2^n - 2)(3^n - 2^{n+1} + 1)$$

Thus we have $E(G(Z(\tilde{n}))) \leq \sqrt{(2^n - 2)(3^n - 2^{n+1} + 1)}$.

Using arithmetic and geometric mean inequality, we have

$$\begin{aligned} \frac{1}{(2^n-2)(2^n-3)} \sum_{i \neq j} |\omega_i| |\omega_j| &\geq (\prod_{i \neq j} |\omega_i| |\omega_j|)^{\frac{1}{(2^n-2)(2^n-3)}} \\ &= (\prod_{i=1}^{2^n-2} |\omega_i|^{2(2^n-3)})^{\frac{1}{(2^n-2)(2^n-3)}} \\ &= (\prod_{i=1}^{2^n-2} |\omega_i|)^{2/(2^n-2)} \\ &= |\prod_{i=1}^{2^n-2} \omega_i|^{2/(2^n-2)} \\ &= |\det A_{ij}|^{2/(2^n-2)} \\ &= D^{2/(2^n-2)} \end{aligned}$$

$$\sum_{i \neq j} |\omega_i| |\omega_j| \geq (2^n - 2)(2^n - 3) D^{2/(2^n-2)}$$

So we have $E(G(Z(\tilde{n})))^2 = (\sum_{i=1}^{2^n-2} |\omega_i|)^2$

$$= \sum_{i=1}^{2^n-2} |\omega_i|^2 + \sum_{i \neq j} |\omega_i| |\omega_j|$$

$$E(G(Z(\tilde{n}))) \geq \sqrt{(3^n - 2^{n+1} + 1) + (2^n - 2)(2^n - 3) D^{\frac{2}{(2^n-2)}}$$

Illustration 3.3. Let $\tilde{4} = \{1,2,3,4\}$.

$V(\tilde{4}) = \{1,2,3,4,\{12\},\{13\},\{14\},\{23\},\{24\},\{34\},\{123\},\{124\},\{134\},\{234\}\}$

The $G(Z(\tilde{4}))$ graph is given below. The spectral radii of $A(G(Z(\tilde{4})))$ are $[4.7913, 1^{(6)}, 0.2087, -0.3820^{(3)}, -1, -2.6180^{(3)}]$

The adjacency matrix of $G(Z(\tilde{4}))$ graph is given as follows

DISTANCE ENERGY

Definition 4.1. The distance matrix of $G(Z(\tilde{n}))$ is defined by

$$DG(Z(\tilde{n})) = d(\tilde{n})_{(ab)} = \begin{cases} 1 & \text{if } |a \oplus b| = |a \cup b| \leq n \\ 2 & \text{if } |a \oplus b| > |a \cup b| < n \\ 3 & \text{if } |a \oplus b| > |a \cup b| = n \\ 0 & \text{if } a = b \end{cases}$$

where $|a \oplus b| = |a| + |b|$

In an $G(Z(\tilde{3}))$ graph, if $a = \{12\}$ and $b = \{13\}$ then $|a \oplus b| = 4$





Praba and Sudha

Note that $|a \oplus b| \geq |a \cup b|$.

Definition 4.2. Let $G(Z(\tilde{n}))$ be an \tilde{n} -graph then the energy of $DG(Z(\tilde{n}))$ is given by $DE(Z(\tilde{n})) = \sum_{i=1}^{2^n-2} \tau_i$ where τ_i are the eigen values of $DG(Z(\tilde{n}))$.

Note: For any $a \in V(\tilde{n})$, $d_1(a) = \{b \in V(\tilde{n}) \mid d(a,b) = 1\}$, $d_2(a) = \{b \in V(\tilde{n}) \mid d(a,b) = 2\}$,
 $d_3(a) = \{b \in V(\tilde{n}) \mid d(a,b) = 3\}$.
 In $G(Z(\tilde{3}))$ graph,
 $d_1\{2\} = \{1,3,\{13\}\}$
 $d_2\{1\} = \{\{12\}, \{13\}\}$
 $d_3\{12\} = \{\{13\}, \{23\}\}$

Lemma 4.1. If $G(Z(\tilde{n}))$ is an \tilde{n} -graph then $|d_1(a)| = 2^{n-r}-1$.

Proof. Let a, b be any two vertices in $G(Z(\tilde{n}))$, then
 $d_1(a) = \{b \in V(\tilde{n}) \mid d(a,b) = 1\}$
 $= \wp(\tilde{n} - a) - \phi$
 If $|a| = r$ then $|\tilde{n}-a| = n-r$.
 Therefore $|d_1(a)| = 2^{n-r}-1$.

Lemma 4.2 For any two vertices $a, b \in G(Z(\tilde{n}))$, $|d_2(a)| = (2^{r-2}) + (2^{r-1})(2^{n-r-2})$

Proof. $d_2(a) = \{b \in V(\tilde{n}) \mid d(a,b) = 2\}$
 $= \{\wp(a) - (\phi, a)\} + \{\wp(a) - \phi\} \wp(\{\tilde{n} - a\} - (\phi, a))$
 If $|a| = r$ then $|\{\tilde{n}-a\} - (\phi, a)| = (n-r) - 2$
 $|d_2(a)| = (2^{r-2}) + (2^{r-1})(2^{n-r-2})$

Lemma 4.3 For any $a, b \in G(Z(\tilde{n}))$, $|d_3(a)| = (2^{r-2})$

Proof. $d_3(a) = \{b \in V(\tilde{n}) \mid d(a,b) = 3\}$.
 $d_3(a) = \{\wp(a) - (\phi, a)\}$
 If $|a| = r$ then $|d_3(a)| = (2^{r-2})$

Theorem 4.1. The diameter of $G(Z(\tilde{n}))$ is 3.

Proof. Let $a, b \in V(\tilde{n})$ where $a = \{i_1, i_2, \dots, i_r\}$ and $b = \{j_1, j_2, \dots, j_s\}$. Then there are three cases arises.

Case1. $a \cap b = \phi$

If $a \cap b = \phi$ then a and b are adjacent and hence $d(\tilde{n})_{(ab)} = 1$.

Case2. $a \cap b \neq \phi$ & $a \cup b \neq \tilde{n}$

Let $a \cap b \neq \phi$ and if $a \cup b \neq \tilde{n}$ then there exist an element $c \in V(\tilde{n})$ such that $c \notin a$ and $c \notin b$. This implies that a is adjacent to c and c is adjacent to b and hence $d(\tilde{n})_{(ab)} = 2$

Case3. $a \cap b \neq \phi$ & $a \cup b = \tilde{n}$





Praba and Sudha

Let $a \cap b \neq \emptyset$ and if $a \cup b = \tilde{n}$ then as $a \neq b$ there exist a $c_1 \in b$ that does not belong to a . Also there exist a $c_2 \in a \notin b$. Hence a is adjacent to c_1 , c_1 is adjacent to c_2 and c_2 is adjacent to b . Therefore $d(\tilde{n})_{(ab)} = 3$. Hence the diameter of $G(Z(\tilde{n}))$ is 3.

Corollary. If $|d_i(a)|$ denote the cardinality of $d_i(a)$ then

$$2 \sum_{a,b} d(\tilde{n})_{(ab)}^2 = \sum_{r=1}^{n-1} nC_r \{ |d_1(a)|^2 + |d_2(a)|^2 + |d_3(a)|^2 \}$$

Theorem 4.2. Let $G(Z(\tilde{n}))$ be an \tilde{n} -graph and let Δ_D be the absolute value of the determinant of $d(\tilde{n})_{(ab)}$ then

$$\sqrt{\sum_{r=1}^{n-1} nC_r \{ 4(2^n - 2^{r+1}) - 3(2^{n-r}) + 13(2^r) - 19 \} + (2^n - 2)(2^n - 3)\Delta_D^{\frac{2}{(2^n-2)}}} \leq DE(Z(\tilde{n})) \leq \sqrt{\sum_{r=1}^{n-1} nC_r \{ 4(2^n - 2^{r+1}) - 3(2^{n-r}) + 13(2^r) - 19 \} (2^n - 3) + (2^n - 2)\Delta_D^{\frac{2}{(2^n-2)}}}$$

Proof. $DE(Z(\tilde{n}))^2 = (\sum_{i=1}^{2^n-2} |\tau_i|)^2$

$$\begin{aligned} &= \sum_{i=1}^{2^n-2} \tau_i^2 + 2 \sum_{i < j} |\tau_i| |\tau_j| \\ &= 2 \sum_{a,b} d(\tilde{n})_{(ab)}^2 + 2 \sum_{i < j} |\tau_i| |\tau_j| \\ &= 2 \sum_{a,b} d(\tilde{n})_{(ab)}^2 + \sum_{i \neq j} |\tau_i| |\tau_j| \tag{1} \\ &= \sum_{r=1}^{n-1} nC_r \{ |d_1(a)|^2 + |d_2(a)|^2 + |d_3(a)|^2 \} + \sum_{i \neq j} |\tau_i| |\tau_j| \\ &= \sum_{r=1}^{n-1} nC_r \{ 4(2^n - 2^{r+1}) - 3(2^{n-r}) + 13(2^r) - 19 \} + \sum_{i \neq j} |\tau_i| |\tau_j| \end{aligned}$$

$$\text{And } \sum_{i \neq j} |\tau_i| |\tau_j| \geq (2^n - 2)(2^n - 3)\Delta_D^{\frac{2}{(2^n-2)}} \tag{2}$$

From equations (1) and (2)

$$DE(Z(\tilde{n})) \geq \sqrt{\sum_{r=1}^{n-1} nC_r \{ 4(2^n - 2^{r+1}) - 3(2^{n-r}) + 13(2^r) - 19 \} + (2^n - 2)(2^n - 3)\Delta_D^{\frac{2}{(2^n-2)}}}$$

$$\begin{aligned} \Omega &= (2^n - 2) \left\{ \frac{1}{(2^n-2)} \sum_{i=1}^{2^n-2} \tau_i^2 - \left(\prod_{i=1}^{2^n-2} \tau_i^2 \right)^{\frac{1}{(2^n-2)}} \right\} \\ &= (2^n - 2) \left\{ \frac{2}{(2^n-2)} \sum_{a,b} d(\tilde{n})_{(ab)}^2 - \left(\prod_{i=1}^{2^n-2} |\tau_i| \right)^{\frac{2}{(2^n-2)}} \right\} \\ &= 2 \sum_{a,b} d(\tilde{n})_{(ab)}^2 - (2^n - 2) \Delta_D^{\frac{2}{(2^n-2)}} \\ &= \sum_{r=1}^{n-1} nC_r \{ |d_1(a)|^2 + |d_2(a)|^2 + |d_3(a)|^2 \} - (2^n - 2) \Delta_D^{\frac{2}{(2^n-2)}} \end{aligned}$$

$$\Omega \leq (2^n - 2) \sum_{i=1}^{2^n-2} \tau_i^2 - (\sum_{i=1}^{2^n-2} |\tau_i|)^2 \leq (2^n - 3)\Omega$$

$$\Omega \leq 2(2^n - 2) \sum_{a,b} d(\tilde{n})_{(ab)}^2 - DE(Z(\tilde{n}))^2 \leq (2^n - 3)\Omega$$

$$\Omega \leq 2(2^n - 2) \sum_{a,b} d(\tilde{n})_{(ab)}^2 - DE(Z(\tilde{n}))^2$$

$$DE(Z(\tilde{n}))^2 \leq 2(2^n - 2) \sum_{a,b} d(\tilde{n})_{(ab)}^2 - \Omega$$

$$DE(Z(\tilde{n})) \leq \sqrt{2(2^n - 2) \sum_{a,b} d(\tilde{n})_{(ab)}^2 - \sum_{r=1}^{n-1} nC_r \{ |d_1(a)|^2 + |d_2(a)|^2 + |d_3(a)|^2 \} - (2^n - 2)\Delta_D^{\frac{2}{(2^n-2)}}}$$





Praba and Sudha

$$DE(Z(\tilde{n})) \leq \sqrt{2(2^n - 2) \sum_{a,b} d(\tilde{n})_{(ab)}^2 - \sum_{r=1}^{n-1} nC_r \{ |d_1(a)|^2 + |d_2(a)|^2 + |d_3(a)|^2 \} - (2^n - 2) \Delta_D \frac{2}{(2^n - 2)}}$$

$$DE(Z(\tilde{n})) \leq \sqrt{\sum_{r=1}^{n-1} nC_r \{ 4(2^n - 2^{r+1}) - 3(2^{n-r}) + 13(2^r) - 19 \} (2^n - 3) + (2^n - 2) \Delta_D \frac{2}{(2^n - 2)}}$$

Illustration 4.3. Consider the $G(Z(\tilde{4}))$ graph as in example 3.3. The $G(Z(\tilde{4}))$ distance matrix $DG(Z(\tilde{4})) = d(\tilde{4})_{(ab)}$ is given by

The spectral radii of $DG(Z(\tilde{4}))$ are $[25.7689, 0.4495^{(3)}, -1^{(3)}, -1.4923, -3^{(2)}, -3.2767, -4.4495^{(3)}]$

LAPLACIAN ENERGY

Definition 5.1. Let $G(Z(\tilde{n}))$ be an \tilde{n} –graph. The degree matrix of an \tilde{n} -graph is defined as $(Deg(Z(\tilde{n}))_{ab})$ where

$$Deg(Z(\tilde{n}))_{ab} = \begin{cases} 2^{n-r} - 1, & \text{if } a = b \text{ and } |a| = r \\ 0 & \text{otherwise} \end{cases}$$

Definition 5.2. The Laplacian matrix of an \tilde{n} -graph $(L(Z(\tilde{n}))_{ab})$ is defined by

$$L(Z(\tilde{n}))_{ab} = \begin{cases} 2^{n-r} - 1 & \text{when } a = b \\ -1 & \text{when } a \cap b = \phi \\ 0 & \text{otherwise} \end{cases}$$

Where $a = \{i_1, i_2, i_3, \dots, i_r\}$ and $b = \{j_1, j_2, \dots, j_s\}$

Definition 5.3.

For a given \tilde{n} -graph $G(Z(\tilde{n}))$, let $\{\sigma_1, \sigma_2, \dots, \sigma_{2^{n-2}}\}$ be the laplacian eigenvalues then the laplacian energy of $G(Z(\tilde{n}))$, denoted by $LE(G(Z(\tilde{n})))$, is equal to $\sum_{i=1}^{2^{n-2}} |\gamma_i|$

i.e., $LE(G(Z(\tilde{n}))) = \sum_{i=1}^{2^{n-2}} |\sigma_i - \frac{(3^n - 2^{n+1} + 1)}{2^n - 2}|$

Theorem 5.1

Let $G(Z(\tilde{n}))$ be an n -graph and $LE(G(Z(\tilde{n})))$ be its laplacian energy

then $\sqrt{2(3^n - 2^{n+1} + 1) + 2 \sum_{r=1}^{n-1} nC_r \{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^n - 2} \}^2} \leq LE(G(\tilde{n})) \leq \sqrt{(2^n - 2) \left\{ (3^n - 2^{n+1} + 1) + \sum_{r=1}^{n-1} nC_r \{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^n - 2} \}^2 \right\}}$

Proof.

Since $\sum_{i=1}^{2^{n-2}} \gamma_i = 0$ and (3)

$$\sum_{i=1}^{2^{n-2}} \gamma_i^2 = (3^n - 2^{n+1} + 1) + \sum_{r=1}^{n-1} nC_r \{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^n - 2} \}^2$$
 (4)





Praba and Sudha

From equations (3) and (4),

$$(3^n - 2^{n+1} + 1) + \sum_{r=1}^{n-1} nC_r \left\{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right\}^2 = -2 \sum_{i < j} \left(\sigma_i - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right) \left(\sigma_j - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right)$$

$$(3^n - 2^{n+1} + 1) + \sum_{r=1}^{n-1} nC_r \left\{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right\}^2 = 2 \left| \sum_{i < j} \left(\sigma_i - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right) \left(\sigma_j - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right) \right|$$

And by Holder inequality,

$$(3^n - 2^{n+1} + 1) + \sum_{r=1}^{n-1} nC_r \left\{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right\}^2 \leq 2 \sum_{i < j} \left| \sigma_i - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right| \left| \sigma_j - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right|$$

But $LE(G(Z(\tilde{n}))) = \sum_{i=1}^{2^n-2} \left| \sigma_i - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right|$ (5)

Combining equations (3) --- (5)

$$LE(G(Z(\tilde{n}))) \geq \sqrt{2(3^n - 2^{n+1} + 1) + 2 \sum_{r=1}^{n-1} nC_r \left\{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right\}^2}$$

By Cauchy Schwarz inequality and equation (4)

$$LE(G(Z(\tilde{n}))) \leq \sqrt{\sum_{i=1}^{2^n-2} \gamma_i^2 \sum_{i=1}^{2^n-2} 1}$$

$$LE(G(Z(\tilde{n}))) \leq \sqrt{(2^n - 2) \left\{ (3^n - 2^{n+1} + 1) + \sum_{r=1}^{n-1} nC_r \left\{ (2^{n-r} - 1) - \frac{(3^n - 2^{n+1} + 1)}{2^{n-2}} \right\}^2 \right\}}$$

Illustration 5.2. Let us consider $G(Z(\tilde{4}))$ graph as in example 3.3. The laplacian matrix of $G(Z(\tilde{4}))$ graph is

CONCLUSION

In this paper for every finite positive integer n, \tilde{n} graph is defined. The properties of such graphs are studied. Their distance matrix and laplacian matrix of an \tilde{n} graph are defined. The corresponding energies and their bounds are obtained. All the concepts are illustrated with examples. The future work is to use \tilde{n} graph in obtaining the energy of Rough zero divisor graph of the Rough semiring (T, Δ, ∇) for a given information system $I = (U, R)$.

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Praba and Sudha

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	$\begin{pmatrix} 0 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$
<p>Fig1. $\tilde{4}$ graph</p>	<p>Fig.2. Adjacency Matrix of $G(\mathbb{Z}(\tilde{4}))$ graph</p>
$\begin{pmatrix} 0 & 1 & 1 & 1 & 2 & 2 & 2 & 1 & 1 & 1 & 2 & 2 & 2 & 1 \\ 1 & 0 & 1 & 1 & 2 & 1 & 1 & 2 & 2 & 1 & 2 & 2 & 1 & 2 \\ 1 & 1 & 0 & 1 & 1 & 2 & 1 & 2 & 1 & 2 & 2 & 1 & 2 & 2 \\ 1 & 1 & 1 & 0 & 1 & 1 & 2 & 1 & 2 & 2 & 1 & 2 & 2 & 2 \\ 2 & 2 & 1 & 1 & 0 & 2 & 2 & 2 & 2 & 1 & 2 & 2 & 3 & 3 \\ 2 & 1 & 2 & 1 & 2 & 0 & 2 & 2 & 1 & 2 & 2 & 3 & 2 & 3 \\ 2 & 1 & 1 & 2 & 2 & 2 & 0 & 1 & 2 & 2 & 3 & 2 & 2 & 3 \\ 1 & 2 & 2 & 1 & 2 & 2 & 1 & 0 & 2 & 2 & 2 & 3 & 3 & 2 \\ 1 & 2 & 1 & 2 & 2 & 1 & 2 & 2 & 0 & 2 & 3 & 2 & 3 & 2 \\ 1 & 1 & 2 & 2 & 1 & 2 & 2 & 2 & 2 & 0 & 3 & 3 & 2 & 2 \\ 2 & 2 & 2 & 1 & 2 & 2 & 3 & 2 & 3 & 3 & 0 & 3 & 3 & 3 \\ 2 & 2 & 1 & 2 & 2 & 3 & 2 & 3 & 2 & 3 & 3 & 0 & 3 & 3 \\ 2 & 1 & 2 & 2 & 3 & 2 & 2 & 3 & 3 & 2 & 3 & 3 & 0 & 3 \\ 1 & 2 & 2 & 2 & 3 & 3 & 3 & 2 & 2 & 2 & 3 & 3 & 3 & 0 \end{pmatrix}$	$\begin{pmatrix} 7 & -1 & -1 & -1 & 0 & 0 & 0 & -1 & -1 & -1 & 0 & 0 & 0 & -1 \\ -1 & 7 & -1 & -1 & 0 & -1 & -1 & 0 & 0 & -1 & 0 & 0 & -1 & 0 \\ -1 & -1 & 7 & -1 & -1 & 0 & -1 & 0 & -1 & 0 & 0 & -1 & 0 & 0 \\ -1 & -1 & -1 & 7 & -1 & -1 & 0 & -1 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & -1 & -1 & 3 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & -1 & 0 & 3 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & -1 & 0 & 0 & 0 & 3 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & -1 & 0 & 0 & -1 & 3 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & -1 & 0 & 0 & -1 & 0 & 0 & 3 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$
<p>Fig. 3. Spectral Radii of $DG(\mathbb{Z}(\tilde{4}))$</p>	<p>Fig.4. The laplacian matrix of $G(\mathbb{Z}(\tilde{4}))$</p>





An Outlook of Student - Teachers towards Online Teaching - Learning: an Empirical Study

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ABSTRACT

Online education has been emerged as a new standard in the higher education for regular mode of education due to the emergence of pandemic situation in the whole country. As per the information provided by United Nations Education, Scientific and Cultural Organization (UNESCO) (2020) 191 countries adopted online mode of teaching-learning to avoid unprecedented crises in the educational field. The students as well as teachers were not prepared for such transitional phase in education that emerged all of sudden. Although required facilities are available for both teachers and students, but lack of awareness, monitoring and guidance to participate in online learning and submission of assignments and activities may be the key challenges appearing in online teaching-learning process. The present study aimed to understand outlook of student-teachers towards online teaching-learning through descriptive survey method. A total of 138 student-teachers of Four-Year Integrated Programme of Central University of Jammu were constituted as sample of the study. For collection of required data, a self-constructed semi-structured questionnaire and three Point Likert-Scales were employed. The findings of the study revealed that majority (65.5%) of student-teachers were not interested in online teaching-learning because they had to spend most of the time on electronic gadgets. It was also found that majority (60%) of the student-teachers lost interest to attend online classes because having duration of one hour. The findings of the present study will be beneficial for the teachers for designing online teaching classes in more effective way in the future.

Keywords: Perspective, Student-teachers, Online Teaching-Learning



**Rajni Kumari and Ravi Vanguri**

INTRODUCTION

The modern education system has been revolutionized by new technological advancement in teaching-learning. In the present era of technology the walls of traditional classrooms seem to be broken through the use of internet. Before pandemic a very limited number of educational institutions were teaching through online and blended mode. But when the unavoidable conditions appeared due to the spread of corona virus (COVID -19) it was a matter of concern for continuing the education of students when there was complete lockdown in the world. As per the information provided by United Nations Education, Scientific and Cultural Organization (2020) 191 countries adopted online mode of teaching learning to avoid unprecedented crises in the educational field. In the developing countries like India various education institutions were not prepared for complete transition from traditional to online teaching-learning system. Different teaching-learning apps i.e. Google classroom, Zoom, G-meet etc. has been used by the teachers for the transaction of their lessons.

In Indian educational scenario the online system of teaching-learning was introduced in most of the educational institutions on 25th march, 2020 when nationwide lock-down in the whole country imposed by the decision of Union Government on a large scale. The traditional way of learning was replaced by online mode for teaching and evaluation. Availability of resources in the institutions as well as to the learners becomes a challenge due to immediate change occurred in the whole teaching learning scenario. Online teaching Learning challenges the quality of education that depends on the accessibility and effectiveness.

Earlier the online learning was taken by those students who prefer to learn through distance mode of learning. But due to the upsurge of pandemic in the whole world make online teaching learning as essential part of education system. Moreover new educational opportunities have been provided to the students by online learning but at the same time different kind of challenges were also faced by the teachers as well as learners. The traditional way of learning was replaced by online mode for teaching and evaluation. The teachers as well as learners faced many challenges due to the lack of prior experience of teaching learning through online mode. The teachers faced the difficulties related to adopting new methodology of teaching through online mode because it is not just delivering the lectures through screen but the teacher have to ensure that every learner is able to learn through online mode of learning. Learners on the other side also faced challenges related to internet connectivity, economical conditions as well as communication gap between students and teachers.

Agung, Surtikanti, and Op (2020) revealed in the study that there were three different types of difficulties faced by students during online learning i.e. internet connectivity is not available, teaching learning barrier as well as lack of electronic gadgets to the students for learning online. Blizak, et.al. (2020) expressed that the student's possess negative perception towards online learning. It was also revealed that most of the students prefer offline mode of teaching because they did not know how to use the digital devices effectively for learning purpose. Unger & Meiran (2020) examined that offline learning as compared to online learning preferred by majority of the students because students relied that they felt anxiety while learning online. Chakraborty (2020) examined that very less number of students were interested to take education through virtual mode instead they were in favour of physical mode of learning. Obeidat, et. al. (2020) found that learning through online mode had cause severe affect on the psychology of the students. It was revealed that online education provided less opportunity for the students to interact with their classmate share the problems related to learning.

Need and significance of the study

Online learning has been emerged as a new prototype in higher education for regular mode of education due to the emergence of pandemic situation in the whole country. Because it was impossible to maintain social distancing in the educational institutions and the health of students was also at stake. Under these conditions technology emerged as a rout way to carry education directly to the home of individual student of schools as well as higher education to maintain the social distancing norms. The students as well as teachers were not prepared for such transitional phase



**Rajni Kumari and Ravi Vanguri**

in education that emerged all of sudden. Although online learning was appeared as bliss for education purpose but at the same adopting a new paradigm in education that too on very short period of time was challenging for both the teachers as well as the students. There is a need to examine what kind of challenges has been faced by the students while learning online? Do they find online learning as an effective mode of teaching? Are they willing to pursue online courses in future? The researcher tried to ponder over these questions that aroused due to the transitional phase in the field of education.

Research Questions

- What perspectives do the student-teachers posses towards online learning?
- What challenges has been faced by the teacher trainees during online teaching learning?

Statement of the study

An outlook of student-teachers towards online teaching-learning: An Empirical Study

Objectives of the study

- To measure the perspective of student-teachers towards online teaching-learning
- To ascertain the challenge faced by the student teachers during online teaching-learning

Operational Definition of the term used

Online Teaching- Learning: An environment where student teachers and mentor teachers are involved in teaching-learning by virtual mode through the use of technology.

METHODOLOGY AND SAMPLE OF THE STUDY

The present study was descriptive survey-type in nature. Purposive sampling technique was employed for the collection of the data. All the student-teachers pursuing four-year integrated B.A. B. Ed. Programme in the central university of Jammu constituted the sample of the study. A self-constructed semi-structured questionnaire and three Point Likert-Scales were employed for the collection of the data.

Analysis of Data

For achieving the formulated objectives the investigator collected data from 90 student-teachers and the data collected through semi-structured questionnaire and three Point-Likert scales was analysed by using Frequency percentage. From Table no.1 it can be observed that more than half (55.6%) of the student teachers replied that online teaching was not effective than the traditional way of teaching and believed that they were restricted to virtual world only by the online mode of learning (53.4%). Majority (60.1%) of the respondents stated that teaching through online mode had made the students more techno-friendly. Although, (65.5%) student teachers stated that they did not like online learning because mostly they had to spent time on electronic gadgets.

From Table no. 2 it can be observed that most (65.5%) of the teacher educators stated that lectured delivered with the help of PPTs were understood easily, whereas duration of class exceeded from one hour lost interest of the student teachers (60%). More than half (52.2%) of the respondents acknowledged that they were interested in online teaching because the recorded lectures could be accessed easily after the class, whereas rest of them were in opposite view. Some (40%) of the student teachers stated that they got clear understanding about the topic with the content shared by teachers, whereas only (18.8%) disagreed and it was observed that (41.1 %) of the remained neutral.

From Table no. 3 it can be observed that (68.9%) respondents believed that student teachers became active in the class due to the group task assigned by the teachers. Nearly half (47.7%) of the respondents acknowledged that online mode had not made learning interesting, whereas (30%) of them were remained neutral and only (23%)



**Rajni Kumari and Ravi Vanguri**

agreed. It was also found that some (37.7%) of the student teachers were motivated to learn from the online learning resources provided by teachers, whereas only (25.6%) of them disagreed and (36.7%) were given neutral response.

From Table no. 4 it can be observed that most (68.9%) of the respondents stated that they lost interest if questions were not asked by teachers during online mode of learning. Furthermore (66.7%) of the student teachers stated that the scope of interaction between student and learner was limited in online teaching. More than half (50.4%) of the respondents answered that interaction between students and teachers was affected by on online mode of teaching learning. Whereas, some (45.6%) of the respondents stated they had been shown disinterest when expression of teacher were not visible to them while teaching through online mode, whereas (40%) of them respond neutral and only (18.8%) were in opposite view.

From table no. 5 it can be observed that majority (66.7%) of student teachers stated that mental health of the students had been affected by the online mode of learning and believed that learning online mostly leaded stress (62.3%). Less than half (48.9%) of the respondents acknowledged that assessment done through online mode was effective and caused more anxiety than the traditional way of assessment, whereas only (21.1%) specified opposite point of view and 30% of the student teachers responded as neutral.

From Table no. 6 it can be understood that majority (77.7%) of student teachers stated that material shared by teachers through online mode would be helpful for future readings also whereas (22.2%) had opposite point of view. Furthermore majority (81.1%) of the respondents answered that physical health of the students deteriorated by sitting passively in front of screen for long time duration. Majority (60%) of the respondents stated that online courses could not be preferred by them in future. More than half (53.3%) of the teacher trainees stated that a sense of belongingness could not developed through online mode of learning.

From Table no.7 it can be observed that majority (81.1%) of the student teachers stated that electronic gadgets had easily used by them for online learning, whereas some (18.9%) of the respondents stated that they faced difficulties. Also majority (78.9%) of the respondents answered that assignments were easily submitted in online mode of assessment, whereas some (21.1%) of them found it difficult. Furthermore majority (65.6%) of the student teachers acknowledged that they did not found feedback given by teachers through online mode better than the traditional mode, whereas some (34.4%) of teachers preferred online feedback of teachers rather than traditional feedback provided by teachers.

Major Findings of the study

- The present study revealed that online learning found to be disliked by majority (65.5%) of the student teachers as most of their time spent on electronic gadgets that leaded to stress among student teachers (62.3%). It was also observed that majority (61.1%) of student teachers found to become more techno-friendly while learning through online mode.
- It was found from the study that the content delivered with the help of PPTs understood easily by majority (65.5%) of the student teachers, moreover they lost interest in online class if the time duration exceeded from one hour (60%).
- The study revealed that majority (68.9%) student teachers found to be lost their interest if there would be no questions asked by the teachers from the learner, while teaching by online mode at the same time tasks assigned in groups during online teaching by the teachers made student teachers active during online class. The scope of teacher-learner interaction was found limited in online teaching by majority (66.7%) of the student teachers and also affected the mental health of the learner.
- The study also revealed that majority (81%) of the student teachers found to be competent for using electronic gadgets for learning and believed that physical health of the learners deteriorated while sitting passively in front of screen for long time during online learning. Moreover, the online mode of submitting assignments was considered as easiest way by majority (78.9%) of the student teachers.



**Rajni Kumari and Ravi Vanguri**

- It was found in the study that majority (77.8%) of the student teachers believed study material shared by the teachers while teaching online would be helpful for future readings also. The feedback given by teachers through online learning is not considered as better way than the feedback provided in traditional way of teaching by majority (65.6%).
- The study also revealed that majority (60%) of the student teachers had not shown interest in pursuing online courses in future.

DISCUSSION AND CONCLUSION

The focus of the study was to understand the outlook of student-teachers on online teaching-learning. A significant number of studies were conducted on online-learning during COVID-19 pandemic. To understand the future perspective of online teaching-learning, the outlook of student teachers towards teaching-learning and the challenges they have faced while learning online was needed. More than half of the student teachers believed that online teaching-learning was not an effective way teaching-learning. The findings of the supported by the study conducted by Unger & Marian (2020) that revealed that 91.5% of the students believed offline learning cannot be replaced by online-learning. Online teaching-learning has improved the competence of student teachers for using technology for educational purpose it was supported by Muthuprasad, et. al. (2021) revealed about fifty percent of the learners expressed that their technical skills improved by online learning than face to face learning. The study also revealed that of the student-teachers believed that online teaching-learning affected the mental and physical health. It was supported by Obeidat, et.al.(2020) research study that reflected the negative effects of online learning on the psychology of the learner. Hence, it was found that effectiveness of online teaching-learning depends on the effective time management, to be handy with technology, Content delivery and presentation, recorded lectures, feedback, Communication, Health issues, online assessment, Socialization and motivation among the learner to pursue online courses in future. It was also observed that complete shift towards online education seems impossible. Universities should Adopt Hybrid mode of learning considering the benefits and challenges of online teaching learning. The content and Structure of online education Can be drawn from the findings of the study.

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Table No.1. Perspective of student teacher towards online mode of transaction (N=90)

S.No.	Statements	Agree	Neutral	Disagree
1.	I believe online teaching is effective way of teaching than physical mode of teaching	18.9% (17)	25.6% (23)	55.6% (50)
	For me learning become more interesting through online mode	22.3% (20)	30% (27)	47.7% (43)
2.	Learning through online mode makes students techno-friendly.	61.1% (55)	27.8% (25)	11.1% (10)
3.	I found online learning easily accessible to the students	31.2% (28)	37.8% (34)	31.1% (28)
4.	I believe that online learning restricted me to the virtual world only	53.4% (48)	33.3% (30)	13.3% (12)
5.	I don't like online leaning because it make me spend most of time on electronic gadgets	65.5% (59)	22.2% (20)	12.2% (11)

Table No. 2. Responses of student teacher regarding Content Delivery (N=90)

S.No.	Statements	Agree	Neutral	Disagree
1.	The content shared by teachers during online learning helps me to get a clear understanding of the topic	40% (36)	41.1% (37)	18.8% (17)
2.	The lectures delivered with the help of PPTs are easily understood by the students	65.5% (59)	25.6% (23)	8.9% (8)
3.	The duration of the online class (One hour) makes me to lose the interest	60% (54)	21.1% (19)	18.9% (17)
4.	I like online teaching because I can access the recorded lectures to clear doubts	52.2% (47)	27.8% (25)	20% (18)

Table No. 3. Responses of student teacher regarding Motivation (N=90)

S.No.	Statements	Agree	Neutral	Disagree
1.	I found some motivation in online teaching because of online learning resources provided by teachers.	37.7% (34)	36.7% (33)	25.6% (23)
2.	I like online teaching because it encourages me to participate in discussion during online class.	42.3% (38)	30% (27)	27.8% (25)
3.	I felt that learners can be motivated to participate actively through online teaching.	37.9% (36)	35.6% (32)	25.5% (23)
4.	The group task assigned by teachers makes every students to be active in the class	68.9% (62)	24.4% (22)	6.6% (6)





Rajni Kumari and Ravi Vanguri

Table No. 4. Responses related to interaction during online learning (N=90)

S.No.	Statements	Agree	Neutral	Disagree
1.	I show disinterest in the lecture if the expression of the teacher is not visible, while teaching through online mode	45.6% (41)	40% (36)	14.4% (13)
2.	The scope of teacher-learner interaction is very limited in online teaching	66.7% (60)	23.3% (21)	10% (9)
3.	I lose interest in the online class, if teachers do not ask questions while teaching	68.9% (62)	16.7% (15)	14.4% (13)
4.	I believe that online learning affected the interaction between student and teachers	50.4% (49)	33.3% (30)	12.2% (11)

Table No. 5. Responses related to online Assessment and Health effects (N=90)

S.No.	Statements	Agree	Neutral	Disagree
1.	Online tests conducted by the teachers are effective way of assessment	48.9% (44)	30% (27)	21.1% (19)
2.	Assessment through online mode cause more anxiety in comparison of traditional assessment	48.9% (44)	28.9% (26)	22.2% (20)
3.	Spending more time on learning through online mode leads to stress among students.	62.3% (55)	21.1% (19)	16.7% (15)
4.	Online learning has affected the mental health of the students	66.7% (60)	23.3% (21)	10% (9)

Questionnaire**Table No. 6 Responses related to future perspective and impact of online learning (N= 90)**

S.No.	Items	Yes	No
1.	Are you interested to pursue online courses in future?	40% (54)	60% (36)
2.	Do you think that the study material shared by teachers through online teaching is helpful for further readings in future?	77.8% (70)	22.2% (20)
3.	Do you think that sitting passively in front of screen for long time during online class deteriorates the physical health of the learners	81.1% (73)	18.9% (17)
4.	Do you think that online teaching learning process develops a sense of belongingness among the students	46.7% (42)	53.3% (48)

Table No. 7. Student teachers responses regarding competence of technological aspects (N= 90)

S.No.	Items	Yes	No
1.	Are you able to use the electronic gadgets easily for learning	81.1% (73)	18.9% (17)
2.	Do you think that submitting assignments through online mode is easiest	78.9% (71)	21.1% (19)
3.	Do you think that feedback given by teachers in online mode of learning is better than that of traditional way of giving feedback	34.4% (31)	65.6% (59)





A New Extraction Method for the Determination of Oxytocin in Milk by UV, HPLC and ELISA

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ABSTRACT

Oxytocin is a hormone that produce in hypothalamus and released into the blood stream by the pituitary gland. The main function of oxytocin is to facilitate child birth , which is one of the reason it is called “ The love hormone”. It also stimulates the muscles of uterus to contract,helps for the production of prostagladins and also increase the uterine contractions. It is a key hormone that manage male and female reproductive system. Some times this hormone is given to speed up the labour process in pregnant woman .Once the baby is born oxytocin helps to move the milk from the ducts in the breast to the nipple and foster a bond between mom and baby. By taking this aspects into consideration we made a research for the estimation of oxytocin in different milk samples. As a part of our research we extracted oxytocin from milk samples by using Trichloro acetic acid precipitation method by passing through a solid phase extraction column. The extracted oxytocin was quantified by using different analytical methods like UV, HPLC and ELISA methods and the concentration of oxytocin was found to be higher in buffalo milk compare with cow and packet milk. This research concludes that consuming regular buffalo milk has a high chance of increasing oxytocin levels when compared to packet milk and other synthetic goods and it is also safer for pregnant women's.

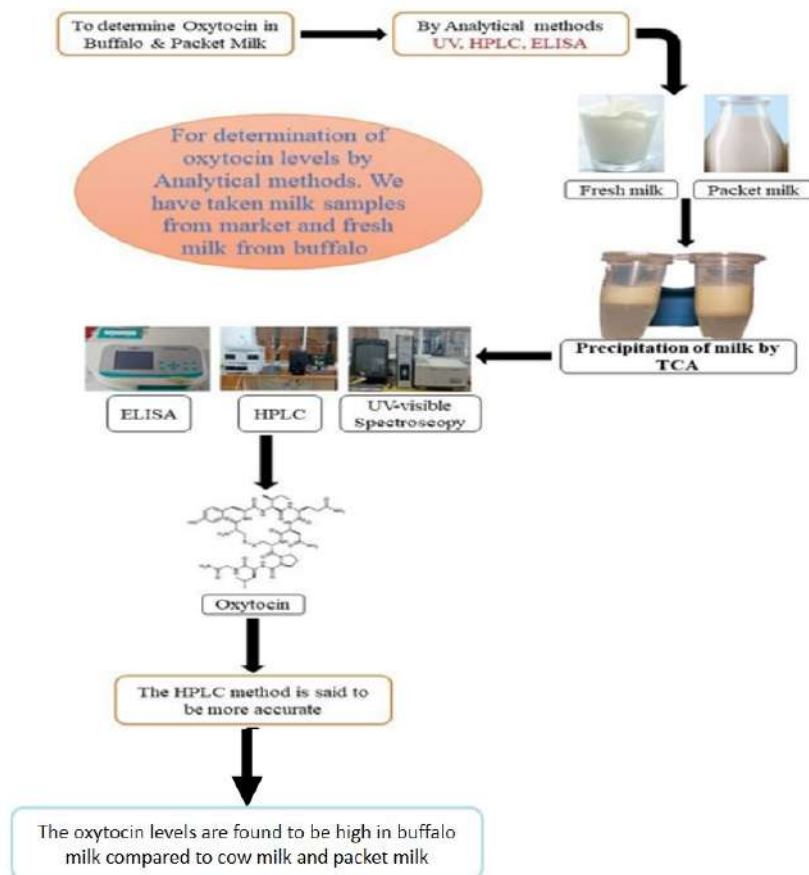
Keywords: Oxytocin, Milk, Trichloro acetic acid, UV, HPLC, ELISA.





Nirmala et al.,

Graphical Abstract



INTRODUCTION

Oxytocin is a peptide hormone, it has the distinction of being the first peptide hormone to be sequenced and synthesized. Today, synthetic oxytocin is used clinically for the induction and augmentation of the first stage of labour, mid trimester abortion and the cessation or prevention of postpartum hemorrhage [1-3]. It is estimated that 30% of the new born delivery's in the United States used oxytocin to induce the labour. It is a key hormone that manages the both male and female reproductive system. It is also called as "Love hormone". The present work describes the estimation of oxytocin by different analytical methods like UV, HPLC and ELISA in different milk samples like cow milk, buffalo milk and packet milk [4-7].

STUDY OBJECTIVES

To collect different milk samples and extract the oxytocin from milk.

- To estimate the oxytocin in milk samples by Analytical methods.
- To select the suitable method for determination of oxytocin.



**Nirmala et al.,****EXPERIMENTAL WORK**

Trichloro acid (TCA), Methanol, Ethanol, Hydrochloric acid and Acetonitrile all AR- grade chemicals were used for the proposed work

PREPERATION OF STANDARD

The standard oxytocin injection (IP) of 5IU/ml was further diluted with Acetonitrile to get a series of concentrations of 0.05,0.1,0.15,0.2 and 0.25IU/ml[8,9] .The prepared working standards were subjected to UV, HPLC and ELISA analysis and the results were noted.

PREPERATION OF SAMPLES

5ml of each milk sample were collected from cow, buffalo and packet milk in separate testtubes.To each testtube add 500µl of TCA and vortex for 10mins then collect a supernatant from each testtube and keep it aside.To the precipitate which remains in each testtube add 1ml of acetic acid and 100µl of TCA and vortex for 5mins then supernatant liquid is collected from each testtube. Now combined both supernatants and filtered through whatman filter paper.Add 1ml of methanol , 1ml of water were added followed by the addition of 1ml of methanol. To the filtrate 2ml of ethanol with 6N of Hcl added the entire content were transferred into the testtube and boiled for few minute and add a little amount of Acetonitrile to make the volume upto 5 mland subjected for analysis in UV, HPLC and ELISA [10-13].

METHOD FOR STANDARD CURVE

The standard curve was constructed by taking the concentration on X- axis and absorbance on Y-axis in both UV & ELISA .

The concentration of oxytocin was calculated by using below formula

$$Y = mx + c$$

Where,

Y= absorbents, M= slope, X= concentration, C= y- intercept

RESULTS AND DISCUSSION

The Oxytocin levels in Buffalo and packet milk was determined by using the UV, HPCL and ELISA Methods.

Finding of concentration for cow milk

$$2.301 = 0.056X + 0.006$$

$$2.301 - 0.006 = 0.056X$$

$$2.295 = 0.056X$$

$$X = 2.295/0.056$$

$$X = 40.9821 \text{ IU/ml}$$

Finding the concentration for buffalo milk

$$2.417 = 0.056X + 0.006$$

$$2.417 - 0.006 = 0.056X$$

$$2.144 = 0.056X$$

$$X = 2.144/0.056$$

$$X = 43.053 \text{ IU/ml}$$

Finding of concentration for packet milk

$$2.326 = 0.056X + 0.006$$

$$2.326 - 0.006 = 0.056X$$

$$2.32 = 0.056X$$



**Nirmala et al.,**

X = 2.32/0.056

X = 41.42857 IU/ml

Single standard method:

$C1/C2 = A1/A2$

Where , C1 = concentration of standard, C2 = concentration of test, A1 = Area of standard, A2 = Area of test

$C2 = A2/A1 \times C1$

Cow milk:

C2 = 1524876/985476 X 0.15

C2 = 0.23210246 IU/ml

Buffalo milk :

C2 = 1617794/985476 X 0.15

C2 = 0.2462455IU/ml

Packet milk:

C2 = 1358922/985476 X 0.15

C2 = 0.2068424IU/ml

CONCLUSION

It was concluded that the amount of oxytocin in buffalo milk was more than that of cow milk and packet milk. The amount of oxytocin in three different milk samples are more than the limit(0.007ng/ml). All the three analytical methods are suitable for estimation of oxytocin in milk samples. The UV method is suitable whereas HPLC method is more accurate.

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Table 1: Absorbance values of Standard oxytocin by UV:

Concentration (IU/ml)	Absorbance
0.05	0.096
0.1	0.107
0.15	0.112
0.2	0.117
0.25	0.119

Table 2: Absorbance values of oxytocin in sample by UV

Samples	Absorbance
Cow milk	2.301
Buffalo milk	2.417
Packet milk	2.326

Table 3: Absorbance values of Standard Oxytocin by ELISA:

Concentration	Absorbance
0.05	0.009
0.1	0.011
0.15	0.015
0.2	0.017
0.25	0.020

Table 4: Absorbance values of oxytocin in samples by ELISA

Samples	Absorbance
Acetonitrile (Blank): 1	0.015
2	0.015
3	0.016
Cow milk	0.053
Buffalo milk	0.066
Packet milk	0.047





Nirmala et al.,

Table 5: Peak areas of Oxytocin by HPLC

Samples	Peak Area	Retention Time
Cow Milk	1524876	2.4
Buffalo Milk	1617794	2.3
Packet Milk	1358922	2.6
Standard (0.15)	985476	2.5

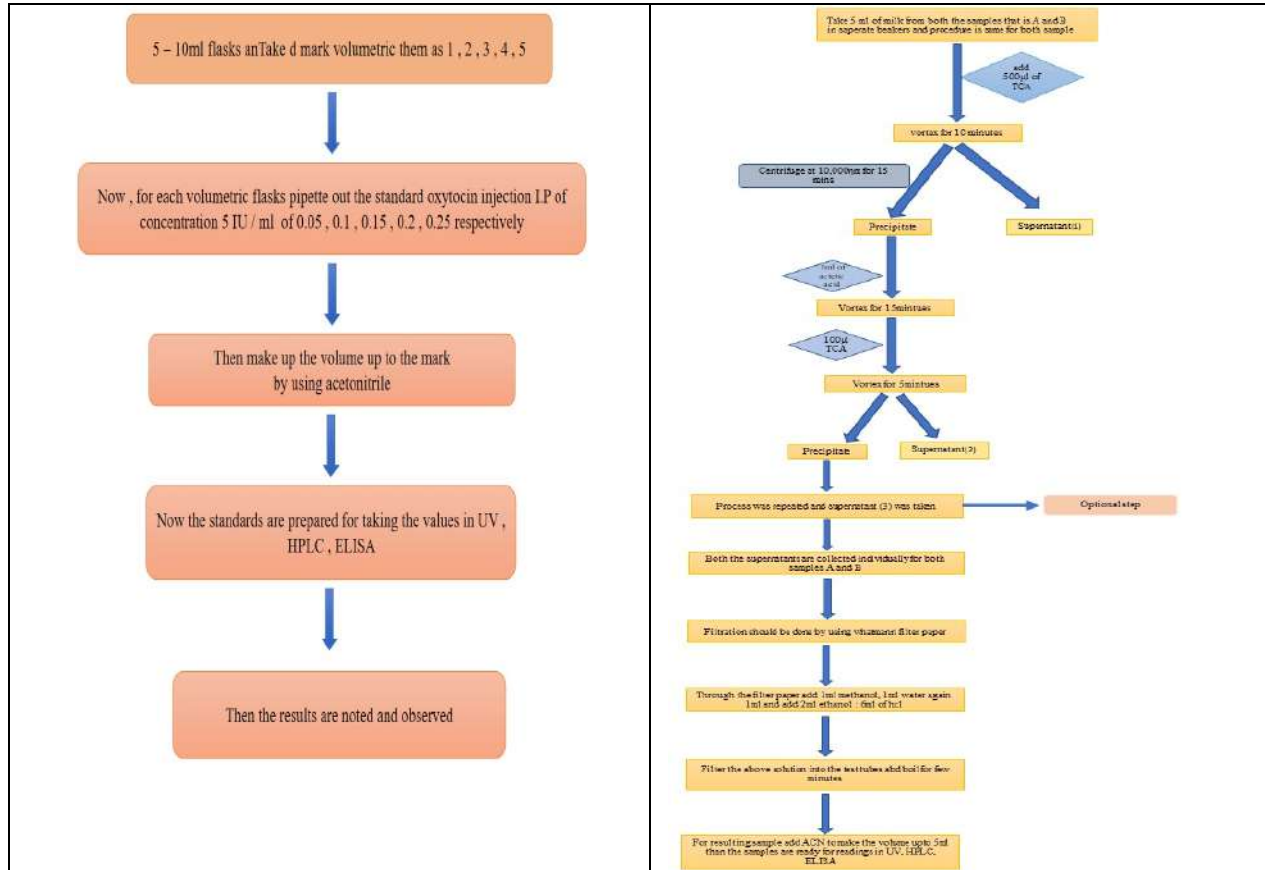


Figure : 1Preparation of standard

Figure : 2 Preparation of samples

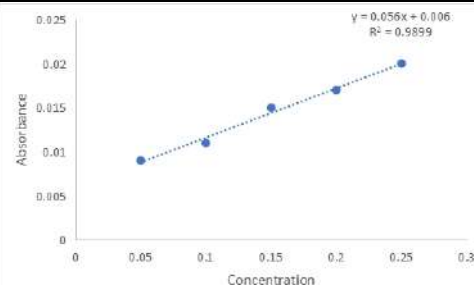
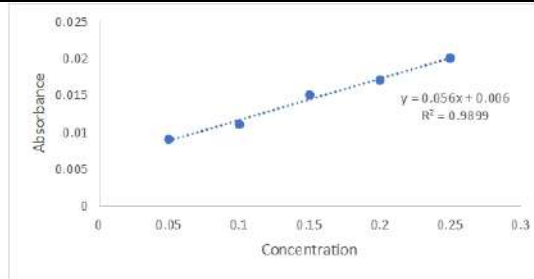


Figure 3: Linearity Graph By UV

Figure 4: Linearity Graph By ELISA





Science Content Profundity among Pre-Service Teachers at Secondary Level

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ABSTRACT

The role of teachers in the educational system is essential for passing on knowledge to the next generation in any nation. All teachers must be experts in their fields since teaching ability and subject matter knowledge are interrelated and both greatly contribute to the academic success of pupils in the classroom. In this situation, a study was conducted to determine whether or not the potential teachers have sufficient knowledge of the science discipline. A sample of 120 secondary level pre-service teachers was randomly chosen for this study from teacher education colleges in the Tamil Nadu districts of Dindigul and Madurai. The study's key finding indicates that the majority of pre-service teachers had moderate level science content knowledge and that there was a significant difference between pre-service teachers who were male and female in terms of their knowledge of science.

Keywords: Content knowledge, Pre-service teachers, Science subject areas, Secondary level teacher education programme.





Ponnusamy et al.,

INTRODUCTION

According to Nelson Mandela, the most effective tool we have to transform the world is education. Because education will determine the destiny of humanity, it is crucial to maintain its quality. Teachers are crucial in influencing student success along with the curriculum, and both have an impact on the standard of formal education. The pre-service phase is one that affects the calibre of instructors. Prospective teachers acquire knowledge, opinions, and values throughout the pre-service time that they will use in their future careers (1,2). Science teachers-to-be must learn fundamental scientific principles and teach them to students. Owning a strong command of the subject matter is essential for aspiring teachers, along with pedagogical expertise (3). We must determine the crucial topic information required for teaching, how that knowledge must be understood, and how that knowledge is really acquired in the classroom while preparing pre-service teachers (4).

Teachers' expertise and competence in the classroom have an impact on students' learning (5). As a result, in order to handle the issues that arise in the classroom, instructors need to have a solid foundation of professional knowledge that is continually updated (6). To comprehend and address societal problems, society must be scientifically literate. This suggests that people need to be educated and develop a scientific basis. Science educators play a crucial role in educating the public about how the world functions. According to AlSultan et al. (2018), pre-service instructors have low self-efficacy views when they first start teaching (7). Science education became predominantly teacher-centered, with limited opportunity for students' originality and curiosity, as a result of instructors' lack of mastery of the science material. Ineffective scientific instruction and, ultimately, poor student science performance can result from teachers' inadequate science content knowledge (8). Therefore, it is crucial to assess how well-versed in science the potential instructors are in order to guarantee the future quality of the educational system.

NEED AND SIGNIFICANCE OF THE STUDY

According to the Cambridge Dictionary, profundity refers to the quality of demonstrating a clear and in-depth comprehension of significant issues; as a result, profundity in content refers to a profound understanding of the subject matter that the teachers were going to cover in the classroom. Teachers' success in the classroom may be impacted by their unique perspectives of their skills and aptitudes. Many factors, such as training, preparation, and higher education studies before starting to teach in a classroom, might affect a teacher's self-efficacy. However, both science knowledge and teacher efficacy in primary schools are notoriously low (7). To help students create helpful cognitive maps, connect ideas, and clear up misconceptions, teachers must have a comprehensive and flexible mastery of the subject matter. Teachers need to understand how concepts relate to one another across disciplines and to daily life.

Al Sultan, Henson, and Fadde (9), contend that instructors with high levels of scientific literacy and understanding will also have high levels of self-efficacy because they will be appropriately schooled in science subject and science teaching methods (7). The primary entry point into higher education and the workforce is through the school system. The best place to successfully prepare the next generation of citizens for the development of the country is in the classroom. The foundation for a person's future development is laid in school, so it is crucial to guarantee that teaching and learning are of the highest calibre. The depth of the teachers' subject matter is one of several variables that affect the quality of teaching and learning. Ladipo (10), one of the important causes of pupils' inadequate performance in their public exams, attributes this to the calibre of the teachers (11). The type of training instructors receive, as well as the depth of the material they are expected to teach, determines the quality of their instruction. The depth of the teacher's subject matter determines how science teachers interpret a lesson's objectives. The depth of the teacher's subject-matter knowledge affects how they respond to student inquiries and how easily they can connect with them, which helps students develop scientific attitudes and a scientific temperament. Therefore, the depth of the prospective teacher's science topic understanding is crucial for both their professional and academic success. With this background, this study was undertaken to investigate the science content profundity of prospective teachers at secondary level.



**Ponnusamy et al.,****OBJECTIVES OF STUDY**

- To study the science content profundity level of pre-service teachers at secondary teacher education programme;
- To know whether there is any significant difference between science content profundity of male and female pre-service teachers; and
- To know whether there is any significant difference between science content profundity of male and female pre-service teachers with reference to subject content areas- Physics, Chemistry and Biology.

METHODOLOGY**Research Design**

The descriptive survey research design was used in the study to know the secondary level science content profundity among the pre-service teachers. The content topics from classes VI, VII, VIII, IX and X in Physics, Chemistry and Biology were included in the Science Content Knowledge Test and was administered to the pre-service teachers to examine their content profundity level.

Study Sample

A sample of 120 pre-service teachers from the secondary level teacher education programme was selected randomly from six teacher education colleges located in the Dindigul and Madurai districts of Tamil Nadu, India. Among the selected 120 pre-service teachers, there were 52 male and 68 female pre-service teachers.

Instrument

The *Science Content Knowledge Test* in science subject portions of the classes - VI, VII, VIII, IX and X textbooks was prepared following with all the standardizations norms properly and same was administered to the selected sample to collect the necessary data for investigation. The Science content knowledge test is divided into three sections: Physics, Chemistry, and Biology, each with 50 multiple choice questions in each of these subject content areas. The right response of the pre-service teachers in the achievement test was assigned a score of one mark, and the wrong response had been assigned a score of zero mark. As a result, the Science content knowledge test has 150 questions in total, with a maximum score of 150. The findings are summarised as below.

RESULTS**Analysis on Science Content Knowledge Test Scores of Pre-Service Teachers**

The collected data scores from the pre-service teachers at secondary level to know about their science content profundity were analysed and their obtained mean and standard deviation scores in Physics, Chemistry, Biology and in total were summarized as follows. The table-1 data shows that the mean scores of pre-service teachers at secondary level in Physics, Chemistry, Biology and in total are 35.88, 32.80, 32.48 and 101.16 respectively. This indicates that the pre-service teachers were having better knowledge in Physics subject when compare it with Chemistry and Biology. Further, their content knowledge levels were categorized based on their mean and SD scores which furnished as follows.

Analysis on Science Content Knowledge Levels of Pre-Service Teachers

The results furnished in table -2 refers that 11.67% of pre-service teachers had low level of content knowledge in Physics; 80% of pre-service teachers had moderate level of content knowledge in Physics; 8.33% of pre-service teachers had good level of content knowledge in Physics. Similarly, 33.33% of pre-service teachers had low level of content knowledge in Chemistry; 38.33% of pre-service teachers had moderate level of content knowledge in Chemistry; 28.33% of pre-service teachers had good level of content knowledge in Chemistry. Then, 30.83% of pre-service teachers had low level of content knowledge in Biology; 45% of pre-service teachers had moderate level of content knowledge in Biology; 24.17% of pre-service teachers had good level of content knowledge in Biology. Further, 15.83% of pre-service teachers had low level of content knowledge in total Science ; 70.83% of pre-service





Ponnusamy et al.,

teachers had moderate level of content knowledge in total Science; 13.33% of pre-service teachers had good level of content knowledge in total Science. Therefore, it is found that *majority of the pre-service teachers at secondary teacher education programme had moderate level of science content knowledge*. The following table -3 describes the gender wise comparison of mean scores of pre-service teachers in science content knowledge test.

Comparison of Science Content Knowledge of Pre-Service Teachers: Gender wise and Subject Area wise Analysis

The table -3 data describes that mean scores of male and female pre-service teachers in Physics content area are 37.21 and 34.85; 32.69 and 32.88 in Chemistry content area; 33.27 and 31.88 in Biology content area respectively. In general, the male and female pre-service teachers obtained the mean scores 103.17 and 99.62 respectively in science content knowledge test. It means that the male pre-service teachers' science content knowledge was better than that of female pre-service teachers. The gender wise data analysis shows that there was a significant difference between the science content knowledge of male and female pre-service teachers ($t = 1.987$ and $p = 0.06 > 0.05$). Also, the comparison on subject content area wise and gender wise indicate that there was a significant difference between the content knowledge of male and female pre-service teachers in Physics contents but not in Chemistry and Biology as well (In Physics, $t = 3.79$ and $p = 0.00 > 0.05$; Chemistry, $t = 0.17$ and $p = 0.87 < 0.05$; Biology $t = 1.22$ and $p = 0.23 < 0.05$).

CONCLUSION

Main findings of the present study reveal that most of the pre-service teachers at secondary level teacher education programme had moderate level of science content knowledge. Science and mathematics subjects are important subjects to the students at school education system and therefore contents of these subjects should be taught among the students carefully by the teachers and often they have to verify whether the transmission of the content knowledge properly reached to the student end or not. Prior to this, the teachers of these subjects must have adequate teaching competence and mastery in subjects as well. Teachers always be conscious on improving themselves through reading their subject related books and the online resources.

CONFLICTS AND INTEREST

None.

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Ponnusamy et al.,

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Table-1 Subject wise Mean and Standard Deviation (SD) Scores of Sample in Science Content Knowledge Test

Subject	Mean	SD
Physics	35.88	3.86
Chemistry	32.80	6.21
Biology	32.48	6.15
In Total	101.16	9.80

Table-2 Science Content Knowledge Level

Content Knowledge Level of Sample in %	Low	Moderate	Good
Physics	11.67	80.00	8.33
Chemistry	33.33	38.33	28.33
Biology	30.83	45.00	24.17
In Total	15.83	70.83	13.33

Table-3 Mean, SD Scores of Male and Female Pre-Service Teachers in Science Content Knowledge Test

Subject	Gender	N	Mean	SD	t	p
Physics	Male	52	37.21	2.08	3.79	0.00
	Female	68	34.85	4.55		
Chemistry	Male	52	32.69	6.21	0.17	0.87
	Female	68	32.88	6.25		
Biology	Male	52	33.27	6.28	1.22	0.23
	Female	68	31.88	6.03		
In Total	Male	52	103.17	9.99	1.987	0.06
	Female	68	99.62	9.43		





***Leucas aspera* (Willd.) Linn. A Potential Plant from North East India: An Overview**

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ABSTRACT

Leucas aspera (Willd.)Linn.(Family: Lamiaceae) commonly known as 'Thumbai', and is distributed throughout India from the Himalayas down to Ceylon. *Leucas aspera* (Willd.) Linn. a species are widely distributed in tropical Asia, Africa and grows as a competitive weed in highland crop fields, homesteads, fallow lands and roadsides. Many phytochemicals belong to the classes of terpenes, terpenoids, sterols and fatty compounds, glycosides, long-chain compounds, flavonoids, lignans, alkaloids and others were identified and isolated by different extraction methods. These extracts were being investigated for their wide varieties of biological activities. Therefore, in this narrative review of literature we aimed to describe and delineate on medicinal perspectives of plant *Leucas aspera* (Willd.) Linn.

Keywords: Antioxidant, antimicrobial, larvicidal activity, Antibacterial activity, *Leucas aspera* (Willd.) Linn.

INTRODUCTION

Medicinal plants are the only source for the treatment of diseases in ancient days and since then numerous herbs and plants have been recognized as medicinal plants because of their potency to cure various ailments [1]. Medicinal plants are the rich source of lead molecules for new drug discovery and hence the biological importance of medicinal



**Madhumita Sarkar and Gunamoni Das**

plants is increasing rapidly nowadays [2]. Several medicinal plants have been investigated against mitigation and cure of a variety of devastating diseases such as cancer [3]. *Leucas aspera* (Willd.) Linn. sometimes known as "Thumbai," is a member of the Lamiaceae family and is found all over India, from the Himalayas to Ceylon [4]. A wide variety of herbal plants are available in the Indian subcontinent, and they are the backbone of Indian traditional medicinal system Ayurveda and Siddha [6]. In India, the herbs have always been the prime type of medicine such as Ayurveda, Homeopathy, Siddha, and Unani. Medicinal plants are the native heritage with universal importance. Natural product extracts are very important source of new drugs. In the ancient medical system, various parts of plants, namely bark, roots, buds, leaves, fruits, and latex are used to cure various ailments. Herbs and medicines derived from plants have been extensively used in traditional cultures all over the world and are popular in modern medicine as alternatives to produce new prospective natural therapeutic compounds for aggressive diseases [6,7]. Herbal therapies are preferred over synthetic ones since they are natural. Many different herbal and contemporary medicine combinations come from medicinal plants. Indians are quite passionate about using medicinal herbs, and they do so in a variety of ways that are connected to health. The ethnic medical books contain information on almost 25,000 plant-based medicines. In addition, at least 25% of the medications used in modern medicine come from plants, either naturally occurring chemicals or synthetically. One of the richest sources of therapeutic herbs in the world, India has a unique modern application that provides millions of people with health security [8–10].

L. aspera belongs to the family Lamiaceae of the genus *Leucas*. The plant, which is widely dispersed and known as "Thumabi" in common parlance, is also known by several common names depending on the region where it grows. All of India contains *Leucas aspera* (Willd.) Linn. although the Himalayas are where it is most common. It is typically used as an insecticide and antipyretic. The stimulant, insecticide, emmenagogue, diaphoretic, expectorant, and aperient properties of flowers are well documented. In addition to treating psoriasis, rheumatism, and various chronic skin eruptions, leaves of *Leucas aspera* (Willd.) Linn. are also utilised topically. In cases of snakebite, bruised leaves are applied externally [10,11].

Description of the plant:

Taxonomic classification:[12]

Kingdom	: Plantae
Subkingdom	: Tracheobionta
Super division	: spermatophyte
Division	: Angiosperma
Class	: Dicotyledonae
Sub-class	: Gamopetalae
Series	: Bicarpellatae
Order	: Tubiflorae
Family	: Labiatae
Genus	: <i>Leucas</i>
Species	: <i>aspera</i>

Morphological Description

The branches and stem of *Leucas aspera* (Willd.) Linn. are stout and hispid, with sharply quadrangular leaves. It is an erect annual herb that grows to a height of 15–60 cm. Petiole 2.5–6 mm long; flowers white, sessile tiny, in dense terminal or axillary whorls; leaves sub-sessile or briefly petiolate, linear or linearly lanceolate, obtuse, pubescent up to 8.0 cm long and 1.25 cm broad, with whole or crenate edge; Calyx is 1 variable, tubular, 8–13 mm long; tube is contracted and curved above the nutlets; lower half is typically glabrous and membranous; upper half is ribbed and hispid; mouth is small, very oblique, not villous, with the upper part produced forward; teeth are triangular, small, bristle-tipped, ciliate, with the largest upper tooth. Corolla 1 cm long; tube 5 mm long and pubescent above, annulate in the middle; upper lip 3 mm long, densely whitewoolly; lower lip about twice as long, the middle lobe obviate, rounded, the lateral lobes small, subacute. Fruit nutlets, 2.5 mm long, oblong, brown, smooth, inner face angular and outer face rounded (Figure 1) [13,14].



**Madhumita Sarkar and Gunamoni Das****Other names:[15]**

Sanskrit	: Dronapushpi, Chitrapathrika, Chitrak-shupa
Punjabi	: Guldora
Bengali	: Darunaphula, Hulkasha
Gujarati	: Kulnnphul
Hindi	: Goma madhupati
Sindhi	: Kubo
Maharashtra	: Bahuphul
Bombay	: Tumba
Telugu	: Tunni

Medicinal properties of *Leucas aspera***Antimicrobial property****Antimicrobial activity of *Leucas aspera* flowers**

The antimicrobial property was reported that the ethanolic extract contains more active principles than the water for better antimicrobial activity against different bacterial strains[16]

Antimicrobial action of some essential oils.

The essential oils from *L. aspera* possessed bacteriostatic activity against *Vibrio cholerae*, *Staphylococcus aureus*, *Klebsiella aerogenes*, *Salmonella typhi*, *Escherichia coli*, *Pseudomonas pyocyanea*, *Proteus vulgaris* and *Dys. Flexneri*[17].

Antimicrobial activity of *Leucas aspera* flowers

The methanol extract of *Leucas aspera* (Willd.) Linn. Flowers its fractions, the alkaloidal residue and the expressed flower juice showed good antibacterial activity for methanol fraction with maximum activity for the alkaloidal residue[18]. Identification of antimicrobial agents from different sources to combat microbial resistance is the great interest of current researchers. Antimicrobial susceptibility testing has wide applications in drug discovery, epidemiology and prediction of therapeutic outcome[19]. The antimicrobial property of *Leucas aspera* (Willd) Linn. was reported and discussed by many researchers. They indicated that the bacterial membrane damage may be caused by the phenols and flavonoids from this plant, and that the activity is time- and concentration-dependent[20]. According to Gangadharan et al.'s findings on phytochemical analysis, ethanol can extract more of the plant's active ingredients than water for better antibacterial activity[21]. The petroleum ether extract of *Leucas aspera* (Willd.) Linn. was said to be more efficient by Sarathambal et al.[22]. Biofilm is made up of bacterial colonies that are encased in an extracellular polymeric matrix that they have self-produced[23]. Bacteria and fungi use the formation of biofilm as a means of surviving in adverse environments and adjusting to their surroundings. Because biofilm microorganisms are immune to medicines and immunological responses, it is challenging to treat biofilm infections clinically [24]. *Streptococcus pyogenes* cannot form a biofilm when *Leucas aspera* (Willd) Linn extract is dissolved in methanol and ethyl acetate[25].

Antioxidant property

Numerous researches have noted that *Leucas aspera* (Willd.) Linn. has antioxidant properties. Very strong antioxidant activity was demonstrated by the *Leucas aspera* (Willd.) Linn. ethanol extract. Chloroform, ethanol, ethyl acetate, isopropyl alcohol, and petroleum ether have the highest levels of antioxidant activity, with the petroleum ether extract of *L. aspera* leaf having the lowest levels. For better extraction of phytochemicals and phytoconstituents, they also recommended petroleum ether (non-polar solvent selection) and ethanol or isopropanol (polar solvent selection). In addition, when compared to in vitro callus extract, antioxidant activity was found in wild leaf extracts [26].

Antifungal Activity

**Madhumita Sarkar and Gunamoni Das**

It has been reported that the chloroform and petroleum ether extracts of *Leucas aspera* (Willd) Linn. have good antifungal activity against the fungi *Trichophyton* and *Microsporum gypseum*. The minimum inhibitory concentration value reported as 5 mg/MI [27].

Antinociceptive Activity

The antinociceptive action of *Leucas aspera* (Willd) Linn. has been documented in entire plants using Swiss albino mouse models of stomach pain generated by acetic acid. At dosages of 50, 100, 200, and 400 mg, the methanolic extract of entire plants of *Leucas aspera* (Willd) Linn. demonstrated stronger antinociceptive action. The study also shows that *Leucas aspera* (Willd) Linn. extract, even at low doses, exhibited antinociceptive effectiveness when compared to the aspirin-standard medication [28].

Hepatoprotective Activity

The hepatotoxicity in rats is caused by carbon tetrachloride was significantly prevented by the cold methanolic extract of *Leucas aspera* (Willd) Linn. [29].

Anti-Inflammatory Activities

Numerous aerial components of *Leucas aspera* (Willd) Linn. have been found to have anti-inflammatory properties [30]. For the local treatment of psoriasis, recurrent skin eruptions, and chronic rheumatism, *Leucas aspera* (Willd) Linn. leaf juice is extracted [31]. At various concentrations, *Leucas aspera* (Willd) Linn. leaf ethanolic extract shown considerable ($p < 0.001$) anti-inflammatory efficacy in both chronic and acute inflammation, according to Patil et al. [32].

Antibacterial Activity

Using the double diffusion method, the antibacterial activity of *Leucas aspera* (Willd) Linn. was examined in relation to human pathogens such as *Klebsiella pneumoniae*, *Bacillus cereus*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Enterobacter faecalis*. The methanol, hexane, ethylacetate, and dichloromethane-based organic leaf extracts had strong antibacterial activity. Among them, hexane and methanol extracts showed to be more efficient against pathogenic strains of *Escherichia coli* and *S. aureus* [33]. *Leucas aspera* (Willd) Linn. stem, flower, leaf, and root extract had antibacterial efficacy against *Salmonella choleraesuis*, *S. aureus*, *E. coli*, *Salmonella typhimurium*, *Shigella flexneri*, and *Pseudomonas aeruginosa* [34]. Additionally, ethyl acetate extract and methanolic extract had strong antibacterial effects on *Proteus vulgaris*, *E. coli*, *Klebsiella pneumoniae*, and *S. aureus* [35].

Antidiabetic Activity

In alloxan and streptozotocin-induced hyperglycemic rats, Gupta et al [36] demonstrated strong anti-hyperglycemic effects of ethanol and petroleum ether extracts of *L. aspera*. When *Leucas aspera* (Willd) Linn. leaves and stem were extracted in methanol at a maximal dosage of 400 mg extract/kg body weight, Mannan et al. [37] observed reductions in serum glucose levels of 34.01% and 28.39% in mice.

Larvicidal Activity

Crude leaf extracts *Leucas aspera* (Willd) Linn. has reported for their larvicidal activity against *Aedes aegypti* and *Culex quinquefasciatus*. Among extracts, hexane extract has shown the most potent larvicidal activity against the two vectors compared with chloroform and ethanol extracts. The lethal concentration 50 (LC50) values for *C. quinquefasciatus* were found to be 122.5 ppm and against *A. aegypti* the LC50 values were 77.4 ppm, respectively. The hexane extract of *Leucas aspera* (Willd) Linn. leaf showed good larvicidal activity [38].

Anti-ulcer Activity

Reddy et al. [39] investigated the antiulcer activity of *Leucas aspera* (Willd) Linn. alcoholic extract by the following experimental models: aspirin induced ulcer and Shay rat ulcer. They observed a significant decline in acid secretion along with reduced ulcer score in rats and concluded as a result of anti-secretory and protective action on gastric mucosa.



**Madhumita Sarkar and Gunamoni Das****Perspectives on Traditional Uses**

The juice of the leaves of *L. aspera* is used in psoriasis, chronic skin eruption, in chronic rheumatism and applied to disperse painful swellings [40]. The flowers are being warmed with a little honey and given orally for cough and cold to children [41]. The leaves are used as an insecticide and mosquito repellent in rural areas [42]. The juice of leaf is used as local application for psoriasis and chronic skin eruptions. The leaves are applied to the bites to serpents, poisonous insects and scorpion sting. The extract of plant is used with honey in case of abdominal pain and also in digestion [42].

Pharmacological value

The Ethno medicinal use to cure cold, cough, and skin disorders by a village population in India supports its medicinal value[43] Several researchers reported the use of *Leucas aspera* (Willd) Linn. for treating different health issues. Phytochemicals and trace elements present in this plant are responsible for its use as medicine for many diseases. Major elements identified in the *Leucas aspera* (Willd) Linn. include Carbon, Oxygen, Calcium, Silica, and Aluminum. Apart from this presence of Iron, Sodium, Potassium, Phosphorus and Chlorine were also identified[44]. Yashvanth et al., also reported that no harmful heavy metals were detected in their study.

CONCLUSION

Leucas aspera (Willd) Linn. is a wild herb or shrub which is having medicinal value to a great extent and is available abundantly in field of India, and also adjoining areas in India. It is easily available at a very low cost. Phytochemical and pharmacological investigations on *Leucas aspera* (Willd) Linn. revealed the presence of various chemical constituents like terpenes, sterols, glycosides, lignans, flavonoids and long-chain fatty compounds which are responsible for pharmacological activities. *L. aspera* is a common plant found as weed throughout the Indian subcontinent. Its antimicrobial potential recorded by the researchers proves that it has broad spectrum antimicrobial activity. The antioxidant potential of this plant proves that it is one of the natural sources of antioxidant and it can be used as a preventive medicine. Alcoholic extracts showed better activity than aqueous extracts. The research on the pharmacological value of this plant proves that it has valuable compounds for curing many diseases and thus it is a promising plant for future advanced medicine.

Future Perspectives

Despite applications of *L. aspera* in green synthesis of nanoparticles, majority of research work done is limited to its preliminary evaluation. It is imperative to identify and isolate the promising active constituents and to study them in mechanistic levels against specific targets of deadly diseases. Extensive research has to be done in this direction to transform *Leucas aspera* the roadside weed into an very important medicinal plant [73].

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**Madhumita Sarkar and Gunamoni Das**

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**Madhumita Sarkar and Gunamoni Das**

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**Madhumita Sarkar and Gunamoni Das**

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Madhumita Sarkar and Gunamoni Das

SI no	Tissue	Compound/Extract	Activity	Source
1	Aerial parts	Hydroalcoholic extract	Arthritis, anti-arthritic activit [45]	Kripa KG et al. 2010;4(4):281-7
2	Leaf	Hydroalcoholic extract	Hepatoprotective activity[46]	Thenmozhi M et al. 2013;6(1):78-81.
3	Aerial parts	Methanol extract	Ulcer protective effect[47]	Augustine BB et al. 2014;4(1):S395-S402.
4	Aerial parts	Ethyl acetate fraction	Anticancer activity[48]	Augustine BB et al.2014;10(38):118-24
5	Aerial parts	A-amylase inhibitor	Diabetes[49]	Meera C et al. 2017;6(3):346-55.
6	Leaves	Aqueous suspension	Anabolic effect [50]	Kavitha R, Kannan Ret al. 2013;2(4):433-7
7	Roots	Methanol and petroleum ether extract	Analgesic activity[51]	ShelkeSet al.2015;5(01):333-7.
8	Roots	Hydro-ethanol and aqueous extract	Chemoprotective effect[52]	Gupta N et al. 2015;30(1):22-7.
9	Roots	Nano-particles of <i>L. aspera</i>	Anticancer activity[53]	Mohan A et al.2017;181(4):1388-400.
10	Roots	Ethanol extract	Antiepileptic activity[54]	Ramani R et al.2014;6(3):391-4.
11	Whole plant	Ethanol extract	Cytotoxic activity[55]	Chowdhury N et al. 2012;2(2):87-90
12	Whole plant	Aqueous and alcoholic extracts	Antiinflammatoryaction[56]	Reddy MK et al. 1986;5(3):168-171.
13	Shoot system including stem, leaves and flower	Ethanol extract	Antiinflammatoryactivity[57]	Goudgaon NM et al. 2003;35(6):397-8.
14	Whole plant	Aqueous extract	Hepatoprotective[58]	Banu S et al. 2012;50(12):1592-5
15	Leaf	Methanol Extract	Cytotoxic Activities[59]	Ali MS et al. 2013;2(1):8-13
16	Leaf	Ethanol extract	Antidiabetic activity[60]	Gupta Net al.2011;2(1):275-80
17	Leaf	Ethanol extract	Antidiabetic activity[61]	Tukaram T et al. 2011;2(3):246-8.
18	Whole plant	Methanol Extract	Antihyperglycemic activity[62]	Atchutkumar K et al. 2013;5(2):76-8.
19	Whole plant	Ethanol extract	Cytotoxic effect[63]	Rahman MA et al.2013;3(4):273-9
20	Root	Ethanol extract	Cytotoxic effect and antinociceptive activity[64]	Rahman MS et al. 2007;78(7-8):552-5.
21	Root	Ethanol extract	Central nervous system depressant activity[65]	Rahman S et al. 2006;6(3):174-8.
22	Leaf	Triterpenoid from methanol extract	Antivenom activity[66]	Venkatesan C et al.2013;33(4):336-59.
23	Leaf	Methanol leaf extract	Antivenom activity[67]	ManonmaniS et al.





Madhumita Sarkar and Gunamoni Das

				2016;1(7):27-35.
24	Aerial parts	Ethanol extract	Antipsoriatic activity[68]	Singh SK et al. 2015;53(9):1295-301.
25	Aerial parts	Diterpenes	Activity Inhibiting Prostaglandin-Induced Contractions[69]	Sadhu SK et al. 2006;69(7):988-94.
26	Whole plants	Ethanol extract	Anti-inflammatory activity[70]	Patil Net al. 2014;6(2):715-9.
27	Whole plants	Methanolic extract	Anti-mutagenic activity[71]	Hasmukhlal TJet al. 2016;2(3):56-60.
28	Whole plants	Ethanol extract	Anthelmintic activity[72]	Agarwal S et al. 2011;3(24):77-80.



Figure 1: *Leucas aspera* plant



Figure 2: Inflorescences and flower





A Literary Review on Jeevakarpam in Siddha Literature

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ABSTRACT

Siddha medicine is one of the ancient Indian traditional systems of medicine practiced for many ailments in this contemporary world. Kayakarpam (Rejuvenation therapy) is an important division of Siddha system that consists of extensive Karpam medicines and yogic practices. These karpam medicines are prepared from herbs (*Mooligai*), metals (*Ulogam*), minerals (*Thathu*) and animal and Marine products (*Jeevam*). The Mooligai karpam medicines (herbal formulation) were mentioned in various Siddha literatures like *Theran Yamaga Venba* and *Karuvurar Vatha Kaaviyam*. The Thadhu karpam medicines (Metals and Mineral formulation) were mentioned in *Agathiyar chenduram 300*. The kayakarpam medicine mainly used to prevent diseases and to attain longevity. The Jeevakarpam medicines usage is lesser in the treatment compared with other herbomineral medicines. Hence the kayakarpam medicines of Animal and marine origin are collected and compiled by review of various Siddha literature and documented for academic, clinical and research purpose. This review of literature brings out that the wide collection of Jeeva karpam formulations mentioned in Siddha literatures. 27 Jeevakarpam formulations mentioned in Siddha literatures are documented. In this study, 95 Siddha literatures were reviewed. Most of the evidences of these preparations are described by sage Bogar in his literatures.

Keywords: Siddha medicine, Jeevakarpam, Kayakarpam, Rejuvenation.





INTRODUCTION

Siddha medicine is one of the Indian traditional medicinal systems practiced for many ailments in this contemporary world. Siddha medicine consists of Alchemy (*Vatham*), Medicine (*Vaidhyam*), Yogam (*Yogam*) and Wisdom (*Gnanam*) in it. Siddhar Yogam is an advanced science which describes the union of body and mind to become the precious soul through 96 thathuvams to attain immortal life and improve the quality of life. Siddhars also elaborated the lot of techniques of kayakarpam including Siddhar yogam and karpa medicines which are considered as strengths of Siddhar Yoga therapies. Kayakarpam medicine plays a vital part in the Siddha system of medicine. The karpam medicines are those which prevents greying, wrinkles of skin ageing, senile diseases and promote longevity with free of illness. In short, kaya karpam is a rejuvenating medicine and also a boon given by Siddhars to strengthen our physical as well as our mental health [1].

Karpaththai undaal kaayam azhiyadhu
Karpathinale kaanalam kayilaiyai
Karpathinale kaanalam sothiyai
Karpathinale kaalaiyum kattidae. -Thirumoolar

The karpam medicines are broadly classified as given below. Among them, mooligai and thathu karpam medicines were broadly used and have various evidences. The Jeevakarpam were not much exposed and lesser in usage.

Types of karpam [2]:

- As per indication,
 - i. Pothu karpam (used for general health and longevity)
 - ii. Sirappu karpam (used to treat the specific disease and to strengthen the body)
- As per origin,
 - i. Mooligai karpam (Herbal origin)
 - ii. Thathu karpam (Metals and mineral origin)
 - iii. Jeeva karpam (Animal and marine origin)
- As per the composition of drugs
 - i. Thani karpam (Single drug)
 - ii. Kootu karpam (Multi drug composition)

OBJECTIVE

To review and document the various Siddha literatures regarding Jeevakarpam (Karpam medicines of animal and marine products).

METHODS

Review of Siddha literature from the libraries of National Institute of Siddha, Government Siddha medical colleges Chennai & Palayamkottai.





REVIEW OF LITERATURE

Book Name:Bohar 7000 [3]

S.NO	MEDICINE	DOSE	ADJUVANT	INDICATION
1.	Nathai karpam (Snail)	-	-	
2.	Vilaangu karpam (Eel)	Kazharchi (5gram)	-	<ul style="list-style-type: none"> ● Rejuvenation ● To strengthen the body
3.	Naarai karpam (Storks)	-	-	<ul style="list-style-type: none"> ● Helps in vasiyogam (pranyamam)
4.	Mayilmuttai karpam (Peacock egg)	-	-	<ul style="list-style-type: none"> ● Retains youthfulness ● longevity
5.	Seval karpam (Rooster)	-	-	<ul style="list-style-type: none"> ● To strengthen the body ● Regulates breathing ● Aphrodisiac
6.	Mayil karpam (Peacock)	-	-	<ul style="list-style-type: none"> ● Prevents ageing and increases lifespan
7.	Anda seyaneer (Egg)	-	-	<ul style="list-style-type: none"> ● Cures many diseases ● Rejuvenation
8.	Indhirakobam (Red velvet mite)	1 kundri (130 mg)	-	<ul style="list-style-type: none"> ● Prevents ageing ● Strengthens the body ● Rejuvenation
9.	Poonaga chathu (Earthworm)	-	-	<ul style="list-style-type: none"> ● Alchemy
10.	Aamai karpam (Turtle)	-	-	-
11.	Kalaimaan karpam (Deer)	-	-	<ul style="list-style-type: none"> ● For longevity

Book name: Bohar karpam 300 [4]

12.	Anda karpam (Egg)	-	-	<ul style="list-style-type: none"> ● Protects the body ● Regulates appetite, sleep
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Book name: Ramadevar vaidhya kaviyam 1000^[5]

13.	Anda seyaneer (Egg)	-	-	<ul style="list-style-type: none"> ● Rejuvenation ● Cures many diseases
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Book name: Sattamuni vadha kaiyam [6]

14.	Anda mezhugu (Egg)	-	-	<ul style="list-style-type: none"> ● Rejuvenation
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Book name: Yogobu chunna kaandam 600^[7]

15.	Uroma thylam (Children's hair)	-	Milk	<ul style="list-style-type: none"> ● Body will glow
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Book name: Pathartha guna vilakkam [8]

16.	Karungozhi (Black hen)	¼ Panavedai (122mg)	-	<ul style="list-style-type: none"> ● Rejuvenation
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Akila et al.,

17.	Cow Milk (Fresh milk)	-	-	<ul style="list-style-type: none"> • Burning sensation in hands and feet • Anemia • Jaundice • Kapham • Strengthens the body
	Boiled cow milk	-	-	<ul style="list-style-type: none"> • Pitha diseases

Book name: Theraiyar vagadam [9]

18.	Kozhi karpam (Hen)	Verugadi (1.250-1.500mg)	-	<ul style="list-style-type: none"> • Vatha diseases
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Book name: Agathiyar poorana soothiram [10]

19.	Muthu chunnam (Pearl)	-	Betal leaf	<ul style="list-style-type: none"> • Kapha diseases • Rejuvenation
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Book name: Theraiyar yamaga venba [11]

20.	Aamai odu parpam (Turtle shell)	Panavedai (488mg)	Honey& milk	<ul style="list-style-type: none"> • Steadiness • Improves vision • Regulates breathing
21.	Nathai odu parpam (Snail shell)	Panavedai (488mg)	Milk	<ul style="list-style-type: none"> • Promotes vocal tone and strengthens the body.
22.	Pavala parpam (Corals)	¼ in pepper	-	<ul style="list-style-type: none"> • For good vocal quality
23.	Madhana kameshwaram (Horns)	2-3gram	-	<ul style="list-style-type: none"> • Nervine tonic • Retains youthfulness • Protects the body form disease

Book name: Sattaimuni karpa vidhi [12]

24.	Poonaga chathu chendooram (Earthworm)	1 kundri (130mg)	-	<ul style="list-style-type: none"> • Gives glow to the body
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Book name: Kaayakarpam [13]

25.	Kombu (Horns)	Panavedai (488mg)	Milk	<ul style="list-style-type: none"> • Rejuvenation
26.	Kandamiruga kombu (Rhinoceros horn)	1 kundri (130mg)	-	<ul style="list-style-type: none"> • Strengthens the body
27.	Poonaga parpam (Earthworm)	-	-	<ul style="list-style-type: none"> • Nervine tonic • To prevent the diseases

DISCUSSION

As per this review, there are 27 Jeevakarpam formulations which consists of 15 animal species and their products (i.e Snail, Eel, Storks, Rooster, Hen and Egg, Black hen, Peacock, Red velvet mite, Earthworm, Turtle, Deer, Corals,



**Akila et al.,**

Pearls, Rhinoceros Horns, Cow milk). Among the 15 species, herbivores and carnivores are each 4 and Omnivores are 7. Kalaimaan karpam and aamai karpam formulations were not clearly mentioned. This review mainly highlights the evidence of Jeevakarpam in Siddha system of medicine. As per the wild animal protection law to protect the endangered species, some of the medicines cannot be prepared and practiced. By knowing their medical importance, we can protect the animals from endangered due to liability.

CONCLUSION

This review emphasizes the formulation and indication of Jeevakarpam which is mentioned in Siddha literature. It may be advised for prevention and treatment of diseases. Furthermore clinical studies maybe carried out to ascertain the safety and efficacy of karpam medicines to ensure their significance.

RECOMMENDATION

The karpam medicines of animal origin were less common in the practice of Siddha medicine. Yet this review will be a repository for further clinical research studies in Jeevakarpam medicines.

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Tunnel Gas Inspector

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ABSTRACT

Only humans within an area can detect gas leakage; if no one is present in the zone, no leakage can be recognized. In other cases, persons with poor senses of smell cannot detect the gases. Gas leakages can potentially start fires that harm human property and inflict catastrophic injuries or fatalities. As a conclusion, this technology will aid in the monitoring of gas seepage. The desire of our work is to build a gas inspection robot which navigates through tunnels and pipes and estimate the gas level in it. This mobile robot tells us whether the tunnel environment is safe or not. An android app is developed which controls the navigation system of the bot using a Bluetooth module and a live stream video footage using Wi-Fi module. This shall enable us to remotely access the bot and explore the tunnel. Gas sensors are mounted on the bot to collect different gases that are present within the tunnels.

Keywords: Gases, Gas Inspection Bot, Internet of Things (IoT), Tunnel, Android Application

INTRODUCTION

The industrial revolution has made substantial use of the Internet of Things (IoT). Its growth has been exponential in the last ten years, and it is typically utilised for measuring and reporting data. The concept of connecting any gadget to the internet and other linked items, such as people, cars, and even household appliances, is known as the "Internet of Things". By doing so, this network creates a giant repository of data about how these objects are used and their surrounding environment. Powerful IoT platforms allow for precise data management, identifying which information is most important and determining what can be discarded. IoT is a cutting-edge automation and analytics system that improves performance across a range of domains, including cloud, artificial intelligence, sensors, networking, and electronic messaging. Developed over time through innovative workarounds and ingenious technological solutions, IoT has made its mark on the industry by providing greater transparency into systems while maintaining control.



**Sankari Subbiah et al.,**

A deep buried long tunnel is typically found passing through complex geological conditions. This type of tunnel is most likely to be discovered during excavation efforts in areas with a high concentration of these types of features. The transportation system for gas involves a complex network of pipelines, designed to quickly and efficiently move the gas from its original location to where it is needed. Geological disasters, such as rock bursts and harmful gas emission are common during the construction process. Instead of one specific gas, there are a hazardous or explosive combination of many gases with diverse effects on human health and safety. There are a number of harmful gases that can be found in deep water, such as high pressure water gushing and high temperature. These gases can cause serious problems for marine life and humans who encounter them. Many of China's gas transportation tunnels have experienced significant gas eruptions and explosions, resulting in significant economic losses. More than 70 people were killed in the Yanjiaozhai tunnel due to a gas explosion [1]. As a result, it is critical to expand research into the characteristics of harmful gas in deep buried long tunnels. This paper aims to build a gas inspection robot which navigates through tunnels and pipes and estimates the gas level in it. This mobile robot tells us whether the tunnel environment is safe or not. Gas sensors are mounted on the bot to collect different gases that are present within the tunnels. A bluetooth module and a live video stream from the built-in camera on the bot are used by an android app to control the navigation system of the robot. This shall enable us to remotely access the bot and explore the tunnel.

The following is how the paper's sections are arranged: - Brief introduction to IoT is covered in Section 1. A study of several literatures where a few models for gas leakage detection have been created is included in Section 2 of this paper. The scope of IoT is briefly discussed in Section 3 before moving on to the IoT applications. Section 4 presents the IoT components used in the proposed system. Methodology and the system architecture is discussed in Section 5 and the conclusion and future enhancements are discussed in Section 6.

Literature Survey

An IoT-based system was developed for gas leakage detection that includes integrated Pushbullet notifications. When gas leaks from the environment, the user receives a tangible warning in the manner of a buzzer and an LED to take necessary precautions prior to actually harming the environment is done. A notification is also sent to the user's mobile device or laptop [1]. In [2][13], summarized the IoT based smart LPG gas detector robot controlled by Android. This system was primarily developed to warn consumers about the waste of gas while removing cookware from the burner using an object detection sensor. A Gas leak detection system was developed based on sensors. When the system notices that the gas concentration in the air is higher than the acceptable level, it will activate an alarm with a buzzer to notify the user within the home of the unusual condition and prompt them to take the appropriate action [3] [12].

A model for LPG gas leak detection and alarm system was discussed. When a LPG leak is detected, the system activates LEDs and a buzzer to alert people. This system is very simple, but reliable [4]. In [5], comprehensive review of a paper was provided on Gas monitoring and control systems in coal and gas explosion laboratories. In this study, we designed a simple monitoring and control system to ensure personnel safety during small blowout experiments. The results show that in simulations of four hazard scenarios, a system based on the detector feedback loop can cover the evolution of gas content in temporal and spatial disciplines to improve the accuracy of early warning. A system was developed using an Arduino to find explosive sewage toxins in drainage systems. This device can detect explosive sewer toxins in the drainage pipes, and that's where the entire process happens. The code is developed as a sketch in the Arduino IDE (Integrated Development Environment) and is saved with an extension. The created model has been simulated, and the program's outcomes are scrutinized. Methane, carbon monoxide and hydrogen sulfide, which are gases produced by sewage, are the major targets of this technology. Explosive gases like methane and hydrogensulfide can be found using it [6]. In [7], a self-propelled continuous-track-robot was developed by adapting the idea of continuous tracks that are moved and directed by wheels. Because it is constructed of actuated chain segments, the robot is capable of changing shape without the use of guiding systems. Therobot can adjust to the terrain and go around obstacles with the help of embedded sensors. The robot could also roll and climb in two dimensions.



**Sankari Subbiah et al.,**

A tool was provided that can identify gas leaks and notify owners to prevent difficulties caused by gas leaks. The system tracks gas leakage and sends SMS alerts as needed using an Arduino microcontroller, a buzzer and a MQ2 gas sensor. A buzzer, LCD screen, GSM module, and MQ2 gas sensor are all included in the circuit. The microcontroller makes a decision after receiving information from the sensor about a gas leak and then sends the user a warning message as an SMS to a mobile phone [8].

Scope of IoT

"IoT" is an idea of extending the power of internet to a variety of different items, processes, and surroundings in addition to computers and smart phones. These "connected" items can be used to transmit information back or receive information, or both. "IoT," is the idea of extending the power of the internet to a variety of different items, processes, and surroundings in addition to computers and smart phones. These "connected" items can be used to transmit information back or receive information, or both. The Internet of Things is a network of interconnected gadgets, including cameras, electrical devices, and sensors. They are configured in a way that the linked devices benefit from automation provided by IoT. Smart TVs, refrigerators, and air conditioners are a few of the typical IoT gadgets we encounter and utilize on a daily basis. To control these devices, we only need to provide commands using the smart phone application. We also utilize a lot of wearable Internet of Things gadgets, such as smart watches and wristbands that display our heartbeat, blood pressure, and walking distance. All of this is made feasible by cleverly fusing technologies and apparatus to create an IoT product [9,10]. Furthermore, the potential of IoT has been significantly expanded as a result of developments in AI and machine learning [11]. Healthcare is not the only industry where IoT has potential application and there are plenty of IoT based applications in day to day life activities. The classification of IoT is showcased in the fig. 1.

The IoT streamlines, enhances, and automates operations thanks to the seamless connectivity between machines, people, and data. Many systems might become more effective with the use of sensors, networking, and artificial intelligence. Costs are reduced in ways that were previously impossible. The Global IoT Enterprise Expenditure Dashboard from IoT Insights, which was updated in March 2022, projects that the IoT market would grow at a CAGR of 22% and reach a valuation of \$525 billion by 2027 [10]. The development of technology is mostly to blame for the growth of IoT solutions. Sensitive and energy-efficient technology, such as RFID tags and sensors, is widely available today. The high bandwidth necessary to operate an IoT system is ensured by wireless networks and more recent cellular networks. The complexity and sophistication of machine learning algorithms have made fast data analysis possible. Cloud computing also makes it simple for systems to easily store, transport, and analyze data. The IoT also helps ITIL, a system of IT service management, which is a crucial point since IT departments are being asked to perform more and more in a world that is becoming more digital and dependent on wireless networks. IoT technology naturally benefits block chain, which is being employed as a more effective and secure way of transaction and data processing. IoT and Block chain will likely combine more frequently in the future. Both professionally and personally, the Internet of Things has the potential to drastically alter our lives. Several of the advances described are already in use, either fully or partially. There is no turning back that much is certain. No sector can ignore the IoT's extraordinary level of efficiency and control.

IoT Components**MQ2 GAS SENSOR**

One of the MQ Sensor's series most widely used sensor is the MQ2 Sensor as in fig. 2. Because sensing is based on the change in the resistance of the sensing material when exposed to gases, they are also known as Chemiresistors. It detects smoke, propane, LPG, alcohol, carbon monoxide and methane between the range of 200 and 10,000 parts per million (ppm). MQ2 is sensitive to smoke and combustible gases. It is a heat-driven sensor. A two-layer "anti-explosion network", made of fine stainless steel mesh, is used to cover it. As we are monitoring flammable vapours, this ensures that the heating element inside the sensor will not cause an explosion. Moreover, it protects the sensor



**Sankari Subbiah et al.,**

from damage and removes suspended particles so that only gaseous components pass through the chamber. The MQ2 sensor is cost-effective and appropriate for a variety of uses.

MQ4 GAS SENSOR

The MQ4 Gas Sensor as showcased in fig. 3, is mainly used to measure the concentration of methane and CNG in air. It has a stainless steel mesh-encased ceramic detecting element with an aluminum-oxide substrate and a tin-oxide concealment. Gases can be produced at concentrations between 300 and 10,000 ppm. This sensor responds quickly with great accuracy. In this sensor, the output voltage will rise as the gas concentration increases. This sensor consumes 750mW while operating at 5V DC. MQ4 gas sensor detects the gas by using an analog or digital pin. As soon as the sensor module receives 5V of power, it begins to detect methane gas. The primary function of its circuit is to monitor and detect natural gas using an Arduino Uno board. These sensors come in a variety of sizes and detecting abilities.

NODE MCU

A development board and open-source Lua-based firmware called NodeMCU are made for Internet of Things applications. It is a microcontroller development board with Wi-Fi capabilities. It makes use of ESP8266 microcontroller chip. The designs for the prototyping board and firmware are also open-source. It combines the advantages of Wi-Fi access point and microcontroller. Wi-Fi connection can be established with just a few lines of code. The NodeMCU is an incredibly powerful tool for Wi-Fi networking. The ESP8266 microcontroller, on which the NodeMCU is based, has an extremely low current consumption range of 15A to 400 mA, which can be further reduced to 0.5A by activating the deep sleep mode. Thus, NodeMCU is better than Arduino. NodeMCU are inexpensive, have built-in Wi-Fi network support, have smaller boards, and use less energy. The main advantage is the built-in network-compatible wireless technology that does not require any shielding or other Arduino-specific peripherals. Good speed and processing power improve the economy and compactness of the module. The NodeMCU platform is a popular option for building IoT projects because of its inexpensive cost and the ease with which Lua can be used to program its hardware and network interfaces as shown in fig. 4.

L293D DRIVER

The L293D Motor Driver as in fig. 5, is a high-power motor driver which can run Stepper and DC Motors. The components used here are a 78M05 5V regulator and an L293D motor driver IC. The L293D motor can control up to 4 DC motors with speed and direction control. It is a high-voltage, high-current full-bridge double-bridgedriver. The motor driver allows for the simultaneous

MOTOR

Motors are one of the mechanisms by which robots move. Electric motors are used by a vast majority of robots. Portable robots frequently utilize brushless or brushed DC motors, while industrial robots frequently employ AC motors. High sustained torque is a feature of DC motors. They are therefore perfect for robotics applications where a steady force is needed. DC motors are also excellent for robotics applications that need precise speed control due to their wide range of speed capabilities. Robotics applications that demand a motor with a high torque at low RPMs are perfect for DC motors. They come in particularly handy for tasks that call for precision positioning or movement. Fundamentally, DC motors are effective in robotics because they enable battery power for the robot, which has several benefits for a range of robotic applications, notably for mobile and collaborative robots. The DC motor is ideal for robotic applications due to its adjustable torque and speed as well as the use of batteries to help in movement.

System Architecture

The proposed system architecture was given in the fig. 6 and consists of BOT which is integrated with mobile application for tracking BOT navigation in tunnel



**Sankari Subbiah et al.,****BOT DESIGN**

The main step of going ahead with adopting IoT technology is to figure out every device or asset that will be integrated into the network. It includes gas sensors, camera module for live feed and motor for navigation. NodeMCU acts as the heart of the bot. The bot is sent inside the tunnel for gas leakage detection. The hardware part of BOT is showcased in the fig. 7

BOT NAVIGATION

The navigation system of the bot is managed by android software that includes a Bluetooth module. This will allow us to access the bot remotely and explore the tunnel. MIT App Inventor is used to create an android application. Bot navigation in mobile application is showcased as in fig. 8 which consists of navigation button to move forward, backward, left and right direction. Bot navigation is controlled using accelerometer control

CAMERA MODULE

The surrounding environment of the bot is monitored using the camera module. There are also options for front and back cameras with two-way audio options. Night vision is also supported in this module. Any obstacle or human movement can be detected and its photo can also be captured as in fig.9 .

GAS DETECTION

The MQ2 and MQ4 sensors are used to measure the concentration of the gas within the tunnel. The MQ2 is a versatile sensor to detect the concentration of LPG, smoke, alcohol, propane, hydrogen, CO in air. MQ4 is used to measure the percentage of methane and CNG in the air. The gas sensors have a potentiometer that can be used to set the threshold values. Whenever the threshold value for gas concentration is reached, the module outputs LOW otherwise HIGH. To detect the harmful value, the experimental threshold value ranges from 300 to 600 ppm. The analog signal is converted to digital value by the D0 pin of the sensor and then gets displayed in the application as in fig. 10. In the graph, 'X' axis depict the different time values and 'Y' axis depict the detected sensor values. A real-time gas inspection robot that travels through the underground tunnels with live video footage is developed. An android application to control the robot's navigation based on the video stream, to monitor the surrounding environment and to display the sensor values, is developed. The prototype of our work is showcased in the fig. 11

CONCLUSION AND FUTURE ENHANCEMENT

Exploring tunnels carries a similar level of risk as examining a collapsed structure. Human life is constantly in peril in these circumstances. Additionally, people with poor senses of smell cannot identify gas leaks. This can result in fire, which can destroy human property and cause significant harm or even death. Building a robot that will inspect the necessary region in accordance with user instructions is therefore the main goal in order to reduce this risk factor. In this work, a sturdy design for a little robot is suggested. The bot can easily traverse through the underground tunnels according to the installation of this architecture. Using a bluetooth module and a live stream of video from the built-in camera on the bot, an android app is created to control the navigation system. The bot has sensors attached to it to gather important data, such as gas leakage. With the camera module built into the bot, some automation is also offered. The bot can be used to examine the nature of any recently excavated location before sending in human personnel during archaeological trips, assuring the safety of the staff. The proposed work can be further enhanced by implementing GPS based automated navigation. Alert system with a buzzer can be implemented to improve the functioning of the bot. Port forwarding mechanism can be deployed to control the bot from any location. The excavation of inhabited regions and military activities may both benefit from this.





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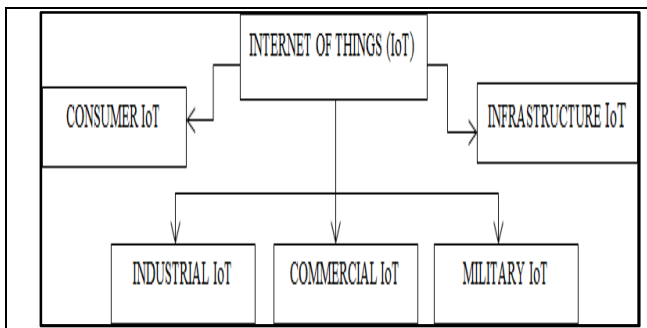


Fig. 1 Classification of IoT



Fig. 2 MQ2 Sensor





Sankari Subbiah et al.,



Fig. 3 MQ4 Sensor

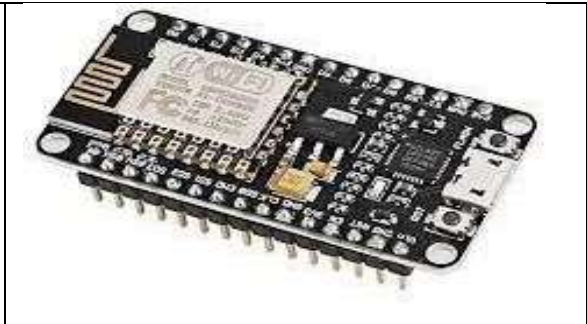


Fig. 4 Node MCU

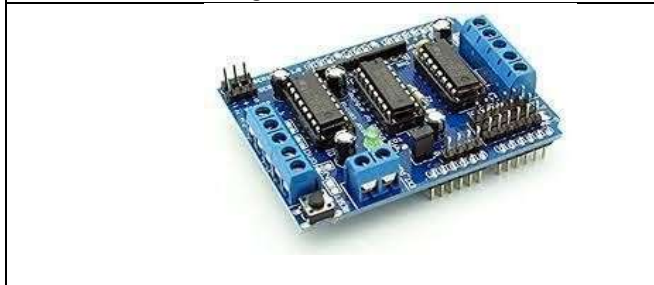


Fig. 5 L293D Motor

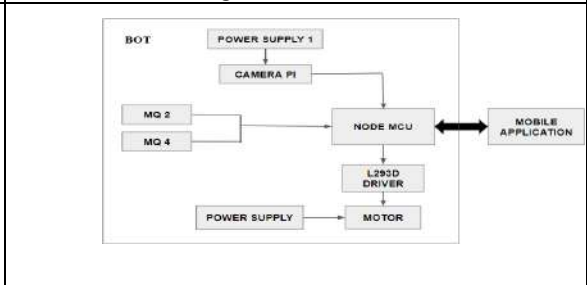


Fig. 6 Proposed System Architecture

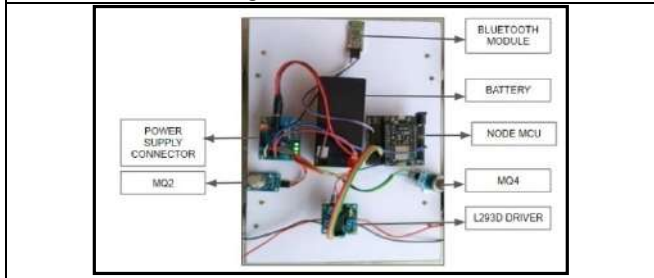


Fig. 7 Bot Design

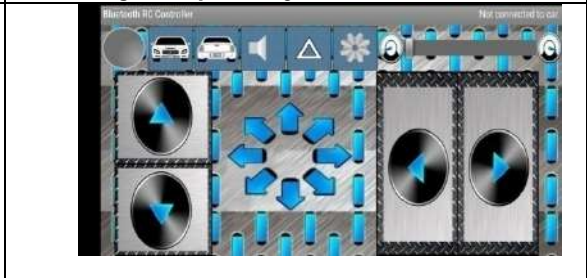


Fig. 8 Mobile application for Bot Navigation

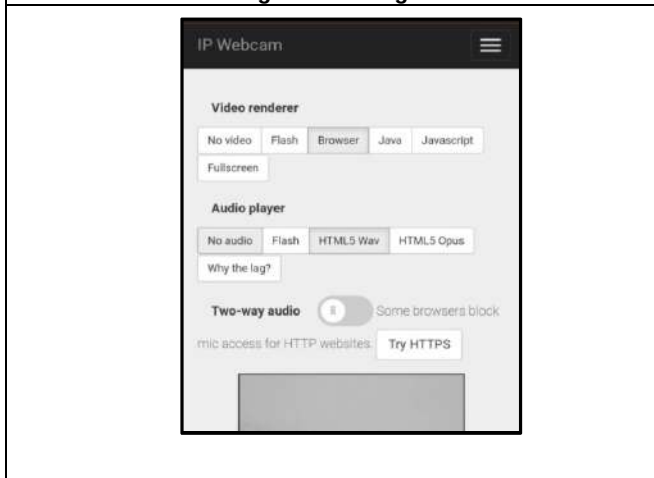


Fig. 9 Snapshot of Camera Module





Sankari Subbiah et al.,

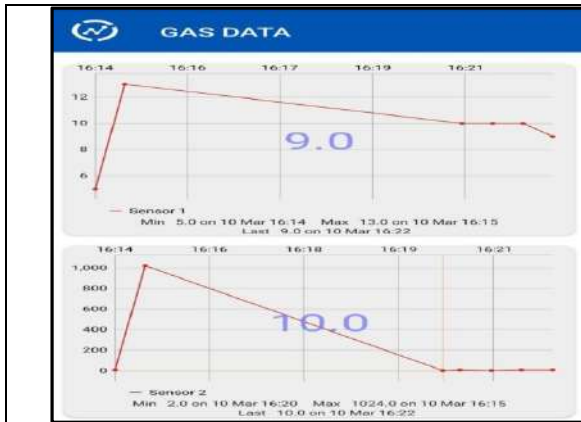


Fig. 10 MQ2 and MQ4 sensor values in the application

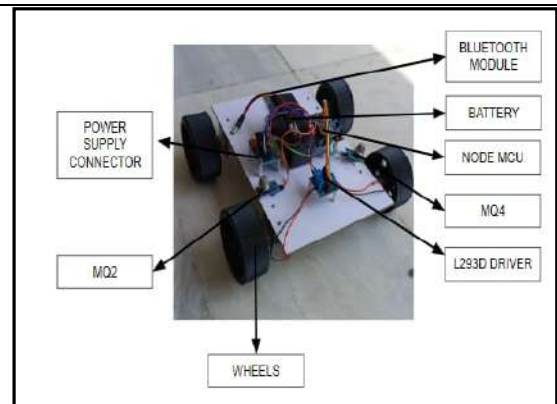


Fig. 11 Bot Prototype for navigation in the tunnel





A Study on Factors Influencing the Consumers to buy Organic Food Products in Bengaluru City

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ABSTRACT

To qualify as "organic," a farming method must forego the use of chemical inputs like fertilizers and pesticides. This research examined the motivations of Bangalore City customers who shopped for organic food items. This study relies heavily on empirical evidence. Primary and secondary sources were used to compile the study's findings. According to the results, word-of-mouth is crucial for people switching to organic food in Bangalore. After this come recommendations from friends, family, and co-workers. The findings highlight the significance of social networks and word-of-mouth marketing in driving interest in organic food items in Bangalore. The benefits of organic food items are not widely known, and their excellent price is a barrier for some consumers, as this study demonstrates. The expansion of the organic market in India is driven by several causes, including the rising awareness and promotion of a better lifestyle among consumers, worries about food quality, and the imperative to preserve the environment. The availability of locally grown organic goods also affects how customers evaluate organic agriculture. To further encourage the expansion of the organic market, raising the supply of organic goods in regions with strong demand is crucial.

Keywords: Farming System, Food Quality, Food Safety, Health consciousness, Organic food.



**Rajeswari and Anil**

INTRODUCTION

"Organic food" refers to fare grown without chemical inputs like fertilizers or pesticides. The agricultural system's guiding principles use cutting edge scientific knowledge and technological advances to provide improved long-term food security. Only 30 additives are authorized under organic standards for animal husbandry, while GMOs and antibiotics are strictly forbidden. The belief in the healthiness and maybe a pleasant taste of these items, as well as the belief in the beneficial influence on the environment and the welfare of production animals, can all be considered as motivating the purchase of organic foods. Pesticides and artificial fertilizers are not used in the production of organic foods. Compared to conventionally grown food, organic produce has lower levels of pesticides and other chemical residues. However, food from both productions is likely to include environmental pollutants. Conventional food has three times as many pesticides as organic food—fewer vulnerability results from reduced exposure. Pesticide residues in conventionally produced foods are often lower than allowable levels. Concerns regarding the use of agrochemicals, hormones, and other medications in livestock farming, as well as the use of artificial additives in produce, have been voiced by consumers.

Bajra, mustard, wheat, chili peppers, cereals, cereals and pulses, kholar, maize, ginger, soybeans, large cardamom, passion fruit, and from Bhilwara, bajra from Bharatpur, bajra from Alwar, bajra from Alwar, cotton grass from Dungarpur, bajra, mustard, Nagpur from Dungarpur, and cereals and Products such as guar-cumin, guar-wheat, moong, mustard, cotton from Ganganagar, bajra from Jaisalmer, pulses from Jhunjhunu, maize from Banswara, and so on.

IMPORTANCE OF THE STUDY

Eating organic food helps keep people in harmony with the environment and other life forms. Many shoppers now choose organic goods because of increased health problems and food safety concerns. The rising need for food free from pesticides and chemical residues, encouraging no artificial preservatives, and best keeping food's uniqueness are why organic food has become increasingly popular among consumers. This guarantees that harmful components aren't used excessively, protecting people's health. As a result, this research aimed to learn how people think about organic food products and assess whether such information may influence their purchasing decisions.

REVIEW OF LITERATURE

Organic food items' health and environmental benefits are increasing their demand worldwide. Several research has looked at what makes people opt for organic foods over conventional ones. Here is an analysis of 20 previous works on the subject:

According to research by Bourn and Prescott (2002), health and environmental concerns drive customers to choose organic food items. Consumers' beliefs about the quality and safety of organic food items play a role in their purchase decisions, according to research by Zanolli and Naspetti (2002). Magnusson et al. (2003) found that those who buy organic food do so out of concern for the planet and social equity. Padel and Foster (2005) found that those buying organic food do so out of concern for the planet, animals, and social equity. Yiridoe et al. (2005) found that those who buy organic food do so out of concern for the well-being of animals and the planet. Hughner et al. (2007) found that those who buy organic food do so because they value eating whole, unaltered foods. Lobb et al. (2007) discovered that customers' opinions of organic food's flavor and nutritional content significantly impacted their purchase decisions. Organic food buyers are concerned about the environment, their health, and the quality of the food they eat, according to research by Verbeke et al. (2007). Egan et al. (2008) revealed that customers' beliefs about the safety and quality of organic food items strongly impact their purchase preferences. Organic food buyers are impacted by their expectations of the product's price and availability, according to research by Gracia and de Magistris (2008).



**Rajeswari and Anil**

Consumers' beliefs about the health advantages of organic food products play a role in their purchase decisions, according to research by Aertsens et al. (2009). These (2009) observed that people's beliefs and values regarding sustainability have a role in their decision to purchase organic food items. Consumers' beliefs about the genuineness and reliability of organic food items play a role in their purchase decisions, according to research by Janssen and Hamm (2012). Dabija and Pop (2013) found that those who buy organic food items are more likely to have higher levels of education, higher incomes, and more excellent environmental care. One study found that those who buy organic food do so because they believe it is better for the planet and their bodies (Chen et al., 2016).

Sari et al. (2017) found that customers who purchased organic food goods did so because they trusted the products' labels and certifications. Organic food shoppers are impacted by their expectations of the product's quality and safety, according to research by Gao et al. (2019). Organic food shoppers are impacted by their beliefs about the product's long-term viability and moral propriety, according to research by Garca-Torres et al. (2020). Li et al. (2020) found that people who buy organic food do so because they believe it is better for their health and the environment.

STATEMENT OF THE PROBLEM

There are several potential drivers of organic market expansion in India. They could have something to do with customers being more health-conscious or with the general increase in consumer knowledge of food quality. Consumers are also becoming more conscious of the need to protect the environment. Organic farming may receive greater attention since consumers view it as more ecologically beneficial. However, the availability of organic products in a given location may influence how local consumers see organic farming. The rising demand for organic goods may be attributed to improved attitudes and solid purchase plans. It's intriguing to investigate whether or not consumers' opinions of organic food goods change as their wealth increases or decreases in the exciting city of Bangalore.

OBJECTIVE OF THE STUDY

To know the factors affecting buying organic food products.

SCOPE OF THE STUDY

As people become more worried about their health and food safety, more and more of them are looking to organic options. The rising desire for pesticide- and chemical-free food has contributed to a surge in the popularity of organic produce. Eating organic food helps keep people in harmony with the environment and other life forms. It also encourages using natural preservation methods and the optimal preservation of food's inherent flavor. This guarantees that harmful components aren't used excessively, protecting people's health.

RESEARCH METHODOLOGY

Methodology in research is the study of how a specific area conducts its studies systematically, hypothetically—speculatively exploring a range of methods and criteria applicable to a discipline. It's a methodical process for getting to the truth. Finding the truth or conclusion based on the scientific method requires identifying the study topic, developing a plan for collecting data, interpreting the data, and drawing conclusions. Instead of using philosophical ways to collect and organize material before logically and systematically manipulating it, scientific methodology is a logical and systematized application of the foundations of science and scientific processes.

Research Design

The study here is purely empirical. Both primary and secondary sources were used to compile this report. A questionnaire is used to collect the necessary information from the respondents. The city of Bangalore is the site of this study's survey. Consumers of organic foods were the target audience for this survey. The term "user" refers to someone who has eaten organic food on at least one occasion.



**Rajeswari and Anil****SAMPLING**

- Census India estimates that there were 8,520,435 people living in Bangalore City in 2011, with 4,433,855 men and 4,086,580 females. As a result, the total number of people in the sample is 8,520,435.
- Probability sampling will be used to choose the samples. Using probability and random sampling allows the researcher to zero in on certain features of interest within a population.
- The participants in this study are expected to be residents of Bangalore City, Karnataka.
- With a population size of interest, a 95% confidence level and a 5% confidence interval yield a sample size of 384 respondents.

SOURCES OF DATA COLLECTION**Primary Data**

The questionnaire was designed with specific goals and distributed to those who regularly consume organic foods. The distribution of the questionnaire was strictly adhered to. However, it was only given to those who regularly consume organic foods.

Primary data were gathered through a standardized questionnaire about various criteria pertinent to the issues.

Secondary Data

The necessary secondary data is obtained from Books, National journals, international journals, research materials, Research articles, Business Magazines, Periodicals, and Websites.

Location of the Study

The location of the study is Bangalore City.

Period of the Study

The study was conducted from January 2023 to March 2023.

Statistical tools used for data analysis of the study

The Primary data collected are analyzed using the IBM SPSS Statistics 25.0 for this study. Friedman Test was used to analyze the data in this study.

LIMITATIONS OF THE STUDY

- The research was limited to the city of Bangalore.
- The study assumes that the data provided by the respondents is accurate.
- Only people who buy organic food are taken into account.
- The research centers on the ever-evolving drivers of consumer demand for organic food items.

DATA ANALYSIS AND INTERPRETATION

In this article, the factors influencing buying of organic food products are examined. It regards "Family members/relatives, Friends, Colleagues, Advertisement, Health consciousness, Beat of quality, Price, Availability, and Variety" investigated. Friedman's test analysis was used to identify the factor which is more influencing the respondents to buy organic food products, and the results are given below.

Hypothesis:

H₀: The mean ranks of the factors influencing the respondents to buy organic food products are similar in Bangalore City.

H₁: The mean ranks of the factors influencing the respondents to buy organic food products are significantly different in Bangalore City.



**Rajeswari and Anil**

Table No.1 presents the statistical interpretation of a survey on different factors influencing the respondent's choice of a particular product. The survey responses were collected on a scale of 1 to 5, where 1 represents the lowest and 5 represents the highest.

The variables presented in the Table No.1 are as follows:

- Family members/relatives: the influence of family members or relatives on product choice.
- Friends: the influence of friends on the choice of a product.
- Colleagues: the influence of colleagues on the choice of a product.
- Advertisement: the influence of advertisements on the choice of a product.
- Health consciousness: the influence of health consciousness on the choice of a product.
- Beat of quality: the effect of a product's quality on consumer preference.
- Price: the influence of the price of a product on the choice of a product.
- Availability: the impact of product accessibility on consumer preference.
- Variety: the influence of the variety of options available on the choice of a product.

Table No.1 represents a descriptive analysis of the mean ranks of the nine factors influencing the respondents to buy organic food products in Bangalore City. The median, first-quartile, and third-quartile scores across nine criteria are included in the descriptive analysis.

Table No.1 results indicate that the "Friends" has the highest mean score of 4.0573, followed by the "Colleagues." According to the respondents, "Friends" is more important. It is followed by the "Colleagues" as influencing the respondents to buy organic food products. Other factors are the least affected among the respondents.

RESPONDENTS' OPINIONS TOWARDS FACTORS INFLUENCING TO BUY OF ORGANIC FOOD PRODUCTS

An attempt has been made to study the respondents' opinions towards factors influencing buying organic food products in Bangalore City. The statement's qualitative information was converted to a quantitative form, and then the respondents' average score was calculated across several factors like "Family members/relatives, Friends, Colleagues, Advertisement, Health consciousness, Beat of quality, Price, Availability, and Variety" and obtained results are and presented in Table No.2.

We analysed the characteristics that led people to choose organic foods using Friedman's ANOVA test. Table No.2 displays the findings. It represents the mean ranks of the nine factors influencing the respondents to buy organic food products in Bangalore City. It could be noted from the above table that among the nine factors, "Friends" was ranked first. It is followed by the "Colleagues." "Family members/relatives" was ranked third.

The average ranking of the nine variables that respondents said made them more likely to purchase organic food items was 6.51 for the "Friends" factor. On the other hand, "Price" comes in at a dismal 3.77 on the mean ranking.

Table No.3 represents the chi-square statistic along with its p-value. According to the data in Table No. 3, the p-value is much lower than the accepted level of 0.05. In light of this evidence, we reject H_0 (the null hypothesis) and accept H_1 (the alternative hypothesis) on the mean ranks of the factors influencing the respondents to buy organic food products in Bangalore City. As a result, there is a large disparity in how people in Bangalore City evaluate the criteria that influence their decisions to purchase organic food items.

FINDINGS

According to the data, personal recommendations are the primary driver of organic food product purchases among Bangalore City residents. After that comes testimonials from friends and family. The study indicated that cost was



**Rajeswari and Anil**

the least significant variable. Based on these findings, it's clear that word-of-mouth and online social networks play a significant role in boosting demand for organic food items in Bangalore. More evidence of this trend is that people will pay more for organic goods if they are convinced of their superior quality and health advantages. The research highlights the need for well-planned marketing campaigns to inform customers of the benefits of organic food products and ease their minds about the additional expense.

CONCLUSION

The expansion of the organic market in India may be attributed to several causes, including the increased awareness and promotion of a healthy lifestyle among consumers, concerns for food quality, and the need for environmental preservation. The impression of organic farming is affected by the availability of organic products in a specific location. As a result, expanding access to organic options in high-demand regions is crucial for driving market expansion. An exciting chance to investigate how wealth level affects consumers' views on organic products presents itself in the example of Bangalore City, where the availability of organic products differs. This might inspire initiatives to boost the organic market in India by illuminating the aspects that impact customers' decision-making about organic food goods. The Indian organic market is expanding and is expected to continue doing so. The correct policies in place may significantly impact the national economy while fostering environmentally friendly farming practices and safeguarding natural resources.

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Rajeswari and Anil

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Table No.1. Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25 th	50 th (Median)	75 th
Family members/relatives	384	3.5990	1.04749	1	5	3	4	4
Friends	384	4.0573	0.87127	1	5	4	4	5
Colleagues	384	3.9505	1.02966	1	5	4	4	5
Advertisement	384	3.2917	1.18887	1	5	2	4	4
Health consciousness	384	2.9896	1.17409	1	5	2	3	4
Beat of quality	384	2.8646	1.10418	1	5	2	2	4
Price	384	2.9583	1.11169	1	5	2	3	4
Availability	384	3.2344	0.99988	1	5	2	4	4
Variety	384	3.6094	1.07111	1	5	3	4	4

Table No.2. Respondents’ Opinions towards Factors Influencing to Buy of Organic Food Products

Factors	Mean Rank
Family members/relatives	5.51
Friends	6.51
Colleagues	6.49
Advertisement	4.94
Health consciousness	3.97
Beat of quality	3.84
Price	3.77
Availability	4.45
Variety	5.53





Rajeswari and Anil

Table No.3. Test Statistics^a

N	384
Chi-Square	632.464
df	8
Asymp. Sig.	0.000

a.Friedman Test





Educational Apps and Students' Response towards Them

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ABSTRACT

This paper is an attempt to understand the learning behaviors of the new generation of students in the digital platform with special reference to educational apps. Digitization affects every sphere of our lives and including education also. The experiences of education in the virtual platform during the pandemic have brought a new experience to the students. With tiny portable mobile phones in their hands, the new generation students have adopted the mobile phone as a tool for learning along with entertainment. Thus, this study wants to reveal their awareness regarding educational apps and it is also an attempt to find the factors which are playing a crucial role in app selection.

Keywords: Mobile phone, Education, Knowledge, Technology, Android App

INTRODUCTION

Wilbur Schramm in his famous book Mass Media and national development says "light is better than darkness and knowledge is better than ignorance (Schramm, 1964)". So, knowledge is an essential requirement for human beings to survive in society. Thus, education should be designed in such a way that it should inspire students to gain more and more knowledge. It should help them to empower themselves by learning life skills and solve challenges of life. While discussing the above, we understand it that education is an essential requirement for the survival, growth, and development of an individual in any society. A properly imparted education perfectly shapes the personality of an individual making him aware about his and others' human rights. Real education empowers an individual to solve life problems in a skillful manner. So, in other words proper education promotes empowerment in a student and enlightens him. But in the contemporary social and educational scenario of India, imparting quality and meaningful





Ambika Sankar Mishra et al.,

education has various challenges and there is a need of removing these obstacles from the path. The basic problems those work like road blocks in imparting meaningful education are:

Language

Language as a medium of communication plays a crucial role in exchange of ideas and information. In the process of communication connotation and denotation keeps a lot of meaning. According to Saussure, for each object, the signifier (Sound/Image) and signified (Concept) play a crucial role in meaning formulation (Lesley, 2019). When we communicate, meaning formulation or signification aspect of our communication remains dependent on signifier and signified and such meaning formulation is also culture-dependent because in the process of signification, the relationship between signifier and signified is many times culture dependent. In Indian context, India is a multilingual country thus the situation is quite critical again popularization of English education and development of English as a window language has become a challenges to the students of rural India .

Lack of Communication Skills

Communication is the most important element required for humans to adapt the environment. Through communication, people can find opportunities to reveal, share and evaluate the concepts and ideas in their minds (Ozkan, 2014). Mistakes made in exchanging messages may result in the mis delivery of feelings, thoughts, or information. Thus communication skills is one among the important requirements for imparting meaningful education.

The Teaching Vs Preaching Debate

Famous educationist Ivan Illich in his book *Deschooling Society* says “The pupil is “schooled” to confuse teaching with learning, grade advancement with education, a diploma with competence, and fluency with the ability to say something new. His imagination is “schooled” to accept service in place of value. Medical treatment is mistaken for health care, social work for the improvement of community life, police protection for safety, military poise for national security. (Illich, 2002)” Thus, teaching as a noble profession is involved with imparting knowledge within the students but in India most of the teachings are purely classroom based having no practical demonstration of the subjects.

Communicative Ecology

Earlier while defining communication, we have defined it as a process of human experience which plays a crucial role in information dissemination in the process of teaching. Communicative ecology (Hearn, 2014) plays a crucial role to make communication process meaningful for imparting education. As India is a multicultural country so the communicative ecology plays a crucial role in imparting meaningful education and at the same time creates challenges for imparting effective education also.

Banking concept of Education

Present educational system prevalent in our country is only based on the concept of retention of information and it never promotes learning or developing life skills in a student. To speak in a more better way if we analyze our present educational scenario we will find it that our educational system has all the same characters same as that of “Banking concept of education (Friere, 2000)” of Freirean pedagogy. In the banking concept of education the teacher holds a key position and the student never becomes a part of the educational system which hinders learning. The process of learning is not participatory and it is completely authoritarian where the teacher imposes everything and the students work with the illusion of learning though they never become a part of the learning process. Thus, the banking concept of education has the least scope for learning and at the same time the banking concept of education being authoritarian and suppressive, kills the interest of students towards learning. Thus, when Indian educational scenario is surrounded by such road blocks there is a need and necessity of strategic intervention to solve the problems of educational system. Education should be designed in such a manner that, it should be attractive and bring critical consciousness among the students to make learning effective. In a better way according to a Chinese proverb, it can be said that “Give a man a fish, and he eats for a day; help him learn how to fish, and he eats for



**Ambika Sankar Mishra et al.,**

life". Education should solve this purpose by igniting inner talents of the students. But to satisfy the purpose of a meaningful education it should be imparted in an attractive and fascinating manner. In an era when we are chatting about edutainment with slogans like "Karlo Duniya Muthi Main" things have changed a lot. A sim card has gone cheaper than a plate of rice. Swiggy or Zomato have become the managers of our food. Byzu or Udemy have emerged as the new managers of our education. The digital intervention has reached even to the rarely explored areas. For all our needs we have started depending on the digital systems. Youth of this country have started loving technology. With android phones at hand, education has gone more technology oriented and hybrid mode of education has become more popular. Education has no more remained limited to books only, rather with easy availability of internet, new edutech companies have emerged. Such companies have come forward with attractive contents not only with text materials rather new age teaching has become more and more edutainment oriented with 3d animated audiovisual contents. The use of virtual reality helps in understanding the subjects in a better manner promoting immersive learning (Ifanov, 2022). The virtual reality by creating an environment of immersive learning helps in understanding the concepts in a better manner by creating learner engagement. The adoption of technology oriented learning helps in developing the cognitive thinking skills and it enhances the absorption skills of the learners leading the learning outcomes to the next level (Chiquet, 2023). Thus in the internet-oriented learning environment, education has gone more and more technology oriented and students have gone more and more edutainment centric to become more and more engaged in the educational process through virtual reality. In such a condition and at this juncture of time the mobile phones with their educational apps can be made meaningful for the students and the selection of proper educational apps can make the learning process more attractive and interesting.

The Android Technology

On context of the educational apps, it can be said that in the mobile phone platform there are prominently two types of educational apps like I-Phone based mobile apps and the google based android apps . Android has become the most popular mobile platform with over 2.5 billion active users who use many different languages across many different countries (Liu, 2022). Android is a mobile operating system developed by Google, and designed primarily for touch screen mobile devices such as smart phones and tablets. Within last few years it has gone through a continuous process of development and has reached to many generations.

Educational Apps

Apps are the applications installed in an android device to perform a particular task. In case of educational apps, they are mostly developed by the developers to provide educational resources to the learners and these days, there are a large number of apps in the Google play store. Few user-friendly characteristics of the educational apps can be discussed as below.

Low Cost

In case of the android mobile phones the cost involved is very low because anybody with the facility of even a 2G internet connection can access to internet at the same time considering the qualitative education aspect we can use apps for developing virtual class room environments.

Anytime any where accessible

Available in tiny portable mobile phones android educational apps are a faster and smarter choice to access educational resources at anytime and at anyplace with a very easily available 2G connection also.

It minimizes the linguistic barriers

As a modern tool for education android apps provide the facility to learn a large number of national and international languages to minimize the linguistic barrier. Again there are apps to translate from one language to another.





Ambika Sankar Mishra et al.,

It provides a real feeling to the learner

Due to the facility of audio-visual education and practical based learning resources android apps provide a better understanding of the subjects by creating a virtual learning environment.

Self based learning

The android educational apps are very helpful for self based learning in which students get the opportunity to learn as per their own interest on their own preference which make the learning more attractive.

Compatible for Flipped Classrooms

The flipped classroom is a pedagogical model in which the typical lecture and homework elements of a course are reversed. The notion of a flipped classroom draws on concepts like active learning, student engagement, hybrid course design, and course podcasting and educational apps are capable of providing all such facilities. During the adoption of new educational apps, the user must have the idea about their utility and should have a proper understanding of the fact that , whether it matches to their needs to satisfy their interests or not. In this context, selection of proper apps becomes a highly challenging task and it is dependent upon few factors to yield proper results (Montazami, 2022). It is important to understand that, whether the students consider their preferences in the same manner.

Past studies have found that well-designed educational apps are capable of facilitating an interactive learning experience. Researchers have found that various factors motivate learners intentions to use educational apps. Scholars have observed that motives such as entertainment, convenience, academic assistance, , interactivity and engagement influence students' selection of educational apps. Though many studies are already conducted relating to motivations associated with educational apps but a very few of them have succeeded Identifying the motivations behind using a particular media (Menon, 2022). Similarly studies have already revealed it that the use of smart mobile devices, tablets in particular, may have a positive role on improving the teaching and learning. Thus, a study relating to students' response is a necessity.

Objectives

1. The study is an attempt to understand the factors affecting the preferences of college going students in choosing educational apps for their study purpose.
2. Their awareness level relating to the educational apps and their use to satisfy their educational needs.

METHODOLOGY

For the purpose of the study, survey method using questionnaires was taken into consideration and a total number of 100 Master degree students from 3 departments like journalism and mass communication, Department of computer science and English of Centurion University of Technology and Management were taken into consideration through, convenient sampling technique. These students were considered because being the students of Computer Science, language and communication, the students of these three departments have a better understanding about educational apps. Data used for the purpose of the study were both primary and secondary by nature. Variables of the study are rate of adoption of smart phones and internet availability to access educational apps.

FINDINGS

From the study it has been found that:

- ❖ All the students use android mobile phones with android apps installed in them.
- ❖ 83% of the students use mobile phones as a learning device but 17% consider it to be a communication device only and in their view mobile phones are meant for telephonic interaction only.



**Ambika Sankar Mishra et al.,**

- ❖ All the students know it that educational apps are there which can be used for study purpose.
- ❖ 66% of the students are of the view that initially the apps look very attractive but latter they fail to satisfy the real purpose. 22% of the students are of the view that it is very difficult to find a proper educational app to satisfy their purpose and 12% of the students are of the view that they are attractive tools for learning.
- ❖ 61% of the students have educational apps installed in their phones where as 39% of the students have not installed or removed educational apps from their phones.
- ❖ 78% of the students use educational apps for study purpose and 22% do not do so.
- ❖ 42% of the students use educational apps to learn things of their own discipline and 46% prefer the apps to improve their English where as 12% students use the apps to improve general knowledge.
- ❖ All the students have responded with the view that apps with audio visual facility are best tools for learning.
- ❖ While downloading the apps they prefer those apps which have a better rating in the play store.
- ❖ While downloading the apps 66% of students prefer the apps available online with updated data Base and 34% prefer those apps which are available both online and offline.
- ❖ All of them have agreed to the view that more and more awareness should be promoted among students relating to educational apps and the apps are an easy and attractive way of study.

From the above, talking about the availability of mobile phones to them and their perceptions about mobile phones, it can be well understood that all the students are well equipped with the facility of mobile phones and many of them consider it that mobile phones can be used as learning devices. However, some of the students consider it to be a device of communication only. From the findings it can be said that, all of them are aware about mobile educational apps and majority of them have installed educational apps in their mobile phones. However regarding the uses and gratification perspective, majority of the respondents have told it that in initial look the apps look attractive but later they fails to satisfy the needs and a notable number of respondents are of the opinion that, it is very difficult to find a proper app to satisfy the need. However, a very a smaller number of respondents were of the opinion that most of the students are interested to use educational apps for study but selecting proper apps to satisfy their purpose is proving difficult for them. Again, installation of improper apps is embarrassing them. They prefer the audio-visual facility based apps matching to their interest and they need the apps to be available in updated format.

CONCLUSION

Thus from the above study we can say that the popularity of educational apps as a study resource is increasing among students but due to lack of proper awareness they are not able to make its proper use and are not able to consider the apps as a proper alternative resource so satisfy their study purpose. Hence it is expected that awareness generation and development of more and more student centric apps will be able to establish android educational apps as an alternative learning resource in future.

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Ambika Sankar Mishra et al.,

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Biosynthesis of Zinc Oxide Nanoparticles using *Syzygium aromaticum* (Cloves) Extract and its Characterization

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ABSTRACT

Nowadays, biosynthesis plays a crucial role in modern science, as it reduces the usage of toxic chemicals in the synthesis process and enhances their applications. This current work describes the synthesis of zinc oxide nanoparticles (ZnO NPs) using *Syzygium aromaticum* extract as a stabilizing agent. The synthesized nanoparticles are characterized by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), High-resolution transmission electron microscopy (HRTEM), and Energy dispersive X-ray spectroscopy (EDAX). XRD shows the crystallite size is about 18 nm with the crystallinity of 92.48%. HRTEM images confirmed the spherical morphology of ZnO nanoparticles with an average diameter of around 15-20 nm.

Keywords: zinc oxide, biosynthesis, syzygium aromaticum, characterization.

INTRODUCTION

The field of nanotechnology is one of the most active areas of research in modern material science.[1] Nanoparticles are of great interest due to their large surface area to volume ratio, a high fraction of surface atoms, and a wide gap between valence and conduction band when divided to near an atomic level, which leads to differences in their physical and chemical properties compared with bulk materials.[2] Several metal oxide nanoparticles have been produced with future applications.[3] Among them, ZnO is one of the most exploited n-type semiconducting



**Sabitha and Helen**

material. It has a wide direct band gap of 3.37eV and a high exciton binding energy of 60 meV.[4]ZnO is interesting because it is inexpensive to produce, and authentically USFDA has enlisted ZnO as a safe material.[5]Synthesis of nanoparticles using physical methods requires expensive instrumentation and high temperature, thus exhibiting limitations in using them for cost-effective large-scale production. Chemical methods are comparatively simple and low-cost, but they require too much attention during the synthesis procedures. Moreover, it requires a particular type of vessel like polypropylene.[6,7] The literature states that some of the toxic chemicals used in the physical and chemical methods may reside in the nanoparticles formed, which may prove hazardous in the field of application in the medical field. [8]Hence, the researchers are motivated to develop several simple methods to synthesize nanoparticles. Biosynthetic routes provide nanoparticles with a better-defined size and morphology than some physicochemical methods. [9] It is more efficient to prevent waste than to treat or clean up after its formation. The use of plants in the synthesis of nanoparticles has numerous advantages compared to microbial synthesis. Because, the microorganisms based synthesis involves an elaborate process of cell culture and multiple purification steps. Hence, plant-mediated synthesis is gaining importance due to its simplicity, non-toxic and eco-friendliness. [10]The active agent in green synthesis is to be polyphenols [11].

Syzygium aromaticum (Myrtaceae) commonly known as clove, is a median size tree (8-12 m) native to the Maluku islands in Eastern Indonesia. It is rich in many phytochemicals such as sesquiterpenes, monoterpenes, hydrocarbon, and phenolic compounds. Eugenol (89%), Eugenyl acetate, and β -caryophyllene (5-15%) are the most significant phytochemicals in clove oil. One review reported that when eugenol combined with zinc oxide could act as an analgesic for alveolar osteitis.

MATERIALS AND METHODS

Zinc nitrate hexahydrate ($Zn(NO_3)_2 \cdot 6H_2O$) and sodium hydroxide (NaOH) were supplied by Sigma-Aldrich Chemicals. Cloves were purchased from a local shop in Nagercoil. Deionized water was used throughout the experimental work.

Preparation of Cloves Extract

The cloves were crushed using a mortar. Add 20 g of cloves to 100 mL of deionized water taken in a 500 ml beaker. Allow the solution to boil until the colour changes to deep brown. Filter the supernatant liquid using Whatman filter paper and store it at 4°C for further work.

Synthesis of Zinc oxide Nanoparticles

For the synthesis of ZnO NPs, 0.25 M $Zn(NO_3)_2 \cdot 6H_2O$ was taken in a beaker and placed on a magnetic stirrer. Add 25 ml of freshly prepared cloves extract to the precursor solution. Then stir the solution using magnetic stirrer. To maintain a pH at 10, add NaOH solution dropwise to the above solution. Light yellow colour precipitate started to form. The mixture kept at 60°C for two hours on a magnetic stirrer. Wash the precipitate two to three times using deionized water followed by ethanol to remove all impurities. Filtered the pale yellow precipitate using Whatman filter paper and dried the sample using hot air oven at 120°C for 3 hours. Collect the dried sample and store it in an airtight container for further analysis.

FTIR Analysis

FT-IR spectrum of synthesized ZnO NPshave taken using Shimadzu, FTIR 8400S spectrometer by KBr pellet method. The spectral range of FTIR spectrometer was 4000- 400 cm^{-1} . The absorption spectrum arise due to vibrations of the bond and these give useful information about the presence of the functional groups in the sample. [12]



**Sabitha and Helen****XRD Spectrum**

XRD pattern of the sample was performed with the help of an instrument named as Philips X'pert PRO 3040/60 diffractometer at 298K in range $2\theta = 20-80^\circ$ using $\text{CuK}\alpha$ radiation $\lambda = 1.5405 \text{ \AA}$. The average crystalline size of ZnO NPs can be calculated using Debye-Scherrer equation,

$$D = k\lambda/\beta \cos \theta$$

Where D is particle size, K is constant, λ is the wavelength of X-rays used (1.54056 Å), B is full width at half maximum and θ , Bragg's angle. Lattice parameters can be calculated using Unit Cell Win software and crystallinity using Origin 2019b software.

HRTEM Studies

HRTEM gives the confirmed topographical information and particle size of the sample by using accelerated electrons. [12] Here, an examination done using an instrument Talos F200 S.

EDAX Analysis

EDAX analysis was carried out to determine the elemental composition and purity of synthesized ZnO nanoparticles [13] using Quantax 200 (EDS), Evactron XEI (plasma cleaner).

RESULTS AND DISCUSSION**FTIR Studies**

FTIR used to find the bioactive compounds responsible for the stabilization of synthesized nanoparticles. The sharp peak at 424.34 cm^{-1} confirmed the probable presence of pure ZnO NPs. FT-IR spectrum of ZnO NPs shown in fig.1. The peak at 910.41 cm^{-1} corresponds to stretching and bending vibration of C-H from aromatic rings, 1396.46 cm^{-1} corresponds to O-H bending of alcohol, 2924.08 cm^{-1} corresponds to C-H stretching band of alkane and broad band at 3387.01 cm^{-1} corresponds to (O-H) stretching hydroxyl group of phenol. This result revealed that the phenolic compounds are responsible for the stabilization of synthesized nanoparticles.

XRD Spectrum

X-ray diffraction studies carried out to estimate the crystalline size and purity of the synthesized ZnO NPs. The 2θ values at 31.67, 34.27, 36.12, 47.42, 56.47, 62.72, 66.32, 67.82, 68.97, and 72.37 corresponding to lattice planes (100), (002), (101), (102), (110), (103), (200), (112), (201) and (004) planes, are relative to hexagonal wurtzite structure with lattice constant $a=b= 3.25446$ and $c= 5.22024$. (JCPDS No. 89- 0510). XRD spectrum of ZnO NPs is shown in fig. 2. The sharp and intense peaks indicate the high purity and crystalline nature of ZnO NPs. The average crystallite size is found to be about 18 nm using Debye-scherrer equation with crystallinity percentage of 92.48.

High-resolution Transmission Electron Microscope (HRTEM)

The HRTEM images confirmed that the synthesized nanoparticles is spherical in shape with the average particle size ranges from 15 to 20 nm. The selected area electron diffraction (SEAD) pattern confirms that ZnO NPs is single crystalline in nature. HRTEM images and SEAD pattern shown in fig. 3.

Energy Dispersive X-ray Spectroscopy (EDAX)

EDAX spectrum clearly revealed the presence of separate peaks for oxygen and zinc, which further confirmed the purity of the synthesized ZnO NPs. The elemental composition of synthesized nanoparticles by weight are 86.52% and 13.48% for zinc and oxygen respectively. (Fig.4)





CONCLUSION

Zinc oxide nanoparticles were successfully synthesized using extracts of *Syzygium aromaticum* via the green method. Here, the *Syzygium aromaticum* extracts act as a stabilization agent. FTIR peak at 424.34 cm^{-1} confirmed the probable presence of pure zinc oxide nanoparticles and revealed that phenolic compounds are responsible for the stabilization of synthesized nanoparticles. XRD showed that the crystallite size of the synthesized nanoparticles is around 18 nm with a crystallinity percentage of 92.48%. HRTEM confirmed the morphology of ZnO NPs is spherical with an average diameter of 15- 20 nm. The crystalline nature of synthesized ZnO NPs confirmed by SEAD pattern. From EDAX, the elemental composition of zinc and oxygen is about 86.52% and 13.48%. There are no peaks other than zinc and oxygen, which further confirms the purity of synthesized zinc oxide nanoparticles.

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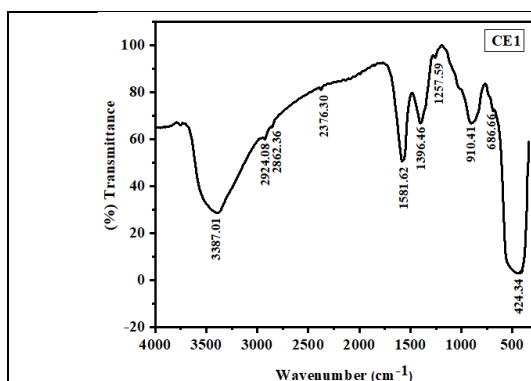


Fig.1. FTIR spectrum of ZnO nanoparticles

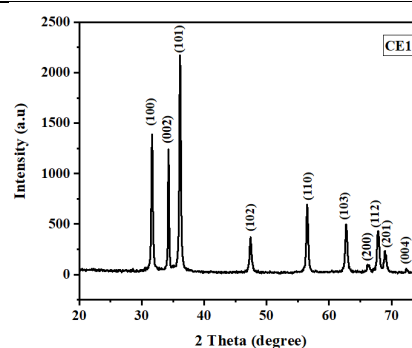


Fig.2. XRD spectrum of ZnO NPs





Sabitha and Helen

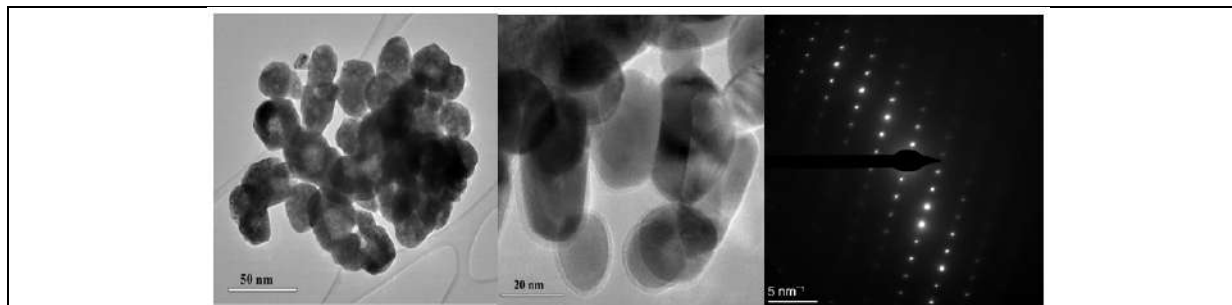


Fig. 3. HRTEM & SEAD Pattern of ZnO nanoparticles

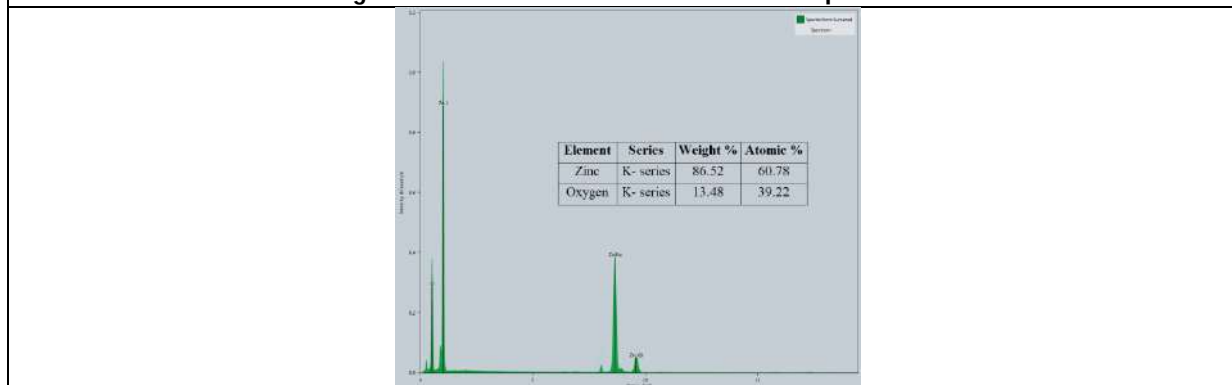


Fig. 4. EDAX spectrum of ZnO nanoparticles





Control Chart using Length Biased Three Parameter Sujatha Distribution (LBTPRD)

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ABSTRACT

The control chart is one of the most commonly used tools for monitoring and managing product quality during the manufacturing process. Despite the fact that the product is made with a set nominal value and a defined deviation or variance, random influences can occur and disrupt the manufacturing process. When the manufacturing process is statistically controlled, the control chart must quickly recognise process changes and keep false alarms to a minimum. Because of its flexibility and better fit with real-world data, this research employs a new distribution method, specifically the length biased three parameter Sujatha distribution, to monitor the process.

Keywords: Statistical Quality Control, Control Charts, Length Biased Distribution.

INTRODUCTION

The quality and consistency of the products and services were great, in contrast to the poor reputation of those who lived in the first half of the twentieth century. This generated concern because the manufacturing company planned to continue producing all of the products. Statisticians have been mathematically aware of the solution of this issue, but their analysis can be questionable when data is given out of context. The world has been full of variations for centuries. Two men from the same company can create "personalized" products that seem identical. If you look attentively, you will notice that they are not the same. It is well acknowledged that perfection is unattainable. Everyone knows it, yet the person in charge of many industrial companies' processes refuses to admit it. People must realize that there are variations and, as a result, specific methods must be implemented to put it within the limits that





Muthusamy and Venkatesan

satisfy both producers and buyers. Statistical process control is one way for keeping process variability within limits. The process graphic represents the control charts used in Statistical Quality Control. Control charts display the moving image of the process when used and updated during production. When charts and graphs are not presented correctly or are repeatedly misused, they will be viewed suspiciously. To avoid this issue, operators must be truthful and accurately display the control charts without distorting them. Control charts are one of the most commonly used methods for controlling product quality in a manufacturing process. Even if the items are remanufactured at a set mean and variance, arbitrary modifications to the production process may occur. A control chart is designed to quickly recognize a process change and restrict the erroneous alarm when the process is truly under control. The real control chart detects small changes in the average and/or variation. For example, if the data is asymmetric, the normal distribution is not an appropriate choice. Section 2 evaluates the pertinent literature. Section 3 covers the length Biased Sujatha distribution and the measurements that go with it. The statistical properties of the moment generating function and the characteristic function are discussed in Section 4. Section 5 examines control constraints. The section explains the procedure of identifying out of control using actual data. Section 6 contains a summary.

REVIEW OF LITERATURE

Fisher (1934) was the first to propose the use of newly developed probability models known as weighted probability distributions to investigate how the method of ascertainment influences the distribution of recorded observations. Rao (1965) proposed and established a broad approach for applying standard distributions in relation with statistical data modelling after it was proved to be wrong. The application of weighted distributions modifies the probability of events as witnessed and transcribed. The concept of weighted distributions offers an integrative approach to model development and data interpretation. When samples can be collected from both the original and created distributions, weighted distributions give a method for fitting the model to the unknown weight function. Khatree (1989) was the first to compare weighted and length biased distributions, as well as offer stability results and different biased distribution properties. Weighted distributions become length skewed when the weighted function only considers unit length. A distribution is said to be size biased when the sampling process chooses units with a corresponding probability to size. Several authors have examined and researched the various weighted probability models, as well as offered examples of how they are used in various fields. The Length Biased Weighted Weibull distribution was discussed by Roy et al. (2011). Mir et al. also examined the first form of length biased beta distribution. (2013). Jing and Broderic discovered the length biased inverse weibull distribution as well. (2012). The length biased Exponentiated inverted Weibull distribution was discovered by PalakomSeenoi et al. (2014). The Shewhart Control chart tests for separate causes were proposed by Nelson. (1984). The length biased erlang truncated exponential distribution was found to be applicable. Rather, as an alternative to the classical distribution, (2020) were able to obtain the length biased Shanker distribution. Ganaie and Rajagopalan (2020) recently discussed the length biased Weighted Quasi Gamma distribution, including characterizations and applications, and discovered that it was more reliable and effective than the original distribution. Biology, ecology, the branching process, and reliability are all applications of the length biased weighted distribution. Shanker and Shukla studied the three-parameter length biased Shukla distribution. (2019). In the study, the length biased Shukla distribution is used to monitor the control chart and estimate the manufacturing process control limits.

Description of the distribution

Definition: The probability density function of three parameter Sujatha distribution is given by

$$f(x; \theta; \alpha) = \frac{\theta^2}{2(\theta^2 + \lambda + \alpha)} (\theta\alpha x^2 + 2\lambda x + 2\theta) e^{-\theta x}; \quad x > 0, \alpha > 0, \theta > 0, \lambda > 0 \quad \text{-----(1)}$$

The density function given in (1) is a combination of exponential and Sujatha distribution with three parameter sujatha distribution is given by. The cumulative distribution function (c.d.f) sujatha distribution can be given as:





Muthusamy and Venkatesan

$$F(x; \theta; \alpha) = 1 - \left[1 + \frac{\theta^2 x^2 \alpha + 2\theta x}{2(\theta^2 + \lambda + \alpha)} \right] e^{-\theta x}; \quad x > 0, \theta > 0, \alpha > 0, \lambda > 0 \tag{2}$$

Let X be a random variable following non-negative condition with probability density function $f(x)$. Let $w(x)$ be the weight function which is a non-negative function, and then the probability density function of the weighted random variable X_w is given by

$$f_w(x) = \frac{w(x)f(x)}{E(w(x))}, \quad x > 0.$$

Where $w(x)$ be a non-negative weight function and $E(W(X)) = \int w(x)f(x)dx < \infty$.

Depending upon the choice of the weight function $w(x)$, we have different models. Clearly when $w(x) = x$, the resulting distribution is called length biased or size biased. In this paper, we have to obtain the length biased version of sujatha distribution, so consequently the weight function at $w(x) = x^2$ to obtain the length biased Sujatha model.

Definition 2: The probability density function of length biased distribution is given by

$$f_l(x) = \frac{x f(x; \theta; \lambda; \alpha)}{E(x)} \tag{3}$$

Where $E(x) = \int_0^\infty x f(x; \theta; \lambda; \alpha) dx$

$$= \int_0^\infty x \frac{\theta^2}{2(\theta^2 + \lambda + \alpha)} (\theta \alpha x^2 + 2\lambda x + 2\theta) e^{-\theta x} dx$$

$$E(x) = \frac{6\alpha + 4\lambda + 2\theta^3}{2\theta(\theta^2 + \lambda + \alpha)} \tag{4}$$

Substitute equation (1) and (4) in equation (3), we will obtain probability density function of length biased Sujatha distribution as

$$f_l(x) = \frac{\frac{x\theta^2}{2(\theta^2 + \lambda + \alpha)} (\theta \alpha x^2 + 2\lambda x + 2\theta) e^{-\theta x}}{\frac{6\alpha + 4\lambda + 2\theta^3}{2\theta(\theta^2 + \lambda + \alpha)}}$$

$$f_l(x) = \frac{x\theta^3}{6\alpha + 4\lambda + 2\theta^3} (\alpha + x^3) e^{-\theta x} \tag{5}$$

and the cumulative distribution function of Length biased Sujatha distribution can be obtained as

$$F_l(x) = \int_0^x f_l(x) dx$$

After the simplification of equation (6), we will obtain the cumulative distribution function of length biased distribution as

$$F_l(x) = \frac{1}{6\alpha + 4\lambda + 2\theta^3} [\alpha \gamma(4, \theta x) + \lambda \gamma(5, \theta x) + 2\theta^2 \gamma(2, \theta x)] \tag{6}$$





Muthusamy and Venkatesan

Statistical Properties

In this section, we will go over the statistical aspects of the length biased Sujatha Distribution, such as its moments, Moment Generating Function (MGF), and Characteristic Function.

Moment Generating Function

Let X be a random variable following length biased Sujatha distribution with parameters θ , then the MGF of X can be obtained as

The moment generating function

$$M_x(t) = \int_0^{\infty} e^{tx} f_1(x) dx$$

One gets after simplifications

$$M_x(t) = \frac{1}{6\alpha + 4\lambda + 2\theta^3} \sum_{j=0}^{\infty} \frac{t^j}{j! \theta^j} [\alpha \Gamma j + 4 + 2\lambda \Gamma j + 3 + 2\theta^3 \Gamma j + 2]$$

Characteristic Function

Similarly the characteristic function of Length biased Sujatha Distribution obtained

$$\phi_x(t) = M_x(it)$$

$$\phi_x(t) = \frac{1}{6\alpha + 4\lambda + 2\theta^3} \sum_{j=0}^{\infty} \frac{it^j}{j! \theta^j} [\alpha \Gamma j + 4 + 2\lambda \Gamma j + 3 + 2\theta^3 \Gamma j + 2]$$

Performance measures of the Length biased Sujatha distribution

From the above obtained Length biased Sujatha distribution density function (pdf), the r^{th} moment $E(X^r)$ of the Length biased distribution can be calculated. First Let X be the random variable of Length biased distribution with parameter θ .

$$\begin{aligned} E(X^r) = \mu_r^1 &= \int_0^{\infty} x^r f_1(x) dx \\ &= \int_0^{\infty} x^r \frac{x\theta^5}{\alpha\theta^3 + 24} (\alpha + x^3) e^{-\theta x} dx \end{aligned}$$

After simplifications, one gets

$$E(X^r) = \mu_r^1 = \frac{\alpha \Gamma r + 4 + 2\lambda \Gamma r + 3 + 2\theta^3 \Gamma r + 2}{\theta^r (6\alpha + 4\lambda + 2\theta^3)} \text{-----}$$

(7)

Putting $r=1$ and 2 in equation (7), we get mean and second moment of Length biased Sujatha distribution as

$$E(X) = \mu_1^1 = \frac{24\alpha + 12\lambda + 4\theta^3}{\theta(6\alpha + 4\lambda + 2\theta^3)} \text{-----} \tag{8}$$

$$E(X^2) = \mu_2^1 = \frac{120\alpha + 40\lambda + 12\theta^3}{\theta^2(6\alpha + 4\lambda + 2\theta^3)} \text{-----} \tag{9}$$

Using the above equation (8) and (9), the variance can be obtained as





Muthusamy and Venkatesan

$$= \frac{120\alpha + 4\theta\lambda + 12\theta^3}{\theta^2(6\alpha + 4\lambda + 2\theta^3)} - \left[\frac{24\alpha + 12\lambda + 4\theta^3}{\theta(6\alpha + 4\lambda + 2\theta^3)} \right]^2$$

And after simplifications, one gets the

$$V(X) = \frac{1}{\theta^2(6\alpha + 4\lambda + 2\theta^3)^2} \left[(120\alpha + 12\lambda + 4\theta^3) - (24\alpha + 12\lambda + 4\theta^3) \right] \dots\dots\dots (10)$$

Control limits

Three sigma UCL and LCL are obtained as specified by Montgomery (2012) and one can get the control limits for Length biased Sujatha distribution using (8) and (10) and are given by

$$UCL = \frac{1}{\theta^2(6\alpha + 4\lambda + 2\theta^3)^2} + \theta(24\alpha + 12\lambda + 4\theta^3)(6\alpha + 4\lambda + 2\theta^3) + \frac{3\sqrt{(120\alpha + 4\theta\lambda + 12\theta^3)(6\alpha + 4\lambda + 2\theta^3) - (24\alpha + 12\lambda + 4\theta^3)^2}}{\theta^2(6\alpha + 4\lambda + 2\theta^3)^2}$$

$$CL = \frac{1}{\theta^2(6\alpha + 4\lambda + 2\theta^3)^2}$$

$$LCL = \frac{1}{\theta^2(6\alpha + 4\lambda + 2\theta^3)^2} + \theta(24\alpha + 12\lambda + 4\theta^3)(6\alpha + 4\lambda + 2\theta^3) - \frac{3\sqrt{(120\alpha + 4\theta\lambda + 12\theta^3)(6\alpha + 4\lambda + 2\theta^3) - (24\alpha + 12\lambda + 4\theta^3)^2}}{\theta^2(6\alpha + 4\lambda + 2\theta^3)^2}$$

Numerical Illustration

To demonstrate the uses of the proposed method, an example involving the development of control limits is considered. Using a simulated data set for parameters, the control limits of the Length biased Sujatha distribution are determined. Table 1 lists all of the samples that were created.

Data Set

A production manager for a steel company has inspected the number of defective screws in five random samples with 1000 screws in each sample. The table below shows the number of defective pens in each sample of 1000 screws.

25,	38,	40,	32,	15,	38,	42,	10,	25,	42,	25,	15,
43,	27,	36,	22,	42,	40,	35,	20,	38,	26,	20,	12,
09,	35,	25,	21,	43,	36,	41,	27,	34,	40,	15,	32,
43,	39,	22,	25,	31,	24,	42,	31,	12,			

Table 1 shows that the fixed value of the parameter λ, θ and α , the control limits increase whenever the parameter increases, the control limits increase. The length biased Sujatha distribution Control chart is shown in Fig.1 for $\lambda = 3$, $\theta = 3$ and $\alpha = 3$





It is also recognized that the process control observations must be otherwise, the process will be out of control. That

Muthusamy and Venkatesan

the type of data they are working with. Table 1 illustrates this. The parameter is being increased. The control chart is monitored by taking into account the particular circumstance in all the observations are control. As a result, it is best to maintain more than the observed process data.

CONCLUSIONS

In this study, we propose the Length biased Sujatha distribution as a new generalisation of the Sujatha distribution. The Sujatha distribution is utilised as the basis distribution in the Length biased technique to generate the topic distribution. Its various structural features, such as moments, moment generating function, and characteristic function, have been characterised and investigated. Finally, the newly proposed distribution was demonstrated using real-world data in order to discuss the benefits of the length biased Sujatha distribution over the Sujatha distribution. The length biased Sujatha distribution is used for process quality control. The control limits for the Length biased Sujatha distribution are also determined when the parameters and disagree. A table is created to help the manufacturing engineer choose parameters based on the type of data they are dealing with. A control chart is constructed by taking into account the specific circumstance in which and all observations are shown in control (Jing Kersey *et.al.*).

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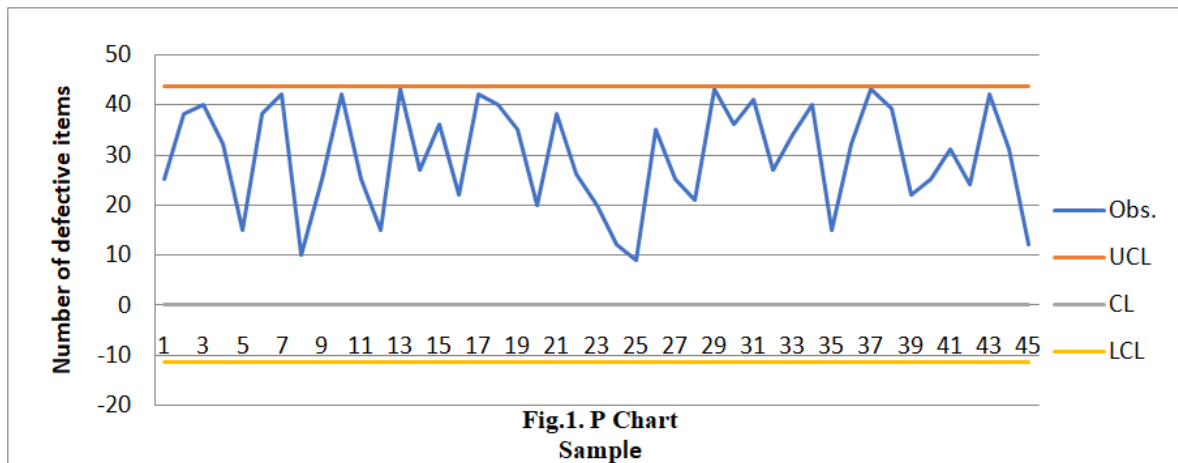




Muthusamy and Venkatesan

Table 1: Control limits using Length biased Sujatha distribution

λ	θ	$\alpha = 3$			$\alpha = 5$		
		UCL	CL	LCL	UCL	CL	LCL
1	1	22.45	2.85	-32.54	23.35	0.20	-54.20
	3	57.15	0.025	-38.57	16.38	0.019	-81.44
	5	23.70	0.020	-50.68	12.29	0.001	-10.8
	7	12.21	2.81	-63.54	15.20	0.01	-62.67
3	1	22.32	0.031	-38.57	93.18	0.001	-79.10
	3	43.66	0.001	-11.39	32.67	0.0001	-17.47
	5	22.15	0.0001	-50.69	25.42	2.80	-62.67
	7	15.47	2.85	-63.65	16.38	0.019	-81.44
5	1	67.15	0.025	-56.27	12.29	0.001	-10.8
	3	27.15	0.001	-13.90	38.52	0.0001	-20.55
	5	23.70	2.81	-55.03	27.14	2.772	-67.45
	7	15.92	0.020	-67.95	16.85	0.016	-86.05
7	1	92.59	0.001	-77.23	15.68	0.0009	-13.18
	3	32.51	0.0001	-16.67	44.85	0.0001	-23.88
	5	25.37	2.78	-59.54	28.92	2.74	-72.40
	7	16.38	0.022	-72.35	17.32	2.96	-90.75





RESEARCH ARTICLE

Knowledge, Attitudes, and Practices (KAP) towards COVID-19: A Cross-Sectional Study in India during First Wave

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ABSTRACT

The public must routinely practice precautionary behaviours to control the spread of COVID-19, as no vaccines and antiviral treatments were available during first wave Covid 19 in India. This article inspects the public's knowledge, attitudes, and practices (KAP) related to COVID-19 and their relationships and identified the pandemic's vulnerable populations to provide recommendations for behavioural interventions and policies. Data collection took place over 3 months (April 2020 – June 2020) via an online survey using a structured questionnaire in India; 285 subjects were included and after data collection it was double entered in Microsoft excel sheet and validated. Distribution of study population according to demographic details KAP in relation to their comorbidities were analysed. Knowledge directly affected both attitudes (e.g., perceived risk and efficacy belief) and practices (e.g., personal hygiene practices and social distancing). According to the socio demographic data out of the 285 respondents, majority of them (N = 150) were from Tamil Nadu. In all subsections Diabetic, Pregnant women, subjects with respiratory illness were well aware of their risk during the pandemic and were effectively managing the situation through proper check-ups and medications. All the geriatric respondents except one was aware of age-related risk and 50% were adopting precautionary methods

58819





Our study found a high prevalence (98%) of adequate knowledge among the sub-section of the geriatric

Priya et al.,

By addition of traditional antioxidant herbs in diet, awareness on Ayush systems were also marked in all categories of respondents, especially Kaba Sura Kudineer a siddha herbal decoction formulation was used by majority. **Conclusion:** There were various attitude and practices followed for prevention and control in the meantime, certain proportion have negative and wrong practices too which can be removed through time-to-time guidelines from the health sectors. This study provides evidence that knowledge is an important predictor of attitudes, contributing to advancing intervention strategies to promote and sustain the public's precautionary practices in the context of the COVID-19 pandemic.

Keywords: Attitude, Ayush, COVID-19, India, Knowledge, Practice, Survey.

INTRODUCTION

Since the WHO declared Covid 19 as a pandemic [1], the government of India started adopting strategies to tackle the crisis and incline the health infrastructure to deal with the cases. In this background it was observed with great expectation that Siddha, one of the traditional health care systems of India would be considered to play a role in the management of cases, since there were reports that Traditional Chinese Medicine was adopted in China to deal with their patients [2]. During the initial period before Ministry of Ayush announced regarding Covid treatment guidelines there were a lot of discussions on the ability of traditional medicine in preventing the pandemic. Later on, Ministry of Ayush released guidelines for practitioners for the management of this pandemic. But the impact of these on common public needed to be evident by means of survey analyses.

The WHO [3] pointed out that using knowledge, attitude, and practice (KAP) models to conduct studies and surveys can help in collecting information on the knowledge, opinion, attitude, and behavioral practice of relevant specific groups on a specific issue, so as to understand the relationships among knowledge, attitude, and behaviour, and they can further be used as evaluation references of related programs or interventions. Hence, many studies also explored public perceptions and behaviour toward COVID-19 using KAP-based models [4,5,6]. KAP models are often used in public health research to explore people's health behaviors and explain their changes, which can be divided into three aspects: acquiring correct knowledge, generating attitude, and adopting behaviour. In addition, advocating knowledge is the basis of behaviour, while attitude is the momentum of behaviour, urging individuals to implement behaviour to achieve goals. Knowledge, attitudes, behaviours and practice studies are used to investigate patterns of community responses to the development and prevention of a disease epidemic. Coronavirus was a new disease and the interaction of public attitudes, belief, and behaviours would determine the effectiveness of the prevention of the disease. Therefore, the main purpose of this study was to understand the status of the Indian public's COVID-19 knowledge, attitude, and behaviour. Along with that knowledge regarding traditional systems of medicine, their usage, socio - demographic status which may have an effect on personal preventive measures amid the COVID-19 pandemic thus, this study also explores the relationship between socio - demographic status (e.g., gender and age) and KAP of COVID-19.

MATERIALS AND METHODS

The study aims to report the findings on attitudes, knowledge, and behaviours of Indian population in response to the public health crisis during the COVID-19 pandemic. The study population includes adults from different parts of the country. An online survey was conducted during lockdown period from March 2020 to June 2020 using a structured questionnaire with both open and closed ended items having five subsections. Before entering into





subsections consent was obtained from all respondents when they choose option 'yes' to proceed for taking the

Priya et al.,

native place, were sought from the respondents and the next sections were related with attitude, perception and behaviours of Geriatric, Pregnant women, Diabetic patients, individuals with respiratory system relate comorbidities and healthy individuals during COVID-19 pandemic. After data collection it was double entered in Microsoft excel sheet and validated. Distribution of study population according to demographic details KAP in relation to their comorbidities were analysed.

RESULTS

Socio-Demographic Details:

Out of 285 respondents n=150 were from Tamil Nadu, n= 90 were from New Delhi n=35 from Kerala and 10 from other states of India. Among them thirty-five people were geriatric population. Among the respondents n = 285, n = 211 were healthy individuals, n = 35 were geriatric population, n = 26 were having diabetes, n = 8 were having lung disease as a comorbidity, n = 4 were pregnant ladies and one pregnant respondent was a known case of lung disease.

SUB SECTION I – GERIATRIC POPULATION

Geriatric population was asked questions regarding their awareness on their age specific risk, level of anxiety, knowledge regarding health care facilities in AYUSH streams, preventive measures followed by them, medium through which information regarding COVID spread is gathered and the availability of health care facilities in their area and their expectation on health care providers. Among all the 35 respondents except one was aware of age-related risk and 50% were adopting precautionary methods. Regarding level of anxiety during lockdown around 55% of respondents were not anxious regarding that, but 16.7% showed anxiety about risk of getting the disease, 10% were anxious on the lack of local health care facilities, 11.7% felt helpless and a meagre group showed some level of insecurity.

Around 68.3% were aware about AYUSH system of health care. Likewise, 90% of respondents were adopting all type of COVID preventive measures like, social distancing, using face mask, proper hand sanitization etc. They mainly relied on information propagate through TV channels social media and newspaper, but a few were not relying on any of the media platforms.

Suggestions on improving health care facilities in containment zones

58.2% respondents suggested promoting AYUSH health care facilities, 20.3% suggested need for improving awareness regarding COVID 19 and the rest suggested on making stringent rules to avoid spread.

SUB SECTION II - PREGNANT WOMEN

Out of the twenty respondents n=17 had availability of health care facilities n= 3 did not had proper availability of health care facilities. For the question regarding regular health check up only 16 responded, among them n=10 was able to go for regular health checkup and six were not able to go for health checkup regularly due to the pandemic. Fear on pandemic and lack of transportation was the reason behind irregularity in health checkup. Among 12 respondents 9(75%) had availability of health care products, and the rest had issues such as non-availability and few had stored up the commodities.

Degree of anxiousness during lock down:

Out of the thirteen respondents n=3 felt helpless in case of emergency situation during pregnancy, n= 2 were over anxious, n=2 was less anxious, and 6 felt alright.

Comorbidities

Only one respondent had comorbidity of bronchial Asthma during pregnancy.





Priya et al.,

Out of 14 respondents n= 11 were satisfied, one was somewhat satisfied and two were not satisfied.

SUB SECTION III - DIABETIC POPULATION:

Legend 6: Duration of diabetes: Out of 42 respondents n=24(57.1%) had a duration of more than five years and n=18(42.9%) had less than five years.

Legend 7: Blood sugar level status: Out of the 43 respondents n= 30(69.8%) had controlled status of blood sugar level, nine were having uncontrolled blood sugar(20.9%) level and four(9.3%) were not able to check due to pandemic.

Around n= 30 respondents were taking Allopathic medicines for Diabetes, n=4 was taking Siddha medicines, one each for Naturopathy, Homeopathy, Siddha in combination with Allopathy and Ayurveda in combination with Allopathy. Three were controlling blood sugar level by exercise and food control.

SUBSECTION IV – RESPIRATORY DISEASES:

All the respondents were aware regarding AYUSH system of medicine, and they were using it in daily basis as mentioned in the above frequency table. All the respondents adopted some type of immune boosting herbs in their diet as mentioned in the above table.

DISCUSSION

COVID-19 pandemic had caused unprecedented human health consequences all over the world. Due to the novel nature and indistinctness of COVID-19, the perception of general population of India moved towards the transmission and prevention which plays vital role for effective disease control measures. Since India started COVID-19 vaccination in this country from 16th January 2021[6]. Before that the prevention and control of COVID-19 were achieved through increasing the population knowledge (especially high-risk groups), attitude, and practice towards COVID-19 via various platforms. The present study was conducted to assess the attitudes, knowledge, and behaviours of Indian population in response to the public health crisis during the COVID-19 pandemic and knowledge regarding AYUSH system of medicine is also assessed. In this study, a web-based cross-sectional survey was conducted between April 2020 to June 2020.

According to the socio demographic data out of the 285 respondents 53% male and 47% female were registered their responses. Majority of them (N = 150) were participated from Tamil Nadu. Among all the respondents except one was aware of age-related risk and 50% were adopting precautionary methods. Our study found a high prevalence (98%) of adequate knowledge among the sub-section of the geriatric populations. This finding is significantly higher than the study results from other countries like Ethiopia, Kenya, China, and Iran, where the authors reported a low prevalence of poor knowledge [7-10]. In a study, it was reported that more than 80% of their respondents experienced anxiety and depression with contracting COVID – 19 [11]. In our study, due to the good knowledge their anxiety levels were very low because 90 % of them were adopting all preventive measures and 68.3 % of them were aware about the AYUSH system of health care in India. 58.2% respondents suggested promoting AYUSH health care facilities. We also got some responses from the pregnant women that out of 20 responses 17 of them availed the health care facilities during lock down and 50 % of them were even able to go for regular health check-up in India. 75 % were acquired the essential commodities for pregnancy and postpartum.

We also asked in our subsection respondents with diabetic population related to their management of diabetes. They managed in a better way with self-monitoring of blood sugar levels. 69.8% of them had well controlled status of their blood sugar level. 68.2% were taking modern medicines for diabetes and 59% of the respondents were not able to





consult their physician because of peak lock down. This can be attributed to increase use of tele-consultation consultations regarding diabetes education.

Priya et al.,

During the pandemic, the uses of various herbal medicines like incense, infusion, and chewing or sucking was emphasized as preventive measure [12]. In our study, 58.2% of respondents had suggested to improve the AYUSH health care preventive measures and many of the respondents had taken Kaba Sura Kudineer and NilaVembu Kudineer for the prevention of COVID – 19 because majority of the respondents in our study from Tamil Nadu. People in India were also followed some herbs in their regular diet like ginger, lemon, turmeric, garlic, gooseberry, pepper, and Vit C rich fruits.

CONCLUSION

All available literature hints that individuals with comorbidities face a high-risk of contracting COVID-19. Knowledge about the COVID – 19 pandemic was good in various sub-groups in the study population especially regarding AYUSH system. There were various attitude and practices followed for prevention and control in the meantime, certain proportion have negative and wrong practices too which can be removed through time-to-time guidelines from the health sectors. This study provides evidence that knowledge is an important predictor of attitudes, contributing to advancing intervention strategies to promote and sustain the public's precautionary practices in the context of the COVID-19 pandemic.

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Table 1: Respiratory disease as comorbidity and its frequency

SI No	Respiratory condition	Frequency
1	Bronchial Asthma	13
2	Chronic bronchitis	1
3	Others	3

Out of respondents n = 17, majority, n=13 was known case of bronchial asthma.

Table 2: Severity of Respiratory illness

SI No	Severity	Frequency
1	Mild	11
2	Under control by medication	5
3	Severe	7

Table 3: Practice of Yoga and Pranayama

SI No	Practice of Yoga and Pranayama	Frequency
1	Yoga	1
2	Pranayama	5
3	None	11

Table 4: Knowledge and practices of Covid Preventive measures

SI no	Covid preventive measures followed	Frequency
1	Taking Siddha Decoction formulation Kaba Sura Kudineer	11
2	Maintaining social distancing	4
3	Taking immune boosters	2
4	Taking Nilavembu Kudineer	6
5	Healthy food	1
6	Taking AYUSH medicines	2
7	Taking Vit C	2
8	Using Arogya Setu App	1

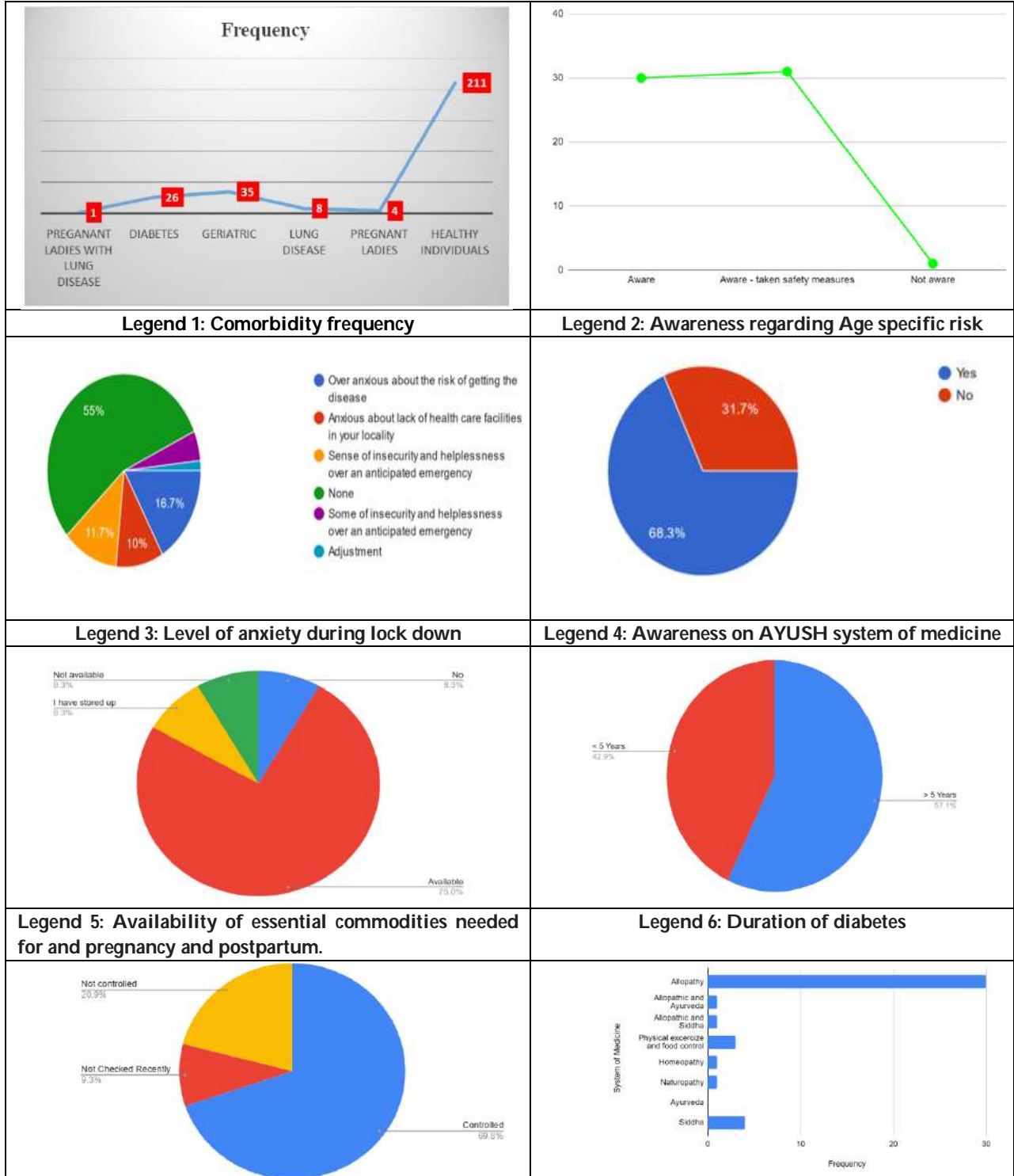
Table 5: Attitude related to diet

SI No	New items included in diet in a regular basis	Frequency
1	Lemon, ginger	13
2	Turmeric	4
3	Garlic	4
4	Gooseberry	2
5	Pepper	4
6	Garden grown Fruits and vegetables	8
7	Vit C rich food	4





Priya et al.,





Legend 7: Blood sugar level status

Legend 8: System of medicine used for Diabetes

RESEARCH ARTICLE

Impact of the Internship Programme on the Anxiety of Physical Education and Sports Undergraduates

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ABSTRACT

The objective of investigation was to find out the impact of Internship Program on anxiety of undergraduate students of physical education. Based on the review of literature it was hypothesized that there will be an insignificant effect of internship on anxiety of pupil teachers and, there will be a significant effect of internship on self-confidence of pupil teachers. A total of Fifty (50) male undergraduates (B.P.E.S) students of physical education were randomly selected for the study belonging to Manipal University Jaipur as subjects through purposive sampling. All the subjects underwent the regular academic program in Manipal University Jaipur. Their age ranged from 20 to 25 years; random sampling technique was used. Pretest and post test single group design was used. We discovered a disparity between the pre- and post-test results collected before and after the internship program of physical education undergraduate students, in relation to anxiety, the calculated t-value we found was 0.94 which was less compared to the tabulated value 1.671 at 0.05 levels of significance, which meant that there was no change in the level of anxiety of the undergraduate students.

Keywords: Internship, Anxiety, Undergraduate, Physical Education and Sports.





Deepak Bangari *et al.*,

INTRODUCTION

The field of Physical Education and Sports encompasses various practical and hands-on activities, including teaching, coaching, and athletic training. As part of their undergraduate education, students in this field often participate in internship programs to gain real-world experience and apply their theoretical knowledge in professional settings. While internships are valuable for skill development and career exploration, they can also be accompanied by increased levels of anxiety among students and supports by the research work of Wang, Y. F et.al (2014). Thompson, M. L. (1963) identified anxieties experienced by student teachers, understanding the impact of internships on anxiety levels is crucial for several reasons. Firstly, anxiety can have negative consequences on students' mental health, well-being, and overall performance. High levels of anxiety may impair students' ability to learn and adapt to new situations, reducing the effectiveness of their internship experience. It is important to identify the factors that contribute to anxiety during internships and explore potential strategies to mitigate its impact.

Secondly, physical education and sports professionals often work in high-pressure environments that require quick decision-making, effective communication, and the ability to handle unexpected challenges. Anxiety management is an essential skill for future professionals in this field. By studying anxiety in the context of internships, educators and practitioners can develop interventions and support systems that prepare students to cope with anxiety in their future careers even supports by Muslem, A et.al (2019). Thirdly, research on anxiety in physical education and sports internships can inform educational institutions and internship providers about the specific challenges faced by students in this field. This knowledge can help in designing more supportive and tailored internship programs that address anxiety-related concerns and enhance the overall internship experience. By identifying effective coping mechanisms and support strategies, educators can better equip students to manage anxiety and build resilience.

Lastly, studying anxiety in physical education and sports internships contributes to the broader understanding of internship experiences across different disciplines. It provides insights into the unique stressors and anxieties faced by students pursuing careers in physical education and sports, which may differ from other fields. This knowledge can guide future research and inform best practices in internship program development and implementation. In summary, investigating anxiety in physical education and sports internships is essential to support the well-being and professional development of undergraduate students. By understanding the factors that contribute to anxiety and identifying effective strategies to manage it, educators and practitioners can create a more positive and supportive learning environment, ultimately benefiting students' transition into the professional world support by the research work of Gelman, C. R. (2004). The Internship Programme attracts current students, and it replaces programmes called Student Temporary Employment (STEP) and Student Career Experience (SCEP). The IP provides paid chances for students already enrolled in different kinds of educational institutions to work and explore federal vocations while still in school. They might be qualified for noncompetitive conversion to career or career-conditional jobs following the successful completion of this programme. The following summarizes provisions of the Internship Program.

In this part, research design, sample size, sample Area, sampling technique, instrument Reliability, Tester's Competency and Reliability of data, Procedure for administering the test and Statistical Technique going to be employed in the study are described. After the selection of the problem and formulation of hypothesis, there is need to give practical shape to there search. A total of Fifty (50) students both male and female undergraduates (B.P.E.S.) students of physical education was randomly selected for the study. Manipal University Jaipur was selected for the subject through purposive sampling. All the subjects were undergone the regular academic program in MUJ. Their age ranges from 20 to 25 years. They extended their cooperation to the investigation in the completion of the data. Random sampling technique was used. Pretest and posttest single group design was used to conduct the present





Deepak Bangari et al.,

subject selected for this research work was 600 players from Individual, Team and Combat Sports studied in various universities of state Punjab. The subjects selected for this study had represented the intercollegiate.

Tools and Variables

Variables	Tools	Author	Criterion Measures	Reliability/ Validity
Comprehensive Anxiety	Sinha's Comprehensive Anxiety Test(SCAT)	A.K.P Sinha &L.N.K Sinha (2011)	Scoring.	R- 0.85(TR)V-.62

This part includes the analysis of data, discussions of the findings, discussion of the hypotheses and result of the study. The dependent t-test was utilized to analyze the data. The data to study the impact of internship program on anxiety of undergraduate students of Physical Education was collected from the B.P.E.S. students at Manipal University Jaipur; the data was collected from the 50 students. The level of significance was set at 0.05. It is evident from table 1.1 that mean change in anxiety levels between the pre- and post-tests of B.P.E.S students who underwent an internship program was insignificant. This suggests that there was no change in the anxiety levels of the students before or after the internship training.

CONCLUSIONS

After the collection of data and applying relevant statistical measures following conclusions were drawn: There was no significant difference found between the pre and post comprehensive anxiety levels of pupil teachers who went for internship program.

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Deepak Bangari et al.,

Table1. Anxiety mean difference between pre- and post-test scores (N=50)

Anxiety	Mean	S.D	t-value	Level of significance
Pre-test	35.370	18.835	.093	Insignificantat0.05
Post-test	35.210	20.021		

t-Value to be significant at 0.05 level of significance (1.671), $df(n-1) = 49$

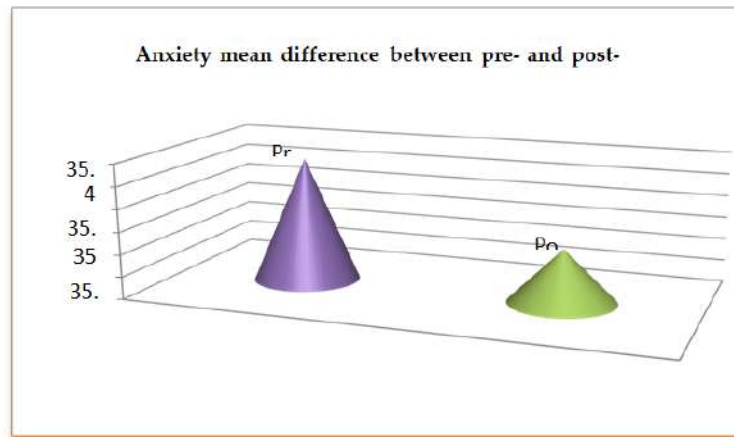


Fig.1. Anxiety mean difference between pre- and post-test scores.





RESEARCH ARTICLE

Antibiotic Utilization using ATC/DDD System in a Secondary Referral Healthcare Setting of South India

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ABSTRACT

Antibiotic consumption is one of the metrics used to assess the effectiveness of antimicrobial stewardship programmes. But data on antibiotic prevalence based on actual prescriptions and dosing patterns are lacking. The current cross sectional, observational study was performed to assess the antibiotic utilization pattern using the WHO ATC/DDD system; which would help in developing strategies to minimize antibiotic misuse, and further improves patient clinical and humanistic outcomes. The study included 180 antibiotic prescriptions from 100 and 80 patients, in the general medicine and general surgery departments of a secondary referral hospital in south India. Each prescription yielded the drug, the dose, the frequency, and the duration of treatment. The prescribed daily dose values for each antibiotic drug were calculated using the daily dose average. The demographic results in the department of general medicine showed an equal distribution of both genders with the mean age observed was 50 years. In general surgery department one-third of patients were within age group of 21-30 years and 31-40 years each respectively. Cephalosporins (26.5%) account for the highest proportion of antibiotics prescribed,





Mohanraj Rathinavelu et al.,

sub-use and overuse. The study observed no deviation of the prescribed daily dose from the defined daily dose; implying the need for antibiotic stewardship teams to monitor and set intervention targets.

Keywords: Antibiotics, Defined Daily Dose, Pharmacoepidemiology, Prescribed Daily Dose, Retrospective, Utilization.

INTRODUCTION

The burden of infectious diseases in India is among one of the highest in the world [1]. The fact that infectious diseases can no longer be treated with antibiotics depicts an unknown future in health care [2]. India was the largest consumer of antibiotics in 2010 with 12.9×10^9 units (10.7 units per person) [3]. Between 2000 and 2018, antibiotic usage in India increased dramatically, from 48% to 67%, with India having the highest relative deviation (51%) in LMICs [4]. Antibiotic resistance has actually been exacerbated by the improper use of antibiotics, making it one of the most serious and urgent public health problems [5,6] hampered by the lack of access to essential antibiotics in many low-income and middle-income countries (LMICs) [7,8] and been declared as one of the top ten global public health threats facing humanity by WHO in 2019 [9]. Infection with antimicrobial resistance leads to serious illnesses and prolonged hospital admissions, increases in healthcare costs, higher costs in second-line drugs, and treatment failures [10-12]. Antibiotics are one of the most commonly used medicines in hospitals and have substantial share from the hospitals' budget, when used appropriately have a positive impact on both clinical and economic outcomes [13]. Antibiotic usage quantification is a crucial component of antibiotic stewardship programmes (ASPs)[14]. Evidences from India reported increase in resistance to antibiotic use [15-17] in relation to high treatment costs, reduced efficacy, and limited access [18-22]. Increasing amounts of data show that hospital-based ASPs can reduce the number of days that a patient takes an antibacterial medication, regardless of the number of different medications [23] and could help clinicians improve clinical outcomes and minimize harms by improving antibiotic prescribing. There is thus a need to build pharmaco epidemiological research capacity and support in the areas of antibiotic utilization, safety and effectiveness. The current cross sectional, observational study was performed to assess the antibiotic drug utilization pattern using World Health Organization Anatomical Therapeutic Chemical-Defined Daily Dose (WHO ATC-DDD) system; which would help in developing strategies to minimize antibiotic misuse, and further improves patient clinical and humanistic outcomes.

MATERIALS AND METHODS

The current cross-sectional observational study was performed to evaluate the antibiotic drug utilization patterns as per World Health Organization-Drug Utilization Metrics (WHO-DUS, 2003) [24]; and its appropriateness of use in various disease conditions as per the International Rational Use of Drugs (WHO-INRUD) drug use indicators (WHO, 2012) [25], in department of general medicine and general surgery of a secondary referral healthcare setting of south India.

Study design: Cross-sectional observational retrospective study.

Study duration: Investigation was performed for a period of 12 months (January - December 2021).

Study site: The current study was carried out in department of general medicine and general surgery of a 340-bed secondary referral healthcare setting in south India Rural Development Trust (RDT) Hospital.





Study criteria: Prescriptions composed of antibiotic with other drugs were incorporated and related information was

excluded. **Mohanraj Rathinavelu et al.,**

Study procedure

Phase I (3 Months) [January - March 2021]

Preparation and submission of a detailed proforma (including critical evaluated biomedical literatures which reflects the objectives and rationale of study, and patient data collection form) to the Institutional Review Board (IRB) of RIPER Autonomous for approval (RIPER/IRB/PP/2021/012). After IRB clearance, the permission from concerned hospital authority and the head of departments were obtained (Institutional Ethics Committee approval).

Phase II (6 Months) [April - September 2021]

Data collection (3 Months) [April - June 2021]

A structured process was followed in collection of data from prescriptions, of general medicine and general surgery department of a 340 bedded secondary referral healthcare setting in south India. A documentation from (data collection form) was designed to collect the patient's information which was kept confidential. The following data were collected: (a) Patient's demography - Age, gender, past medical and medication history, complaints of admission, and socioeconomic status; and (b) Objective data's - Laboratory investigations and diagnosis. Antibiotics therapy prescribed like: Number of drugs, names of individual drugs (generic/brand), any fixed dose combinations (FDCs) prescribed, whether the prescribed drug(s) was available from the hospital pharmacy, dose, dosage form, dosing schedule, and duration of treatment.

Data analysis (3 Months) [July - September 2021]

The following data were analyzed: (a) Assessment of prescription patterns as per the WHO-INRUD drug use indicators. (b) Pattern of antibiotic drugs used as per DUS metrics. (c) Categorization of prescribed drugs as per WHO ATC DDD classification. (d) Calculation of DDD, DDD/100 beds and PDD. (e) The PDD to DDD ratio was calculated, ratio found to be lesser or greater than 1 indicates under or over utilization of antibiotics.

Phase III (3 Months) [October - December 2021]

Analysis and synthesis of results and interpretations

Data processing was performed with Microsoft excel software, and further interpretation and analysis was carried out in the light of WHO guidelines of drug utilization standards; and Drawing conclusion, along with limitations (if any). The number of bed days in the departments of general medicine and surgery during the study were 28 and 27, respectively, with occupancy indexes of 0.91 and 0.9.

Formulae

Defined Daily Dose (DDD):
$$\frac{\text{Number of issued items} \times \text{Amount of drug per item}}{\text{WHO recommended DDD of drug}}$$

DDD/100 bed days:
$$\frac{\text{Number of Units administered in a given period (mg)} \times 100}{\text{DDD (mg)} \times \text{Number of Days} \times \text{Number of Beds} \times \text{Occupancy Index}}$$

Prescribed Daily Dose (PDD):
$$\frac{\text{Total amount of drug}}{\text{Duration of hospital stay}}$$

RESULTS

Characteristics of studied patients

In our study, participants data from department of general medicine (n=100) and general surgery (n=80) were extrapolated based on age group, gender, and socio-economic status. Out of 100 patient prescriptions assessed in department of general medicine (48) 48% were male and 52 (52%) were female, in which 37 (37%) of patients were within the age group of 61-70. In general surgery department out of 80 patient prescriptions handled 60 (60%) were



**Mohanraj Rathinavelu et al.,**

each respectively. As of socio-economic status, majority of participants were in low-income category, particularly the female gender both in general medicine (48.08%) and general surgery department (58.75%); results of which are thoroughly analyzed and the relative distribution is reported in Table 1.

Pattern of antibiotics use (WHO - INRUD) drug use indicators

In 100 prescriptions of general medicine department, a total of 682 drugs were prescribed out of which 23.75% were antibiotics in which 58% of antibiotics were prescribed with generic name, the average number of drugs per prescription was found to be 6.82 and mean number of antibiotics per prescription were 1.62. A total of 349 drugs were prescribed in 80 general surgery department prescriptions, 42.69% of which were antibiotics and 57% were prescribed with generic names. The average number of drugs per prescription was 4.36, and the average number of antibiotics per prescription was 1.86; results of which are summarized in Table 2.

Antibiotic utilization

In our study, ceftriaxone (26.5%) was the most commonly utilized antibiotic in the department of general medicine, followed by augmentin (11.1%) and azithromycin (10.4%). Metronidazole (26.84%), cefazoline (22.2%), and amikacin (18.1%) were the highly utilized antibiotic in department of general surgery; results of which are analyzed, relative distribution is reported in Figure 1.

Pattern of antibiotics utilization as per the WHO ATC/DDD classification

Detailed quantitative and qualitative knowledge of antibiotic use is essential to implement approaches for limiting deviations and threats in utilization of antibiotics. DDDs mentioned in our study are for the oral route as obtained from the WHOCC-ATC/DDD Index 2012 (WHO, 2012) [25]. Bacterial resistance occurs in a higher proportion when they are administered in inadequate doses (e.g., when posology was prescribed in doses below the therapeutic ranges or during periods too short) [26]. As mentioned above, these two factors regarding the posology of prescription are dependent on both the prescriber and the patient, so this study indirectly assesses the prescriber by the comparison of the PDD values against their corresponding DDD. The Prescribed Daily Dose (PDD) was calculated by taking the average of the daily doses of the antibiotics as the PDD. The PDD to DDD ratio was then calculated. Our study observed appropriateness in antibiotics utilization, except for amoxicillin, vancomycin, and piptaz, the PDD:DDD ratio of antibiotics prescribed in the department of general medicine was less than one in our study; and cefaperazone + sulbactam, in the department of general surgery; results of which thoroughly analyzed and reported in Table 3 and Table 4.

DISCUSSION

The demographic results in the department of general medicine showed an equal distribution of both genders. The mean age in our study was found to be around 50 years, which was consistent with the findings of John et al., (2011) [27] and Meher et al., (2014) [28]. As per WHO-INRUD indicators, the average number of drugs per prescription is an important index of the standard of prescribing and the scope for review and educational intervention in prescribing practice. Our study found that the average number of drugs per prescription was 6.82, which is similar to the findings of Taskeen et al., (2012) [29], in which the average number of drugs per prescription was 6.07. In our study, the average number of antibiotics per prescription was 1.62, which was similar to the findings of Abraham et al., (2015) [30], where the average number of antibiotics per prescription was 1.65. Mean number of antibiotics prescribed through injection route in our study was 69.1% which is similar to study performed by Randad et al., (2017) [31]. Prescribing by generic name can reduce the cost incurred on drugs and the risk of medication errors. Our study found that 58% of antibiotics were prescribed generically, which was lower than the findings of Admane et al., (2015) [32]. In our study, antibiotic was prescribed for respiratory tract infections primarily based on disease prevalence, which was found to be 35%, similar to Meher et al., (2014) [28] findings. Among the wide range of antibiotics, the beta-lactams, cephalosporin's account for the highest which



**Mohanraj Rathinavelu et al.,**

Results observed in study performed by Gowthami et al., [33]. The ratio of PDD: DDD of anti-infectives prescribed in department of general medicine in 100 prescriptions was found to be lesser than for all drugs except amoxicillin, vancomycin, piptaz and sulbactam were PDD: DDD ratio was = 1, findings of which show that the anti-infectives utilized in department of general medicines was rational. In our study, 26.5% ceftriaxone was utilized which is considered safe for geriatrics which require no dosage adjustments during infections [34].

The average number of drugs per prescription is an important index of the standard of prescribing and the scope for review and educational intervention in prescribing practice. Our study observed 24 (30%) of patients in the department of surgery who are between the ages (in years) of 21 and 30, which was similar with the findings of Khan et al., (2017) [35]. According to WHO-INRUD indicators, the average number of antibiotics prescribed as injection in our study was 82.5%, which was higher than the results of a study conducted by Hafeez et al., (2004) [36], where the average number of anti-infectives prescribed as injection was 42.7%. However, the figure is higher than that reported by two Delhi tertiary-care hospitals Biswas et al., (2000) [37]. Excessive injection use increases the cost of sterilization and nursing resources while also exacerbating problems such as pain and local edema. Our findings revealed that 57% of antibiotics were prescribed with generic names, which is lower than the findings of the Nepal study [38]. Prescriptions written under a generic name can help to reduce drug costs and the risk of medication errors. The ratio of PDD: DDD of anti-infectives prescribed in department of general surgery in 80 prescriptions was found to be lesser than for all drugs except cefaperazone + Sulbactam were PDD: DDD ratio was = 1, findings of which show that the anti-infectives utilized in department of general medicines was rational.

CONCLUSION

In conclusion, the current antibiotic pharmacoepidemiological research sufficiently investigated actual prescriptions and dosing patterns and found no deviation of the prescribed daily dose (PDD) from the defined daily dose (DDD); implying the need for antibiotic stewardship teams to monitor and set intervention targets.

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Mohanraj Rathinavelu et al.,

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Table 1. Characteristics of study participant

Variable	Gender Distribution					
	General Medicine			General Surgery		
	Male (n%)	Female (n%)	Total (n%)	Male (n%)	Female (n%)	Total (n%)
	48 (48)	52 (52)	100	48 (60)	32 (40)	80
Age Distribution (in years)						
21 – 30	13 (27.08)	4 (7.69)	17 (17)	15 (31.25)	9 (28.12)	24 (30)
31 – 40	2 (4.17)	7 (13.46)	9 (9)	11 (22.92)	10 (31.25)	21 (26.25)
41 – 50	7 (14.58)	14 (26.92)	21 (21)	7 (14.58)	4 (12.5)	11 (13.75)
51 – 60	6 (12.5)	10 (19.23)	16 (16)	8 (16.67)	6 (18.75)	14 (17.5)
61 – 70	20 (41.67)	17 (32.69)	37 (37)	7 (14.58)	3 (9.37)	10 (12.5)
Socio-economic status						
Low-income	14 (29.17)	25 (48.08)	39 (39)	30 (62.5)	17 (53.12)	47 (58.75)
Middle-income	19 (39.58)	21 (40.38)	40 (40)	10 (20.83)	10 (31.25)	20 (25)
High-income	15 (31.25)	6 (11.54)	21 (21)	8 (16.67)	5 (15.63)	13 (16.25)

Table 2. Pattern of antibiotics use (WHO - INRUD) drug use indicators

(WHO – INRUD) drug use indicators	General Medicine	General Surgery
Total number of prescriptions handled	100	80
Total number of drugs prescribed	682	349





Mohanraj Rathinavelu et al.,

Total number of antibiotics prescribed	162	149
Average number of drugs per prescription	6.82 (682:100)	4.36 (349:80)
Average number of antibiotics per prescription	1.62 (162:100)	1.86 (149:80)
Percentage of antibiotics prescribed by generic name	58	57
Percentage of antibiotics prescribed as an injection	69.1	82

Table 3. ATC/DDD Classification and DUS Metrics of antibiotics in department of general medicine

Antibiotics	PDD (Daily dose in Gram)	WHO DDD (In Gram)	DDD	DDD/100 Patient bed days	PDD:DDD
Cefixime	0.2	0.4	0.5	0.0087	0.4
Amikacin	0.75	1	3.75	0.0042	0.2
Amoxicillin	1	1	1	0.0218	1
Clindamycin	0.9	1.2	4.5	0.4267	0.2
Doxycycline	0.1	0.3	2.3	0.0009	0.04
Ciprofloxacin	1	1	5	0.0042	0.2
Cefaperazone + Sulbactam	3	4	8.25	0.0079	0.3
Vancomycin	2	2	2	0.0218	1
Azithromycin	0.5	0.3	28.3	0.0004	0.01
Chloroquine	0.25	0.5	0.5	0.0109	0.5
Primaquine	0.015	0.015	10	0.0003	0.0015
Albendazole	0.4	0.4	11	0.0007	0.03
Piptaz	14	14	12.8	0.0306	1
Metronidazole	1.5	0.5	21	0.0015	0.07
Artesunate	0.24	0.28	7.71	0.0007	0.03
Ceftriaxone	2	2	43	0.0010	0.04

Table 4. ATC/DDD Classification and DUS Metrics of antibiotics in department of general surgery

Antibiotics	PDD (Daily dose in Gram)	WHO DDD (In Gram)	DDD	DDD/100 Patient bed days	PDD:DDD
Ceftriaxone	2	2	13	0.0038	0.15
Cefixime	0.2	0.4	1.5	0.0331	0.13
Cefazoline	2	3	21.3	0.0023	0.09
Amikacin	0.75	1	19.5	0.0010	0.03
Augmentin	1.4	1	14	0.0025	0.1
Clindamycin	0.9	1.2	3.75	0.0059	0.24
Doxycycline	0.1	0.1	3	0.0008	0.03
Ciprofloxacin	1	1	4	0.0062	0.25
Cefaperazone + Sulbactam	3	4	3	0.0976	1
Metronidazole	1.5	0.5	114	0.0003	0.01





Mohanraj Rathinavelu et al.,

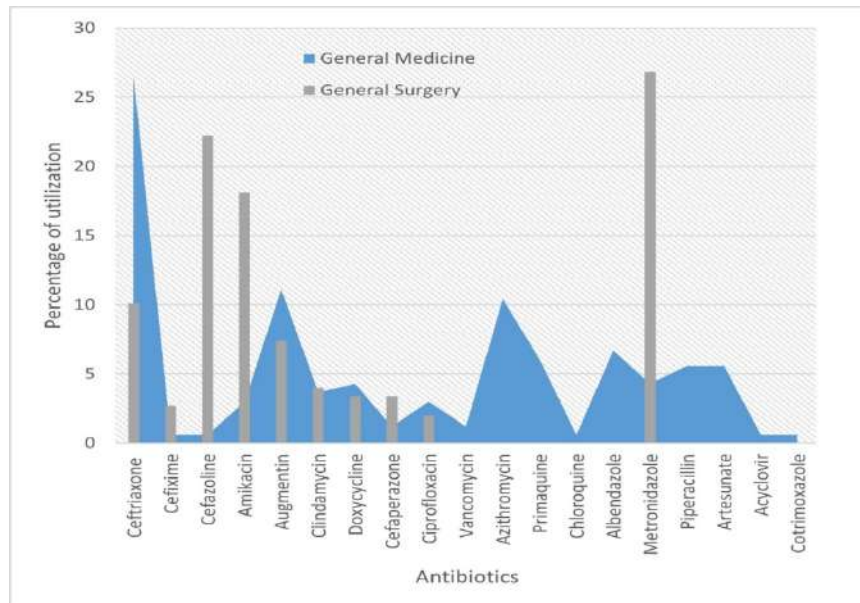


Figure 1. Percentage of antibiotics utilization





Smart Agriculture - Automatic Water Flow and Water Level Monitoring

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ABSTRACT

The total populace is developing every day. As a result, there will be a greater demand for food production. With advancements in IOT, automatic irrigation of the crops can be done when the moisture in the soil reduces, and the water level in the water tank can also be monitored using a soil moisture sensor and ultrasonic sensor. When control is increased, overproduction leads to better cost management. This automation increases efficiency by decreasing manual labor. For the implementation, the following components are used. Arduino UNO, a 2.5 Volt Relay Module, Water Pump, and a tube/pipe. Soil Moisture Sensor, Ultrasonic Sensor, and Jumper Wires. This paper aims to use readily available materials to create a simplified circuit for automatic smart irrigation.

Keywords: Arduino, smart irrigation, soil moisture sensor, ultrasound sensor, automatic irrigation.

INTRODUCTION

It is expected that by the end of the year 2050, the world population will reach 9.9 billion[1], which will obviously increase the demand for food production. Such demands can be met mainly by the adoption of technologies that enables the agriculture sector to meet the required demands without compromising quality and at minimal cost. Agriculture is a very important aspect of any country. Irrigation largely depends on groundwater and seasonal rainfall in India. When there's an excess of rainwater is wasted, and when there's no water at all, there is a drought, but in a country like India, many of the farmers still use traditional methods, which are time-consuming and





Pally Shelly Chelsy et al.,

unpredictable. When agriculture is automated, it needs less labor and less effort. Automatic irrigation systems will automatically detect the moisture content instead of manually checking the status. Many farmers do not have water pumps even if they do know how full or how empty the tank is. That is where the ultrasonic sensor comes into the picture. With an ultrasonic sensor, the user clearly understands how much water is there precisely in the tank, so the user can plan accordingly. With advancements in IoT, automatic irrigation of the crops can be done when the moisture in the soil reduces, and the water level in the water tank can also be monitored. To do this, two sensors are required. The soil moisture sensor and the ultrasonic sensor. Since we use IoT technology and it is automated, this is called smart irrigation. The soil moisture sensor and ultrasonic sensor are simple to use and yet are powerful enough to reduce the load of the farmers who do go with the advancements of Inter of Things. When control is increased, overproduction leads to better cost management. Automation helps in better efficiency. Water is conserved and is used only when it is really needed because of the use of soil moisture sensors. Remote monitoring can be done by farmers by monitoring multiple farms in different locations, and decisions can be made even without visiting the farms manually.

LITERATURE REVIEW

S. Badotra et al presented a novel smart irrigation technology integrating sophisticated machine learning algorithms and IoT frameworks that permit unparalleled accuracy in optimizing plant watering schedules[2]. Aiming for meticulous measurements pertaining to soil moisture levels, surrounding environment temperature & humidity rates, with comprehensive weather forecasting predictions. Our conducted experiments present ground-breaking results; exhibiting an impressive decrease in total water usage by an estimated 40% while simultaneously maintaining outstanding growth status across all plants tested. B. Alomar et all described a novel irrigation method that integrates fuzzy logic and IoT tools to forecast the ideal watering timetable for each unique plant[3]. The method employs soil dampness sensors, weather forecasts, and past records to anticipate future watering necessities. Our study discovered that by using this method we could reduce water utilization by up to half while still holding up plant health as well as development. The mechanism that R. Y. Rao et all used, automates the watering of plants, utilizing the Internet of Things to optimize and regulate the process[4]. This system is equipped with soil moisture, temperature, and humidity sensors, as well as weather forecasts, in order to determine the perfect watering schedule for each individual plant. Through this sophisticated and intricate system, it has been discovered that water usage can be decreased by a staggering 35%, all while ensuring that the plants are healthy and thriving.

The system I. K. Y. T. Permana et all used harvests data from soil moisture sensors, temperature and humidity sensors, and plant growth sensors, and employ cutting-edge deep learning algorithms to determine the most optimal watering schedule for each plant[5]. The system's efficiency is simply unparalleled, slashing water usage by a staggering 45% while keeping the plants hale. R. Prabha et all make use of microcontroller-based sensors and actuators to mechanize irrigation scheduling contingent on soil moisture levels [6]. The manuscript also spotlights the prospective of the system, such as conserving water and advancing crop output, and delves into the obstacles entailed in executing smart irrigation technology in provincial areas. The existing prototypes which have been studied have used models with Arduino Mega for detection of water level in the tank. A simple circuit that contains only Arduino UNO with soil moisture sensor and ultrasonic sensor without using a breadboard has not been implanted to the best of the author's knowledge.

DESIGN

The following components are used for implementing smart irrigation: Arduino UNO ,5 Volt Relay Module,Water Pump and tube/pipe, Soil Moisture Sensor ,Ultrasonic Sensor, Jumper Wires





Pally Shelly Chelsy et al.,

Arduino UNO

Arduino UNO is a microcontroller board. It's ATmega328P model. Six of 14 digital input/output pins are used as PWM outputs, and six are used for analog inputs. Arduino has a 16 MHz ceramic resonator, an ICSP header, a USB connection, a power jack, and a reset button. It is connected to a computer with a USB cable or battery or AC-to-DC adapter to start it.

5 Volt Relay Module

A 5v relay is an automatic switch commonly used in an automatic control circuit to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V.

Water Pump and tube/pipe

Submersible Pump Motor is a DC 3-6 V Mini Micro Submersible Water Pump. It is a small size and low-cost pump motor. It needs a 2.5 to 6V power supply. It can take up to 120 liters per hour. Current consumption is 220mA. The tube pipe has to be connected to the motor outlet and needs to be submerged in water, and then has to be powered on.

Soil Moisture Sensor

The soil moisture sensor is used to gauge the volumetric water content within the soil. Straight gravimetric dimension of soil moisture needs eliminating, drying, and sample weighting. These sensors measure the water with volumetric content not directly but with the help of other soil rules like dielectric constant, electrical resistance, interaction with neutrons, and replacement of the moisture content.

Ultrasonic Sensor

Ultrasonic sensors are electronic devices that calculate the target's distance by emission of ultrasonic sound waves and convert those waves into electrical signals. The speed of emitted ultrasonic waves traveling speed is faster than the audible sound.

Jumper Wires

Jumper wires are electric wires with connector pins at each end, allowing them to connect two points without soldering. These wires are typically used with breadboards and other prototyping tools to make it easy to change a circuit as needed. The flowchart of the working model is given in figure 4.

IMPLEMENTATION

Arduino UNO, 5volt relay module, water pump and tube/pipe, soil moisture Sensor, ultrasonic Sensor, jumper wires are assembled together as per the design in figure 3 Set up for the Smart irrigation system: The Arduino uno is set up with the different sensors to it. The ultrasonic sensor is attached to the Arduino uno with the different pins: the Vcc is connected to 3v ,trig & echo is connected to the PwM 5 & 2, Gnd is connected with the ground pin of the arduino uno board . The moisture sensor D0 is connected to PwM 6, Gnd is connected to the Gnd of the Arduino board, Vcc is connected to the Vcc of the arduino board. The Relay module of 5v is connected, the IN is connected to PwM 3 ,Gnd is connected to Gnd, Vcc is connected to 5v of the arduino board.

A motor is attached to the relay module where the negative is connected to the relay module and the positive is connected to the negative of the battery and the positive of the battery is connected to the Relay module. Once the arduino has wired the components as described above, we can write a program for the ArduinoUno using the Arduino IDE to program in order to read the sensor values, control the motor via the relay module, and perform any desired actions based on the sensor inputs. The Arduino Uno is connected to the Pc via a USB cable.





Pally Shelly Chelsy et al.,

RESULTS

The file was run in Arduino IDE in C++. The file was compiled and uploaded to the Arduino board through COM 3 port with Serial communication. After connecting the circuit, it was analyzed that when the soil is dry, water flows out of the outlet of the submerged water pump and flows when the soil is moist. When the tank is half empty, the ultrasonic sensor senses the distance from the surface of the water, and the distance is displayed on the serial monitor. Similarly, when the tank is empty, the ultrasonic sensor senses the distance and displays it on the serial monitor. The Sample output is shown in Figure 6. The distance from the ultrasound sensor to the surface of the water is initially 9 cm as the water flows into the pot when the soil is dry, the water level decreases and the distance from the ultrasound sensor and the surface of the water increases to 11cm.

CONCLUSION

The soil moisture sensor and the ultrasonic sensor were used in this paper to automate water flow and detect water levels. The soil moisture sensor was used to sense the moisture content in the soil and automate the water from the water tank if the soil was dry. The ultrasonic sensor was used to automatically detect the water level in the water tank. Manual labor is greatly reduced and a simple circuit has been implemented successfully. In the future, more sensors like rain and temperature sensors can be added. With a Rain sensor, an automatic catchment could be developed for storing water when it rains. Instead of a breadboard, a PCB board could be used.

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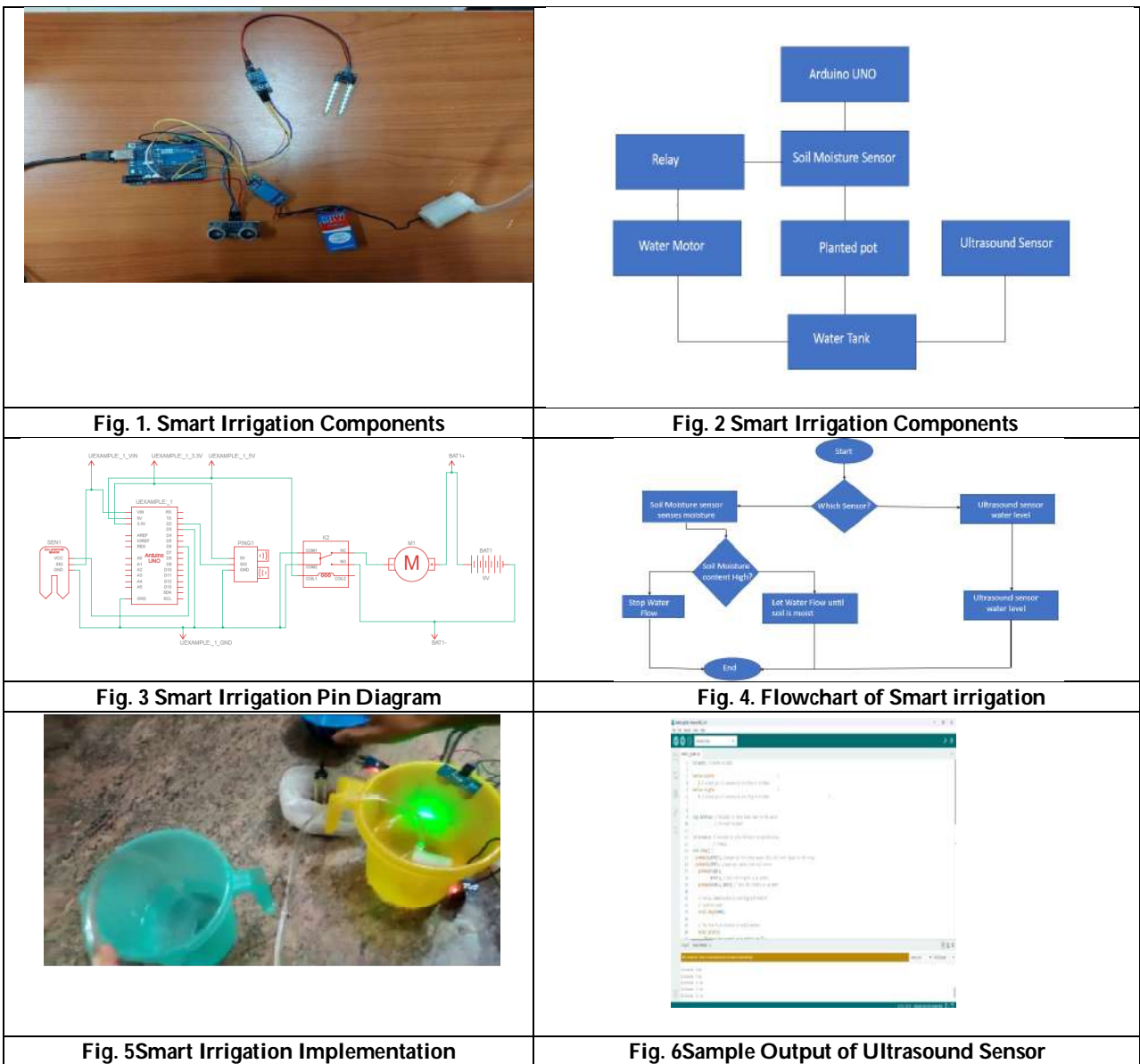
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The Consensus Study : “Designing and Validation of Clinical Tool for Assessment of Volitional Motor Control for Stroke Survivors

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ABSTRACT

In industrialized nations, stroke is the third-leading cause of adult death and the primary cause of adult disability. A stroke can have severe effects, leaving a person with long-term impairments in their ability to function physically, socially, emotionally, and cognitively. The motor disorder known as spasticity, which is a component of upper motor neuron syndrome, was first described by Lance in 1980. It is characterized by an increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks that is velocity-dependent. In patients with severe UE paresis, the prediction of voluntary UE movement recovery has not been thoroughly studied and is still uncertain. There is a dearth of literature on lower extra remedy volitional control. Clinically useful, valid, and reliable assessment techniques are required. The complete lower extremity of stroke patients needs to be assessed for volitional motor control using a valid, dependable, and clinically useful approach. This study's goal is to outline the creation of a clinical tool called the Volitional Motor Control Assessment of the Lower Extremity (SCALE) and provide proof of its internal consistency and validity. This mixed-methods study contains three phases to create a core set of outcomes for evaluating volitional motor control. It was the goal of qualitative interviews with experts to determine whether results are significant. To improve the content of the core outcome set, experts took part in a Delphi study, an iterative consensus exercise. The CONSENSUS study's methodology will be followed according to this protocol. A core outcome set stipulates a minimal requirement for outcome reporting for clinical trials in a certain field of medicine or healthcare. Its regular use in clinical studies with voluntary controls has raised the standard and applicability of research. This study is registered at the CTRI. (CTRI no.: CTRI/2022/05/042467 [Registered on: 11/05/2022])

Keywords: Volitional Control Grading, Consensus, Delphi, Stroke, Upper extremity, lower extremity.





INTRODUCTION

A serious global health issue, stroke is a leading cause of mortality and morbidity in industrialized nations and is becoming more prevalent in LMICs (low-middle-income countries). Since 70% of strokes occur in LMICs, these nations have a higher illness burden than high-income nations. Since India's life expectancy has lately risen to nearly 60 years old, age-related, non-communicable diseases like stroke have become more prevalent, making them the country's fourth major cause of death and the fifth leading cause of disability. Reliable statistics on stroke incidence, prevalence, and the ones needed to guide healthcare policies, organize stroke services, and monitor the effects of any changes in care are required to meet the rising burden of stroke in India. According to the Global Burden of Disease project, India had 1,175,778 incident stroke cases in 2016. A recent systematic analysis that was primarily composed of cross-sectional research suggested that between 105 and 152/100,000 people in India experience a stroke annually [1]. In industrialized nations, stroke is the third-leading cause of adult death and the primary cause of adult disability. A stroke can have severe effects, leaving a person with long-term impairments in their ability to function physically, socially, emotionally, and cognitively [2]. Usually, the method and site of the var damage are used to categorise strokes. Strokes originate from a blockage of a cerebral vessel and can also be classified as being caused by thrombosis or embolism. The two main causes are ischemia and haemorrhage. The stenosis or obstruction of a vessel is known as thrombosis, and it typically results from atherosclerosis. This occlusion usually occurs gradually, frequently with warning signals like transient ischemic attack (TIA). Dislodged platelets, cholesterol, or other substances that develop elsewhere and move via the bloodstream to clog a brain vessel are called emboli. About 87% of strokes are ischemic, making them the most prevalent form [2,3].

A weak cerebral blood artery ruptures to cause hemorrhagic strokes. Blood builds up outside of the vascular space during such strokes, compressing the tissue around the brain. Both intracerebral (bleeding into the brain itself) and subarachnoid (bleeding into the space around the brain) hemorrhagic strokes can occur. The most frequent types of compromised blood arteries that result in hemorrhagic strokes are aneurysms and arteriovenous malformations. Although they are less frequent than ischemic strokes (13% of all strokes), hemorrhagic strokes have a greater fatality rate [3]. The majority of lesions are either posterior circulation strokes, which show symptoms of brainstem involvement, or anterior circulation strokes, which show symptoms of hemispheric dysfunction. Whether the lesion is caused by large- or small-vessel disease is another distinction related to the site of CVA. The big cerebral blood arteries are where thrombosis happens most frequently. Only where small arterioles diverge from the larger vessels do small-vessel, or lacunar, strokes take place [2,3].

In most nations, stroke is one of the main causes of mortality and morbidity among adults. Spasticity is a typical, though not always present, symptom in stroke victims. Following a stroke, spasticity is frequently accompanied by discomfort, soft tissue stiffness, and joint contracture and may result in incorrect limb posture, lower quality of life, higher medical expenses, and a heavier caregiver load. In addition to reducing these complications, early diagnosis and treatment of post-stroke spasticity may also enhance patient independence and function [4]. The motor disorder known as spasticity, which is a component of upper motor neuron syndrome, was first described by Lance in 1980. It is characterized by an increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks that is velocity-dependent. Because the definition's criterion, "velocity-dependent increase in tonic stretch reflexes," may separate spasticity from other movement disorders including hypertonia, rigidity, and hyperreflexia, it is valuable in clinical practice.

This description, however, misses the crucial role that sensory input plays in the feeling of spasticity. According to some research, improper processing of sensory inputs by muscle spindles results in an excessive amount of alpha-motoneurons firing as a reflex, which worsens spasticity. Spasticity is now described as "disordered sensory-motor control, resulting from an upper motor neuron lesion, presenting as intermittent or sustained involuntary activation of muscles" in the new definition provided by the Support Programme for Assembly of a Database for Spasticity Measurement (SPASM) initiative. This definition considers the contributions of proprioceptive and cutaneous



**Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya**

sensory pathways as well as the impact of soft tissue's viscoelastic qualities to joint stiffness [3,4]. Spasticity is common after stroke, with the prevalence ranging from 30% to 80% of stroke survivors. The incidence of spasticity among paretic patients has been reported to be 27% at 1 month, 28% at 3 months, 23% and 43% at 6 months, and 34% at 18 months after stroke. There are no large studies on the natural history of spasticity and contracture development, but permanent loss of joint range has been reported to occur within 3- 6 weeks after stroke [4]. The onset of spasticity is highly variable in the post-stroke period, and studies have shown that spasticity develops and peaks at 1-3 months after stroke. Although the neuronal components of spasticity peak at 3 months after stroke, the muscular components of spasticity may increase over time, thus, contributing to increased incidence of spasticity at 6 months post-stroke [4]. Spasticity is more often found in the flexor muscles of the upper limb (fingers, wrist, and elbow flexors) and extensor muscles of the lower limb (knee and ankle extensors). Wissel et al observed that spasticity developed most often in the elbow (79%), wrist (66%), ankle (66%), and shoulder (58 %). Lundstrom et al concluded that spasticity is observed more frequently in the upper extremities than in the lower extremities, and Urban et al found a higher degree of spasticity in the upper limb muscles [2,4].

One of the upper motor neuron disorders that contribute to hypertonia is spasticity. Muscle tone abnormalities may result from any lesion, injury, or extrapyramidal fibres along the pyramidal tract. Although the central nervous system must be involved for spasticity to spread and manifest, it is caused by the local stimulation of muscle spindles. Spasticity can be classified into two types: spasticity caused by muscle contraction, often known as non-reflex spasticity, and spasticity mediated by the neural reflex. When the top motor neurons are damaged, the brain and spinal cord are unable to communicate, which leads to a net disinhibition of the spinal reflexes [3]. Alpha-motoneurons are activated and supraspinal inhibitory control is lost during passive muscular stretching of a patient because muscle spindles send sensory information to the spinal cord through primary group Ia afferent fibres. This results in excessive muscle activation. Additionally, the Renshaw cell and spinal interneurons Ia and Ib shut downward facilitation or inhibition impulses from the central nervous system. When spinal interneuron-mediated effects are disrupted, it may result in an excessive amount of muscle activation by decreasing the antagonist's muscular inhibition and increasing action potentials in the sensory neurons. However, spasticity may also be explained by changes in the mechanical properties of muscles and not only by neural-media hyperreflexia [4]. Several studies [6,7]. bolster the idea that peripheral tissues including muscular fibres and connective tissue are involved in spasticity. Sarcomere density can be decreased and the fraction of connective tissue in the muscle can be increased by chronic spasticity. The soft tissue alteration may make it easier for the pulling forces to reach the muscle spindles, increasing sensory input from the spindles and causing an increase in spasticity.4 Patients with spasticity experienced increased intrinsic muscular stiffness. Through an excessive activation of spindle afferents, muscle fibrosis and the other aspects of muscular contracture may enhance spasticity [2,4].

Patients with stroke typically exhibit impaired movement, which may be caused by a variety of upper motor neuron disorders, such as spasticity, weakness, lack of coordination and dexterity, and prolonged muscle contraction. Patients with spasticity have poorer quality of life and reduced functions. It is common to see abnormal postural patterns, which may be caused by hypertonia and an imbalance of agonist and antagonist strength. In the early stages of voluntary movement recovery in stroke patients, synergic patterns with mass muscle contraction are observed in the upper and lower limbs. The most frequent patterns in the upper limbs are pronation in the forearm, adduction and internal rotation in the shoulder, flexion in the elbow, wrist, and fingers. Extensor synergy is frequently seen in the lower limbs, where there is equinovarus foot, adduction of the hip, and extension of the hip and knee. Later, synergic patterns are weakened and individual motions become compromised [3,4].

Planning treatment and assessing results rely heavily on the patient's opinions of his or her health and coping with the handicap. The goals of conventional stroke rehabilitation are symptom relief and function recovery. However, while evaluating the efficacy of interventions, it is important to consider both the patient's perspective and that of the doctor or healthcare professional. Systematic evaluation of the patient's perspective may yield useful information for treatment results because some therapy effects, including changes in mood, are only known to the patient. Patient-centered evaluation, which includes a wider range of outcomes, such as health status, social involvement, or health-



**Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya**

related quality of life (HRQOL), has attracted more attention in recent years. This element has been represented in a number of multi-domain stroke-specific assessments that evaluate the patient's self-perceived health state and recovery after a stroke. Although the adoption of patient-centered techniques was reported in these measures, the sample sizes were small and severe stroke patients were not included in the trials.⁵ These elements weaken the validity of psychometric testing and restrict the applicability of their findings. Therefore, further research is still required to determine how a stroke affects a patient's perception of their health and ability to cope with their handicap [2,5 and 6]. Stroke patients' quality of life is significantly impacted by severe upper extremity (UE) paresis. Severe UE paresis patients may have no or very little voluntary UE movement. They can move their shoulders, elbows, or scapulae partially, but they cannot carry out basic daily functions like holding a cup. Even though only about one-third of stroke patients experience severe UE paresis, they require the majority of the healthcare and social services. According to research, the key factor affecting UE functional loss and everyday function restriction following stroke is the degree of one's impairment in the ability to regulate their UE motor units voluntarily, known as paresis [7,8].

It was discovered that the voluntary UE movement recovered quickly for the first three to six months before slowing down in the chronic phase of recovery. Therefore, one of the main goals of inpatient therapy is to enable the best possible recovery of voluntary UE movement. Therapists may use compensatory techniques to help patients regain their functions in everyday activities if patients do not exhibit recovery potential. Therefore, for rehabilitation therapists to deliver appropriate therapies in patients with severe UE paresis, correct assessment of a patient's voluntary UE movement recovery is a crucial concern [7]. The prediction of voluntary UE movement recovery in patients with severe UE paresis has not been examined well and remains inconclusive. Three reasons might explain such an observation. Firstly, although previous studies^{8,9} have suggested that poor initial voluntary UE movement is associated with poor prognosis at or after discharge, these findings are difficult to generalize to patients with severe UE paresis. Previous studies [8,9,10] investigated the association between initial UE impairment severity and recovery in a group of patients with heterogeneous severity of UE paresis. However, because various subgroups have varied recovery patterns, the association assessed in a heterogeneous group is a weighted consequence of the pooled sample and might not correctly represent all subgroups. In other words, when such results are analysed along with slightly and moderately impaired patients, the estimated connection between initial severe UE paresis and poor recovery may be biased. Therefore, additional research on a uniform sample of patients with severe UE paresis is required [10].

Second, the outcome measures did not assess voluntary UE movement in most studies that investigated motor recovery in patients with severe paresis. For example, the Scandinavian Stroke Scale assesses muscle strength, which cannot describe whether an individual can perform isolated wrist or forearm movements. Some studies⁸ used functional assessments of UE. UE function is a broad term, covering a range of abilities including voluntary UE movement, muscle tone, multiple joints movement coordination, and adjusting interactions with objects. For instance, "take up and put down an object" is a UE function that involves several joints in voluntary movements simultaneously; i.e., the thumb, fingers, elbow or shoulder. Different sizes and weights of objects also influence the results of functional assessments. Thus, the results of this studies [8,9,10 and 11] are difficult to apply to the interpretation of voluntary UE movement recovery in patients with severe paresis. Voluntary UE movement is the foundation of UE function and reflects the basic control of the brain over the musculoskeletal system. Investigating voluntary UE movement recovery in patients with severe UE paresis provides the most fundamental research evidence regarding UE motor recovery after stroke [12]

Third, potential predictors have not been broadly explored in patients with severe UE paresis [11,12 and 13]. Initial severity of UE movement [12,13,14] and lesion locations was associated with voluntary UE movement recovery at 3 or 6 months after stroke in patients with severe UE paresis. However, the initial severity of UE movement alone can explain only 16% of the variance of patients' recovery. It is unknown whether the other variables, such as duration after stroke onset and lesion volume, could be predictors as well and might increase the total predictive power for patients' recovery [13].



**Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya**

The most frequent cause of neurological disability in the community at large is strokes. Loss of voluntary movement control on the side of the body opposite the injury is the main impairment. Other symptoms could be sensory loss, perceptual issues, intellectual impairment, communication issues, and difficulty with psychosocial adjustment [15]. Measurement of the patient's functional abilities in terms of ability to conduct activities of daily living (ADL) is a typical technique for gauging recovery following a stroke. Such ratings are suitable descriptors for tasks like highlighting the long-term consequences of a stroke. However, there are a number of shortcomings with ADL scales when choosing a suitable therapeutic regimen. Many tasks can be completed with little to no use of the involved side. The tasks don't call for the kind of fine motor control common to many hand-related activities.

The findings of this study have validated the requirement for a battery of assessments to gauge stroke recovery. The tests looked at could gauge many aspects of the restoration of upper limb function, The evaluation tests were able to track several aspects of the 30 patients' improvement of upper limb function. It was noted that the tests kept track of alterations even after a stroke had started for six months. Therefore, it is believed that recovery can be tracked for longer than six months after beginning by employing the tests that are right for each individual patient. The final test battery will comprise the following tests: Rivermead ADL, motor assessment, grip, peg test and bimanual coordination task. Together these tests are considered to provide a comprehensive and sensitive measurement of recovery following stroke [15]. Lower extremity volitional control literature is scarce. A valid, reliable assessment method that has clinical utility is needed for volitional motor control assessment of the entire lower extremity in patients with stroke. The purpose of this study is to describe the development of a clinical tool entitled Volitional Motor Control Assessment of the Lower Extremity (SCALE) and present evidence of its validity and interrater reliability. Designing a tool to assess volitional control grading for stroke patients can be helpful for Neuro therapists working with neurologically ill patients to set appropriate goals regarding volitional motor development and can guide their family to plan for future realistically.

The aim of this paper is to present the results of a Consensus among the best experts of Volitional control grading on the recommendation for research studies on the treatment of Stroke patients. The goal of the consensus statement is to establish a framework for research with clearly delineated inclusion criteria, methodologies, and outcome measures so that future meta- analysis or comparative studies could occur.

METHODS

Design

A set of recommendations for grading volitional motor control were agreed upon using the Delphi method. The Delphi method is helpful when group dynamics (such as time differences, physical distance, and personality conflicts) make communication difficult and when the situation at hand would benefit from a group's subjective evaluations or conclusions. Following this initial phase, it was decided to develop the recommendations, and four additional Delphi Rounds were held. It also included the creation of a reference scheme that was evaluated in two Delphi Rounds. The process was completed in April 2022 with an online consensus gathering overseen by academics and experts. The experts formally accepted the final suggestions. There are different ideas about how to choose a group of specialists. Despite the fact that every case and the pool of specialists from which to choose will be different, some general guidelines for the procedure are given. Rowe and Wright summarise the following approaches for exploiting expert opinion in Delphi applications.

Make advantage of experts who are knowledgeable about the subject.

- Make use of a range of skills.
- Use five to twenty specialists.
- Provide the panel's mean or median estimate as well as the justifications for each panellist's estimate when providing input for a Delphi analysis.

Delphi polling should continue until responses show consistency. Usually, three formal rounds are enough.



**Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya**

- Compile the final prognosis by evenly considering and merging the opinions of all the experts.

Experts

To provide expert opinion and consensus for the revision and review of the content and structure of the scale format so that it could be modified and a new pre-final draught of the scale could be designed, a panel was formed that included three senior neuro-physicians, one senior neurosurgeon, eleven senior physiotherapists, one senior occupational therapist, and one research expert with expertise in qualitative research.

The group concentrated its thought on four key areas:

1. Content Equivalence: Assures that the concept of volitional motor control in stroke survivors is evaluated correctly by the tool's content. As part of this process, appropriate items, activities, and measurements are identified and chosen to evaluate the intended construct.
2. Construct Equivalence : When testing the same construct of volitional motor control in stroke survivors across several groups or situations, the term "construct equivalence" is used. This calls for a detailed analysis of the factors that may affect the construct, such as linguistic or cultural differences, and their bearing on how the findings should be interpreted.
3. Contextual Equivalence: This refers to ensuring that the tool is appropriate and pertinent for the therapeutic setting in which it will be used. Take into account the assessment's clinical population, context, and aim as well as any tools or resources that could be accessible for its delivery or interpretation.
4. Psychometric Equivalence: This describes a tool's capacity to be used in clinical practice and research by having appropriate psychometric properties, such as reliability and validity. This entails carrying out pertinent analyses to ascertain the validity and reliability of the tool as well as locating any potential bias or error sources.

The Delphi consensus procedure

The primary goal of the initial reference system for research studies was to encourage specialists to write articles that were meaningful to clinical populations. While producing data with diverse groupings, the objective was to require them to record their data according to this precise reference scheme, to enable future meta-analysis and data pooling. However, this did not mean that they should restrict their studies to these groups of patients.

Recommendations

It became evident following the first two Delphi Rounds that a reference scheme consensus could not be reached. However, based on the input provided and earlier panel discussions, it was feasible to create a number of proposals that were submitted to the Delphi Consensus procedure.

Delphi process

The Consensus process adhered to the Delphi guidelines.²³ The professionals and researchers have coordinated every stage. Seven rounds of the process were used. The researcher created the materials that were delivered to the Delphi participants, and the experts reviewed and approved them. Table 1 provides information about each individual Delphi Round. (Additional files 1, 2, 3, 4, 5, 6, 7)

Agreement and importance of the recommendations -

The researcher made the decision to assign a rating to the recommendations based on the level of consensus attained at each stage and the importance assigned by the Delphi process participants. Table 2 reports the definitions of agreement gained for the recommendations. The responses to the questions were binary (Yes/No): if a recommendation did not receive at least 80% agreement, it was disregarded and was not taken into further consideration. Table 3 provides descriptions of the significance of suggestions. A Likert scale with five points was used to define the recommendation's importance: 1- strongly agree, 2 - agree, 3 - neutral, 4 - disagree, and 5 - strongly disagree.





Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya

Face and content validation

A team of seventeen clinical subject experts with a combined experience of more than five years were given the researcher's created scale, and they used a consensus method to determine the face and content validity of the volitional motor control grading scale. The experts reviewed each item on the scale for content, format, wording, meaning, scoring, and administration ease. Each expert gave each item a score of either rejected, accepted, or accepted with modifications. After the study and debate, volitional motor control grading was created. For content validation, all the experts were required to score each item of the scale from 1 to 3 where 1 signal "rejected", 2 indicate "accepted with modification and 3 indicate "accepted". Content Validation Ratio (CVR) was calculated using below formula: [24]

$$CVR = \frac{\{N_e - (N/2)\}}{N/2}$$

Where,

N_e =number of expert indicating "accepted"

N =total number of expert

CVR value more than 0.62 was approved [24]

Item level Content Validation Index (I-CVI) was calculated using below formula [25]:

$$I-CVI = \frac{\text{Number of experts offering rating 3}}{\text{Number of total experts}}$$

Interpretation of I-CVIs²⁵:

>79%-appropriate; 70-79%-needs revision; less than 70%- eliminated

Modified Kappa (K) for chance Agreement was calculated using below formula [24,26]

$$K = \frac{(I-CVI) - P_c}{(1 - P_c)}$$

Where Probability of chance agreement (P_c) was calculated using the below formula

$$P_c = \{N/A (N-A)\} * 0.5N$$

Here,

N = number of experts in a panel

A = number of experts agree that the item is relevant

Interpretation of the K values²⁷:

> 0.74: excellent; 0.60- 0.74: good; 0.40- 0.59: fair

The proportion agreement was calculated using the below formula [24, 25]

The proportion of agreement= Number of experts who have identified Scale comprehensiveness favorable/Total number of experts.

STATISTICAL ANALYSIS

SPSS version 24.0 was used to analyze the data. Descriptive data was presented as mean and Standard Deviation (SD).

RESULTS

Content and Face Validity

All the experts ($n=17$) accepted (A) each item of volitional motor control grading. So, the CVR value for each item of volitional motor control grading was 1, which was more than 0.62 suggesting approval for each item Table 4.



**Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya**

I-CVI values for each item of volitional motor control grading were 1 suggesting that each item of volitional motor control grading was appropriate. K values for each item of volitional motor control grading were 1. The proportion of agreement for each item of volitional motor control proportion was 1 (Table 5). For the face validation, 17 experts were requested to judge the understandability and simplicity of the items during the expert review procedure. According to their opinion, volitional motor control grading was simple and easy to understand. All the items of volitional motor control grading were accepted for appropriate wording, meaning, format and ease of administration by experts during the review process. The content of volitional motor control grading items was understandable and they were related to volitional motor control grading and can be used for the evaluation of the volitional motor control grading for stroke patients.

DISCUSSION

As this study is part of a large research project to explore the designing and validation of clinical tools for the assessment of volitional motor control for stroke survivors, there was a need to make use of reliable and valid scales to evaluate volitional control grading for stroke patients. In the present study, the CVR was calculated, which was more than its cut-off value (0.62) for the approval of items in the scale. Authors also calculated I-CVI, modified kappa and proportion of agreement for each item of the scale and found acceptable values on I-CVI for each item, excellent values of K for each item and 100% agreement of each item for comprehensiveness. It is impossible to establish reliability if there is lacking content validation for any instrument. As content validity is a prerequisite for the other types of validity, higher CVR provides a good base for the measurements of other types of validity [28].

CONCLUSION(S)

Currently, literature is scarce for a valid scale of volitional motor control grading in stroke patients which quantifies and purely measure volitional movements. So volitional motor control grading can contribute to a better understanding of volitional movements in stroke patients and thereby it can be helpful to provide better outcomes.

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**Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya**

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Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya

Table 1: Details of each single Delphi Round performed

DELPHIE ROUND	METHODS	PARTICIPANTS	MATERIAL DISCUSSED
1	EMAIL DISCUSSION	All 17 experts	Content of a volitional control grading scale
2	EMAIL DISCUSSION	All 17 experts	Suggestions given for the same and modifications were done for the same
3	EMAIL DISCUSSION	All 17 experts	Suggestions given for the same and modifications were done for the same
4	EMAIL DISCUSSION	All 17 experts	Suggestions given for the same and modifications were done for the same
5	EMAIL DISCUSSION	All 17 experts	Suggestions given for the same and modifications were done for the same
6	EMAIL DISCUSSION	All 17 experts	Final results and scale generated with modifications suggested.
7	EMAIL DISCUSSION	All 17 experts	Need of the Volitional control grading scale

Table 2 - Definitions of Agreement reached for recommendations -

ANSWERS	RATING
100%	A.Complete
95-99.9%	B.High
90-94.9%	C.Good
80-89.9%	D-Weak
Below 80%	Absent

Table 3: Definitions of the importance of recommendations

ANSWERS	RATING
4.5-5	1- Strongly agree
3.5-4.4	2 – Agree
2.5-3.4	3 – Neutral
1.5-2.4	4 – Disagree
1-1.4	5 - Strongly disagree.

Table 4: Values of CVR for each item of volitional motor control grading. E1, E2, E3, E4, etc. suggest the number of expert member; A: Accepted; CVR: Content validation ratio -

A Number of experts Opinion About Essentiality Of The Items																	Number of experts indicated "accepted" (Ne)	CVR	
Items	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17		
1	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
2	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
3	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
4	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
5	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1





Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya

6	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
7	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
8	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
9	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
10	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
11	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
12	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
13	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
14	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
15	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
16	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
17	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
18	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
19	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
20	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
21	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
22	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
23	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
24	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
25	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
26	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
27	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
28	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
29	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
30	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
31	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
32	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
33	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
34	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
35	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
36	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
37	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
38	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
39	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
40	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
41	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
42	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
43	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
44	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
45	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
46	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
47	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
48	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
49	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
50	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
51	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
52	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
53	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1





Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya

54	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
55	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
56	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1
57	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	17	1

Table 5: Values of I-CVI, Modified kappa (K) and proportion of agreement for Items in Volitional Motor control Grading Scale -

(I-CVI: Item level content validity index)

Em no.	I-CVI	K	Interpretation	No. of experts agreed to the comprehensiveness	Proportion of agreement
1	1	1	Excellent	17	1
2	1	1	Excellent	17	1
3	1	1	Excellent	17	1
4	1	1	Excellent	17	1
5	1	1	Excellent	17	1
6	1	1	Excellent	17	1
7	1	1	Excellent	17	1
8	1	1	Excellent	17	1
9	1	1	Excellent	17	1
10	1	1	Excellent	17	1
11	1	1	Excellent	17	1
12	1	1	Excellent	17	1
13	1	1	Excellent	17	1
14	1	1	Excellent	17	1
15	1	1	Excellent	17	1
16	1	1	Excellent	17	1
17	1	1	Excellent	17	1
18	1	1	Excellent	17	1
19	1	1	Excellent	17	1
20	1	1	Excellent	17	1
21	1	1	Excellent	17	1
22	1	1	Excellent	17	1
23	1	1	Excellent	17	1
24	1	1	Excellent	17	1
25	1	1	Excellent	17	1
26	1	1	Excellent	17	1
27	1	1	Excellent	17	1
28	1	1	Excellent	17	1
29	1	1	Excellent	17	1
30	1	1	Excellent	17	1
31	1	1	Excellent	17	1
32	1	1	Excellent	17	1
33	1	1	Excellent	17	1
34	1	1	Excellent	17	1
35	1	1	Excellent	17	1





Sneha Dineshbhai Dhanani and AmalKumar Bhattacharya

36	1	1	Excellent	17	1
37	1	1	Excellent	17	1
38	1	1	Excellent	17	1
39	1	1	Excellent	17	1
40	1	1	Excellent	17	1
41	1	1	Excellent	17	1
42	1	1	Excellent	17	1
43	1	1	Excellent	17	1
44	1	1	Excellent	17	1
45	1	1	Excellent	17	1
46	1	1	Excellent	17	1
47	1	1	Excellent	17	1
48	1	1	Excellent	17	1
49	1	1	Excellent	17	1
50	1	1	Excellent	17	1
51	1	1	Excellent	17	1
52	1	1	Excellent	17	1
53	1	1	Excellent	17	1
54	1	1	Excellent	17	1
55	1	1	Excellent	17	1
56	1	1	Excellent	17	1
57	1	1	Excellent	17	1

Table 6: Professionals who participated in the Consensus and gave consent to be cited -

Sr. No.	Name of Professionals	Designation
1	Dr Anjan Desai	PhD
2	Dr Vivek Ramanandi	PhD
3	Dr Ashish Kakkad	PhD
4	Dr Harihara Prakash	PhD
5	Dr Thangamani Ramalingam	PT
6	Dr Rajendra Kabariya	Neuro surgeon
7	Dr Tanmay Trivedi	Neuro Physician
8	Dr Prakash Bhatt	Neuro Physician
9	Dr Viral Shah	MPT in Neurological Sciences
10	Dr Saurabh Shukla	Neuro physician
11	Dr Bhakti Kotak	MPT in Neurological Sciences
12	Dr Bhakti Desai	MPT in Neurological Sciences
13	Dr Shailesh Kagathara	PT
14	Dr Shilpa Khandale	MPT in Neurological Sciences
15	Dr Ramesh Tiruttani	MPT in Neurological Sciences
16	Dr Swati Patel	Statistician
17	Shreya Sharma	Occupational Therapist





Lung Diseases Classification using Deep Learning Technique

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ABSTRACT

The main aim of this innovative work is to categorize different lung conditions, including pneumonia, Coronavirus Diseases (COVID-19), and lung opacity, using standard Chest X-Ray (CXR) images and volume datasets. While deep learning models have proven to be highly effective in the medical field, they require extensive amounts of data. Unfortunately, this is difficult due to patient privacy regulations and the lack of openly available medical databases. Nonetheless, deep learning methods are a promising and successful approach that expands on the machine learning domain. Convolutional Neural Networks (CNNs) can be trained to extract features from image datasets in biomedical applications. In this proposed method, images are classified into COVID-19, viral pneumonia, and normal categories using a residual network 101. The classification accuracy is 94% by utilizing transfer learning. These results indicate that the proposed technique is robust, effective, and suitable for clinical applications.

Keywords: Residual Network 101, Transfer Learning, Convolutional Neural Network

INTRODUCTION

Lungs play a vital role in the human system, which performs expansion and relaxation to bring in oxygen and take out carbon dioxide. Lung diseases are respiratory diseases that affect the various organs and tissues associated with breathing, leading to airway diseases, lung tissue diseases, and lung circulation diseases. Some of the respiratory diseases like common cold and influenza cause mild discomfort and hindrance while others like pneumonia, tuberculosis and lung cancer are life-threatening and cause severe acute respiratory problems [1]. According to a research study done by the "Proportionate clinical burden of respiratory diseases in Indian outdoor services and its relationship with seasonal transitions and risk factors", the eligible number of patients from across 302 sites in India was 25,177. The mean age of study population was 46.1±18.1 years, 14102 (56.0%) were males and 11075 (44.0%)

58857



**Hema Rajini**

females. The common diagnoses were: asthma (29.8%), Chronic Obstructive Pulmonary Disease (COPD), 15.6%, Respiratory Tract Infections (RTIs), 11.3%, and tuberculosis (8.7%) [2]. Lung cancer kills an astounding number of people every year. More than 1.6 million people were reported to have died every year as per the survey carried out. Pneumonia is one of the top respiratory diseases and 1.23 million children under the age of 5 died due to pneumonia according to the review [3]. Detection of the above mentioned diseases at the early stages of infection can drastically increase the chances of survival and can prevent human casualties. CXR images are common examinations that determine the presence of these diseases [4]. The presence of trained professionals is required to examine the scanned images and determine the infections. According to the Union Health Ministry data statistics a shortfall exist of 76.1 percent of physicians at the Community Health Centres (CHCs) in rural areas. To overcome this, deep learning techniques are implemented, which pave the way for a new strategy.

Numerous works have already been conducted by researchers around the world and have led to promising results. These works can help and support existing methods or open pathways to new ones that could not have been possible. These advancements can help in quick and accurate detection as well as classification of diseases and provide quick support to obtain impressive results to eliminate deadly infectious diseases. Recent developments in deep neural networks lead to major improvements in medical imaging. The efficiency of dimensionality reduction algorithms like lung segmentation was demonstrated in the CXR images analysis. Recently researchers aimed at improving tuberculosis detection on relatively small data sets of less than 103 images per class by incorporating deep learning segmentation and classification methods. The Residual Network (ResNet) CNN is a 101-layer deep model trained on more than a million fixed-size images from the ImageNet dataset. The network classifies an input image into one of 1000 object classes like car, airplane, horse or mouse. The network has learned a large amount of features to training images diversity and achieved 6.71% top-5 error rate on the ImageNet dataset. The ResNet-50 CNN consists of 5 stages, each having convolutions and identity blocks. Every convolution block consists of 3 convolutional layers. ResNet-50 is related to ResNet-34, however, the idea behind its sibling model remains the same. The only difference is in residual blocks; unlike those in ResNet-34 ResNet-50 replaces every two layers in a residual block with a three-layer bottleneck block which reduce and eventually restore the channel depth.

The model input is first processed through a layer with 64 filters and stride 2 and downsized by a max-pooling operation with a stride of 2 pixels. The second stage consists of three identical blocks, each containing a double convolution with 64 pixels filters and a skip connection block. The third pile of convolutions starts with a dotted line as there is a change in the dimensionality of an input. This effect is achieved through the change of stride in the first convolution block from 1 to 2 pixels. The fourth and fifth groups of convolutions and skip connections follow the pattern presented in the third stage of input processing, yet they change the number of filters (kernels) to 256 and 512, respectively. This model has over 25 million parameters. The rest of this paper is organized as follows. Section 2 presents the literature survey. Section 3 experimentally demonstrates the performance of the proposed method. Section 4 describes the result and discussion of this paper. Finally, Section 5 describes the conclusion of this paper.

LITERATURE SURVEY

There are many computer aided detection systems for the classification of diseased lung images in the literature, most of them are used to detect the disease through CXR images. Amirhossein et al. has performed an accurate and automatic technique based on a deep ResNet to analyze CXR images to monitor COVID-19 and diagnose verified patients [4]. The physician states that it is significantly challenging to separate COVID-19 from common viral and bacterial pneumonia, while COVID-19 is additionally a variety of viruses. The work is expanded to perform detailed diagnostics for two multi-class classification (COVID-19, Normal, Viral Pneumonia) and (COVID-19, Normal, Viral Pneumonia, Bacterial Pneumonia) and binary classification. By comparing this work with the popular methods on public databases, the results show that this algorithm can provide an accuracy of 92.1% in classifying multi-classes of COVID-19, normal, viral pneumonia, and bacterial pneumonia cases. It can be applied to support radiologists in verifying their first viewpoint.





Hema Rajini

Farhan et.al has proposed a method for the classification of automatic lung disease from the CXR images using hybrid deep learning algorithm [5]. Adam et al. implemented three deep convolutional neural networks (VGG16, ResNet-50, and InceptionV3) pre-trained on the ImageNet dataset and assessed them in lung disease classification tasks using transfer learning approach to address the problem of medical data scarcity by considering the task of detection of pulmonary diseases from CXR images [6]. They created a pipeline that segmented CXR (CXR) images prior to classifying them and they compared the performance of our framework with the existing ones. They also validated our framework on the publicly available Shenzhen and Montgomery lung datasets and compared its performance to the currently available solutions. Their method was able to reach the same level of accuracy as the best performing models trained on the Montgomery dataset however, the advantage of this approach is in smaller number of trainable parameters. Furthermore, their InceptionV3 based model almost tied with the best performing solution on the Shenzhen dataset despite being computationally less expensive.

Naik et al. has proposed the pre-trained images of lung nodules with simple classifiers such as shallow neural networks which can compete with the complex systems [7]. Rajiv Singh et al. proposed a framework for the lung disease predictions like pneumonia and Covid-19 from the CXR images of patients [8]. The framework consists of dataset acquisition, image quality enhancement, adaptive and accurate Region of Interest (ROI) estimation, features extraction, and disease anticipation. In dataset acquisition, they have used two publically available CXR image datasets. As the image quality degraded while taking X-ray, they have applied the image quality enhancement using median filtering followed by histogram equalization. For accurate ROI extraction of chest regions, they have designed a modified region growing technique that consists of dynamic region selection based on pixel intensity values and morphological operations. For accurate detection of diseases, robust set of features plays a vital role. They have extracted visual, shape, texture, and intensity features from each ROI image followed by normalization. For normalization, they formulated a robust technique to enhance the detection and classification results. Soft computing methods such as Artificial Neural Network (ANN), Support Vector Machine (SVM), K-Nearest Neighbour (KNN), ensemble classifier, and deep learning classifier are used for classification. For accurate detection of lung disease, deep learning architecture has been proposed using Recurrent Neural Network (RNN) With Long Short-Term Memory (LSTM). Experimental results show the robustness and efficiency of the proposed model in comparison to the existing state-of-the-art methods.

Proposed Solution

Building the Model

The process involved in building the proposed method is shown in Fig. 1. The dataset of lung CXR images used in our proposed work is COVID-19 Radiography.

Dataset

A team of researchers from Qatar University, Doha, Qatar, and the University of Dhaka, Bangladesh along with their collaborators from Pakistan and Malaysia in collaboration with medical doctors have created a database of CXR images for COVID-19 positive cases along with Normal and Viral Pneumonia images. This COVID-19, normal, and other lung infection dataset is released in stages. In the first release, it includes 219 COVID-19, 1341 normal, and 1345 viral pneumonia CXR images. In the first update, the COVID-19 class was increased to 1200 CXR images. In the second update, the database was increased to 3616 COVID-19 positive cases along with 10,192 Normal, 6012 Lung Opacity (Non-COVID lung infection), and 1345 Viral Pneumonia images and corresponding lung masks.[9]

Preprocessing

Preprocessing is performed before feeding our images to the neural network, which can lead to better results from our method. As the images are different in size and width, it is necessary to resize all of them. X-ray images are taken with a low resolution which may have a variable height to width ratio. Therefore, training and testing dataset images are resized to 224×224 in the developed model architecture. After adjusting and normalizing the images, the model can be trained. The trained data of the model is shown in the table I.



**Hema Rajini****Training**

Training involves the training of the ResNet-101 classifier. The proposed framework is developed for efficient prediction of COVID-19 using CXR images. A new CNN architecture is introduced based on a ResNet-101 architecture and makes use of the pre-trained model of ResNet-101 [10,11,12,13,14,15]. The formulation of $F(x)+x$ can be realized by feedforward neural networks with shortcut connections. Shortcut connections are those skipping one or more layers shown in the above Fig. 2. The shortcut connections perform identity mapping, and their outputs are added to the outputs of the stacked layers.

Residual block with identity mapping can be calculated by the following formula given in Eqn. (1).

$$x_{i+1} = x_i + F(x_i, \{W_i\}) \quad (1)$$

where x_i and x_{i+1} are input and output of the i^{th} unit in the network, the function $F(x, W_i)$ represents the residual mapping to be learned and W_i are parameters of the block. The operation $F + x$ is accomplished by element-wise addition and a shortcut connection. The pre-trained version of the network trained on more than a million images from the ImageNet database. The pre-trained network can classify images into 1000 object categories. The architecture of ResNet-101 is shown in Fig. 3. ResNet-101 consists of mainly five types of convolution blocks called conv-1, conv-2, conv-3, conv-4, and conv-5. conv-5 is succeeded by a fully connected layer and softmax layer for output classification. Each convolution block makes use of three convolution layers of size 1×1 , 3×3 , and 1×1 . At the end, the average-pooling and fully connected dense layers, max-pooling and batch-normalization layers are used. Also, the softmax optimizer is utilized, which produces the prediction of each class of X-ray images in case of probabilities. 100 Epochs and 16 batch sizes are given for training and it acquires 30 epochs for achieving better accuracy.

Testing

Model training is the phase in the data science development lifecycle where practitioners try to fit the best combination of weights and bias to a learning algorithm to minimize a loss function over the prediction range. The purpose of model training is to build the best mathematical representation of the relationship between data features and a target label (in supervised learning) or among the features of themselves (unsupervised learning). Loss functions are a critical aspect of model training since they define how to optimize the machine learning algorithms. Model training is the key step in learning that results in a model ready to be validated, tested, and deployed. The performance of the model determines the quality of the applications that are built using it. Quality of training data and the training algorithm are both important assets during the model training phase. Typically, training data is split for training, validation and testing. The training algorithm is chosen based on the end use case. There are a number of tradeoff points in deciding the best algorithm-model complexity, interpretability, performance, compute requirements, etc. All these aspects of model training make it both an involved and important process in the overall machine learning development cycle.

Prediction:

The predicted loss and accuracy in training, validation and testing are:

Train Loss: 0.04591525346040726

Train Accuracy: 0.9870689511299133

Validation Loss: 0.3480631709098816

Validation Accuracy: 0.9137930870056152

Test Loss: 0.18738128244876862

Test Accuracy: 0.9428436756134033



**Hema Rajini**

RESULT AND DISCUSSION

Automatic lung diseased image classification was done using classifier ResNet-101 in google colab environment. The accuracy of the model during training and testing was evaluated for 50 epochs with batch size of 16 and the final accuracy is 94%. The dataset of lung CXR images used in our proposed work is COVID-19 Radiography. Training and testing dataset images are resized to 224×224 in the proposed model architecture. The total number of images in the dataset is 25,270, of which 80% of images are used for training and 20% of images are used for testing. Finally, ResNet-101 classifier have been developed to classify COVID-19, viral pneumonia, lung opacity and normal images. We evaluate the performance of the classifier in terms of sensitivity (also called recall in some fields), specificity and accuracy. The formulae for these are given in Eqs. (2), (3), and (4). The three terms are defined as follows: Sensitivity (true positive fraction) is the probability that a diagnostic test is positive, given that the person has the lung disease. Specificity (true negative fraction) is the probability that a diagnostic test is negative, given that the person does not have the disease,

$$\text{Recall} = \text{TP}/(\text{TP}+\text{FN}) \quad (2)$$

$$\text{Specificity} = \text{TN}/(\text{TN}+\text{FP}) \quad (3)$$

Accuracy is the probability that a diagnostic test is correctly performed.

$$\text{Accuracy} = (\text{TP}+\text{TN})/(\text{TP}+\text{TN}+\text{FP}+\text{FN}) \quad (4)$$

The sample images tested using the proposed method is shown in the above Fig. 4. The performance metrics of the proposed model is presented in table II. The proposed work of classifier ResNet-101 has acquired the accuracy of 94%.

CONCLUSION

In this work, automatic classification of lung diseases for COVID-19, viral pneumonia, lung opacity and normal using ResNet-101 classifier have been developed. Presence of 101 layers to the ResNet-101 allows extracting more robust features. An accuracy of 94% is obtained by applying the proposed scheme on the CXR images of COVID-19 radiography dataset. Experimental results proved the success of our model can be utilized to diagnose and discriminate COVID-19 from Non-COVID-19 patients.

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Hema Rajini

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Table 1. Trained Data of the Proposed Model

Data	Count
Total Parameters	42,666,372
Trainable Parameters	42,561,028
Non-Trainable Parameters	105,344

Table 2. Performance Metrics of the Proposed Model

Images	Precision	Recall	F1-Score
COVID	0.98	0.96	0.97
Normal	0.93	0.96	0.95
Viral Pneumonia	1.00	0.95	0.97
Lung Opacity	0.93	0.90	0.91





Hema Rajini

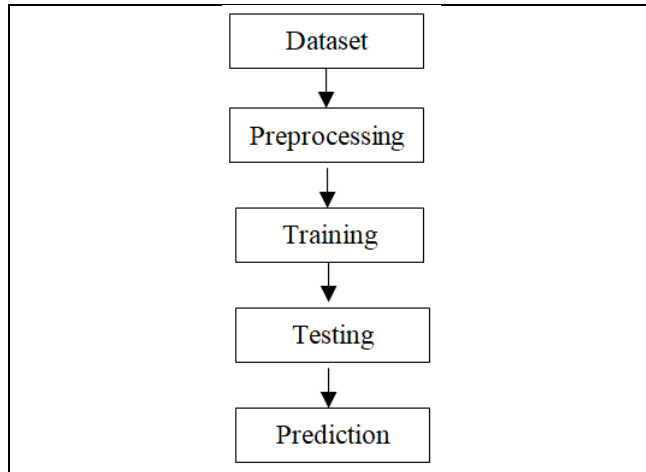


Fig. 1. Process involved in Building the Model

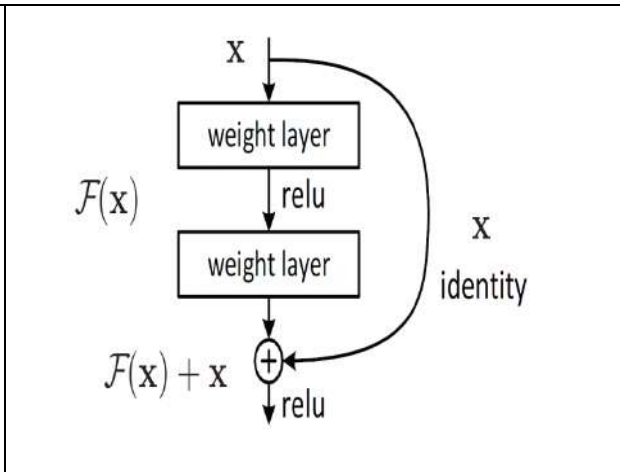


Fig. 2. Skip Connection in ResNet

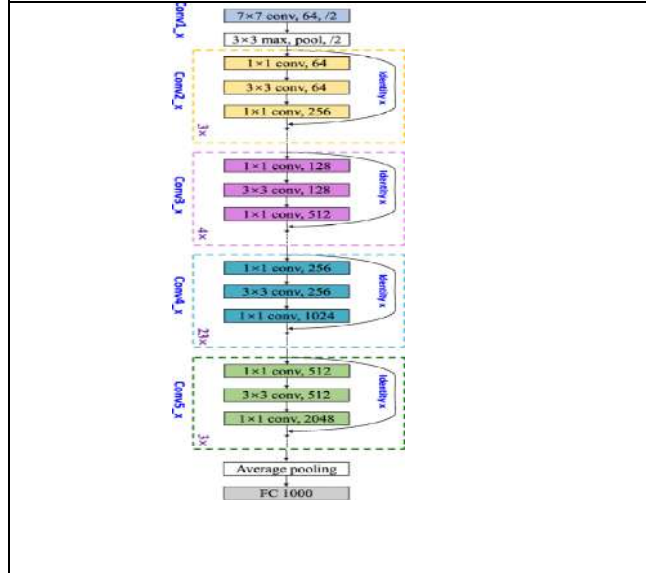


Fig. 3. Architecture of ResNet-101

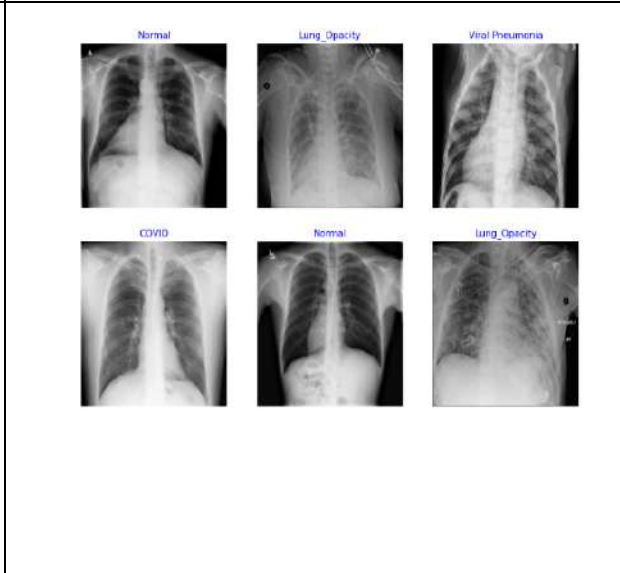


Fig. 4. The result of sample images tested using the proposed method





Clinical Evaluation and Correlation of Post Covid Complications with *Oja Kshaya* in Ayurveda

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ABSTRACT

Our body's immunity is dependent on two aspects as per Ayurveda. One of them is *Bala* (Innate Strength) and another one is *Oja* (Essence of all the tissues). Most of the people are suffering with some kind of complications even after the recovery from the covid infection. It is just because covid virus directly depleted the *Oja* and affected the natural immunity of the body and the symptoms left after can be related to *Oja Kshaya Lakshanas* mentioned in the Ayurvedic text. The present article evaluates the correlation of post covid complications with the *OjaKshaya*. The references have been taken through the textbook of Charaka Samhita along with its commentary, Susruta Samhita, from the available published articles in peer-reviewed journals, published books and subjects related material available online also have been thoroughly screened, compiled, organized and described in a systemic manner. After observing the post covid complications in the patients through various sources and *Oja Kshaya Lakshanas*, a clear correlation was found in between them.

Keywords: *Oja Kshaya*, Immunity, Covid, Complications, Ayurveda, Correlation





Varnika Singh and Sangeeta Gupta

INTRODUCTION

Nobody in this world is unknown to covid pandemic in last few years. Covid is a deadliest infection which is caused by SARS-CoV-2 virus [1]. Despite being a common infection, fear of spreading of new variants of SARS-CoV-2 still hovers the world [2]. Initially covid has been named as severe acute respiratory syndrome virus 2 as most of the symptoms included respiratory system but later it was seen that it could affect multiple systems of the body [3]. In covid infection the symptoms which remain for more than three weeks after the diagnosis of COVID-19 are collectively termed as post-COVID syndrome [4]. Just as there is diversity of symptoms in acute initial phase, there is diversity in the long term symptoms or complications also as is seen in covid -19 infections [5]. Covid infection is a never ending infection now for the human community, like other viral infections. That is why post covid Nobody in this world is unknown to covid pandemic in last few years. Covid is a deadliest infection which is caused by SARS-CoV-2 virus [6]. Despite being a common infection, fear of spreading of new variants of SARS-CoV-2 still hovers the world [7]. Initially covid has been named as severe acute respiratory syndrome virus2 as most of the symptoms included respiratory system but later it was seen that it could affect multiple systems of the body [8]. In covid infection the symptoms which remain for more than three weeks after the diagnosis of COVID-19 are collectively termed as post-COVID syndrome [9]. Just as there is diversity of symptoms in acute initial phase, there is diversity in the long term symptoms or complications also as is seen in covid -19 infections [10]. Covid infection is a never ending infection now for the human community, like other viral infections. That is why post covid complications can be identified as a new clinical syndrome in the context of SARS-CoV-2 [11]. Although lots of studies has been done on covid-19 related to different aspects of it but none of them stipulate the knowledge which can exactly specify the correlation between different post covid complications and *Oja Kshaya* in Ayurveda. This correlation can provide a way to Ayurvedic physicians to treat particular post covid symptoms as per specific *Dhatu Kshaya and Ojokshaya*.

OJA IN AYURVEDIC LITERATURE

Qualitatively, *Ojas* depicts the contentment and nourishment of the body and is the vital strength of the body in terms of *Vyadhikshamatwa* [12] According to Charaka Samhita, (during embryogenesis) the *Oja* appears foremost in the human body [13]. If we summaries the *Ojas* in a single line then it has been considered the vital element behind life to perform the disease resisting activity in the body [14]. As per Charaka Samhita *Oja* is defined as yellowish, reddish and predominantly white color element of the body which dwells in the heart. If *Oja* is depleted completely from the body, the body perishes immediately. *Oja* which is produces first time in body having the appearance of *Ghee*, tastes as honey and smell is like *Laja i.e fried paddy* [15]. It is the sap or extract of all the tissues responsible for the strength, stamina liveliness, energy and overall health of the body. *Oja* is having some peculiar qualities mentioned in the Charaka Samhita such as it is heavy, cold, soft, smooth, sweet in nature along with other characteristic [16]. On the other hand if it starts depleting from the body, it is called as *Oja Kshaya*, and the symptoms that arise are said to be *Oja Kshaya Lakshanas*. Depletion of *Oja* has been mentioned with progressive degradation in three stages as per SushrutaSamhita. These stages are called as *OjaVisrans*, *Oja Vyapad* and *OjaKshaya*. Features of first stage i.e. *OjaVisrans* are multiple joint pain and lack of strength in joints, weakness in the body which can be malaise or fatigue, increase of *Dosha* (which has to be remain in balanced state) and lack of normal functioning in the body. Features of second stage i.e. *OjaVyapad* are stiffness and heaviness of the body, edema due to increase in *VataDosha*, skin discoloration, fatigue, improper functioning of sense organs, excess sleepiness. Features of the last stage of *OjaKshaya* are unconsciousness, lack of muscular mass, delusion, delerium, and death [17]. The last stage is the critical stage or death in *Oja Kshaya Lakshanas*.The clinical features of these three stages have been summarised in the form of a table below (Table.1) along with their correlation in modern science and with *Dhatu KshayaLakshanas* in *Ayurveda* [18].



**Varnika Singh and Sangeeta Gupta****Correlation in modern science along with *Dhatu Kshaya Lakshanas***

There are numerous studies present mentioning different aspects of the covid, in terms of treatment, symptoms, different situations in rural and urban areas during covid pandemic etc. but no study has been found which can properly stipulate the knowledge to specify the correlation between different post covid complications and *Oja Kshaya Lakshans*. (Few studies are found having terminologies related to post covid complications and *Oja Kshaya*) [19].

POST COVID COMPLICATIONS AS PER DIFFERENT STUDIES

Pathogenesis of covid and post covid has multi stages which produce several complications in the later stages of the disease. Other than this immune mediated vascular dysfunction is another pathogenesis related to the post covid complication [20]. It is correlated with *Oja Kshaya* in this study as per Ayurveda. Long term inflammation is playing the key role in making other symptoms after post covid [21]. Studies revealed that due to inflammation some patients showed the symptoms like arthritis having swelling, pain in joints, warmth etc. known as post covid-19 arthritis [22]. It is because covid infection directly affected the body's natural immune system. As per some of the other studies most common complication post covid are muscle pain, sleep related disorders, mental illness, fatigue, weakness, digestive issues etc [23,24] Among all above complication fatigue is the commonest symptom found in the patients of post covid ranging from 17.5% to 72% [25,26,27]. Mental and sleeping disorders found in 40% and 26% respectively in the individuals [28]. Musculoskeletal pain, cognitive difficulties found in 12% of the patients [29]. Dyspnea and short breath found in 24% of the patients [30]. The table below shows the same. The purpose of this study is primarily to find out correlation in between post covid complications with the symptoms of *Oja Kshaya*, in terms of different corollary symptoms that have been observed in each organ system. This study also helped to explore the facts behind specific *Dhatu Kshaya* (among 7 *Dhatu*s) after covid infection and comment briefly about most frequently occurring complication related to *Oja Kshaya*.

MATERIALS AND METHODS

After going through Charaka Samhita, Susruta Samhita, along with their respective commentaries such as Ayurveda Dipika, Nibandha Samgraha & others available published articles in peer-reviewed journals, other related books available online, it has been thoroughly screened, compiled, organized and described systemically.

CORRELATION OF POST COVID COMPLICATIONS WITH *OJA KSHAYA*

Most of the post covid complications have exact resemblance with different progressive stages of *Oja Kshaya* which are mentioned in Ayurvedic Literature. Table.3 is depicting this correlation below

AYURVEDIC TREATMENT DURING COVID SCENARIO

Many studies has been published in the renowned journals which revealed that Ayurvedic treatment had a pivotal role to treat the patients of covid infection. Most of the patients were treated with both the Allopathic and Ayurvedic medicines but few studies are there dedicated to only Ayurvedic cure of covid-19. A patient aged 43 lived in America showed some symptoms such as whole body pain, cold and cough, loss of taste and smell along with fever since 7 days. Treatment was started on the principles of Ayurveda and found tremendous improvement within 7 days [30]. Another patient experienced with fever, myalgia, fatigue, throat irritation recovered after exclusive use of Ayurvedic treatment both physically as well as mentally [31]. In one of the case series study patients suffering with fever and respiratory illness and were treated with different combinations of Ayurvedic medicines got wonderful results [32]. A cohort study was also done in large sample size of covid 19 patients at Gujarat ayurved university, Jamnagar in which treatment with AYUSH medicines gave promising results [33]. A non-randomized control trial was also done on frontline Indian Police personals in which AYURAKSHA kit was given which was proved to have the potential to manage the covid-19 infection and improved the quality of life as well [34].





Varnika Singh and Sangeeta Gupta

CONCLUSION

In the study for post covid complications most of the people were found suffering with multiple joints pains, difficulty in breathing, weakness, lack of enthusiasm of doing any work, disability to do the daily routine work properly, fatigue, anxiety, muscle pain and other vague complaints. Few people were able to compare their immunity status before and after covid infection which was definitely lower than before. After covid infection, people got sick easily due to lowered immunity. It is concluded after study that most of the post covid complications have exact resemblance with different progressive stages of *Oja Kshaya* which are mentioned in Ayurvedic Literature. Multiple joint pains can be correlated with *Sandhivishlesha*, weakness with *Gatranam Sadnam*, Dyspnoea, breathlessness, persistent cough are the most common symptoms found in the people, can be correlated with *Dosha Chyavan*, lack of enthusiasm is *Kriyasannirodha*, these all above symptoms comes under the heading of *Oja Visrans*. Persistent fatigue can be correlated with *Glani*. Myocardial oedema and myocarditis can be correlated with *Vatashopha*. Joint stiffness can be correlated with *Stabdha Gaatra*. Excess sleep found in the people can be correlated with *Tandra* and *Nidra*. These above symptoms are of *Oja Vyapad* which is the second stage of progressive degradation of *Oja Kshaya*. The symptoms like delirium and delusion can be correlated with *Pralaap* and *Moha*, which comes in the last stage of *Oja Kshaya* where there is complete disorientation and may terminate in death. *Oja* is the life extract according to Ayurveda and is responsible for the health and vigour of the body and the covid infection is definitely leading to *Oja Kshaya* thereby lowering the general immunity of the body and making it more susceptible to diseases. Therefore the diet and lifestyle measures to regenerate the *Oja* must be adopted. Ayurveda can help in this way to maintain the health after the fatal covid infection.

CONFLICT OF INTEREST

No conflict of interest

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Table.1 showing Clinical Features of Different Stages of Oja Kshaya with Their

S. No.	Oja Kshaya Lakshana	Modern Correlation	DhatuKshayaLakshana
1.	Sandhi Vishlesh	Multiple joint pains and lack of strength in joints	Asthi Dhatu (SandhiShaithilya)
2.	Gatranamsadanam	Weakness in the body	
3.	Dosha Chyavanam	Increase of Doshas in the body	
4.	Kriyasannirodhah	Diminished activity or lethargy in the body	Rasa Dhatu (AlpaCheshtasya)
5.	Stabdha Guru Gatrata	Stiffness and heaviness of the body	Asthi D. (shrama – tiredness) Shukra D. (shrama)
6.	Vatashofa	General swelling of the body parts	
7.	Varnabheda	Skin discoloration	
8.	Ghani	Fatigue	
9.	Tandra	Drowsiness	
10.	Nidra	Sleepiness	
11.	Murccha	Loss of Consciousness	
12.	Mamsa Kshaya	Wasting of Muscles	Mamsa Dhatu
13.	Moha	Delusion	
14.	Pralapa	Delirium	
15.	Maran	Death	





Varnika Singh and Sangeeta Gupta

Table.2 Post Covid complications list as per different studies

• Joint Stiffness	• Lack of energy to do normal activities
• Multiple joint pain	• Delirium
• Dyspnoea	• Delusion
• Myocardial oedema	• Visual and Auditory Hallucinations [1]
• Myocarditis	• Loss of sensation of smell/taste
• Breathlessness	• Headache
• Persistent cough	• Muscle pain
• Persistent fatigue	• Insomnia
• Anxiety	• Hands and foot pain
• Weakness [2]	• Sleepiness all the time

Table 3. Correlation of Post Covid Complications with Oja Kshaya

Complications of post covid pandemic	Oja Kshaya Lakshanas	Oja Kshaya Stage
Multiple Joint Pain	<i>Sandhivishlesha</i>	<i>Oja Visrans</i>
Weakness	<i>GatranamSadnam</i>	<i>Oja Visrans</i>
Dyspnoea, Breathlessness, Persistent cough	<i>DoshaChyavnam</i>	<i>OjaVisrans</i>
Lack of energy to do normal activity	<i>Kriyasannirodha</i>	<i>OjaVisrans</i>
Persistence fatigue	<i>Glaani</i>	<i>OjaVyapad</i>
Myocardial oedema, Myocarditis	<i>Vatashopha</i>	<i>OjaVyapad</i>
Joint Stiffness	<i>StabdhaGaatra</i>	<i>OjaVyapad</i>
Sleepiness	<i>Tandra, Nidra</i>	<i>OjaVyapad</i>
Delirium	<i>Pralaap</i>	<i>OjaKshaya</i>
Delusion	<i>Moha</i>	<i>Oja Kshaya</i>





Preliminary Phytochemical Screening and *In vitro* Antibacterial Activity of *Sambucus wightiana* Wall. ex Wight and Arn. against Human Pathogens.

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ABSTRACT

The article reports data on preliminary phytochemical analysis and antibacterial activity of leaf extracts of *Sambucus wightiana* using solvents with increasing polarity like : *n* - hexane, chloroform, ethyl acetate and methanol investigated in vitro system. FT-IR spectral study of methanolic leaf extract was examined to identify the functional components in the extracts with unique peak values. Preliminary phytochemical screening findings showed that leaf extracts contain an abundance of flavonoids, phenolics, saponin, alkaloids, glycosides, and terpenoids. *In vitro* antibacterial assay depicted that the methanol and ethyl acetate extracts possess a remarkable antibacterial activity against tested pathogenic bacterial strains three Gram positive and three Gram negative. The FT-IR spectrum analysis revealed that the extract contains a broad variety of functional groups, including O-H, C-H, CO-O-CO, N-H, C=C, C-N, C=F, C=O, etc. Thus, based on these findings, the methanol leaf extract of *Sambucus wightiana* might be a potential source of novel medicinal activities. It will encourage further research on isolation and purification of medicinally important phytocompounds to develop a potential therapeutic agent against countless infectious diseases.

Keywords: *Sambucus wightiana*, antibacterial activity, FT-IR, in vitro





INTRODUCTION

Traditional herbal medicines were considered as the base for the invention of modern medicines (Sudhan *et al.*, 2021). Medicinal plants are valuable source of biologically active compounds for the production of novel therapeutic drug candidates (Süntar, 2020). Currently, plant species are commonly utilized by people as a cure for different types of ailments such as diabetic, infectious, cardiovascular, mental-nervous, dietary, respiratory, renal, reproductive, intestinal, neurological, skin infections and many other diseases (Huang *et al.*, 2022). One of the greatest challenges confronting the global healthcare sector worldwide in the treatment of microbial infectious diseases is due to the steadily rising prevalence of drug resistance among the causal organisms (Treboosc *et al.*, 2019; Sudhan *et al.*, 2021). More than 27% of the mortality per year in developing countries is due to infectious diseases (Arbo *et al.*, 2019). Persistent rise in the antibiotic resistance, the advent of new strains of pathogenic microbes, as well as the crippling side effects of synthetic antibiotics led to surge the thrust for exploring new non-toxic natural compounds to treat the drug-resistant bacterial infections (Costa *et al.*, 2017). Currently, the research attention for the isolation and identification of natural bioactive compounds with antimicrobial property has tremendously increased. Such compounds isolated from the traditional plants have capability to inhibit the growth of drug-resistant bacteria (El-Shahaby *et al.*, 2019). Diverse components with potential therapeutic use were isolated from different parts of medicinal plants by subjected to solvent extraction. (Silva *et al.*, 2020).

Sambucus wightiana Wall. ex Wight and Arn. (Adoxaceae), a perennial woody shrub common across the sub-continent. It mostly thrives in mountainous regions, especially in the northern himalayas of Kashmir, India and Kalam and Swat regions of Pakistan (Niaz *et al.*, 2019). Polyphenols, steroids, and glycosides are only some of the phytochemicals found in this plant (Malik *et al.*, 2018). It has been used to treat inflammation, skin infections, UTIs, enteritidis, typhoid, cancer, and high blood pressure in traditional medicine (Chashoo *et al.*, 2012; Hassan *et al.*, 2020). Based on its biological properties, *Sambucus wightiana* has powerful bioactive chemicals, which are responsible for its antibacterial effects (Mir *et al.*, 2018; Hassan., 2020). Because of the plant's wide range of medicinal applications, present study aims to determine the preliminary phytochemical screening and antibacterial efficacy of leaf extracts and to evaluate the functional group compounds responsible for new therapeutic drug candidates.

MATERIALS AND METHODS

Chemicals and Apparatus

Common laboratory equipment includes a soxhlet extractor, separator funnel, rotary evaporator, petri dish, incubator, autoclave, hot air oven, and Laminar airflow cabinet. Nutrient Broth, Nutrient agar, Agar Agar and Mullen Hilton Agar were purchased from Hi-Media®, Mumbai, India. DMSO, *n*-Hexane, Ethyl acetate, Chloroform and Methanol were obtained from Sigma Aldrich, Anekal, Bangalore, India.

Collection of Plant Material

Fresh and disease-free leaves of *Sambucus wightiana* were collected from Pahalgam region of Kashmir Valley (34.01°N; 75.19°E and at an altitude of 2739 masl) in June 2022. Taxonomic identification was done by Dr. Mullainathan L, Professor, Department of Botany and a voucher specimen (AU480) was deposited at Department of Botany (Herbarium), Annamalai University.

Preparation of the Crude Extract

The plant leaves were properly washed, dried in the shade in an aseptic environment, then ground into a powder using a mechanical grinder. Using a Soxhlet apparatus, 250 g of ground-up leaf material was extracted with each 1000 ml of *n*-hexane, chloroform, ethyl acetate, and methanol (LR grade). After each extraction cycle, the mixture was filtered through Whatman's filter paper and the filtrate was concentrated in vacuo using a Rotary. Antibacterial activity assays were performed on the residue of each extract (concentration in 12.5 to 100mg / ml), and FTIR spectral analyses were performed on methanolic leaf extract.



**Aamir Sultan Lone and Ravindran****Preliminary Phytochemical Analysis**

Preliminary phytochemical screening was performed to determine the active components of plant extracts, such as alkaloids, carbohydrates, proteins, saponins, glycosides, terpenoids, flavonoids, tannins, quinones and phenols by following the standard procedures for each test.

Test for Alkaloids

With 3 N hydrochloric acid, nearly 1g of leaf extract was dissolved. After filtering, the mixture was treated with a few drops of Mayer's reagent. The presence of alkaloids is confirmed by the formation of a white or cream-colored precipitate (Dorantes *et al.*, 2000).

Test for Saponins

Approx 0.5 g of the leaf extract was thoroughly mixed with distilled water in a test tube and heated in a water bath. The existence of the saponins was determined by the persistence of the foam (Ahmad *et al.*, 2019).

Test for Tannins

In a test tube, around 0.5 g of leaf extract was firmly diluted with 10 ml of water before being filtered. On addition of few drops of 0.1% ferric chloride to the filtrate, appearance of blue-black or light brownish coloration indicates the presence of tannins (Ahmad *et al.*, 2019).

Test for Flavonoids

To 4 ml of leaf extract, 2.5 ml of 50% methanol solution was added. After warming the solution, magnesium metal was added. When a few drops of concentrated HCl were added to this solution and red color confirms flavonoids in the solution (Nascimento *et al.*, 2000).

Tests for Proteins

Few drops of 3% copper sulphate were added to 1 mL of extract followed by 3 drops of 15% of sodium hydroxide, violet or red colour of test solution indicating that proteins are present (Rather *et al.*, 2022).

Test for Phlobatannins

0.5 g of the extract was dissolved completely in distilled water, boiled and then filtered. A further boiling process was performed on the filtrate using a 1% aqueous HCl solution. The presence of phlobatannins is shown by the formation of red precipitate (Evans and Trease, 2002).

Test for Phenolic Compounds

About 0.5 g of the sample leaf extract was thoroughly dissolved in 6 ml distilled water and filtered. On addition of few drops of ferric chloride solution, the mixture became deep green, indicating the presence of phenolic chemicals (Mir *et al.*, 2013).

Test for Glycosides

Exactly 0.2 g of extract was dissolved in 1 ml of glacial acetic acid followed by addition of 1 to two drops of ferric chloride solution. This was then under layered with 1 ml of concentrated sulfuric acid. A brown ring appeared at the interface indicated the presence of glycosides (El-Kamali and Elshikh, 2015).

Test for Terpenoids

Approx 10 ml of sample extract, 4 ml of chloroform and 6 ml of con. H₂SO₄ was mixed completely to form a monolayer of reddish brown colour on the interface, indicating the presence of terpenoids (Ngarmsak *et al.*, 2006)

Test for Quinone

On addition of few drops of concentrated hydrochloric acid to 1 ml of plant extract, yellowish brown colour confirms the presence of quinones (Gayathri and Kiruba, 2014).



**Aamir Sultan Lone and Ravindran****Test for Carbohydrate**

To the crude extract, pre-prepared Fehling's solution (Fehling A and B reagent) was added and then gently boiled. A brick red precipitate at the test tube's bottom is an indication for presence of carbohydrates. (Roller and Seedhar, 2002).

FT-IR Spectroscopic Analysis

FT-IR analysis has been used to structurally delineate the various functional groups found in the methanol fraction of the leaf extract. The analysis of the extract was performed by placing it at the passing end of the KBr pellet. Using a pelletizer machine, powdered KBr that had been heated to 60 °C for 24 hours was transformed into KBr pellets. Thermo Nicolet 6700 FT-IR spectroscope with DTGS-XT-KBr detector and Xt-KBr beam splitter assembly was used to record FT-IR spectra of sample in the region of 4000–400 cm⁻¹ for 32 scans at 4.0 cm⁻¹ resolution (Olivira *et al.*, 2016).

Antibacterial Activity

Micro-organisms used: Stock cultures of Gram-positive bacteria such as *Streptococcus pyogenes*, *Bacillus subtilis* and *Enterococcus faecalis* Gram-negative bacteria such as *Pseudomonas aeruginosa*, *Salmonella typhimurium* and *Klebsiella pneumoniae* were obtained from Department of Microbiology, RMMC Hospital, Annamalai University. Bacterial strains examined in this research are clinical isolates from individuals with varying degrees of the aforementioned bacteria-associated diseases. Bacteria were grown on nutrient agar (Himedia®, Mumbai) slants at 4°C and sub-cultured into nutrient broth using a picking-off method (Basak *et al.*, 2021). Each time, pure cultures that were 24 hours old were readied for use.

Preparation of culture Medium and Inoculation

Nutrient agar was used as the bacteriological medium, which was autoclaved at 120 degrees Celsius for 20 minutes. To achieve a consistent depth of 3.5 mm, 15–17 ml of culture media was dispensed into sterilized Petri plates in a laminar air flow under aseptic conditions. The microbial cultures were inoculated using the spread plating method after the medium had solidified.

Preparation of Test Solutions

Crude extracts of n-hexane, chloroform, ethyl acetate, and methanol were each dissolved in DMSO separately. The resulting concentration was then diluted to obtain the second concentrations (12.5, 25, 75, and 100 mg/mL) used to examine antibacterial activity.

Agar Well Diffusion Assay

Agar well diffusion method was used to test various concentrations of leaf extracts (12.5, 25, 75, and 100 mg/ml) for antibacterial activity by following the procedure of Nair *et al.*, (2005). 50µl of each concentration were loaded into wells made in the agar plates with a sterile cork borer of 7.0 mm diameter. After allowing the extract to diffuse into the agar for 1 hour at room temperature, the plates were incubated at 37°C for 24 hours. The antibacterial activity was then determined by measuring the diameter of the growth inhibited zone (mm) in accordance with the method reported by Doughari *et al.*, (2007) and comparing it to the standard antibiotic employed in the study. To evaluate the effects of the plant extract, we compared the results to those obtained from negative control (DMSO) and positive control (Ciprofloxacin; Cipla, Bangalore) at a concentration of 30 mg/ml.

Statistical Analysis

The results of the antibacterial study are shown as the mean ± standard deviation of three independent tests. The data were evaluated by SPSS 16.0 software using one-way Analysis of Variance (ANOVA). To identify statistically significant differences between groups, Tukey tests were performed using the trial edition of 'Stat plus 2009 professional' software. Means were determined statistically significant at $p < 0.05$.





RESULTS AND DISCUSSION

Phytochemical Screening

The phytochemical evaluation of *Sambucus wightiana* leaf carried for four different solvents with increasing polarity confirms the presence of alkaloids, carbohydrates, proteins, saponins, glycosides, terpenoids, flavonoids, tannins, quinones and phenols and the results are tabulated in table 1. Negative results were recorded for phlobatannins which confirm the absence of this active principles in all examined extracts. Our results revealed that methanolic extract has abundance of afore mentioned phytochemicals followed by ethyl acetate extract. Previous study of the plant also supports the presence of alkaloids, saponins, glycosides, terpenoids, flavonoids (Parveen *et al.*, 2018). The antibacterial activity of the active principles identified in this study was observed against all the tested organisms used in our study (Table 2). Alkaloids have been studied extensively for therapeutic properties, such as antidiabetic, antiprotozoal, cytotoxic, and anti-inflammatory effects (Al Kazman *et al.*, 2022). Terpenoids are also known to have anti-bacterial, antifungal, antiviral, antiparasitic, anti-allergenic, antispasmodic, antihyperglycemic, anti-inflammatory, and immunomodulatory activities (Mekala and Murthy, 2020). Glycosides are naturally occurring bioactive compounds, used in the preparation of cardioactive drugs for treatment of congestive heart failure and cardiac arrhythmia (Thapa *et al.*, 2022). Saponins are glycosides occurring abundantly in plants. In medicine, it is used in antioxidant, anti-cancer, anti-inflammatory and weight loss etc. Phenolics are the major constituents in majority of plants reported to possess notable antioxidant activity. Flavonoids are effective water-soluble antioxidants and free radical-scavengers that reduce oxidative cell damage and also have potent antibacterial and anti-arthritic properties (Dixit, 2021). A variety of plant species rich in alkaloids, glycosides, and terpenoids have been proven to have antibacterial action. For instance, Fidelis *et al.* (2022) studied the antibacterial properties of *Eugenia uniflora* leaf extract and found that it was effective against *E. coli*, *Proteus vulgaris*, *Klebsiella pneumoniae*, and *Aspergillus niger*. It is therefore possible that preliminary screening tests might help in the identification of bioactive principle and eventually lead to the discovery and development of new drugs.

Antibacterial Activity Result

Table 2 represents the results of bacterial growth inhibition. Antibacterial activity of each extract was determined by measuring the zone of inhibition (in millimeters) including well diameter. Methanol leaf extract displayed a strong inhibition zone of 32.3 ± 0.35 mm against *Salmonella typhimurium*, 30.6 ± 0.24 mm against *Bacillus subtilis* and 28.5 ± 0.45 mm *Pseudomonas aeruginosa* at 100 mg/mL concentration. These findings are promising when compared to the positive control ciprofloxacin (30mg/ml) on the same pathogens. *n*-Hexane extract depicted least inhibition zones while chloroform and ethyl acetate extract exhibited moderate inhibition against all tested bacterial strains. Our results are in agreement with previous studies that polar extracts of plants such *Salix capensis*, *Jatropha elliptica*, *Schotia latifolia*, *Juniperus oxycedrus*, *Combretum cafrum*, and *Morus nigra* were able to inhibit the growth of both Gram-positive and Gram-negative bacteria (Masika and Afolayan, 2002; Karaman *et al.*, 2003; Sharifee *et al.*, 2022). Based on previous research on many species belonging to this genus, it has been shown that various plant components exhibit relevant pharmacological actions such as antioxidant, anti-inflammatory, antibacterial, antifungal, anticancer (Shokrzadeh and Saravi, 2010; Chashoo *et al.*, 2012; Benevide *et al.*, 2017; Mir *et al.*, 2018; Waswa *et al.*, 2022).

Functional Groups Present in methanol leaf Extract

FT-IR spectral study of Methanol leaf extract of *Sambucus wightiana* was assessed to identify the functional groups of the active compounds and the results were shown in table 3; Fig.1. The absorption spectrum shows shifts in absorption bands which were used to predict the functional groups present in the extract. The result of FT-IR analysis confirmed the presence of Amines with peaks at 2918.623 cm^{-1} , 1647.401 cm^{-1} and 1169.634 cm^{-1} , Alkanes with peaks at 2849.708 cm^{-1} , 966.391 cm^{-1} and 717.885 cm^{-1} , Aldehyde with peak 1734.637 cm^{-1} , Conjugated ketone with peak at 1684.940 cm^{-1} , Aromatics with peak at 1497.804 cm^{-1} , Fluoro-Compound with peak at 1457.69 cm^{-1} , Phenols with peaks at 1376.208 cm^{-1} and 1313.765 cm^{-1} , Alkyl Aryl Ether with peak at 1239.930 cm^{-1} and Anhydride with peak at 1045.496 cm^{-1} .





Aamir Sultan Lone and Ravindran

CONCLUSION

The rising prevalence of bacterial resistance to commercially available antibiotics poses a major dilemma for the global treatment infectious diseases. Natural products are regarded as one of the best sources of biologically active compounds. In addition, the most recent scientific data on treatments using natural resources has already been offered by ethno-pharmacologists. In the current evaluation, our results showed that the methanolic leaf extract of *Sambucus wightiana* has strong and promising antibacterial activity. Phytochemical investigation of leave extract of *Sambucus wightiana* demonstrated the abundance of bioactive phytochemicals and their inherent functional groups. These phytocompounds have a wide range of biological and therapeutic actions, lending credence to the plant's ethnomedicinal use for the treatment of various disease conditions amongst ethnic groups. Further study is needed to isolate specific bioactive components responsible for the antibacterial activity and elucidate their mode of action.

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Aamir Sultan Lone and Ravindran

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Table 1: Preliminary Phytochemical Screening of leaf extracts of *Sambucus wightiana*.

Phytoconstituents	Plant Extracts			
	Methanol	Ethyl acetate	Chloroform	Hexane
Alkaloids	+	+	+	-
Carbohydrates	++	+	+++	+++
Proteins	++	+++	+++	+
Saponins	++	-	-	-
Glycosides	+	+	++	+
Terpenoids	++	+	-	-
Flavonoids	++	+	-	-
Tannins	++	+	-	-
Phlobatannins	-	-	-	-
Quinones	+	-	+	-
Phenols	++	+	-	-

strongly present(+++); moderately present(++); present(+); absent (-)

Table 2: Antibacterial activity of leaves of *Sambucus wightiana* against pathogenic bacteria. (Results are expressed as mean of three assays; \pm S.D)

S. No.	Microorganisms	Solvent extracts	Minimum zone of inhibition (mm)				
			Concentration of <i>Sambucus wightiana</i> leaf extract (mg/ml)				
			12.5	25	50	100	Ciprofloxacin (30 mg/ml)
1.	<i>Pseudomonas aeruginosa</i>	<i>n</i> -Hexane	11.5 \pm 0.25	12.4 \pm 0.3	14.5 \pm 0.33	15.5 \pm 0.37	25 \pm 0.13
		Chloroform	12.3 \pm 0.45	13.4 \pm 0.14	17.4 \pm 0.73	19.4 \pm 0.55	
		Ethyl acetate	20.5 \pm 0.4	22.4 \pm 0.33	23.8 \pm 0.09	25.7 \pm 0.13	
		Methanol	24 \pm 0.35	25.4 \pm 0.22	27.1 \pm 0.43	28.5 \pm 0.45	
2.	<i>Salmonella typhimurium</i>	<i>n</i> -Hexane	13.4 \pm 0.67	14.5 \pm 0.58	16.4 \pm 0.55	19.3 \pm 0.22	36 \pm 1.08
		Chloroform	15.2 \pm 0.58	17.3 \pm 0.17	21.2 \pm 0.53	24.7 \pm 1.08	
		Ethyl acetate	19.4 \pm 0.33	23.4 \pm 0.15	27.1 \pm 0.22	29.4 \pm 0.35	
		Methanol	22.1 \pm 0.18	25.3 \pm 0.13	29 \pm 0.33	32.3 \pm 0.35	
3.	<i>Klebsiella pneumoniae</i>	<i>n</i> -Hexane	11.4 \pm 0.5	12.6 \pm 0.27	14.6 \pm 0.17	17.7 \pm 0.12	22 \pm 0.14
		Chloroform	11.9 \pm 0.22	13.4 \pm 0.2	16.2 \pm 0.74	20.1 \pm 0.54	
		Ethyl acetate	15.4 \pm 0.2	16.4 \pm 0.35	19.4 \pm 0.45	24.5 \pm 0.55	
		Methanol	17.6 \pm 0.45	21.1 \pm 0.15	23.3 \pm 0.35	26.2 \pm 0.15	
4.	<i>Streptococcus pyogenes</i>	<i>n</i> -Hexane	9.7 \pm 0.11	11.3 \pm 0.33	12.8 \pm 0.2	14.5 \pm 0.21	19 \pm 0.33
		Chloroform	10.4 \pm 0.64	13.6 \pm 0.22	14.8 \pm 0.13	15.8 \pm 0.25	
		Ethyl acetate	15.3 \pm 0.35	16.5 \pm 0.57	17.7 \pm 0.22	18.9 \pm 0.14	
		Methanol	15.3 \pm 0.33	17.1 \pm 0.2	18.4 \pm 0.42	19.5 \pm 0.88	
5.	<i>Bacillus subtilis</i>	<i>n</i> -Hexane	12.2 \pm 0.35	13.4 \pm 0.35	15.6 \pm 0.14	17.8 \pm 0.73	36 \pm 0.45





Aamir Sultan Lone and Ravindran

		Chloroform	14.6 ± 0.05	15.8 ± 0.15	18.1 ± 0.13	19.7 ± 0.14	
		Ethyl acetate	17.3 ± 0.03	22.6 ± 0.14	23.4 ± 0.13	25.3 ± 0.13	
		Methanol	19.3 ± 0.14	21.6 ± 0.15	25.2 ± 0.45	30.6 ± 0.24	
6.	Enterococcus faecalis	n-Hexane	11.3 ± 0.25	13.4 ± 0.13	14.8 ± 0.13	16.9 ± 0.05	22 ± 0.05
		Chloroform	12.4 ± 0.18	15.3 ± 0.15	17.2 ± 0.13	19.4 ± 0.15	
		Ethyl acetate	12.8 ± 0.05	17.3 ± 0.31	19.3 ± 0.13	20.2 ± 0.05	
		Methanol	13.2 ± 0.22	18.1 ± 0.33	22.3 ± 0.13	25.4 ± 0.24	

Table 3: Tabulated data showing the interpretation of the FTIR spectra.

S. No.	Frequency (Cm ⁻¹)	Absorption Intensity	Functional Groups	Compound Nature
1.	2918.623	Sharp, Strong	N-H Stretching	Amine
2.	2849.704	Sharp, Medium	C-H Stretching	Alkane
3.	1734.637	Sharp, Strong	C=O Stretching	Aldehyde
4.	1684.940	Strong	C=O Stretching	Conjugated ketone
5.	1647.401	Medium	N-H Bending	Amine
6.	1570.704	Medium	C=C Stretching	Alkene
7.	1497.804	Medium	C-H Stretching	Aromatics
8.	1457.695	Strong	C-F Stretching	Fluoro-Compound
9.	1376.208	Medium	O-H bending	Phenol
10.	1313.765	Medium	O-H bending	Phenol
11.	1239.930	Strong	C-O Stretch	Alkyl Aryl Ether
12.	1169.934	Medium	C-H Stretching	Amine
13.	1045.496	Strong, Broad	CO-O-CO stretching	Anhydride
14.	966.391	Strong	C=C bending	Alkene
15.	717.885	Medium	C=C bending	Alkene

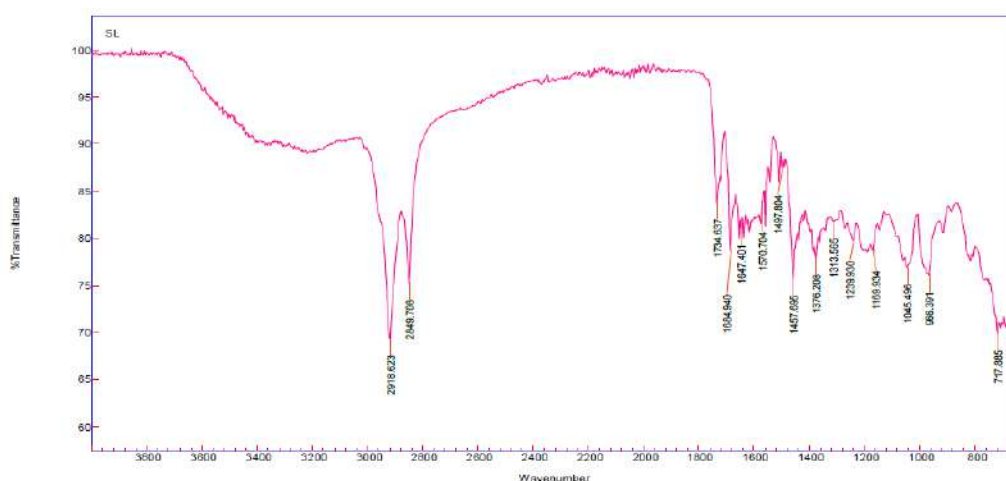


Fig 1. FT-IR analysis of Methanolic leaf extract of *Sambucus wightiana*.





Emerging Analytical Techniques for Mycotoxin Detection in Food and Feed: A Comprehensive Review

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ABSTRACT

Mycotoxins, which are created by fungi, are present in food and feed and can harm both humans and animals. However, due to the low concentration of toxins in samples, detection is difficult. The accessibility of this activity has been enhanced by developments in mycotoxin analysis. Improved sample clean-up technologies and cutting-edge chromatographic approaches have made high-performance liquid chromatography a go-to for mycotoxin analysis. In addition, advanced techniques like gas chromatography-tandem MS/MS and High-resolution mass spectrometry have found widespread use. Immunoassays and other advanced quantitative techniques are widely used for mycotoxin analysis and have achieved recognition on a global scale. Traditional and cutting-edge approaches to assessing mycotoxins and their features are summarised in this review. Despite the challenges, researchers have made great strides in mycotoxin detection and effect analysis using these methods.

Keywords: Mycotoxins, Quantitative Techniques, Fungi Species, Food Samples, Long-Term Effects.





Sandeep Kumar et al.,

INTRODUCTION

Fungi create mycotoxins, which are low-molecular-weight (300-700 Da) secondary metabolites with a high toxicity. They can be made either before or after harvest. Although the amount of a toxin that a certain species of fungus produces is dictated by its genes, several species can produce the same toxin(1). Due to their potential adverse effects on human health, mycotoxins in food are a major problem that must be constantly monitored. Aflatoxin, ochratoxin A, patulin, zearalenone, trichothecenes, fumonisin, and citrinin are among the mycotoxins tested for most frequently. On the other hand, data from conventional analytical methods of mycotoxin identification can take several days to materialise. The need for efficient, quick, and trustworthy methods for analysing mycotoxins led to the creation of rapid mycotoxin analysis techniques. Methods for identifying and quantifying major and minor mycotoxins during the past half-century are summarised in this article. The sources of mycotoxins, their toxicity, and their effects on human health are also discussed. Mycotoxin detection relies heavily on solid-phase extraction methods, which are discussed in the study along with numerous advancements to those methods. The lower detection limits and sensitivity of Fourier transform near infrared and adsorptive stripping voltammetry in different types of matrices are investigated, together with those of UV, fluorescence, photomultiplier, ion mobility, and tandem mass spectrometry. Quantitative techniques for identifying mycotoxins are reviewed in depth, including chromatography and immunological methods from the past and ultrahigh-performance liquid chromatography, fluorescence polarisation immunoassay, nanoparticle-based methods, microfluidics, and phage display techniques from the present.

Mycotoxins toxicity and their adverse effects

Mycotoxins are a class of secondary metabolites that can be produced by some species of fungi that colonise food and feed crops. Both humans and animals are vulnerable to the ill effects of these mycotoxins, which can vary from immediate poisoning to long-term health issues. Aflatoxins, ochratoxin A, patulin, zearalenone, trichothecenes, fumonisins, and citrinin are all examples of mycotoxins. In order to guarantee the quality and safety of food and feed products, it is crucial to be aware of these mycotoxins and their possible impacts.

Aflatoxins

Aflatoxins are mycotoxins found in peanuts, corn, and cottonseed; they are produced by the fungus *Aspergillus flavus* and *Aspergillus parasiticus*. Aflatoxins are extremely carcinogenic, and they have been linked to problems with the liver, the immune system, and stunted development in children. The dangers connected with consuming food and feed that contain aflatoxins can be reduced by being aware of their existence.

Ochratoxin A

Mycotoxin ochratoxin A is produced by the fungus *Aspergillus* and *Penicillium* and is widely found in grains, coffee, and wine. Damage to the kidneys, lowered immunity, and aberrant foetal development can all result from this mycotoxin's presence. To reduce the danger of adverse health effects, ochratoxin A levels in food and feed must be closely monitored.

Fumonisin

Mycotoxins called fumonisins are typically present in corn and corn-based products because they are produced by *Fusarium* fungi. Both humans and animals are vulnerable to the ill effects of these poisons, which can lead to esophageal cancer in humans and pulmonary edoema and other respiratory disorders in animals.

Trichothecenes

Mycotoxins called trichothecenes are commonly found in cereal grains including wheat, barley, and oats because they are produced by the *Fusarium* fungus. Animals and humans exposed to trichothecenes may have gastrointestinal and neurological symptoms.



**Sandeep Kumar et al.,****Zearalenone**

Mycotoxin zearalenone, generated by fungi like *Fusarium*, is commonly detected in maize and other grains. Reproductive problems in people and animals have been linked to zearalenone because of the hormone's resemblance to oestrogen.

DETECTION TECHNIQUES:

Mycotoxins can be identified and measured thanks to their UV absorbance and fluorescence properties. UV, fluorescence, laser-induced fluorescence (LIF), mass spectrometry (MS), and photomultipliers are only some of the detectors that have been used for this. (PTM). These methods permit the accurate quantification of mycotoxins.

Ultraviolet absorption

Absorption spectroscopy includes ultraviolet-visible spectroscopy. According to research, the highest absorption of all AFs occurs at 360 nm, and their absorptivity is 20,000 cm²/mol(2). Based on experimental evidence, improving the detection limit of AFs can be as simple as choosing the right extraction and cleanup approach(3, 4). Since the UV system's limit of detection is only in the micro molar range, it cannot detect AFs at trace levels(5, 6). As a result, fluorescence (FL) methods have become more commonplace for AFs detection.

Fluorescence

The ability to detect and characterise compounds that radiate at specific wavelengths is greatly aided by fluorescence. According to studies, maximal absorption for nearly all AFs occurs at 360 nm(2).

Fluorescence spectrophotometer

Fluorescence has been used for the study of AFs in grains, most notably peanuts. In less than 5 minutes, this approach can accurately measure AF concentrations between 5 and 5,000 g/kg (7). Fluorometric derivatization is necessary to increase AFs' fluorescence for improved analysis. The EU has set a limit of 4 ug/kg, although this approach has a greater detection limit. A method for the analysis of ZEA and -zearalenol in wheat samples and swine feed was developed by Urraca, Marazuela, and Moreno-Bondi (2004), with a LOD of 6 ng/g for ZEA in both types of samples. The wheat and swine feed LODs for -zearalenol were 3 and 4 ng/g, respectively. Over a wide concentration range, fluorescence detection offers improved accuracy and precision.

High-performance liquid chromatography coupled with fluorescence detection

With its higher sensitivity to other HPLC sensors, fluorescence detectors can detect as little as a single molecule of an analyte. They can be as much as a thousand times more sensitive than UV detectors for strongly UV-absorbing materials, making them ideal for detecting specific fluorescent chemicals in samples. HPLC-FLD is routinely employed to identify AFs in food products, despite the fact that reversed-phase chromatography can boost the fluorescence emission of AFs in aqueous solutions. Several matrices, including rice(8) and blue cheese(9), can be tested for OTA using HPLC-FLD. Ultrasonic solid-liquid extraction using a methanol/water (80/20) solution, followed by IAC cleaning, photochemical derivatization, and HPLC-FLD, has been developed for the analysis of seven mycotoxins in coix seeds. The approach has a lower detection limit for mycotoxins (between 0.01 and 0.04 g/kg) than the European Union's tolerance criteria. Faster separation and more sensitive detection are only two of the benefits it offers over standard practises(10).

High-performance liquid chromatography coupled with photodiode array

Spectral profiles are obtained from chromatographically separated samples or molecular mixtures using diode array detectors (DAD detectors) or high-performance liquid chromatography (HPLC) photodiode array detectors. They are crucial for high-performance liquid chromatography (HPLC) because they are used in conjunction with separation techniques that elute based on molecular weight, hydrophobicity (reverse-phase), or ionic load. PDA detectors are versatile, as they can be used to analyse molecules in solids, static solutions, or flow cells, and they offer low-noise spectral analysis. Limits of quantification of 2.3 ng analyte per 1 gramme of feed sample were achieved using an HPLC-UV-PDA array for the detection of AFB1 in cattle feed supplements. Fluid chromatography devices can detect

58882



**Sandeep Kumar et al.,**

as little as 4 ng analyte per 1 gramme of material, and our approach has been proved to be similar to those standards(11, 12). The results revealed the above method was more reliable than others for detecting mycotoxins.

Laser-induced fluorescence screening method

Detecting AFs at concentrations as low as one quadrillionth of a gramme is possible with the help of laser-induced fluorescence and high-performance liquid chromatography. Aflatoxins are identified as they go from the reverse-phase column to the LIF detector and through the detection window(5, 13). For the direct detection of AFs in maize and pistachio kernels, multiplexed fibre optic LIF has been developed (14, 15). Due to these limitations, LIF detection is only used in a select number of academic research facilities. Limitations include the high price of the laser and the need to mark analytes with dyes that operate at similar wavelengths. Furthermore, if the labelling reactions are not carried out precisely, it can lead to erroneous results in LIF(16).

Photomultipliers

Since mycotoxin detection can't rely just on fluorescence detection techniques, we need to look elsewhere. In order to detect bioluminescence, chemiluminescence, or vanishingly weak fluorescence, a photomultiplier tube (PMT) is a very sensitive sensor that employs a flow-through detection method. FIALab Instruments' PMT-FL is a portable, simple sensor that can detect trace amounts of AFM1 without any sample preconcentration(9, 17).

Ion-mobility spectrometry

Ion-mobility spectrometry (IMS) is a method for chemical identification that uses the velocity of gas-phase ions subjected to an electric field. Its advantages include a quick response time, low detection limits, ease of use, and affordable costs. The authors have used corona discharge IMS to measure OTA in licorice root for mycotoxin detection, with a LOD of 0.01 ng. Righetti et al. (2018) used the method to detect many mycotoxins across multiple matrices with great reproducibility and low influence from complicated sample matrices. IMS has greater sensitivity and lessens background noise than conventional LC and GC-MS techniques. It also offers more information on mass spectrum and retention duration, which improves the accuracy of targeted and non-targeted methods for identifying chemicals(18).

Mass spectrometry/Tandem mass spectrometry

Mass spectrometry is a potent analytical tool for ionising different chemical species and separating them based on their mass to charge ratio. Liquid chromatography, ion mobility spectrometry, and gas chromatography are just some of the separation methods that can benefit from being used in tandem with it. The chromatographic peaks are easier to spot with tandem mass spectrometry (MS/MS). The authors analysed many mycotoxins (including AFs, 3aDON, 15aDON, Nivalenol, HT-2, T-2, ZEA, OTA, Enniatin, and Beauvericin) in tea beverages using a dispersive liquid-liquid microextraction (DLLME) technique. Finding no risk of mycotoxin exposure from drinking tea beverages, the study found LODs in the range of 0.05-10 g/L(19).

Fourier Transform Near Infrared spectrometry

The method relies on the fact that different wavelengths of light in the Near Infrared (NIR) spectrum are absorbed to varying degrees by a sample. The energy absorbed by the various types of molecular bonds is evaluated using an Infrared spectrometer, which passes a wide spectrum of Infrared frequencies through a sample of the chemical under study. The output spectrum is often a scatter plot of wavelength (cm⁻¹) vs transmission (percent). The scientists calibrated their NIR spectroscopy with reference molecules to identify OTA in green coffee beans, which has been used to detect AFs(20). Using transmittance and reflectance data from the FT-IR approach, they were able to reliably detect and quantify OTA in fungal isolates (21). Corn, wheat, and barley were tested for the presence of fusarium mycotoxins DON, ZEA, FB1, and FB2. The authors detailed their methodology for this detection. Mycotoxin detection using infrared techniques is a quick, cheap, and non-destructive alternative to spectrometry procedures. Model preparation is critical, but it only needs minimal sample preparation and educated staff to be a success. This technique allows for the simultaneous detection of numerous mycotoxins utilising multivariate calibrations, boasting



**Sandeep Kumar et al.,**

benefits including high accuracy, precision, and the capacity to predict physical and chemical attributes from a single spectrum(22).

QUANTITATIVE DETECTION METHODS

Thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC) with various detectors (UV, fluorescence, diode array, or mass spectrometer [MS]), and gas chromatography (GC) with FID, ECD, or MS detectors are all used to detect mycotoxins in cereals. Immunometric assays, including membrane-based immunoassays and ELISAs, are also commonly employed in screening applications.

Chromatography methods

TLC (thin-layer chromatography) is a popular approach despite the availability of other chromatographic techniques for testing mycotoxins; this is because to its low cost, simple equipment, and ability to produce fluorescent spots under UV light, making it an excellent screening tool. Quantification can be difficult because of TLC's accuracy and sensitivity limits. Aflatoxins (AFs) can still be detected with TLC, however HPLC has essentially superseded it as the gold standard for quantitative analysis of mycotoxins. Ochratoxin A (OTA) detection using TLC has recently advanced, with a reported limit of detection as low as 0.2 g when 2 l is dropped onto the TLC plate. Comparable to LC (liquid chromatography) techniques, this technology can detect OTA at concentrations as low as parts per billion (g/kg), making it more sensitive than UV lamp detection(23).

Liquid chromatography

TLC was vulnerable to environmental influences like humidity and temperature, and its plate length was limited because it was an open system; these shortcomings were overcome with the introduction of liquid chromatography. Before or after the column, LC is combined with UV absorption, amperometric detection, and fluorescence detection steps. Using a fluorescence stage in conjunction with LC, the fluorescent features of AFs can be used for precise quantification. For mycotoxin detection, LC-MS and LC-FLD are generally accepted as the gold standards(24, 25). The simultaneous determination of DON, NIV, FB1, FB2, T-2, HT-2, ZEA, and AFs has been achieved by the development of a reversed-phase SPE Oasis® HLB column-based LC-APCI-MS/MS technique. This technique is ideal for cleaning up extracts and has been shown to accurately detect and quantify a wide range of mycotoxins(26). DLLME, liquid-liquid extraction, SPE, accelerated solvent extraction, solid-phase matrix dispersion, and dilute-and-shoot methods are just some of the extraction column techniques used in conjunction with LC-MS/MS analysis to reduce interference from the extraction step. The purpose of these techniques is to enhance the precision and consistency of the analysis by decreasing the matrix effects and interference that can arise during the extraction process(19). Mycotoxin type, matrix, ionisation method, and the sensitivity of the process can all affect how well LC-MS methods perform when analysing mycotoxins. However, difficulties with LC-MS methods, such as ion suppression and matrix effects, can reduce the trustworthiness of the data and prevent them from being used for quantitative analyses of mycotoxins.

High-performance liquid chromatography and ultrahigh-performance liquid chromatography (UHPLC)

High-performance liquid chromatography (HPLC) has come a long way since the late 1960s, and it is now a well-established chromatographic technology with numerous detection options (27). In fact, this technique is used for the examination of around 80% of all organic compounds in the world. This includes nutritional fortifiers, vitamins, proteins, and health food components. This method of assessing the quality of food is an alternative, acceptable, and reliable way to design strategies and estimate the amounts of AFs in tainted foods. In high-performance liquid chromatography (HPLC), analytes are typically detected by UV and fluorescence detectors (FLD) due to their sensitivity to light absorption at specific wavelengths and the presence of chromophores, respectively. Tandem mass spectrometry has surpassed FLD as the dominant detection method because it is more cost-effective and can identify both fluorescent and nonfluorescent toxins, such as AFs. The authors of a study used an HPLC-FLD technique based on the natural fluorescence features of these toxins to successfully identify OTA and AFM1 in human milk and dairy products (7, 29). Electrochemical and fluorescence detection are two highly sensitive detection modalities utilised for quantitative analysis in high-performance liquid chromatography (HPLC). The authors of the study used high-

58884





Sandeep Kumar et al.,

performance liquid chromatography (HPLC) coupled with laser-induced fluorescence to detect OTA because it was more sensitive than conventional fluorescence techniques. To further reduce the amount of solvent needed for the analysis and concentrate the toxin at low concentrations (ng/L), a simple liquid-liquid microextraction approach was implemented(30). Because of things like matrix effects, sample type, sample preparation, and calibration options, HPLC techniques aren't as portable or practical as they could be. To get over these restrictions, more analytical approaches are required.

Gas chromatography–Mass spectrometry (GC-MS)

Analytes in a sample are separated by GC based on how they are distributed between the stationary and mobile phases. Mass spectrometry equipped with an ECD or FID can detect the volatile compounds generated during separation. With high sensitivity and specificity for all mycotoxins that can be transformed to a sufficiently volatile molecule for gas chromatography, the authors created a GC-MS approach for mycotoxin analysis in grain products and human urine. Nonlinear calibration curves, carryover effects, drifting responses, weak fluorescence and absorption properties, column blockage, and contamination risk are just some of the difficulties that can arise during GC analysis for mycotoxin identification as opposed to HPLC and LC techniques(31, 32).

IMMUNOLOGICAL METHODS

Enzyme Linked ImmunoSorbent Assay

Since the late 1970s, immunological tests like ELISA have gained popularity for mycotoxin screening. Mycotoxin extract can be analysed directly using these assays, eliminating the need for any sorting or purification steps. Rapid and inexpensive, these assays may suffer from imprecision at low doses and a restricted range of test matrices. Conjugate and antibody binding can be hampered by structural similarities between mycotoxins or matrix interference, both of which can contribute to inaccurate measurement. Using the same antibody as before, Tang et al. (2014) validated an indirect ELISA detection method with an immunoaffinity column sample preparation(33). Many scientists have concentrated on improving the sensitivity of the regular ELISA procedure. Mycotoxin screening using ELISA formats (direct, indirect, competitive, and sandwich) is regarded effective and precise, although the process can be time-consuming and is not ideal for field testing due to the need for specialised plate readers. In order to make molecular recognition components, such as immunochemical ones, more portable and field-friendly, scientists have combined them into a transduction system(34).

Microplate reader

Microtiter readers measure optical absorbance and the strength of a fluorescent or chemiluminescent signal. In contrast to AFs or secondary antibodies, these readers may uniformly bind proteins to microtiter plates, including antibodies and antigens. Comparable to enzyme-linked immunosorbent assay (ELISA), but more sensitive, is the quantitative approach of chemiluminescence immunoassay. 384-well black polystyrene microtiter plates, a luminol-based substrate, and a secondary antibody labelled with horseradish peroxidase are used in this technique. Due to the elimination of the need for excitation of fluorescent labels or external light sources, chemiluminescence detection is more portable and convenient than fluorescence microarrays(35, 36).

Lateral flow strip

The lateral flow strip test for immunochromatography has attracted a lot of attention in recent years due to its ability to identify analytes quickly and specifically through the use of antigen-antibody interactions. For the quick identification of mycotoxins like DON, ZEA, T-2 Toxin OTA, and AFB1, this approach has become a popular and commercially accessible immunoassay(37-43). Detection of target analytes is rapid and visible without the need for specialised equipment, enabling for on-site testing to be completed in as little as 5-15 minutes with the help of a lateral flow strip assay. There is less expense and less complications from chromatographic separation using this approach.



**Sandeep Kumar et al.,****NEW DETECTION METHODS FOR MYCOTOXINS QUANTITATIVE ANALYSIS**

The rapid advancement of detection technologies and the deployment of biotechnology have led to explosive increase in the detection of mycotoxins in recent years. The following sections elaborate on several of the cutting-edge methods now in use for mycotoxin identification.

Ultrafast liquid chromatography connected with tandem mass spectrometry (UFLC-MS/MS)

In contrast to conventional liquid chromatography, which relies on pressure, the development of Ultrafast Performance Liquid Chromatography (UFLC) has led to notable improvements in speed, resolution, and separation performance. UFLC is consistent with Van Deemter theory, exhibiting special features that shorten the amount of time spent on analysis(44). In order to rapidly and accurately detect and quantify mycotoxins including OTA, FB1, FB2, AFB1, AFB2, AFG1, AFG2, and ZEA in different yam products and Chinese yam, the authors devised a very productive UFLC-MS/MS approach. Analyses take only 8 minutes per sample and have a high degree of accuracy, precision, and sensitivity because to the optimisation of critical aspects such chromatographic separation, MS/MS settings, and sample preparation. Mycotoxins in different compound matrices have also been detected successfully using this approach. Separately, Xing et al. (2016) used a similar method to detect 21 mycotoxins in Radix Paeoniae Alba; their detection limit was 0.031 to 5.4 g/kg, and their quantification range was 0.20 to 22 g/kg. The suggested method is highly advantageous for the detection and quantification of several mycotoxin pollutants in various matrices due to its ease of use, speed of analysis, high accuracy, and sensitivity. Mycotoxin detection via MS/MS has significant promise(45).

Fluorescence polarization immunoassay

In the 1980s, a cutting-edge technique known as time-resolved fluorescence immunoassay (TRFIA) was developed. Trivalent rare-earth metal ions are used as tracers in this method to identify the antigen, and examples include Eu³⁺, Tb³⁺, Sm³⁺, and Dy³⁺. Chelates of rare earth ions with an antigen and a chelator are made by combining the three ingredients. Rare-earth metal ions in the antigen-antibody-binding part of immune complexes are responsible for the fluorescence produced when a labelled antigen and a tested antigen compete for the antibody. Accurate detection and quantitation of target analytes are achieved by the use of the TRFIA method, which measures the intensity of fluorescence emitted from the metal ion(46). To identify AFB1 and OTA, the researchers developed a TR-FIA method that makes use of Eu and Sm as markers. Applying the antigen-protein to micro titer plates, then adding the sample, antibody (Monoclonal Abs for OTA and Polyclonal Abs for AFB1), and labelled second antibody, are the steps that make up the procedure. The TR-FIA showed a LOD of 0.02 g/L for AFB1 and 0.05 g/L for OTA. With its wide detection range, outstanding repeatability, high sensitivity, and longer-lasting luminescence compared to conventional fluorophores, this approach is ideal for performing multiplex immunoassays with several markers. Mycotoxin detection in big samples can benefit from TRFIA because it is a fast, stable, and inexpensive approach. Combining immunochemical identification elements with Raman spectroscopy has also helped researchers make strides(47). For AFB1 detection, they turned to Raman spectroscopy (48). Authors' multi-analyte immunoassays are rising in popularity because they require less sample, take less time to run, and cost less to detect than traditional methods. The optimised MWFPIA approach was sensitive enough for these three pollutants in maize to meet EU criteria (LOD = 17.8, 331.5, and 242.0 g/kg for T-2 toxin, FB1, and DON, respectively). In less than 30 minutes, we had completed analysis and sample preparation. Simplifying the process is as simple as making certain adjustments to homologous MWFPIA, such as increasing sensitivity, decreasing detection time, and zeroing in on specific pollutants(49).

Nanoparticles based detection methods

Utilizing gold nanoparticles enhanced the standard ELISA technique. We created a label-free sensor with detection sensitivity comparable to commercially available ELISA kits. An additional label-free method was also revealed(50). For their electrochemical detection of AFB1, the authors used gold nanorods coated with antibodies, and they used a similar strategy to encapsulate components magnetically labelled with particular antibody enzyme complexes(51). Surface plasmon resonance (SPR) is an optical detection method in which surface plasmon waves are generated by the absorption of incident photons by free electrons on a biochip's surface. In SPR imaging (SPRi), a

58886





Sandeep Kumar et al.,

CCD camera is used to offer sensitive label-free detection throughout the whole chip, allowing the biochips to be placed in an array arrangement to collect SPR data simultaneously from each active site. Multiple mycotoxin detection is essential for food quality management. Using a competitive immunoassay setup, researchers have reported success in detecting multiple mycotoxins at once using a gold nanoparticle (AuNP) enhanced SPRi chip, with results showing high sensitivity and specificity for an immediate analysis of three signature mycotoxins: OTA, ZEA, and AFB1 (with detection limits of 30, 15, and 8 pg/ml, respectively). While the SPRi device is novel for performing many studies at once with higher accuracies, it is hindered by problems including having only a single epitope for a competitive immunoassay that doesn't work, and having a low enough sensitivity to detect even trace levels of mycotoxins because of instrument limitations.

Lateral flow immunochromatographic assay detection method

Mycotoxin analysis in many types of agricultural goods has made extensive use of the rapid, cheap, and easy lateral flow immunochromatographic assay (LFICA) method. Recent developments in LFICA have been examined and anticipated; these developments entail the use of different nanomaterials for the detection of mycotoxins(52). The sensitivity and specificity of LFICA have been steadily improving, and can now detect at the picogram level. Fast, sensitive, stable, and cost-effective testing is possible with this method, making it ideal for mass screening for mycotoxins. However, it still has several problems and needs unique tools for on-site application and quick testing. The authors have developed SAMNs, a robust and effective technology for eliminating citrinin from *Monascus* preserved foods, to combat this problem. Magnetization measurements and Mossbauer spectroscopy were used to verify SAMNs' binding efficiency with citrinin, making them a viable magnetic nanocarrier for toxin elimination in the food business(53).

Implementation of microfluidic "lab-on-a-chip" for the detection of mycotoxins in foods

Microfluidic devices have emerged as a viable modern analytical platform, and significant efforts have been made to achieve very precise and quick quantification of minute levels of mycotoxins in food products. Microfluidic analytical platforms are predicated on the Total Analysis System (TAS) philosophy, which seeks to consolidate and streamline the several procedures typically required to analyse a sample. The utility of the microfluidic analytical platform—also known as Micro Total Analysis Systems (mTAS)—is enhanced by the fact that it allows for the miniaturisation of an entire laboratory onto a single chip at the micrometre scale(54, 55). Microfluidics is the study of the control of fluids in extremely small volumes (typically nanoliters) by means of channels that are themselves micrometres in size(56). The channels of microfluidic analytical instruments typically range in size from 1 to 1 m. Electrochemical-based detection methods are very advantageous for incorporation into microfluidic lab-on-a-chip (LOC) devices because of their sensitivity, compatibility, and ability to function at small scales without sacrificing performance(57, 58). It's beneficial because the reaction is unaffected by factors like sample turbidity or optical path length(59). When paired with microfabricated devices, the MS detection method's fast speed and great sensitivity make it a powerful tool for obtaining low detection limits.

Combining label-free MS analysis with a microfluidic immunosensor is an exciting new direction for mycotoxin testing. The authors of this work analysed AFs in peanut food products using a Chipnano LC/QqQ-MS system, which used a two-column chip-based LC approach to lessen matrix interference and permit online sample preconcentration. The microfluidic immunosensor was integrated with an indirect competitive detection approach based on chemiluminescence(60). Microfluidic LOC equipment can be used in conjunction with molecularly imprinted polymers (MIPs), aptamers, antibodies, and microarray technologies to capture individual molecules. Microfluidic devices are limited to the use of antibodies as the only immunological separation agent. Specificity is the main benefit of antibody-based immunoassays. Quantitative determination of mycotoxins can be enhanced by incorporating multiple antibodies into a multi-channel microfluidic system. Capillary force-driven lateral flow test strips (LFTS) and capillary electrophoresis-driven microchips (CE chips) are the two most common types of microfluidic immunosensors used for mycotoxin detection(61, 62). The creation of a competitive immunoassay approach for the detection and quantification of ZEA is one example of how microfluidic devices might be put to use(63). To efficiently separate molecules, the template-induced creation of particular recognition sites known as

58887



**Sandeep Kumar et al.,**

molecular imprinting (MIP) has been implemented into the microfluidic LOC system. MIP uses a self-build mechanism to generate these sites, with the template directing the alignment and positioning of the substance within the structural parts(64). In order to specifically detect T-2 toxin, a sensor based on molecularly imprinted polymers (MIP) and electrochemistry was developed. The detection strategy included boosting the template-metal ion chelation by introducing iron ions (Fe^{3+})(65). Molecularly imprinted polymers (MIPs) provide a number of benefits, including the ability to create synthetic receptors that are sensitive to a wide variety of substances, even those found in nature. Additionally, MIPs show increased specificity in organic solvents, robustness in harsh environments, and the capacity to be tailored to different pH, temperature, and pressure settings. However, there are drawbacks to MIPs as well, including the fact that stereochemical structures of the imprint are unknown, template costs fluctuate, mass transfer is sluggish, and unfavourable adsorption isotherms exist in separation media. Aptamers, which are single-stranded oligonucleotides created using the in vitro selection procedure SELEX, are another useful tool for detecting target molecules. Different aptamers have different spatial and folding structures that allow them to bind to their targets with high affinities and selectivities(66). Environmental monitoring, drug research, food analysis, toxicology, and clinical diagnosis and therapy are just some of the areas where aptamers have been demonstrated to be superior to antibodies. Microfluidic-based analytical equipment have been integrated with immunoassays and nanotechnology for use in the modern setting of mycotoxin analysis. Microfluidic systems provide many advantages over traditional immunoassays, including increased analytical sensitivity and decreased analysis durations as a result of shorter diffusion distances made possible by the system's high surface-to-volume ratio(59). Microarray technology is a relatively new lab-on-a-chip technique that employs the use of a solid substrate, such as a thin silicon film or glass slide, to do high-throughput, parallel screening of vast volumes of biological material.

Phage display techniques

Creating protein libraries on the surface of filamentous phage allows for the efficient selection of proteins and peptides, including antibodies, with high specificity and affinity for a wide range of targets. In order to efficiently separate peptides with high binding affinity, the scientists have developed a biological phage display technology (PDT). To expedite the selection and evaluation of protein expression libraries, this approach integrates the genotype of the phage carrier with the phenotype of the protein molecule. By simulating antigen epitopes, phage display technology can produce antibodies without resorting to cell synthesis. Safer and less hazardous than traditional mycotoxin detection technologies like ELISA, it can be used to screen for single antibodies as target molecules or to imitate epitopes of mycotoxins using monoclonal antibodies (McAbs)(67). Three rounds of screening of a 7-peptide library yielded nine clones that tested positive for the ZEA phage. In competitive ELISA testing, ZEA was found to inhibit these clones at concentrations between 0.1 and 10 g/L. The development of a non-hazardous ELISA kit for mycotoxin detection is based on the successful construction of an epitope simulation of orange penicillin utilising PDT(68). The OTA simulation epitope peptide discovered by screening was used by Lai, Xu, Xiong, Chen, Liu, Fung, Yang, Renrong, and Xiong in 2008 and 2009 to create a nontoxic colloidal gold paper slip system for OTA detection. By eliminating the need for conventional toxin products, this technology not only helps lessen mycotoxin pollution in the environment, but also boosts worker security. Therefore, there is considerable hope for the future of mycotoxin detection using a combination of PDT and immunological colloidal gold marker technologies(69).

CONCLUSION

This review compiles the most up-to-date information available on the analytical methods used to identify mycotoxins in cereals and cereal-based products. TLC and HPLC are both chromatographic techniques that have found widespread application in laboratories, but HPLC's greater sensitivity and accuracy have led to their replacement of TLC. Mycotoxin analysis often employs the use of UV, PDA, and FL detectors. Science and technology have come a long way, but some approaches may still be difficult to put into practise. Method selection relies on knowledge about sample type, research goal, and available laboratory resources. The purpose of this analysis is to help scientists and businesses who study mycotoxins decide which detection and quantification methods will work best for them.





Sandeep Kumar et al.,

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Design of Intrusion Detection System to Detect Cyber Attacks in IoT Network using Ensemble Technique

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ABSTRACT

The Internet of Things (IoT) is one of the technologies in contemporary wireless communications that is expanding quickly. Its uses are extensive in a variety of industries, including household, agriculture, health care, transportation, etc. Cyberattacks against IoT applications and devices have also grown because of the extensive growth of IoT services. Considering this, security and privacy are two main issues in the field of the Internet of Things. The intrusion detection system is one method for protecting the Internet of Things system against cyberattacks. So, to identify cyber-attacks in IoT network traffic, we have proposed an intrusion detection system for detecting attacks based on ensemble learning. This proposed study aims to increase detection rates while lowering false positive rates. To determine the effectiveness of the proposed strategy, the UNSW_NB15 dataset was utilized. Based on the accuracy, precision, false detection, and false omission rates, the performance of different classifiers in the framework is compared with the ensemble technique

Keywords: Internet of Things, Ensemble Technique, Network Intrusion Detection System, Cyber-Attacks





Sivasankari and Kamalakkannan

INTRODUCTION

We currently live in a digital age. Every human life in the world includes the internet. The next technological innovation, the "Internet of Things," was made possible by the widespread use of the Internet. Even though the Internet of Things has been hailed as one of the most significant developments in technology history, there is a need to find proper solutions and approaches for four basic engineering problems: security, privacy, compatibility, or connectivity. [1]. The situation of vulnerability in the IoT is caused by a variety of factors. Each manufacturer is rapidly trying to offer an entirely novel, advanced linked device before opponents do. In such cases, security takes a backseat as they concentrate primarily on their functionality. Insecure IoT products are also a result of scalability problems. The Internet of Things environment is made up of a variety of devices, networks, protocols, and standards. No network is immune to security risks and weaknesses. IoT system security flaws result in a variety of security risks for the various IoT levels. Because IoT is used in so many different industries, including the medical field, power generation, home automation, etc., attacks on such vital applications may have serious consequences.

IoT security is an area that is crucial for protecting the hardware and the system, but it is more difficult due to the system's heterogeneity and scalability (i.e., growth in the count of nodes). In the Internet of Things, it may not be enough to rely on existing security mechanisms that have been used in a traditional network. Because of their small size and limited computation and communication resources, only a few rapid techniques can be used [2]. One method for spotting unusual activity in network traffic is network intrusion detection. A traditional NIDS has four steps, as seen in Fig 1. The data traffic includes a collection of network traffic instances with the essential attributes to distinguish between trusted and unauthorized observations. Data preparation is the act of detecting and removing extraneous attributes from the data source. A detection approach uses a variety of classification algorithms to determine whether the traffic is legitimate or under assault. A defense response is a choice made to stop assault-related behaviors. Because it detects common irregularities in network traffic, the traditional NIDS is inappropriate for an IoT network. However, the IoT network's traffic pattern will be different from that of a traditional network. Therefore, creating a NIDS tailored to IoT traffic aids in ensuring improved protection from intruders via IoT networks. This research suggests a network intrusion detection system that uses an ensemble-based approach to detect attacks in the Internet of Things Network Traffic, which is designed to protect the IoT System against attackers.

The following are the paper's main contributions:

1. The suggested ensemble learning system uses the supervised machine learning algorithms Decision Tree (DT), Naive Bayes (NB), Support Vector Machine (SVM), and Artificial Neural Network (ANN) to identify the assault.
2. Relevance analysis was carried out, and correlation-based feature selection was used to identify relevant features for attack detection.
3. Using the UNSW_NB 15 dataset, the performance of the ensemble approach with each classification technique contained in the framework was assessed.

The remaining paper was arranged as follows: Section II set out the work related to the proposed work. The proposed methodology for the research is explained in section III. Section IV describes how the proposed techniques are working and compares them with other State-of-the-Art works, while section V concludes this paper

RELATED WORKS

This study aims to develop a NIDS that can identify network traffic that exploits or impairs IoT devices by identifying its unusual symptoms. Numerous studies have used the ensemble method to enhance NIDS' overall performance. The earlier research that is relevant to this work is as follows





Sivasankari and Kamalakkannan

Chebrolu et al. [3] suggested a Bayesian network-based ensemble method where classification and regression trees were utilized to identify questionable cases. Even with an increase in computational overhead, the hybrid/ensemble offers higher performance when compared to each component evaluated separately. Giacinto et al. [4] developed an approach to use the ensemble method to detect various forms of attacks. However, the voting rule technique ultimately determines the attack detection choice. Yan Naung Soe [5] proposed employing a sequential architecture and machine learning to detect botnet attacks but did not look into the regular traffic patterns. Dewan Md. Farid et al. [6] suggested a hybrid IDS that uses a decision tree and naive Bayes to identify multiclass attacks. To identify unexpected cyber-attacks in the IoT, Mohammad Shorfuzzaman [7] presented a tree-based ensemble and feedforward neural network, although the placement method of NIDS is unfocused. To identify unexpected cyber-attacks in the IoT, a hybrid method to identify infiltration using a hybrid approach of genetic algorithms was proposed by Vivekananda [8]. However, the suggested solution addresses the actual issue with categorizing machines. Adeel Abbas et al [12] proposed an ensemble approach to detect both binary and multiclassification attacks using logistic regression, naive Bayes, and decision trees. They deployed a simple bagging technique and analyzed the performance to increase the accuracy, but the false detection measures were not analyzed. Priscilla. Et.al [13] proposed an ensembled technique in IDS using the algorithms, Naive Bayes, K-Nearest Neighbour, and Support Vector Classification and IDS was housed in an IoT gateway. Two public datasets are used for evaluation, but its dataset was not specific to IoT-related attacks. Rubayyi. Et al [14] proposed an ensemble technique using deep learning techniques. Lambda architecture was used to prolong the multiclassification approach. To improve efficiency and optimization, Lambda architecture was used. But the accuracy of the system can still be increased. To detect cyber-attacks, this paper provides a Network Intrusion Detection System that ensures that higher rate of detection and provides better security for an IoT environment because it is installed in a central controller node.

PROPOSED ENSEMBLE METHODOLOGY

To safeguard the IoT system against cyberattacks, an ensemble-based NIDS was proposed to identify harmful behaviors in IoT network traffic. Due to its compact size and low processing power, the NIDS cannot be installed directly into IoT end node devices [9]. To ensure that all communication between IoT end nodes and application servers is routed through the controller node, this proposed method centered on installing a central controller of IoT devices where NIDS is housed. As a result, the controller node's NIDS checks the traffic for anomalies. The IoT architecture shown in Fig. 2 is used to position NIDS. It demonstrates how communication is transmitted through a controller node between an End node at the IoT end device layer and application services that are hosted on a cloud server.

Two key processes make up a suggested ensemble-based NIDS shown in Fig. 3: first is the pre-processing stage, features that can distinguish between legitimate and fraudulent patterns were extracted using correlation-based feature selection. Secondly, to categorize the traffic as legitimate or malicious, the ensemble-based technique is constructed based on Bootstrap aggregating and uses Decision Tree, Support Vector Machine, Naive Bayes, and Artificial Neural Network techniques.

Correlation-Based Attribute Selection

When implementing NIDS, feature selection is crucial in determining the key aspects that can be helpful in both meticulously legitimate and hostile situations. Thus, feature selection improves accuracy, reduces attribute redundancy, and improves NIDS performance. The correlation between the attributes is computed in this work using correlation-based feature selection. The ensemble approach used the lowest N ranking criteria to identify traffic exhibiting unusual behavior. The computed correlation (R) between features A1 and A2

$$R(A1, A2) = \frac{\sum_{i=1}^n (A1o_i - \bar{A1})(A2o_i - \bar{A2})}{\sqrt{\sum_{i=1}^n (A1o_i - \bar{A1})^2 \sum_{i=1}^n (A2o_i - \bar{A2})^2}} \quad (1)$$

$$\bar{F1} = \left[\frac{\sum_{i=1}^n A1o_i}{n} \right]; \quad \bar{F2} = \left[\frac{\sum_{i=1}^n A2o_i}{n} \right] \quad (2)$$



**Sivasankari and Kamalakkannan**

R produces results that range from -1 to +1. If the R value is near to 1, it indicates that there is a high correlation between the two attributes (A1 and A2) and that their trends are moving in the same direction. The largest correlation between A1 and A2 is shown if the R-value is approaching -1, while the direction of the feature trends is opposite.

Bootstrap Aggregator

In the suggested study, an ensemble-based classifier is created using the bootstrap aggregator method. Network traffic was distributed to the machine learning algorithms after significant attributes were identified from the dataset using coefficient correlation, and a Bootstrap aggregator model was utilised. For a brand-new instance, X, each classifier Model M_i used in the task delivers its predicted value. The Bagging model tallies each classifier's votes and gives X the label with the most support.

Ensemble Approach Techniques

This suggested study implements an ensemble method with bootstrap aggregating to categorise the cases as normal and malicious. Supervised machine learning algorithms like DT, SVM, NB, and ANN are applied. The DT, NB, SVM, and ANN machine learning approaches were selected because to their effectiveness in distinguishing reliable and suspect vectors with little fluctuations. The three methods employed in the ensemble-based NIDS are briefly discussed below.

Decision Tree

It is a structural technique based on trees that is used to solve classification problems. Test conditions for features to distinguish instances with different attributes are contained in internal nodes of the tree. Due to its simplicity, the C4.5 DT method is employed for implementation. The information gain principle is used to divide the samples into subsets during the training phase. The value of the gain ratio will ultimately determine which splitting attribute is selected. The attributes with the highest gain ratio value are chosen.

Naïve Bayes

In order to determine the maximal likelihood hypothesis, the NB algorithm solves the classification issue and determines the categorical label based on the Bayes theorem. It is appropriate for datasets with high levels of dimension and provides rapid predictions based on the likelihood of an object. The data objects are predicted using the posterior function.

Support Vector Machine

Nonlinear mapping is used in SVM to transform training data into better dimensions. The linear hyperplane that divides instances of one class from another is then discovered. The 'decision border' is created by SVM using the most extreme vectors. Let dataset D contain a collection of instances X_i , each of which is connected to a class label f_i . f_i has two possible values: -1 and +1.

Artificial Neural Network

It generates a set of hidden layers by converting inputs into outputs that align with targets. To train network weights and build a model that differentiates between normal and abnormal network data, an ANN needs information about the normal data class in the NIDS methodology. A large number of observations are utilized to determine the activation function

RESULTS AND DISCUSSION

The UNSW_NB15 dataset and performance evaluation measures used in the suggested study are shown in this section. The ensemble learning framework's conclusions are also demonstrated.





Sivasankari and Kamalakkannan

The UNSW_NB15[10,11] dataset is used to illustrate the suggested approach. This dataset includes a variety of data types for NIDS evaluation. Eight different types of cyberattacks are represented in this dataset, including Backdoor, Analysis, Exploits, Fuzzer, Generic, Reconnaissance, Worm, and DoS. The data set was divided. The ensemble approach was built using 70% of the data collected as training, and the remaining 30% was utilized as testing to determine how well the suggested work was performed. Several experiments using the UNSW_NB15 data source assess the effectiveness and performance of the ensemble approach. The accuracy, precision rate, false detection rate, and false omission rate are some of the metrics that are used to evaluate how well the ensemble classifier performs in comparison to the individual classifiers in the framework. Figure 4 displays the confusion matrix that was used for the evaluation

Attacks that are accurately anticipated as attacks are known as true positives (TP), while incorrectly predicted normal traffic is known as true negatives (TN). False Positive (FP) refers to incorrectly classifying legitimate communications as harmful, whereas False Negative (FN) refers to incorrectly classifying an attack as a non-attack.

Actual Positive: represent the actual number of attack observations.

Actual Negative: represent the actual number of non-attack observations.

Predicted Positive: represent the total number of predictions for attack

Predicted Negative: represents the total number of predictions for non-attack.

Below is a quick description of the metrics that were utilized in the evaluation.

Accuracy

It calculates the proportion of observations that are appropriately classified as attacks and normal, as indicated by

$$\text{Accuracy} = \frac{TP+TN}{\text{Total of actual positive and actual Negative}} \quad (3)$$

Precision: On analyzing all of the positive predictions, precision shows the percentage of occurrences that were accurately predicted as positives

$$\text{Precision} = \frac{TP}{\text{Predicted Positive}} \quad (4)$$

False Detection Rate

False Detection Rate (FDR) is the ratio of cases mistakenly identified as attacks to all instances predicted to be attacked.

$$\text{FDR} = \frac{\text{Predicted Positive}-TP}{\text{Predicted Positive}} \quad (5)$$

False Omission Rate

The false omission rate (FOR) is the proportion of attacks misclassified as non-attacks predicted events overall attack predictions.

$$\text{FOR} = \frac{FN}{\text{Predicted Negative}} \quad (6)$$

The UNSW_NB15 dataset was first pre-processed by turning categorical factors into numeric variables. The correlation coefficient is then utilized to determine the dataset's key characteristics that can be used to forecast attacks. 27 of the 44 attributes were chosen, and these 27 attributes were employed in the ensemble technique to prediction. The performance of the ensemble-based NIDS design is then assessed using the test data set. Python is



**Sivasankari and Kamalakkannan**

implemented using an i7 processor and 8 GB of RAM on a Windows 10 computer. Table I shows the performance of DT, SVM, NB, ANN, and ensemble approach performed in terms of measurements of positive measures accuracy and precision. From the table I and II, it is clear that the ensemble approach produces higher accuracy and precision rate in terms of positive measures and produces a lower rate for FDR and FOR in terms of negative measures compared to other techniques used in the framework. NB attains 0.9031 accuracy and 0.8970 precision which is the lowest rate among the others but the FOR of NB was 0.0090 which is low compared to the ensemble approach.

Fig 5 and 6 show the performance of the ensemble approach in terms of positive measures. From the figure, the ensemble approach outperforms the other techniques used in the framework. Fig 7 and 8 show the performance of the ensemble approach in terms of negative measures (i.e.) False detection and false omission rate. From the figure, the ensemble approach produces a lower rate compared to the other techniques used in the framework.

CONCLUSION

IoT systems are expanding at the fastest rate, which relates to increased cyber-threat. One of the difficult security problems in the IoT ecosystem is a cyber-attack. In this paper, we present a NIDS for detecting cyber-attacks in IoT end-node networks using an ensemble approach based on classification algorithms including DT, NB, SVM, and ANN. Additionally, was demonstrated that the suggested ensemble framework outperforms the individual techniques contained in the framework in terms of results. The architecture of an IoT environment was examined. As a result, it lowers each node's overhead in an IoT network. To evaluate the effectiveness of the suggested NIDS in the real-time data flow, further work will require the implementation of a test bed.

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Sivasankari and Kamalakkannan

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TABLE I. PERFORMANCE MEASURES OF ACCURACY AND PRECISION

ML Techniques	Accuracy	Precision
DT	0.9502	0.9721
NB	0.9031	0.8970
SVM	0.9670	0.9678
ANN	0.9759	0.9751
Ensemble Approach	0.9868	0.9859

TABLE II. PERFORMANCE MEASURES OF FDR AND FOR

ML Techniques	FDR	FOR
DT	0.0279	0.0814
NB	0.1030	0.0090
SVM	0.0321	0.0277
ANN	0.0248	0.0229
Ensemble Approach	0.0140	0.0119

<p>Fig. 1. Steps of NIDS</p>	<p>Fig.2. IoT Architecture houses NIDS</p>													
<p>Fig. 3. Proposed Framework for Ensemble attack detection</p>	<table border="1" style="margin: auto;"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="2">Actual Data</th> </tr> <tr> <th>Attack</th> <th>Non-Attack</th> </tr> </thead> <tbody> <tr> <th rowspan="2">Predicted</th> <th>Attack</th> <td>TP</td> <td>FP</td> </tr> <tr> <th>Non-Attack</th> <td>FN</td> <td>TN</td> </tr> </tbody> </table> <p>Fig.4. Confusion Matrix</p>			Actual Data		Attack	Non-Attack	Predicted	Attack	TP	FP	Non-Attack	FN	TN
				Actual Data										
		Attack	Non-Attack											
Predicted	Attack	TP	FP											
	Non-Attack	FN	TN											





Sivasankari and Kamalakkannan

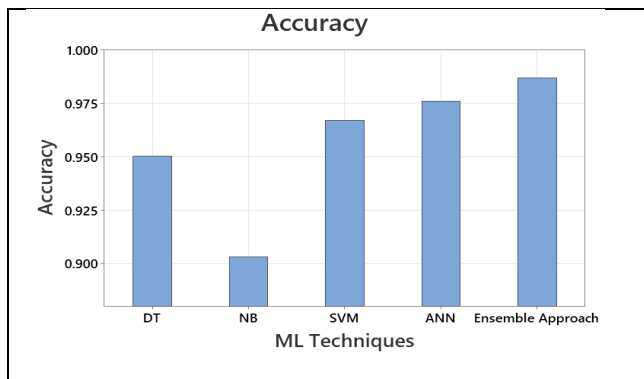


Fig.5. Comparison of Accuracy Rate

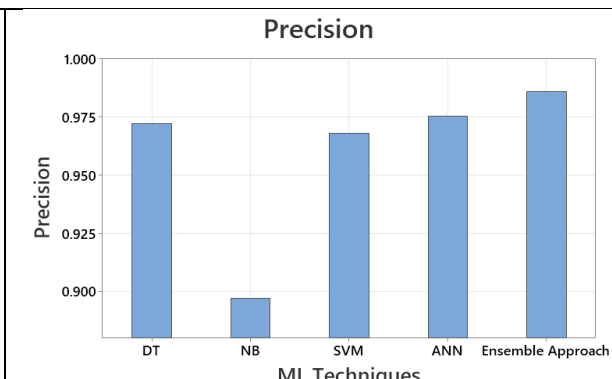


Fig.6. Comparison of Precision rate

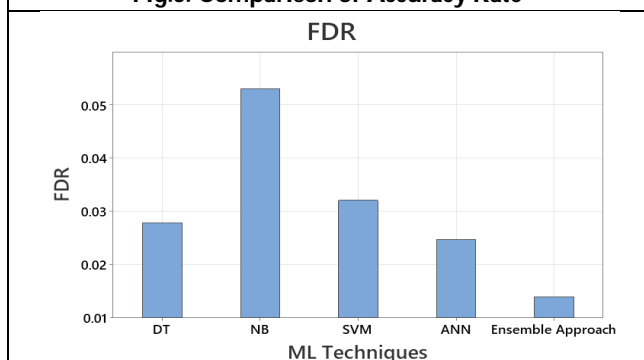


Fig.7. Comparison of False Detection Rate

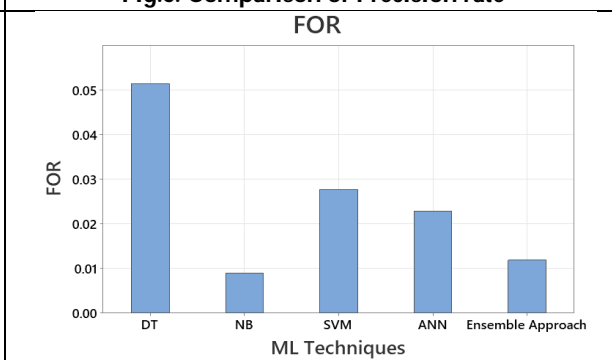


Fig. 8. Comparison of False Omission Rate





A Study on the Toxicity of *Tecoma stans* leaf Extracts against Two Common Mosquito Species: *Aedes aegypti* and *Culex quinquefasciatus*

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ABSTRACT

Mosquito-borne diseases are a growing public health concern, particularly in tropical and subtropical regions like India, where *Aedes aegypti*, *Culex quinque fasciatus*, and *Anopheles stephensi* mosquitoes transmit diseases like dengue, chikungunya, and malaria. Plant extracts have emerged as a viable method for controlling the spread of these diseases due to their anti-mosquito properties. This study aimed to assess the effectiveness of sequential extracts of *Tecoma stans* leaves against *Ae.aegypti* and *Cx.quinquefasciatus* mosquitoes by evaluating their larvicidal, pupicidal, and ovicidal activities and comparing their LC₅₀ values to determine their relative effectiveness. The research found that the chloroform and methanol extracts were effective in killing larvae of both mosquito species, with the chloroform extract having LC₅₀ values of 119.5 and 117.9 ppm, and the methanol extract having LC₅₀ values of 128.0 and 116.2 ppm, respectively. However, all three extracts lacked pupicidal and ovicidal activity. The study's findings suggest that chloroform and methanol extracts could be used to develop eco-friendly mosquito control measures. Further research is needed to identify the active compounds responsible for the extracts' larvicidal activity and to investigate their mechanisms of action.

Keywords: *Tecoma stans* leaves, *Aedes aegypti*, *Culex quinquefasciatus*, extracts.





Jelin Vilvest et al.,

INTRODUCTION

Mosquitoes are responsible for the transmission of several deadly diseases, including malaria, dengue fever, Zika virus infection, and yellow fever. According to the World Health Organization (WHO), mosquito-borne diseases cause millions of deaths worldwide each year, particularly in low- and middle-income countries [1]. In India, it is estimated 1.3 billion people at risk of contracting these diseases [2]. Malaria is the most prevalent mosquito-borne disease in the country, with around 5.6 million cases reported in 2019 [3]. Other mosquito-borne diseases, such as dengue fever and chikungunya, have also emerged as significant health threats in recent years. In addition to causing illness and death, mosquito-borne diseases impose a significant economic burden on individuals and health systems in India [4]. To reduce the spread of these diseases, various control mechanisms have been implemented, including the use of synthetic chemicals such as insecticides. Insecticides are widely used to control mosquito populations, particularly through indoor residual spraying (IRS) and the use of insecticide-treated bed nets (ITNs). The effectiveness of insecticides in controlling mosquito populations has been demonstrated in several studies, including a systematic review and meta-analysis by Hemingway [5], which found that ITNs and IRS with pyrethroids reduced the incidence of malaria by up to 90% in some settings. However, the overuse and misuse of insecticides have led to the development of insecticide resistance in mosquito populations, which threatens the effectiveness of these control mechanisms [6]. Additionally, the use of synthetic chemicals has raised concerns about the potential health and environmental impacts of these compounds [7]. The control of mosquito populations and the prevention of mosquito-borne diseases are therefore major public health priorities in the country. Therefore, alternative and sustainable approaches to mosquito control, such as the use of natural products and biological control methods, are being explored as potential solutions to these issues.

Tecoma stans(L.) Kunth belongs to the family Bignoniaceae, which is a family of flowering plants comprising over 800 species, including trees, shrubs, and lianas[8]. It has several synonyms, including *Bignonia stans* L., *Stenolobium stans* (L.) Seem, and *Tecoma stans* var. *angustata* [9].It is commonly known as yellow trumpetbush or yellow bells due to its trumpet-shaped yellow flowers. It is native to Central and South America but has been introduced to other regions, including the Caribbean, Florida, and parts of Africa and Asia. It is commonly grown as an ornamental plant and is also used for medicinal purposes [10]. It has been used in traditional medicine to treat a variety of ailments, including fever, cough, asthma, dysentery, and inflammation. The plant has demonstrated several pharmacological activities, including anti-inflammatory, antidiabetic, antitumor, and antimicrobial properties [11-14]. The aim of the present study was to assess the effectiveness of sequential extracts (n-hexane, chloroform, and methanol) of *T. stans* leaves against *Ae.aegypti* and *Cx.quinque fasciatus* mosquitoes by evaluating their larvicidal, pupicidal, and ovicidal activities and comparing their LC₅₀ values to determine their relative effectiveness.

MATERIALS AND METHODS

Collection of Plant Material

The leaves of *T. stans* were obtained from Loyola College Campus, Chennai, Tamil Nadu, India, in April 2020. The authenticity and identity of the plant material were confirmed by Dr. K. N. Sunilkumar, a Research Officer in the Department of Pharmacognosy at Siddha Central Research Institute, Chennai. A voucher specimen (Authentication Code No: T24012303S) was deposited in the institute's herbarium to establish and verify the plant's authenticity and identity.

Extraction of the Plant Material

To extract bioactive compounds from 1kg of shade-dried leaves of the plant, a sequential extraction process was employed using n-hexane, chloroform, and methanol as solvents in a Soxhlet apparatus. Each solvent was used for successive extractions to obtain a range of compounds with varying polarities. The resulting extracts were then filtered and concentrated using a vacuum rotary evaporator. The n-hexane extract yielded 21.14g, the chloroform extract yielded 26.77g, and the methanol extract yielded 82.0g. The dry extracts were stored in air-tight containers at

58902





Jelin Vilvest et al.,

4°C until further use. This extraction technique allows for the isolation of different bioactive compounds, which can have various applications.

Insect Rearing

The third instar larvae of *Ae. aegypti* and *Cx. quinque fasciatus* were obtained from the Animal Husbandry unit of the Department of Advanced Zoology and Biotechnology at Loyola College, Chennai. They were raised in tap water at a temperature of 27.4°C, a relative humidity (RH) of 75-85%, and a photoperiod cycle of 13 hours of light and 11 hours of darkness (L/D). The larvae were fed a diet consisting of dog biscuits and Brewer's yeast in a ratio of 3:2 [15].

Tests for Evaluating Larvae and Pupa Control Methods

The larvicidal and pupicidal activities of various extracts were tested according to the guidelines set by the World Health Organization (WHO)[16]. The assays were carried out using concentrations of 500, 250, 125, and 62.5 ppm, with five replicates for each concentration for all three activities. The extracts were emulsified in a 1.0% aqueous DMSO solution. For the assays, 20 larvae or pupae were introduced into 100 ml of the solution in 150 ml plastic containers. A negative control was included using a 1% aqueous DMSO solution, while temephos was used as the positive control. After 24 hours of incubation, the mortality of the larvae or pupae was recorded. The larvae or pupae were considered dead when there was no observable movement upon touching with a glass rod. The percentage mortality and corrected percentage mortality were calculated using the given formulas [17].

Percentage Mortality

$$\frac{\text{No. of dead larvae or pupae}}{\text{No. of larvae or pupae exposed}} \times 100$$

Corrected Percentage Mortality

$$[1 - nT/nC] \times 100$$

Using a formula that takes into account the mortality rate in the control group is recommended when it's less than 5%. This formula involves calculating the percentage of larvae or pupae that survived after treatment compared to those that survived in the control group. By doing so, the formula ensures that any differences in mortality rates between the treatment and control groups are accurately reflected, thereby avoiding any overestimation of treatment effectiveness. In summary, this approach ensures that the comparison between the two groups is fair and unbiased.

Ovicidal Activity

To determine the ovicidal activity, a modified version of Elango's method [18] was used with some minor changes. The experiment involved taking twenty newly laid eggs each from *Ae. aegypti* and *Cx. quinquefasciatus* and exposing them to five different doses, which were previously tested for their efficacy in larvicidal and pupicidal activities. The eggs were examined under a microscope to assess their hatchability. After a 120-hour exposure period, the percentage of ovicidal activity was calculated by determining the percentage reduction in the number of hatched eggs using the following formula.

Percentage of Ovicidal Activity

$$\frac{\text{No. of unhatched eggs}}{\text{Total number of eggs exposed}} \times 100$$





Jelin Vilvest et al.,

The results were compared with those of the standard control of the Temephos.

Statistical Analysis

To determine the LC₅₀ and LC₉₀ values, the corrected percentage mortality data for larvicidal, pupicidal, and ovicidal activities were subjected to probit analysis using the US EPA probit analysis software version 1.5. The statistical significance level was set at $p \leq 0.05$, and any observed differences were considered significant. In other words, the study used a statistical software to analyze the data and calculate the concentration of the tested substance that caused a 50% and 90% reduction in mosquito mortality rates. The study also ensured that any observed differences were statistically significant by setting a significance level at $p \leq 0.05$ [19].

RESULTS

The study aimed to investigate the effectiveness of three different plant leaf extracts (n-hexane, chloroform, and methanol) against two species of mosquitoes, *Ae. aegypti* and *Cx. Quinque fasciatus*. The results showed that the chloroform and methanol extracts were highly effective in controlling mosquito larvae, with LC₅₀ values ranging from 117.9-128.0 ppm. The n-hexane extract also exhibited some larvicidal activity but was less effective than the other two extracts. However, the pupicidal activity of the extracts was found to be insignificant for both mosquito species. The chloroform extract exhibited the highest pupicidal activity with LC₅₀ values of 950.1 ppm against *Ae. aegypti* and 364.9 ppm against *Cx. quinquefasciatus*. The ovicidal activity of the extracts against both mosquito species was found to be insignificant except for the chloroform extract, which showed a moderate ovicidal activity of 13.6% and 20.0% at the highest concentration of 500 ppm against *Ae. aegypti* and *Cx. Quinque fasciatus*, respectively. Overall, the study suggests that the chloroform and methanol extracts of the plant leaves could be effective in controlling mosquito larvae, while the ovicidal and pupicidal activities of the extracts were found to be insignificant or moderate.

DISCUSSION

T. stans contains insecticidal compounds that make it a potential natural alternative to synthetic insecticides. Research has shown its effectiveness against cotton aphids and fall armyworms due to the presence of compounds like ursolic acid, oleanolic acid, and quercetin [20]. The plant extracts were studied for their insecticidal properties against the diamondback moth larvae, a major pest of cabbage crops. The extracts showed significant insecticidal activity, which was attributed to the presence of flavonoids, alkaloids, and tannins [21]. Several studies have explored the mosquito-controlling properties of *T. stans*, a plant with known insecticidal properties. One such study found that *T. stans* extracts exhibited significant larvicidal activity against *Ae. aegypti*, the mosquito responsible for transmitting dengue, chikungunya, and Zika viruses. The petroleum ether extract showed the highest activity, and the researchers attributed this activity to the presence of flavonoids and alkaloids in the extracts [22]. In another study, the mosquito larvicidal activity of *T. stans* extracts against the filariasis-transmitting mosquito species *Cx. Quinque fasciatus* was evaluated. The results showed that the extracts had strong larvicidal activity against the mosquito larvae, which was attributed to the presence of bioactive compounds such as ursolic acid and oleanolic acid [23]. Additionally, a study examined the adulticidal activity of *T. stans* extracts against the malaria-transmitting mosquito species *An. stephensi*. The results revealed that the extracts demonstrated notable adulticidal activity against *An. stephensi*, which was attributed to the presence of bioactive compounds like quercetin and rutin [24]. A study investigated the potential of *T. stans* extracts to control the malaria mosquito, *Anopheles gambiae*. The researchers found that the extracts had significant larvicidal activity against *An. gambiae*, and suggested that this activity was due to the presence of compounds such as ursolic acid and oleanolic acid [25]. The researchers used different concentrations of the extracts and evaluated their effect on the larvae and pupae of the mosquitoes. The results showed that the *T. stans* leaf extracts had a significant toxic effect on both mosquito species, with the larvae being more susceptible than the pupae [26].





Jelin Vilvest et al.,

The present study suggests that this finding is in line with previous studies that have shown the larvicidal activity of plant extracts against mosquito larvae [27]. The n-hexane extract also exhibited some larvicidal activity, albeit less effective than the chloroform and methanol extracts. However, the pupicidal activity of the extracts was found to be insignificant for both mosquito species. This suggests that the plant extracts may not be effective in controlling mosquito pupae, which is a critical stage in the mosquito life cycle. The chloroform extract exhibited the highest pupicidal activity with LC₅₀ values of 950.1 ppm against *Ae. aegypti* and 364.9 ppm against *Cx. Quinque fasciatus*, but the values are relatively high compared to the larvicidal activity. The ovicidal activity of the extracts against both mosquito species was found to be insignificant except for the chloroform extract, which showed a moderate ovicidal activity of 13.6% and 20.0% at the highest concentration of 500 ppm against *Ae. aegypti* and *Cx. quinquefasciatus*, respectively. This suggests that the chloroform extract may have some potential in controlling mosquito eggs, although its effectiveness may still be limited. Overall, the study suggests that the chloroform and methanol extracts of the plant leaves could be effective in controlling mosquito larvae, while the ovicidal and pupicidal activities of the extracts were found to be insignificant or moderate. However, further studies are needed to fully elucidate the mechanisms of action and safety profile of the plant extracts for mosquito control purposes.

CONCLUSION

Plant extracts from *T. stans* show promise as a natural and eco-friendly alternative to synthetic insecticides for controlling mosquito-borne diseases. The study found that sequential chloroform and methanol extracts of *T. stans* leaves exhibited larvicidal activities against *Ae. aegypti* and *Cx. Quinque fasciatus* mosquitoes, with the chloroform extract being the most effective. However, all three extracts lacked pupicidal and ovicidal activity. The study's findings suggest that further research is needed to identify the active compounds responsible for the extracts' insecticidal activity and to investigate their mechanisms of action. Overall, these findings support the potential of *T. stans* extracts as a natural and eco-friendly alternative for mosquito control measures.

Recommedantion for Future Studies

To advance the understanding of *T. stans*' potential for mosquito control, future studies should focus on identifying the active compounds and their mode of action, as well as evaluating the safety and efficacy of the extracts in field conditions. There is also potential for investigating the synergistic effects of different plant extracts and combining them with conventional insecticides. Furthermore, expanding the study to include other medically important mosquito species could provide valuable insights into the plant's broader applicability.

Abbreviations

Ae.aegypti : *Aedes aegypti*;

Cx.quinquefasciatus: *Culex quinquefasciatus*;

T.stans: *Tecoma stans*;

ANOVA: Analysis of variance;

LC: lethal concentration;

LL: lower limit;

UL: upper limit;

PPM: Parts per million;

DMSO: Dimethyl sulfoxide.

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Table 1. Lethal concentration (in ppm) of crude extracts of leaves of *T.stans* against the larvae of *Ae. aegypti* and *Cx. quinquefasciatus*

Species	Extract	LC ₅₀ (ppm)	95% confidence limit		LC ₉₀ (ppm)	95% confidence limit		Slope ± SE	Intercept ± SE	χ ²
			LL	UL		LL	UL			
Ae. aegypti larvae	n-Hexane	142.1	61.3	273.7	352.2	206.0	5236.4	3.2 ± 0.5	-2.0 ± 1.2	8.7*
	Chloroform	119.5	66.2	187.3	269.2	175.3	1168.4	3.6 ± 0.5	2.5 ± 1.1	6.1*
	Methanol	128.0	60.1	225.4	296.2	182.1	2545.9	3.5 ± 0.5	-2.4 ± 1.2	7.9*
Cx. quinquefasciatus larvae	n-Hexane	130.3	59.6	230.0	321.8	194.0	2919.3	3.2 ± 0.5	-1.9 ± 1.1	7.6*
	Chloroform	117.9	106.2	130.3	262.5	228.7	314.1	3.6 ± 0.3	-2.6 ± 0.6	5.8*
	Methanol	116.2	104.4	128.5	261.9	227.8	314.0	3.6 ± 0.3	-2.4 ± 0.6	5.7*

LC₅₀-lethal concentration that kills 50% of the exposed larvae; LC₉₀-lethal concentration that kills 90% of the exposed larvae; LL-lower limit (95% confidence limit); UL-upper limit (95% confidence limit). *p ≤ 0.05, level of significance of chi-square values.





Jelin Vilvest et al.,

Table 2. Lethal concentration (in ppm) of crude extracts of leaves of *T.stans* against the pupae of *Ae. aegypti* and *Cx. quinquefasciatus*

Species	Extract	LC ₅₀ (ppm)	95% confidence limit		LC ₉₀ (ppm)	95% confidence limit		Slope ± SE	Intercept ± SE	χ ²
			LL	UL		LL	UL			
<i>Ae. aegypti</i> larvae	n-Hexane	1616.0	908.0	5872.8	11908.0	3863.5	16344.1	1.4 ± 0.3	0.2 ± 0.7	0.1*
	Chloroform	950.1	678.0	1782.2	3790.6	1960.3	13947.0	2.1 ± 0.3	-1.3 ± 0.9	0.7*
	Methanol	1741.3	964.9	7057.0	10536.4	3486.9	15949.0	1.6 ± 0.3	-0.3 ± 0.8	0.1*
<i>Cx. quinquefasciatus</i> larvae	n-Hexane	364.0	197.8	1087.6	1158.0	495.0	1499.0	2.5 ± 0.5	-1.5 ± 1.2	7.6*
	Chloroform	364.9	316.7	434.6	1127.5	849.2	1706.8	2.6 ± 0.2	-1.7 ± 0.6	4.9*
	Methanol	369.2	313.9	454.3	1375.9	975.7	2308.7	2.2 ± 0.2	-0.7 ± 0.5	3.3*

LC₅₀-lethal concentration that kills 50% of the exposed larvae; LC₉₀-lethal concentration that kills 90% of the exposed larvae; LL-lower limit (95% confidence limit); UL-upper limit (95% confidence limit). *p ≤ 0.05, level of significance of chi-square values.

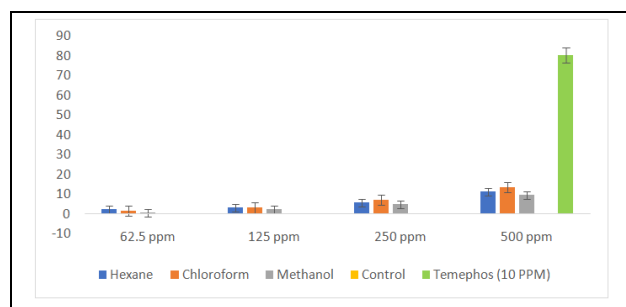


Figure1. Percent ovicidal activity of crude extracts of leaves of *T.stans* against *Ae. aegypti* eggs.

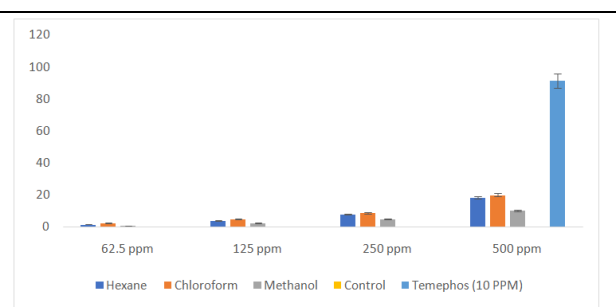


Figure2. Percent ovicidal activity of crude extracts of leaves of *T.stans* against *Cx. quinquefasciatus* eggs.





Growth Trend of FPOs in Farmers' Empowerment and Rural Development of Indian Agriculture

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ABSTRACT

Farmer Producer Organizations (FPOs) have emerged as an important stakeholder in the agricultural sector of India, enabling small and marginal farmers to collaborate and market their produce together for better economic returns. Additionally, they contribute to the adoption of environmentally sustainable farming practices and improve the standard of living of farmers. This study aimed to investigate the present status of FPOs in India and examine the region-wise trend in their formation from 2012 to 2022. The analysis was conducted using compound annual growth rate (CAGR), which provided valuable insights into the growth and development of FPOs across different regions of the country. The findings of this study can inform policymakers and stakeholders on the factors driving FPO growth and identify regions that require targeted interventions to promote FPO development. Overall, this research contributes to the existing literature on FPOs in India and provides a better understanding of their potential impact on the agricultural sector and rural development. Promotion of FPOs has been widespread across different states in India, with the majority of states having more than one hundred



**Sasikanth et al.,**

FPOs promoted. Overall, the CAGR of FPO promotion in different regions of India indicates progress towards more inclusive, sustainable, and profitable agriculture.

Keywords: FPO, Formation, Promotion, CAGR, Trend, SFAC

INTRODUCTION

Landholding in India is fragmented, making small-scale farming unprofitable. This has resulted in limited forward connections, market prospects, supply chains, quality inputs, and advanced technologies. Small and marginal farmers, who make up 85% of the landholding[1], face poor technology adoption, inadequate extension help, and little financial support. Reviving Indian agriculture requires structural reforms and transformational approaches. Collective farming can help small farmers access contemporary technologies, financial support, and greater market prospects by achieving economies of scale. India has experimented with various forms of collective model to support small and marginal farmers, but cooperatives have faced several challenges[2]. These include excessive dependence on government funding, political interference, bureaucratization. As an alternative, producer companies were recommended in 2000 by a committee chaired by Y.K. Alagh. Producer companies were envisioned to combine the best aspects of the cooperative and corporate sectors to benefit primary producers, especially small and marginal farmers[3]. The Companies Act of 1956 was amended in 2002 to allow for the creation of producer companies as a new form of corporate entity in India[4]. These companies were designed to operate as member-owned and member-controlled entities, with a focus on promoting the economic interests of their members through the production, marketing, and sale of agricultural produce[5]. In India, there are various legal provisions under which a Producer Organization (PO) can be registered. Apart from registering under the Companies Act of 1956, a PO can also register under the Cooperative Societies Act or Autonomous or Mutually Aided Cooperative Societies Act of the respective state, the Multi-State Cooperative Society Act of 2002, the Producer Company under Section 581(C) of the Indian Companies Act of 1956 as amended in 2013, the Section 25 Company of the Indian Companies Act of 1956 as amended in Section 8 in 2013, Societies registered under the Society Registration Act of 1860, or Public Trusts registered under the Indian Trusts Act of 1882[5].

This flexibility in registration options allows for greater accessibility and choice for producer organizations seeking legal recognition, and enables them to choose the legal form that best suits their specific needs and objectives. FPOs have positively impacted farmers by improving their incomes, providing them with access to better inputs and technologies, and mitigating risks associated with crop failure[6]. Government of India has recognized the importance of Farmer Producer Organizations (FPOs) in enhancing the income of farmers and promoting agricultural growth. In the Union Budget 2021-22, the government announced its plan to establish 10,000 new FPOs by the end of 2027-28[7]. The Small Farmers Agribusiness Consortium (SFAC) is the nodal agency for the promotion of Farmer Producer Organizations (FPOs) in India[8]. The formation and promotion of Farmer Producer Organizations (FPOs) under the Central Sector Scheme for the Formation and Promotion of FPOs is implemented through Implementing Agencies (IAs). The IAs are responsible for identifying, registering, and providing technical assistance and capacity-building support to FPOs[9]. The Implementing Agencies (IAs) under the Central Sector Scheme for the Formation and Promotion of FPOs engage Cluster Based Business Organizations (CBBOs) to provide professional handholding support to each FPO for five years. CBBOs provide training, capacity building, and market access support to FPOs to become efficient and competitive[10].

Purpose of the study

The study aims to analyze and assess the current status and growth of Farmer Producer Organizations (FPOs) in different regions of India. The study seeks to provide valuable insights into the growth and development of FPOs in the country. The findings of this study can help policymakers, stakeholders, and investors to understand the potential of FPOs and make informed decisions to support their growth and expansion.





Sasikanth et al.,

MATERIALS AND METHODS

The study focused on analyzing the current status and growth of Farmer Producer Organizations (FPOs) in India, using secondary data collected between 2012 and 2022. The data was sourced from the Small Farmers' Agribusiness Consortium (SFAC) and the National Bank for Agriculture and Rural Development (NABARD). The Compound Annual Growth Rate (CAGR) was used to determine the annual growth rate of FPOs. The percentage distribution of each state was calculated to present the state-wise share of FPOs registered. To analyze the promotion of Farmer Producer Organizations (FPO) in different regions, a classification was made based on the states. The northern region included Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh, and Uttarakhand. The western region comprised Chhattisgarh, Goa, Gujarat, Madhya Pradesh, and Maharashtra. Andhra Pradesh, Karnataka, Kerala, Lakshadweep, Puducherry, Tamil Nadu, and Telangana were considered the southern region. The eastern region included the Andaman and Nicobar Islands, Bihar, Jharkhand, Odisha, Sikkim, and West Bengal. Finally, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura were grouped together in the north-eastern region.

RESULTS AND DISCUSSIONS

Status of Farmer Producer Organisations (FPOs)

India have gained significant momentum in recent years as a means to promote farmer entrepreneurship, enhance bargaining power, and provide access to better technology, inputs, and markets. The table 1 shows a list of implementing agencies involved in the promotion of FPO and their corresponding number of FPOs promoted under various initiatives. NABARD tops the list with 2062 FPOs promoted under Produce Fund and various initiatives and 1173 FPOs promoted under Central Sector Scheme, making a total of 3235 FPOs (44.01% of the total). SFAC follows with a total of 2454 FPOs (33.38% of the total), out of which 901 FPOs were promoted under 5 Year Programme and 1553 FPOs under Central Sector Scheme. NAFED has promoted 551 FPOs (7.50% of the total), while NCDC has promoted 472 FPOs (6.42% of the total). Other agencies that have promoted FPOs include the FDRVC-MoRD (215 FPOs, 2.92% of the total), GAICL (100 FPOs, 1.36% of the total), WDD-Karnataka (100 FPOs, 1.36% of the total), NERAMAC (54 FPOs, 0.73% of the total), SFAC-TN (50 FPOs, 0.68% of the total), UPDASP (50 FPOs, 0.68% of the total), SFAC-HR (49 FPOs, 0.67% of the total), TRIFED (12 FPOs, 0.16% of the total), and NDDDB (9 FPOs, 0.12% of the total). The promotion of Farmer Producer Organizations (FPOs) by various agencies can have a significant impact on the agricultural sector and rural development in India.

State-wise FPO distribution

Based on the information presented in Table 2 promotion of FPOs has been widespread across different states in India, with the majority of states having more than one hundred FPOs promoted. It is possible to gauge the level of interest and support for FPOs as a tool to improve the standard of living of farmers by looking at the number of FPOs that are being formed in a state. It is clear that there is a growing interest in FPOs in various parts of the country, as seen by the large number of FPOs that are being promoted in states such as Uttar Pradesh, Madhya Pradesh, and Rajasthan. On the other hand, Lakshadweep is tied for last place with Puducherry and the Andaman and Nicobar Islands in terms of the number of FPOs that have been promoted. The northern region of India is responsible for the promotion of the most FPOs, with a total of 2006. This represents 27.29% of the total FPOs promoted in India. The Western region stands second with a total of 1882 FPOs, contributing to the overall total of 25.60 percent of FPOs promoted. The number of FPOs promoted in the southern region is 1667 (22.68%), while the number promoted in the eastern region is 1363 (18.54%). The number of FPOs promoted in India's north-eastern region is the lowest of any other region in the country, at 433; this represents only 5.89% of the country's total number of FPOs promoted.



**Sasikanth et al.,****Compound Annual Growth Rate analysis**

The table 3 and Figure 1 provides information on the Compound Annual Growth Rate (CAGR) of Farmer Producer Organizations (FPOs) promotion in different regions of India. The data shows that the overall CAGR for FPO promotion in India is 29.75%. The Southern region has the highest CAGR of 36.12%, followed closely by the Eastern and North Eastern regions with CAGRs of 33.89% and 35.03% respectively. This suggests that FPO promotion is growing at a faster rate in these regions than in other parts of India. The Northern and Western regions also have a relatively high CAGR with 23.38% and 22.71% respectively. Although the growth rate in these regions is lower than the Southern, Eastern and North Eastern regions, it still indicates a positive trend towards the promotion of FPOs in these areas.

CONCLUSION

The promotion of Farmer Producer Organizations (FPOs) has emerged as a key strategy for empowering small and marginal farmers in India. The Compound Annual Growth Rate (CAGR) of FPO promotion in different regions of the country provides insights into the progress and potential of this approach. The Southern region of India has recorded the highest CAGR in FPO promotion, followed by the Eastern and North Eastern regions. This indicates a positive trend towards the promotion of FPOs in these regions, which can have significant implications for the income and livelihoods of farmers. The Northern and Western regions of India also have a relatively high CAGR, suggesting that the promotion of FPOs is gaining momentum in these regions as well. The higher growth rate in FPO promotion can suggest that more farmers are joining FPOs, which could lead to an increase in their income. By promoting FPOs, the government can encourage more farmers to adopt modern farming practices and increase their yield. A higher growth rate in FPO promotion can, therefore, indicate a positive trend in agricultural productivity. The scheme can also help farmers access better markets, improving the integration of the agricultural supply chain and ensuring better prices for farmers. Overall, the CAGR of FPO promotion in different regions of India indicates progress towards more inclusive, sustainable, and profitable agriculture. However, it is important to ensure that the success of FPOs is sustained by effective implementation, coordination among stakeholders, and adequate policy support. A holistic approach is necessary to maximize the potential of FPOs in transforming the lives of small and marginal farmers in India.

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Sasikanth et al.,

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Table 1: Implementing agency-wise number of FPOs promoted

Implementing agency	FPOs promoted
National Bank for Agriculture and Rural Development Under Produce fund & Various initiatives -2062 Under Central Sector Scheme -1173	3235 (44.01)
Small Farmers' Agri-Business Consortium Under 5 Year Programme - 901 Under Central Sector Scheme – 1553	2454(33.38)
National Agricultural Cooperative Marketing Federation of India	551 (7.50)
National Cooperative Development Corporation	472 (6.42)
Foundation for Development of Rural Value Chains (Ministry of Rural Development)	215 (2.92)
Gujarat Agro Industries Corporation Limited	100 (1.36)
Watershed Development Department - Government of Karnataka	100 (1.36)
North Eastern Regional Agricultural Marketing Corporation	54 (0.73)
Small Farmers' Agri-Business Consortium-Tamil Nadu	50 (0.68)
Uttar Pradesh Diversified Agriculture Support Project	50 (0.68)
Small Farmers' Agri-Business Consortium- Haryana	49 (0.67)
Tribal Cooperative Marketing Development Federation	12 (0.16)
National Dairy Development Board	9 (0.12)
Total	7351 (100.0)

Source: Compiled from web source of [11,12,13]





Sasikanth et al.,

Table 2: State-wise distribution on the formation of FPO

State	Total
NORTHERN REGION	
Delhi	4 (0.05)
Haryana	205 (2.79)
Himachal Pradesh	153 (2.08)
Jammu & Kashmir	123 (1.67)
Punjab	109 (1.48)
Rajasthan	533 (7.25)
Uttar Pradesh	705 (9.59)
Uttarakhand	174 (2.37)
Northern region total	2006 (27.69)
WESTERN REGION	
Chhattisgarh	193 (2.63)
Goa	12 (0.16)
Gujarat	424 (5.77)
Madhya Pradesh	682 (9.28)
Maharashtra	571 (7.77)
Western region total	1882 (25.60)
SOUTHERN REGION	
Andhra Pradesh	280 (3.81)
Karnataka	511 (6.95)
Kerala	190 (2.58)
Lakshadweep	3 (0.04)
Puducherry	3 (0.04)
Tamil Nadu	426 (5.80)
Telangana	254 (3.46)
Southern region total	1667 (22.68)
EASTERN REGION	
Andaman and Nicobar Islands	6 (0.08)
Bihar	346 (4.71)
Jharkhand	244 (3.32)
Odisha	409 (5.56)
Sikkim	43 (0.58)
West Bengal	315 (4.29)
Eastern region total	1363 (18.54)
NORTH-EASTERN REGION	
Arunachal Pradesh	28 (0.38)
Assam	221 (3.01)
Manipur	40 (0.54)
Meghalaya	38 (0.52)
Mizoram	34 (0.46)
Nagaland	37 (0.50)
Tripura	35 (0.48)
North-Eastern region total	433 (5.89)
All India total	7351 (100.0)

Source: Compiled from web source of [11,12,13]

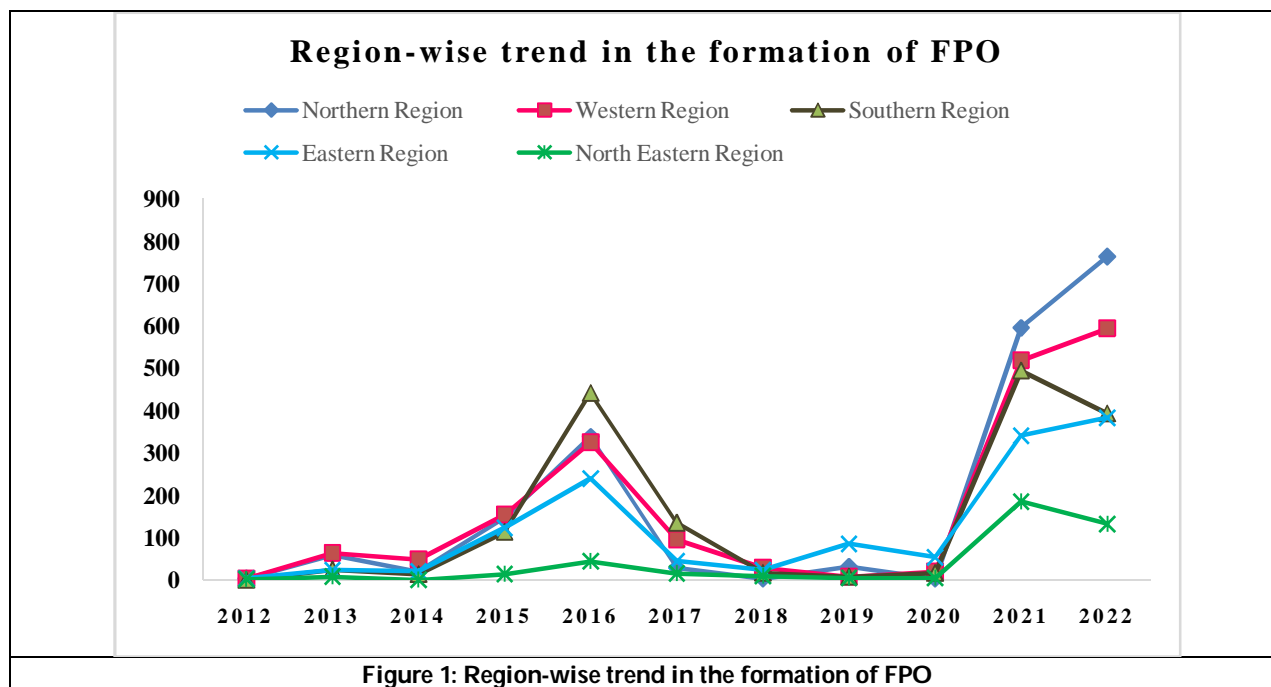




Sasikanth et al.,

Table 3: Compound Annual Growth Rate

Region	Compound Annual Growth Rate
Northern Region	23.38
Western Region	22.71
Southern Region	36.12
Eastern Region	33.89
North Eastern Region	35.03
All India Total	29.75





Identification of Corona Disease using Mobile Net - based Convolutional Neural Network

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ABSTRACT

In order to make a difference in the fight against coronavirus disease, quick and precise diagnostic tools are now necessary. Recent uses of deep learning in image classification, including the identification of coronavirus disease using X-ray chest images, have shown significant promise. The Convolutional Neural Network (CNN) built on the ResNet50 architecture and the MobileNet architecture were developed, tested, and evaluated for their performance with metrics like accuracy, sensitivity, and specificity in order to determine the most efficient coronavirus disease advanced machine learning framework identification. The research reveals that the MobileNet-based CNN is suggested to be a better option than the ResNet50- based CNN, given the significance of a quick and accurate diagnosis of coronavirus disease due to its computational effectiveness and real-time capabilities. In environments with limited resources, the MobileNet-based CNN could be a helpful tool for coronavirus disease monitoring and diagnosis. In comparison to the ResNet50-based CNN's, obtaining 100% accuracy, sensitivity, and specificity, compared to 99.4% accuracy, 98.3% sensitivity, and 100% specificity for the ResNet50-based CNN.

Keywords: corona virus disease, diagnostic technologies, deep learning, Convolutional Neural Network (CNN), ResNet50, Mobile Net.

INTRODUCTION

The coronavirus disease, which resulted in widespread illness and fatalities, had an immense effect on the world. The pandemic has brought attention to how crucial quick and trustworthy diagnostic techniques are in preventing its





Moufia Justin et al.,

spread. Evaluations done by the radiologists on the X-ray images in the chest area are rigid and prone to errors, despite the fact that it is one of the frequently used examination methods for coronavirus disease detection. The coronavirus disease that resulted as a pandemic had an enormous influence on the world, resulting in widespread illness and fatalities. Deep learning techniques in classifying pictures have diagnostic tool that will enable radiologists quickly and highlighted the need for quick and precise diagnostic tools to help halt the propagation of the disease. The goal is to create a real-time, dependable, and effective solution for the diagnosis of coronavirus disease and monitoring in resource-constrained environments. The results of this research may be helpful in creating a computerized. precisely identify coronavirus disease. This study compares the ResNet50-based CNN and the MobileNet- based CNN for coronavirus disease detection .The images used are chest X-ray images. Deep learning approaches play a vital role in bringing a revolution in the health industry. It was assessed how well the two models detected coronavirus disease when chest X-ray images were used. The results of this study could have a big impact on the creation of real-time, inexpensive, and precise coronavirus disease diagnostic tools that can be applied in environments with limited resources.

The ResNet50 and MobileNet architectures, two well- known deep learning models developed for predicting the presence of coronavirus disease, are assessed in the paper. The following information will be useful to researchers and practitioners in the fields of computer vision and medical imaging as they work to advance more precise and potent diagnosis approaches. Deep learning models may help to prevent the viral infection from spreading by providing a quick and accurate diagnosis, which are crucial in preventing further transmission.

LITERATURE REVIEW

The ResNet50 architecture, a popular convolutional neural network, has been modified by Elpeltagy, Marwa, and Hany Sallam[1] in an effort to improve the coronavirus disease diagnostic accuracy with X-ray and Computerised Tomography (CT) scan images. As a result of this update, three new layers will be added: Batch Normalise, Activation Relu and Conv. Convolutional operations are carried out by the Conv layer and aid in the extraction of pertinent features from the images we give as input. The Batch Normalize layer helps in normalizing the activations of the previous layer, which helps in reducing the internal covariate shift and speeds up the training process. The model's Activation Relu layer, which adds non-linearity, is helpful in boosting the network's ability to discriminate. With an accuracy of 97.1% for the X- Ray dataset, and 97.7% for the CT dataset, the suggested adjustment excels in comparison to earlier techniques. These results demonstrate the potential for precise coronavirus disease identification and diagnosis on radiological images using transfer learning and pre-trained Convolution Neural Networks. Models from Deep learning were used by Nandi, Ritika, and Manjunath Mulimani[2] to develop a technique for automatically diagnosing coronavirus disease. The hybrid model includes two portable deep neural networks, MobileNet and ResNet50 , which can be used with personal digital assistants (PDAs) that are based on low hardware resource for quick detection of coronavirus disease.

Two publicly accessible coronavirus disease chest X-ray datasets were used. Among the datasets are chest X-rays that have been tainted with coronavirus disease and pneumonia. The average accuracy of the hybrid model was 84.35% on the first Dataset and 94.43% on second Dataset. For classification into 4 classes, the hybrid model's AUROC is 1.00, and for classification into 3 classes, it is 0.99. The researchers (Nayak, Soumya Ranjan et al.) [3] test the ability to distinguish between coronavirus disease situations. Eight pre-trained Convolutional Neural Network (CNN) models, namely GoogleNet, AlexNet, VGG-16, Inception-V3 , MobileNet-V2, ResNet-34, ResNet-50, and Squeeze Net were used for implementation. They also compare these models while taking into account a number of crucial factors, such as learning rate, batch size, type of optimizers and number of epochs, in order to determine which model is the most suitable. When the models were tested on chest X-ray images that were made public, ResNet 34 outperformed with an accuracy score of 98.33%. With a precision of 96.72%, specificity of 96.67%, sensitivity of 98.33%, F1-score of 0.9752, accuracy of 97.50%, and AUC of 0.964, the AlexNet network placed second for coronavirus disease prediction.





Moufia Justin et al.,

To detect coronavirus disease using chest X-rays, Kumar, Sanjay, and Abhishek Mallik[4] proposed TOTL, a highly effective and efficient method. By using additional symptoms or infections in the organ, this task to identify coronavirus disease could be extended. Future studies may take into account factors like age, gender, respiratory characteristics, medical genetic history, history, and location data, among other things. Computer vision-based techniques can be used to identify a number of additional diseases. Chest X rays are pre-processed with contrasting, denoising, segmentation, and by pre-processing cropping around the lung region order to extract only pertinent information. InceptionV3, InceptionResNetV2, Xception, ResNet50, MobileNet, VGG19, ResNet50V2, VGG16, and are just a few number of the pre-trained transfer learning models that are fed the pre-processed images.

Teja Krishna Cherukuri, Tejik, and Nagur Shareef[5] Several pre-trained models, such as VGG16, VGG19, InceptionV3, ResNet50, Xception, ResNet50V2, MobileNet and Inception ResNetV2, are adjusted using lung CT scan images. These trained models are combined into an effective ensemble classifier, which makes the final prediction. The results imply that Modified MobileNet, ResNet with 50 layers, and VGG with 16 layers have demonstrated their architectural stability for the covid detection job by producing accurate predictions in comparison to other models. The highest (97.79%) was achieved by ResNet50V2 and InceptionResNetV2 (IRV2) classification accuracy was the lowest (91.35%)

METHODOLOGY

Artificial neural networks and representation learning are key components of supervised, semi-supervised, and unsupervised learning methods that all fall under deep learning. Convolutional Deep belief networks, neural networks, transformers, recurrent neural networks, and deep reinforcement learning are just a few of the deep learning models that have applications in a wide range of industries, consisting of naive Bayes, computer vision, speech recognition, and natural language understanding. The term "deep" means using multiple layers in the neural network is known as "deep learning". Initial research demonstrated that a linear perceptron was unable to reflect all biological systems' information processing and communication patterns. For improved effectiveness, trainability, and interpretability, deep learning allows the layers to be diverse and deviate greatly from connectionist models that were inspired by biology. The number and size of layers can be changed to produce different degrees of abstraction, and the learning process can determine where the best features should be positioned Gathering the data and pre-processing: The collection of a publicly accessible dataset of X-ray images for coronavirus disease identification is the first stage in the planned approach. The dataset should contain a sufficient number of coronavirus-positive and negative examples in order to ensure accurate model training and evaluation. Out of 1612 chest X-ray images, 1016 coronavirus disease were positive cases, and 596 were normal cases. The dataset needs to be pre-processed after collection in order to improve model performance. This entails scaling the images to a fixed size and normalizing the pixel values in order to guarantee that all photographs have the same scale and range. As was previously mentioned, by taking this step, the effect of variations in image size and brightness on model performance can be lessened.

Data splitting and model selection: The following step is to choose models of deep learning for coronavirus disease identification using the X-ray images of the chest. As previously mentioned, two well-known models, ResNet50 and MobileNet, have been selected for the purpose of this research. These models were selected because they have demonstrated promising performance in image classification tasks and have been successfully applied to coronavirus disease detection in earlier studies. The dataset is used to create three sets: a training set, a testing set and a validation set. In this investigation, an 80:20 ratio was used. The training set is for developing the models, the testing set is for evaluating the effectiveness of the models. The validation set is for modifying the hyper parameters and preventing overfitting.

Model training: The chosen models are then trained using tried-and-true methods like transfer learning on the training set. Modifying a previously learned model for a specific task is what transfer learning entails. After





Moufia Justin et al.,

being trained on a sizable dataset of images, the pre-trained models in this study were modified to the precise objective of coronavirus disease identification using X- ray images of the chest

After the models have been trained, their effectiveness is evaluated using metrics like accuracy, specificity, and sensitivity on the testing set. Model comparison and deployment follow. Sensitivity is the percentage of true positive cases, while specificity is the percentage of true negative cases. Accuracy is the percentage of occurrences that are correctly identified. The models' ability to distinguish between coronavirus disease positive and negative cases is evaluated using these metrics. The performance of the MobileNet and ResNet50 models is then assessed using the evaluation metrics to determine which model performs the best at coronavirus disease detection. As was previously mentioned, the MobileNet-based CNN performed better in this study than the ResNet50-based CNN, achieving 100% accuracy, sensitivity, and specificity. If the chosen model performs well in real-world situations, its clinical performance can be evaluated using fresh chest X-ray images. This step is crucial to ensuring that the model can reliably and accurately detect coronavirus disease in practical settings. The selected model has been tested and validated in real-world scenarios and is ready for use in clinical settings for coronavirus disease identification. The model can be a useful tool for diagnosing and monitoring coronavirus disease in environments with limited resources. Last but not least, it's crucial to keep reviewing and updating the model in light of new data and input from medical professionals. This step can help the model become more accurate and reliable over time while also keeping it up to date with the most recent developments in coronavirus disease detection using X-ray images of the chest.

Dataset

The dataset used for this is the COVID-1016 and Normal-596 dataset, which is available on Kaggle. This dataset contains 1,612 chest X-ray images, of which 1,016 are coronavirus disease-positive cases, and the remaining 596 are normal ones. An 80:20 ratio was used to divide the pre- processed dataset into training and validation sets, meaning that 80% of the data were used to train the model and 20% were used to validate it. Tools used for this proposed system included the Image Processing Toolbox and MATLAB Online, a cloud-based version of the MATLAB software. A pre-trained model, such as ResNet50 or MobileNet, is used to create the graphs in Figures 3 and 5, which are then refined for a new task using a set of layers tailored to the new classification problem. By adding augmentation concept to the original images, the training dataset is created, and the augmented images are saved in an augmented Image Datastore object. The transfer learning model is then trained using the augmented Image Data store object, the layer graph object graph, and the training options object options. The model's weights and biases are updated during training to bring down the classification error between predicted and actual labels.

Performance Metrics

Accuracy, specificity, F1 score, and sensitivity are performance metrics that are computed using the confusion matrix. Following is the calculation for these metrics:

$$\text{Accuracy} = \frac{(\text{TP} + \text{TN})}{(\text{TP} + \text{FP} + \text{FN} + \text{TN})}$$

$$\text{Sensitivity (or recall)} = \frac{\text{TP}}{(\text{TP} + \text{FN})}$$

$$\text{Specificity} = \frac{\text{TN}}{(\text{TN} + \text{FP})}$$

$$\text{F-score} = 2 * (\text{precision} * \text{recall}) / (\text{precision} + \text{recall})$$



**Moufia Justin et al.,**

Performance Evaluation

ResNet50 and MobileNet, two well-liked deep-learning models for coronavirus disease recognition, are evaluated in Table.1 using chest X-ray images. Both models showed exceptional levels of sensitivity, specificity, and in the identification of coronavirus disease, with MobileNet outperforming ResNet50 in terms of F1-score and accuracy. Particularly, ResNet50 achieved accuracy, sensitivity, and specificity of 99.4%, 62.4%, and 100%, whereas MobileNet achieved accuracy, specificity and sensitivity of 100%. In comparison to MobileNet's precision and recall for the sample, ResNet50's were 1.0 and 62.4% and 1.0 and 60 %, respectively.

RESULTS

MobileNet-based CNN beat the ResNet50-based CNN in terms of all three parameters, reaching 100% accuracy, 100% sensitivity, and 100% specificity, compared to 99.4% accuracy, 98.3% sensitivity, and 100% specificity for the ResNet50-based CNN. The fact that ResNet50 has more computational requirements and more parameters than MobileNet architecture, which is specifically created for mobile devices, may be the cause of the performance gap between the two models. Additionally employing depth with separable convolution layers, MobileNet achieves good accuracy while utilizing minimal CPU resources. ResNet50, on the other hand, is a significantly larger model and needs more computing power

CONCLUSION AND FUTURE SCOPE

The coronavirus disease pandemic has, in conclusion, highlighted the urgent need for precise and efficient diagnostic tools to halt the disease's spread. In this study, we investigated ResNet50-based CNN and MobileNet-based CNN using chest X-ray images and two well-known deep learning models, coronavirus disease authentication. The MobileNet-based CNN outperformed the other models in terms of precision, sensitivity, and specificity, according to our findings. The MobileNet-based CNN was found to be computationally more efficient, making it a better choice for implementation in the real world. In order to validate coronavirus disease, future research must evaluate the efficacy of using more varied and substantial datasets. Examining the use of additional imaging techniques, like CT scans (computed tomography), as well as the potential for combining various imaging modalities, is also necessary to diagnose coronavirus disease with greater accuracy. Last but not least, it is critical to consider the moral implications of using automated techniques to diagnose coronavirus disease and to ensure that they are fairly and responsibly integrated into the healthcare system.

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Table. 1. Comparing performance metrics of two models ResNet50 and MobileNet

Model	Precision	Accuracy	F1-Score	Recall
ResNet50	1.0	99.4%	77.6%	62.4%
Mobile Net	1.0	100%	78.8%	64.0%





Moufia Justin et al.,

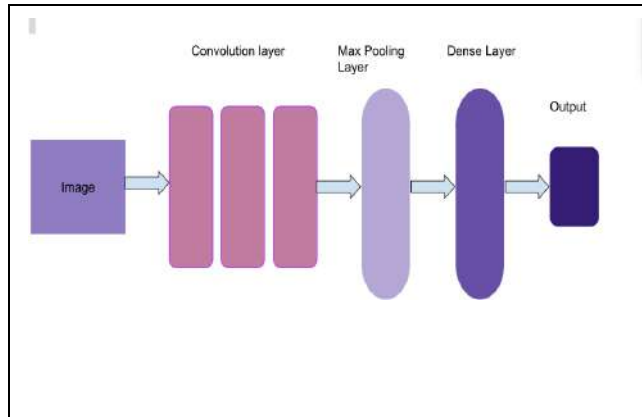


Fig.1.CNN architecture

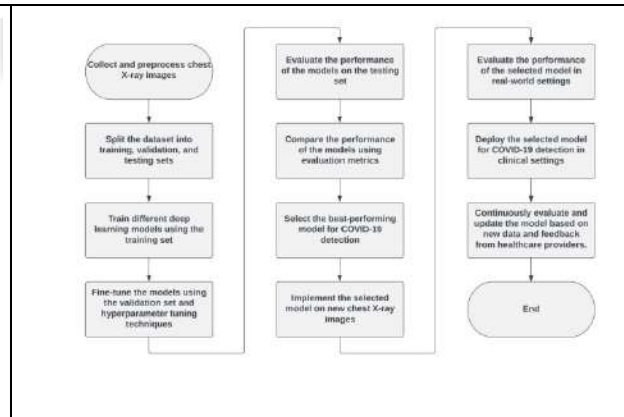


Fig.2 Flow chart

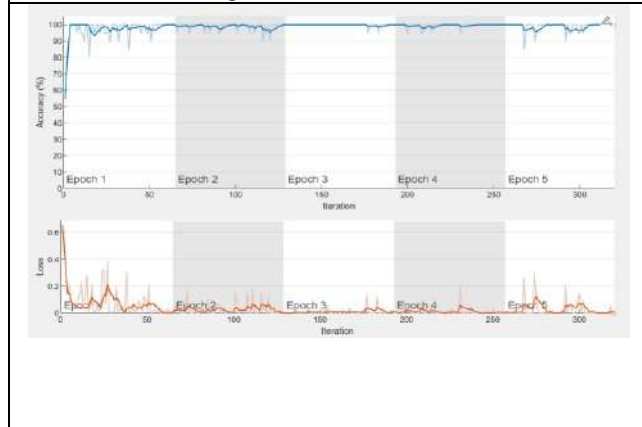


Fig. 3. ResNet50 model's training progress and identify issues such as overfitting or underfitting

Results	
Validation accuracy:	N/A
Training finished:	Max epochs completed
Training Time	
Start time:	10-Apr-2023 22:42:37
Elapsed time:	14 min 7 sec
Training Cycle	
Epoch:	5 of 5
Iteration:	320 of 320
Iterations per epoch:	64
Maximum iterations:	320
Validation	
Frequency:	N/A
Other Information	
Hardware resource:	Single CPU
Learning rate schedule:	Constant
Learning rate:	0.0001

Fig. 4. ResNet50 Model Training Report

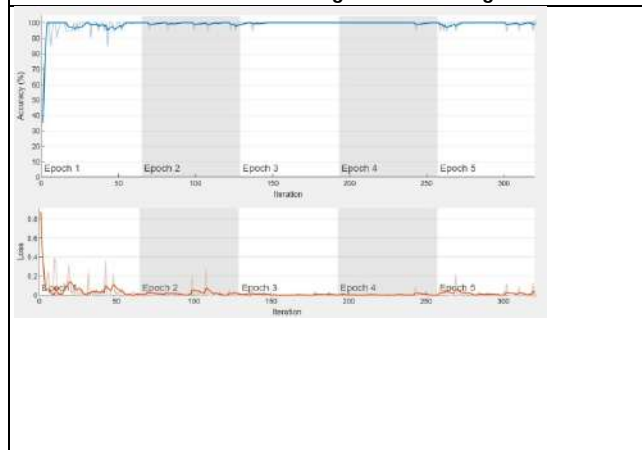


Fig. 5. Mobile Net model's training progress and identify issues such as overfitting or underfitting

Results	
Validation accuracy:	N/A
Training finished:	Max epochs completed
Training Time	
Start time:	10-Apr-2023 23:58:56
Elapsed time:	11 min 44 sec
Training Cycle	
Epoch:	5 of 5
Iteration:	320 of 320
Iterations per epoch:	64
Maximum iterations:	320
Validation	
Frequency:	N/A
Other Information	
Hardware resource:	Single CPU
Learning rate schedule:	Constant
Learning rate:	0.0001

Fig. 6. MobileNet Model Training Report





Moufia Justin et al.,

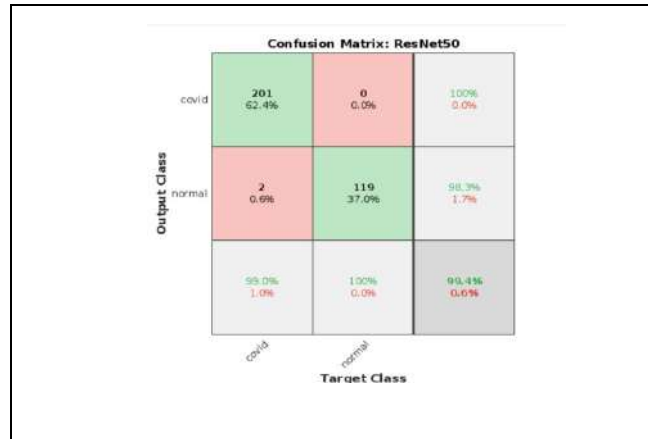


Fig. 7. Confusion matrix for ResNet50

Fig. 8. Confusion matrix for Mobilenet

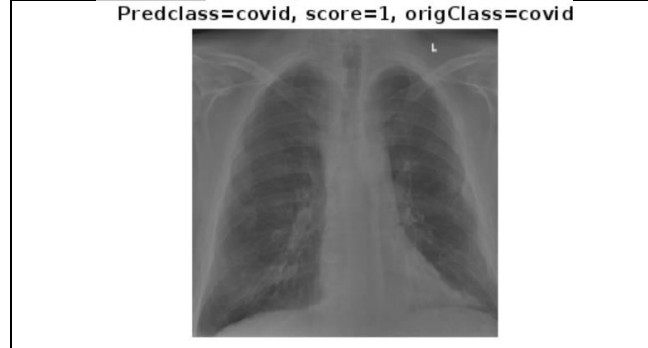


Fig. 9. Output of resnet50 which is identified as covid image

Fig. 10. Output of Mobilenet, which is identified as a covid image





Wound Healing Activity of Ethanolic Extract of Leaves of *Ampelocissus araneosa*

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ABSTRACT

The objectives of this study are to evaluate the wound healing activity of ethanolic extracts of leaves of *Ampelocissus araneosa* by excision wound model and incision wound model in rats. Powdered leaf materials were extracted with ethanol using the soxhlet apparatus. The dried extracts were subjected to preliminary phytochemical analysis and the extracts were evaluated for dermal toxicity by OECD guideline 402 and acute oral toxicity by OECD guideline 425. Preliminary phytochemical examination showed the presence of Alkaloids, Flavonoids, Tannins, Proteins and Amino acids, Sterols, and Triterpenoids and Carbohydrates. Furthermore, the toxicological studies showed that the extracts were found to be safe up to 2000 mg/kg b. wt. The ethanolic extract of dried leaves of *Ampelocissus araneosa* (Family: Vitaceae) was tested for their wound healing activity by excision wound model and incision wound model. The results obtained from the study indicate that *Ampelocissus araneosa* leaves possess promising wound-healing activity. The activity might be due to the presence of the phytoconstituents including Flavonoids, Tannins, Triterpenoids, alkaloids, and Proteins in the extract. Further studies are required to identify the active principle responsible for wound healing activity.

Keywords: Wound healing, Incision, excision, *Ampelocissus araneosa*.

INTRODUCTION

The vast majority of people on this planet rely on their traditional material medica (medicinal plants and other materials) for their primary health care. There has another fact that one-quarter of all medical prescriptions are formulations based on the substance derived from plants or plant-derived synthetic analogs (Ameena Garib Fakim et



**Venkatesh Sellamuthu and Sheela Angappan**

al., 2006). India is known as the 'Emporium of medicinal plants' because of the availability of several thousands of medicinal plants in different bioclimatic zones (Thillaivanam S and Samraj K., 2014). According to WHO (World Health Organisation), about 80% of the world's population relies on herbal-derived medicines for their health care. Of about 250,000 species of higher plants around the world only 17% have been investigated for medical potential (Nazim Mamedov et al., 2012). In Asian countries, particularly for the agricultural population, flavoring medication acquires primary selection for treatment. Medicinal plants have their safety, efficacy, and lesser side effects. The chemical constituents present in them are a part of the physiological functions of living organisms and hence they are believed to have better compatibility with the human body (Thillaivanam S and Samraj K., 2014). A wound is defined as a disruption of the cellular, anatomical, and functional continuity of living tissue. The wound may be produced by physical, chemical, microbial, thermal, or immunological injury to the tissue (A. Divya et al., 2015). Various plant products have been used in the treatment and care of wounds over the years. Healing of wound with plant extracts promote blood clotting, fight infection, and accelerate the healing of wounds (Hemant Kumar Nagar et al., 2016). Wound infection is one of the most common diseases in developing countries because of poor hygienic conditions (C. Velmurugan et al., 2013). Wound healing is an integrated cellular and biochemical process of restoring normal structure functions of damaged tissue.

The wound healing process is proceed in different overlapping phases and processes including inflammation, wound contraction, re-epithelialization, tissue remodeling, and formation of granulation tissue with angiogenesis. The phases of wound healing normally progress in a predictable, timely manner, and if they do not the healing may progress inappropriately to either a chronic wound like a venous ulcer or pathological scarring like keloid scar (Prافulla Sabala et al., 2012 and Rupesh Thakur et al., 2011). Plant extracts have immense potential for the management and treatment of wounds. The phytomedicines for wound healing are cheap and affordable and hypersensitive reactions are rarely encountered with the use of these agents. These natural agents induce healing and regeneration of the lost tissue by various mechanisms. However, there is a need for scientific validation, standardization, and safety evaluation of these medicinal plants before they could be recommended for healing wounds (Rajinder Raina et al., 2008). Herbal treatment aims to produce persisting improvements in well-being. The medicinal value of these plants depends on the bioactive phytochemical constituents that produce definite physiological action in the human body (M. Ayyanar et al., 2005). These constituents include various chemical families like alkaloids, phenolic compounds, flavonoids, tannins, essential oils, terpenoids, and saponins. Some plants have promising wound-healing activity.

They are *Aloe vera*, *Azardica indica*, *Lantana camara*, *Hypericum species*, *Tridax procumbens*, *Chromolaena odorata*, *Hydnocarpus wightiana*, *Helianthus annus Linn.*, *Jasminum auriculatum*, *Ginkgo biloba*, *Curcuma longa Linn.*, *Centella asiatica*, *Cedrus deodara*. Also reported some pro healers such as *Ocimum sanctum*, *Begia odorata*, *Euphoribia nerrifolia*, *Indigofera aspalathoides*, *Kalanchoea integra*, *Mangifera indica* (Rajinder Raina et al., 2008). The present study was to evaluate the wound healing activity of ethanolic extracts of leaves of *Ampelocissus araneosa* by excision wound modeling and incision wound modeling methods.

MATERIALS AND METHODS

Collection and authentication of plant materials

The fresh *Ampelocissus araneosa* leaves have been collected from the Shervaroyan Hills of Yercaud in Salem District, Tamil Nadu in November 2011 and leaves were validated by Dr. A. Balasubramanian, Executive Director of ABS Botanical Gardens, Kaaripatti, Salem District, Tamil Nadu. The voucher specimen of leaves of *Ampelocissus araneosa* was stored in the Department of Pharmacology. Approximately, about 100 leaves powder of had been extracted with 250 ml of ethanol in Soxhlet extractor at a temperature between 50-65°C for 72 h. The ethanol from the extract was removed at room temperature and dried out in the desiccators (Harborn, 1998).



**Venkatesh Sellamuthu and Sheela Angappan****Phytochemical screening**

The crude samples were subjected to the qualitative chemical test for the detection of various constituents like amino acids, proteins, glycosides, saponins, triterpenoids, flavonoids, carbohydrates, alkaloids, tannins (Jaiganesh K.P et al., 2013).

Experimental animals

In the present study, Wistar albino rats (150-200 g) were utilized. The rats were collected from the animal house of J.K.K Nattraja College of Pharmacy, Kumarapalayam, Namakkal District, Tamil Nadu. All the rats were housed in the large polypropylene cage and fed with a standard pellet diet. Before starting the experiment, all the rats were kept in 12 hours of light as well as 12 hours of the dark cycle with controlled temperature (22 ± 10 °C) with relative humidity (60-70%). All experiment in the present study was approved by the IAEC of J.K.K Nattraja College of Pharmacy, Kumarapalayam, Namakkal district, Tamil Nadu, and as per CPCSEA guidelines (Reg. No. 887/ac/05/CPCSEA).

Dermal toxicity study

Based on Acute dermal toxicity, OECD guideline 402.

Limit test at 2000mg/kg

A limit test at one dose level of 2000mg/kg body weight may be carried out with a group of 5 male and 5 female Wistar rats. Test substance should be applied on shaved skin covering not less than 10% of the total body surface area. Test substance held in contact with the skin with a porous gauze-dressing and non-irritating tape throughout a 24 h exposure period. At the end of the exposure period, the residual test substance should be removed. The observation period should be at least 14 days. The rate of onset and length of the recovery period may thus be extended when considered necessary. The time at which signs of toxicity appear or disappear, their duration and the time of death are important, especially if there is a tendency for deaths to be delayed. (OECD guideline 402, 410, Ali Kairullah Zahi et al., 2016, Api AM and Ford RA., 2003, Guadalupe et al., 2004, Anju Sudhakaran et al., 2016, Kairullah et al., 2015, Sung Hwan Kim et al., 2016, Odette Beiro et al., 2016, Nigel Pimone et al., 2013, Khairullah et al., 2017).

Acute oral toxicity study

Acute toxicity of ethanolic extract of *Ampelocissus araneosa* leaves was carried out as per OECD guideline 425 (Up and down procedure). The limit test for acute toxicity was carried out at 2000mg/kg oral dose. Nulliparous and non-pregnant female mice were used for the study and observed continuously for 24 h for behavioral, neurological, and autonomic profiles and after a period of 24 and 72 h, for any lethality, morbidity state, or death (Kokate C.K et al., 1994, Kumar KV et al., 2013, OECD guideline 1998, 42, Joshi CS et al., 2007, Ming YK et al., 2008).

PROCEDURE

Melt hard paraffin and cetosteryl alcohol in a water bath. To the melted mixture, add wool fat and white soft paraffin with stirring. Continue stirring until all the ingredients are melted. Stir the mixture thoroughly until it is cooled (Sheik Usha Y et al., 2015).

In-vivo study

The albino Wistar rats of either sex were divided into four groups, with six animals in each group.

Group 1: Control (Simple ointment) locally once daily

Group 2: 3%W/W extract ointment locally once daily

Group 3: 5%W/W extract ointment locally once daily

Group 4: Standard (Povidone-iodine ointment) locally once daily.



**Venkatesh Sellamuthu and Sheela Angappan****Excision wound model**

The animals were anesthetized by using a mixture of ketamine and xylazine (ketamine 75mg/kg and xylazine 10mg/kg i.p). An impression was made on the dorsal thoracic region 5 cm away from the ear on the anesthetized rat. The particular skin area was shaved 1 day before the experiment. The skin of the impressed area was excised to the full thickness to obtain a wound area of about 500 mm². Hemostasis was achieved by blotting the wound with a cotton swab soaked in normal saline. The wound contraction was studied by tracing the raw wound area on the subsequent days 4, 8, 12, 16, and 20 on graph paper. Scar area and time for complete epithelialization were also measured. The percentage of wound contraction was recorded (Talekar et al., 2012, Ansar M Patel et al., 2013, Karodi R et al., 2009, F. Villegas et al., 1997, Amol Mekonnen et al., 2012, Shivananda Nayak et al., 2006, Vipin Kumar Garg et al., 2011, Abubakar Ameli Muhammad et al., 2016, K. Ilango and V. Chitra., 2010, Mithun Vishwanth Patil et al., 2017, C. Sundharamoorthi et al., 2009). Wound contraction = $[(\text{Area on the day of measurement} - \text{Area on the day of measurement}) / \text{Area on day zero}] \times 100$

Incision wound model

The animals were anesthetized by using a mixture of ketamine and xylazine (ketamine 100mg/kg and xylazine 10mg/kg i.p). A Para vertebral straight incision of 6 cm in length was made through the entire thickness of the skin, on either side of the vertebral column with the help of a sharp scalpel. After complete hemostasis, the wound was closed using interrupted sutures placed at equidistant points about 1 cm apart. Animals were treated once a day with drugs (extract ointment and Povidone iodine ointment.) from 0 day to the 10th post-wounding day. After the suture removal, the wound-breaking strength is estimated on the 11th day by using a tensiometer. The breaking strength was expressed as weight in grams to break the closed skin (Esimone et al., 2009, Emery Tsala et al., 2013, C. Velmurugan et al., 2012, Suguna et al., 2002, Sumitra et al., 2005, Suzzane Lam et al., 2003).

Statistical analysis

One-way analysis of variance (ANOVA) followed by Tukey's method of multiple comparisons was employed using Instat and Graph Pad Prism 6 software. The result was obtained as more significant when compared with the control. P value obtained as $p < 0.001$.

RESULTS

100g of dried leaf powder of *Ampelocissus araneosa* yielded 68.2g of crude ethanol extract which was about 10.07% w/w of the leaves powder. The preliminary phytochemical analysis of the ethanolic extract of *Ampelocissus araneosa* revealed the presence of Alkaloids, Carbohydrates, glycosides, phenolic compounds, flavonoids, tannins, and proteins. There was no toxicity observed up to the dose of 2000mg/kg in the dermal toxicity test. Oral administration of ethanolic extract of *Ampelocissus araneosa* did not produce any toxicity up to the dose of 2000mg/kg. All the animals were found to be normal.

In- vivo study**Excision wound model**

In the excision wound model topically applied ethanolic extract ointment of leaves of *Ampelocissus araneosa* revealed a significant ($p < 0.001$) increase in the wound contraction area, decreasing the epithelialization period when compared to the control. The 5 % extract ointment shows good activity and it's nearly equal to the standard. The 3% extract ointment shows the highest percentage of wound contraction compared to the control.

Incision wound model

In the incision wound model topically applied ethanolic extract ointment of leaves of *Ampelocissus araneosa* revealed significant ($p < 0.001$) increases in the tensile strength measurement. The 3 % extract ointment shows good activity and it's nearly equal to the standard. The 5% extract ointment shows the highest tensile strength of the skin compared to the control.



**Venkatesh Sellamuthu and Sheela Angappan**

DISCUSSION

Wound healing involves various phases. Initially involves an acute inflammatory phase followed by the synthesis of collagen and other extracellular macromolecules, which are later removed to form a scar. Drugs, which influence one phase, may not necessarily influence another. Within a few hours after injury, inflammatory cells invade the wound tissue. Neutrophils arrive first within a few minutes, followed by monocytes and lymphocytes. They produce a wide variety of proteinases and reactive oxygen species as a defense against contaminating microorganisms, and they are involved in the phagocytosis of cell debris. In addition to these defense functions, inflammatory cells are also an important source of growth factors and cytokines, which initiate the proliferative phase of wound repair. Healing is a physiological process and does not normally require much help but still, wounds cause discomfort and are prone to infection and other complications. Therefore, the use of agents expediting healing is indicated. Such conditions especially require the use of agents, which can facilitate healing. Wound healing is a process by which damaged tissue is restored as closely as possible to its normal state and wound contraction is the process of shrinkage of the area of the wound. It mainly depends on the repairing ability of the tissue, the type and extent of damage, and the general state of the health of the tissue. The granulation tissue of the wound is primarily composed of fibroblast, collagen, edema, and small new blood vessels. The undifferentiated mesenchymal cells of the wound margin modulate themselves into fibroblasts, which start migrating into the wound gap along with the fibrin strands. The increase in dry tissue weight also indicated the presence of higher protein content. Flavonoids reduce lipid peroxidation by preventing or slowing the onset of cell necrosis and also by improving vascularity.

Hence, any drug that inhibits lipid peroxidation is believed to increase the viability of collagen fibrils by increasing circulation, increasing the strength of collagen fibers, preventing cell damage, and promoting DNA synthesis. Flavonoids and triterpenoids are also promoted in the wound healing process mainly due to their astringent and anti-microbial property, which are responsible for wound contraction and increased rate of epithelialization. Tannins promote wound healing activity through several mechanisms including chelation of free radicals, and antioxidant, antimicrobial, and astringent properties. Phenolic acids have been reported to possess anti-inflammatory, antioxidant, analgesic, and wound-healing properties. Overall, When a wound is affected skin components or underlying structures will in turn affect their physiological functions of them. This leads to an imbalanced state of physiological function and the body tries to recover from this situation by repair. The body shows various symptoms of these imbalances and also various factors which either accelerate or diminish the wound healing activity. The administration or application of formulations containing active constituents which promote wound healing activity and also the awareness about risk factors will help proper healing of wounds with in a short period. In histo-pathological studies, a significant increase in collagen content was observed during the wound-healing process in the treated group resulting due to enhanced migration of fibroblasts and epithelial cells to the wound site. The evaluation of tissue sections revealed that tissue regeneration was much quicker in the treated group compared to control wounds. The standard group shows normal skin appendages.

CONCLUSION

Phytochemical analysis shows the presents of polyphenols like tannins and flavonoids which promote wound healing activity. Toxicological studies reveal that the plant did not possess any toxicity. So further research can isolate active compounds with fewer side effects than synthetic compounds. The literature review revealed that the above plants were used traditionally for various ailments, especially for wound healing activity. But extensive scientific studies were not performed on this plant. These interesting activities require further research to identify and isolate the compounds involved followed by the mechanism of action.





Venkatesh Sellamuthu and Sheela Angappan

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Venkatesh Sellamuthu and Sheela Angappan

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Table 1: Effect of EEAA on wound healing, table shows wound contraction in mm²

Groups	4 th day	8 th day	12 th day	16 th day	20 th day
Control	388.67±3.63	285.00±4.19	239.15±2.33	183.65±2.97	127.17±2.87
3% Extract ointment	349.00±3.61***	197.67±2.79***	123.83±4.08***	91.21±3.40***	34.00±3.23***
5% Extract ointment	344.00±4.24***	185.83±3.77***	80.88±2.64***	47.60±3.55***	11.62±2.28***
Standard	332.50±3.59***	172.33±3.29***	66.03±3.40***	32.17±2.40***	4.07±1.55***

Values are Mean ± SEM from 6 animals in each group. p<0.001 as compared to control.

Epithelialization period:

Table 2: Epithelialization period of excision wound model in days

Groups	Epithelialisation period in days
Control	26.50±0.58
3% Extract ointment	22.00±1.57***
5% Extract ointment	18.52±0.43***
Standard	16.39±0.48***

Values are Mean ± SEM from 6 animals in each group. p<0.001 as compared to control.

Percentage of wound contraction:

Table 3: Percentage of wound contraction on post wounding days

Groups	4 th day	8 th day	12 th day	16 th day	20 th day
Control	22.27±0.73	42.33±1.05	52.17±0.47	63.30±0.62	74.57±0.57
3% Extract ointment	30.20±0.72***	60.47±0.56***	75.23±0.82***	81.77±0.68***	93.20±0.65***
5% Extract ointment	31.20±0.85***	62.83±0.75***	83.83±0.53***	90.48±0.71***	97.68±0.45***
Standard	33.50±0.72***	65.53±0.66***	86.80±0.69***	93.57±0.48***	99.19±0.31***

Values are Mean ± SEM from 6 animals in each group. p<0.001 as compared to control.

Tensile strength measurement

Table 4: The effect of EEAA on Tensile strength in incision wound healing model on 11th day

Groups	Tensile strength of skin (g)
Control	373.33±3.58
3% Extract Ointment	414.17±2.27***
5% Extract Ointment	457.50±2.35***
Standard	565.83±2.14***

Values are Mean ± S.E.M. of six animals in each group. p<0.001 as compared to control.





Venkatesh Sellamuthu and Sheela Angappan



Figure 1: Excision wound on 0th day



Simple ointment I.P

3% Extract ointment



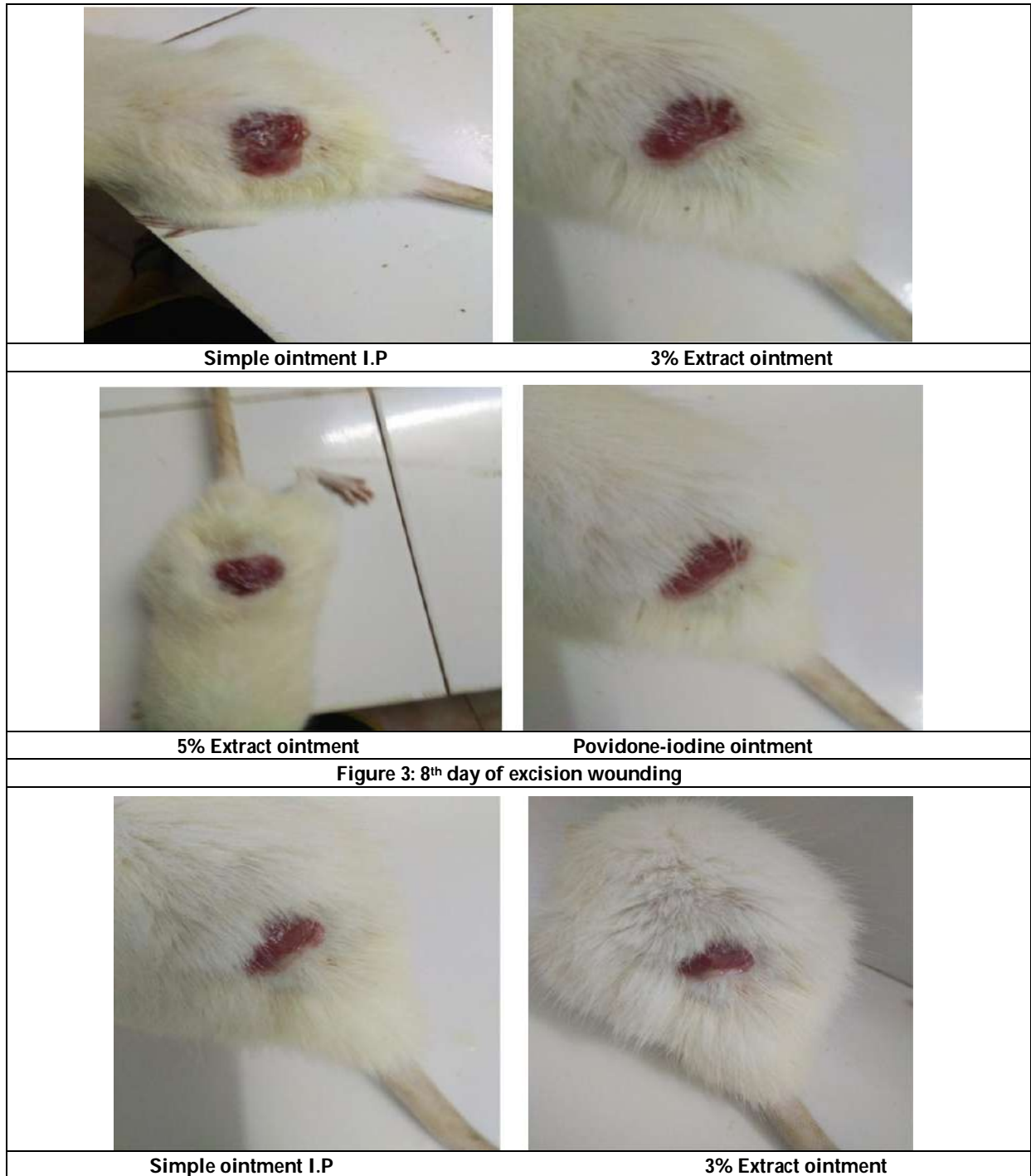
5% Extract ointment Povidone-iodine ointment

Figure 2: Excision wound on 4th day



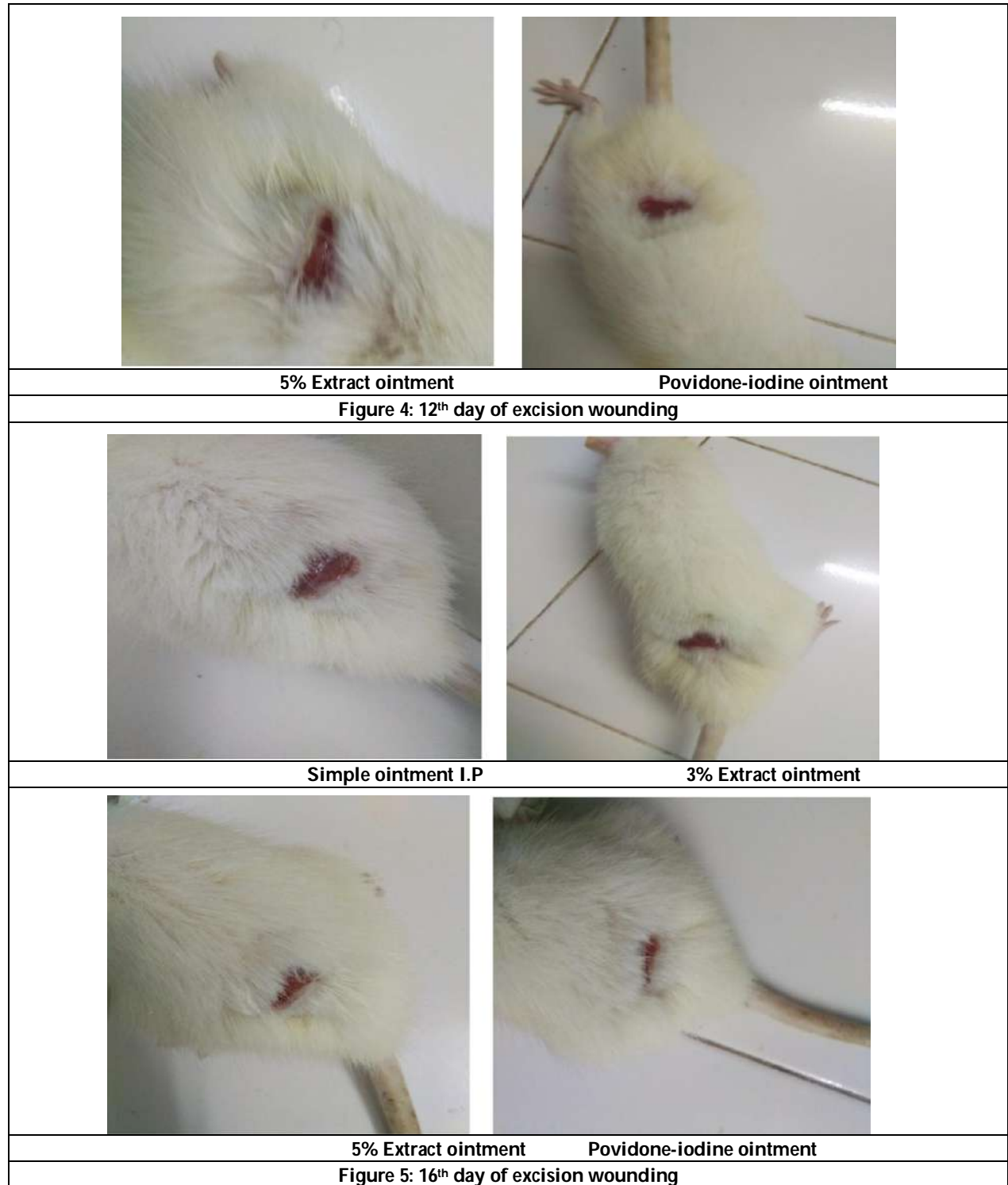


Venkatesh Sellamuthu and Sheela Angappan



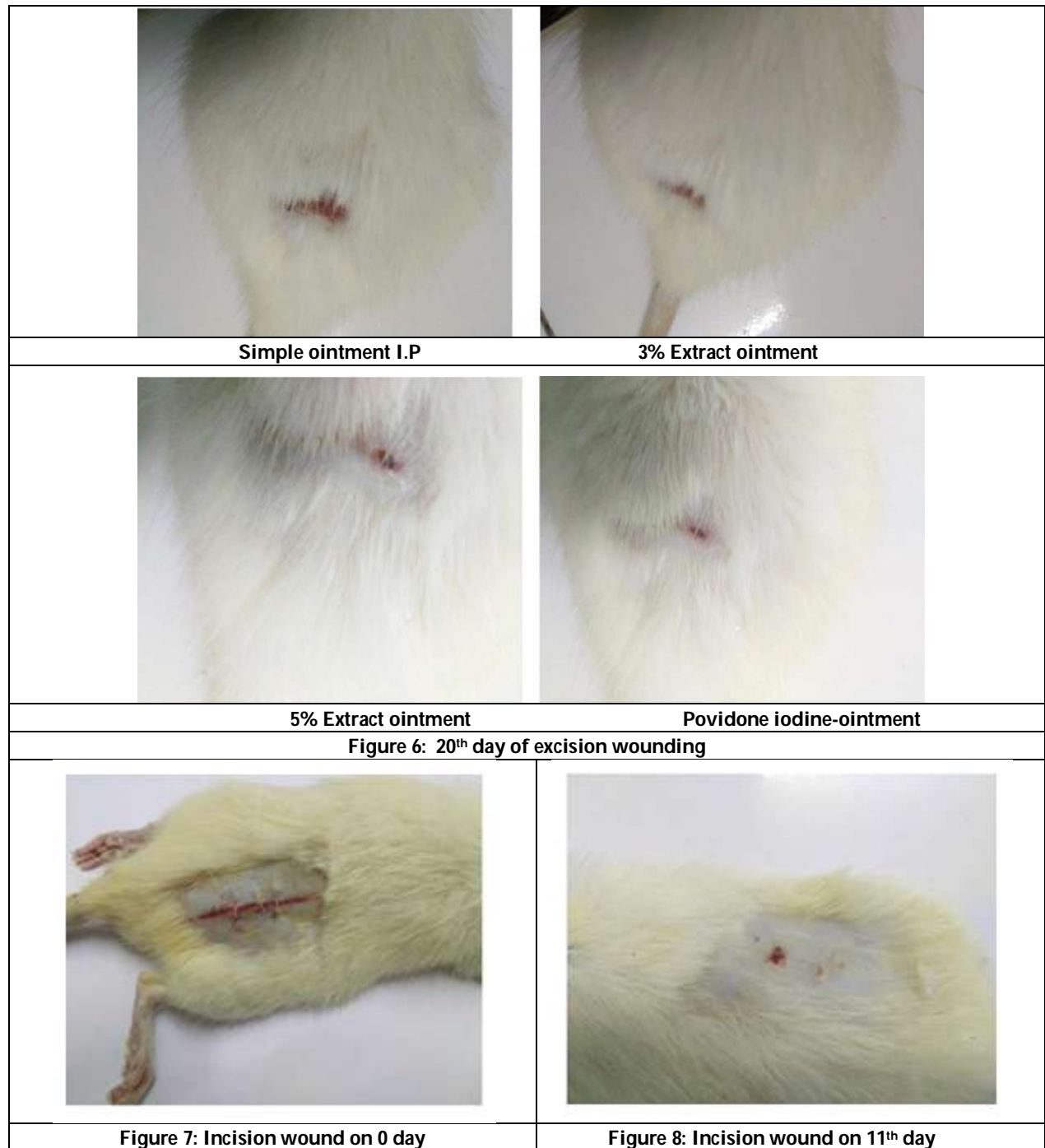


Venkatesh Sellamuthu and Sheela Angappan





Venkatesh Sellamuthu and Sheela Angappan





Venkatesh Sellamuthu and Sheela Angappan



Figure 9: Tensiometer

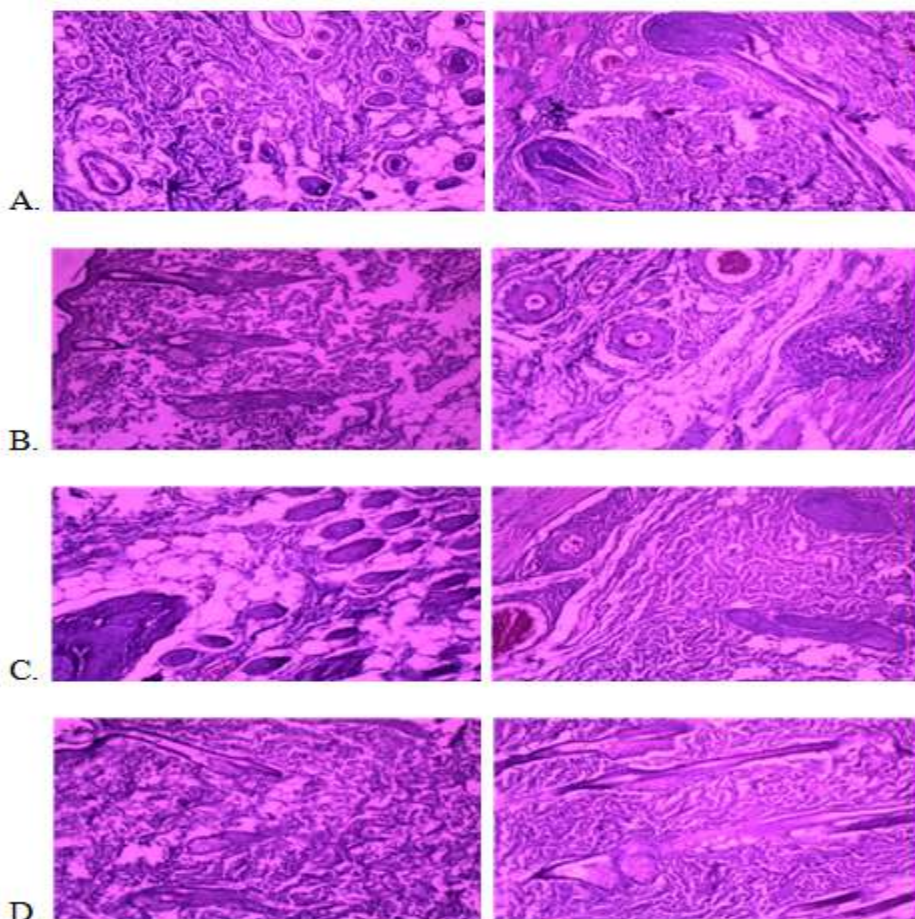


Figure 10: Histopathology of skin of incision wound model.

- A. **Control:** Skin shows superficial ulcerations, floor of which show inflammatory. More macrophages, few collagen fibers than test and standard group.
- B. **3% Extract ointment:** Shows significant increase in collagen deposition, less macrophages and more fibroblasts when compared to control.
- C. **5% Extract ointment:** Shows significant increase in collagen deposition, less macrophages, more fibroblast and nearly normal skin with skin appendages.
- D. **Standard:** Normal skin with normal skin appendages.





Emerging Technologies and Roles of Nanomaterial for Heavy Metal Removal from Water

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ABSTRACT

Water is a valuable resource since it is essential to life. Despite the fact that 70% of the Earth's surface is covered by water, freshwater supplies are fast depleting. Heavy metal ions, such as Pb^{2+} , Cd^{2+} , Zn^{2+} , Ni^{2+} , and Hg^{2+} , are the most poisonous and non-biodegradable of all water contaminants and can seriously harm both humans and animals. With the rising industrialization of human civilization come various toxins that are extremely detrimental to human health, such as heavy metal ions, organics, germs, viruses, and so forth. Various technique such as biosorption, electrokinetic process, supercritical fluid extraction, zeolite as nanosorbent, hydroxide precipitation, ultrafiltration, electrodialysis and chemical coagulation are promising technique for removal of heavy metal from water. The objective of this study is to give different methodologies for removal of heavy metal from waste water.

Keywords: Heavy metals, Ground water, Removal techniques

INTRODUCTION

In recent years most pressing environmental concerns of scientists is presence of Heavy metal in drinking water contaminated water has been found in more than 70 countries, threatening over innumerable human beings globally. Further reducing the accessibility of sources of fresh, clean water is the rapid industrialization and lifestyle changes that have led to these is contamination watery resources that include a variety of contaminants. Particularly, a



**Priyanka Gupta and Gaurav Tamrakar**

substantial invasion of organic compounds, pharmaceuticals, consumer goods, viruses, and heavy metals entering water reservoirs has been caused by farming, excessive dumping, volcanic eruptions, and mining of dangerous chemicals [44]. Due to their significant contribution to environmental destruction, heavy metals in water are among the permanent pollutants that are of the most concern on a global scale [2][18]. Wastewater composition varies greatly, and it is greatly influenced by the source from which it is produced. Excreta, plant matter, food, protein, natural organic matter, heavy metals, metal ions, gases, and other contaminants found in industrial water, groundwater, or surface water are examples of complex organic molecules that are frequently found in wastewater. Typically, hazardous and non-hazardous waste can be separated into two groups. Paper, plastic, glass, stone, iron, and organic waste are used to create non-hazardous industrial wastes, which don't pose any risks to the environment or human health [22]. With the rising industrialization of human civilization come various toxins that are extremely detrimental to human health, such as heavy metal ions, organics, germs, viruses, and so forth. Some examples of metal ions includes lead, cadmium, zinc, nickel & mercury (Pb^{2+} , Cd^{2+} , Zn^{2+} , Ni^{2+} , and Hg^{2+}) the most poisonous and non-biodegradable of all water contaminants and can seriously harm both humans and animals [59].

All living things are at risk from these water toxins, which also have a significant impact on ecosystems. Therefore, it is necessary to remove these contaminants from contaminated water in order to stop their negative effects on both people and the environment [25]. According to predictions, high performance and affordable, efficient solutions for treating wastewater will be available because to the incredibly efficient, integrated, and multifunctional advancement made possible by Nano science and Nanotechnology as opposed to big infrastructure [41]. Nanoparticles, such as metal oxide nanoparticles, carbon nanotubes, Zerovalent nanoparticles, and Nano composites, are promising technologies for use in various wastewater ecosystems [56].

Heavy Metals Present in waste water

The term "heavy metal" describes an element that is harmful even at low concentrations and has a higher density. Heavy metals in wastewater have become a significant environmental issue in recent years due to the substantial damage they pose to ecosystems and human health even at extremely low concentrations. They give the impression that they are a component of nature. Heavy metal pollution is a significant environmental burden due to its flexibility, accumulation, non-biodegradability, and persistence [39][42]. Metals are released into the atmosphere through a variety of processes, such as human activity, soil and rock degradation, and volcanic eruptions including mining, manufacturing, and the usage of metal-derived pollutants. Metals with a density of more than 5 g/cm³ are considered to be heavy metals [5]. Algal blooms, inadequate oxygen levels, and the extinction of aquatic life are all caused by heavy metals in open waters. The heavy metals are changed to create hydrated ions, which are far more harmful than metal atoms, when they are released into rivers. The enzymatic activity is disturbed by such hydrated ions and therapid absorption occurs. To reduce the dangers to the general public, heavy metal removal is therefore required. Both the World Health Organization (WHO) and the Environmental Protection Agency (EPA) have established the maximum permissible release amount environmental contamination via heavy metal in order to control the degree of water pollution. However, the released wastewater has a high concentration of heavy metals compared to permitted limits, which results in difficulties for both health of people and the environment.

Impact of heavy metals

Heavy metals which are poisonous and damaging to human health and the environments include chromium, copper, zinc, cadmium, cobalt, antimony, nickel, arsenic, zinc, and many others. Metals in their ionic forms, such as As^{3+} , Pb^{2+} , Hg^{2+} , Ag^+ , Cd^{2+} react with bio particles inside the body to produce hazardous chemicals that must be isolated. The enhanced bio magnification and concentration have a large impact on the harmful properties. Bioavailability of heavy metal is greatly influenced by the ligand and oxidation state. If the concentration of heavy metals exceeds the allowable limit and the metal interferes with cellular metabolism, it is hazardous [33]. The water contains arsenic in a variety of forms, including As(III) and As(V). The sources of arsenic contamination in water are anthropogenic (thermal power plants, the paper industry, the cement sector, pesticides or herbicides, etc.) as well as



**Priyanka Gupta and Gaurav Tamrakar**

natural (weathering and dissolution) processes that raise the quantity of arsenic present in water [47]. The most toxic heavy metal of them all, arsenic (As), has long been known to be deadly. It can have a variety of negative consequences on living things. There are several distinct types and toxicities of arsenic. Arsenic can enter water supplies naturally or as a result of human activities. The World Health Organization states that 10 mg/L is the maximum allowed level of arsenic in water [53]. Cadmium affects the reproductive, respiratory, kidney, and liver systems in addition to bringing about disorders like lung cancer and hepatic toxicity. Due to this, treatment is necessary the wastewater be treated to eliminate cadmium in an economically viable and effective manner [10]. Since chromium is the most commonly utilized element, it is present in potable water as a result of numerous industrial processes, including those used in the production of dyes, photographs, paints, steel fabrication, cement, leather and wood preservative finishing. These significant applications lead to an increase in chromium contamination in environment [3]. Power plants, batteries, and waste dumps all release nickel (Ni) into the environment [58]. The metal nickel, which has an atomic number of 28, is tough and silver. It is the kind of heavy metal that is non-biodegradable and is present in wastewater. The nickel metal is used in commercial sources like the printing, electroplating, silver refineries, battery manufacturing, and alloy sectors [34]. Lead (Pb) is emitted into the environment via a variety of ceramics, Cathode ray tubes, finishing tools, cable recycling, and lead flashing [53]. Sulphide, Cerussite ($PbCl_2$), and galena are examples of heavy and soft metals, of nickel respectively. Wastewater from lead-acid batteries is mostly to blame for the association of lead in industrial effluent. Many companies, including those that create explosives, steel, electrical equipment, and electroplating, produce wastewater that contains lead on a regular basis. Additionally, it facilitates the production of DNA and protein and promotes cell division.

Mercury is the highly hazardous heavy metal present in the water. There are several different types of mercury, including elemental mercury (Hg_0), mercuric ions (Hg^{2+}), and mercurous ions (Hg_2^{2+}) [30]. Mercury exposure may have negative effects on the respiratory, reproductive, nervous, and kidney systems. As a result, academics have recently given mercury removal from industrial wastewater has received a lot of attention. Typically, significant amounts of mercury are added in industries such as plastics, chloro-alkali, medicines, oil refineries, and paper and pulp etc. [37]. The metabolic processes and physiological functions of living tissues are controlled by zinc. For other metals, this metal serves as a decorative and protective covering. For instance, corrosion is prevented when zinc is added to steel. Zinc used in industrial processes like making burning coal, steel and mining.

Even though it is a trace requirement for humans, it can lead to health problems such as discomfort, nausea, skin irritation, fever, vomiting, and anemia. The electroplating, paper and pulp, steel manufacturing, and brass metalwork sectors are the major sources for zinc metal [40]. The abovementioned consequences as well as the requirement for efficient treatment to remove zinc from wastewater.

Different technique for heavy metal removal in water**Biosorption**

The term "bio sorption" describes the process of removing molecules (i.e., particular substances of concern) from a solution by adsorbing them to a biological substance. This method is used particularly for metals and metalloids. Although it uses living or dead creatures and their parts, bio sorption is a physico-chemical technology that also takes into account the biological properties of the adsorbent [28]. There are numerous mechanisms for biosorption, including ion exchange, chelation, reduction, precipitation, and complexation. [55]

The following is a list of the benefits of biosorption [28]

- the efficiency in treating wastewater,
- the similarity in operation to traditional physicochemical processes,
- The large abundance of bio sorbent materials,
- the simplicity,



**Priyanka Gupta and Gaurav Tamrakar****The cost-competitiveness****Electrokinetic process**

Metals and organic contaminants have been removed using the electrokinetic (EK) approach [4]. Electrode arrays are inserted into SS during EK process, and direct electrical current is then applied at low levels. The conductive material is either the water already present in the SS or an electrolyte solution that has been added [52].

Supercritical fluid extraction

Using supercritical fluids as the extracting solvent to separate one component (the extractant) from another is known as supercritical fluid extraction (SFE) (the matrix). Despite the fact that liquids can also be utilised for extraction, a solid matrix is frequently employed. The most widely used supercritical solvent is supercritical CO₂ (SCeCO₂) because it has so many benefits, including being inexpensive, having low critical pressure and temperature (73.8 bar, 30.9 °C), being environmentally friendly, having a high diffusivity, and having a low viscosity and surface tension [24]. Additionally, CO₂ is safe to use and chemically inert [9]. SFE has been hailed as a technique that holds promise for removing heavy metals from a variety of matrices [51]. Chelating agent (Cyanex 302) was used to modify SC-CO₂ so that As, Cu and Cr could be removed from CCA (As, Cu and Cr) wood with efficiencies of more than 31.3%, 63.5% and 28.6%, and respectively. They also discovered that the kind of chelating agent used affected the removal efficiency [1].

Electro dialysis

One of the most cost-effective new technologies is Electrodialysis (ED), which uses electrically driven ion-exchange membranes to remove water ions. [43] In addition to eliminating even the lowest amounts of metal ions from the effluents, the process also has the benefit of creating waste water that may be recycled. Using an industrial nickel electroplating technique, it is possible to concentrate and remove nickel (Ni) and its salts from synthetic effluent, as well as to remove organic compounds from additives, a laboratory-scale ED system is utilised. [6] Low pH, three-compartment electrodialysis using distinct electrodes from the sample using ion-exchange membranes has been used to simultaneously extract heavy metals and phosphorus [13]. Electrodialytic remediation indicated a reduction at a pH lower than 8, in Cd, Cu, Pb, and Zn leaching for heavy metals and salts that cause the most issues in Municipal Solid Waste Incineration (MSWI) [29]. In a hybrid anaerobic bioreactor, Santos et al. used the ED method as a sequential treatment to remove Cr (VI) from waste water that had already completed anaerobic biological treatment, and they were successful in removing more than 99% of Cr (VI) in 75 minutes of operation time [12].

Zeolites as Nano adsorbent

Zeolites have a hydrophilic affinity for polar molecules, making them effective and promising substances for heavy metal removal from wastewater. A broad collection consisting of hydrated aluminosilicate minerals with 1 to 10 nm in size make up the inorganic crystalline substance known as zeolites [7]. They have a variety of benefits, which support a number of industrial applications. Distinctive adsorption capacity, low cost, catalytic and ion-exchange capabilities, uniform-sized pores, great abundance, By metakaolin-based (MK) zeolites and an ion exchange mechanism, Luo and colleagues created a system that is both economical and environmentally benign for treating polluted water with Cu²⁺ and Pb²⁺ [32]. Similar to this, Sprynskyy et al. looked at the capacity of naturally occurring zeolites to Cu²⁺, Pb²⁺, Ni²⁺, and Cd²⁺ from single and multicomponent aqueous systems [49].

Hydroxide precipitation

Through the use of alkaline substances, which increase water's pH and reduce the solubility of the metal ions it contains. Metal ions can more easily precipitate as hydroxides [26]. The subsequent flocculation or sedimentation of these metal hydroxides can eliminate them. The procedure calls for the use of alkaline chemicals such as NaOH, CaO, and (Ca(OH)₂). Bivalent heavy metals like Zn²⁺, Mn²⁺, Cu²⁺ and Cd²⁺, have the ability to precipitate out as hydroxide and can be easily removed from wastewater, according to certain reports [14].





Priyanka Gupta and Gaurav Tamrakar

Ultrafiltration

One of the best methods for cleaning up wastewater is ultrafiltration. The diameter of hydrated metal ions is 400–500 times smaller than the membrane whole diameters, which range from 10 to 100 nm. As a result, metal ions pass through membrane, disappointing the separation. Although, the presence of polymer ligands or surfactants can make the removal easier [21]

Chemical coagulation

Chemical coagulation is the process of adding chemical coagulants to wastewater contaminants to destabilise the surface charges, which is how it is usually done (CC). Because they are widely accessible, affordable, and have high rates of electro dissolution, sulphates and chlorides of aluminium and iron have been the most commonly utilised coagulants for effective pollutant removal [17][57]. Additionally, Al and Fe are commonly used for coagulation because of their improved ability to produce polyvalent ions and strong coagulating properties.

Magnetic nanomaterial

Magnetic nanoparticles are the primary class of advanced nanomaterials that enable both enhanced harmful metal removal and simple magnetic separation. After separation, this class of nanomaterials brings exceptional recyclability, providing geological advantages and a variety of environmental cleanup applications. The magnetic nanoparticles have a wide surface area, are chemically inert, less hazardous, and are easily diffused. These characteristics of magnetic nanoparticles make them reliable, affordable, and useful for the purification of water. With an effective adsorption capacity of 36 mg/g, Fe₃O₄ nanoparticles were created and employed to remove lead divalent ions from water [36].

Furthermore, using nanoparticles of Fe₃O₄ produced by Giraldo et al. with a limited adsorption capacity towards Mn (II) and a maximal adsorption capacity towards Pb(II), Zn (II), Cu (II), Pb (II), and Mn (II) were all eliminated. This is because these metals' hydrated ionic radius differs from one another [20]. In a different study, Fe₃O₄ nanoparticles were created, and their ability to absorb the hazardous elements Cu (II) and As (II) was compared to that of commercially produce iron oxide. Commercial iron oxide had a decreased capacity for metal adsorption, indicating that produced nanoparticles had enhanced characteristics.

Metal Oxide Nanoparticles

Current research has shown that the metal oxide nanoparticles are extremely productive at removing harmful metal ions from wastewater. Due to their instability in agglomeration or separation, only a small number of metallic nanoparticles are examined for sorption. Additionally, it is challenging to separate individual metallic nanoparticles from wastewater.[35]. Therefore, they need to be functionalized in order to stabilise their properties and aggregate them in an easy way. Superior water filtration methods have, however, been developed thanks to the discipline of Nano science. Significant nanoparticles used in the water purification process play an important role in the removal of poisonous metal ions and tiny contaminants smaller than 300 nm, as well as the removal of the toxic metal ions by smart reagents with mechanical stability. Because of its adjustable physicochemical properties and larger surface area nanotechnology has been seen to attract more interest in field of environmental application. Metal oxide semiconductors, like titanium oxide and zinc oxide, have the power to effectively remove heavy metal contamination from water. Once suspended for filtration, multifunctional nanoparticles like ZnO can then be removed from water systems [50].





Priyanka Gupta and Gaurav Tamrakar

CONCLUSION

The most important element on earth is water, yet as urbanisation, human population growth, and the expansion of various sectors like mining, paper manufacturing, battery manufacturing, fertiliser manufacturing, and electroplating have all increased, so has the quality of water resources. Heavy metal contamination in aquatic systems has greatly grown during the last few decades. Metals are necessary for life and are crucial to its functioning, but when their acceptable concentration limits are exceeded, they become poisonous. Human water demands are unquestionably a breaking point for the welfare of both humans and other animals in the world in some areas where there is a shortage of pure water to satisfy the basic necessity for sanitation. To get rid of these restrictions, academicians, research organisations, research fellows, and young scientists must find a novel solution. This review paper evaluates the most recent advancements for the removal of harmful substances from water.

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Priyanka Gupta and Gaurav Tamrakar

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Priyanka Gupta and Gaurav Tamrakar

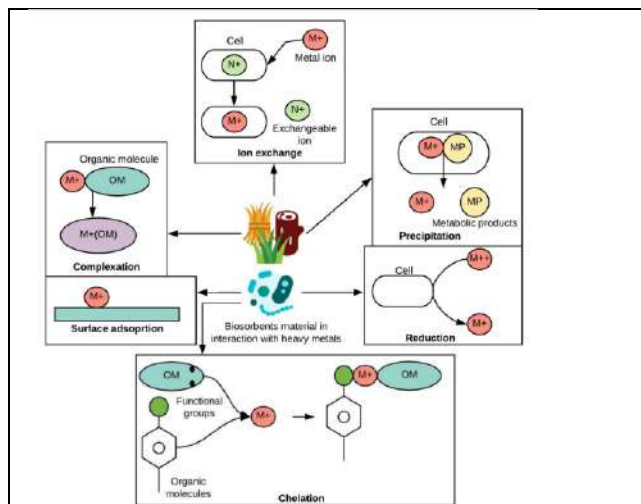


Fig.1. Biosorption process [23]

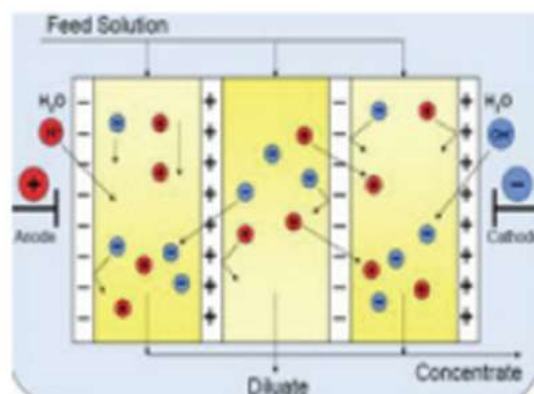


Fig.2. Electrodesorption [54]

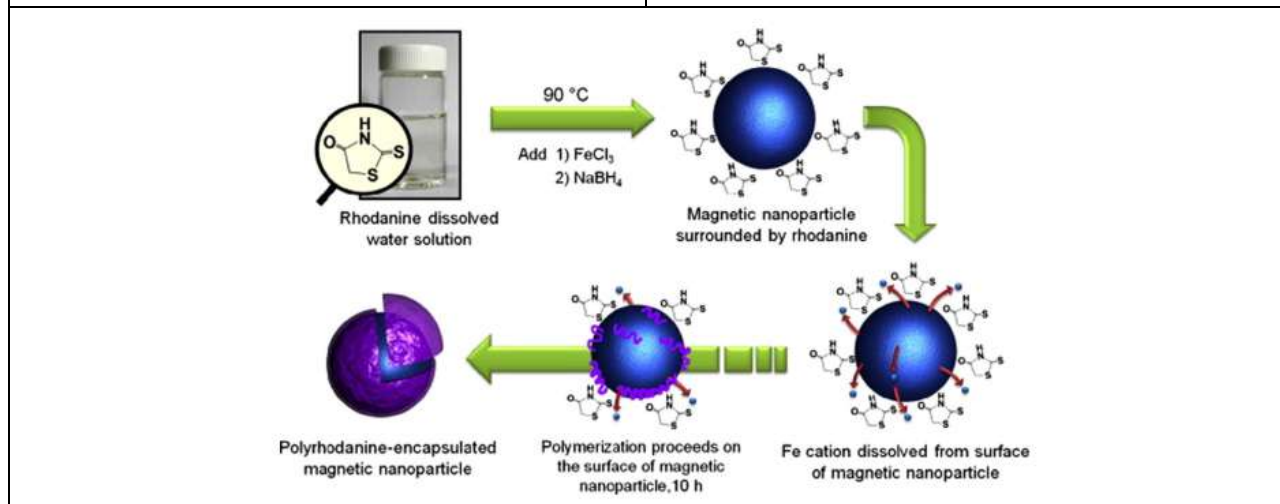


Fig.3. Fabrication process of polyrhodanine-encapsulated magnetic nanoparticles [48]





Impact of IIoT and Cloud Adoption in Digital Transformation with A Business Perspective and Key Challenges

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ABSTRACT

The set of modern techniques employed in the industrial sector includes predictive analysis, automation, the Smart Factory (IIoT), machine learning, cloud services, and other digital breakthroughs. These cutting-edge technologies help in establishing businesses to create digitally enabled business models besides improving operational effectiveness and customer satisfaction in logistics and production. These advantages cannot be overlooked by manufacturing businesses looking to modernise; several big companies in this field are already using these technologies, at least in part. Research on IoT in addition to cloud technology is now extensively acknowledged in both the academic and business communities. Fund shortage and knowledge in digitization are two factors limiting small and medium-sized businesses (SMEs), which is challenging for smaller businesses (SMEs) to accomplish business digitalization. This paper highlights the impact of IoT and digital transformation on digital business models. Additionally, various case studies that are either looking to deploy a Smart Manufacturing system in their business or have already done so are considered. The report also includes information in-depth on the difficulties SMEs have implementing Smart Factory. Further, this research also outlines important obstacles and consequences that supervisors should consider for effective IoT technology in the growth of digital businesses.

Keywords: Digital transformation; Internet of Things; cloud computing, SME, SMS, Smart Factory, IIOT, Advanced Driver Assistance Systems (ADAS), Firmware of the Air.





INTRODUCTION

Manufacturers have been gathering and storing data for decades to enhance their processes. Since the start of the digital revolution a decade ago, the amount of data produced has grown dramatically, making it impossible to effectively manage it all manually. As a result, they require an infrastructure that can manage this data on their behalf. A balancing technology as cloud computing has been growing in popularity in the IT Business at the same time. The user can remotely store and process a sizable amount of data using a cloud platform. Since the information is accessible online and kept in the "cloud", there is no further need for computer infrastructure to utilise the computational capabilities. In this case, it's crucial to keep in mind that beside cloud computing, there are numerous options for Industry 4.0 implementation. It is an effective tool that gives everyone access to the high processing power needed to implement contemporary digitalization alternatives. Cloud computing offers scalable power and memory resources. Businesses can deploy big data analytics to gather and use business intelligence. It aids in their commercial and production operations getting consolidated and streamlined.

Digital Transformation

To boost the overall effectiveness of the organisation and give customers more value, digital transformation is a type of restructuring that focuses primarily on integrating digital tools and technology into all areas. It is typified by the digital technology integration, alterations to procedures and procedures, in addition to shifts in thoughts and behaviour that transform strategy. In Figure 1, the traditional Industrial Automation is compared with latest technologies like IoT, Cloud Computing incorporated in Industrial Automation.

To integrate the technical and business layers of the enterprise, the digital transformation, also known as digitalization, refers to the interaction between the physical and informational worlds and involves the virtualization of reality-reflecting structural elements (products, orders, and resources) managed in Service Oriented Architectures (SOA) [1]. The definition of digital manufacturing is the intense use of digital models (twins) and ontologies in the supply, production (including planning), and delivery activities of a networked organisation. To establish a broad, Internet-scale platform for networked, intelligent production that will effectively and scalably link various stakeholders (technology providers, manufacturing plants, supply chains, and service providers), it is necessary to use advanced, integrated information, communication, and control technologies (IC2T) with core technologies. This will enable the emergence of a sustainable Internet economy for industrial logistics. Resource and process virtualization, which results in intelligent decisions through machine learning and cloud services, are the essential elements of digital manufacturing. Resource virtualization presupposes the use of Digital twin technology to create extended digital models of the three types of physical entities that are unique to manufacturing: products, resources, and orders. The digital twins serve as "intelligent beings" that reflect portions of reality from the perspective of the digital, computer-based control of distributed manufacturing processes. They must be implemented in industrial systems where they interact with planning, scheduling, and control entities in a way that prevents any limitations with respect to the corresponding reality, such as controlled processes, from being introduced. A digital twin, which is defined as an extended virtual model of a physical asset, service, or commodity that is persistent even if its physical counterpart is not always online or connected, can contain the comprehensive view of the real capabilities, status, and features of an entity (equipment, process, or product), including its digital representation, execution context, history of behaviour, time evolution, and status.

The primary enabling technology for cloud manufacturing is resource virtualization, which also has to do with the ability to create and manage virtual machines (VM)(CMfg). For the Digitalisation of Production, virtualization enables the separation of a set of physical computing or manufacturing resources from their Cyber-Physical Systems, enabling simple workload movement to alternative resources. Resource hypervisor is also a crucial component of digital manufacturing because it makes it possible to efficiently balance local computing capabilities, such as those found near manufacturing resources and intelligent embedded products, with global computing abilities, such as a private cloud manufacturing infrastructure. This is accomplished by virtualization of assembly line devices



**Prateek Jain and Archana Sharma**

(products, machines, tools, etc.). Resource hypervisor is also a crucial component of digital manufacturing because it makes it possible to efficiently balance local computing capabilities, such as those found near manufacturing resources and intelligent embedded products, with global computing abilities, such as a private cloud manufacturing infrastructure. This is accomplished by virtualizing production line devices of any kind (goods, machineries, equipment, etc.). Resource virtualization is made possible by the Industry Internet of Things (IIoT) platform, which enables the cloud-based integration of smart linked equipment.

Before delving into the details of digital transformation, we examine three related terms that are sometimes used interchangeably:

- digitization,
- digitization and
- digital transformation as highlighted in figure 2.

Importance of Digital Transformation in Modern Enterprise

Market pressure is one of the key drivers for executing digital transformation, as market leaders compete with technologically advanced and agile companies, according to the State of Digital Transformation research. Digital transformation is the best method to prepare your business for the future while keeping it ready to handle technological upheaval, and this is not an exaggeration. Businesses must adapt their existing business processes with the aid of new developing technology as client expectations and requirements continue to change quickly. Enterprise digital transformation has continued to be very beneficial, whether it is managing internal procedures or providing a personalised consumer experience. The Digital Transformation key benefits in Business/s are as follows:

Increased customer satisfaction Modern clients who are tech aware demand real-time, enhanced support to answer their questions. They never stop looking for cutting-edge tools to improve their quality of life. Therefore, businesses must develop digital solutions built on cutting-edge technology that can improve the consumer experience.

Increased Effectiveness Innovative technology and solutions can automate a variety of business activities, which will enable you to gradually increase efficiency. Solutions for digital transformation help businesses save money and reduce manual labour over time.

Increased Security Digital processes are more dependable and secure than old ones. Using digital transformation solutions, organisations may more effectively and securely secure their sensitive and important data. Over time, it can help them maintain data security and win the trust of their clients.

Improved Judgement The goal of digital transformation is to provide useful information for making decisions. All data analysis tools and methods can help businesses track performance metrics and gain greater insights in this data-driven era. It also helps to provide a better outcome.

IoT

Individuals can and work more smartly and have total control over their own lives owing to the IoT. It is crucial to business in addition to providing intelligent appliances to automate households. By providing an insight to everything from machine performance to supply chain and delivery operations it gives an organisation a real-time look into how their systems function. It gives companies the ability to streamline operations and slash labour costs. Furthermore, it eliminates waste and enhances service delivery, which lowers the cost of manufacturing and delivering items and increases consumer transaction transparency.

CRM Using IoT

IoT entails a constant flow of customer data into the databases of CRM systems. This is fantastic news because CRM depends on customer information. The IoT's strength in CRM depends on its capacity to interpret past company data, combine it with present-day data from "Things," and offer useful insights. Everything revolves on data and technology and how CRM can take advantage of both. The results of this might either be used right away or saved for when the right "context" is available. In the appropriate environment, data presents options depending on customer behaviour, geography, needs, and patterns. IoT has potential benefits for all these CRM functional domains and related areas, including Sales, Service, and Marketing. In addition to providing customers with a better





experience, it gives businesses a new revenue stream. Nowadays, managing client relationships is the focus of CRM, and the customer is at the heart of everything. Regardless of the channel, businesses strive to improve and optimise the customer experience, and IoT devices are one such channel. A whole new world of contextual and personalised offerings, services, and improved support opens as a result of close cooperation between devices and intelligent systems, all the while continuously upgrading goods and services as shown in figure 3.

Digital Transformation via IoT & Cloud

Resource virtualization is made possible by an IIoT platform, which seamlessly integrates smart, connected products in the cloud. This encourages a product-centric strategy as well, where the product directly solicits processing, assembly, and handling from available providers as it is in the execution, delivery, and use stages. The intelligent goods virtualization enables the transfer of some processing power from the embedded intelligent devices on product carriers to cloud computing IaaS, allowing for a dynamic balance between the best control with a long-term perspective and the quick local response capabilities to unforeseen events. The shorthand term "CMfg" stands for "cloud-based manufacturing services," which are a development of connected and service-oriented production models that incorporate a pool of interchangeable and reconfigurable shop floor components. In accordance with cloud computing's key principles (CC), CMfg models may potentially utilise a shared pool of computational resources., in which case CC is included at the IaaS (Infrastructure as a Service) abstraction level [2]. Manufacturing companies have already embraced cloud computing for supply chain management, digital marketing, and enterprise resource planning (ERP), but production and logistics layers have not yet been fully connected in real time [3]. SaaS (Software as a Service)-based solutions are promoted by cloud adoption at enterprise business and operations management levels to address issues with managing client orders globally optimally, matching capacity and demand, or boosting market share through client segmentation. The adoption of the CMfg in IaaS model on the production layer of businesses with high production volumes, variable batch sizes, and/or frequently changing product types is thought to be necessary in the future smart digital factory for the sustainability and resilience of production processes [4]. This is despite the widespread acceptance that this category of cloud-based services ensures smart management of networked companies and complex manufacturing value chains. Customers can order, configure, pick, and use specifically tailored resources and services, ranging from computer-aided engineering software tools to after-sales services, when high level SaaS cloud models are integrated with CMfg models at the production level [5]. In that they enable Direct Digital Manufacturing (DDM), which often uses both cutting-edge 3D printing and digital shape modelling techniques, cloud services are a crucial component of digital manufacturing [6] [7]. Parts are directly generated using digital models, eliminating the need for tooling and setup. Cloud services support DDM by giving consumers access to service-oriented networked product development patterns that allow them to choose, set up, and employ certain resources, recipes, and services.

The following are a some of the top illustrations of digital transformation approaches:

SEAT: A Spanish automaker, begins recruiting talent for its Breaking Fab innovation project by holding a case-solution competition.

Suzuki Motorcycle A well-known company that makes precise motorcycles, begins by thinking about the user's path on the website, including what they would be looking for, what they would need to know, and any barriers they could run into that would prevent them from making a purchase.

L'Oréal A century-old beauty brand, has created new venues for interaction with its clients by utilising the opportunities provided by digital surroundings. Another one of its choices as part of its digital transformation strategy has been developing applications.

Lego A global leader in the toy sector, is focusing on digital products including movies and mobile apps as part of its business strategy diversification.

Muroxe An unusual shoe manufacturer opens its Design Lab division to offer a more individualised client experience and boost sales.



**Prateek Jain and Archana Sharma**

Utilising KPIs to monitor your digital transformation is essential for success. To ensure accurate assessment and keep track of objectives, it is essential to have a solid understanding of the KPIs of the services after determining the starting point. Following KPIs which are a blend of internal and external metrics are mentioned below:

- user loyalty
- monitoring the income from new digital outlets.
- the business's ability to survive.
- Results of outbound marketing.
- the enhancement of performance.

Although it may appear overwhelming, digital transformation is neither unachievable nor always doomed to failure. It can be done, but it will take time, talent, and effort. It's crucial to remember that there is no "one-size-fits-all" digital transformation strategy; each one should be adapted to your organisation's specific demands to make the most of your technological investment.

Related Work

For ordinary businesses, several studies tend to offer high-quality digital transformation solutions. [7] describes the construction of a digital road map that considers changes to people, process, content, and technology in order to increase corporate effectiveness, customer experience, and the integration of information infrastructure. In a similar vein, [8] emphasised the importance of starting the digital transformation road map by sequentially taking obstacles, objectives, capabilities, and actions into account. According to the maturity of digital technology and business model preparation, the study [9] categorised digital transformation initiatives into four groups. The authors of [10] stressed the need for the digital strategy to consider functional, company, and corporation levels and presented a down-up process model for the formulation of a digital strategy for manufacturing organisations. The article [11] suggested a technique for creating a digital strategy map that considered the needs of digital transformation as well as corporate profit and customer experience. Business process management tools for SMEs to help them accomplish digital transformation were presented in references [12] [13]. From a strategic viewpoint, these works gave an overview of digital transformation initiatives. The strategy is rarely applied to a thorough investigation or case study about using it in a real industry.

The digital transitions occurring in actual industries are another topic covered in several publications. For instance, the study [14] looked at 25 businesses and concluded that digital solutions and customer involvement were the two most important tactics for large, established businesses to undergo digital transformation. Three case studies illustrating how digital transformation is effectively implemented are described in [15], and the authors have come up with a suggestion for corporate managers on how to deal with the difficulties and risks involved. The authors of the study [16] presented a case study of how the retail sector has undergone a digital transformation, using IoT to implement inventory control and create an information platform as a result. The food industry's value chain was the subject of a case study in [17], and the digital transformation journeys of three significant firms in the electrical, agricultural, and telecommunications manufacturing industries were examined by the authors [18]. They concluded their interesting research of how real-world industries are undergoing digital transformation, but they did not provide any useful advice on how to proceed with technology development. In [19], the authors outlined many significant obstacles to consider while exploiting IoT in the development of business models, including data ethics and trust. These works mostly offer an abstract, untested road map for the industry's digital transition. In-depth architectures and solutions for integrating IoT and cloud computing into the digitalization of many industrial sectors have also been provided by numerous technical studies.

Driving Force Behind Digital Transformation

Market pressure and the prospect of competition are currently the main forces behind digital transformation. Competitors will be inspired to follow suit or risk losing market share if one firm successfully facilitates a robust digital transition. Another element driving the digital revolution is customer demand, which comes from people who live in a connected and mobile world. Optimised process efficiencies and the ability to offer reduced costs on goods and services are just two examples of how a digitally transformative project can change the value proposition



**Prateek Jain and Archana Sharma**

of a business. The way that customers behave changes as technology develops and the times change. The foundation of all modern enterprises is gratifying their clients. So, if you want to offer excellent customer experiences, you must adapt to the digital transition. Not only that, but businesses can embrace innovation and increase productivity thanks to digital transformation tools. It helps a firm take off safely into the future by empowering employees to make wiser decisions, fostering stronger professional ties, and more. The following are the digital transformation tools which have been mentioned in figure 4.

- Big Data and Real-Time Analytics
- IoT and 5G
- Mobile
- Virtual Reality
- AI And Machine Learning
- Digital Twin

Smart Factory: Industry 4.0

The industry 4.0 definition refers to the fourth industrial revolution, Figure 6. Previous industrial revolutions led to increases in productivity and were driven by mechanisation (first industrial revolution or industry 1.0), electricity (second industrial revolution or industry 2.0) and information technology (third industrial revolution or industry 3.0) [6] [7]. Industry 4.0 refers to digital transformation [8] as shown in Figure 5. It describes changes in manufacturing systems and transformation from “machine manufacturing” to “digital manufacturing”, driven mainly by information technology [9] which has been highlighted in Figure 6. Simultaneously with the transformation of manufacturing models, there was a transformation of the society from “Hunting society, through Agricultural society, Industrial society, Information society to Super smart society” [10], Figure 7.

The shift to Industry 4.0, according to Lasi et al. [9], is fuelled by a strong emphasis on applications, which creates a big need for change due to shifting operating conditions and enormous technological impulses (application-pull and technology-push). Zheng [7] asserts that the demand for quicker delivery, more efficient and automated processes, greater quality, and customised products is what is driving the shift to Industry 4.0. The goal of the fourth industrial revolution is to increase the efficiency and maintenance of traditional machines and equipment by turning them into smart, self-learning machines [16]. Industry 4.0's primary objective is to build collaborative, intelligent production platforms that make it possible to use networked information systems [17]. The goals of Industry 4.0 include “real-time data monitoring, tracking the status and positions of product as well as to hold the instructions to regulate manufacturing processes” [18][9] as illustrated in figure 8..

Characteristics of Smart Factory

A factory is referred to as a “smart factory” if it combines big data, artificial intelligence, smart computing, and physical production processes and operations. It delivers production and manufacturing positive outcomes like increased productivity, cost savings, less downtime, and reduced waste. It is additionally referred to as the “factory of the future” since it possesses traits that have made it the primary option used by numerous businesses to compete in the present-day industrial environment.

Technologies and Networks

Both conventional and smart factories make use of electrical equipment and machinery, as well as information technologies (IT), but a smart factory integrates IoT devices with networks to allow for communication and data exchanges that enable deeper data insights. Additionally, intelligent equipment, robots, tools, and workpieces are used in smart factories to monitor, manage, and automate the production processes, resulting in self-improvement. For instance, embedded sensors provide analytics of sensor data that is useful in preventive maintenance, when a machine's failure signal is followed by an automatic repair signal.





Prateek Jain and Archana Sharma

Production

Smart factories emphasise mass customization rather than mass manufacturing, which is the goal of traditional factories. Due to the use of a more flexible production and logical framework, items made in smart factories are more innovative and one-of-a-kind and have a shorter product life cycle. Additionally, smart factories can produce in a sustainable manner over the long term compared to conventional factories because of their more effective resource use.

Decision Making

Smart factories use data analytics to provide businesses and manufacturers with information based on previous data and production patterns. Additionally, depending on data, sales margins, and staff gained from human resources as well as sales or warehousing, they can make better decisions to improve their production process.

Supply chain

Supply chains are made more effective and transparent by smart factories. Sharing production data with the suppliers is a part of it. This enables businesses or factories to more accurately forecast or have better shipment or delivery times. The potential of digital transformation as a remedy for numerous enterprises and industries has been realised. Therefore, smart factories will eventually become the "factories of the future," as was formerly thought.

Impact of Smart Factory (Industry 4.0) in manufacturing sector

Industry 4.0 is revolutionising processes in manufacturing, product creation, and distribution. Manufacturers are integrating cutting-edge technology like Internet of Things (IoT), cloud computing and analytics, machine learning and artificial intelligence (AI) into their processes and production facilities. These "smart" factories contain cutting-edge sensors, embedded software, and robotics that collect and analyse data and support decision-making. Even more value is created when operational data from ERP, supply chain, customer service, and other business systems is combined with data from manufacturing processes. This enables previously isolated data to now be seen and understood at completely new levels. Modern IoT devices are employed in smart industries to boost output and quality. By substituting AI-powered visual insights for manual inspection business models, production errors can be reduced while costs and time are reduced. A smartphone that is cloud-connected can be simply configured by quality control staff members to be used for remote monitoring of industrial processes. Producers can find errors earlier rather than later, when fixes are more expensive, by employing machine learning algorithms. A look at five key statistics shows that Industry 4.0 activity has risen since 2011, with COVID-19 and the 2022 slowdown presenting recent bumps on the road. The analysis considered five indicators: Public search interest, academic papers, start-up funding, M&A activity, and enterprise adoption. Only a few of the industries that could gain from the ideas and technologies that make up Industry 4.0 include discrete and process manufacturing, mining, oil and gas, and other industrial divisions. A manufacturing operation can be significantly impacted by the Industrial IoT. The following are important places to seek for benefits:

- Productivity:** The plant is on course to experience previously unheard-of productivity increases because of more data, connectivity, and communication as well as more efficient maintenance, process management, and automation. These advantages result in increased uptime and inventory management, which we shall explore below, as well as higher throughput, optimal product quality, and more effective resource usage.

- Uptime:** Predictive maintenance, which aids in identifying the early stages of equipment faults before they affect production, is made possible by performance monitoring, data collection, and fully integrated CMMS software, all of which work together to make maintenance more efficient. This makes it possible for you to plan corrective maintenance for times when there will be less disruption, while also more effectively ensuring that the right tools and employees are available. As a result, repairs take less time to complete, downtime is decreased, and machinery keeps working as it should at the appropriate times.

- Inventory:** Industry 4.0 technology, such as sensors helps in ensuring the accuracy in counts and that parts are where they should be by ensuring that they are in the right place. The sourcing process can be made more flexible by applying the principles of Industry 4.0 to the analysis of partners in the supply chain and for procurement.





Prateek Jain and Archana Sharma

●**Advantage over competitors:** Industry 4.0's focus on quality and timeliness on the customer end helps you maintain client satisfaction. The linked facility can set itself apart in the crowded, cutthroat production environment with more uptime, much fewer unexpected outages, and enhanced processes and operations.

●**Profit margins:** Each minute that your equipment is out of commission reduces your profit margins, and unexpected downtime increases this impact tremendously. Industry 4.0 can increase profits and pay for the equipment and infrastructure investments you've made by lowering downtime and offering more sophisticated, inventive automation possibilities.

●**Keeping track of documents and records** Industry 4.0 makes it possible for record keeping to be more effective and precise by integrating processes like predictive maintenance and preventive maintenance with systems like CMMS. This reduces unnecessary work and misses deadlines by ensuring that essential tasks and duties are carried out when required.

Components of the future Smart Factory

The following elements/technologies of a smart factory from an Indian perspective are listed. We predict that manufacturers in India will have a constant need for these components soon:

●**Smart supply networks:** For traceability, automation, and optimization of inventory-related choices. Transparency over inventories.

●**Smart manufacturing systems of the future:** For automated and intelligent scheduling of production tasks, machine intelligence, and remote visualisation, control, and monitoring.

●**Data analytics** will also require several other elements, such as cloud storage, business analytics, cyber security and encryptions, cyber-physical systems, etc.

●**Sensors and actuators:** To collect information for real-time automated decision-making and to operate equipment and systems based on those decisions.

●**Mobility management:** For instantly responding to notifications and updates and making manual decisions as needed.

●For quick prototyping, quick printing of replacement parts, etc., use additive manufacturing.

●**Robotics:** The use of adaptable robots to enhance intelligence and automate processes.

●Innovative computational materials engineering and nanomaterials are examples of advanced materials.

●A customised intelligence methodology is designed for responsive manufacturing.

In addition to the solutions mentioned above, big data analytics, Blockchain and virtual reality are some other technologies that will gain popularity.

Key Challenges in Transitioning to IoT

Businesses have access to amazing savings and growth potential because of the IoT. Various obstacles while selecting the IoT Transition as shown in Fig 10.

Below we outline the six essential elements that must be considered for your organisation to properly integrate the IoT ecosystem.

●**Connectivity:** Because the "Internet of Things" demands extremely strong connectivity, it is preferable to have a separate network that guarantees uninterrupted service from other connected devices. Network engineers can implement the necessary protocols, ports, and services with the aid of an isolated network.

●**Bandwidth:** Increased data traffic, users, and device additions to the network will occur when the IoT ecosystem is introduced. As a result, it is necessary to consider the bandwidth specifications. For IoT requirements, most businesses prefer to invest in bandwidth expansion. IoT devices, as was previously noted, are small and use wireless connections that are considerably slower than average, therefore little information is shared between them. As a result, compared to regular internet usage, the aggregate traffic from IoT devices will be significantly lower.

●**Platform:** One of the most important aspects of a successful IoT migration is selecting the best platform for your needs. Among the most well-liked platforms, there are Xively, Thingsquare, and Sensinode. Selecting the best platform requires careful consideration of its supporting hardware, operating system, and programming.

●**Security:** Implementing the IoT ecosystem for businesses might be difficult due to data security concerns. Intrusion detection systems, firewalls, online security, and internet intelligence from cloud computing should all be part of a





holistic network security system. To help with security, it will be helpful to keep track of the quantity and variety of devices that connect to the network.

●**Storage:** A lot of storage space will be required to accommodate the continuous flow of data from the many devices, user accounts, and web resources. There is a need for analytics platforms to be put in place that can gather, organise, and analyse streams of data. This data will be further examined to determine significant correlations or information that will benefit client businesses.

●**Training Staff:** Employers should inform staff members of the migration to the IoT after the IoT ecosystem has been installed. The employment process must also be in line with this technological transformation, and applicants with a solid understanding of technology should be selected.

Safety: It should be highlighted that IoT systems, like many others, are prone to device or communication failures, faulty apps, or unexpected undesirable app behaviours. These flaws may cause physically harmful and unsafe things to happen, such as malware telling a gadget to "open the front door while no one is home."

Case Studies

Case 1: There are numerous businesses in India that operate fully operational smart factories when it comes to smart manufacturing. Industry 4.0 requirements have already been met by the Jamnagar complex of Reliance Sectors, the Mysore, Rohtak, and Khandala facilities of Asian Paints, and the Hazira, Talegaon, Powai, Ranoli, and Coimbatore heavy engineering facilities of L&T for the defence, aerospace, and nuclear industries. The announcement of Hero MotoCorp's Global Parts Centre as a smart factory is almost complete.

Case 2: For the Cadbury facility in Andhra Pradesh, Mondelez India has implemented smart manufacturing technologies. They are using a device that transmits information immediately if the moulds contain too much liquid chocolate or if there is a quality rejection. A camera system in the tunnel keeps an eye on things and looks for any anomalies. This reduces waste and facilitates preventive maintenance. Additionally, the firm uses robots to pack the pre-made packs into the boxes.

Case 3: With employees all throughout the world, Schneider Electric is an international business. As it was challenging for it to process the same documents from several locations at the same time before the Box initiative, a cloud-based solution, business processes were generally delayed before that. For its widely scattered staff, Schneider Electric also needs a method of data management and security. To integrate its own proprietary cloud environment with Microsoft Office programmes, Schneider Electric outsourced the work to Box. By utilising shared links, granular permissions, and content controls, the platform also maintains strict control over corporate data. The company now hosts 90% of its material in the cloud and has a more adaptable workforce thanks to this project, which saw it go from hosting 80% of its content on-premises.

Case 4: An automotive sector with the goal of bringing a transformative approach in their business by determining whether the digital transformation of manufacturing robots may be used to maximise their working speed and save electricity [20]. Robots use 100% of the motion speed in a body-in-white manufacturing environment and generally work in collaboration and communicate in teams. As a result of the need to wait for one another, not every robot can operate at full speed. These waiting periods offer the chance to slow down robots whose cycle times are not crucial. Reduced energy consumption is the outcome of slower motion. The Internet-based digital networking of machines creates the fourth industrial revolution. These "smart machines" are already revolutionising several industries, from manufacturing and agriculture to healthcare and transportation [21]. Research has been done by [21] to visualise and analyse technological knowledge patterns that result in discoveries that drive industrial digitization with significant effects on the value chain.

Case 5: Today, however, a lot of traditional supply chains are transitioning from just being static lists to becoming dynamic, interconnected systems—the digital supply network—that may further soak up ecosystem partners and develop over time to a more ideal state. Digital supply networks combine data from different sources and sites to fuel the underlying process of production and distribution. Figure 10 portrays the interlinked lattice of the modern



**Prateek Jain and Archana Sharma**

digital supply network concept with digital at its centre. Each node in the network does have the capability to communicate with all the other nodes, boosting connectivity between previously isolated places. In this approach, interactions are bidirectional, establishing connectedness between previously disconnected supply chain segments.

Case 6:

The country is getting transformed by utilising renewable energy resources, especially solar panels. As more panels will be installed in the field, it is getting a bit impossible to keep track of these panels simultaneously through manual fashion. This also led to the involvement of more manpower thereby increasing the cost. A work related to optimization and automating the tracking, monitoring and configuration activities of all the assets of the plant, including solar panels and various electric motors was conducted by the SCADA Solution Development. They conducted the same to solve the concern of their client. The ultimate aim was to bring out the improvement in the efficiency of their existing solar power open field implementations. For solving this the An IoT Gateway solution was given for making it integrated with the cloud..

Key Findings in Adoption of Industrial IoT in digital transformation of Business

Through the adoption of digital transformation by the companies have recently experienced an enormous evolution. The business world is more favourable than ever for sectors to advance digitization. An IoT adoption has continued to be a game-changer for organisations in the frenzy of 2022. Yet as sectors move past the problems caused by the pandemic and towards 2023, linked gadgets will keep reinventing how businesses operate. In the below figure we can see the IoT developments of 2023 & have thereon comprehended the current IoT buzzwordswith the division of data as per the industry needs.

Navigation and audio playback are no longer the only methods used to evaluate in-car infotainment systems. A significant transition is being noticed in the recent years, and in their modern avatar they are termed as digital piloting systems. Further, the automotive sector is getting transformed by the usage of phone connectivity, cloud integration, HMI. This is also improving the user experience, and all this is getting possible through the digital cockpit solutions.

- A digital cockpit system unifies the functionality of the head unit, instrument cluster, and ADAS on a single platform. As cars become software-defined machines, this kind of ECU consolidation represents an important development for the sector.
- The redistribution of workload across various computing resources is facilitated through the hypervisor to segregate the infotainment OS. Superior system availability and performance are consequently guaranteed.
- Operations can be totally safe if functional safety regulations are followed and ASIL requirements are met.
- Head Up Displays based on Augmented Reality are another tool used by automakers to improve the experience of the driver and passengers.
- FOTA upgrades allow for smooth system maintenance and upgrade.

Let's now examine more crucial levers for improving business process efficiency in Industry 4.0 today:

- **Automated asset management** – In 2023, more people will adopt automated asset management, a popular Industrial IoT concept. In Industry 4.0, more efficient asset management procedures can improve productivity and generate funds. Businesses have been using automation and the Internet of Things (IoT) to effectively manage assets ever since they realised this. The above-mentioned case study has shown how a solar power facility benefited from an automated asset monitoring system using the case study about automating the monitoring of renewable resource management.
- **Predictive maintenance** – It is yet another trend that is getting momentum in Industry 4.0. The constant data monitoring helps in preventing industrial equipment failure. It helps to avoid extended periods of system unavailability. Long-term savings from this include time, effort, and money. The Figure 11 highlights the global adoption of IoT in Business using various use cases.



**Prateek Jain and Archana Sharma**

Even though they rely on the same technology, an IoT system and workforce management can function together. Hence, integrating an IoT infrastructure into a company can significantly increase its value. It offers adaptability and enhances operational visibility. To forecast lucrative actions for the organisation, analytical methods can also be used.

CONCLUSION

The company ecosystem that results from digital transformation connects numerous objects, people, and operations. The ability to link the disconnected not just inside the company ecosystem but also throughout the whole supply chain is made possible by the integration of IoT and cloud platforms. As many business-related aspects as possible are learned about through the analysis and feeding of the information that has thus been acquired. Further, the Internet of Things (IoT) will hasten digital transformation through generating greater company value through useful insights gleaned from IoT devices, enterprise data, and social media. As a result, IIoT resolutions will be a crucial component and significantly speed up the digital transformation process. All impacted sectors will now have access to functionality that was previously unavailable thanks to the opportunities provided by IoT implementation. According to our examination of numerous case studies, the perception of IoT dissemination has been shaped so that businesses may see the advantages and prospects brought about by the adoption of this technology. As discussed in the case study above we saw that companies are finding these innovative technologies a boom for their growth and increasing sales. Likewise, the Cadbury facility in Andhra Pradesh, Mondelez India has implemented smart manufacturing technologies to identify the quantity of liquid chocolate or if there is a quality rejection. This was made possible by using the camera, devices & robots to pack the pre-made packs into the boxes. Further, Schneider Electric transformed their business from traditional to cloud based and now they are using cloud-based hosting with more than 80% content on premises being laid down. Further, we saw that Reliance Sectors is also transforming their business by the means of a smart factory. In another case study of an automobile industry, we explored the position of Robots and on how developments in industry 4.0 help to produce new inventions in the machine tool business. In India, the ball has already begun to move in the direction of smart manufacturing, and there is already some policy backing. The ROI will start to become more and more appealing for SMEs and MSMEs as well as major companies accelerate their smart manufacturing projects, and the volumes rise. Worldwide vendors with pertinent solutions to offer have a tonne of opportunity.

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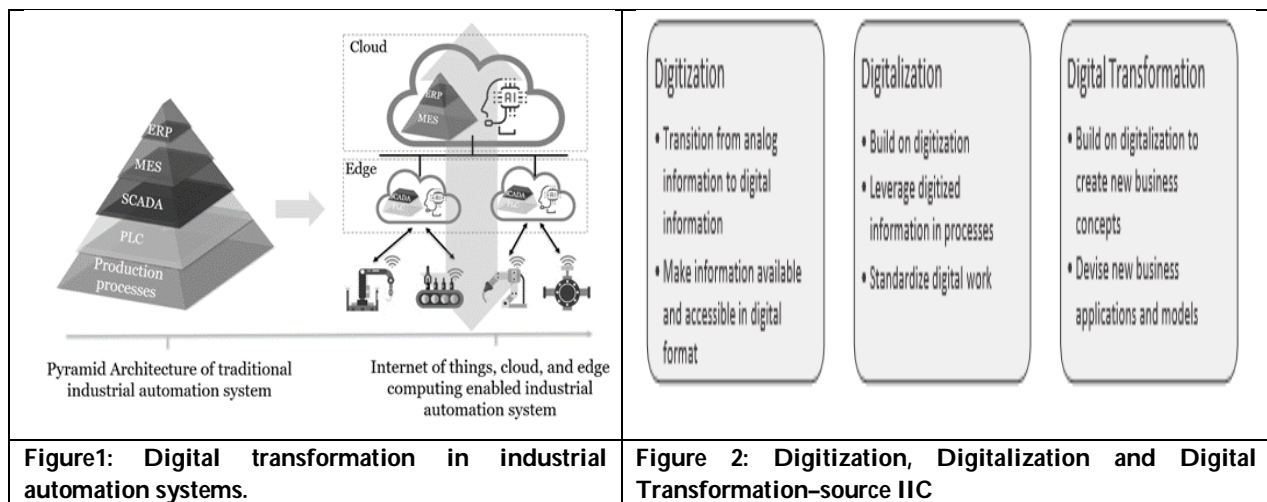
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Prateek Jain and Archana Sharma

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Prateek Jain and Archana Sharma

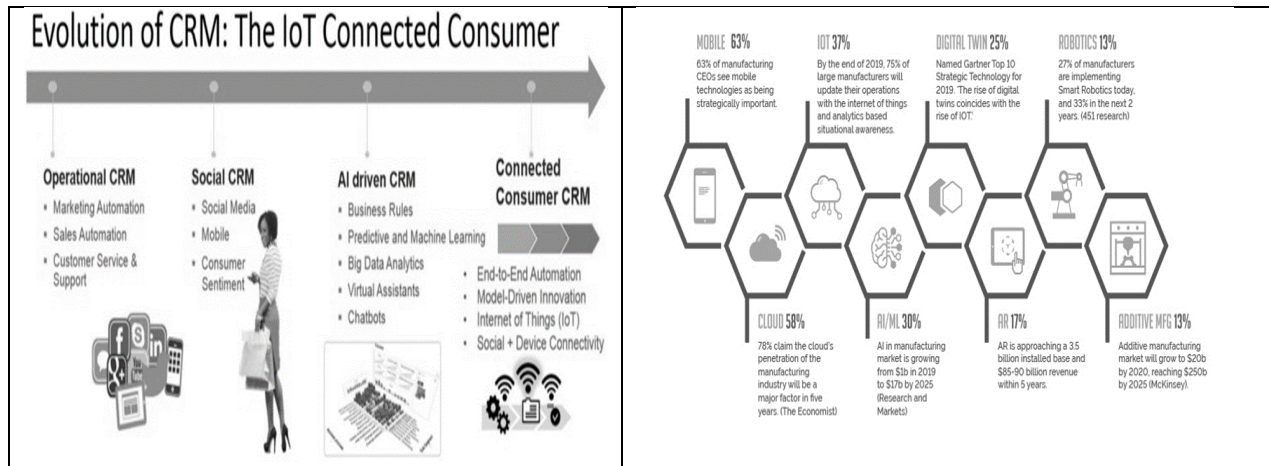


Figure 3: CRM using IoT.

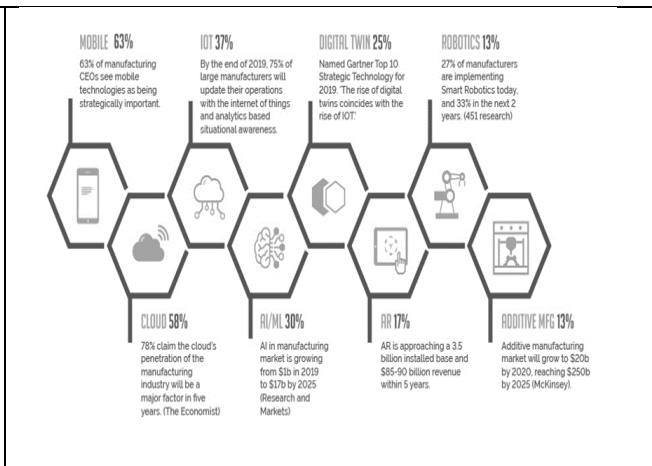


Figure 4: Digital transformation Tools

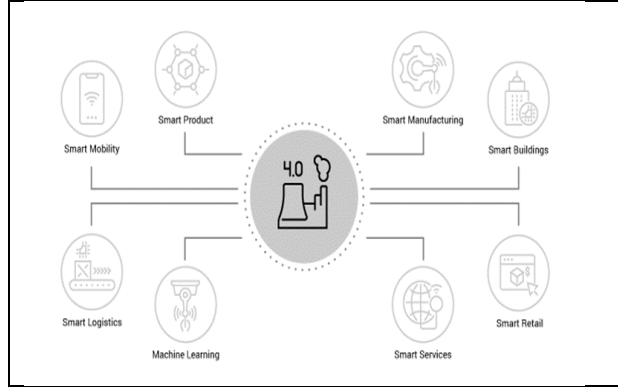


Figure 5: Industry 4.0

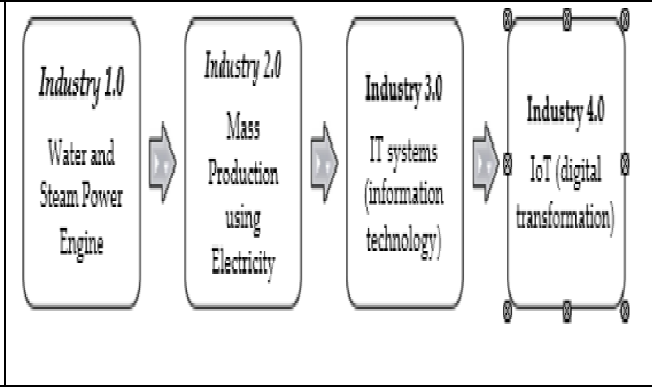


Figure 6: Four industrial revolutions.

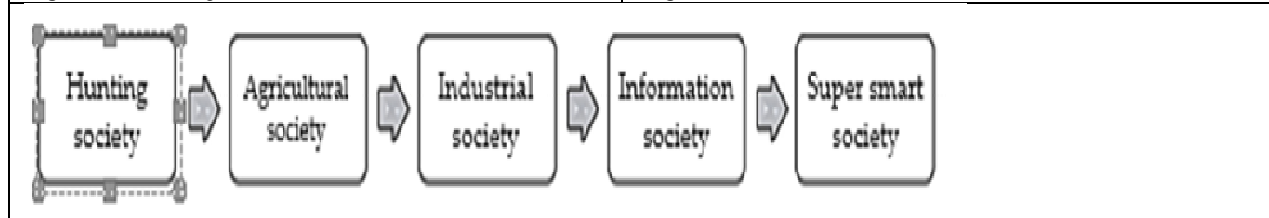


Figure 7: Transformation of society.

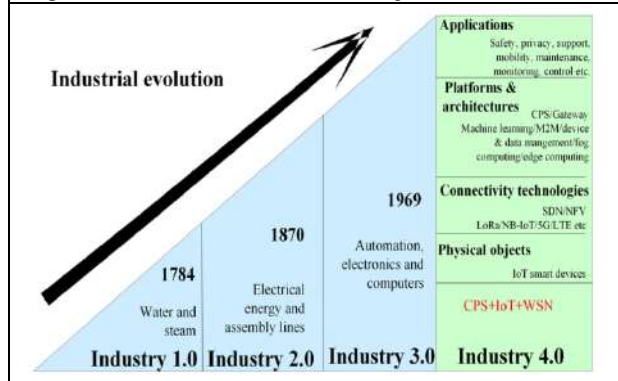


Figure 8 Industrial evolution



Figure 9: Industry growth analysis (Source: Analytics Research 2022, Google Trends)

IoT





Prateek Jain and Archana Sharma

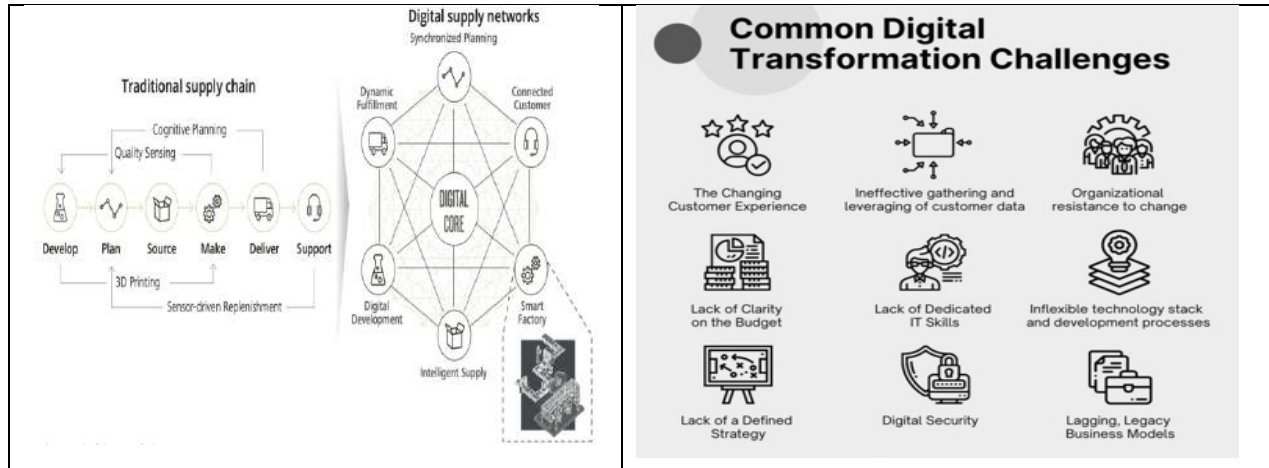


Figure 10: Shift from traditional supply chain to digital supply network

Figure 10: Digital transformation Challenges

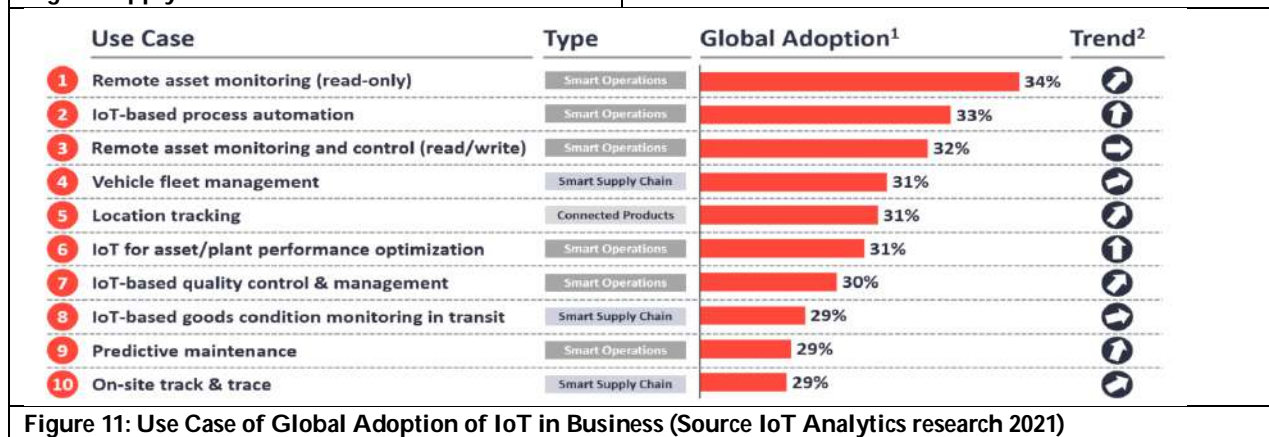


Figure 11: Use Case of Global Adoption of IoT in Business (Source IoT Analytics research 2021)





Prediction of Water Pollution and Water Quality using Data Mining Techniques

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ABSTRACT

Water pollution has an impact on nature in two different ways. As a result, both the living and the environment suffer. Pollution has numerous detrimental effects on both humans and aquatic communication. Every day, over 14,000 people die from the effects of water pollution on drinking water. Untreated sewage in developing countries contributed significantly and in no small part to the degradation and pollution of the environment, which had a detrimental effect on the water bodies (rivers and oceans) that are necessary for life. These human activities included industrialization and agricultural practices. Pollution is the practice of contaminating the environment. Commercial and industrial trash, agricultural practices, routine human activities, and most significantly, transportation modes, all contribute to its production. Here, attribute selection is used to do the analysis both before and after. The dataset of waste water treatment plants was used to the SimpleKMeans, Canopy, and Cobweb clustering algorithms with attribute selection. These clustering results suggest that the best clustering algorithm for this dataset is SimpleKMeans.

Keywords : Water Pollution, Water Quality, SimpleKMeans Clustering, Canopy Clustering, Cobweb Clustering, CfsSubsetEval, Best First

INTRODUCTION

One of the most important natural resources for the survival and existence of all life on the earth is water. Almost every day, we utilize water for drinking, cooking, personal cleanliness, agricultural practices and recreational purpose. WHO estimates that in 2005, 2.6 billion people did not have access to basic sanitation and 1.1 billion did not have access to safe drinking water. To improve evaluation and prediction accuracy, many researchers have created





Sumathi Ganesan

or employed big data analytics models and machine learning-based methods to conduct water quality assessments [1]. In South Asian countries, especially Bangladesh, arsenic is a major problem. Arsenic The naturally occurring high concentration of arsenic in deeper layers of ground water is a common cause of ground water contamination. Kidney failure and damage are two disorders that can be brought on by arsenic contamination. Skin lesions, diabetes, anemia, lower performance on intellect and long-term memory tests when young, cardiovascular disorders, neurological issues, etc. Numerous NGOs are attempting to reduce the issue of arsenic contamination. These NGO's gather and record information about arsenic contamination, and more information is being gathered and analyzed every day. It is impossible to overstate how essential water is to life. It is crucial to remember that the depletion of this resource—whether caused by contamination or reckless use—has a number of negative effects[2].

Water contaminants include[2]:

1. Biological (Pathogens like bacteria and viruses)
2. Chemicals (organic chemicals such as biocides and inorganic chemicals such as phosphates, nitrates, and fluoride)

If a chemical is present in water to the point where it makes it impossible to use it for a certain purpose, it is deemed polluted. Olaniran (1995) defined water pollution as the presence of dangers (pollutants) in excessive quantities to the point where the water is no longer fit for drinking, bathing, cooking, or other purposes. The elements of ion toxicity, acidification, salination thermal pollution that influence the water's quality. Therefore, it becomes crucial and vital to evaluate the water quality in order to guarantee the environment's quality [2].

One of the biggest problems that humanity has is maintaining a sustainable supply of water. Proper water monitoring, which necessitates the analysis and interpretation of enormous amounts of environmental data, is the first step in ensuring the sustainability of water resources. They tackle the issue of pattern recognition, rectification, and prediction in signals from water monitoring systems. Despite the critical nature of this monitoring, the proper machine learning methods have not yet been used. In the future, it will be able to raise the level of automation and efficiency in the water management system by using these techniques to give operators high level summaries for better decision support. As there is a direct correlation between water and health, water supply resources like the Kinta River in Perak and Malaysia are crucial for Ipoh, Perak, Malaysia's utilization and production. To categorize the water quality, classification models like Bayes, Rule, Trees, Lazy, and Meta were used. The classification of lake-water resources in five-acid sensitive areas of the United States has been modified using a knowledge-based methodology [3].

The clustering algorithms of SimpleKMeans, Canopy, and Cobweb are compared in this paper along with the attribute selection procedure. The paper is organized in the manner described below. The different related works of water pollution and water quality assessments are presented in Section 2. With the dataset description, clustering algorithms, and attribute selection algorithms in Section 3, the proposed methodology is explained. The findings and performance comparison of the SimpleKMeans, Canopy, and Cobweb clustering methods with and without attribute selection are highlighted in Section 4. The paper is concluded in Section 5.

LITERATURE REVIEW

The research works carried out by various researchers that are connected to the water pollution and water quality are reviewed in this section. The literature review primarily focuses on the types of analyses that are available in water pollution and water quality prediction. A research conducted by Putri et al. to evaluate the water quality of 14 significant Taiwanese rivers. Principal component analysis-multiple linear regression (PCA-MLR), a multivariate statistical technique, was effectively utilised to classify Taiwan's river pollution levels and locate potential sources of contamination. 14 significant rivers in four regions of Taiwan's were analysed for water quality and heavy metal monitoring data from the Taiwan Environmental Protection Administration (EPA), with the Erren River being identified as the nation's most contaminated river [4].



**Sumathi Ganesan**

In 2019, Wang et al., suggested actively preventing collapses through regulating river discharge to help maintain the eutrophic rivers' water quality. Significantly increased sediment oxygen consumption and nutrient release from deposited phytoplankton detritus in the navigation channel are the main causes of deteriorated water quality, according to research [5]. Liu et al., in 2020 emphasized the importance of regulating and monitoring environmental quality in regional lakes. This study involved fieldwork in 55 lakes along the middle and lower sections of the Yangtze River (MLR-YR), where the majority of lakes were characterized by eutrophication because of heavy human activities [6]. In 2020, Loos et al., provided data assimilation for the Yeongsan River in South Korea's water quality accuracy. The traditional Ensemble Kalman Filter (EnKF) and two related algorithms (Dud-EnKF and EnKF-GS), which either provide opportunities to improve initial conditions for non-linear models or reduce computation time (important for real-time forecasting) by using a (smaller) time-lagged ensemble to estimate the water quality, have all been studied to increase the accuracy and skill of water quality forecasts along the Yeongsan River in South Korea [7].

Using the irrigation water quality index (IWQI) and GIS-Zoning maps, Batarseh et al. conducted a case study to evaluate the groundwater quality for irrigation in the arid regions in 2021. For the goal of evaluating groundwater resources for irrigation in Abu Dhabi Emirate, United Arab Emirates, this study created an Irrigation Water Quality Index (IWQI) and GIS-Zoning maps. The computed IWQI values ranged from 8.78 to 77.44, and 52% of the samples were classified as having severe irrigation constraints, in which groundwater can only be utilized to irrigate plants with a high tolerance to salt [8]. To reduce water pollution, Wikurendra et al. undertook a water quality analysis of the Pucang River in the Sidoarjo Regency in 2022. The Pucang River in Sidoarjo Regency was the subject of this study, which sought to assess the water quality and manage pollution. The method was used to determine the 11 parameters' water quality and compare them to Indonesia's government regulation number 22 of 2021 about water quality criteria. In this investigation, secondary data were employed from 2018 to 2020[9]. A review of the impacts of water pollution on disease heterogeneity and human health was conducted in 2022 by Lin et al. The objective of this review is: According to the United Nations (2016), diarrheal diseases cause more than two million deaths annually around the world, with children bearing the brunt of this burden due to poor sanitation and tainted water supplies. Poor drinking water quality contributes to the development of more than 50 different diseases, and it is the cause of 80% of illnesses and 50% of child deaths worldwide. However, diarrhoea, skin conditions, malnutrition, even cancer and other disorders linked to water contamination are brought on by pollution [10]. From the above related works, the analysis of water pollution and water quality prediction is performed by using clustering algorithms with and without attribute selection.

METHODOLOGY

The methodology to perform the analysis of water pollution and water quality prediction is as follows:

Data Set

The used dataset is about waste water treatment plants. Information on wastewater treatment plants with permits issued under the New York State Pollutant Discharge Elimination System (SPDES). The primary justification for locating waste water treatment facilities in New York State is: Surface and underground water resources abound in New York. To safeguard and preserve these priceless resources, the Environmental Conservation Law (ECL) was amended to include "Water Pollution Control" in Article 17. In order to sustain the State Pollutant Discharge Elimination System (SPDES) programme and preserve the reasonable standards of purity for New York's waters, Article 17 authorized its creation [11]

The SPDES programme is intended to stop water pollution in New York and maintain the maximum water quality possible in accordance with[11]:

- Fish and wildlife preservation and propagation;
- Public health;
- Public enjoyment of the resource;



**Sumathi Ganesan**

- Industrial development in the state

The United States Environmental Protection Agency has approved New York's SPDES program for the regulation of surface waste water and storm water discharges in line with the Clean Water Act. The SPDES program, however, has a wider scope than that mandated by the Clean Water Act because it regulates point source emissions to both surface waters and ground waters [11]. The SPDES general fees permission is shown in above Table 1. The Department levies permit costs for the yearly Environmental Regulatory Program costs depending on the kind of facility, the type permission, and the discharge volume, even though there are no application fees for reviewing permit applications. The aforementioned Table 2 summarizes the New York State Pollutant Discharge Elimination System (SPDES) subterranean water, including the capacity, fees (per year), and whether the facility is an industrial or municipal one.

Dataset Description

Data Set — Waste Water Treatment Plant

No. of Attributes — 10

No. of Instances - 535

The first attribute name is plant type where its description identifies municipal or industrial waste water plants and it belongs to the type of plain text. The second attribute name is SPDES Permit Number, which is a special identification number for each waste water treatment facility that has been granted permission through the New York Statewide Pollutant Discharge Elimination System (SPDES). This number is generated by the New York State Department of Environmental Conservation and is of the plain text data type. The third attribute name, Ground or Surface, indicates whether the treated water is discharged to surface water (surface water) or groundwater (groundwater), and it is of the type plain text. The waste water treatment facility is planned to handle an average column of millions of gallons per day (mgd) under the fourth attribute, Average Design Hydraulic Flow and it belongs to the type of Number. Street is the name of the fifth attribute, which contains the facility's street address and is of the type plaintext. City, which refers to the facility's city of residence, is the sixth attribute name and it falls under the category of plaintext. State where its state is where the facility is located is the eighth attribute name, and it is of the type of plain text. Country is the name of the eighth attribute, which belongs to the plaintext type and is the country where the facility is located. The facility's zipcode is the name of the ninth attribute, which is called Zipcode, and it falls under the category of plaintext. The tenth attribute name is Latitude where it Latitude (decimal degree) and it belongs to the type of number. Table 3 shows the sample dataset of waste water treatment plants [11]. The data set is preprocessed to remove unwanted data. Table 4 shows the preprocessed dataset of waste water treatment plants.

Clustering Algorithms used:

In this step, the clustering algorithms of SimpleKmeans, Canopy and Cobweb were applied to the preprocessed dataset. When objects are grouped together based on similarities in their features, this process is known as clustering. In terms of data mining, this process divides the data using a particular join algorithm that is best suited for the desired information analysis. Hard partitioning is the term for this sort of grouping, which permits an object not to strictly belong to or be a part of a cluster [12].

Simplekmeans

K-means clustering is clustering method in which we move the every data item nearest to its similar cluster. There are some of the steps for working this clustering method which includes to find the centroid randomly. It is better to take the boundary and middle value as the centroid. Assign cluster to each item set. To repeat all the process, every time the process can be repeated and the total sum of the error rate is changed. When error rate, stops to change then finalize the cluster and their item set [13].



**Sumathi Ganesan****Canopy**

An unsupervised pre-clustering approach is called a canopy clustering algorithm. It is frequently used as a pre-processing step before running a hierarchical or Kmeans method. Remove a point from the set by starting a new canopy from the set of data points that need to be clustered. If the distance from any remaining element in the set to the starting point of the new canopy is less than the loose distance T_1 , that element will be assigned to the new canopy. There are no more data points in the cluster set, and clustered canopies can be sub-clustered rather affordably [14].

Cobweb

Cobweb is a hierarchical conceptual clustering incremental system. It builds a classification tree out of observations in an incremental fashion. A probabilistic concept that summarises the attribute-value distributions of the objects categorized under the node is used to label each node in a classification tree, where each node represents a class (concept). Merging two nodes, dividing a node, adding a new node, and transferring an object down the hierarchy are the four fundamental operations. [15].

Attribute Selection Algorithms

It is the process of choosing a portion of pertinent information (variables or predictors) to incorporate into a model. A combination of a search technique for suggesting new feature subsets and an assessment metric that ranks the various feature subsets is what is known as an attribute selection algorithm. Here, CfsSubsetEval and BestFirst are employed as the attribute selection methods [16].

Cfs Subset Eval

By taking into account each feature's individual predictive power as well as the degree of overlap between them, it assesses the value of a subset of attributes. In general, subset traits with low inter-correlation and strong correlation with the class are selected. The value of feature subsets is assessed by CFS using a search method and a function. CFS evaluates the degree of inter-correlation between features as well as how well they predict the class label [16].

Best First

By using greedy hill climbing and a backtracking facility, it explores the space of the attribute subsets. The amount of retracing is controlled by the number of consecutive nodes that are not improving. Best To begin, one can either begin by starting with a blank set of attributes and searching in one direction or by beginning with the entire set of attributes and searching in the opposite direction [16].

EXPERIMENTAL RESULTS**Clustered Instances before Attribute Selection:****Cobweb**

By using training dataset, the cobweb algorithm gives the following results: No. of Merges- 336, No. of Splits- 325 and No. of Cluster-656. The time taken to build this model is 455.93 seconds. The no. of cluster instance starts from 4 to 655.

Canopy

By using training dataset, the canopy algorithm gives the following results: No. of canopies (cluster instances) found: 37 where T_1 radius: 1.423 and T_2 radius: 1.779. The time taken to build this model is 0.05 seconds. The number of cluster instance starts from 0 to 36. the instance starts from 0 to 36.



**Sumathi Ganesan****Cluster instances after attributes selection****Cobweb**

By using training dataset, the Cobweb algorithm with attribute selection gives the following results: No. of Merges - 100, No. of Splits -125 and No. of Cluster - 138. The time taken to build this model is 48.33 seconds. The number of cluster instance starts from 0 to 138.

Canopy

By using training dataset, the Canopy algorithm with attribute selection gives the following results: No. of canopies (cluster instances) found. 37 where T1 radius: 1 .423 and T2 radius: 1 .779. The time taken to build this model is 0.03 seconds. The number of cluster instance starts from 0 to 45. The below Figure 1 represents the time taken for clustering each algorithm before and after attributes selection using the clustering algorithms of Canopy, Cobweb and SimpleKMeans. The below Figure 2 represents the line chart for the number of clustered instances before and after attribute selection for the clustering algorithms Canopy, Cobweb and SimpleKMeans. The below Table 5 represents the time taken to build each clustering algorithm before and after attribute selection.

In this research work, the attribute selection algorithms of CfsSubsetEval and Best First were employed to minimize the time taken to build the clustering models. The preprocessed data samples were clustered with Simple KMeans, Canopy, and Cobweb clustering algorithms to predict the level of water pollution and water quality. The outcomes of clustering algorithms of SimpleKMeans, Canopy, and Cobweb with attribute indicate that SimpleKMeans is the most effective clustering algorithm for the waste water treatment dataset.

CONCLUSION

The analysis for predicting water pollution and water quality using different data mining approaches is described in this research. This study focused on wastewater treatment facilities that have received licenses under the SPDES, or State Pollutant Discharge Elimination System, in New York. In the above results, I used clustering algorithm before and after attribute selection to predict the dataset of waste water treatment plants. The above used clustering algorithms are Canopy, Cobweb and SimpleKMeans. To select attribute, CfsSubsetEval algorithm was used. By using this algorithm, the ten attributes are reduced to three attributes. Here the analysis is done by before and after attribute selection. Before attribute selection the time taken to build the clustering with Canopy Algorithm is 0.05s, Cobweb Algorithm is 455.93s and SimpleKMeans is 0s. After attribute selection the time taken to build the clustering with Canopy Algorithm is 0.03s, Cobweb Algorithm is 48.33s, SimpleKMeans is 0.03s. When the ten attributes are reduced into three attributes the time taken to build a model is also reduced. Before Attribute selection the clustered instance of Canopy algorithm is 0 to 36, Cobweb algorithm is 0 to 655, SimpleKMeans is 0 and 1. After attribute selection the clustered instance the for Canopy algorithm is 0 to 45, Cobweb algorithm is 0 to 136, SimpleKMeans algorithm is 0 and 1. When the attribute is reduced the cluster neither increased nor decreased. From the above results, SimpleKMeans can be concluded as the best clustering algorithm for the given dataset.

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Sumathi Ganesan

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Table- 1 SPDES General Permit Fees[11]

Type	Fees (per year)
MSGP	\$110
Aquatic Pesticides General Permit	\$110
PCI (to groundwater)	\$110
CAFO (Medium or Large)	\$50
Construction	\$110
Construction - one time initial authorization fee	\$110 per disturbed acre and \$675 per future impervious acre

Table-2 SPDES Individual permit fees [11]

	Capacity	Fee (per year)
Industrial	Less than 10,000 gpd	\$675
	10,000 - 99,999 gpd	\$2,300
	100,000 - 499,999 gpd	\$6,700
	500,000 - 999,999 gpd	\$22,500
	1,000,000 - 9,999,999 gpd	\$33,500
	10,000,000 gpd or more	\$56,000
Municipal	Less than 200,000 gpd	\$425
	200,000 - 999,999 gpd	\$2,000
	1,000,000 - 4,999,999 gpd	\$8,000
	5,000,000 - 39,999,999 gpd	\$15,500
	40,000,000 gpd or more	\$38,500
Private/Commercial/ Institutional (PCI)	Less than 100,000 gpd	\$330
	100,000 gpd or more	\$675
Power Plant	any size	\$56,000
Ballast Dischargers	Less than 1,000,000 gals. in any 24 hr. period	\$100
	1,000,000 gals. or more in any 24 hr. period	\$500





Sumathi Ganesan

Table 3. Sample Dataset for Waste Water Treatment Plants

Plant Type	SPDES Permit Number	Ground or Surface	Avg. Design Hydraulic Flow	Street	City	State	Country	Zip Code	Latitude
Industrial	NY0002127	Surface	0.1	1000 WEST AVE	ROCHESTER	NY	USA	14611	43.15
Industrial	NY0218855	Ground		815 ST RTE 208	GARDINER	NY	USA	12525	41.66
Municipal	NY0023680	Surface	1	RIVER ST	WARWICK	NY	USA	10990	41.25
Industrial	NY0210803	Ground	0.01	725 ST RTE 25A	MILLER PLACE	NY	USA	11764	40.94
Industrial	NY0246492	Surface	0.18	40 POWELL LANE	PENNYAN	NY	USA	14527	42.67
Industrial	NY0002372	Surface	1.1	7801 LYONSDALE RD (CORTE 39) @ LOWDALE RD	LYONS FALLS	NY	USA	13368	43.62
Industrial	NY0271497	Surface		4141 BATES RD	MEDINA	NY	USA	14103	43.21
Municipal	NY0026310	Surface	9	2 RENWICK ST	NEWBURGH	NY	USA	12550	41.49
Industrial	NY0257940	Surface	0	CO RTE 8 - E SIDE - N OF ST RTE 12E	CHAUMONT	NY	USA	13622	44.08
Municipal	NY0021377	Surface	0.8	TABERG ST	CAMDEN	NY	USA	13316	43.33
Industrial	NY0236616	Surface	0.08	23080 CO RTE 47	GREAT BEND	NY	USA	13643	44
Municipal	NY0093637	Surface	0.55	RUNDLE LN	STILLWATER	NY	USA	12170	42.94
Industrial	NY0272582	Surface		1141 RIVER RD	NEW WINDSOR	NY	USA	12553	41.48

Table 4. Sample Preprocessed Data

Plant Type	SPDES Permit Number	Ground or Surface	Avg. Design Hydraulic Flow	Street	City	State	Country	Zip Code	Latitude
Industrial	NY0002127	Surface	0.1	1000 WEST AVE	ROCHESTER	NY	USA	14611	43.15
Municipal	NY0023680	Surface	1	RIVER ST	WARWICK	NY	USA	10990	41.25
Industrial	NY0210803	Ground	0.01	725 ST RTE 25A	MILLER PLACE	NY	USA	11764	40.94
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Sumathi Ganesan

Industrial	NY0002372	Surface	1.1	7801 LYONSDALE RD (COURTE 39) @ LOWDALE RD	LYONS FALLS	NY	USA	13368	43.62
Municipal	NY0026310	Surface	9	2 RENWICK ST	NEWBURGH	NY	USA	12550	41.49
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Industrial	NY0236616	Surface	0.08	23080 CO RTE 47	GREAT BEND	NY	USA	13643	44
Municipal	NY0093637	Surface	0.55	RUNDLE LN	STILLWATER	NY	USA	12170	42.94
Municipal	NY0027766	Surface	2.75	501 PLETCHER RD	LEWISTON	NY	USA	14092	43.21
Industrial	NY0279919	Ground	0.01	1052 ISLIP AVE	BRENTWOOD	NY	USA	11717	40.77
Municipal	NY0020281	Surface	0.06	BLUE ST	GLENFIELD	NY	USA	13343	43.72

Table 5 - Time taken to build Clustering

ALGORITHM	TIME TAKEN BEFORE ATTRIBUTE SELECTION (s)	TIME TAKEN AFTER ATTRIBUTE SELECTION (s)
Canopy	0.05	0.03
Cobweb	455.93	48.33
SimpleKMeans	0	0.03

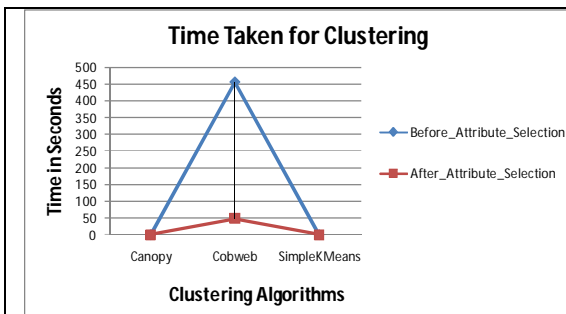


Figure 1-Time taken for Clustering

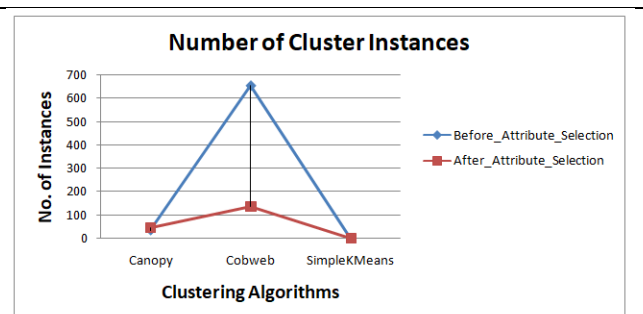


Figure 2.- Number of Clustered Instances





Genetic Algorithm Inspired Intelligent COVID-19 Prediction Model using Data Mining

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ABSTRACT

The COVID-19 pandemic has emerged as a global crisis, causing widespread illness, death, and economic disruption. Accurate and efficient methods for predicting the spread and severity of the disease are urgently needed. Machine learning (ML) algorithms have shown promise in forecasting COVID-19 outcomes, such as infection rates, hospitalizations, and mortality. This study aims to develop a prediction model for COVID-19 using Machine Learning and Artificial Intelligence to identify potential outbreaks early and mitigate their severity. The proposed model utilizes Decision Tree, Adaboost, Random Forest, and Gradient Boosting as classifiers, with Genetic Algorithm serving as the optimizer. By applying these algorithms, we achieved accuracies of 91.98%, 91.57%, 91.98%, and 92.01% for Decision Tree, Adaboost, Random Forest, and Gradient Boosting, respectively. To further enhance the accuracy, we optimized the Gradient Boosting algorithm using Genetic Algorithm, resulting in the highest accuracy of 92.01%. The proposed model holds promise for accurate and timely prediction of COVID-19, aiding in mitigating its disastrous effects.

Keywords: Adaboost, COVID 19, Decision Tree, Genetic Algorithm, Gradient Boosting, Random Forest.





INTRODUCTION

The SARS-CoV-2 virus is the cause of COVID 19. This illness spreads quickly. Mild to moderate respiratory illnesses are typically seen [1]. Worldwide pandemics are caused by numerous cases of severe illness, extensive medical care, and fatalities out of the disease. It is crucial to find this disease early in order to preserve lives. Every country in the world has made every effort to combat it. For last few days sudden increase in COVID19 in India has observed [2]. In a study by Dr. Alaa Atamna and colleagues, it was found that during the 2021–2022 season, adults (18 years and older) hospitalised with influenza had a 55% reduced chance of dying within 30 days than those hospitalised with Omicron. [3]. The most important thing is to identify the disease at very early stage for avoiding adverse outcome.

The objective of the experiment, presented through the paper is to utilize technology in early and accurate prediction of the disease to accelerate the medical care of a patient. An optimized model has been presented using Gradient Boosting and Genetic Algorithm. The data set has been collected from Israel Government official website. Then on the dataset four different classifiers have been applied and performances have been compared. The four classifiers considered are Decision Tree, Adaboost, Random Forest and Gradient Boosting. Decision Tree is simple, cost effective, can handle missing values, works well in multiclass classification as well, so it has been considered as one of the classifiers of our proposed work. Adaboost is an ensemble learning mechanism, which is again simple, and is not suffering from over fitting issue. Random Forest is another classifier taken into consideration for this study because it can manage missing values, doesn't require hyper parameter adjustment, and can handle over fitting issues. Due to its ability to optimize on a range of loss functions, lack of data pre-processing requirements, and lack of over fitting, Gradient Boosting has been taken into consideration in this study as another classifier. Analyzing the performance of these four classifiers the best one has been chosen for final classification and on which Genetic Algorithm has been applied for optimization of performance. For both optimization and machine learning applications, the genetic algorithm provides a practical and efficient method. One population's solutions are used to create a new population. A generation is the name given to each new population. The belief that the new population would be superior to the previous one drives this.

The major observation out of these experiments is that out of four applied classifiers Gradient Boosting has achieved best performance with an accuracy of 92.01%. Applying Genetic Algorithm the model's performance has enhanced to 92.68%. This proposed model can be utilized for early and accurate prediction of COVID19 based on symptoms. In this experiment the first contribution is on the field of machine learning research addressing the issue of lack of proper and timely medical support. Medical support and experienced medical practitioner are not adequate in numbers, so some times patients are not being identified at proper stage which leads to adverse consequences [4]. First the study extends the research on the field of machine learning based disease prediction. Second is that the study analyzed performance of few classifiers and identified best performer which has been chosen as final classifier. Third, through this study it has been identified that combination of Gradient Boosting and Genetic Algorithm can be considered for an early and accurate prediction of COVID 19.

In section two few works in the field of machine learning based disease prediction have been discussed and analysed as motivation of the work. In section three the proposed model has been put forth with detailing. Section four represents the details observation of the experiments carried out in this study and finally in section five conclusion remark has been presented.

LITERATURE REVIEW

Machine learning based classifiers are being utilized in healthcare application for last few years. In this section some of the works in prediction of COVID 19 have been discussed.



**Annwasha Banerjee Majumder et al.,**

Using Feature Correlated Naive Bayes, Mansour NA, Saleh AI, Badawy M, and Ali HA designed a model and predicted COVID 19 with 99% accuracy [5]. A deep CNN based model utilizing ResNet34, ResNet50, DenseNet169, VGG19, InceptionResNetV2, and RNN-LSTM was proposed by Hammoudi et al. To assess the effectiveness of the suggested methods, 5,863 normal and pneumonia X-ray pictures of children were used as a dataset. DenseNet169 beats other deep CNN models in simulations, achieving an average accuracy of 95.72%.[6]. The linear regression model using SVM and ANN was utilized by Salama et al. [7] to predict COVID-19-infected patients. The Epidemiological dataset, which was compiled from numerous health reports of actual cases, was used to evaluate the efficiency of the suggested model.

A ResNet50 deep transfer learning method was put forth by Pathak et al. [8] for the identification and categorization of COVID-19-infected patients. 852 CT scans from diverse datasets were used to assess ResNet50's performance. For the purpose of identifying COVID-19-infected individuals from X-ray pictures, Hassanien et al. [9] developed a novel method based on the hybridization of SVM with Multi-Level Thresholding. For the prediction of COVID-19 cases, Singh et al. [10] suggested Least Square-SVM (LS-SVM) and Autoregressive Integrated Moving Average (ARIMA). This model achieved 80% accuracy. Machine learning techniques including SVM, Decision tree (DT), and KNN were used by Nour et al. [11] to automatically identify COVID-19 positive cases. The effectiveness of the suggested method was confirmed using the public COVID-19 radiology database. Sethy et al. suggested a hybrid method combining of SVM with 13 pre-trained CNN models for COVID-19 detection from chest X-ray pictures. By reaching an average classification accuracy of 95.33%, the experimental findings demonstrated that ResNet50 combined with SVM surpasses other CNN models combined with SVM.[11].

A Deep Learning-Based Computer-Aided Detection (CAD) System was put into place by Hwang et al. [13] with the purpose of identifying patients who were infected with COVID-19. On the basis of chest X-ray and CT pictures, the system was trained. The system achieved 72.3% sensitivity. Sumayh S. Aljameel et al. proposed a model of COVID 19 severity prediction using logistic regression (LR), random forest (RF), and extreme Gradient Boosting(XGB). The experiments were carried out on data collected from King Fahad University Hospital, Saudi Arabia.[14]. Utilizing XGBoost, Adaboost, Random Forest, and ExtraTrees Mariam Laatifi et al. proposed a model for COVID 19 severity prediction. This experiment was carried out on Morocco [15]. AB Majumder et al. proposed a model of COVID 19 prediction applying Logistic Regression. The model was trained using the dataset collected from Kaggle and achieved 92% accuracy.[16]. In order to identify predictive biomarkers, Li Yan et al. collected blood samples from 404 patients in Wuhan, China [17]. They then tried to predict COVID 19. Another method for COVID-19 prediction utilizing a Chest X-Ray image and a deep feature learning model has been put out by Rahul Kumar et al. This classifier uses Res Net 152 and is based on machine learning [18].

To combat COVID-19, another machine learning-based approach has been put forth. The model can identify the majority of vulnerable individuals based on unique genetic and physiological traits.[19]. Support vector machine (SVM)-based prediction models were created by Sun et al. [20] to forecast the severity of COVID-19 patients' illnesses. The clinical and laboratory characteristics that are strongly related with these instances were employed in the investigation. The model achieved 77.5% accuracy. Using 1969 COVID-19-positive patients, Sánchez-Montaés et al. constructed LR-based mortality prediction. Age and O₂ were identified as the key features in the study, which also obtained an AUC of 0.89, a sensitivity of 0.82, and a specificity of 0.81 [21]. In our proposed model four different existing classifiers have been used which are Decision Tree, Adaboost. Random Forest and Gradient Boosting. In the below mentioned section these classifiers' basic functionality has been discussed.

Thrust Areas**Decision Tree**

Decision Tree is a supervised learning mechanism. Decision trees with one level, or Decision trees with only one split, are the most popular estimator used with Adaboost. Decision tree learning employs a divide and conquer strategy by employing a greedy search to locate the best split points inside a tree. This dividing process is then repeated top-down and recursively until most or all of the records have been assigned to distinct class labels.





Annweshha Banerjee Majumder et al.,

Whether or not all data points are grouped as homogenous sets depends greatly on how complicated the decision tree is.

Adaboost

Yoav Freund and Robert Schapire developed the statistical classification meta-algorithm known as Adaboost, or Adaptive Boosting, in 1995 [23]. It is an ensemble learning method that combines the classification power of multiple weak learners which increases the performance.

Random Forest

Random Forest is a popular ensemble learning mechanism which was developed by Tin Kam Ho in 1995[24]. The random forests or random decision forests ensemble learning strategy, which is used for classification, regression, and other tasks, builds a lot of decision trees during the training phase.

Gradient Boosting

Gradient Boosting is another ensemble learning mechanism used in this proposed work. With huge and complicated datasets, Gradient Boosting is a strategy that stands out for its prediction speed and accuracy. Leo Breiman made the insight that boosting can be seen as an optimization technique on an appropriate cost function, which is where the concept of Gradient Boosting came from [25].

Methodological Aspects

Proposed Model

In this paper an optimized model for prediction of COVID 19 has been proposed. Decision Tree, Adaboost, Random Forest and Gradient Boosting have been applied and their performances have been analysed through this experiment. Genetic Algorithm has been utilized in this experiment as an optimization tool for performance enhancement. Block diagram of proposed model has shown in the figure 1 below.

Dataset Collection

The dataset for the experiment has been collected from Israel Government COVID data repository [22]. The independent features are cough, fever, soar_throat, head_ache, gender, test indication and dependent feature is corona_result. Dataset sample distribution and relationship among different features have shown in figure 2 below.

Applying Label Encoder

Label encoding substitutes a numeric value between 0 and the number of classes minus one for the category value. In this dataset gender and test_indication store string data. *For training purpose these two features have been encoded to numerical values using Label Encoding. Label Encoding has been taken into consideration in the experiment since it is simple to understand, simple to use, and effective for the same number of categorical data.*

$$f: \text{dataset}[\text{gender}] \rightarrow \{0, \dots, -1\} \quad (1)$$

$$f: \text{dataset}[\text{test_indication}] \rightarrow \{0, \dots, -1\} \quad (2)$$

Here f is the Label Encoding function that converts 'gender' and 'test_indication' values to numerical values.

Applying classifiers

In this phase Decision Tree, Adaboost, Random Forest and Gradient Boosting, have been utilized for classification of disease.

Selection of Best Classifier

In this phase the performance of all four classifiers have been analysed and best one has been identified based on accuracy which is formulated with below mentioned equation no (3) and (4).

$$\partial = f(\text{maxAccuracy}(Dt(\varphi))) \quad (3)$$





Annwasha Banerjee Majumder et al.,

Where f represents a function that will select classifier for disease prediction based on highest accuracy achieved.

$$Dt(\varphi): \{f_{dt}(X \rightarrow Y), f_{adboost}(X \rightarrow Y), f_{rf}(X \rightarrow Y), f_{gb}(X \rightarrow Y)\} \quad (4)$$

Where f_{dt} represents Decision Tree classifier function.

$f_{adboost}$ represents Adaboost classifier function.

f_{rf} represents Random Forest classifier function.

f_{gb} represents Gradient Boosting classifier function.

With these above-mentioned equations Gradient Boosting has been identified as the best performing classifier considering accuracy value.

Model Optimization applying Genetic Algorithm

In this phase Genetic Algorithm (GA) has been applied for model optimization. It is a heuristic search mechanism inspired by biological selection. Genetic algorithm was proposed by John Holland and his team in 1975[26]. GA is a part of evolutionary computation, a considerably more diverse computing field. In GA, there are population or pool of potential answers to the given problem. Then, as in natural genetics, these solutions go through recombination and mutation, creating new offspring. This cycle is repeated over a number of generations. Based on its objective function value, each person (or candidate solution) is given a fitness value. The fitter individuals are given a higher opportunity to mate and produce more "fitter" people.

Genetic Algorithm is consisting of below mentioned steps:

1. Population Initialization
Population initialization can be done either by Random or Heuristic way.
2. Calculation of fitness function
Fitness function determines how the input parameter performs. An individual is given to the function, which then assesses how well it satisfies the criteria the algorithm is trying to maximise. A fitness function's intention is to minimize the cost function of a solution.

In this experiment the fitness score is identified by the model's accuracy which can be represented in equation no (5). Equation no (6) represents the accuracy formula.

$$f(x, \{p\}) = f_{Accuracy}(x, \{p\}) \quad (5)$$

$$Accuracy = f'(\{p\}, (TN, TP, FN, FP)): (TN + TP) / (TN + FN + TP + FP) \quad (6)$$

Where x is the model with best performance and $\{p\}$ is the population which is the randomly selected feature set.

Crossover

This concept is analogous to biological crossover. One or more offspring will be produced by selecting one or more parent. Based on a probability distribution that the user defines, the selection operator selects some of the chromosomes for reproduction. A chromosome is more likely to be chosen if it is better suited. Consider the fitness function mentioned in equation no (7), the probability of selection a feature set say {cough, fever,...} can be represented by the equation no (7)

$$P(\text{cough, fever, ...}) = \frac{f(\text{cough, fever, ...})}{\sum_{i=1}^N f(p_i)} \quad (7)$$

Mutation

A mutation is a novel outcome that results from a minor, random change in the genome. It is typically utilized with a low probability and is used to preserve and introduce variation in the genetic population. In this experiment Random Resetting mechanism has been applied for mutation.





Annwasha Banerjee Majumder et al.,

Selection of Survivor

Selection of survivor keeps the fittest chromosomes and eliminates the other based on fitness score achieved. Children typically replace the least fit members of the population in this fitness-based selection. The process of survivor selection in this proposed model can be formulated as equation no (8) and (9).

$$F = \{p: \text{all the feature in dataset}\} \quad (8)$$

$$F \supseteq F' = \{x: \max(f(x))\} \quad (9)$$

Where F is the set of all features and F' is the subset F which is a collection of competent features. f is the fitness function based on the accuracy achieved with combination of x different features.

Termination

When a GA run ends, it is crucial to consider the termination condition of the genetic algorithm. It has been noted that the GA advances quickly at first, with improved solutions appearing every few rounds, but that this eventually tends to saturate as it moves into its final phases, where the improvements are quite marginal.

RESULT ANALYSIS AND OBSERVATIONS

In this section the detailed observations of the experiment have been represented. Accuracy, Precision, Sensitivity and F1 Score are the performance metrics taken into consideration here. Accuracy can be used to measure a model's overall performance. A great statistic is accuracy, but only when datasets are symmetric. Precision is the degree of certainty in a true positive. Recall or sensitivity refers to the percentage of positives that were accurately categorized as positives. F1 score represents average precision and Sensitivity. Formulas for calculating Accuracy, Precision, Sensitivity and F1 score have shown in the below mentioned equations (10), (11), (12) and (13).

$$\text{Accuracy} = \frac{TP+TN}{TN+FN+FP+FN} \quad (10)$$

$$\text{Precision} = \frac{TP}{TP+FP} \quad (11)$$

$$\text{Sensitivity} = \frac{TP}{TP+FN} \quad (12)$$

$$\text{F1 Score} = 2 * \frac{\text{Precision} * \text{Sensitivity}}{\text{Precision} + \text{Sensitivity}} \quad (13)$$

Where TP: True Positive; TN: True Negative; FP: False Positive and FN: False Negative.

Observation by applying Decision Tree Classifier

It has been observed that by applying Decision Tree classifier the proposed model has achieved accuracy of 91.98%. In figure-3 the generated confusion matrix through the model applying Decision Tree has been shown. From the confusion matrix it has been identified that True Positive rate is 87.90%, False Positive rate is 1.89%, True Negative rate is 4.08% and False Negative rate is 6.13%. Referring to the equations (10), (11), (12) and (13) accuracy, precision, sensitivity and F1 score have been calculated which are 91.98%,93.48%,97.89%,95.63% respectively. Based on the parameter of Table 1, a chart of overall performance of the classifier has been presented in figure 3. Fig 3: Confusion Matrix of the proposed model applying Decision Tree. In the below figure 4 the overall performance of the proposed model applying Decision Tree classifier has been shown.

Observation by Applying Adaboost classifier

Applying Adaboost the model has generated the confusion matrix mentioned in figure 5. The True Positive, False Positive, True Negative and False Negative rate identified are 89.15%, 0.64%, 7.79% and 2.42% respectively. Based on these score model's accuracy has been calculated as 91.57%. The sensitivity has been calculated as 91.96% and





Annwasha Banerjee Majumder et al.,

precision has been calculated as 99%. The overall performance of the classifier based on the performance measures at Table, has shown in the figure 6 below.

Observation by Applying Random Forest

The next classifier applied in the experiment is Random Forest which has achieved 91.98% accuracy. Generated Confusion Matrix of Random Forest in this experiment has shown in the figure-7. From the confusion matrix it has been identified that the True positive rate is 87.90%, True Negative rate is 4.08%, False Positive rate is 1.89% and False Negative rate is 6.13%. In table 3 the details performance measures of the model applying Random Forest has been shown. The Precision, Sensitivity and F1 score achieved are 97.89%, 93.48% and 95.63% which has been shown in the below mentioned figure 8.

Observation by Applying Gradient Boosting

Gradient Boosting has achieved best performance according to accuracy score which is 92.01% in this proposed model. Confusion Matrix generated through the classifier in shown in the figure -9. Referring the confusion matrix, the True Positive, True Negative, False Positive and False Negative rate have been identified as 88.85%, 3.17%, 0.95% and 7.04% respectively. The details performance measures have been shown in the table 4 and based on the value of the table overall performance chart has shown in the figure 10.

Selection of Competent Classifier:

Based on the accuracy score it has been identified that Gradient Boosting has achieved highest accuracy so it has been chosen as final classifier for the proposed model. Integrated performance of the considered classifiers is shown in the figure 11 which has been plotted based on values at table 5.

Observation by Applying Genetic Algorithm as an Optimizer

Genetic Algorithm has been applied over the Gradient Boosting classifier as it has achieved highest accuracy. Sample run of the applied Genetic Algorithm in this proposed work has shown in the figure 12. By applying Genetic algorithm model's performance has been increased to 92.50%. A chart has been plotted in figure 13 based on the values at table 6 of proposed model's performance with and without optimization.

CONCLUSION

Through this work an optimized model for COVID 19 prediction-based symptoms has been proposed which can help society to predict COVID 19 at an early stage. For building the model four competent classifiers have been experimented out of which Gradient Boosting has been identified as best performer on which Generic Algorithm has applied for optimization purpose. Future research should focus on addressing these challenges and refining Machine Learning algorithms for COVID-19 prediction. This could involve the development of novel data sources, such as wearable devices and internet of things (IoT) sensors, as well as the integration of social and behavioural factors into predictive models. Additionally, it is important to make sure that these models are applied ethically and responsibly and that their use is transparent and understandable.

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Annwasha Banerjee Majumder et al.,

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Table 1. Performance Measure of the model applying decision tree Classifier

Classifier	TP	TN	FP	FN	Accuracy	Sensitivity	Precision	F1 Score
Decision Tree	87.9%	4.08%	1.89%	6.13%	91.98%	93.48%	97.89%	95.63%

Table 2. Performance Measure of the model applying ADABOOST

Classifier	TP	TN	FP	FN	Accuracy	Sensitivity	Precision	F1 Score
Adaboost	89.15%	2.42%	0.64%	7.79%	91.67%	91.96%	99.28%	95.48%

Table 3. Performance Measure of the model applying Random Forest

Classifier	TP	TN	FP	FN	Accuracy	Sensitivity	Precision	F1 Score
Random Forest	87.9%	4.08%	1.89%	6.13%	91.98%	93.48%	97.89%	95.63%

Table 4. Performance Measure of the model applying Gradient Boosting

Classifier	TP	TN	FP	FN	Accuracy	Sensitivity	Precision	F1 Score
Gradient Boosting	88.85%	3.17%	0.95%	7.04%	92.01%	92.65%	98.94%	95.69%

Table 5. Summarized performance of used four classifiers (Decision Tree, Adaboost, Random Forest and Gradient Boosting)

Classifier	Accuracy	Sensitivity	Precision	F1 Score
Decision Tree	91.98%	93.48%	97.89%	95.63%
AdaBoost	91.67%	91.96%	99.28%	95.48%
Random Forest	91.98%	93.48%	97.89%	95.63%
Gradient Boosting	92.01%	92.65%	98.94%	95.69%





Annwsha Banerjee Majumder et al.,

Table 6. Impact of Genetic Algorithm for in the proposed algorithm

Gradient Boosting without Optimization	Gradient Boosting with Optimization
92.01%	92.68%

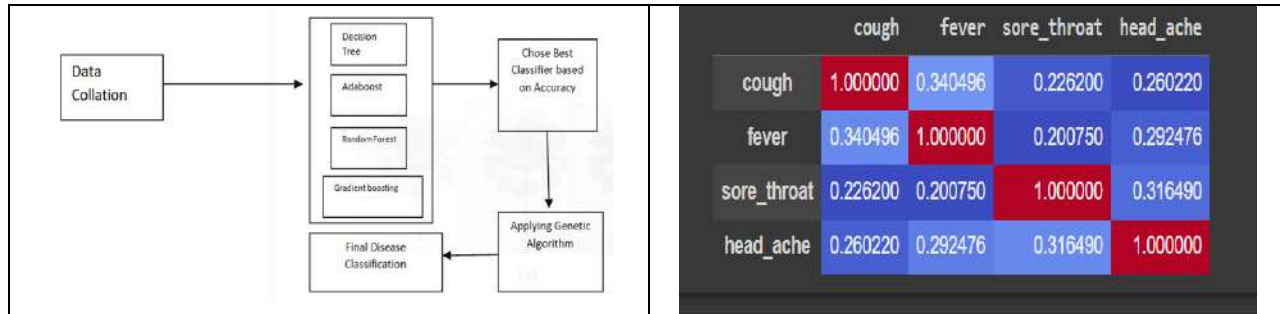


Fig 1: Block diagram of proposed Model

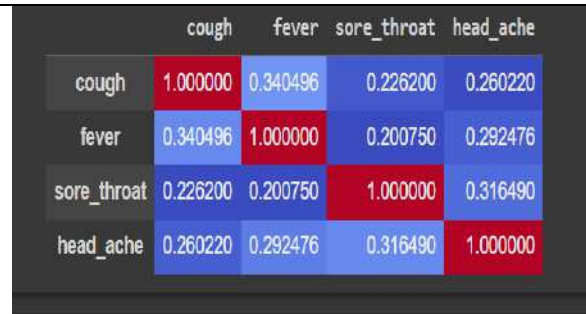


Fig 2: Dataset Correlation graph

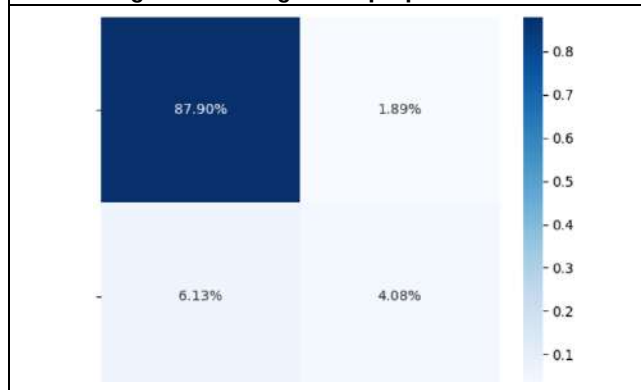


Fig .3. Selection of Survivor

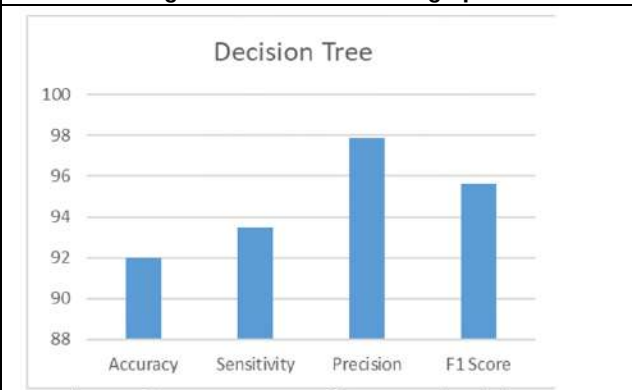


Fig 4 : Performance summary of the proposed model applying Decision Tree classifier.

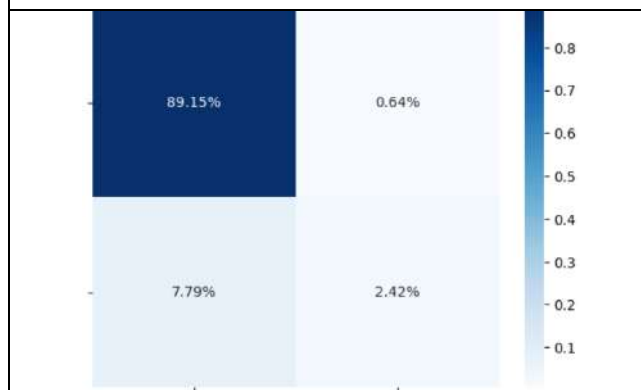


Fig 5: Confusion Matrix of the proposed model applying Adaboost

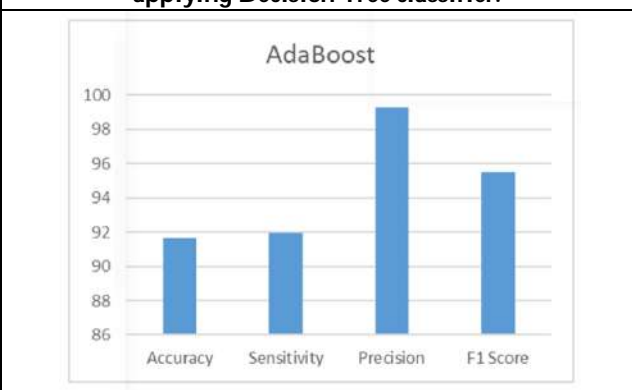


Fig 6 : Performance Summary of the proposed model applying AdaBoost Classifier.





Annweshha Banerjee Majumder et al.,

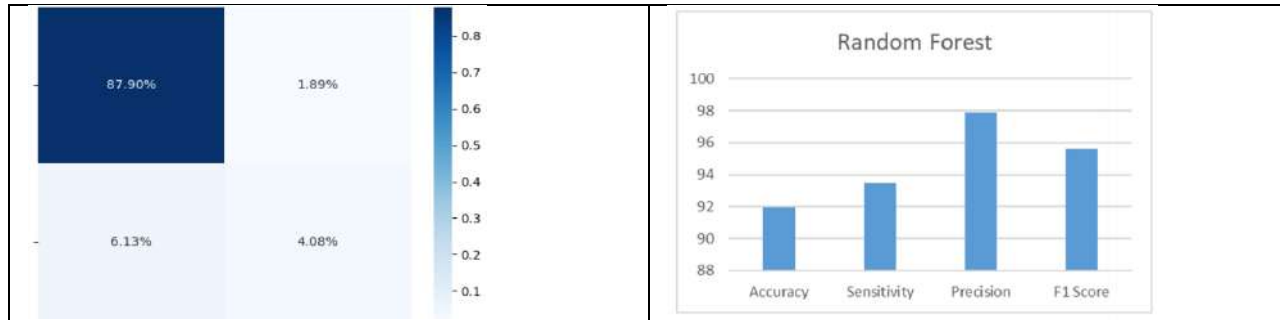


Fig 7: Confusion Matrix of the proposed model applying Random Forest.

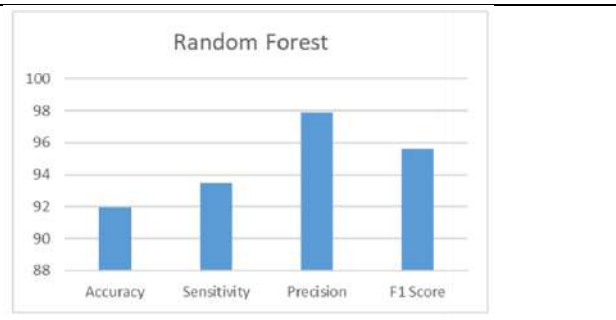


Fig 8: Performance Summary of the proposed model applying Random Forest Classifier.

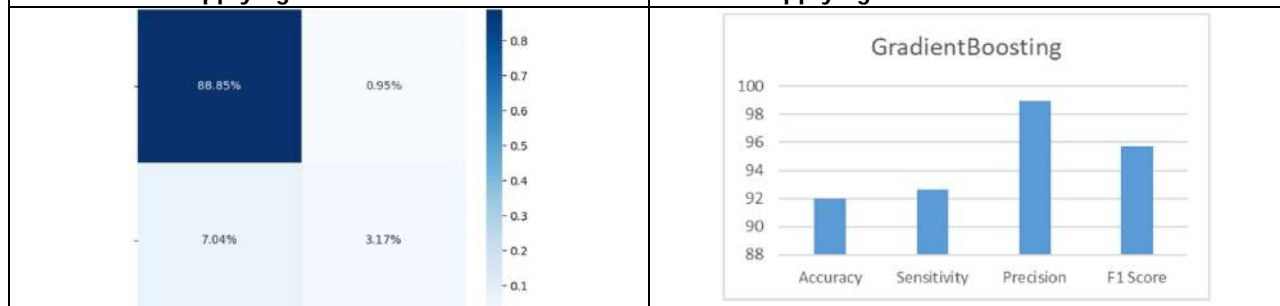


Fig 9: Confusion Matrix of the proposed model applying Gradient Boosting

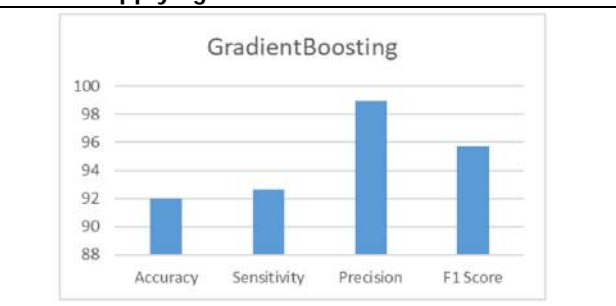


Fig 10: Summarized Performance of the proposed model applying Gradient Boosting.

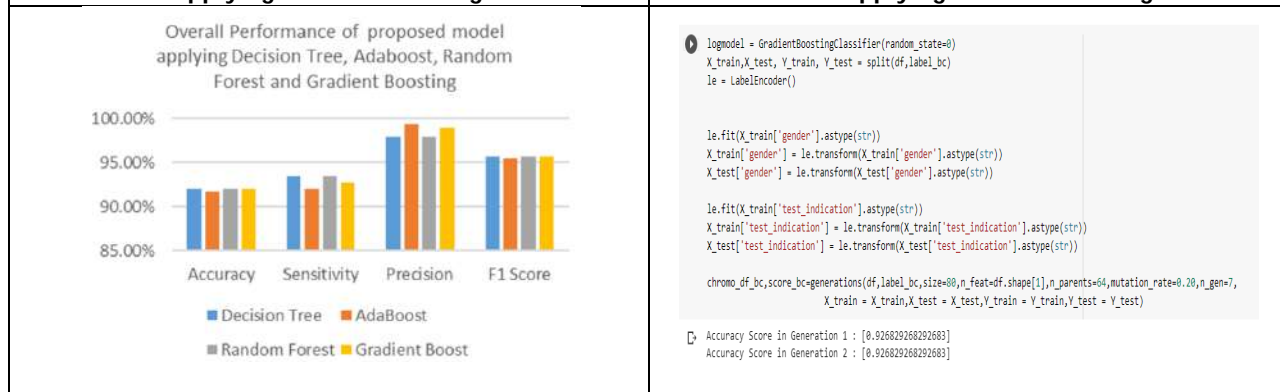


Fig 11: All considered Classifiers Performance

```

logmodel = GradientBoostingClassifier(random_state=0)
X_train,X_test, Y_train, Y_test = split(df,label_bc)
le = LabelEncoder()

le.fit(X_train['gender'].astype(str))
X_train['gender'] = le.transform(X_train['gender'].astype(str))
X_test['gender'] = le.transform(X_test['gender'].astype(str))

le.fit(X_train['test_indication'].astype(str))
X_train['test_indication'] = le.transform(X_train['test_indication'].astype(str))
X_test['test_indication'] = le.transform(X_test['test_indication'].astype(str))

chromo_of_bc,score_bc=generations(df,label_bc,size=80,n_feat=df.shape[1],n_parents=64,mutation_rate=0.20,n_gen=7,
X_train = X_train,X_test = X_test,Y_train = Y_train,Y_test = Y_test)

Accuracy Score in Generation 1 : [0.926829268292683]
Accuracy Score in Generation 2 : [0.926829268292683]
    
```

Fig 12: Sample GA execution.

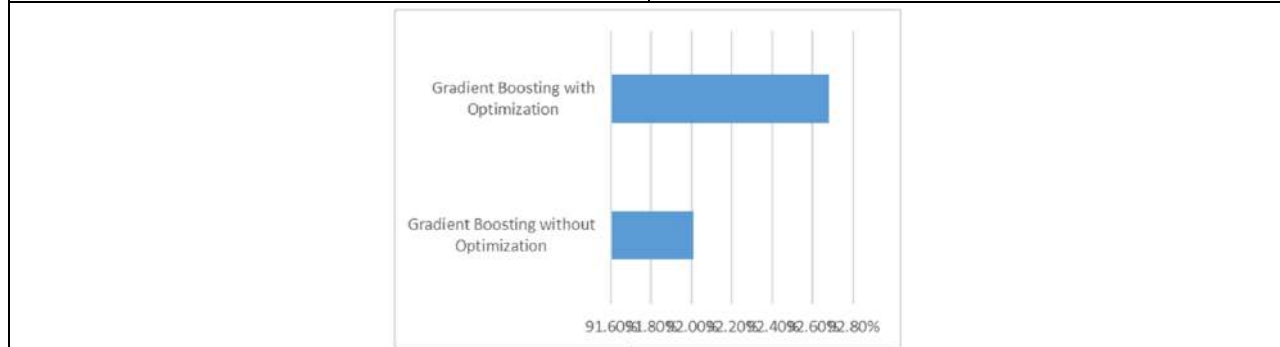


Fig 13: Impact of Genetic Algorithm over Gradient Boosting





Play Skill; An Option of Social Inclusion among Children with Autism Spectrum Disorder

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ABSTRACT

A substantial deal of attention has been attracted by autism in recent years. Autism spectrum disorder is a term used to narrate a constellation of early-appearing social communication deficits and repetitive sensory-motor behaviors. Whilst neurotypical children often spend most of their time engaged in activities of play, children with autism in the development of their play skills can present with substantial delays, requiring intensive intervention. Even though targets for basic learning and language skills are most of the times singled out based on the development of neurotypical children, minimal research has been conducted on methods for selecting play skill targets. Investigation attempts related to various dimensions of autism spectrum disorder have been made to a considerable extent; however, research regarding diverse play skills among children with autism spectrum disorder are very scarce. This particular study reflects those diverse play skills among children with autism spectrum disorder and additionally elicits few strategies to enhance the functioning of this particular population of children in acquiring numerous play skills. The study was carried among 40 participants diagnosed with autism, admitted to special schools to look for a range of play skills based on selected variables and dimensions, using observations and *play checklist* developed by Sandra Heidemann and Deborah Hewitt. More over the study also suggests few strategies to augment the play skills of this specific population. Findings revealed that this particular disability hampers the development of play skills and also reflects that offering a range of integrated play opportunities can help them get used to play alongside and ultimately





playing with the mainstream population. Outcome measures and comprehensive reporting of intervention components are important considerations in future intervention development and testing.

Keywords: Autism spectrum disorder, disability, communication, behavior.

INTRODUCTION

Autism Spectrum Disorder (ASD), an umbrella term, is a neurobiological and developmental disorder that has recently been put under the list of 21 disabilities in Rights of Persons With Disabilities act (RPWD) act, 2016 which impacts the way they communicate and behave. Recent advancements have made it possible to diagnose it at very early age, though the symptoms often appear in the early two years of life. Autism if diagnosed altogether affects the physical, emotional, social as well as cognitive aspects of life and consequently has an impact on their daily living activities. Moreover, its very often that the disability is also accompanied with other types of disabilities, e.g., leaning disability, mental retardation, low vision etc. Despite all the restrictions that come alongside this particular disability it's not uncommon to see them grow, learn and develop to quite a large in their life which is viable with the right sort of support they receive from the family and society they live in. Wolfberg (1995) described play as an pleasurable, intrinsically motivated, non-literal, flexible, voluntary and it encompasses kinematic engagement of an individual. Moreover, in a study by Stuart Brown 2010 an argument emerges that play is evolutionary and has the properties of: apparently purposeless/done for its own sake, inherent desirability, voluntary, shrunked consciousness about self, liberation from time, improvisational potential, and sustaining desire. Play is an indispensable activity for all no matter what life situation you are going through. In spite of the investigations that reveal that autism pose moderate to severe threat in acquiring and engaging in the skillful activities, consequently it has been also drawn from the studies that children with autism can excel in these activities if offered organized and intense training irrespective of their impairment. Their play skills however may vary and requires plentiful of time in comparison to their peers.

Play Skills

Although strenuous it is of utmost important for a child with autism spectrum disorder to play. Attaining play skills can aid children with autism spectrum disorder ameliorate their social, communication, physical and behavioral skills and subside rituals and repetitive routines. As your child with autism develops these particular skills, it will be easier for them to communicate and make bonds with mainstream classmates and siblings or else without this your child may go through isolation and frustration which in turn can have severe impact on the overall development.

Social Stages of Play

1. Unoccupied play: The arbitrarily movements that an infant makes with no intelligible purpose is the beginning of play.
2. Solitary Play: Common in toddler's children do not seem to distract from the other children playing or sitting within their vicinity.
3. Onlooker play: Also common in toddler's children in this type of play watch others playing and imitate the same.
4. Parallel play: When children develop further they initiate playing side by side with other children without having any interaction.
5. Associative play: Eventually at the age of three to four years children becomes more interesting towards playing with other children.

A voluntary engagement in passionate activities which are often associated with contentment and amusement is defined as play. Play provides opportunities to enhance social skills across above mentioned developmental domains in a composite manner and imparts opportunities to a sense of belonging and friendship which are indispensable for



**Amjad Hussain and Joicey P. Manickam**

young children with disabilities. Nevertheless, in order for children with disabilities including autism spectrum disorder to benefit from the interactivity that take place in the course of play and to continue to advance in play skills, systematic intervention in social skills is of utmost importance. The present study illustrates young children with developmental disabilities including autism spectrum disorder can benefit from participation in play activities from the very beginning.

REVIEW OF LITERATURE

In order to distinguish autism spectrum disorder the three areas need to be considered; (a) obstructions in social relationships, (b) struggles with imaginative thoughts, and (c) troubles in social communication (Sicile-Kira, 2004). Impairments in communication with this population fluctuate markedly. It is reflected through difficulty with back-and-forth communication for some autistic children according to American Psychiatric Association, 2013. Despite the social skill interventions available for children with autism spectrum disorder, in depth studies are carried out by the researchers to augment the intervention strategies primarily focused on social skills (White et al., 2007; Jung and Sainato, 2013). Among interventions of play skills, video modelling has unveiled some promising results and its impact on play skills has been reported in children with autism spectrum disorder. Integrated play group primarily eye on to encourage children with autism to mingle and play with other peers. The professional in integrated play prompts and encourages the duo of children with autism and peers to use relevant play skill (Disalvo and Oswald, 2002; Bass and Mulick, 2007). General public believes that children with autism display three deficits during the course of play i.e., (a) inadequate potential to generate ideas, (b) switching the thinking from pretend to real world, (c) motivation to engage in pretend play. In typically developing children it usually follows a same course and pattern in development of play skills. However, the trajectory of development of play skills in children with autism fluctuates to a great extent (Thomas and Smith, 2004). In spite of the fact that symbolic play skills among typically developing children are reported at an approximate age of two years, the same skills among children with autism begin to emerge much later in their life (Marcu et al., 2009; Wolfberg, 2009).

MATERIALS AND METHODS**Research Design**

Descriptive research design is employed by the researcher to carry out the study.

Universe and Sampling

The universe of sampling comprised of forty children aged between six to thirteen years with autism from two reputed special schools in Tiruchirappalli i.e., sixteen from Holy Cross Blossoms Opportunity School (School 1) and twenty-four from Nest School for Children with Autism Trichy (School 2). Purposive method of sampling is implemented to conduct this study.

Variables**Independent**

Gender (Male/Female)

Age (6-9/10-13 years)

Locality (Rural/Urban)

Family (Nuclear/Joint)

School Enrolled (School I / School II)

Dependent

Level of play skills in varying dimensions of play skills



**Amjad Hussain and Joicey P. Manickam****Description of Tool**

Pertaining to the study, the data collection tool used is Play Checklist developed by Sandra Heidemann and Deborah Hewitt. The checklist comprised of 10 dimensions of skills for play as: pretending with objects, role playing, verbalizations about the play scenario, persistence in play, enhance into a play group, problem solving, interactions, verbal communication during a play episode, entrance into a play group, support of peers and turn taking.

Procedure for Data Collection

Post selection of topic the objectives for the study are selected and later permission from the authorities of the respective schools is sought for the prosperity of this research. Moreover, the children with autism are observed during the course of their extracurricular activities including class play and rated them on the selected tool in accordance of their engagement.

Significance

Children with autism have limitations accompanied with the play skills in comparison to mainstream population. Developing play skills within this specific population may improve the way of their behavior, communication and socialization and lessen the stereotypy and rituals. The study is based with a motive to report the level of play skills among children with disability and hint the researchers and other professionals to comprehend the level of participation and interest of children with autism in a range of play circumstances.

RESULTS AND DISCUSSIONS

The respondents selected for the study are of the age group ranging from 6 years to 13 years. The interpretation of the collected data, the study reveals that level of play skills among children with autism is almost coinciding in both schools that is 40% and 41% respectively in school 1 and school 2. The skills difference among gender reflects that girls possess a bit higher level (44%) of play skills when compared to boys (37%). Level of play skills in children with autism of moderate category is whereas it is 38% in the mild category and reduces to 17% in the severe category. The study also conveys that children with autism show inadequate play skills in the dimensions of problem solving (23%), support of peers (36%), entrance into a play group (37%) in contrast to other dimensions where it is a bit higher (verbalization about the play scenario-53%, persistence in play-50%, pretending with objects-44%, role playing-43% and turn taking-40%).

CONCLUSION

It is of no denial that this specific disability of autism significantly impairs development of play skills among children. Offering a variety of integrated play opportunities can help this particular population to get used to playing alongside (parallel play), and ultimately transmit the learnt skills while playing with mainstream population without disability.

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Conflict of Interest

I declared there is no potential conflict of interest with respect to this research study.



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Record of Vulture Nests in Bandipur Tiger Reserve

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ABSTRACT

Vultures are medium- to large-sized birds of prey, which are known for eating carrion (bodies of dead animals). There are 23 species of vultures in the world and 9 in India. On January 14th 2023, the author who is working on a project “Population status and ecology of vultures in Bandipur Nagarahole and BRT Tiger Reserves”, The nesting area is photographed and following are the individual count and nest count details. Sightings are individual numbers recorded nest counted from one end; our continuous observation in future will gather more information. Keeping safe distance was very important that not to disturb the newly – hatched chicks and fledgling juveniles. 1 chick was found in each of the nests counted.

Keywords: Ecology, Tiger, birds, Vultures.

INTRODUCTION

Vultures are medium- to large-sized birds of prey, which are known for eating carrion (bodies of dead animals). There are 23 species of vultures in the world and 9 in India. Being scavengers, they deliver important ecological services. Vultures identify their dead prey soaring in the sky using thermal air current, keen eye sight and evocative smelling capacity helps identify dead animals from very high space. Their habit of eating carrion is extremely beneficial to humans, as it has a considerable effect on reducing the spread of deadly diseases like brucellosis, rabies, anthrax, plague, tuberculosis that are contagious. Some of which can be fatal. Since the last 2 decades 99 % decline in vulture population so our study and this nest observation gives a positive hope for their recovery from extinction.



**Rajkumar Devaraje Urs et al.,**

Observation

On January 14th 2023, the author who is working on a project "Population status and ecology of vultures in Bandipur Nagarhole and BRT Tiger Reserves", with permission from Karnataka Forest Department (KFD) (PCCF (WL)/E2/CR-34/2021-22) visited Banurgadde that is in Gundre range of Bandipur Tiger Reserve (BTR) (N 110 49'43.8" E 76013" 30.9") elevation - 621 MSL, while the information about the breeding site was earlier noted by the author, congregation of 15 nests in this area is very new and first time record (Fig. 1). In 2001 the author conducted 4 bird surveys for the KFD and had recorded soaring and nesting activities in the area. (Birds of Bandipur Institute for Natural Resources Conservation, Education, Research & Training (INCERT) and Newsletter for Birdwatchers (NLBW) 2005. Status of Vultures in Bandipur Tiger Reserve - Securing Vulture Population in Southern India 2018.

METHODOLOGY

A keen observation revealed nesting of White Rumped Vulture (*Gyps bengalensis*) Red headed Vulture (*Sarcogyps calvus*), and Indian Vulture (*Gyps indicus*) nests were observed using a binocular and at a safe distance, so the birds don't get disturbed. The nesting area is photographed and following are the individual count and nest count details Sightings are individual numbers recorded nest counted from one end; our continuous observation in future will gather more information. Most of the vultures recorded in Bandipur are - R/Br residents and breeding. CR critically endangered (IUCN) red list. Protected under Schedule S-1 of the Indian Wildlife Act of 1972.

RESULT

A total of 54 individual vultures were counted (sightings) resulting in 35 - White Rumped Vulture (*Gyps bengalensis*) 5 - Red headed Vulture (*Sarcogyps calvus*), 14 - Indian Vulture (*Gyps indicus*) were observed soaring near the nest site. The count was done only once hence individuals used to fly back to trees. It was also observed that each individual adults sitting on the nests. Hence, we were able to identify individual species (15) (Table no.1). Keeping safe distance was very important that not to disturb the newly - hatched chicks and fledgling juveniles. 1 chick was found in each of the nests counted (Fig. 2-4).

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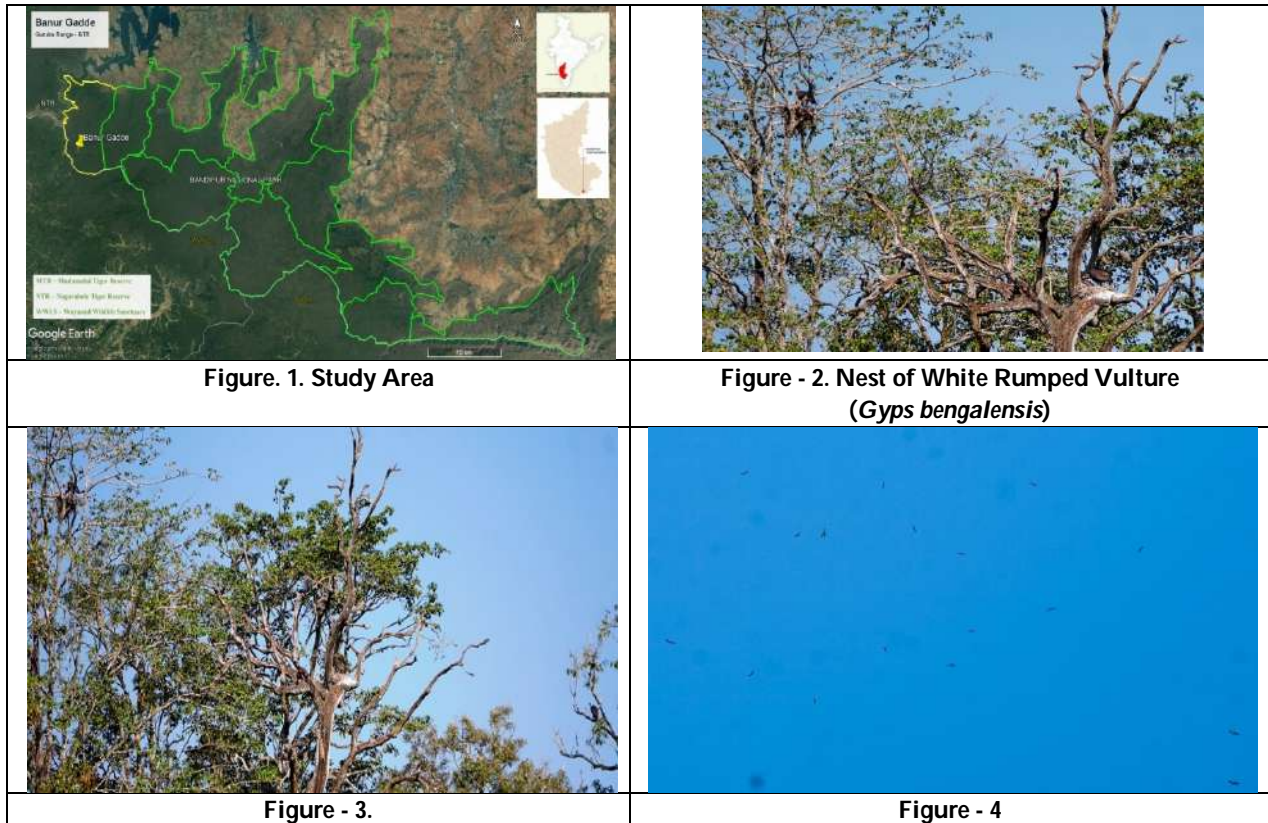


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Table 1. Individual count and nest count

S.No	Common Name	Scientific Names	Status	Wld act	IUCN Thrtnnd	2023 Sightings	Nest
	Vultures	Accipitridae					
1	Indian White-backed Vulture	<i>Gyps bengalensis</i>	R/BR	S-I	CR	35	12
2	Red-headed Vulture	<i>Sarcogyps calvus</i>	R/BR	S-I	CR	5	3
3	Indian Vulture	<i>Gyps indicus</i>	R/BR	S-1	CR	14	0
		Total				54	15





Application of Invertebrate Animal Models in various Biomedical Diseases and Research

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ABSTRACT

Invertebrate animal models provide valuable complementary tools to address a wide range of research problems throughout the infectious diseases and biomedical fields. For fundamental discovery, invertebrate animal models are more cost-effective and time-efficient than other models like; mammalian ones, especially for complex experimental designs and sophisticated genetic screens. *Caenorhabditis elegans*, *Drosophila melanogaster* and *Gallaria mellonella* are most popular models to study the various aspects of infectious diseases and biological sciences research. Invertebrate models have been involved in the various studies on human diseases. Recently, invertebrate models have been proved as the foremost



**Sunil Kumar et al.,**

required tool to link the space between long-established in vitro trials and preclinical animal analysis. These invertebrates have been used as invaluable tools for pharmacological studies to trace the pathological mechanisms. Recently, it has been noticed the rousing growth and optimization of invertebrate animal models in biomedical research including immunology, infection, neurological diseases, developmental biology, aging and apoptosis etc. Nowadays, invertebrate animal models are prevalently preferred over the vertebrate models due to the ease of genetic manipulation, short life span of the model organisms. Biological processes of any of the host models can be studied in a short period of time and on huge scales at relatively low cost. Therefore, due to their merits over other vertebrate model organisms, invertebrate model systems are considered as the promising tool for the success of future biomedical and infectious disease research.

Keywords: Biomedical Research; *Caenorhabditis elegans*; *Drosophila melanogaster*; *Galleria mellonella*; Infectious Diseases; Invertebrate host Models.

INTRODUCTION

Numerous biomedical scientists have utilized a range of in vivo host models to answer biological issues throughout the last decade. According to statistics, each year around the world, so many in vivo models are explored for different experiments. Vertebrates (mice, rats, rabbits, primates, etc.) and invertebrates (yeasts, worms, flies, etc.) are among these animals [1]. Animal models must be studied in order to learn more about human illnesses and pathogen-host interactions (Figure 1) [2]. *Drosophila melanogaster*, which is commonly known as the fruit fly, *Caenorhabditis elegans* - a nematode, and *Galleria mellonella* - the greater wax moth are among the invertebrate models used to research host-pathogen interactions (Greater wax moth) [3]. There are multiple advantages of using invertebrate models over vertebrate ones, such as, ease of handling, small size, cheaper in cost, short lifespan and unsophisticated anatomical make-up. Therefore, comprehensive research work can be carried out with such ideal model organisms [4]. Because not all animal models are suitable for biomedical research due to a variety of restrictions, choosing the best animal model for biomedical research is an important aspect of the research process. When choosing an acceptable animal model for their trials, researchers must consider a number of factors. The most essential feature in general selection is the physiological and pathophysiological similarities between animal species and humans, as well as their reaction to particular substances/drugs and their ability to recreate the disease or condition being studied. The size and availability of animal species are also key characteristics. It is uncommon to utilise unusual animal species for study, as models should be readily available so that research can be validated and repeated, or to use animal species that aren't large enough to sample numerous times (blood, tissues etc.) [5]. Transgenic models, which are described as animals formed by introducing foreign genes inside the embryonic cells' nuclei, thus blocking gene expression, are a recent development in biomedical research that are particularly customised to the needs of different research projects. Alternatively, this experiment can be done by transferring the foreign DNA straight into the embryo or by inserting the trans-gene into an organism's DNA using a retroviral vector [6]. Although invertebrate models are important for infection investigations and chemical screening, mammalian models cannot be completely replaced [7]. Due to its short lifetime, cheaper cost, and availability of modern tools, *D. melanogaster* has been utilised immensely as a model organism to investigate the genetics and developmental biology mechanisms [8]. Tsai et al. evaluated the substantial research on the larvae of *G. mellonella* for examining bacterial infections [9].

General Character

D. melanogaster is commonly known as fruit fly and is frequently used as a model organism in the biomedical science. *D. melanogaster* is most commonly preferred for the basic research because of its marvellous genetic tools, rapid



**Sunil Kumar et al.,**

generation time and low price. Many molecular tools have presented the model organisms to maintain with the most recent advancements. In this regard, many scientists gave example of *D. melanogaster* that how presently it is utilized and what recommendation we consider the system is operational. In the human infectious disease model for the examination of morphogenesis of cells, aging and effects of such affairs showed the benefit of flies and impact of fly research [10]. Presently *Drosophila* research actually grabs declination for genes mixed up in its progress [11]. To know fundamental mechanism of genetics and advancement the fruit fly, *D. melanogaster* is used because it has quick life cycle, price efficacy and accessible up to date technologies [8]. Basically, it is quickly obtainable reagent, modern genetic control; fast experimentation and skill full maintained innate immune system which is fully connected to prepare *Drosophila* a vigorous tool for examine infectious disease [12]. Direct infection and ectopic production of pathogenic proteins these are the two most common strategies for studying infection in *Drosophila* [13-15]. The first method involves feeding or microinjecting the pathogen of interest into the fly [16]. The second is more extensively used technique, which investigates the interactions between host and pathogen by ectopic over-expression of a pathogenic protein of interest utilising the UAS/GAL4 system [17]. The MiMIC transposon technology has recently been used for aiming all genes present in the genome of *Drosophila* by using an exon swapping technique, by resulting null mutations, tracking gene expression, and a protein tagging platform, and a variety of other activities [18]. These have been found to be effective when used in combination with CRISPR/Cas9 knockdown/knockout and over-expression procedures [19]. *C. elegans* is a eukaryotic multicellular organism with a fully sequenced genetic profile and a well-known genetic model organism [20]. Now days, *C. elegans* is used as a model organism to mimic and most human diseases has shown to be essential for experimental study in vivo at both the genetic and metabolic platform [21-23]. *C. elegans* is harmless, free-living nematode, which survives on microbes. In laboratory settings, it is extremely cost-effective and simple to maintain. Fully developed *C. elegans* are 1mm long hermaphrodites showing self-fertilization with a reproductive cycle of 2.5–4 days at room temperature and a mean longevity of 18–20 days when it is cultivated at 20 degrees celsius [24-27].

G. mellonella is a member of the order Lepidoptera, family Pyralidae and sub family Galleriinae. It is also known as greater wax moth or honeycomb moth [28]. The microbiota of the larvae of *G. mellonella* has not been explored much with a limited available data. The microbiota of larvae was initially reported as being quite basic with only one major species like *Enterococcus faecalis* [29]. *G. mellonella* has some physiological and immunological properties that are critical to the model's success. Larvae may be kept at 37°C, which is the same as their mammalian hosts' body temperature. This attribute is significant for analysing the virulence of mammalian infections because temperature is proved to alter the microbial virulence proteins expression. Many pathogen has associated compounds called opsonins, which are produced by *G. mellonella* and target the components of bacterial cell-wall, like; lipoteichoic acid and lipopolysaccharide [30]. No less than 4 opsonin classes have been identified: peptidoglycan recognition proteins, apoLp-III, hemolin and cationic protein 8 and [9, 31]. There are various advantages to utilising the *G. mellonella* model. *G. mellonella* rearing is cheaper and not hard to maintain if compared to mammalian or vertebrate models, and it does not necessitate the large laboratory infrastructure changes. The larvae's big size (12–20 mm) permits effortless handling and easy tissue collection and analysis as well. The larvae's great size also permits for accurate quantification of the inoculums that can be passed straight to the larval hemocoel [32, 33]. So far, over 2000 scholarly articles on *G. mellonella* have been published in the PubMed, with 271 of them have been recorded in 2019, by illustrating the mounting recognition of this infection model. The number of bacterial pathogens researched has been increased significantly and therefore, *G. mellonella* infection host models have proven to be extremely useful in the human and the veterinary bacterial pathogen research [9, 31-34]. The *G. mellonella*'s immune system shares a high degree of functional and anatomical similarities with the vertebrates' innate immune system, which is one of the reasons for its success in the investigation of microbial pathogenicity. *G. mellonella*'s immune response is made up of two interrelated components: humoral and cell-mediated responses [35]. *G. mellonella* was originally utilised for research on *Candida albicans*, a human fungal pathogen, wherein, the *C. albicans* strains were segregated as pathogenic or non-pathogenic based on the susceptibility of larva when challenged with fungus [36].

Application of Animal Model





Sunil Kumar et al.,

Immunology

C. elegans is a small nematode, which is another common invertebrate model organism for innate immunity research, in part because of its broad genetic toolbox [37, 38]. *C. elegans* stands out among immunological model organisms in that it lacks specialized immune cells and instead relies on nonprofessional cells for defence, such as epithelial cells [39]. The synthesis of antimicrobial peptides and substances that fight illness is part of the nematode innate immune response [40]. To find a unique innate immunity regulation system shared in *C. elegans* and mammals, Irazoqui and colleagues used a number of techniques. They first looked at how infection with *S. aureus*, a bacterial pathogen affected *C. elegans* gene expression [41].

Drosophila is a useful model for investigating the innate immune system because it lacks an adaptive immune response [42]. The humoral and cellular systems are the two primary responses in *Drosophila* innate immunity [43]. Toll and IMD these are two NF- κ B signalling pathways that control humoral innate immunity against the bacterial and fungal infection [44]. In the hemolymph, circulating immune surveillance cells (hemocytes) make up the cellular immune response [45]. *Drosophila* was utilized as a host model to study the innate immunity since the 1990s that gave significant contribution to the revitalized attention in this subject [46]. The synthesis of antimicrobial peptides performs a significant function in host defense in *Drosophila* [47]. Investigations on the *Drosophila* innate immunity were initially targeted on fungal and bacterial diseases. *G. mellonella* has a conserved innate immune system that allows it to distinguish between the self and non-self which encodes a range of pattern recognition receptors such as apolipoprotein and the opsonin hemolin [48, 49]. Insect immunity is limited to a natural immune system that recognizes and infects diseases using factors that encode pathogens [50]. Insects' innate immune response is divided into two parts: one is cellular and the second is humoral immune responses. Hemocytes, which are phagocytic cells which are responsible for the cellular response [51]. Effector compounds including melanin and antimicrobial peptides are produced as part of humoral defences [52].

Infectious Diseases

Vaccination, antibiotic research, and improved cleanliness standards have all helped to lower the infectious diseases burden. Infectious disorders presented by bacteria, viruses, parasites and fungi are the top causes of death worldwide [53]. Inflammatory and infectious diseases are among the top most causes of worldwide death cases. In the under-developed countries, infectious diseases responsible for 5 of the top 10 death causes [54]. To get in vivo confirmation of these RNAi findings, researchers have employed *C. elegans* infection models and later knockout mice to test the function of these genes in human infectious diseases [55]. The *C. elegans* worm has been effectively utilised as a model for candidiasis infection [56]. These findings show that many of the conclusions reached with this simpler creature are still relevant in larger mammals, demonstrating the value of *C. elegans* as a model host for infectious disease research [57]. As a result, *C. elegans* is an outstanding host model for studying gastrointestinal infections such as *Salmonella enterica*, *Shigella boydii*, *Salmonella typhimurium*, and *Vibrio cholera* [58-61].

For various reasons, *Drosophila* is an appealing model system for studying the molecular processes of harmful proteins which is encoded in viral and bacterial genomes [62]. These are readily available models, which can undergo complex genetic modifications, quick testing, and a well-preserved innate immune system that enabled *Drosophila* a great tool for researching the infection and diseases [12]. Ectopic production of proteins by pathogens and direct infection are the two most common strategies for studying infection in *Drosophila* [13-15]. *Drosophila* can also be used in conjunction with other animal models to study better antiviral immunity against COVID-19 [63, 64]. *D. melanogaster* is currently the most widely used model organism for researching biochemical and biological characteristics of human viruses, as well as their harmful effects on host cells [13, 14]. *D. melanogaster* could be used as a supplement to other model organisms in studies of HIV-1 infection genetics [65]. A novel *Drosophila* lung cancer model was recently developed that it takes use of the tracheal network's tubular form [66].

The rather advanced antimicrobial defence system of *G. mellonella* makes it a useful and informative infection model [67]. *G. mellonella* is a helpful and instructive infection model because to its robust antimicrobial defence mechanism [9, 34]. In the yeast *Candida albicans*, *G. mellonella* has been initially reported as a model for researching fungal diseases of human [36]. *G. mellonella* has a number of benefits that have helped it to become a popular infection



**Sunil Kumar et al.,**

model. These include its complex innate immune system, which consists of cellular and humoral defences and it is structurally and functionally similar to those of vertebrates [48, 68]. *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Serratia marcescens*, *Proteus vulgaris*, *Enterococcus faecalis*, and *Listeria monocytogenes* are among the microorganisms studied using larvae of *G. mellonella* [69-74].

Neurological Diseases

C. elegans, the nematode, is a well-characterized and easy to manipulate the model system. The simplicity of its nervous system, which consists of only 302 neurons and the intricacy of possible connections with diverse tissue types (e.g. muscle cells, intestinal cells) make this system suitable for studying neurodegenerative diseases [75]. Because of its short lifespan and highly conserved nervous system signalling that leads to complex behaviours, the nematode *C. elegans* is a unique species in which to research age-related neurologic disorders. Furthermore, the worm is well-suited to high-throughput screening methods, enabling for quick evaluation of prospective disease treatments [76]. Scientists have been able to conduct high-throughput screening for pharmacological substances in a relatively short timeframe and at a low cost thanks to these species' incredibly brief life cycles. Transgenic *C. elegans* has been used extensively use to investigate the genetic and molecular pathways underlying Alzheimer's disease and other neurodegenerative illnesses [22, 77, 78]. *C. elegans* is a model which is used for studying human diseases that overcomes the aforementioned constraints. Segalat and colleagues first reported the *C. elegans* DMD model in 1998, and it has been employed in a number of disease-focused researches [79, 80].

For investigating human diseases, like; neurological disorders, the fruit fly has been considered as an appealing model, wherein, genetic manipulation can be done easily using available enormous molecular techniques. Signalling pathways are crucial in defining genes and their functions, which are prominently conserved in humans [81]. *Drosophila*, *C. elegans*, and zebra fish are simple model systems that provide tractable study models for understanding neurological processes. *Drosophila* in particular is appealing because it is easy to genetically change and capable of developing complex behaviours [82]. Fruit flies are thought to be an excellent model for identifying genes involved in brain damage and regeneration [81-83]. Recent research using *Drosophila* infection models has expanded our knowledge of the genetic and cellular processes, followed by the nervous system to give response to brain lesions, mostly found conserved in humans [84, 85].

Developmental Biology

Since the 1970s, the roundworm *C. elegans* is prevalently used as a model organism for genetics and developmental biology research, including transcriptional regulation [76]. *C. elegans* did not become a well-known model organism until the 1970s, when Sydney Brenner's work was published. Brenner wanted to molecularize developmental biology and deconstruct the genetic contributions to development and phenotype based on particular characteristics such as invariant developmental pattern, transparency, quick life cycle, and ease of culture [86]. Light microscopy can easily monitor the internal development of all *C. elegans* cells and organs because they are transparent [20]. The majority of investigations in developmental toxicity have been observational rather than mechanistic [87]. *C. elegans* is a useful and predictive tool for reducing the usage of vertebrates in molecular toxicology research, which is a significant ethical issue [88].

Temperature sensitive (ts) mutants were produced by EMS mutagenesis to assist understand cell fate and behaviour control in *D. melanogaster* in the late 1960s and early 1970s as part of fundamental study into the developmental and neurobiology of multicellular animals [89-92]. *D. melanogaster* is utilised as a model organism to research everything from basic genetics to tissue and organ development [93]. Thoroughly gene investigation associated with embryo development is the core area of *Drosophila* as model organism [11]. This breakthrough paved the way for numerous facets of developmental biology field, as well as Nobel Prize for *Drosophila* [94]. The underlying finding was that distinct genes controlled various elements of development. These genes have survived countless years of evolution and that can be investigated in flies quickly and efficiently. As more scientists realised the prospective of flies for asking fundamental and functional queries, the field exploded, resulting in the invention of ever-smarter molecular techniques to answer such queries [95]. The invention of a reliable approach for creating genetically modified





Sunil Kumar *et al.*,

animals using the P transposable element was an important milestone in the evolution of the *D. melanogaster* as a host model for studying developmental biology [96].

Apoptosis

Genetic experiments in the Horvitz lab utilising the roundworm *C. elegans* initiated research into the mechanics of apoptosis, the first identified form of programmed cell death [97, 98]. Apoptosis occurs in *C. elegans* both during embryonic development and in the adult germ line [99]. Regardless, the worm has established itself as a "very valuable actor" in cell death and cell clearance research [100]. Latest investigation on *C. elegans* suggested two types of lipid transporters, the amino phospholipid translocases and the phospholipid scramblases, which could be implicated to efflux out phosphatidylserine [83] at the time of apoptosis [101, 102]. Although apoptosis is critical in developmental processes in the worm and other species, it can also be triggered by DNA damage, oxidative stress, and other exogenous stresses if the cell is unable to cope [103, 104].

Drosophila's ability for individual cells image and performing genetic manipulations enables it an ideal system for elucidating the molecular signalling, which control the specific developmental apoptosis, as evidenced by investigations presenting a precise decrease in midline glial cells from 10 to 3 during *Drosophila* embryogenesis [105, 106]. Because of its benefits, such as facile and inexpensive rearing and amenability to genetics and molecular biology techniques, *Drosophila* is a good model organism for the study of apoptosis. Most notably, it has been established that the apoptotic mechanism is conserved in fruit flies and vertebrates in general [104, 107].

CONCLUSION

This study highlighted the use of genetic manipulation using invertebrate animal models. Such invertebrate animal models are widespread because they can be utilized to investigate biological or genetic processes on comprehensively on large scale and in short period of time as well. The method, benefits, drawbacks, and applicability of each of these invertebrate model organisms are expected in future research work. Herein, we highlight advantages, applications of three invertebrate animal models, to assist the researcher in selecting the most appropriate experimental animal model for designing in-vivo investigation.

Conflict of Interest Disclosure

Authors declare no conflict of interests.

Availability of Data and Material

Data is transparent and will be available when required.

Code Availability

Custom codes.

Author Contributions

Sunil Kumar planned the study. Gaurav Vats, Mukesh Yadav, & Nirmala Sehwat drafted the manuscript. Razique Anwer monitored the content and arranged the references. Neera Mehra & Anil Kumar Sharma reviewed the manuscript for grammar and English check.

Ethics Approval

Not required.

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Sunil Kumar et al.,

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Sunil Kumar et al.,

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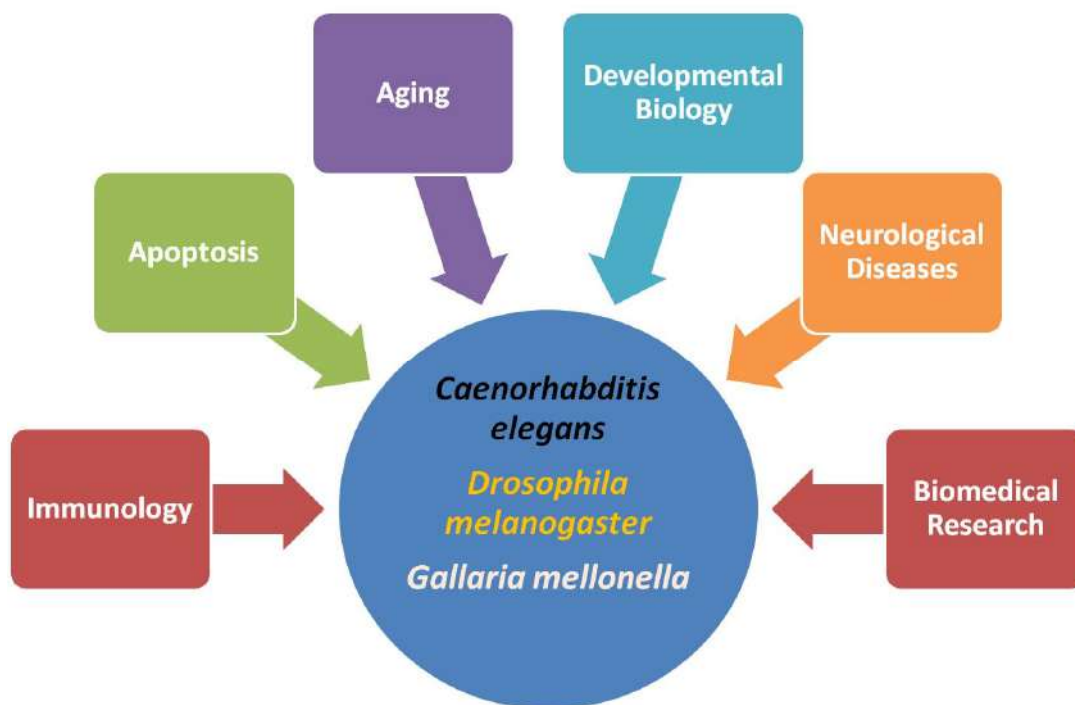


Fig.1. *Drosophila melanogaster*

