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**REVIEW ARTICLE**

# Legislative Formalities in Iranian and French Legal Systems

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**ABSTRACT**

Passing legislations in any of the contemporary legal systems requires observing a specific formal procedure. In fact, after measuring the needs requiring the necessity of legislations, the legislative process that requires observing a specific formality begins. It is a path whose end is equivalent with the emergence of law in the legal field of a country. Multiple articles of the Islamic Republic of Iran's constitution clarify the general discussions regarding legislation. However, the discussions regarding the formal procedure of the legislation are mentioned in the internal by-law of Iran's Islamic Parliament. In addition to discussion legislative formalities in Iran, the present study will briefly discuss the French legal system to determine the similarities and the differences between these two legal systems.

**Keywords:** legislation, bills and legal plans, formal procedure, Iranian law, French law.

## INTRODUCTION

By considering the "legislative method" as a part of the science of legislation, some authors have categorized the legislation as follow:

1. Emergence of a problem;
2. Definition of this problem considering the analysis of the tension between the objectives and wants of a society and the behavior of its members;
3. Determining the goals;

4. Analysis of the realities in the society that should be considered in providing the legal solutions for the problem;
5. Planning the alternative solution that requires the study of appropriate tools for fulfilling the determined goals;
6. Futuristic assessment and measuring of the ability of this tool for achieving the goals;
7. Assessment of the effectiveness and efficiency of the solutions adopted in the past;
8. Selection of appropriate tool (favorable norm) and placing it in the form of law (legislation) (Ghasemi, 2004: 158-159).

Considering what has been mentioned above, the present study aims to explore the procedure related to the creating and passing of legislations from the time the plans and bills are presented to the time they are passed in the legislative bodies of Iran and France. Thus, proposing legislations in the form of legal plans and bills should be discussed first. In other words, the process of passing the legislations begins when there is a suggestion for creating a law by the government or the members of parliament. Therefore, "proposing legislations" is discussed in this section.

**Proposing legislations in the form of bills and legal plans**

Before the revolution in 1979 and beginning of the Islamic Republic of Iran, legislative power belonged to Shah and the members of the Iranian national parliament and senate that were along each other in terms of authority for legislation. Each of the aforementioned three entities had the right to write legislations but their enactment was conditioned on the lack of discrepancy with religious norms and passing by the members of parliament and signing by Shah (Hamidian: 2010: 39). But after the revolution, based on article 71 of the constitution legislation in the Islamic Republic of Iran is only upon the Islamic parliament of Iran. According to the aforementioned article: "the Islamic Parliament can create legislations on every issue in the framework of the limits mentioned in the constitution." Recognizing only one legislative authority in the modern societies is due to the dangers that may be created as the result of passing of different and sometimes opposing regulations by different legislative bodies. Multiple regulations will result in chaos and disorder while the aim of the formation of modern political societies and creation of regulations in these societies is creating orders in issues (Rasekh, 2005: 130). Of course it should be noted that in addition to the Islamic parliament, some authorities in Iran have exceptional right to create regulations. For example, the following institutions and authorities:

- Creating regulations by Supreme National Security Council based on the article 176 of the constitution;
- Creating regulations by the faqihs of the Guardian Council based on the article 108 of the constitution;
- Creating regulations by the executive based on article 85 of the constitution
- Passing regulations by the Expediency Discernment Council of the System based on article 112 of the constitution (Hamidian: 2010: 49).
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Iran's legislature has general authority for passing regulations and can create regulations on any issue. However, the article 72 of the constitution has determined some limitations for the parliament in passing legislations. Based on the aforementioned article: "the Islamic Parliament of Iran cannot pass laws that are in conflicts with the principles and orders of the national religion of the country or the constitution. Determining this is upon the Guardian Council, as stipulated in article 96". The logic and indication of the principle 71 verifies the aforementioned generality based on the verbal principles. However, despite mentioning "in the limits determined in the constitution", in this principle the general and absolute authority given to the Islamic parliament is conditioned on the lack of conflict of the regulations passed by this institution with religion and the constitution (article 72) (Koohi Esfahani, 2012: 114).

**Providing legal bills by the executive**

Proposing the enactment of regulations is done more by the executive rather than the legislature, considering the close relation of the executive with the needs and issues in the society. In other words, the executive feels the need for laws that can guide it in creating public order and meeting the needs of the society (Hashemi, 2005: 314). Also, this branch of the government, compared with the legislature, is more familiar with the legal defects and shortcomings

and thus can practically innovate and propose laws (Ghazi, 2004: 217).Based on article 74 of the constitution, all the legal bills delivered to the parliament must be signed by the president and the respective minister(s). If there is no respective minister, the signing by the president is enough. After being delivered to the parliament, the legal bills are referred to the related commissions by the chairman of the parliament and are then delivered to the members of parliament.

After the bill is proposed to the parliament the representatives of the executive have the duty to defend it. Regarding the bills that are specifically related to the domains under the responsibility of the members of the executive, the views of the related minister, legal and parliament deputy, administrative authority or the head of the related governmental organization in defending the bill indicate the view of the executive. None of the executive's authorities and representatives that are present in the open session of the parliament and in commissions during the examining of the bills is permitted to disagree with the contents of the executive's bill. If a bill or plan is related to several bodies, based on the regulations of the internal by-law of the parliament the representatives of the aforementioned bodies can comment on the bill or plan only when their comments are in favor of the executive otherwise the representative of the body whose views are consistent with those of the executive will talk as the representative of the executive.

After proposing a bill by the executive some political or legal reasons my make the executive to take back the bill. In such case, based on the article 137 of the internal by-law act of parliament: "taking back the legal bills will be possible after approval of the cabinet as follow: 1. If taking back occurs before the passing of the general points of the bill in the first session of the parliament, the president or the related minister takes back the bill in written form by mentioning the reason and its report is announced in the opens session of the parliament. If taking back occurs after passing the general point of the bill and in each stage before the final passing, the related minister or the executive's representative in parliament's affairs can take the bill back by presenting reason in the open session of the parliament and talking of an individual with an opposite view, for ten minutes each, and after approval of the parliament".

In the French parliamentary system the executive participates in enacting legislations by proposing bills and participating in parliament's discussions (Tabatabai Motameni, 2001: 50). According to clause 1 of the article 39 of the French constitution: "the initiative of proposing regulations belongs to prime minister and the members of the parliament". Therefore the constitution has considered the equality of the executive and the parliament in proposing regulations. Thus, two types of initiatives of proposing have been recognized in French legal system. First, when the text is prepared by the executive (legal bill) and second, when the text is prepared by the members of parliament or senators (legal plan). Of course providing some regulations is exclusive to the government and the parliament has no right in this regard. Financial regulations, planning regulations, regulations related to the verification of international agreements and financial regulations of social security are among the cases that, according to the French constitution, must be proposed only by the executive. Also, the executive can take back the bills in any stage on the condition that it is before the final passing by the parliament. This can occur explicitly or implicitly; explicitly in the form of a decree or announcement in the general session. And in the implicitly way, the executive exclude the bill from the priority agenda (that is regulated by the executive) or after the bill is examined by a parliament it is not delivered to the next parliament (Zarei, 2005: 224-225).

**Proposing regulations by the members of parliament and higher council of the provinces (legal plans)**

The Islamic Republic of Iran's constitution has accepted the proposal of legal plans from members of the Islamic parliament in article 74. Thus, in addition to the executive, the Islamic parliament as the symbol of the legislature has the ability of "initiative to propose regulations" also, the higher council of the provinces that is formed from the representatives of the province councils for preventing bias and cooperation in creating construction and welfare program in provinces and monitoring their coordinated implementation can create some plans in the domain of its duty and propose them to the parliament directly or through the executive. These plans too must be explored in the parliament

**The limits of the power of the members of the parliament in presenting legal plans**

In classical parliamentary law the right of legal initiative under the title of "plan" belongs to every member of parliaments. The plan may be prepared and proposed by one of the members of the parliament (British and US laws) or by a group of representatives (Bulgaria, Romania and Poland). Individual initiative right indicates traditionalism in parliamentary behavior and it has been supported in some legal systems. However, individual proposal is not accepted in some systems and a specific number of individuals must sign under the plan to determine that it is a new proposal and a significant number of the members and citizens approve it so be raised in the parliament (Ghazi, 2004: 216).

Article 74 of the Islamic Republic of Iran's constitution says that: "… legal plans recommended by at least 15 members of parliament can be proposed in the Islamic parliament." Also, regarding the way of presenting legal plans by the members, article 130 of internal by-law act of Parliament says: " legal plans are delivered to the head of the session by citing the name and signing of at least 15 members of parliament and after receiving and reading its title by the head of the session or one of the members, it is referred to related commissions in the same session. A printed version of these plans is sent to the related minister(s) after being referred to the related commissions. Like bills, the plans must have specific subject and titles and the reasons for preparing and proposing them must be written clearly and must also have some articles in proportion to the subject and title of the plan."

Those signing the legal plans have the right to be present for providing explanations in the commissions where their plan is investigated… (article 131 of the internal by-law act of Parliament) after announcing the receiving of legal plans, if a group of those who have signed give a written demand for taking the plan back in a way that the remaining signers are less than 15 individuals, the plan is given back if the request is before the passing of the generalities and its report is given to the parliament. And if the generalities are passed, the plan can be given back after the explanations by one of the demanders and talking of one with an opposing view, each for ten minutes, with the passing of the parliament. If a plan is not passed by the parliament or the commissions of the principle 85 of the constitution, it cannot be proposed to the parliament again without fundamental changes until six month is passed unless there is a written demand of 50 members of parliament and passing of the parliament.

In French law too, proposing regulations in the form of legal plans by the French members of parliament and senators is accepted. However, there are differences in proposing "legal plans" with "legal bills". These differences are:

- Difference in assessment procedure: article 39 of the French constitution demands the plans to be assessed and investigated after gaining the view of the governmental council in the cabinet. Consolation with the socioeconomic council is predicted (article 70 of the French constitution). But gaining a view has been not predicted for assessing the plans. Assessment here means an initial investigation that is done by the authority who proposes (the executive or the member of parliament).
- Difference in presenting bills and plans: initiating plans individually is upon the members of parliament while the executive's bills are presented to the parliament under the name of the prime minister regardless of being under the working domain of any minister or ministry. The reason for this is that the bills are implemented under the responsibility of the prime minister.
- Difference in terms of general negotiation: after referring the plan or the bill to the parliament's commissions, it is time for negotiation in the general session of the parliament. If the text under the negotiation is executive's bill, the exact text of the bill is negotiated on and the commission can only provide its view in the form of a correction and cannot directly create changes in the bill text. However, if the text is a plan by the members of parliament there are two results: first, the commission accepts the plan and investigates it. In this case the text corrected by the commission will be the basis for the negotiation and the commission will have the right to create any change in the main plan directly and even change it generally. Second, if the commission wants the plan to be rejected or has no corrective views regarding the plan, the rejection of the plan or negotiation on the plan are determined by the votes of the members of parliament (Zarei, 2005: 226-227).

**Presenting legal plans by the higher council of provinces**

Logical management of the executive affairs in a country requires using all of the existing capacities in a country. Meanwhile the complexities in each of the economic, political, cultural and social domains have resulted in affairs becoming specialized. Thus, the way is paved for participation for the citizens on one hand and creating participatory backgrounds in less-macro-sectors for driving the executive's plans in contemporary societies. Local councils can be an example for this. In fact, these councils use social capacity on one hand and pursue issues in a smaller scale and in the local, city and province levels on the other hand.

In this regard, article 100 of the Islamic Republic of Iran's Constitution says: "fast progress of social, economic, construction, health, cultural and educational programs and other welfare affairs through cooperation of people, considering the local requirements of the office for affairs in each village, section, city, county or province, is done with supervision of a council called the council of village, section, city, county or province whose members are selected by people of that place…". The higher council of provinces is formed from the representatives of the provinces' council members for preventing bias and gaining the cooperation in creating developmental and welfare program in provinces and monitoring their cooperated implementation.

The comprehensive description of the duties and authorities of the higher council of provinces is mentioned in the article 78 (annexed in September 28, 2003) of the act of correcting the law of formations, duties and elections for Islamic council of the country and selection of mayors passed in 1996 and is follow:

"1. Exploring the recommendations received from the council of provinces and determining the priority of each and referring them to the related executive authorities.

2. Announcing shortcomings and defects of the expectative institutions and organizations, in the limits of the councils' duties and authorities, to the related authorities and their follow up.

3. Exploring the recommendations and their presentation to the Islamic parliament or the executive in the form of plans.

4. Passing, correcting and finishing the budget of the secretariat of the higher council of provinces

5. Management and Planning Organization of Iran must give a draft of the bills for development plans and general budget of the country and provinces to the higher council of province. The higher council of provinces will announce their corrective suggestions regarding the aforementioned plan and budget to Management and Planning Organization.

6. Preparing the by-law of the way to spend the budget of the council and announcing the aforementioned by-law to the councils after passing by the cabinet.

7. Planning for training the members of the council and making them familiar with their duties through holding short courses in the framework of the possibilities in the country.

8. Normal sessions of the higher council of provinces are held once a month and for the maximum of three days. In emergency cases the council can hold emergency sessions."

In fact the authority to present plan to the Islamic Parliament (directly or indirectly through the executive) is one of the main authorities of this council. Article 102 of the constitution also indicates such an authority. According to the aforementioned article: "the higher council of provinces has the right to create plans, in the limits of its duties, and propose them to the Islamic parliament directly or indirectly through the executive. These plans must be explored in the parliament".

The plans passed by the higher council of the provinces, which must have a title and a justification as an introduction, are directly presented to the parliament. Receiving of these plans are announced by the chairman of the parliament and are referred to the related commissions to be investigated and then they are printed and distributed among the members of parliament and a version of them are sent to the cabinet for being present and for defending their positions. The way of dealing with these plans and the demand for taking them back are similar to those for the executive's bills. Legislative procedure in the parliament

Though in addition to creating and enacting laws, the legislative parliaments have other duties and authorities such as monitoring the performance of the executive and judiciary and the function of parliaments is not just limited to legislating, it is obvious that the main activity of legislative parliaments is creating and enacting legislations.

**Legislating by the parliament in normal state**

In normal conditions, the right to legislate is exclusive to legislative parliaments. Article 85 of the Islamic Republic of Iran's constitution says: "the position of being people's representative belongs to individual and cannot be transferred to another one. The parliament cannot transfer the authority to legislate to an individual or a group…". Though the exception to exclusive legislation has been mentioned and transferring the authority to legislate has been discussed in the continuation of the aforementioned principle and will be discussed here later, now the exclusive authority of the parliament regarding creating and passing regulations are discussed.

The process of legislating begins with presenting legal plans and bills and ends with their enactment by the parliament and announcing and publishing the laws. Article 74 of the constitution says: "the legal bills are presented to the parliament after passing by the cabinet and legal plans with proposal of at leasing 15 members of parliament can be presented in the parliament." Legal bills must be presented by the related minister or the representative of the executive, by observing article 74 of the constitution, and the related minister or one of the ministers, in proportion to the subject, must be present in the parliament when it is raised. After being delivered to the parliament, these legal bills are referred to the related commissions by the chairman of the parliament and are then delivered to the members of parliament. Specialization of the subjects in legislating has made the role of parliament's commissions more significant in the process of legislating. Specialized investigation and determining defects and shortcomings of the legal plans and bills before the discussion in the open stage of the parliament is upon specialized commissions. Thus, the quality of regulations depends on the performance of these commissions to a great extent. For any plan or bill that is referred to commission, a report on its rejection, or passing, change or completion "must be sent to the parliament during a period that is announced by the board with agreement of the related commission and is not longer than one month from the date it is received by the commission's office. If it is longer than the determined period each of the members of parliament or the executive has the right to ask the parliament to place it in the parliament's agenda. Regarding the detailed bills and plans, whenever the commission could not finish its discussion in the determined period, it should report it to the chairman of the parliament. In such case the period is extended with the suggestion by the related commission and approval of the board".

Discussing plans and bills in the commissions is done in two sessions. First, after the first time it is referred by the chairman of the parliament and second, after the passing of the general points in the open session of the parliament. These bills and plans are sent to the related commissions for discussion again in the second session. In this regard, article 150 of the internal by-law act of Parliament says: "when the reported of the related commissions are given in the open session for the first session regarding an ordinary bill or plan, negotiations are made regarding their weaknesses, strength, defects, and the necessity or the lack of necessity of the bill and plan and then voting is done regarding the bill or the plan itself. If the general points are passed, the bills or plans are sent to the related commissions for discussion in the second session".

Some believe that "expert research and exploration in the parliament are lower than expected and even not enough attention is given to the views of the Parliament Research Center. This becomes more tangible and significant when in a bill or a plan it is mentioned one emergency, two emergencies or three emergencies and in such case minimum

research work is done due to the haste of the members of the parliament for exploring the bill or the plan" (Ajili, 2004: 318).

"The report of the commission is mentioned in the second session on the plan or bill. No new proposal is accepted in this stage but the proposals that are given to the commission between the two sessions and are not accepted by the commission can be mentioned by those giving the proposals. In such case those giving the proposal or one of them (in collective proposals) can give explanations for five minutes for each proposal and a voting is done on such a proposal after one with an opposing view and one with the same view comment on it and also the representative of the commission or the executive give explanations. After acceptance or rejection of the proposal the whole text is voted on. If it is not passed, a voting is done for omitting it, without negotiation, and if the omission of the proposed article is not passed, the corrective suggestions are accepted in the same session"

"There are no negotiations on the articles, in the second session on the bills or plans, unless new articles are added in the commission's report or fundamental changes are done in some articles as discerned by the board. In such case the first ones for and against it (based on the registration board) talk for five minute each and if necessary, the executive's representative talk and then voting is done on the article(s)."

"if the commission omits some of the articles of a bill or plan or makes overall changes, each of the members of parliament can propose those articles and voting on the article is done after talking of someone for and someone against the article and talking of the commission's speaker and the executive's representative. If the article is passed, the corrective suggestions that were given to the commission can be mentioned and voted on".

"in the second session on plans and bills, the priority of dealing with proposals in the open session will be as follow:

1. the proposing of replacement of the executive's bill or the main plan for plans and bills;
2. the proposing of omitting in the order of omitting completely and omitting some parts of each article;
3. the printed proposals of the secondary commissions;
4. members' printed corrective suggestion based on the board's discernment;
5. the article itself"

"The corrections that are proposed for the article are voted on before the vote on the article in the parliament". "when discussing any article, when there is a proposal for omitting the whole article or a part of it or resolving its ambiguity, the proposal is voted on after the explanations of the one giving the proposal and someone for and someone against it. If the proposal is passed, the rest of the article is discussed and voted on."

After the above stages and finally the passing of each of the articles of the proposed bills and plans, overall passing ends. After this stage the bills and plans passed are sent to the Guardian Council. If the Guardian Council does not announce its opposing view during ten days after receiving them or after the extension of the aforementioned time mentioned in article 95 of the constitution, based on the article 94 of the constitutions those bills and plans passed are sent to the president by the parliament for signing and announcing. Thus, the process of enactment that had started since the delivering of bills and plans ends by announcement from the president.

In French law, based on article 34 of the constitution, the bills and plans are sent to a special commission (that has been created for exploring that bill or plan) and if no special commission is created, the plans or bills are sent to one of the permanent commissions of the parliament. From this article it is understood that in principle a social commission is formed for exploring plans and bills. But in practice, the formation of a special commission has gained an exceptional status. Since 1978, special commissions have been formed for exploring plans and bills only 22 times and this exploration has usually been done by one of the six permanent commissions in other times. Special commission is formed with the request of the executive, parliament, chairman of a permanent commission, chairman of a political group or party whose members are not less than 30 individuals (Zarei, 2005: 235-236).

If no special commission is formed, the text is sent to a permanent commission. The chairman of the parliament sends the plans and bills to the related commissions by considering the authorities of each commission. After these steps,

the plans and bills are registered in the agenda for being discussed in the general session. Negotiations regarding the registered text (plan or bill) begin after registration in the agenda. The first stage is general exploration of the text and the second stage is exploring each part of the text. The text is introduced in the general exploration stage and the chairman gives talking time to the executive and the commissions' speakers after reading the text of the agenda. The things that are done in this stage are:

1. general discussion on the whole text without exploring each article;
2. voting on the by-law notifications;
3. making decisions on the texts that have been rejected by the commission or there has been silence about them.

Out of these three things, the first one is general about all texts but the second and the third one are done depending on the case. After the general exploration stage, if there is no notification, the parliament begins the part to part exploration. Exploring the articles is done based on the number and commissions and the members of parliament can talk about each article. After discussion regarding the article itself and before voting on it, the discussions and voting are done on the proposed corrections of the article. If none of the corrections that have been mentioned regarding an article in the review stage, the article remains as it was passed in the first exploration stage. If at least one of the corrections are passed, the whole article is once again voted on. And finally the voting is done on the whole legal text (Zarei, 2005: 236-262).

The last thing about the process of passing laws in France is related to the two parliaments in this country. In fact, for final passing of a text, the text must be explored by the two parliaments and they must reach an agreement on a text as much as possible. Thus, the legal text must be delivered in the two parliaments to reach a final agreement (Zarei, 2005: 268)

**Legislating in exceptional cases**

Article 85 of the Islamic Republic of Iran's constitution has mentioned the exceptions to the exclusive legislating of the parliament. Based on the aforementioned article, the parliament can transfer the authority for creating some legislation to its commissions in necessary cases by observing the article 72 of the constitution. In such case the regulations are enforced experimentally for a period that is determined by the parliament and the final passing of them is decided upon by the parliament. Also, the parliament can transfer the permanent passing of statutes of governmental or government-related organizations, companies and institutions, by observing article 72 of the constitution, or can give the permission to the executive to pass them. According to the provision one of article 182 of the internal by-law act of Parliament: "the executive or the members of parliament must create the necessary plan or bill and present it to the parliament before the expiration of the date of the experimental period for the aforementioned law in order to determine its final condition." Such regulations will not be valid after the expiration of the experimental period (provision 2 of article 168 of the internal by-law act of Parliament).

"Whenever the executive or 15 members of parliament, based on article 85 of the constitution, ask for the transfer of a plan to the parliament's commissions or to the executive the request is announced in the open session and is placed on the parliament's agenda". "The plan or the bill is sent to the commission after the agreement of the parliament. The order for discussing and dealing with these plans and bills in the commission is the same as that of passing plans and bills in the parliament but the passing is conditioned on at least two third of the votes of the commission's members". "Determining the experimental period for implementation of legislation is done by the parliament after the legislation is passed in the commissions. For this purpose, the regulation passed the commission together with the proposal for the duration of implementation are given to the members 48 hours before raising it in the parliament. When the duration is raised in the open session the commission's proposal is voted on, if there is no other proposal. Otherwise, the proposal of the members is voted on in the order of receiving, in the open session, after one for and one against the proposal talk.

Regarding the passing of statutes, the article 173 of the internal by-law act of Parliament has said that: "if the parliament transfer's the authority to permanently pass the statutes of the government's or government-related organizations, companies and institutes to the government the order of dealing with and passing the aforementioned statutes will be according to the internal by-law of the cabinet". The Constitution of the French Fifth Republic has significantly limited the legislative authority of the legislature. According to the article 34 of the French 1958 constitution the authority of the legislature is exclusive to the cases that have been explicitly mentioned. Also, according to the article 37 the passing of regulations is in the domain of by-law and resolution except in cases mentioned in article 34. This means that the executive has general authority and the legislative authority of the legislature is limited to the cases mentioned in the constitution (Islamic Parliament's Research Center, 1997: 302). What is observed in article 71 of Iran's constitution is the general legislative authority for the parliament and this way of legislating is not common in France.

Regarding the transference of authorities of the legislature to the executive, the French 1958 constitution has allowed the legislature to transfer the authority even in the cases mentioned so that it can create regulations for a specific time by issuing a resolution, on the condition that it presents to the parliament what it has passed for the final passing. If the executive does not present the aforementioned regulations to the parliament in the duration, those regulations will lose their validity. In addition, if the executive determines that the legislature has exceeded its authority it can refer to the constitution council what the parliament has passed and if the council's view is rejection of that regulation, the executive can change that regulation with its resolution (Islamic Parliament's Research Center, 1997: 302).

## CONCLUSION

The study regarding the legislating in Iran and France showed that basic and formal regulations governing the legislation process in these two counties are different in a high number of cases despite having relative similarity. In basic aspect, the general authority of the executive is basis and the legislative authority of the legislature is exclusive to the cases mentioned in the constitution. However, in Iran, the Islamic parliament can create regulations on every issue in the limits mentioned by the constitution. Therefore, in Iran, the general authority of the legislature is the basis. However, the legislating in Iran has some limitations that can be justified considering the Islamic nature of the system. But such limitations cannot be seen in the French law. Some similarities between the two countries can be seen in the formal aspect. For example, after being presented to the Parliament, the legal bills in Iran are referred to the related commissions by the chairman of the parliament in the open session and then they are given to the members of parliament. In fact, expert exploration is done in the specialized commissions. In France too, according to the article 34 of the constitution, the bills and plans are sent to a special commission (that has been created for exploring that bill or plan) and if no special commission is created, the plans or bills are sent to one of the permanent commissions of the parliament. Overall, one should distinguish between the basic and formal legislating procedure in Iran and France. These two countries are different in the basic aspect but they have some similarities in the formal aspect.

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RESEARCH ARTICLE

# Nature and Kinds of Emotions, views of Robert Solomon Divided into Crude Emotions and Refined Emotions

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## ABSTRACT

Emotions can be seen as a social construct, or a biological, physical or cognitive phenomenon and judgments or statements. Researchers have tried studying emotions in accordance with the adopted approach. However, any thinker who chooses one of these approaches acknowledges to other aspects of emotions that are discussed in other approaches. The dispute is which of the components of social, biological, and neurological or cognitive factors considered as the first priority and should be the foundation for the study of emotions. Rejecting the mere claim of biological and social approach, Solomon tried to show that emotions as engagements with the world. People according to their beliefs, practices and social norms can refine their emotions and learn how to apply them.

**Keywords**: Emotion, feeling, crude, refined, engagement

## INTRODUCTION

Although emotions usually has a minor role in philosophy, it was considered since last times . In Greek philosophy, Plato and Aristotle talked about emotions following youth education and the arts discussions. In modern times, Kant discussed about the sublime and the beautiful emotions in his critique of Judgment and arts. In fact, talk about emotion and its relationship with rationality in the contemporary era trying to bridge the lack of distinction between soul and body. Spinoza is one of the philosophers has fairly discussion about emotions in details. His views about feelings are new and are interesting for many contemporary scholars. For example, Damasio is an example of the researchers who tried to present a suitable discussion about view of emotions by Spinoza. Hume is perhaps the most famous philosopher who thought about the emotions and has considered a main role to them. Hume considered wisdom as a tool of emotions and feelings. Since Solomon takes out cognitive perspective to emotions , in this article we express his opinion on this issue briefly. Then, we express his view about the division of emotions in crude and refined emotions.

**Definition and classification of emotions**

Philosophers tried to define emotions separately that was associated with modest success. There are about 150 theories for the origin, severity, nature and purpose of emotions (Astrangman, quoted by Bauman, 2001). Despite all the speculation, some emotions are not known. There is no right definition to be able to distinguish between what emotion or not. Although scientific literature usually avoid naming specific emotions, there is agreement in having some initial emotions. For example, some emotions such as fear, sadness, anger, joy are in some mammals, are particularly important in survival. (Bowman, 2001) . According to Rio John Marshall (2009: 315-316), emotion is multidimensional. He considers 4 elements for emotins as follows:

1-Feelings: emotions somewhat are mind feelings resulted in feeling special cases, such as anger or happiness . Emotion is felt and experienced in mind, both in terms of intensity and quality and they have based on cognitive and mental processes .

2- Indignation of body: It relates to the behavior and reactions of the body during the emotion, that is shown physiologically (HR, epinephrine in the blood stream) and the muscular system (the alert of body , clenched fist ) . In fact, one can not angry anger or hate without preparing his or her body ,and it will be phisiological an muscular preparation.

3-Purposefulness: this element provides purposeful motivation to emotion to cope with emotive situations. Purposefulness of emotions represent why people use their emotions. For example, anger emotion provides a motivation to fight and to protest about injustice. Unless anger feeling, we did not do it.

4- social element: it represents that emotions are social events with relationship aspect . when we are excited, we show our feelings by body gestures , and face language. We transfer our feeling to others in non-verbal form about our interpretation of the situation. Emotions, make active our feelings, indignation of body, Purposefulness feeling, and non-verbal communications. It provides an opportunity for us to adapt with challenges and events we deal with them in life. Since Descartes introduced the six main emotions, and then Spinoza reduced them to three, the number of basic emotions and what they have been was controversial topic. But after Ekman works, 6 main emotions were accepted as follows (Prinz, 2004) .The following list is used as a set of main emotions presented in all presented lists in this regard ( Olving 2008).

1. The emotion of fear 2. Emotion of Anger: 3. The emotion of hatred: 4. Emotion of grief: 5. Emotion of Happiness: 6. Emotion of interest. Besides this kind of emotion classified into 2 general topics as pleasant emotion and unpleasant emotion, other emotions were mentioned including surprise, contempt, approval, love, empathy, shame, anxiety, waiting , and complex emotions such as guilt made by a combination of other emotions ( Franken , 2005).

**James- Lange Theory of emotions:**

Lots of people believe when human experiences emotion, it impacts on body changes. For example, when watching blinking lights of police cars and hearing the sound of sirens, it creates fear, and fear causes our hearts beat, or hand sweat. Sequence of events seems as a stimulus is seen in first step. Then, we get excited. Finally, this emotion results in body reaction. But, James believed this common opinion was wrong. He believed that body changes are not occurred after emotion, but emotion experience occurs after body changes. It was his revolutionary opinion. Actually, emotions depends on body responses and behavior on blinking lights and the sound of sirens. Therefore, the body's changes result in emotion experience. Therefore, the mentioned sequence in last article is changed as a stimulus is changed firstly. Then, body reaction occurs, which results in emotion. Danish psychologist Carl Lange had adopted a similar stance. So, it was named as James – Lange theory. James's theory was based on two assumptions as follows: First, the body responds of emotin events in a unique and distinctive manner. Second, the body does not react to events that are not emotive. James believed that the immediate reaction of the body occur as detected cases. Emotion

experience is a way to make sense of the body's response to each of the different modes. If no changes occurred in body, no emotion occur following it ( Marshal Rio, 2008). This theory has found considerable popularity after the release but also faced criticism. For example, critics believed that James referred to the types of reactions that are actually parts of the fight or flight response of the body that is no different in different emotions. The critics also believe that the experience of emotion is faster than the physiological reactions. While a sense of anger in a tenth of a second , it takes a second or two seconds to activate key nodes by her nervous system. In fact, according to critics, the physiological arousal role is not creating emotion, increasing it. Therefore involved physiological changes in emotion experience is not important ( ibid: p.350).

**Antonio Damasio view- difference between feeling and emotion**

At the end of 20th century, Antonio Damasio proposed a theory based on neuroscience observations . It was along with theory of **Jamz- Lange.** He revived the James-Lange theory. Antonio Damasio assumed a brain-body unity. So, according to him, emotional states and self-consciousness is due to this organic unity. In Descartes' error book, Antonio Damasio divided emotions in 2 primary and secondary groups. Primary emotions are in human kind and animals, such as escaping from a predator or show anger to rival . But secondary emotions are made in a period of time gradually, and are formed based on early feelings. According to him, difference between feelings and emotions is that while body changes occur, we inform about them and can observe their continuous developments. We perceive body changes and pursue them in every second and minute. Feeling is defined as continuous observation, experience of what body does, while thoughts of specific topics occur. According to Damasio , feeling is a personal experience. It is a mental experience of an emotion. Actually, it is a physical emotion. Feeling is both mentally and physically (Damasio, 1999: 42) .

**Impulsive and non-impulsive nature of emotion**

Impulsive behaviours are called as risky manners contain a vast range of works low thinking done on it . They occure in absence of a suitable planning. Their risk is high amount ( Moler et al. 2001 quoted by vaxman , 2011).

According to results of impulsiveness , impulsive behaviors creat major core of many mental disorders including hyperactivity / attention deficit, conduct disorders, impulse control disorders, substance abuse, bulimia nervosa, suicidal behavior, personality disorders and learning disorders (Dorian, Mc charge and Cohen, 2006. Impulsiveness is conceptualized as a cognitive aspect i.e. impulsiveness is along with lack of cognitive inhibition, emotional instability ,incomplete and slowly decision-making process in person (Dio, Glo, Logston, 2012). Non-impulsive behaviors and emotions have a purpose or are capable of it. There is difference among of advocates of different viewpoints. There is difference in determining main emotions and its difference with secondary emotions and acquired emotions among their followers. Along with this kind of emotion, all under two general titles as pleasant emotions and unpleasant emotions, it is possible to mention some other emotions including Surprise, contempt, approval, love, empathy, shame, anxiety, anticipation and compound emotions such as guilt feeling formed of combination of other emotions (Franken, 2005: 409).

**Study approaches on emotion**

cognitive, biological, developmental and social perspectives could provide a comprehensive look about emotion for us. However, there still remains a question as which approach is the best one? Each approach is introduced briefly in this investigation. Notably, as solomon is a advocate of the cognitive approach, it is described more than others.

**Emotion such as social structure**

This approach has defined emotion as a cultural and social action. Study on emotion in this approach requires a cultural study that emotion is studied in it. Averill ( 1980 )is one of researchers who insists on it. Theorists who see emotions as a social construct, do not deny physiological and biological aspects of emotions . According to them,

biological aspect on emotions should be considered as a background of social nature of human being (Atkinson, 2009: 544) . Biological factors are a basis for human development as a social creature. But, this social creature shows emotions so, social background should be considered more in emotional studies than biological backgrounds.

**Emotions as a biological- evolutionary phenomena**

Biological- evolutionary approach of emotion referes to Darwin's theory of his famous books "emotions in humans and animals" . Public emotions are considered in this approach. It is assumed we have main emotions that are the same in all cultures. Even they are common between Humans and animals. Although there is some degree difference in it. Sometimes it is called as "The theory of basic emotions" (Atkinson, 2009: 547) . According to Darwin, the development of social behavior is the result of evolution. Additionally, species that adopted with community actions and sympathy have more chances for survive. So, they transfer these behaviors to their next generation. Most of animal live socially. People who select social style of life have passed less risks ,but people who lived alone have died mostly ( Dortier , p 489). Although history of biological theories refers to Darwin and the James- Lange theory, cultural theories prevailed that considered emotions as a social construction.

At the end of 1960s , Paul Ekman as a young anthropologist found scientific evidences in remoted tribes in Papua New Guinea that showed some of the basic emotions are the same in all societies and therefore should be a common biological basis (Evans, 2003: 3-7) . These emotions included 6 items were introduced in last section. According to Ekman ( 1992), emotions start very fast, short -term can occur autonomic and non autonmicly. So when we act emotionally, even before this awareness of it, emotions occure in us.

Emotions are biologically because they were developed by their adapt value for main duties of life. He accepts cognitive, social and cultural factors interference in occurance of emotions , but believes main reasons of emotion is biological factors , not learning, social interaction or socio-adaptipon history of person. There are many criticisms against evolutionary psychology. The final gist is that interactions between genes, tissues, glands, past experience and environmental cues must be considered significantly , including symptoms related to the senses that are exchanged between sucker and those around him, instead of culture or nature or conflict between culture and nature. Edgar Morin's viewpoint is very similar to Solomon who knows move toward to be human as a complicated flow which is described by culture and nature more.And he says a cerain humanity nature resulted in impose of culture to human, and culture accepts these forces relate to biological foundations of human being ( Dortier , p. 493 , 494). Generally viewpoint of Solomon is as follows that : Overview of genetic determinism is false. In fact, every feature of an organism interacts with other organisms and their environment . Genes do not determine on its own, but genes have high power in environment , and community is a part of this environment (Solomon , 2006).

**Cognitive Theories**

For those examine emotion in cognitive approach, social, cultural items, biological events are not necessarily the most important aspects of emotion. Although emotions are made of biological procceses, information processing, social interaction and cultural situations would represent emotions too. Cognitivism claims that emotions are orientationally and have a direct relationship with a subject. For example, fear feeling , is fear of something; a thing as subject of my fear. Cognitive theories focus on the cognitive components that with an intentional content, they believe that the subject of an emotion is always a propositional content. Actually, according to cognitivisms, propositions act as a matter of emotions. Robert Solomon is one of advocaes of cognitive nature of emotions. Scholars and philosophers consider significantly his theory .

***Solomon: overview***

Solomon is the most important contemporary philosophers thought about the emotions. His books in this field are one of the most imporant resources of thinking about emotions and feelings. He is considered as an emotion philosopher. To address his theory about emotions, his views should be divided into several different sections. He is

considered a cognitivism person. Solomon's view about emotions is that they are cognitive, evaluative and intentional phenomena . Responsibility for emotions is main idea of Solomon ( Sherman, 2012).

Solomon has classified emotions as crude emotions and refined emotions . To start our investigation about viewpint of Solomon about emotions, we discuss firstly about that. This classification provides a right entry for obtaining intellectual background of Solomon. So, we discuss this classification as follows:

Notably, main viewpoint of solomon about emotions refers to his existansialist infrastructure. Two books as "The Emotions: Outline of Theory" and "Being and Nothingness" of Sarter impacted on Solomon in this field. "Being and Time" book of Heidegger is the third impressive book on Solomon. Also, impact of Heidegger on Sarter is clear (Sherman , 2012). Sarter thinks similar to other cognitivisms. Emotions are belief and have oriented content. He believes that emotions are focused on other things , such as other states of consciousness. Emotions are a way of perception .

In other words, if Iam angry and if purpose of intentionality of perception is that, my anger is my consiousness of what I am angry with it. I intend an object in my mind when my behavior is angrily. Generally, feelings are oriented such as words. They tell a story of something ( Sarter, 2002). On the other hand, Sarter believes that emotions change the world and are tools for interacting with the world. Actually, any feeling is " changing the world". In fact, emotional and thematic subjects that arouse emotion , both create a unique synthesis which provide physical changes and awareness changes. These changes result in changing the world. Therefore, emotions change the world briefly ( Connor, 2007).

According to Solomon, understanding our emotions is one of the most important parts of self-recognition. Because emotions make our life valuable. A life without emotion, love and passion is just a shadow of a sad life ( Solomon, 2002). In this section, some parts of Solomon theories were reviewed that reflects the refinement of emotions and build a better life based on emotions knowledge and training. Solomon named it as breakdown of trained emotions or refined from the crude emotions.

**Crude and refined emotions**

Emotions play an important role in making our mental structure and thereby play an important role in defining our lives and making it meaningful . Philosophers have noted the importance of emotions since last times. And for someone like Aristotle emotion plays major role in the life and is the key of virtues . Experimental study of emotions in different branches of science was very wide. Many investigations in cognitive sciences filelds especially in psychology and neuro-science have been focused on study on emotions ( Solomon & Higgins , 2006) . But academic and empirical studies of this field is faced with theoretical challenges that philosophical investigations could be useful in finding solution for these challenges. Role of emotion in life is important in two categoresis as follows:Firstly, personal experiences form our emotional intelligence and we acquire a way of interaction with world by emotions. Secondly, culture is transferred to people of society in culture frame and makes this orientation in them to know which option has the most amount of social acceptance , and therefore should choose that option. For example, existansialisms such as sartre have clarified that emotions are not evolutionary strategies, but are some part of experience and are trained by test and error way (Solomon, 2006a). Understanding of emotions is equivalent with self-understanding.Knowing emotin as a chaotic way for engaging with the world is a pre-hy pothesis that must be revised. According to importance of emotions in individual and collective human structure, effort to eliminate any misunderstanding is very essential. Understanding is the primary step to refine emotions. There is not enough knowledge of emotion to present a theory for it to carry the meaning and complexity of them. In the case of crude and refined emotions, Solomon tries to make challenge two relatively accepted approach . One of the views and beliefs is resulted of common sense and beliefs of people , and the other is result of the works of neuroscientists, biologists and psychologists . In fact, Solomon tries make challenge of a common belief about harmfulness of emotions in decision-making, as well as classifying emotions as good and bad emotions . On the other hand, although he has accepted some scientific claims , he did not accept conclusion of some scholars of these claims. Here

he somehow opposed to reductionism and seeing emotions in one dimention in scientific theories. Briefly, Solomon believes that emotions are both cognitive and tools for engaging with the world. We interact with people and world by emotions. They are some strategies to deal with world (Solomon, 2004a). According to Solomon, emotions can not be white or black if they are strategy of dealing with world. On the other hand, he does not accept that we are sentenced to our emotions and are not responsible for them. Actually, we allow our emotions to be strong or control them. So, anger is not a simple feeling.

But it is a tool of interacting with world that can be weak or strong more or less. But it is essential to know that emotions are not like a strategy of what is happened, but it is a thing we let happen (Solomon, 2007). According to Solomon emotions are both trained and crude.As the most important part of emotions , they are tool of our interaction with the world and other people. According to Solomon, we are not sentenced to our emotions. He does not believe to high impact of basic emotions. Many biologists and scientists believe that human kind have basic emotions which are universal . The basic emotions are in both human and animals. According to Solomon, although this theory is true or not, and basic emotions can be some wires in our brain or not , but this is not the whole story, but emotions play cognitive role and they can be controlled or purified (Solomon, 1999 ). Therefore he believes although it is true that we have some emotions with biological basis, we are able to go over these emotions and we could purify them because we are human (Solomon, 2007).

On the other hand, Solomon did not accept it that our emotions are classified as good and bad . " Usually, people believe that some emotions are bad such as proud, anger, lust, envy. Also, they believe some emotions are good such as hope, love,..

But I think that emotions are not white or black, but thay are colorful and complex. I mean, anger is not only a harmful and bad emotion. Sometimes it is good and positive and correct. On the contrary, love is not a good manner in all situations. Sometimes it is harmful and idiotic. Or shame is necesaray for creating a good society, although it represents a degrading image of oneself. In next part of this paper, it is tried to explain what did Solomon mean by classifying emotions as crude emotions and purified ( trained ) emotions by giving some exaples.

**Anger**

Anger is rarely clever, sometimes, confusing and often destructive. Some psychologists and biologists have said anger is a basic emotion, and we are sentenced to anger. According to them, this emotion in children and even in animals is traceable. But under this situation , is it possible to say whether anger is self- regulated less and more? Solomon answered no.

Emotions are not just a neuro-biological reactions . Of course, no doubt that anger is part of our assessment of the situation and the psychological and biological factors, but this is only part of the story and not the whole of it (Solomon, 2007). Aristotle says that anger is sometimes a reaction is exactly right but sometimes a person manner is stupidly, not angrily. For example, with the development of the feminist movement in the world, we saw that it was said that women would have to learn to recognize and express their anger. Here, anger was a correct response to oppression. Anger can lead to positive impact not just violence. Generally when we feel someone insulted us and show our anger, we actually have judged about that person and the world. crude anger or explosive anger is largely irrational and non-utilizable. Crude anger of Billy Budd is an example of it (Solomon, 2006b) . But if the idea of emotion as a strategy is right, then we learn most of our emotions from other people and our actions and reactions with others. We learn to be angry (Solomon: 2007). Actually, anger is not a negative emotion in all situations, although it is not the best one (Solomon: 2007 ). Therefore, it is better to consider anger as a strategy instead of ignoring it completely. It is possible to distinguish between these two kinds of anger in this point , one is crude anger , that is a simple express of our emotion such as anger of Billy Budd and the other is refined anger.

" Guernica" painting of Piccaso is a sample of this kind of refined anger . Nobody is allowed to say Piccasso should not be angry of bombing Guernica city by fashists, or should not represent his anger.

**Afshin Sepahvandi**

**Fear**

Maybe fear is the most important kind of emotion. Fear is unpleasant and sometimes is resulted in shame.But fear is necessary for us to keep ourselves away of some dangers. Most of fears, that are defaulted in our brain and are biologically reactions, are necessary for survive. Irrational fear is result of a break of two levels. Although fear is considered as a negtive thing, many people face themeselve in risky situations in their entertainment (Solomon, 2007) . For example about the fear of the aircraft fligt person knows his fear is not rational, but he fears emotionally i.e. there are two different types of information processing: one emotionally that results in irrational fear and the other is rational which does not allow fear .

According to Solomon, the irrational fear is a result of a complicated set of Internal contradictions (Solomon, 2006b). According to Solomon, fear is the most important emotion , and biologists and neurologists believe it is a basic emotion ( Solomon, 2007). According to Solomon, if our fear of airplane is not based on personal evidences or our beliefs, it is not rational. Actually, it is a sample of crude emotion. But fears based on our recognition of our last experiences are rational fears. This represents training this kind of emotion of our last times and society (Ibid).

**Proud and shame**

Pride was one of the most important virtues in Aristotle's Greek Era. In the Middle Ages, it was one of the seven deadly sins and was the worst sins in Pope's opinion. But it found its positive position again in minds of publics in 20th century. In the ancient Greek era, pride and shame were at odds with each other. In the Middle Ages pride was at odds with humility. False pride was based on wrong assumptions of facts. Such false beliefs remind us that pride is a complex set of moral and evaluative judgments . Pride is a positive assessment of its own and therefore usually is a positive feeling. Mainly , pride is a positive evaluation of the work is done. Pride is a social emotion with social aspect. Self-referential and moral evaluation shows that pride is not a basic emotion. Pride and its other family emotions have higher cognitive function that requires awareness of what is happening around, in society, culture and situations. Pride is in same family with some emotions such as shame and remorse, all of them are about self (Solomon, 2006b). Guilt and shame often are wrong feeling when the law or local custom is violated . All feelings of this group relate to personal assessment ( Solomon, 2007)and are moral. Culture and society deal with concept of responsibility . According to Solomon, these 3 emotions , Pride, guilt and shame, have three aspects. 1- person perspective, 2-through the eyes of others and 3-the situation that has caused these emotions ( Ibid ). Acoording to Solomon, these show that guilt and shame are not also basic emotions, but are complex emotion that are trained by personal learning and experiences.

**Sorrow**

Grief is an emotion that change is seen in it well. That is something that will be changed with time and development. Grief is not something that happens once or get rid of it by taking a pill . Emotions are along with wish. In anger, you want to punish someone. In love, you want to cuddle someone. In shame, you want to hide something. When your loved one is dead, it seems you wish return of a person who is dead, and it is impossible. Mourning is one aspect of grief, when a person tries to solve his problems by focus on his impossible dream. Withdraw is a strong action for reviewing concept of life. When you love someone ,it means that you have learned show your identity with this relation and this is a part of your identity. In grief, the nature is broken and then you step down. You ask who am I? In other societies grief continues for a long time and it seems to be more realistic. In some communities, the mourning continues for whole life. We love the dead person still. Actually, grief is along with love. In a situation that all of society is effected by grief, reminding is more significant. In fact, love and grief are two different sides of a coin. Maybe take a celabration is a nice meaning for dead person.Maybe taking celabrate for alive person is more important. Grief for a loved missed person should not be considered as an irrational behavior, but it is a reaction for reconstruction and re-understanding of self (Solomon , 2006b).

## CONCLUSION

According to Solomon, emotions are not just crude and biological things that work the same in all people, but have cognitive factors , and are capable for learning, improvement and refine. Culture, beliefs, knowledge and experiences, all play role in refining the emotions . Althogh fear and anger are not good in all cases, sometimes are based on wisely valuing according to correct assessment about reality. Even under a situation that fears and angers are not reasonable based on criterion of wise person,those emotional cases do not mean they are non-cognitive, or are unreasonable, but are only based on wrong thought. Understanding and analyzing emotions are helpful to contribute in the process of refining and refining of emotions. Emotions, especially those are in the area of non-impulsive emotions , can act in a spectrum for its owner. For example, it is possible to have different kinds of emotion which begins of its crude form and continues upto its controlled and trained form. In this spectrum, figures and primary emotions forms are uncontrolable and impulsive , while its trained forms are usable in reasonable forms with cultural functions and social acceptance. Briefly, Solomon believes that emotions are cognitivable and also are communicative tool for engagement with world. According to Solomon, if emotions are strategy of engagement with world, they are not white or black . On the other hand, he did not accept that human is sentenced to his emotions . He believes that human is responsible for controlling his emotions. Actually, human lets his feelings and emotions be high degree or low degree. So, anger is not just a simple feeling, but it is communicative tool for human to interact and engagement with world that could be more or less crude or refined.

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RESEARCH ARTICLE

# Morphological Change of Small Intestine under Stress Condition in Broiler Chickens

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## ABSTRACT

Study about theeffects of stress on the length of villus and depth of crypt in duodenum and jejunum and its effect on the morphology of the small intestine, were the main goal of this research.Completely randomized factorial design with two strains (Ross 308 and Arian), two groups per each strain (control and stress)and 6 pens per each group were used to analyze data. Each pen contains twenty 1-day-old male broiler chickens. Each strain fed with the standard diet recommended by the producer company. In stress group, chickens were received 5, 13 and 27 mg of corticosterone by injection in their Peritoneum every 3 days in first, second and third weed of their age. The corticosterone concentration was measured in blood plasma. It was significantly differentbetween control and stress group in each strain in days 10 and 23 ($P<0.05$). The depth of duodenal and jejunal crypts were significantly decreased in stress group in both strains ($P<0.05$). Maximum and minimumheight of duodenal villus was observed in Arian's control and Ross stress groups respectively. There was no difference between the lengthand relative weight of small intestine in all groups ($P\geq0.05$) but the net weight of small intestine was higher in control group of Arian than the others. The body weight on 23-days-old for Arian control group was significantly higher than Ross control group ($P<0.05$) but there was no differences between stress group of Arian and Ross($P\geq0.05$).

**Key word:** Morphology, small intestine, Stress, Corticosterone, chicks

## INTRODUCTION

Chickens are exposed to a wide variety of potential stressors during the first 3 weeks of their growth. Increasing the activity of the hypothalamus-pituitary-adrenal (HPA) axis is one the result of stressful situations (Moberg and Mench, 2000; Vandenborne*et al.,* 2005; Song *et al.,* 2011). Stimulation of the HPA axis, under the stress condition, increases the secretion of adrenocorticotropic hormone (ACTH). The ACTH stimulates adrenals to secret and release glucocorticosteroidslike corticosterone(CORT) into the blood, so stressor caused to increase concentration of adrenal glucocorticosteroids like CORT in the blood circulation (Moberg and Mench, 2000; Hu and Gou, 2008). Antoni (1986) described the paraventricular nucleus containing neurons as the primary initiators of the stress response organisms. The Corticotrophin-releasing hormone CRH has been considered as the possible anorexigenic factor in mammals and birds (Richard, 1993; Richards, 2003).Glucocorticoids are the end product of HPA axis activity and exert feedback effects at the pituitary level and in the hypothalamus (Sato *et al.,* 1975; Kretz*et al.,* 1999; Song *et al,* 2011).

The CORT or ACTH can play a different role in the body of the organisms like broiler chickens. For example the effects of long-term dietary administration of corticosterone on the induction of oxidative injury, in broiler chickens showed the significantly increased plasma nonenzymatic antioxidants in concert with the enhanced enzymatic antioxidant activityduring short-term CORT administration indicate preventive changes to counteract the oxidative injury, and these may be tissue specific (Lin *et al,* 2004).Peripheral and central effect of CORT on feed intake and hypothalamic corticotrophinreleasing hormone (CRH) gene expression in chicks fed a high energy diet were investigated in another study.It demonstrated that, peripheral corticosterone had an inhibited effect on hypothalamic CRH mRNA levels, but it had a stimulating effect on feed intake in broiler chicks fed by high energy diet (Song *et.al,* 2011).

The small intestine is the main absorptive part of the gastrointestinal tract.The gastrointestinal tract of broiler chickens is about 1.5% of BW; however, approximately 6% to 8% of the energy derived from the diets is consumed by it (Spratt *et al.,* 1990; Hu and Guo, 2008). The small intestinal epithelium is a compound multiple cell system, which determines the growth potential of broiler after hatched (Uni*et al.,* 1998, Hu and Guo, 2008). The development of intestinal morphology and function resulted in the development of chickens (Yamauchi and Tarachai, 2000; Yang *et al.,* 2007; Hu and Guo, 2008). Hu and Guo (2008) demonstrated that CORT administration impaired the normal morphology and absorptive capacity of the small intestine of broiler chickens.

The stressor caused to stimulate the secretion of adrenal glucocorticosteroids like CORT in broiler chickens. Hu and Guo (2008) showed the effect of CORT on the normal morphology and absorptive capacity of the small intestine of Arbor Acre broiler chickens. The goal of this study was to compare the change of morphology of small intestine under the stress condition in Ross 308 and Iranian Arian broiler chickens.

## MATERIALS AND METHODS

Two hundred and forty 1-day-old chickens(120 male broiler chickens from Ross 308 and 120 male broiler chickens from Arian strain) were selected randomly and distributed in two groups (control vs stress).Each group contains 6 pens (20 birds per pen).Chickens in control (CTRL) and stress(CORT) groups fed by standard diet recommended by the strain producers company.Lighting schedule, relativehumidity and ventilation were set in standard conditions. Thebirds had free access to feed and water throughout thetrial.

The stressor caused to stimulate the secretion of adrenal glucocorticosteroids like corticosterone in broiler chickens so in stress group, in order to increase the rate of glucocorticosteroids and observed its effect on the morphology of small intestine,peritoneum injection was done by 5, 13 and 27 milligram of Methylprednisoloneacetate (Depo-Medrol),every 3 day, in first, second and third week of the chickens age. Methylprednisolone is a synthetic glucocorticoid or corticosteroid drug.For each trial 3 birds were selected randomly in each pen. Blood sample of tree chicks per each pen, were drawnvia wing veinto define glucocorticosteroids (corticosterone) concentration in day 10 and 23. The Blood kept in tubes with no anticoagulant and werecentrifuged at 1500g for 15

min, sera was collectedfor analysis, corticosterone hormone concentration wasassessed by ELISA kit (Corticosterone ELISA RE52211, IBL Gesellschaft fur Immunchemie und Immunbiologie MBH ,Hamburg, Germany) (Sadeghi *et al,* 2014).

At the age of 23-day-old, tree birds per each replicate were selected randomly and killed after weighting. The intestine was removed, flushed with ice-cold normal saline, wiped with filter paper, then stretched naturally and the length, wet weight andrelative weight(small intestinal wet weight/body weight) were recorded (Hu *et al,* 2010). Four centimeter of the middle of duodenum and jejunum of chickens was cut and fixed in 10%neutral buffered formalin, then dehydrated ,cleared and embedded in paraffin and sliced by a microtome with 7 µmthickness. Slices of Tissue samples were stained by hematoxylin-eosin stain and mounted by entellan rapidmounting medium. Slices of Tissue samples were evaluated underlight microscope with LEICA QWin 0760software (Leica Microsystems Imaging Solutions Ltd ,.Clifton Road, Cambridge CB1 3QH, United Kingdom) to determine the villus height and crypt depthof duodenum and jejunum (Safaee*et al,* 2014;Valizadeh*et al,* 2014).Completely randomized factorial design with two strains (Ross 308 and Arian), two groups per each strain (control and stress) and 6 pens per each group were used to analyze data. Duncan multiple range test were used to compare the average of each group.

## RESULTS AND DISCUSSION

Finding the difference of corticosterone between control groups (CTRL) and stress groups (CORT) was the first important object of this study. Mean and standard error of corticosterone concentration of plasma (ng/ml) in control (CTRL) and stress groups (CORT) in day 10 and 21 on Arian and Ross broiler chicken was shown in Table 1. Significant difference was observed between CTRL and CORT groups in both Arian and Ross strains ($P<0.05$) but there was no significant difference between Arian and Ross CORT or Arian and Ross CTRL groups ($P\geq0.05$). It's showed that the dosage of injection of Methyl prednisolone acetate was enough to increase significantly the level of plasma corticosterone concentration of blood in stress group vs control group. It's showed that, to avoid treatment of animals with physical or physiological stress, addition of the stress-related hormone corticosterone, to the food, water or inject on the peritoneum may serve as a practical alternative to reproduce hormone-related stress in broiler chickens. Rapid uptake of the hormone and distribution in the bloodstream were affirmed by elevated plasma corticosterone concentrations immediately after start of the treatment (Post et al, 2003).

Investigation of the corticosterone on the macroscopic characteristics of the small intestine in CTRL and CORT group of Arian and Ross strain was the second object of this study (Table 2). Corticostrone administration didn't have any significant effect on the length and weight of small intestine in Arian and Ross control and stress group ($P\geq0.05$). There was no significant difference between the weight of small intestine in Arian and Ross stress group ($P\geq0.05$) but the weight of small intestine was higher in control group of Arian and Ross in compare with stress group ($P<0.05$). Arian control group had a maximum body weight between all groups ($P<0.05$), but there was no difference between the body weight of Arian and Ross stress group ($P\geq0.05$). Hu *et al* (2010) investigate the effects of corticosterone on the Arbor Acres male broiler chickens. They showed that corticosterone has a negative effect on the weight, length, relative weight of this strain. The difference between strains, the special nutrition demands of each strain of broilers and dietary formulation may also be effective,beside corticosteroid hormone, on the morphology of small intestine.

Table 3 showed the microscopic characteristics of duodenum and jejunum in control and stress group of both strains.Maximum and minimum value of duodenal and jejunal villus height was observed incontrol groupvs stress group. The duodenal and jejunal crypts depth were significantly difference between stress and control group in both strains. Hu and Guo (2008) showed the same effect of corticosterone on characteristics of duodenal and jejunal villus and crypt on Arbor Acre (AA) male chickens.

It was concluded that stress can affect the morphology of small intestine by increasing the secretion more glucocorticoids on the blood and consequently affect the villus and crypt of duodenum and jejunum in small intestine. In stress situation the performance of two strains was the same according to the 21-day body weight but at the normal condition the performance of Arian was better.

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**Table 1: Mean and standard error of corticosteroneconcentrationof plasma(ng/ml) in control(CTRL) and treatment group(CORT) in day 10 and 21 in Arian and Ross broiler chicken**

| | Arian CTRL | Ross CTRL | Arian CORT | Ross CORT |
|---|---|---|---|---|
| 10 Days old | $7.19^{b} \pm 0.18$ | $8.23^{b} \pm 0.19$ | $16.70^{a} \pm 0.17$ | $20.16^{a} \pm 0.34$ |
| 21 Days old | $6.87^{b} \pm 0.70$ | $8.65^{b} \pm 0.90$ | $23.36^{a} \pm 2.70$ | $26.86^{a} \pm 2.81$ |

**Table 2: Small intestine length (cm) and weight (g), Body weight on day28 of age (g) and relative weight of small intestine(%).**

| | Arian CTRL | Ross CTRL | Arian CORT | Ross CORT |
|---|---|---|---|---|
| Small intestine weight | $46.16^{a} \pm 3.83$ | $33.50^{ab} \pm 5.17$ | $31.50^{b} \pm 8.18$ | $25.17^{b} \pm 4.25$ |
| Small intestine Length | $173.50^{ns} \pm 6.87$ | $166.50^{ns} \pm 4.45$ | $156.17^{ns} \pm 7.14$ | $167.50^{ns} \pm 3.94$ |
| Small intestine relative weight | $4.42^{ns} \pm 0.35$ | $3.67^{ns} \pm 0.34$ | $3.05^{ns} \pm 0.11$ | $3.40^{ns} \pm 0.45$ |
| Body weight on day23of age | $1128.50^{a} \pm 48.20$ | $888.67^{b}$+ 55.50 | $730.67^{c} \pm 33.15$ | $721.84^{c} \pm 34.35$ |

**Table 3: The size of duodenal and jejunal villus and crypt (µm)**

| | Arian CTRL | Ross CTRL | Arian CORT | Ross CORT |
|---|---|---|---|---|
| Duodenal villus Height | $1159.01^{a} \pm 66.97$ | $994.10^{a} \pm 28.13$ | $881.33^{b} \pm 68.69$ | $714.16^{b} \pm 65.86$ |
| Jejunal villus height | $903.44^{a} \pm 47.69$ | $890.06^{a} \pm 25.16$ | $568.11^{b} \pm 23.58$ | $470.33^{b} \pm 33.34$ |
| Duodenal crypts depth | $144.58^{a} \pm 9.44$ | $141.14^{a} \pm 13.46$ | $85.22^{b} \pm 4.80$ | $88.62^{b} \pm 3.22$ |
| Jejunal crypts depth | $107.19^{a} \pm 8.34$ | $121.65^{a}$+ 10.28 | $57.52^{b} \pm 3.61$ | $75.01^{b} \pm 6.15$ |

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RESEARCH ARTICLE

# A New Modeling of Maintenance Risk Based Inspection Interval Optimization with Fuzzy Failure Interaction for Two-Component Repairable System

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## ABSTRACT

Inspection is one of the important activities to detect and fix failures in repairable system. Optimization of inspection intervals has critical role in decreasing total costs of maintenance system, reduces inspection costs and increases the performance of operating system. In addition to cost, Risk Based Inspection (RBI) is one of the most important aspects of maintenance. In systems such as transformer, consideration of risk reduces the inspection interval time. The other characteristic of systems such as transformers is to failure interaction between components. The failure interaction can increases failure rate of other component. The quantity of failure interaction is usually uncertain. In this paper to overcome this uncertainty the fuzzy theory applied. On a finite time horizon, the objective of current study is to figure out the optimal risk based inspection interval time for the first component to minimize the expected total cost with using fuzzy interaction. Therefore, an adapted sample problem is resolved and numerical results are presented.

**Keywords:** Periodic inspection interval, Risk Based Inspection (RBI), maintenance, Failure interaction, reliability.

## INTRODUCTION

One universal measurement of maintenance performance, is the cost of maintenance. The aim of maintenance is to maximizing reliability and minimizing cost [1-2]. The minimizing costs can be considered as returning lost profit or potential budget injection [3-4]. In maintenance, repair caused failure and increasing inspection can induced maintenance cost. In contrast, increasing inspection and maintainability can reduce the downtime penalty cost. The inspection is one of the important activities to detect and fix failures in repairable system. Optimization of inspection

intervals has critical role in decreasing total costs of maintenance system, reduces inspection costs and increases the performance of operating system. In addition to cost, Risk Based Inspection (RBI) is one of the most important aspect of maintenance [5-7].Risk have critical role in maintenance and inspection interval. For example, failure of transformer is few. But, inspection intervals time is short due to risk. So, the optimization inspection interval risk based regard to this cost is so important.

The repairable components increase complexity of reliability assessment in systems. While the component of repairable system was failed, it may have been an increasing impact on the other component failure rate. The interactions between components can be categorized into economic, structural and stochastic dependencies. Grouping maintenance actions either save costs (economy of scale) or result higher costs (because of High down-time costs) as economic dependency. The stochastic dependency occurs when the condition of components influences the lifetime distribution of other components. The structural dependency applies while components structurally form a part. So that maintenance of a failed component implies maintenance of working components [8-11].

The failure probabilistic interaction between components is usually is uncertain. So, the expert judgment is used to overcome this uncertainty [12-13]. Other characteristic of this paper is to consideration risk in selecting optimal inspection interval. The risk can significantly decrease the inspection interval time.As well, in this paper a new optimization inspection interval risk based is proposed that in compare by Sh.Taghipour et al [14] is so time consuming.

In this paper, a two-component repairable system with failure interaction is considered. The failure between components of this system is as follow: a) the failure of the first component is soft and the second component is hard. The hard failure caused the system stop. But, soft failures do not. Soft failure can reduce the system's performance and increase the system operating costs, whereas, hard failures make the system stop. The components are periodically inspected and if a failure is observed, it will be repaired. Thus, for the soft component there is a time delay between a real occurrence of failure and its detection. The long time delay has greater cost to the system. The repair of the both component don't restores them as good as new. The objective is to find the optimal inspection interval for the soft component with failure interaction so that minimizes the expected total cost on a finite time horizon. In proposed model, at the first, $\tilde{p}_{\tau}^{k}(t)$ (the probability that the first component doesn't fail in kth inspection interval of the cycle T with $\tau$ inspection interval) are calculated. Then, the cost risk based model is used to find optimal inspection interval with minimum cost. Other assumptions are:

1. The inspections of the first component are perfect, i.e. they diagnose the soft failure without any error.
2. The inspection time of the first component as well as the time required to repair for both components are ignored and treated as being zero.
3. The soft failure of system cannot convert to hard failure.

Failure interaction implies that the failure of each component affects the failure rate of the other component. In this situation, every failure of one of the components acts as a shock to the other component [10-11]. As mentioned, the quantity of failure interaction is usually uncertain. So, the fuzzy numbers are used to overcome this uncertainty. Fuzzy set theory has been the most important approach used to deal with uncertainty in the problems. The fuzzy approach commonly used to indicating uncertainty and provides proper language to explain expert idea[12-13].

The scheduling optimization problems are usually divided in two classes: the first, the optimization model that needs to heuristic algorithms [1, 4] which attempts to find the optimal inspection number in each period. Because of long distance between two inspections in one period (between zeros to period time), this model is not appropriate for inspection interval. But, it is appropriate for gaining optimum stock inventory. The second, the optimization models which their aim is to find the inspection interval time. In this class, the problems generally modeled based on cost [14-17].

In previous researches, the repairable system has been considered to obtain optimum inspection interval based on cost and soft-hard failure concept [15-18]. They calculated the cost for different modes of inspections (1, 2, 3... 10 periodically) and then selected the inspection interval time with the minimum cost.

In complex repairable system usually components are not independent in which failure/repair of one component have shock on other components [10-11, 15, 19]. Inspection interval with failure interaction for two and multi components have been studied by [15, 19]. They considered a two-component system. In their study, the capacitor bank (first component) and the transformer (second component) for a distribution substation in an electric power distribution system considered. Also, for the failure interaction, Satow and Osaki [20] proposed a two-parameter (T, k) replacement model for a two-component system with shock damage interaction. In their study, the system is replaced preventively whenever the total damage of component 2 exceeds k or the age of the system reaches time T. Zequeira and Berenguer [21] studied inspection policies for a two-component parallel standby system with failure interaction and compared staggered and non-staggered inspections through numerical examples considering constant hazard rates.

The model was presented by [14] for the 'the probability that the first component doesn't fail' and 'the expected survival time of the first component' is required calculating of multi-integrals. This multi-integral values are negligible, which is usually ignored in calculations. In this paper, to simplify and avoid from the error of calculation, the Bayesian theory is applied and proposed the new model to optimization. The proposed model reduced calculations significantly.

In the section 2,the inspection optimization model, including Simpson's rules, problem definition,fuzzy theory, and the proposed model are presented. In section 3, the numerical adaptedexample is solved.

**Inspection optimization model**

**Simpson's rules**

In numerical analysis, Simpson's rule [22] is a method for numerical integration. Simpson's approximational integrals rule is used to calculate the integrals which are difficult to solve by analytical methods. The following equation demonstratesSimpson's rule:

$$\int_a^b f(x)\,\mathrm{dx} \approx \frac{h}{3}\left[ f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + \ldots + 4f(x_{n-1}) + f(x_n)\right] \qquad (1)$$

n, its number of sub-intervals between [a,b]. $x_0 = a + ih$, i=0,1,2,...,n-1,n, $x_0 = a$ and $x_0 = b$. The simpson's rule can be derived by approximating the integrand f (x) (in blue) by the quadratic interpolant P(x) (in red) in Fig 1.

**Problem definition**

Here, a system consists of two- repairable component with failure interaction is considered. The failure of the first component is soft and the second component is hard.The first component is periodically inspected and if a failure is observed during the inspection, it is perfectly repaired. Thus, for the soft component there is a time delay between a real occurrence of failure and its detection. It is assumed that the long time delayhave greater cost to the system. The hard failure of the second component is detected immediately as soon as it occurs and the second component is perfectly repaired. As well, the second component is not inspected. The perfect repair of each component don't restores it to as good as new ones[15].

It is assumed that the first component's failures have increasing failure rate (non-homogeneous Poisson process; NHPP) and the second component's failures have a constant failure rate (homogeneous Poisson process; HPP). In addition to the above assumptions, we make the followingassumptions:

1. The inspections of the first component are perfect, i.e. theydiagnose the soft failure of the first component without anyerror.
2. The inspection time of the first component as well as the timerequired to repair for both components are ignored and treatedas being zero.
3. The soft failure of the first component cannot convert to hardfailure.
4. The cost resulting from the second component includes only thecost associated with its perfect repair. Since the failure rate ofthis component is assumed constant, its corresponding costper unit time is constant and, thus, it is not included in theoptimization model

The defined parameters and variables are encapsulatedin Table.1.

**Fuzzy theory**

As indicated, that human judgment about preferences are often unclear to estimate by exact numerical values, again fuzzy logic is useful for handling problems characterized by vagueness and imprecision. The fuzzy set theory introduced by [23] to incorporate the uncertainty of human thoughts in modelling. The most critical contribution of fuzzy set theory is its capability of representing imprecise or vague data. A symbol that represents a fuzzy set receives a tilde "~" above it. A triangular fuzzy number (TFN) is shown in Fig. 2.

A TFN is represented by or (a,b,c). The parameters l,m, and u refer to the smallest possible value, the most promising value, and the largest possible value, respectively. Each TFN is denoted by linear representations on its right and left sides such that its membership function l can be defined as in Eq. (2)

$$\mu\left(\frac{x}{M}\right)=\begin{cases}0, & X<1\\ \dfrac{x-a}{x-a}, & a\le x\le b\\ \dfrac{c-x}{c-b}, & m\le x\le u\\ 0, & x>c\end{cases} \tag{2}$$

If the fuzzy score of all experts are described as TFN e=1,2,...,E, then the aggregated fuzzy score is given by $\tilde{R}=(a,b,c)$ where

$$a=\min_{e}\{a_e\}\ b=\frac{\sum_{e=1}^{E} b_e}{E}\ c=\max_{e}\{c_e\} \tag{3}$$

According to the extension principles and characteristics proposed by [23],the algebraic operations of triangular fuzzy numbers are performed as follows:

- For addition of a fuzzy number $\tilde{M}_1=(a_1,b_1,c_1)$ and $\tilde{M}_2=(a_2,b_2,c_2)$ are apply the $\oplus$ symbol

$$\tilde{M}_1+\tilde{M}_2=(a_1,b_1,c_1)\oplus(a_2,b_2,c_2)=(a_1+a_2,b_1+b_2,c_1+c_2)$$

- Multiplication of a fuzzy number $\tilde{M}_1=(a_1,b_1,c_1)$ and $\tilde{M}_2=(a_2,b_2,c_2)$ are apply the $\otimes$ symbol

$$\tilde{M}_1\times\tilde{M}_2=(a_1,b_1,c_1)\otimes(a_2,b_2,c_2)=(a_1\times a_2,b_1\times b_2,c_1\times c_2)$$

- Subtraction of two fuzzy numbers:

$$\tilde{M}_1 - \tilde{M}_2 = (a_1,b_1,c_1) - (a_2,b_2,c_2) = (a_1 - a_2, b_1 - b_2, c_1 - c_2)$$

- Division of two fuzzy numbers:

$$\tilde{M}_1 \Big/ \tilde{M}_2 = (a_1,b_1,c_1) \Big/ (a_2,b_2,c_2) = \left(\frac{a_1}{c_2}, \frac{b_1}{b_2}, \frac{c_1}{a_2}\right)$$

- Inversion:

$$\tilde{M}_1^{-1} = (a_1,b_1,c_1)^{-1} = \left(\frac{1}{c_1}, \frac{1}{b_1}, \frac{1}{a_1}\right)$$

- Multiplication of any real number a:

$$a \times \tilde{M}_2 = a \otimes (a_2,b_2,c_2) = (a \times a_1, \mathrm{a} \times b_1, \mathrm{a} \times c_1)$$

And to convert fuzzy number to crisp number the $R = \frac{a + 4b + c}{6}$ formula can be used. By using TFN, the decision group able to certain the p value. The proposed scale by using TFNs is presented in Table 1.

**Proposed model**

As noted, the second component failures accelerates the failure of the first component, but the first component failure does not affect the second component failure. The accelerating effect ( $\tilde{p} = (a,b,c)$ ) is not synergistic.The $\tilde{\lambda}_1^j(x)$ is given by:

$$\tilde{\lambda}_1^j(x) = \tilde{\lambda}_1(x \,|\, N_2(x) = \mathrm{j}) = (1 + j\tilde{p})\lambda_1^0(x),\ j = 0,1,\ldots \qquad (2)$$

Where, $\lambda_1^0(x)$, is the failure rate of the first component, if the second component doesn't fail until time x.

It is assumed that the second component's failures occuraccording to HPP with a constant failure rate. Thus, we have

$$p(N_2(x) = \mathrm{j}) = \frac{(\lambda_2 \times x)^j e^{-\lambda_2 \times x}}{j!},\ j = 0,1,\ldots \qquad (3)$$

The expected failure rate of the first component at time x, $\tilde{\lambda}_1(x)$, depends on the number of the second component's failures j=0,1,2,... . Thus, from Eqs. (2) and (3), $\tilde{\lambda}_1(x)$, is given by

$$\tilde{\lambda}_1(x)=\sum_{j=0}^{\infty}\tilde{\lambda}_1(x|N_2(x)=\mathrm{j})\times p(N_2(x)=\mathrm{j})=\sum_{j=0}^{\infty}\left[\lambda_1^0(x)(1+j\tilde{p})\right]\times\frac{(\lambda_2\times x)^j e^{-\lambda_2\times x}}{j!} \quad (4)$$

$$=e^{-\lambda_2\times x}\lambda_1^0(x)\left[\sum_{j=0}^{\infty}\frac{(\lambda_2\times x)^j}{j!}+\tilde{p}\sum_{j=0}^{\infty}\frac{j(\lambda_2\times x)^j}{j!}\right]$$

$$=e^{-\lambda_2\times x}\lambda_1^0(x)\left[e^{\lambda_2\times x}+\tilde{p}(\lambda_2\times x)e^{\lambda_2\times x}\right]=$$

$$\left(\lambda_1^0(x)\left[1+a(\lambda_2\times x)\right],\lambda_1^0(x)\left[1+b(\lambda_2\times x)\right],\lambda_1^0(x)\left[1+c(\lambda_2\times x)\right]\right)$$

The Cumulative distribution function is given by Eq. (5) and simplification by following equations, Eq. (6-8).

$$F(x)=1-e^{-\int_t^{t+x}\lambda_1(x)dx} \qquad 0\le x\le\tau \quad (5)$$

$$F(x)=1-e^{-\int_t^{t+x}\frac{\beta}{\theta}\left(\frac{x}{\theta}\right)^{\beta-1}\left[1+\tilde{p}(\lambda_2\times x)\right]dx}=1-e^{-\frac{1}{\theta^\beta}\int_t^{t+x}\beta x^{\beta-1}+\tilde{p}\lambda_2 x^\beta dx} \quad (6)$$

$$\overset{t=0}{=}1-e^{-\frac{1}{\theta^\beta}\left(x^\beta+\tilde{p}\lambda_2\frac{x^{\beta+1}}{\beta+1}\right)}$$

Assume that

$$\zeta=\frac{1}{\theta^\beta},\ \zeta_a'=\frac{a\lambda_2}{\beta+1},\zeta_b'=\frac{b\lambda_2}{\beta+1},\zeta_c'=\frac{c\lambda_2}{\beta+1},\ \tilde{\zeta}'=\frac{\tilde{p}\lambda_2}{\beta+1} \quad (7)$$

Then Eq. (7) given by

$$F(x)=1-e^{-\zeta\left(x^\beta+\tilde{\zeta}'x^{\beta+1}\right)} \quad (8)$$

The cycle T is the planning horizon (e.g. One year) which is fixed. In the cycle T, the system is inspected at times, $k\tau$ (k=1, 2,..., n), where $T=n\tau$. Failures of the both component are perfectly repaired if failure accurse. We assume that inspection and possible repairs are also done at the end of the cycle T (last inspection is on the end of cycle T), that is, for k = n. The objective is to find the optimal inspection interval that can minimize the expected total cost of the system incurred over the cycle T. When the component fails, it remains in a failed state until the next inspection time. Therefore, if the component failed in each inspection interval, a downtime penalty cost is incurred. The cost is proportional to the elapsed time from failure time to its detection at inspection time. Thus, the costs for resulting from the system in each of the inspections k, k =1,2, ... , n includes the cost of inspection, $C^s$ , the cost of repair if found failed, $C^d$ , and the penalty cost for the elapsed time for the failure, $C^p$ , Thus, the expected cost incurred in the inspection k for each cycle ( $\tau$) is given by

$$\tilde{E}\left[C_1^T\right]=\sum_{k=1}^{T/\tau}\tilde{E}\left[C_1^{(k-1)\tau,k\tau}\right]=\left[\left(T/\tau\right)C_1^s+\sum_{k=1}^{T/\tau}C_1^d\left[1-p_\tau^k(t)\right]+\sum_{k=1}^{T/\tau}C_1^p\left[\tau\left(1-\tilde{p}_\tau^k(t)\right)\right]\right](1+\psi\tau) \quad (9)$$

$$=\left(T/\tau\right)C_1^s+\left(C_1^d+\tau C_1^p\right)\left[T/\tau-\sum_{k=1}^{T/\tau}\tilde{p}_\tau^k(t)\right](1+\psi\tau)$$

Where, the $(1+\psi\tau)$ is the fuzzy risk statement. The $0\le\psi\le1$ and indicating the present of risk in inspection. With increasing of $\psi$ (risk) or $\tau$, the expected total cost has bold.

Bayesian theory is used to obtain $\tilde{p}_\tau^k(t)$. Due to different times of inspection intervals, the probability of $\tilde{p}_\tau^k(t)$ is depends on $\tilde{p}_\tau^{k-1}(\mathrm{t})$. The Bayesian approach to obtain $\tilde{p}_\tau^k(\mathrm{t})$ is given by

$$\begin{aligned}&\tilde{p}_\tau^k(t)=\tilde{p}_\tau^k(t\,|\,safety\ \text{ in }\ \tilde{p}_\tau^{k-1}(\mathrm{t}))\tilde{p}_\tau^{k-1}(\mathrm{t})+\\&\tilde{p}_\tau^k(t\,|\,\text{unsafety in }\ \tilde{p}_\tau^{k-1}(\mathrm{t}))(1-\tilde{p}_\tau^{k-1}(\mathrm{t}))\quad,k=1,\ldots,\mathrm{T}/\tau\end{aligned} \quad (10)$$

It is possible to rewrite the Eq. (10) as follows:

$$\tilde{p}_\tau^k(t)=\tilde{p}_\tau^{k-1}(\mathrm{t})\left[1-\tilde{F}(x)\Big|_{(k-1)\tau}^{k\tau}\right]+(1-\tilde{p}_\tau^{k-1}(\mathrm{t}))\left[\int_{(k-2)\tau}^{(k-1)\tau}\frac{y-(k-2)\tau}{(k-1)\tau-(k-2)\tau}\left(1-\tilde{F}(x)\Big|_y^{k\tau}\right)dy\right] \quad (11)$$

For the different inspection intervals, the $\int_{(k-1)\tau}^{k\tau}\tilde{f}(x)dx$ indicates the probability of the soft component failure at $((k-1)\tau,k\tau]$ interval, when the soft component is on safety condition in the last interval. As well, $\int_y^{k\tau}f(x)dx$ indicates the probability of the first component failure at $(y,k\tau]$ interval, when the first component is on unsafety condition in the last interval .the y its between $[(k-2)\tau,(k-1)\tau]$ and has uniform distribution. According to Eq. (8), $\tilde{p}_\tau^k(t)$ can be simplified as follows:

$$\tilde{p}_\tau^k(t)=\tilde{p}_\tau^{k-1}(\mathrm{t})\left[e^{-\left[\zeta\left((k\tau)^\beta+\tilde{\zeta}'(k\tau)^{\beta+1}\right)-\zeta\left(((k-1)\tau)^\beta+\tilde{\zeta}'((k-1)\tau)^{\beta+1}\right)\right]}\right]+ \quad (12)$$

$$(1-\tilde{p}_\tau^{k-1}(\mathrm{t}))\int_{(k-2)\tau}^{(k-1)\tau}\frac{y-(k-2)\tau}{\tau}\left[e^{-\left[\zeta\left((k\tau)^\beta+\tilde{\zeta}'(k\tau)^{\beta+1}\right)-\zeta\left((y)^\beta+\tilde{\zeta}'(y)^{\beta+1}\right)\right]}\right]dy\qquad,k=1,\ldots,\mathrm{T}/\tau$$

$$=\tilde{p}_\tau^{k-1}(\mathrm{t})\times\left[e^{-\left[\zeta\left((k\tau)^\beta+\tilde{\zeta}'(k\tau)^{\beta+1}\right)-\zeta\left(((k-1)\tau)^\beta+\tilde{\zeta}'((k-1)\tau)^{\beta+1}\right)\right]}\right]+$$

$$(1-\tilde{p}_\tau^{k-1}(\mathrm{t}))\times e^{-\zeta\left((k\tau)^\beta+\tilde{\zeta}'(k\tau)^{\beta+1}\right)}\times\int_{(k-2)\tau}^{(k-1)\tau}\frac{y-(k-2)\tau}{\tau}e^{\zeta\left((y)^\beta+\tilde{\zeta}'(y)^{\beta+1}\right)}dy$$

The triangular fuzzy number of $\tilde{p}_\tau^k(t)$ as following

$$\tilde{p}_{\tau}^{k}(t)=\begin{pmatrix} p_{\tau,c}^{k-1}(\mathrm{t})\times\left[e^{-\left[\zeta\left((k\tau)^{\beta}+\zeta_c'(k\tau)^{\beta+1}\right)-\zeta\left(((k-1)\tau)^{\beta}+\zeta_c'((k-1)\tau)^{\beta+1}\right)\right]}\right]+ \\ (1-p_{\tau,c}^{k-1}(\mathrm{t}))\times e^{-\zeta\left((k\tau)^{\beta}+\zeta_c'(k\tau)^{\beta+1}\right)}\times\int_{(k-2)\tau}^{(k-1)\tau}\frac{y-(k-2)\tau}{\tau}e^{\zeta\left((y)^{\beta}+\zeta_c'(y)^{\beta+1}\right)}dy, \\ p_{\tau,b}^{k-1}(\mathrm{t})\times\left[e^{-\left[\zeta\left((k\tau)^{\beta}+\zeta_b'(k\tau)^{\beta+1}\right)-\zeta\left(((k-1)\tau)^{\beta}+\zeta_b'((k-1)\tau)^{\beta+1}\right)\right]}\right]+ \\ (1-p_{\tau,b}^{k-1}(\mathrm{t}))\times e^{-\zeta\left((k\tau)^{\beta}+\zeta_b'(k\tau)^{\beta+1}\right)}\times\int_{(k-2)\tau}^{(k-1)\tau}\frac{y-(k-2)\tau}{\tau}e^{\zeta\left((y)^{\beta}+\zeta_b'(y)^{\beta+1}\right)}dy, \\ p_{\tau,a}^{k-1}(\mathrm{t})\times\left[e^{-\left[\zeta\left((k\tau)^{\beta}+\zeta_a'(k\tau)^{\beta+1}\right)-\zeta\left(((k-1)\tau)^{\beta}+\zeta_a'((k-1)\tau)^{\beta+1}\right)\right]}\right]+ \\ (1-p_{\tau,\mathrm{a}}^{k-1}(\mathrm{t}))\times e^{-\zeta\left((k\tau)^{\beta}+\zeta_a'(k\tau)^{\beta+1}\right)}\times\int_{(k-2)\tau}^{(k-1)\tau}\frac{y-(k-2)\tau}{\tau}e^{\zeta\left((y)^{\beta}+\zeta_a'(y)^{\beta+1}\right)}dy \end{pmatrix} \quad (13)$$

For example, from Eq. (13)

$$\tilde{p}_{T}^{1}(t)=\left(1\times\left[e^{-\left[\zeta\left((T)^{\beta}+\zeta_c'(T)^{\beta+1}\right)\right]}\right],1\times\left[e^{-\left[\zeta\left((T)^{\beta}+\zeta_b'(T)^{\beta+1}\right)\right]}\right],1\times\left[e^{-\left[\zeta\left((T)^{\beta}+\zeta_a'(T)^{\beta+1}\right)\right]}\right]\right) \quad (14)$$

**Numerical example and conclusion**

The numerical example which is considered in this paper referred to [15]. They considered a two-component system, a capacitor bank (first component) and a transformer (second component) in a distribution substation in an electric power distribution system. The power capacitors are often used in distribution systems to supply reactive volt-amperes to the system.When it applied to a system or circuit having a lagging power factor, several beneficial results are obtained. These results include power factor increase, voltage increase, system loss reduction, and release of electric system capacity. In this case study, if the transformer doesn't fail until month x, the failure rate of the capacitor bank is estimated as $\lambda_1^0(x)=\frac{\beta}{\theta}(\frac{x}{\theta})^{\beta-1}$, where $\beta=1.8$, $\theta=10$ and other parameters are as following; T=12, $\lambda_2=1/6$ per month, $\tilde{p}=(0,0.05,0.1)$, $C^s=2000$, $C_1^d=7500$ and The downtime penalty cost of the capacitor bank (cost of delay in detecting the capacitor bank's failure) per each unit of elapsed time from its failure to its detection at the inspection is $C_1^p=12000$ per month.Then, the expected total cost of the capacitor bank is calculated by the proposed model in whichMATLAB software is employedtoincrease the correctness of calculation.

The results from table (2-4) indicates the improvement of $\tilde{p}_{\tau}^{k}(t)$ with decreasing inspection interval time ($\tau$) and fixed inspection number (k) (the value of each column is on increasing). As well, for each fixed inspection interval time ($\tau$) and increasing inspection number (k), the $\tilde{p}_{\tau}^{k}(t)$ it's on decreasing.
Increasing the number of inspections increases the inspection costsand reduces the downtime penalty cost. The contrast between these two costs caused the Non-stricttotal cost plot.

In riskless model, total expected cost for each fixed inspection interval time ($\tau$) with inspection cost, repair cost, and downtime penalty cost are shown in Fig (3). The plots of inspection and repair cost have ascending trend. Contrary of them, the downtime penalty cost have decreasing trend. In riskless model, the optimal inspection interval obtain for 5 inspection frequencies and it's related to $\tau = \frac{2.4 + 4 \times 2.4 + 2.4}{6} = 2.4$ (Fig 3)

In table (6), the total expected risk based cost for different present of risk is presented. As indicated, with increasing risk ($\psi$) the optimal inspection interval is reduces.

In this case study, optimal inspection interval relate to a, b and c was equal. It due to its parameters. And in other case may be different. In the proposed model in this paper, the expected total cost risk based and riskless base associated to the soft component formulated in terms of finding optimal inspection interval time. Then, the expected cost is evaluated for different number of inspections in a cycle to identify the optimal one. Risk have critical role in maintenance and inspection interval. For transformer, failure of it is few. But, in practicality the shorter inspection intervals time has been selected. So, the optimization inspection interval risk based is so applicable.The model can be used in different problems where the assumptions made in the model are applicable.

## CONCLUSION

In the model proposed in this paper, the expected total cost associated to the soft component is formulated in terms of finding optimal inspection interval. Then, the expected total cost is evaluated for different number of inspections in a cycle to identify the optimal one. Risk have critical role in maintenance and inspection interval. For example, for transformer, failure of it is few. But, its inspection intervals time is usually short due to risk. So, the optimization inspection interval risk based is so applicable.In this study, applied the expert judgment to considering risk in inspection. As indicated in table (5), with increasing risk $\tilde{\psi}$ the optimal inspection interval time reduced. The model can be used in different problems where the assumptions made in the model are applicable.

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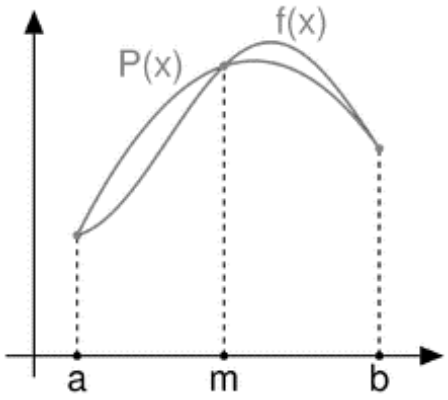


**Fig 1. The simpson's rule approximating**

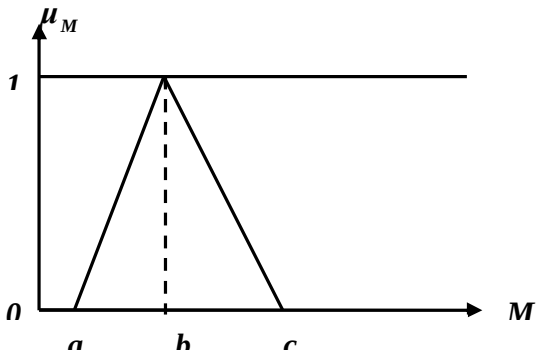


**Fig 2. Triangular fuzzy number (TFN)**

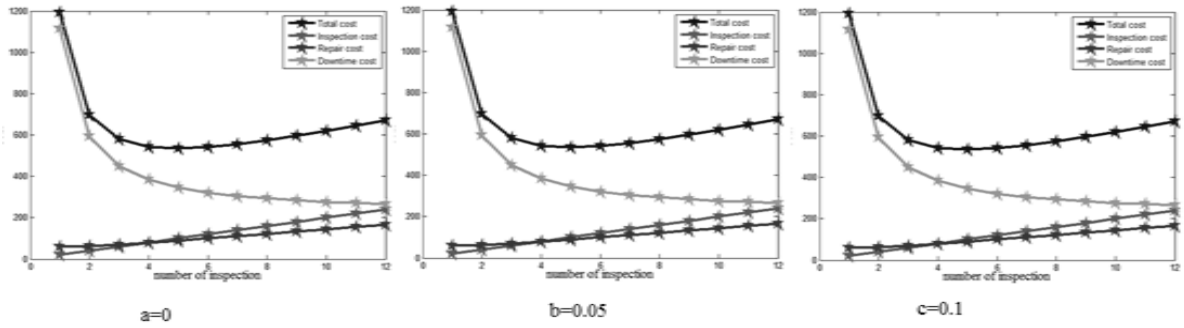


**Fig.3 The riskless costs resulting for different inspection frequencies $\tau$ =1, 1.0909, … , 12**

**Table.1.parameters and variables definitions.**

| | | | |
|---|---|---|---|
| $\tilde{\lambda}_1(x)$ | Thefuzzy average failure rate of the first component at time x | $C_1^s$ | The cost of each inspection of the first component |
| $\tilde{\lambda}_1^j(x)$ | Thefuzzy failure rate of the first component at time x, provided that the number of failures of the second component from the beginning of the planning horizon until time x is equal to j; j =0, 1,2, ... | $C_1^d$ | The cost of each perfect repair of the first component |
| $((k-1)\tau, k\tau]$ | kth inspection interval in the cycle T, k =1,2, ... , n | $C_1^p$ | The downtime penalty cost associated with the first component per each unit of elapsed time from the soft failure of the first component to its detection at the<br>Inspection time |
| $N_2(x)$ | A random variable representing the number of failures of the second component from the beginning of the planning horizon until time x | $\lambda_2$ | The failure rate of the second component |
| $\tilde{E}\left[C_1^T\right]$<br>$\psi$ | Thefuzzy expected total cost of the first component in the cycle T<br>Risk parameter | $\tilde{p}$ | Thefuzzy failure interaction from hard component to soft component. |
| $\tilde{E}\left[C_1^{(k-1)\tau, k\tau}\right]$ | Thefuzzy expected total cost of the first component in kth inspection interval of the cycle T, i.e. From a scheduled inspection at $k\tau$ over time period $((k-1)\tau, k\tau]$. | T | The planning horizon length (e.g. One year) which is known and fixed |
| $\tau$ | The time between two consecutive inspections, $\tau = T/n$ | n | The number of inspections to be performed on the first component during the cycle T |
| $\tilde{p}_\tau^k(t)$ | Thefuzzy probability that the first component dose doesn't fail in kth inspection interval of the cycle T with $\tau$inspection interval,provided that we know that its age at the beginning of the cycle T is equal to t and that it is not as good as new at that time | t | The initial age of the first component at the beginning of the cycle T |

**Table 2. Scale of $\tilde{p}$ , the ratioof first component's failure of the second component**

| Average | (0.45,0.50,0.55) | Negligible | (0,0.05,0.10) |
|---|---|---|---|
| Between average and relatively strong | (0.50,0.55,0.60) | Very very low | (0.05,0.10,0.15) |
| Relatively strong | (0.55,0.60,0.65) | Between very very low and very low | (0.10,0.15,0.20) |
| Between Relatively strong and strong | (0.60,0.65,0.70) | Very low | (0.15,0.20,0.25) |
| Strong | (0.65,0.70,0.75) | Between very low and low | (0.20,0.25,0.30) |
| Between strong and very strong | (0.70,0.75,0.80) | Low | (0.25,0.30,0.35) |
| Very strong | (0.75,0.80,0.85) | Between low and relatively low | (0.30,0.35,0.40) |
| Between very strong and very very strong | (0.80,0.85,0.90) | Relatively low | (0.35,0.40,0.45) |
| Very very strong | (0.85,0.90,0.95) | Between relatively low and average | (0.50,0.45,0.50) |

**Table 3.The $\tilde{p}_{\tau}^{k}(t)$ results for a=0, $\tau = 12, 6, 4, \ldots, 1$ and different k.**

| Inspection intervals | Sub-inspection intervals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | K=1 | K=2 | K=3 | K=4 | K=5 | K=6 | K=7 | K=8 | K=9 | K=10 | K=11 | K=12 |
| $\tau_{=12}$ | 0.2495 | | | | | | | | | | | |
| $\tau_{=6}$ | 0.67118 | 0.55495 | | | | | | | | | | |
| $\tau$ =4 | 0.82516 | 0.71054 | 0.58326 | | | | | | | | | |
| $\tau$ =3 | 0.89181 | 0.78693 | 0.70014 | 0.62057 | | | | | | | | |
| $\tau$ =2.4 | 0.92624 | 0.8364 | 0.76518 | 0.70061 | 0.64224 | | | | | | | |
| $\tau$ =2 | 0.94631 | 0.87078 | 0.80815 | 0.75269 | 0.70255 | 0.65673 | | | | | | |
| $\tau$ =1.7143 | 0.95905 | 0.89552 | 0.83945 | 0.78994 | 0.74534 | 0.70461 | 0.66709 | | | | | |
| $\tau$ =1.5 | 0.96765 | 0.91382 | 0.86344 | 0.81836 | 0.77773 | 0.74067 | 0.70653 | 0.67486 | | | | |
| $\tau$ =1.3333 | 0.97375 | 0.92771 | 0.88236 | 0.84095 | 0.8034 | 0.76912 | 0.73755 | 0.70824 | 0.68088 | | | |
| $\tau$ =1.2 | 0.97824 | 0.93847 | 0.89759 | 0.85939 | 0.8244 | 0.79235 | 0.7628 | 0.73536 | 0.70974 | 0.68569 | | |
| $\tau$ =1.0909 | 0.98163 | 0.94698 | 0.91003 | 0.87471 | 0.84198 | 0.8118 | 0.78391 | 0.75799 | 0.73378 | 0.71105 | 0.68961 | |
| $\tau$ =1 | 0.98428 | 0.95381 | 0.92032 | 0.88763 | 0.85691 | 0.82839 | 0.80192 | 0.77729 | 0.75425 | 0.73261 | 0.7122 | 0.69288 |

**Table 4. The $\tilde{p}_{\tau}^{k}(t)$ results for b=0.05, $\tau = 12, 6, 4, ..., 1$ and different k.**

| Inspection intervals | Sub-inspection intervals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | K=1 | K=2 | K=3 | K=4 | K=5 | K=6 | K=7 | K=8 | K=9 | K=10 | K=11 | K=12 |
| $\tau$=12 | 0.2374 | | | | | | | | | | | |
| $\tau$=6 | 0.66641 | 0.53326 | | | | | | | | | | |
| $\tau$ =4 | 0.82327 | 0.70161 | 0.56554 | | | | | | | | | |
| $\tau$ =3 | 0.8909 | 0.78236 | 0.69024 | 0.60416 | | | | | | | | |
| $\tau$ =2.4 | 0.92573 | 0.83371 | 0.75909 | 0.69021 | 0.62692 | | | | | | | |
| $\tau$ =2 | 0.946 | 0.86906 | 0.8041 | 0.74562 | 0.69193 | 0.64222 | | | | | | |
| $\tau$ =1.7143 | 0.95884 | 0.89434 | 0.8366 | 0.78487 | 0.73761 | 0.69391 | 0.65318 | | | | | |
| $\tau$ =1.5 | 0.96751 | 0.91299 | 0.86135 | 0.81457 | 0.77189 | 0.73249 | 0.6958 | 0.66141 | | | | |
| $\tau$ =1.3333 | 0.97365 | 0.92709 | 0.88078 | 0.83804 | 0.79885 | 0.76269 | 0.72904 | 0.6975 | 0.6678 | | | |
| $\tau$ =1.2 | 0.97816 | 0.938 | 0.89637 | 0.85709 | 0.82078 | 0.78718 | 0.75591 | 0.72661 | 0.69902 | 0.67291 | | |
| $\tau$ =1.0909 | 0.98158 | 0.94661 | 0.90906 | 0.87288 | 0.83904 | 0.80757 | 0.77823 | 0.75074 | 0.72485 | 0.70035 | 0.67709 | |
| $\tau$ =1 | 0.98423 | 0.95352 | 0.91954 | 0.88613 | 0.85449 | 0.82487 | 0.79718 | 0.77119 | 0.7467 | 0.72353 | 0.70153 | 0.68056 |

**Table 5.The $\tilde{p}_{\tau}^{k}(t)$ results for $c = 0.1, \tau = 12, 6, 4, ..., 1$ and different k.**

| Inspection intervals | Sub-inspection intervals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | K=1 | K=2 | K=3 | K=4 | K=5 | K=6 | K=7 | K=8 | K=9 | K=10 | K=11 | K=12 |
| $\tau$=12 | 0.22591 | | | | | | | | | | | |
| $\tau$=6 | 0.66169 | 0.51237 | | | | | | | | | | |
| $\tau$ =4 | 0.82139 | 0.69279 | 0.54825 | | | | | | | | | |
| $\tau$ =3 | 0.889 | 0.777 | 0.680 | 0.588 | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 99 | 82 | 46 | 1 | | | | | | | | |
| $\tau$ =2.4 | 0.925 22 | 0.831 04 | 0.753 04 | 0.679 94 | 0.611 9 | | | | | | | |
| $\tau$ =2 | 0.945 68 | 0.867 34 | 0.800 07 | 0.738 6 | 0.681 45 | 0.627 97 | | | | | | |
| $\tau$ =1.7143 | 0.958 64 | 0.893 17 | 0.833 77 | 0.779 82 | 0.729 96 | 0.683 35 | 0.639 53 | | | | | |
| $\tau$ =1.5 | 0.967 37 | 0.912 15 | 0.859 27 | 0.810 8 | 0.766 09 | 0.724 39 | 0.685 21 | 0.648 21 | | | | |
| $\tau$ =1.3333 | 0.973 54 | 0.926 47 | 0.879 21 | 0.835 13 | 0.794 33 | 0.756 31 | 0.720 62 | 0.686 93 | 0.654 97 | | | |
| $\tau$ =1.2 | 0.978 08 | 0.937 53 | 0.895 15 | 0.854 81 | 0.817 17 | 0.782 04 | 0.749 08 | 0.717 96 | 0.688 46 | 0.660 38 | | |
| $\tau$ =1.0909 | 0.981 52 | 0.946 24 | 0.908 1 | 0.871 04 | 0.836 11 | 0.803 36 | 0.772 59 | 0.743 55 | 0.716 02 | 0.689 82 | 0.664 8 | |
| $\tau$ =1 | 0.984 18 | 0.953 23 | 0.918 77 | 0.884 63 | 0.852 07 | 0.821 37 | 0.792 45 | 0.765 13 | 0.739 23 | 0.714 57 | 0.691 03 | 0.668 48 |

**Table 6. The inspection interval for different present of risk.**

| | $\psi = 0$ | $\psi = 0.1$ | $\psi = 0.2$ | $\psi = 0.3$ | $\psi = 0.4$ | $\psi = 0.5$ | $\psi = 0.6$ |
|---|---|---|---|---|---|---|---|
| *a=0* | *2.4* | *2* | *1.714* | *1.5* | *1.3* | *1.2* | *1* |
| *b=0.05* | *2.4* | *2* | *1.714* | *1.5* | *1.3* | *1.2* | *1* |
| *c=0.1* | *2.4* | *2* | *1.714* | *1.5* | *1.3* | *1.2* | *1* |
| *Final inspection interval** $= \frac{a+4b+c}{6}$ | *2.4* | *2* | *1.714* | *1.5* | *1.3* | *1.2* | *1* |

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RESEARCH ARTICLE

# A New Low-Power CMOS 5Gb/s Optical Receiver for Optical Communication Systems

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## ABSTRACT

In this paper, a new CMOS optical receiver IC consists of a transimpedance amplifier (TIA) and limiting amplifier (LA) in 1.5V supply is presented. A combination of modified RGC circuit with active inductor as a load and a diode connected load is used to effectively extend the frequency bandwidth of the receiver. Furthermore, four stages of differential limiting amplifier are used to increase the output swing where the inductive peaking techniqueis used to extend the frequency bandwidth. However, the proposed optical receiver circuit is simulated in HSPICE using 0.18µm CMOS technology parameters. Finally, as simulation results show, the proposed optical receiver consumes 7.718 mW in a 3.5GHz bandwidth and 80 dBΩ of gain with the input referred noise value of 8.6pA/√Hz.

**Keywords**: Transimpedans amplifier, limiting amplifier, optical receiver, low-power, CMOS.

## INTRODUCTION

In the recent years, optical communications has become more and more applicable for long haul data transmission due to the greater frequency bandwidth in a reduced attenuation, interference and lower costs [1]. Furthermore, because of rapid advances in CMOS technology and fabrication, CMOS integrated circuits attracted the most attention of IC designers due to the highly integration and cost-effective capabilities. However, as it is shown in fig.1, an optical communication system consists of three different parts titled as: transmitter, fiber optic and receiver.The transmitterconverts an electric signal to an optic signal which travels to the receiver via fiber optic media.The photo detector in the receiver, converts the optic signal to an electric signal [3].

Figure 2, shows the block diagram of an optical receiver [4]. The optical receiver consists of a high-speed photo detector, a transimpedance amplifier (TIA) and a limiting amplifier (LA). The TIA converts the output current of photodiode to an amplified voltage signal which is fed to the LA for further amplification. So, a TIA circuit requires high gain and bandwidth while, it should be a low-noise circuit. Giving the above facts, design of an optimized TIA circuit is a challenging and time consuming task. Another problem in the TIA design process is the large photo detector's capacitance which considerably limits the frequency bandwidth [5]. However, the power consumption is another challenge in the design of analog integrated circuits, while, the inherent conflict between the gain and bandwidth of the amplifier makes the design of low-power and high-frequency analog amplifiers more and more complex due to the fact that, higher frequency bandwidth leads to the increased noise value and power consumption as well as lower gain.

However, due to the fact that optical receivers require high-gain and high-speed (frequency bandwidth) amplifiers, the power consumption increases if cascaded amplifiers are used [6, 7]. The problem will be more complex if low supply voltage and bias currentsare used.

As it is reported in literature [8-10], different techniques can be used to extend the frequency bandwidth. So, in this paper, a new TIA using modified regulated cascode (RGC) and inductive peaking techniques to extend the frequency bandwidth of TIA is proposed and simulated in HSPICE using 0.18µm CMOS technology parameters. This paper is organized as follows: the proposed TIA and LA circuits are presented in section 2, while, the circuit simulation results and discussions are presented in section 3. Finally, some conclusions are presented in section 4.

**The proposed optical receiver**
**Transimpedance amplifier (TIA)**

As it is discussed before, a TIA converts the weak output current of the photo detector to an amplified voltage signal as it is shown in fig.3.

As it is discussed above, photodiode capacitance is the major factor which limits the frequency bandwidth of the TIA, so, the common-gate (CG) stage will be a proper solution to improve the bandwidth [1]. As it is shown in fig.4.1, a CG stage has a low value of input impedance (1/gm) [11].

So, a regulated cascode(RGC) structure which is an improved form of conventional CG stage has a higher bandwidth as well as lower power consumption [12-15].

As it is obvious in fig.4.2, the RGCcircuit has a lower input resistance value of 1/gm1(1+gmbRb) in comparison with other conventional designs. A RGC circuit consists of a CG structure with an active feedback (MB, RB) so that, the input resistance will decrease proportional to the value of feedback circuit. However, as the input resistance decreases, the pole associated to the input increases which leads to a higher frequency bandwidth as it is obvious in eq.(1) [16]:

$$f_{-3dB} = \frac{1}{1+SR_1\left\{\left(1+\frac{g_{m1}}{g_{mB}}\right)C_{gd1}+(C_{db1}+C_L)\right\}} \quad (1)$$

Furthermore, the inductive peaking technique can be used to extend the bandwidth without the requirement of increasing the power consumption [17-19]. In this method, by using an active inductor as a load to the structure of TIA, the inductor and parasitic capacitances will resonate which considerably extends the -3dB bandwidth of the amplifier. The basic concept of the active inductor is shown in fig.5. Considering eq.(2), by tuning the pole and zero frequencies of $Z_{out}$ in the range of (zero<W<pole), it is possible to design an active inductor $z_{out}$ which is necessary for bandwidth extension due to the fact that, physical spiral on chip inductors occupy a large on chip silicon area while active inductors have a reduced chip area as well as less parasitic capacitances [21].

$$Z_{out} = \frac{1+SR_SC_{gs}}{g_m(1+S\frac{1}{g_m}C_{gs})} \begin{cases} Zero = -\frac{1}{R_SC_{gs}} \\ Pole = -\frac{g_m}{C_{gs}} \end{cases} (2)$$

So, fig.6, shows the circuit structure of the proposed TIA.

This circuit is a modified RGC block which is used due to the low-voltage, low input impedance and high bandwidth characteristics in which the inductive peaking is used to further extend the bandwidth of the circuit. Also, $M_D$ which is a diode connected transistor, acts as bandwidth extension technique, while, M2, M3 which form a push pull stage, are used to compensate the reduced gain by diode connected load. Furthermore, $M_f$ operates as a negative feedback which limits the input referred noise value to improve the noise-bandwidth performance of the proposed circuit. However, in conventional RGC circuit as it is shown in fig.4.2, the bandwidth of the amplifier is limited due to the gate-drain capacitance located between drain node of $M_B$ and the input node. So, to solve the mentioned problem, transistor $M_{B2}$ is cascoded between the output of the common-source amplifier and the gate of $M_1$. So, the modified circuit has a bandwidth of eq.(3) [11]:

$$f_{-3dB} = \frac{1}{1+SR_1(C_{gd1}+C_{db1}+C_L)} \quad (3)$$

By comparing eq.(1) and eq.(3), it is obvious that the modified RGC has an increased frequency bandwidth in comparison with conventional RGC circuit.Furthermore, the inductor (L) is located in series with the load resistance of the modified RGC circuit to resonate with parasitic capacitances and extend the bandwidth of the modified amplifier. However, in the proposed circuit the inductor (L) as well as the resistances are replaced by the MOSFET transistors in linear region which presents a fully CMOS scheme.
The transimpedance gain is given by (6):

$$A_{V1} = \frac{V_0}{I_{pd}} = \frac{R_1}{\left[1+S\frac{C_{pd}+C_{sb_1}+C_{gs_{B1}}}{g_{m_1}\left[1+g_{m_{B1}}\left[r_{o_{B1}}\left(\left(g_{mb_{B2}}+g_{m_{B2}}\right)r_{o_{B2}}+1\right)\|r_{o_B}\right]\right]}\right]\times\left[1+S(C_L+C_{gd1}+C_{db1})\frac{1}{g_{m_L}}\right]} (4)$$

$$A_{V2} = \frac{g_{m3}+g_{m4}}{g_{m_D}} (5)$$

$$A_V = \frac{A_{V1}A_{V2}}{1+R_FA_{V1}A_{V2}} \quad (6)$$

**The proposed limiting amplifier (LA)**

The main objective of a limiting amplifier, is to increase the output voltage swing of the load stage independent of the input TIA current [3]. In order to eliminate the supply noise, the fully differential structures are used as LA stages which consists of cascoded fully differential amplifier stages as it is discussed in [22-30]. The block diagram of a typical LA stage is shown in fig.7.

In this approach, due to the low DC voltage at the output node of TIA stage, the input transistors of LA stage should operate in low DC voltage conditions. However, the proposed LA circuit is shown in fig.8.
In this circuit, the inductive peaking technique is successfully used to extend the bandwidth of the limiting amplifier by adding the active inductors in series with load resistances which resonate with parasitic capacitances to increase the -3dB cut-off frequency without the requirement of increasing the power consumption.

In the proposed circuit structure, to have a proper value of voltage gain, four cascaded LA stages are used.
Fig.9, shows a fully CMOS scheme of the proposed LA circuit in which the active inductors as well as the load resistances are implemented using MOSFET transistors.

In figure 9, the active inductor consist of PMOS transistors M3, M4 and PMOS resistors as R1, R2. The voltage gain of each cell is given by (7).

$$A = \frac{g_{m1}}{gm_3} \frac{1 + SR_1\left(C_{gs3} + C_{gd3}\right)}{1 + \frac{s\left[g_{m3}R_1C_{gd3} + \left(C_{gs2} + C_L\right)\right]}{g_{m3}} + S^2R_1\left[CL\left(C_{gs3} + C_{gd3}\right) + C_{gs3}C_{gd3}\right]g_{m3}} \quad (7)$$

In this circuit the impedance of the inductor ($Z_L$) which isseen from the sources of M3, M4 can be approximated by (8) :

$$Z_L \cong \frac{1 + sR\left(C_{gs3} + C_{gd3}\right)}{g_{m3} + s\left[g_{m3}RC_{gd3} + \left(C_{gs3} + C_L\right)\right]} \quad (8)$$

Where$C_{gs3}$, $C_{gd3}$and $C_L$ are the gate-source, gate-drain andload capacitances. $g_{m3}$is the transconductance of the transistor M3 and R is the PMOS resistance.In this case the transfer function has two poles $P_1$, $P_2$ and zero $Z_P$. By setting the zero to $P_1$, $P_2$becoms the dominant pole and improves the bandwidth.

$$P_1 \approx \frac{g_{m3}}{g_{m3}R_1C_{gd3} + \left(C_{gs3} + C_L\right)} \quad (9)$$

$$P_2 \approx \frac{g_{m3}R_1C_{gd3} + \left(C_{gs3} + C_L\right)}{R_1\left[C_L\left(C_{gs3} + C_{gd3}\right) + C_{gs3}C_{gd3}\right]} \quad (10)$$

$$Z_p = \frac{1}{R_1\left(C_{gs3} + C_{gd3}\right)} \quad (11)$$

## SIMULATION RESULTS

The proposed circuit is simulated in HSPICE using 0.18µm CMOS technology parameters. Fig.10, shows the frequency response simulation result of the proposed TIA circuit. As it is obvious in fig.10, the proposed TIA circuit has a gain of 59.7dBΩ in a 3.54GHz bandwidth. Furthermore, fig.11, shows the frequency response simulation result of the whole proposed optical receiver which shows a 80 dBΩ gain in a 3.5GHz bandwidth, while, the optical receiver consumes only 7.718 mW power in a 1.5V supply voltage.

Furthermore, in order to analyze the effect of fabrication process variations as well as the variations in transistor dimensions, Monte-Carlo analyzes are done considering the transistor dimensions as the main design variables. Fig.12, shows the Monte-Carlo analyses simulation results of the proposed TIA circuit while, fig.13, shows the Monte-Carlo analyzes simulation results of the optical receiver. As it is obvious in figures 12,13, transistor dimensions variations have not a considerable effect in the frequency response (gain, bandwidth) of the proposed optical receiver IC, which is another advantage of the proposed circuit.Moreover, in order to justify the quality of the output transient signal, the eye diagram is presented in fig.14, which is obtained from simulations in 5Gb/s bit-rate for a 100µA input signal. As it is obvious from the eye diagram in fig.14, the output signal has a good quality which justifies the proper transient performance of the proposed optical receiver circuit which can be successfully used in a5Gb/s optical communication system.However, in order to compare the performance of the proposed circuit with previously reported designs, the performance measures of the proposed design such as: gain, bandwidth, power consumption are summarized in table.1 and table.2, where they are compared with the values of previously reported designs. Due to the inherent conflict between some performance measures such as: gain-bandwidth and power consumption, a figure of merit (FOM) parameter is defined foreffectively comparison between the designs.

## CONCLUSION

In this paper, a new low-power, 5Gb/s optical receiver consists of a TIA and four cascaded stages of LAs is presented. The proposed TIA circuit uses a new modified RGC circuit as the proposed TIA stage which benefits from the inductive-peaking technique to extend the frequency bandwidth as well as a push pull amplifier with a diode-connected load as a TIA stage. Furthermore, four stages of fully differential LA stages are used for further amplification of the output signal of TIA circuit. However, the TIA circuit and the proposed optical receiver have the gain values of 57.9 dBΩ and 80 dBΩ respectively while they have 3.54GHz and 3.5GHz bandwidth respectively. Furthermore, as it is discussed in the paper, the proposed circuit has a better performance considering a figure of merit (FOM) due to the inherent conflict between gain-bandwidth and power consumption in comparison with previously reported designs.

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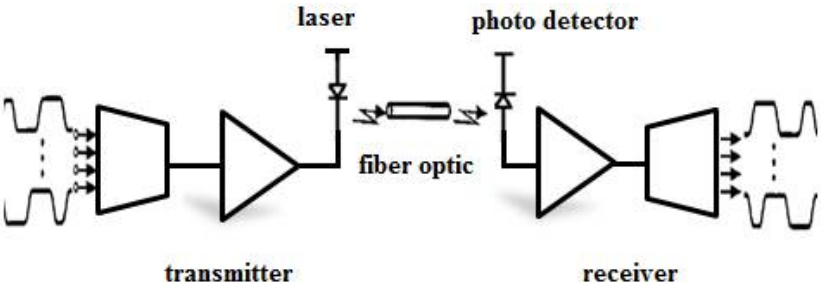


**Fig.1.Block diagram of an optical communication system**

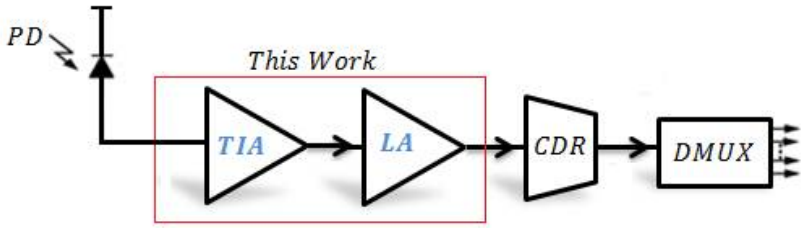


**Fig.2.Block diagram of an optical receiver**

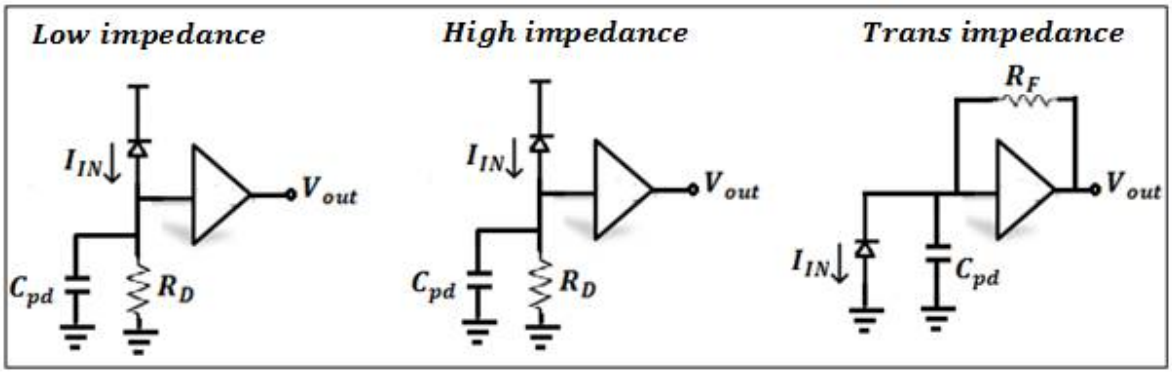


**Fig.3.Preamplifier configuration**

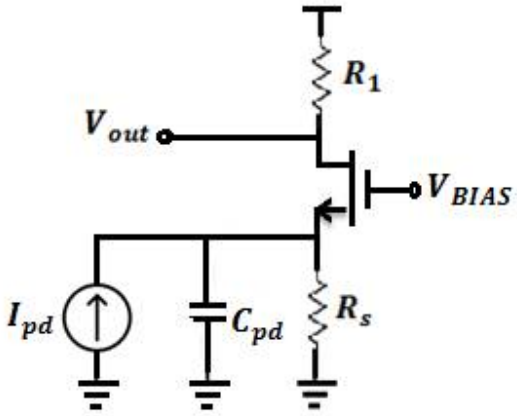


**Fig4.1CG stage**

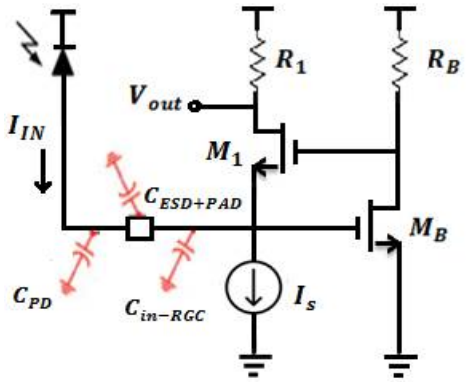


**Fig4.2 RGC circuit**

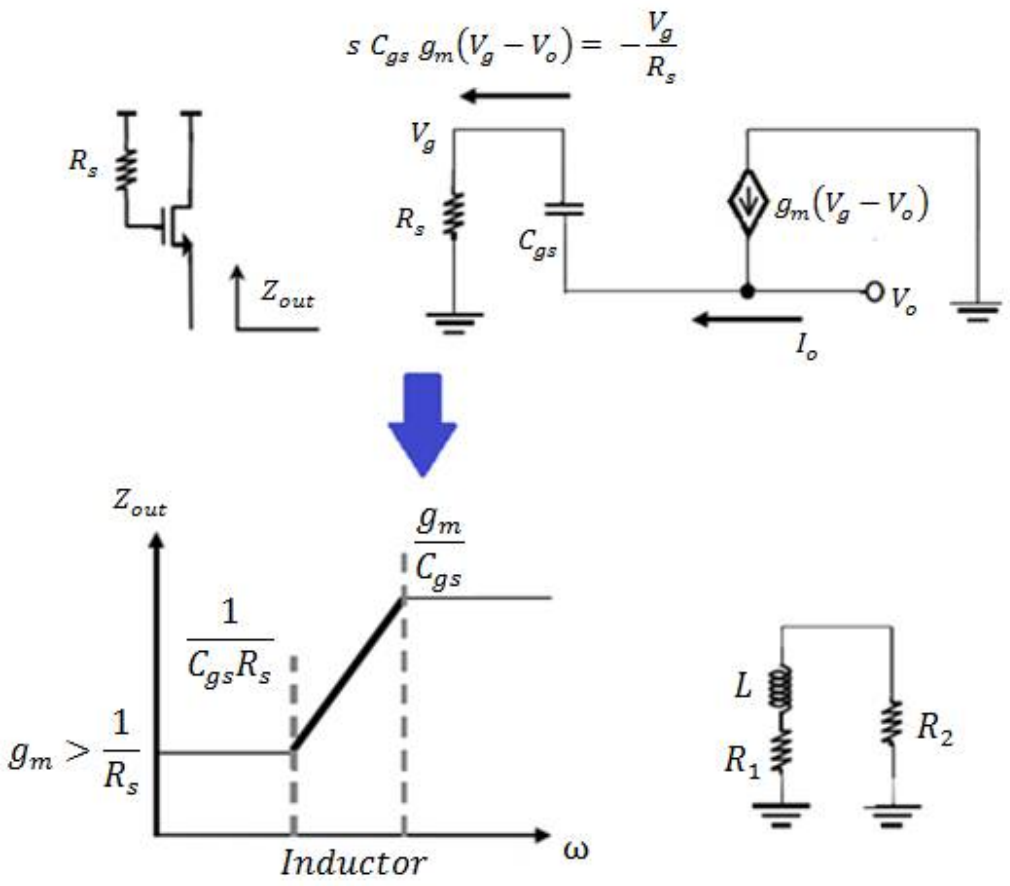


**Fig.5.Active inductor**

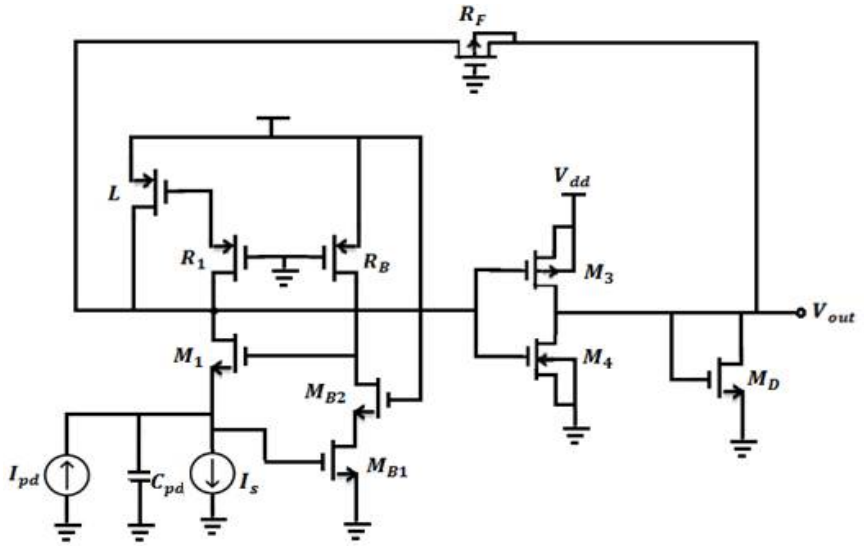


**Fig.6.Circuit schematic of the proposed TIA**

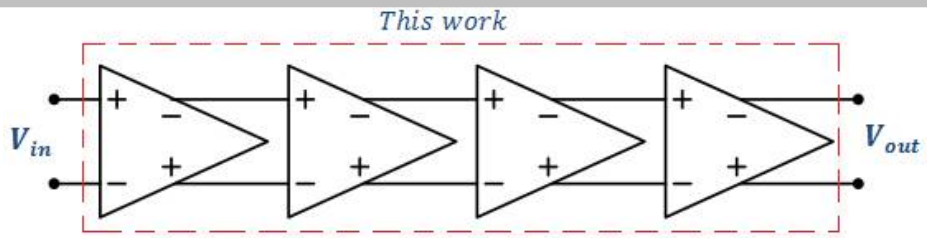


**Fig.7.Block diagram of a typical LA stage**

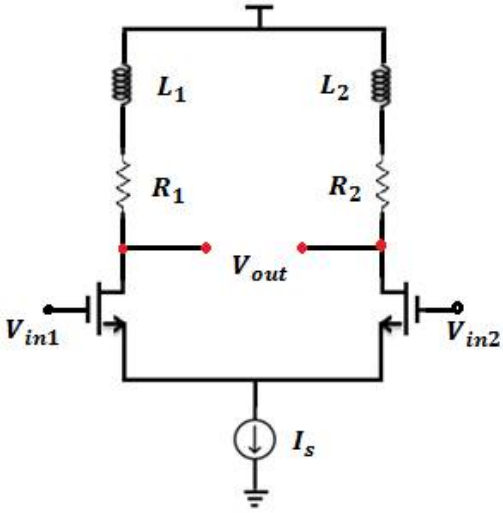


**Fig.8.Proposed LA circuit**

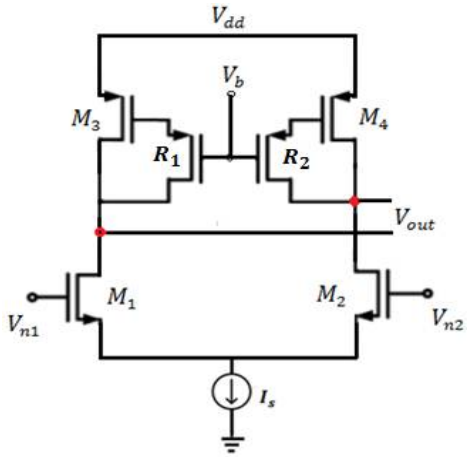


**Fig.9.Fully CMOS scheme of the proposed LA circuit**

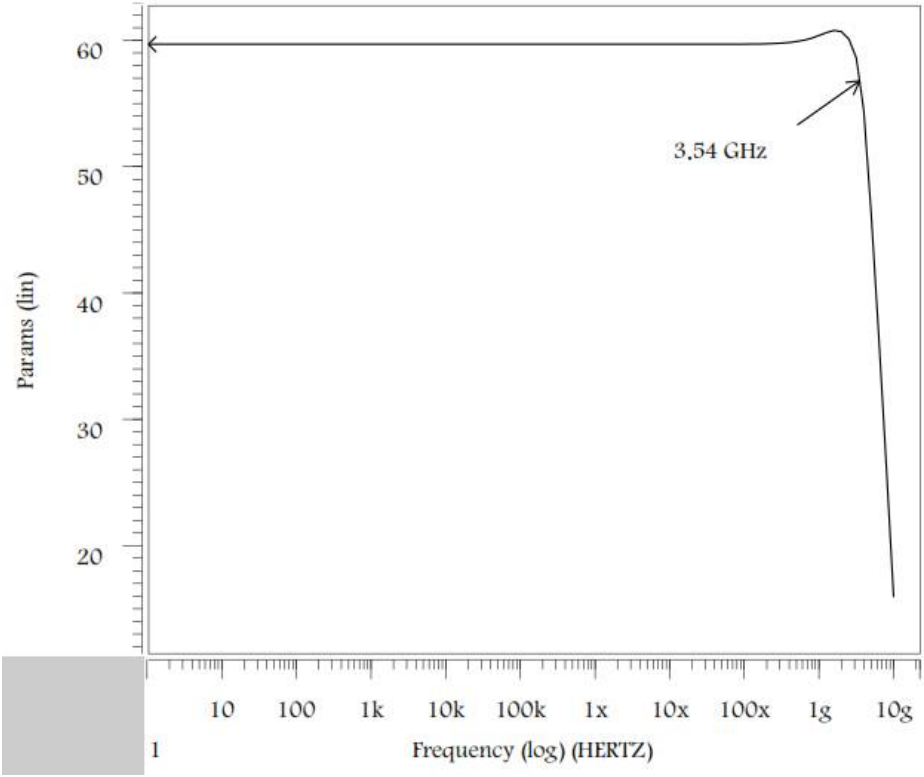


**Fig.10.Frequency response simulation result of the proposed TIA circuit**

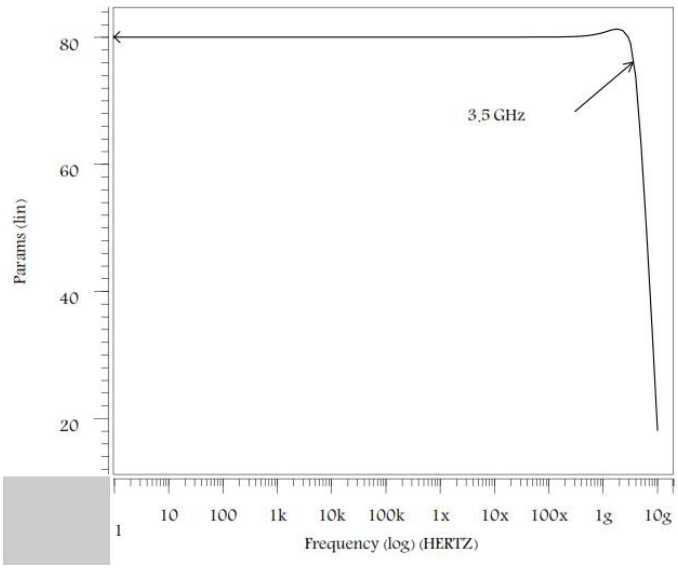


**Fig.11. Frequency response simulation result of the whole proposed optical receiver**

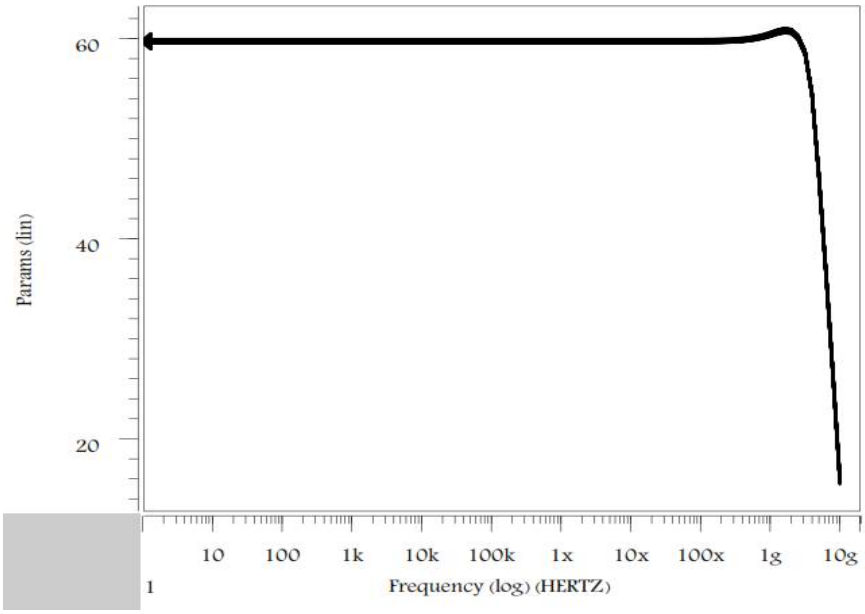


**Fig.12.Monte-Carlo analyses simulation results of the proposed TIA circuit**

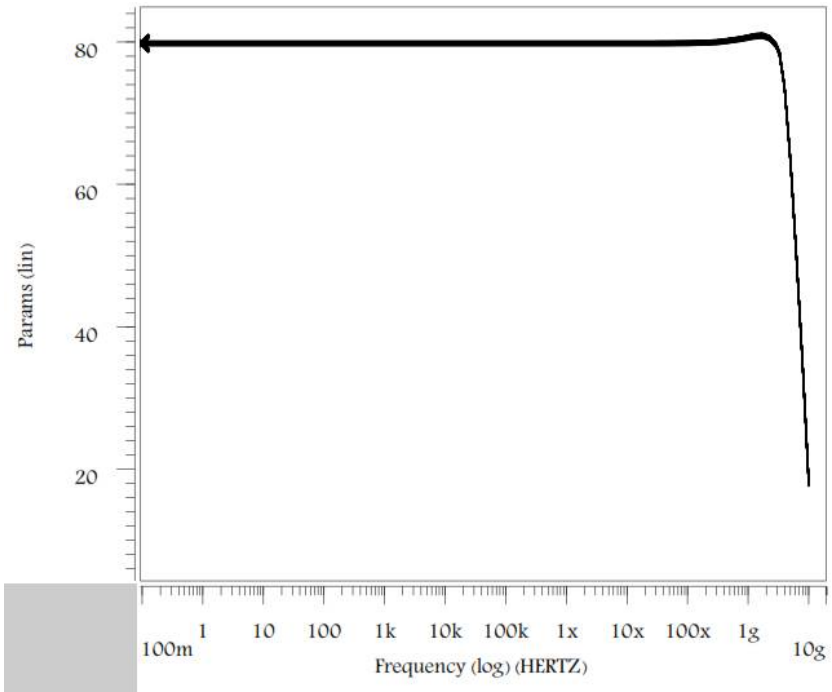


**Fig.13.Monte-Carlo analyzes simulation results of the optical receiver**

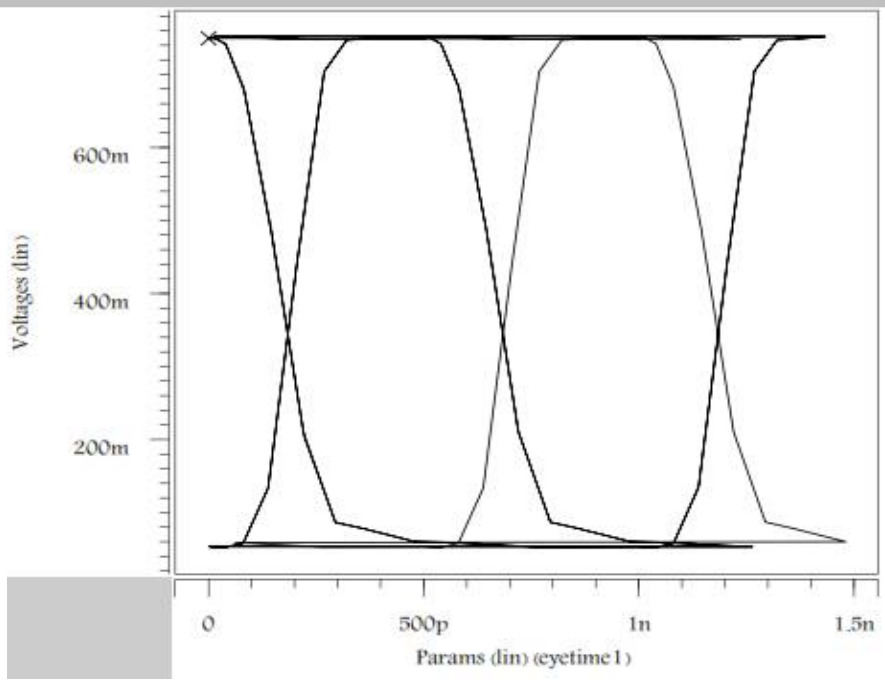


**Fig.14.Eye diagram**

**Table1.Performance Comparison Of Several Transimpedanc Amplifier**

| Ref. | [8] | [11] | [14] | [20] | [21] | [30] | This work |
|---|---|---|---|---|---|---|---|
| Process Technology ($\mu m$) | 0.13 | 0.18 | 0.6 | 0.13 | 0.35 | 0.04 | 0.18 |
| Supply Voltage (V) | 1.8 | 1.8 | 5 | 1.5 | 3 | 1 | 1.5 |
| Gain (dBΩ) | 64.5 | 64.8 | 58 | 57 | 54.5 | 78 | 57.9 |
| Power (mW) | 3.78 | 3.5 | 85 | 1.8 | 22.5 | 4.1 | 0.818 |
| BW (GHz) | 1.05 | 4.5 | 0.86 | 8 | 2.5 | 1.5 | 3.54 |
| $C_{in}$ (pF) | 0.2 | 0.2 | 1 | 0.37 | 0.5 | 0.5 | 0.2 |
| Input Referred Noise (pA/sqrtHz) | - | 13.7 | 6.3 | <30 | - | 7.2 | 7.761 |
| $\frac{FOM = Gain \times BW}{Power}$ | 17.91 | 83.31 | 0.58 | 253.3 | 6.05 | 28.53 | 250.56 |

**Table2.Performance Comparison of Several Optical Receivers**

| Ref. | [25] | [26] | [27] | [28] | [29] | This Work |
|---|---|---|---|---|---|---|
| Process Technology | 130 | 180 | 180 | 130 | 180 | 180 |
| Supply Voltage (V) | - | 1.8 | - | - | 1.8 | 1.5 |
| Gain (dBΩ) | 105 | 58.7 | 123.6 | 111 | 80 | 80 |
| Power (mW) | 74.2 | 47 | 183 | 58.5 | 183 | 7.718 |
| BW (GHz) | 3.15 | 3.5 | 3.5 | 3.85 | 3.5 | 3.5 |
| $FOM = \frac{Gain \times BW}{Power}$ | 4.45 | 4.37 | 2.36 | 7.3 | 1.53 | 36.27 |

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RESEARCH ARTICLE

# Prediction of Sardine Landings using Merged Chlorophyll-a (SeaWiFS), Pathfinder SST and SeaWiFS PAR

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## ABSTRACT

In this study Artificial Neural Network (ANN) models were developed to predict 12 month ahead monthly Sardine landings was analyzed for Tamil Nadu ( Nagapattinam dt) coast, India, considering previous 60 months (Short Time Series STS) Sardine catches as inputs to the models. For this study a total of 14 Neural Network Models (NNM) were developed with Time Series of ocean colour parameters such as Chlorophyll-a (CHL), Sea Surface Temperature (SST) and Photosynthetically Active Radiation (PAR) as dependent variable for the target of Sardine catch time series in the study area. The outputs from seasonal and Non-Seasonal models were compared and the seasonal models were out performed Non-Seasonal models in prediction. The NNM STS_MER_SAR_SST_S model ($R^2$ between the predicted and observed landings is about 0.9594) is performed well when compare to other Seasonal, Non-Seasonal Univariate and Multivariate Neural Network models. This study demonstrates that the ocean colour parameters Chlorophyll-a, Sea Surface Temperature and Photosynthetically Active Radiation can be used in the study area on Sardine landing prediction. In general, seasonal ANN exhibits good performance in prediction of Sardine catch landings when compare to Non-Seasonal ANN architecture.

**Keywords: C**hlorophyll-a, Sea Surface Temperature, Photosynthetically Active Radiation. and Neural Network.

## INTRODUCTION

In India, fish catch Time Series (TS) are available with the data banks of different organizations like Central Marine Fisheries Research Institute (CMFRI) and Fishery Survey of India (FSI). But, ocean environmental parameter's Time Series for a specific area is not readily available in India. Since the advent of satellite remote sensing and its rapid expansion, which leads to deploy ocean colour remote sensors for dedicated ocean colour parameters, satellite derived data on SST, CHL and PAR are available for last two decades in the form of Global Area Coverage (GAC). In this context, the availability of global, daily, systematic, high resolution images obtained from satellites has been a major data source for explaining the relationships between exploited marine organisms and their habitat (Polovina and Howell 2005; Dulvy et al 2009). For that continuous archiving of satellite remotely sensed ocean parameters to a specific region are necessary to discuss the distribution, abundance and migration of fishes.

Since from 1978, (launch of CZCS) remote sensing has played an important role in both the management and utilization of marine fisheries. Although the Sea Surface Temperature based time series are available from 80's, the CHL and PAR time series are available for research only from the year 1997 (launch of Sea-viewing Wide Field of view Sensor (Sea WiFS). Apart from long time trends and seasonality, effective prediction may be accounted with short term impact on the study area . Estrada et al (2008) reported that short-medium time period prediction/ forecast of a TS is necessary to frame the usefulness of any model. For STS preparation the TS period is from 2005 to 2010. The reason for considering 2005 is that, the study area Nagapattinam was heavily affected by tsunami in the year 2004. Hence in this study TS for the above three parameters are created from the year 2005. Further, the conventional fisheries management has focused mainly on single species univariate approach, from there, now it has shifted to ecosystem based approaches for fisheries management practices. So, the CHL, SST and PAR TS were considered from the year 2005 for the development of ecosystem based Multivariate ANN analysis.

The traditional Auto-Regressive Integrated Moving Average (ARIMA p,d,q) models following Box- Jenkinson methodology with Multiple Linear Regression (*MLR)* normally used for obtaining wide variety of fisheries TS predictions. Monthly fish catch landings are generally nonlinear, which is not predicted effectively by –ARIMA models. However, to some extent it is efficient in modelling Linear phenomena in describing and predicting the fisheries TS of with a wide variety of species (Saila et al 1980), Hae-Hoon Park (1998), Stergiou KI (1996), Sathianandan (1995), Venugopalan (1998)). Hence Artificial Neural Network (ANN) modelling has been chosen in this study for prediction of Sardine landings. The advantage of ANN over MLR models is the ability of ANN to directly take into account any non-linear relationships between the dependent variables and each independent variable. Several authors have shown better performances of ANN as compared to the MLR (Ehrman et al 1996; Lek et al 1996; Scardi 2001) in prediction capability.

## MATERIALS AND METHODS

### Study area

The study area Nagapatnam coastal district is situated (white in color) in Tamil Nadu, eastern part in Bay of Bengal covering a coast line length of 190 km. Figure.01 explains the schematic representation of Nagapatnam district falls in the latitudinal and longitudinal extensions between 10°46′1.2″N and 79°49′58.8″E on the Eastern part of Bay of Bengal. The movement of fishermen and for the extraction of Sea Surface Temperature, Chlorophyll-a and Photosynthetically Active Radiation in Bay of Bengal, a seaside limit of 1000 m isobath was created and it is shown in the flowchart in the figure 03. The minimum and maximum temperatures in the study area are 20°C and 34°C. This district comprises of five coastal taluks that is Nagapattinam, Sirkazhi, Tarangampadi, Mayiladuturai and Vedaranniyam.

**Artificial Neural Networks**

There are so many different ways to forecast nonlinear phenomena, among them Neural Networks is the best efficient method to get forecast information from a nonlinear time series (Lin sun et.al 2009). There by the applications of neural networks to landings time series forecasting have become very popular over the last few years, since most of the landings time series are in nonlinear pattern. Neural networks are simple nonlinear computing units and just imitating human neural system has an input layer, a hidden layer and an output layer. Layers in between input and output layers are generally called as hidden layers and commonly referred as neurons. When data is loaded in the ANN (Artificial Neural Network), it must be preprocessed from its numeric range into the numeric range that the ANN can deal with efficiently to improve the efficiency of the learning results (Kim and Lee, 2004). Figure 02. Explains the schematic representation of three layers NNM involved in this study.

**Fishery data**

For the preparation of Time Series (TS) data all sardine (14 species) monthly landing details were obtained from the Central Marine Fisheries Research Institute (CMFRI) Cochin, database. The period considered for Sardine TS is from 2005 to 2010, out of which the CMFRI data pertains to the period 2005-2009. For validation purpose, fish catch data for the year 2010 from fish landing centers were collected. Standardization of commercial catches through Catch Per Unit Effort (CPUE) could provide a powerful method for estimating trends in the stock abundance. Unfortunately, there were many aspects of fishermen's behaviour that will cause CPUE to be not proportional to abundance even on a very small spatial scale (Hilborn and Walters 1992). So, for this study, Sardine landing details are considered instead of CPUE for the preparation of fish landing TS. The data were collected by qualified and well-trained technical staff of CMFRI by following stratified multi-stage random sampling technique, in which the Sardine landings were recorded by covering landing centers along the Nagapattinam coast. The catch data for the year 2010 (on monthly basis) were collected in entire Nagapattinam coastal area from all forty four landing centers physically with the help of Department of Fisheries, Officials. A team of fourteen local fishermen were engaged to cover the entire 44 fish landing centers for the collection of fish catch data. This data is used for testing and validating NNM predicted fish catch.

**Satellite data**
**Chlorophyll-a concentration**

The primary function of Chlorophyll-a is photosynthesis of marine algae in the ocean, which is the main food for Sardine larvae and that availability of food during the critical developmental period of Sardine larvae determines the year class of Sardine population is important for Sardine availability in Bay of Bengal. So Chlorophyll-a in Bay of Bengal is considered in the prediction models in this study. SeaWiFS level 3 standard binned images archived by the Ocean Biology Processing Group (OBPG) were used to estimate sea-surface chlorophyll-a concentrations. These data were obtained from the http://oceancolor.gsfc.nasa.gov/cgi/l3. We used Global Area Coverage (GAC) monthly composite SeaWiFS images with a spatial resolution of about 9 km_9 km for the period from January 2005to December 2010.

**Sea Surface Temperature (SST)**

In Sardine life cycle Sea Surface Temperature is an important factor which leads the Sardine activity levels to increase or decrease, makes Sardines move into certain areas, and influences feeding and reproductive activity. Temperature data are of interest to those who wish to catch fish or study them. Since the Sardine is a tropical fish we need to understand how temperature affects fish behaviour. So Sea Surface Temperature also considered as one of the main environmental factor in the Sardine landing prediction which is normally preferring temperature range of 27°to29°C(Chidambaram,1950)TheNOAApathfinderdatapresentedinftp://podaac.jpl.nasa.gov/allData/avhrr/L3/pathfinder_v5/monthly/ data were used to study SST for the same period having the same spatial resolution along with chlorophyll data.

**Photosynthetically Active Radiation (PAR)**

Photosynthetically Active Radiation (PAR) is the amount of light available for photosynthesis, which is defined as the quantum energy flux from the Sun light in the 400 to 700 nanometer wavelength range. Since the Sardines are herbivores Photosynthetically Active Radiation Also considered as one of the biophysical parameter. PAR changes seasonally and varies depending on the latitude and time of day. This data set consists of algorithm estimates of global Photosynthetically Active Radiation (PAR) reaching the surface obtained by the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), in orbit on the OrbView-2 (formerly SeaStar) platform. SeaWiFS data products are processed and distributed by the Ocean Biology Processing Group (OBPG). For this study SeaWiFS Level 3 monthly Binned data files are downloaded from the FTP site at http://oceancolor.gsfc.nasa.gov/cgi/l3 having 9 km spatial resolution.

**Image processing**

Monthly mean CHL, SST and PAR images for the entire period were downloaded, processed and extracted in BEAM software developed by European Space Agency(ESA). BEAM is an open-source toolbox and development platform for viewing, analyzing and processing of remote sensing raster data. BEAM supports a number of raster data formats such as GeoTIFF, HDF and NetCDF as well as data formats of other EO sensors such as *Moderate Resolution Imaging Spectroradiometer* (MODIS) and *Advanced Very High Resolution Radiometer(AVHRR).*The remote sensing data extracted for this study was in both NetCDF and HDF format, which is supported by BEAM software. The CHL, SST and PAR products were clipped for the study area and the same is processed and spatially averaged as point data for each polygon for this TS preparation. The procedure to create and extract for the 1000m isobath shape file for the study area is explained in detail in the flow chart shown as Figure . 3. In India previous studies on monthly CHL extraction have been performed with 200m isobath to get monthly averaged surface CHL for fisheries studies along the waters of the southwest coast of India George et al (2012). However because of multiday fishing activity and their ability to move form continental shelf area to continental slope area for fishing, a 1000m isobath has been considered in this study. Same 1000m isobath vector files were created for all coastal district of all Tamil Nadu to extract monthly mean information for all the three oceanographic biophysical environmental parameters for the same period.

The extracted satellite derived environmental parameters CHL, SST & PAR values are spatially averaged for the preparation of Short Time Series for the period 2005 to 2010. The fishermen from Nagapattinam district and particularly those who use trawlers are involved in multiday fishing activity. They move out from the Nagapattinam district boundary up to Tiruvallur district in the northern side and Ramanathpuram district in the southern side. Hence, the spatially averaging of all three environmental variable values was created for all districts to derive monthly mean values. Sardine landing Short Time Series (STS) of Nagapattinam district, from the year 2005 to 2009 are obtained from CMFRI are considered as input in this study. The year 2010 Sardine landing data are collected from the landing centers and placed as target in this study

.

## METHODOLOGY

The time series of Nagapatnam district Sardines monthly landings were normalized from zero to one by simply dividing the real value by the maximum of the appropriate set because of their nonlinearity. The time series belongs to Photosynthetically Active Radiation (PAR) is kept as such, since they are having only seasonal influences on it. The in-situ Sardine landing time series collected for the year 2010 January to December in all the landing centers of Nagapatnam district. The spatially averaged PAR value extracted from images of Thiruvallur District to Ramanathapuram District. The Sardine landings time series modeled in Matlab (R2012a) Neural Networks to get the prediction values for the year 2010 and compared with the insitu catch data. In this NN function the PAR parameter up to 2005- 2009 as input against the year 2010 as target to model to predict the Sardine monthly catch for the year 2010 to Nagapatnam area.

**Methods of evaluation**.

Several measures of accuracy were calculated in the calibration between model output and observed value. A measure of correlation between the observations and the predictions is the coefficient of correlation (R). The proportion of the total variance in the observed data that can be explained by the model was described by the coefficient of determination ($R^2$). The estimators to quantify the errors in the same units of the variance were the square root of the mean square error (RMSE), and the mean absolute error (MAE). On the other hand other measures of variance were the Coefficient of Efficiency (E2) (Nash and Sutcliffe, 1970; Kitanidis and Bras, 1980), the Average Relative Variance (ARV) (Grin o. R. 1992), and the percent standard error of prediction (SEP) (Ventura et al., 1995) also analyzed for sensitivity analysis in this study. The E2 and AVR were used to see how the models explain the total variance of the data and represent the proportion of variation of the observed data considered for Sardine forecasting modelling. The SEP allows the comparison of the forecast from different models and different problems because of its dimensionless. For a perfect performance, the values of $R^2$ and $E^2$ should be close to one and these of SEP and ARV close to zero. The optimal model is selected when RMSE and MAE are minimized. The above estimators are given by:

$$R = \frac{n\sum Y_i \hat{Y}_i - (\sum Y_i)(\sum \hat{Y}_i)}{\sqrt{n(\sum Y_i^2) - (\sum Y_i)^2}\sqrt{n(\sum \hat{Y}_i^2) - (\sum \hat{Y}_i)^2}} \quad (1)$$

$$E = 1.0 - \frac{\sum_i^n |Y_i - \hat{Y}_i|^2}{\sum_i^n |Y_i - \bar{Y}_i|^2} \quad (2)$$

$$ARV = 1.0 - E^2 \quad (3)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^n |Y_i - \hat{Y}_i|^2}{n}} \quad (4)$$

$$MAE = \frac{\sum_{i=1}^n |Y_i - \hat{Y}_i|}{n} \quad (5)$$

$$MAPE = \frac{100}{n} \times \sum_{i=1}^n \left|\frac{Y_i - \hat{Y}_i}{Y_i}\right| \quad (6)$$

$$SEP = \frac{100}{\bar{Y}_i} RMSE \quad (7)$$

Where $Y_i$ is the observed value, $\hat{Y}_i$ is the forecasted value to $Y_i$, and n is the number of the observations of the validation set. $\bar{Y}_i$ is average mean value of the target.

## RESULTS AND DISCUSSION

Artificial Neural Network's performance over real TS is not satisfactory because the environmental factors and its seasonal fluctuations are not considered in ANN modeling. The advantage of the ANN approach is its ability to predict biomass developments without the need to directly specify parameter values such as growth or mortality rates, which are difficult to establish ahead in the ocean environment. Rather these are specified absolutely in the weights of the ANN by relating input data to the resulting dynamics and use these relationships to train the network. By combining several variables, the network can predict the dynamics given the current state of the input variables. In this study, for NN modeling, time series environmental parameters such as CHL, SST and PAR are considered as three input functions for the prediction of Sardine monthly time series landings as output.

It is evident that both Sardine and mackerel are dominated each other during recruitment during the bloom initiation period of previous year which in turn gives the result in next year landings. The landing reduction not only

depended on fishing effort but also by mismatching of early spawning and time lag in development of food, creating unfavourable conditions to recruitment. (Madhupratap et al 1994 ). (Antoni Raja 1967) also described that the migratory nature of the species in search of food, spawning and the strong influence of environmental conditions during migration also leads to the chaotic nature of fish landings. The success of Sardine and Mackerel fishery mainly depends on recruitment strength of early juveniles during post monsoon months. The landings mainly depends on the bloom initiation month ( May) in south west coast about 39% inter annual variability in Sardine and Sardine landings are related to the availability of chlorophyll concentration (George et al 2012). But, in Bay of Bengal the bloom initiation is very less during summer monsoon because of its less productivity due to lack of nitrate in open ocean and upwelling (Prasenna Kumar et al 2002).

**STS (Merged) Sardine Neural Network Analysis**

Table 1. shows fourteen NNM developed for STS Sardine landings in the study area. This TS is developed from the year 2005, because, Nagapatinam coastal district has experienced a very huge damage in crafts and gear used for fishing and their population in 2004 Tsunami. All three independent environmental parameters and dependent fish landing TS values are as same as the long TS, but it was considered only from the year 2005. The number of samples involved in the non seasonal NNM is 72, for seasonal it is six, considered only the respective month from the corresponding year. Coming to prediction point of view seasonal NNM once again giving very good correlation, which may be due to of seasonal influence of environmental parameters and on Sardine and Mackerel landings. The prediction capacity among STS NN architecture have increased remarkably in STS_MER_SAR_SST_S model , which gave a very good correlation and stood first with the following sensitivity analysis results. i.e. $R^2$=0.9594, %SEP=23.4157,E=0.9547 and MAPE=47.5097.

The other NN Models having SST with their combination captured the next 3 ranks as STS_MER_SAR_SC_S, STS_MER_SAR_SP_S and STS_MER_SAR_CSP_S. This clearly indicates that Sardine landings have correlated much with SST when compare to CHL and PAR in the study area. In long time series SST_S model on Sardine gives an high $R^2$ value of 0.8158 stands first among all other NNM (Madhavan. et. Al 2015). Here in STS the degree of coefficient of determination gives better results with an $R^2$ value of 0.9594. In LTS for Non-Seasonal models, the number of hidden layers involved in the NN analysis is two for all models except CSP_NS model. In STS the number of hidden layer involved in Non-Seasonal models are one and the NNM structure is having only three layers.

**STS (Merged) Sardine Non Seasonal Models**

The predictive performance of NNM for all NS in the LTS (Madhavan et.al. 2015.) is having very less correlation, but, here in STS, a better performance is observed over LTS in all seven NS models. The STS_MER_SAR_CSP_NS stood first among all the NS model architectures with the model results of $R^2$=0.3569%, SEP= 119.9799 , E= -0.1902 and MAPE = 89.9337 % and the other NNMs followed the CSP_NS. are STS_MER_SAR_CP_NS and STS_MER_ SAR_ SP_NS.

The predictive performance of NS models are shown in the Figure 5., where the STS_MER_SAR_ CSP_NS has very less variations in the low profile catch months of April, May, October, November and December. At the same time, except April and May, other months which fell under winter season again predicted in similar way to LTS. The models STS_MER_SAR_SST_NS, STS_MER_SAR_SC_NS and STS_MER_ SAR_ CSP_NS gave a reasonable prediction in the month of July. All the above models are having SST as one of the parameter in their model. On the other hand STS_MER_SAR_SP_NS and STS_MER_SAR_SST_NS has more prediction values in the month of March which had 2nd high profile landing value next to June in the observed values. The only model STS_MER_SAR_SST_NS is over estimating (60 %) the month August among all the models. The models such as STS_MER_SAR_CHL_NS and STS_MER_SAR_SC_NS and STS_MER_SAR_CP_NS and STS_MER_ SAR _ SP_NS are observed with >100 % overestimation in their prediction values for the month of December.

**STS (Merged) Sardine Seasonal Models**

The prediction performance of NNM for seasonal models are available in Figure 6., A perfect prediction performance is achieved in the model SST_S which has a $R^2$ value of 0.9594. In this model all the months have predicted perfectly except in the months of July, August and November, where 10-20% of overestimation is observed. The high profile landing values of Sardine are perfectly predicted in this model and the low profile catch values also matching well with this model. Further the high profile landing values are perfectly estimated in STS_MER_SAR_SP_S model like SST_S model, but because of a high over estimation in February month left this model to 3rd rank. Even though the STS_MER_SAR_SP_S model 's predictions are perfectly fit over the months of July, August and November, where the SST model having more variations, the over fit in the month February take this model to rank three. The models STS_MER_SAR_CHL_S, STS_MER_SAR_SC_S, STS_MER_SAR_CP_S and STS_MER_SAR_CSP_S are over estimates 5 to 12 % the second high profile landing value month March , where the CHL involves in all four models. So CHL influence for over prediction in the month of March is clearly exhibited during this seasonal NN analysis. PAR underestimates the June month in all its combinations except, when it is associated with SST. The CHL overestimate in November month prediction with its combinations except with PAR. The PAR also over estimate November month landings when it is individually targeted with the Sardine landings for prediction.

## CONCLUSION

In this study, the SST seasonal modelling analysis has shown much better correlation with the Sardine landing in the study area, which is clearly indicated from the Figures 5and 6. The variation in intensities in observed and predicted Sardine landing in different combinations (Table 1.0) are clearly shown by various models . This indicates that the landing response of matured Sardine to SST was more when compared to CHL in the study area.

The accuracy and correlation of the model prediction was not only strongly influenced by the data quality used in the calibration phase and the kind of relationship between the original series data, but also by the quantity of the data available for the calibration and validation phases. (Czerwinski et al 2007). The selection of input variables, their ecological significance and the use of a test data set to assess the model precision and accuracy are also important elements for Neural Network approach (Lin sun et al 2009). A potential disadvantage of the ANN approach, as in most statistical models, is that there is no detailed specification of the processes involved. This means that although we can get a predictive ability we do not achieve an understanding of the mechanisms causing the specific relationship between the variables (Huge and Otterson 2000).

Previous reports shown that Among seasonal and Non-Seasonal models the seasonal NNM have predicted well when compared to Non-Seasonal NN Models, (Madhavan et.al. 2015). In this study also the seasonal Neural Network models as a whole is giving good correlation and stood first eight positions out of fourteen models. The results from **STS_MER_SAR_SST_S,** on the Sardine fish landings have shown 95% correlation and a minimum MAE of 0.0187 between observed and estimated Sardine landings in Nagapatnam district. This gives the Sardines in the study area are closely associated with SST when compare to temperature in Bay of Bengal . In this study STS_MER_SAR_SST_S model performed well among all models and SST's influence on Sardine landings is once again proved in short term modeling also. Over estimation occurs in all CHL models in the month of March and STS_MER_SAR_PAR_S and STS_MER_ SAR_ SP_S overestimates February month. Further studies including more environmental time series and their combinations will be included to confirm and predict the large-scale fluctuation in landing, sudden declining trend in landings and subsequent recovery of Sardine fishery in the Nagapatnam coast of Tamil Nadu India.

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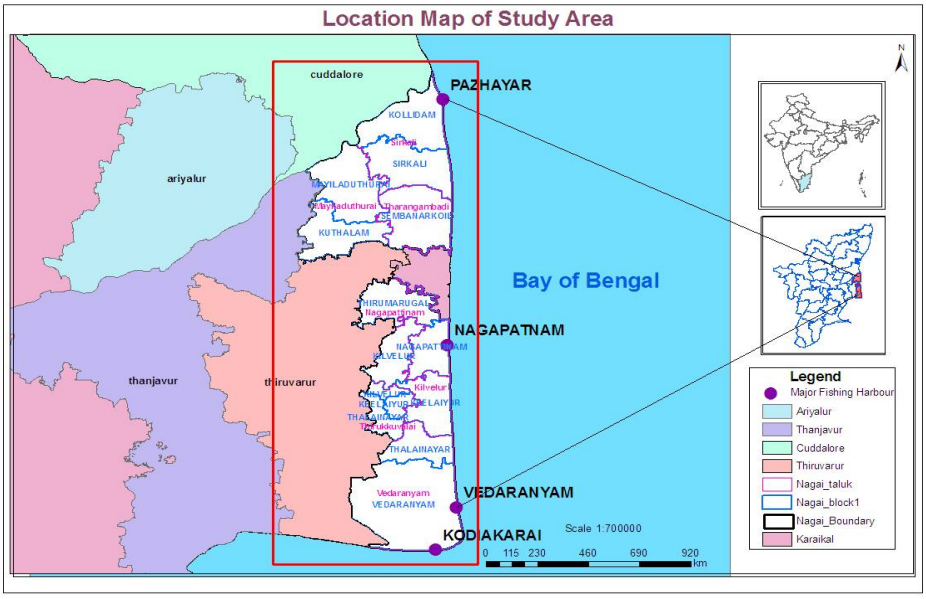


**Figure 1.Study Area Details Of Nagapatnam District in Bay of Bengal**

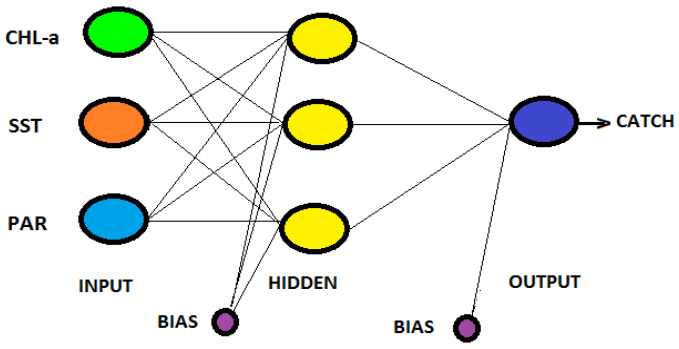


**Figure 2. Schematic representation of three layer Feed Forward Neural Network (3-3-1)**

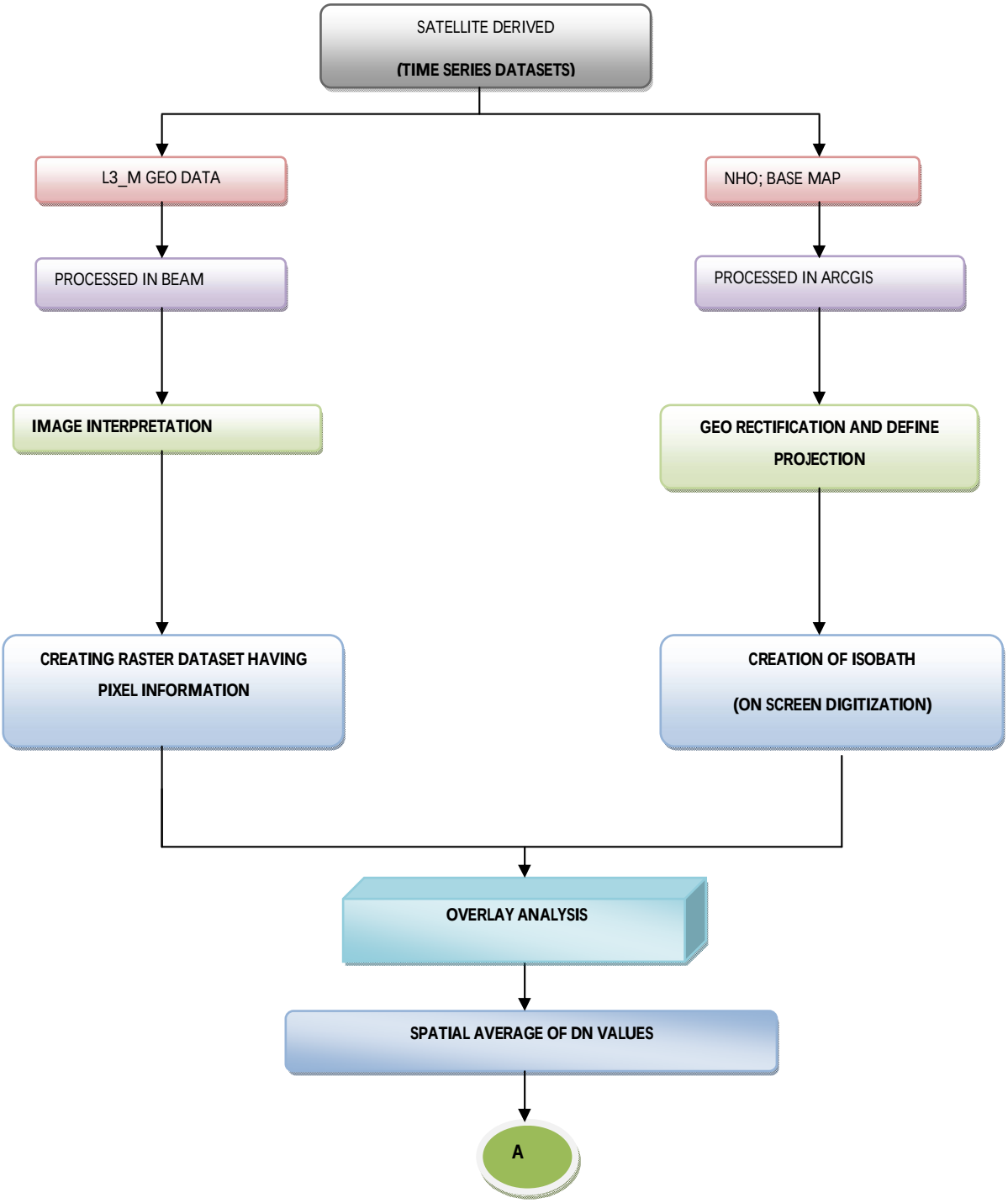


**Figure 3.Flowchart showing methodology for image DN value extraction**

**Table 1.Summary of STS (Merged) Sardine Neural Network analysis**

| | STS (Merged) SARDINE NEURAL NETWORK ANALYSIS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **DESCRIPTION** | **R** | **$R^2$** | **MSE** | **RMSE** | **MAE** | **MAPE** | **E** | **ARV** | **SEP** | **MODEL** | **EPCH** | **Rank** |
| 1. | STS_MER_SAR_SST_NS | 0.3828 | 0.1465 | 0.0125 | 0.1116 | 0.0737 | 224.6528 | -0.0668 | 1.0668 | 113.5926 | 1:10:01 | 3000 | 12 |
| **2.** | **STS_MER_SAR_SST_S** | **0.9795** | **0.9594** | **0.0005** | **0.0230** | **0.0187** | **47.5097** | **0.9547** | **0.0453** | **23.4157** | **1:03:01** | **500** | **1** |
| 3. | STS_MER_SAR_CHL_NS | 0.4031 | 0.1625 | 0.0038 | 0.0620 | 0.0464 | 395.7552 | 0.0920 | 0.9080 | 104.7957 | 1:10:01 | 3000 | 11 |
| 4. | STS_MER_SAR_CHL_S | 0.7324 | 0.5364 | 0.0055 | 0.0744 | 0.0377 | 61.1809 | 0.5260 | 0.4740 | 75.7135 | 1:03:01 | 500 | 5 |
| 5. | STS_MER_SAR_PAR_NS | 0.1195 | 0.0143 | 0.0145 | 0.1203 | 0.0608 | 82.8278 | -0.2393 | 1.2393 | 122.4316 | 1:07:01 | 3000 | 14 |
| 6. | STS_MER_SAR_PAR_S | 0.7002 | 0.4902 | 0.0063 | 0.0791 | 0.0456 | 74.6906 | 0.4641 | 0.5359 | 80.5101 | 1:03:01 | 500 | 6 |
| 7. | STS_MER_SAR_SC_NS | 0.2482 | 0.0616 | 0.0136 | 0.1166 | 0.0787 | 375.4867 | -0.1653 | 1.1653 | 118.7207 | 2:07:01 | 3000 | 13 |
| 8. | STS_MER_SAR_SC_S | 0.9176 | 0.8420 | 0.0020 | 0.0442 | 0.0290 | 71.1730 | 0.8326 | 0.1674 | 44.9933 | 2:03:01 | 300 | 2 |
| 9. | STS_MER_SAR_SP_NS | 0.4377 | 0.1916 | 0.0127 | 0.1128 | 0.0690 | 251.0042 | -0.0898 | 1.0898 | 114.8063 | 2:07:01 | 3000 | 10 |
| 10. | STS_MER_SAR_SP_S | 0.9100 | 0.8281 | 0.0027 | 0.0524 | 0.0207 | 37.4395 | 0.7650 | 0.2350 | 53.3131 | 2:03:01 | 300 | 3 |
| 11. | STS_MER_SAR_CP_NS | 0.4638 | 0.2151 | 0.0143 | 0.1194 | 0.0690 | 201.4645 | -0.2214 | 1.2214 | 121.5427 | 2:03:01 | 3000 | 9 |
| 12. | STS_MER_SAR_CP_S | 0.6269 | 0.3930 | 0.0076 | 0.0872 | 0.0446 | 46.4320 | 0.3484 | 0.6516 | 88.7774 | 2:03:01 | 300 | 7 |
| 13. | STS_MER_SAR_CSP_NS | 0.5974 | 0.3569 | 0.0139 | 0.1179 | 0.0673 | 89.9337 | -0.1902 | 1.1902 | 119.9799 | 3:10:01 | 3000 | 8 |
| 14. | STS_MER_SAR_CSP_S | 0.8560 | 0.7328 | 0.0032 | 0.0563 | 0.0361 | 57.3883 | 0.7284 | 0.2716 | 57.3130 | 3:03:01 | 250 | 4 |
| SAR -Sardine, S-Seasonal, NS-Non-Seasonal, MER-Merged, SC-SST & CHL, SP-SST & PAR, CP-CHL & PAR, CSP-CHL, SST & PAR | | | | | | | | | | | | | |

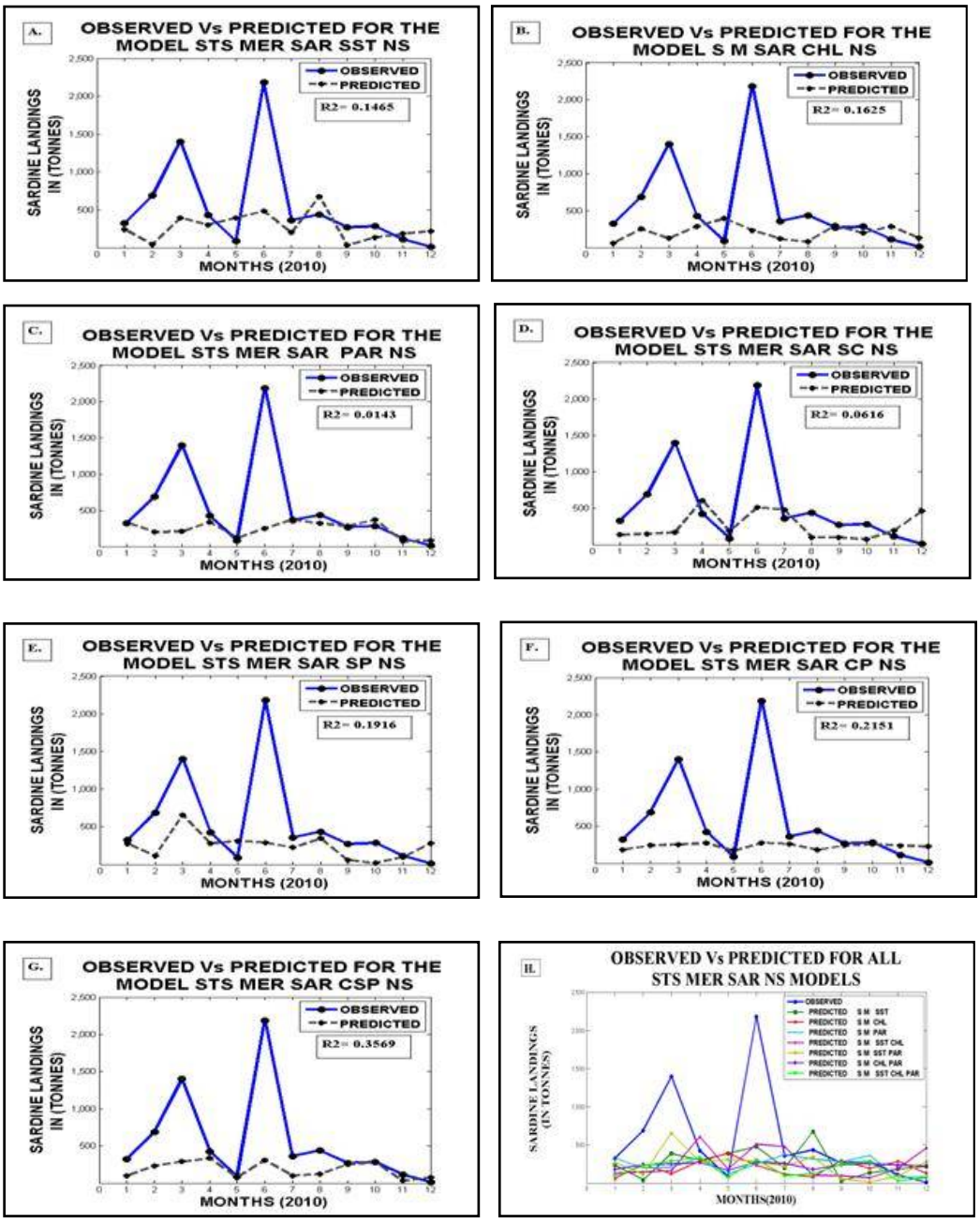


**Figure 4.STS (Merged) Sardine Non-Seasonal fit for all model combinations**

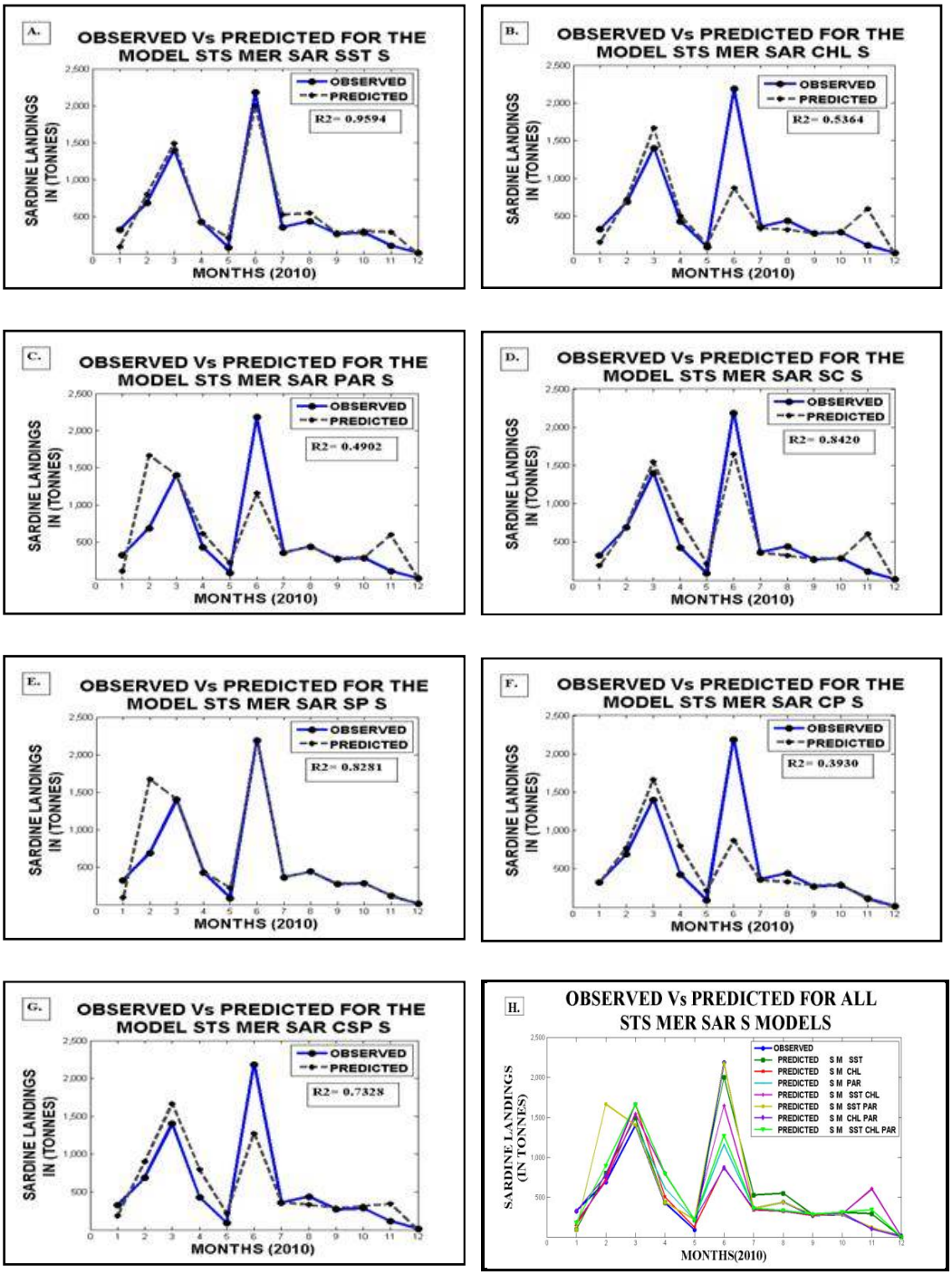


**Figure 6.STS (Merged) Sardine Seasonal fit for all model combinations**

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RESEARCH ARTICLE

# Neural Network Prediction on Mackerel Landings using Satellite Derived Ocean Parameters Chlorophyll-a (SeaWiFS), SST and PAR

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## ABSTRACT

In this study Artificial Neural Network (ANN) models were developed to predict 12 month ahead monthly Mackerel landings was analyzed for Tamil Nadu ( Nagapattinam dt) coast, India, considering previous 144 months Mackerel catches as inputs to the models. For this study a total of 14 Neural Network Models (NNM) were developed with Time Series of ocean colour parameters such as Chlorophyll-a (CHL), Sea Surface Temperature (SST) and Photosynthetically Active Radiation (PAR) as dependent variable for the target of Mackerel catch time series in the study area. The outputs from seasonal and Non-Seasonal models were compared and the seasonal models were out performed Non-Seasonal models in prediction. The NNM LTS_MER_MAC_CHL_S model ($R^2$ between the predicted and observed landings is about 0.7908) is performed well when compare to other Seasonal, Non-Seasonal Univariate and Multivariate Neural Network models. This study demonstrates that the ocean colour parameters Chlorophyll-a, Sea Surface Temperature and Photosynthetically Active Radiation can be used in the study area on Mackerel landing prediction. In general, seasonal ANN exhibits good performance in prediction of Mackerel catch landings when compare to Non-Seasonal ANN architecture.

**Keywords: C**hlorophyll-a, Sea Surface Temperature, Photosynthetically Active Radiation. and Neural Network.

## INTRODUCTION

The capricious nature of Mackerel landing is observed in Tamil Nadu coastal waters, because of the environmental disturbances. Climate fluctuations have always affected fish abundance, but their consequences on fish populations were very different when the confounding effects of fishing were not present Larkin (1996). Considering the present on-going global climate change, it is appropriate to stress the linkage between climate, the ocean ecosystem, fish population dynamics and its landings. In order to understand the complexities and to ameliorate the strategies of fishery management, it is necessary to study the nature of uncertainty associated with the abundance of fish stocks, the effects of fishing, and particularly the influence of the ocean environment.

Fishermen community requires information regarding fish availability to maximize fish catch with minimal effort. Several studies have shown that ocean environmental parameters like Chlorophyll-a (CHL), Sea Surface Temperature (SST) and Photosynthetically Available Radiation (PAR) influence the fish availability at particular region. However, *insitu* data collection of above parameter over vast stretches on a regular basis is prohibitively costly. Satellite based estimation of above ocean environmental parameters is an established technique now, to map spatial variability and is gaining importance as a reliable, accurate and economic alternative, because of its capability in providing synoptic and repetitive coverage of vast area. The temporal variability of above satellite based ocean environmental parameters is used to provide advisory services to fishermen community to target potential fishing locations.

The traditional Auto-Regressive Integrated Moving Average (ARIMA p,d,q) models following Box- Jenkinson methodology with Multiple Linear Regression (*MLR)* normally used for obtaining wide variety of fisheries TS predictions. Monthly fish catch landings are generally nonlinear, which is not predicted effectively by –ARIMA models. However, to some extent it is efficient in modelling Linear phenomena in describing and predicting the fisheries TS of with a wide variety of species (Saila et al 1980), Hae-Hoon Park (1998), Stergiou KI (1996), Sathianandan (1995), Venugopalan (1998)). Hence Artificial Neural Network (ANN) modelling has been chosen in this study for prediction analysis. The advantage of ANN over MLR models is the ability of ANN to directly take into account any non-linear relationships between the dependent variables and each independent variable. Several authors have shown better performances of ANN as compared to the MLR (Ehrman et al 1996; Lek et al 1996; Scardi 2001) in prediction capability.

## MATERIALS AND METHODS

The study area Nagapatnam coastal district (Blue in color) in Tamil Nadu, eastern part in Bay of Bengal covering a coast line length of 190 km. Figure.01 explains the schematic representation of Nagapatnam district falls in the latitudinal and longitudinal extensions between 10°46′1.2″N and 79°49′58.8″E on the Eastern part of Bay of Bengal. The movement of fishermen and the seaside limit (1000 m isobaths) for the extraction of Sea Surface Temperature, Chlorophyll-a and Photosynthetically Active Radiation in bay of Bengal also shown in the figure 01. (Yellow in color). The minimum and maximum temperature in the study are 20°C and 34°C. This district comprises of five coastal taluks that is Nagapattinam, Sirkazhi, Tarangampadi, Mayiladuturai and Vedaranniyam.

**Artificial Neural Networks**

There are so many different ways to forecast nonlinear phenomena, among them Neural Networks is the best efficient method to get forecast information from a nonlinear time series (Lin sun et.al 2009). There by the applications of neural networks to landings time series forecasting have become very popular over the last few years, since most of the landings time series are in nonlinear pattern. Neural networks are simple nonlinear computing units and just imitating human neural system has an input layer, a hidden layer and an output layer. Layers in between input and output layers are generally called as hidden layers and commonly referred as neurons. When data is loaded in the ANN (Artificial Neural Network), it must be preprocessed from its numeric range into the numeric

range that the ANN can deal with efficiently to improve the efficiency of the learning results (Kim and Lee, 2004). Figure 02. Explains the schematic representation of three layer NNM involved in this study.

**Fishery data**

For the preparation of Long Time Series (LTS) data in terms of Indian Mackerel (*Rastrelliger kanagurtha*), the monthly landing details were obtained from the Central Marine Fisheries Research Institute (CMFRI) Cochin, database. The period considered for LTS is from 1998 to 2010, out of which the CMFRI data pertains to the period 1998-2009. For validation purpose, fish catch data for the year 2010 from fish landing centers were collected. Standardization of commercial catches through Catch Per Unit Effort (CPUE) could provide a powerful method for estimating trends in the stock abundance. Unfortunately, there were many aspects of fishermen's behaviour that will cause CPUE to be not proportional to abundance even on a very small spatial scale (Hilborn and Walters 1992). So, for this study, Mackerel landing details are considered instead of CPUE for the preparation of fish landing LTS. The data were collected by qualified and well-trained technical staff of CMFRI by following stratified multi-stage random sampling technique, in which the Mackerel landings were recorded by covering landing centers along the Nagapattinam coast. The catch data for the year 2010 (on monthly basis) were collected in entire Nagapattinam coastal area from all forty four landing centers physically with the help of Department of Fisheries, Officials. A team of fourteen local fishermen were engaged to cover the entire 44 fish landing centers for the collection of fish catch data. This data is used for testing and validating NNM predicted fish catch.

**Satellite data**
**Chlorophyll-a concentration**

The primary function of Chlorophyll-a is photosynthesis of marine algae in the ocean, which is the main food for Mackerel larvae and that availability of food during the critical developmental period of Mackerel larvae determines the year class of Mackerel population is important for Mackerel availability in Bay of Bengal. So Chlorophyll-a in Bay of Bengal is considered in the prediction models in this study. SeaWiFS level 3 standard binned images archived by the Ocean Biology Processing Group (OBPG) were used to estimate sea-surface chlorophyll-a concentrations. These data were obtained from the http://oceancolor.gsfc.nasa.gov/cgi/l3. We used Global Area Coverage (GAC) monthly composite SeaWiFS images with a spatial resolution of about 9 km_9 km for the period from January 1998 to December 2010.

**Sea Surface Temperature (SST)**

In Mackerel life cycle Sea Surface Temperature and CHL are an important factor which leads the Mackerel activity levels to increase or decrease, makes Mackerels move into certain areas, and influences feeding and reproductive activity. Temperature data are of interest to those who wish to catch fish or study them. Since the Mackerel is a tropical fish we need to understand how temperature affects fish behaviour. So Sea Surface Temperature also considered as one of the main environmental factor in the Mackerel landing prediction which is normally preferring temperature range of 27° to 29°C (Chidambaram, 1950). The NOAA pathfinder data presented in ftp://podaac.jpl.nasa.gov/allData/avhrr/L3/pathfinder_v5/monthly/ data were used to study SST for the same period having the same spatial resolution along with chlorophyll data.

**Photosynthetically Active Radiation (PAR)**

Photosynthetically Active Radiation (PAR) is the amount of light available for photosynthesis, which is defined as the quantum energy flux from the Sun light in the 400 to 700 nanometer wavelength range. Since the Mackerels are herbivores Photosynthetically Active Radiation Also considered as one of the biophysical parameter. PAR changes seasonally and varies depending on the latitude and time of day. This data set consists of algorithm estimates of global Photosynthetically Active Radiation (PAR) reaching the surface obtained by the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), in orbit on the OrbView-2 (formerly SeaStar) platform. SeaWiFS data products are processed

and distributed by the Ocean Biology Processing Group (OBPG). For this study SeaWiFS Level 3 monthly Binned data files are downloaded from the FTP site at http://oceancolor.gsfc.nasa.gov/cgi/l3 having 9 km spatial resolution.

**Image processing**

Monthly mean CHL, SST and PAR images for the entire period were downloaded, processed and extracted in BEAM software developed by European Space Agency(ESA). BEAM is an open-source toolbox and development platform for viewing, analyzing and processing of remote sensing raster data. BEAM supports a number of raster data formats such as GeoTIFF, HDF and NetCDF as well as data formats of other EO sensors such as *Moderate Resolution Imaging Spectroradiometer* (MODIS) and *Advanced Very High Resolution Radiometer(AVHRR).*The remote sensing data extracted for this study was in both NetCDF and HDF format, which is supported by BEAM software. The CHL, SST and PAR products were clipped for the study area and the same is processed and spatially averaged as point data for each polygon for this TS preparation. The procedure to create and extract for the 1000m isobath shape file for the study area is explained in detail in the flow chart shown as Figure . 3.

In India previous studies on monthly CHL extraction have been performed with 200m isobath to get monthly averaged surface CHL for fisheries studies along the waters of the southwest coast of India George et al (2012). However because of multiday fishing activity and their ability to move form continental shelf area to continental slope area for fishing, a 1000m isobath has been considered in this study. Same 1000m isobath vector files were created for all coastal district of all Tamil Nadu to extract monthly mean information for all the three oceanographic biophysical environmental parameters for the same period.

The extracted satellite derived environmental parameters CHL, SST & PAR values are spatially averaged for the preparation of long Time Series for the period 1998 to 2010. The fishermen from Nagapattinam district and particularly those who use trawlers are involved in multiday fishing activity. They move out from the Nagapattinam district boundary up to Tiruvallur district in the northern side and Ramanathpuram district in the southern side. Hence, the spatially averaging of all three environmental variable values was created for all districts to derive monthly mean values. Mackerel landing Long Time Series (LTS) of Nagapattinam district, from the year 1998 to 2009 are obtained from CMFRI are considered as input in this study. The year 2010 Mackerel landing data are collected from the landing centers and placed as target in this study.

## METHODOLOGY

The time series of Nagapatnam district Mackerels monthly landings were normalized from zero to one by simply dividing the real value by the maximum of the appropriate set because of their nonlinearity. The time series belongs to Photosynthetically Active Radiation (PAR) is kept as such, since they are having only seasonal influences on it. The in-situ Mackerel landing time series collected for the year 2010 January to December in all the landing centers of Nagapatnam district. The spatially averaged PAR value extracted from images of Thiruvallur District to Ramanathapuram District. The Mackerel landings time series modeled in Matlab ($R2012_a$) Neural Networks to get the prediction values for the year 2010 and compared with the insitu catch data. In this NN function the PAR parameter up to 1998- 2009 as input against the year 2010 as target to model to predict the Mackerel monthly catch for the year 2010 to Nagapatnam area.

**Methods of evaluation**

Several measures of accuracy were calculated in the calibration between model output and observed value. A measure of correlation between the observations and the predictions is the coefficient of correlation (R). The proportion of the total variance in the observed data that can be explained by the model was described by the coefficient of determination ($R^2$). The estimators to quantify the errors in the same units of the variance were the square root of the mean square error (RMSE), and the mean absolute error (MAE). On the other hand other measures

of variance were the Coefficient of Efficiency (E2) (Nash and Sutcliffe, 1970; Kitanidis and Bras, 1980), the Average Relative Variance (ARV) (Grin o. R. 1992), and the percent standard error of prediction (SEP) (Ventura et al., 1995) also analyzed for sensitivity analysis in this study. The E2 and AVR were used to see how the models explain the total variance of the data and represent the proportion of variation of the observed data considered for Mackerel forecasting modeling. The SEP allows the comparison of the forecast from different models and different problems because of its dimensionless. For a perfect performance, the values of $R^2$ and $E^2$ should be close to one and these of SEP and ARV close to zero. The optimal model is selected when RMSE and MAE are minimized. The above estimators are given by:

$$R = \frac{n\sum Y_i \hat{Y}_i - (\sum Y_i)(\sum \hat{Y}_i)}{\sqrt{n(\sum Y_i^2) - (\sum Y_i)^2}\sqrt{n(\sum \hat{Y}_i^2) - (\sum \hat{Y}_i)^2}} \quad (1)$$

$$E = 1.0 - \frac{\sum_i^n |Y_i - \hat{Y}_i|^2}{\sum_i^n |Y_i - \bar{Y}_i|^2} \quad (2)$$

$$ARV = 1.0 - E^2 \quad (3)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^n |Y_i - \hat{Y}_i|^2}{n}} \quad (4)$$

$$MAE = \frac{\sum_{i=1}^n |Y_i - \hat{Y}_i|}{n} \quad (5)$$

$$MAPE = \frac{100}{n} \times \sum_{i=1}^n \left|\frac{Y_i - \hat{Y}_i}{Y_i}\right| \quad (6)$$

$$SEP = \frac{100}{\bar{Y}_i} RMSE \quad (7)$$

Where $Y_i$ is the observed value, $\hat{Y}_i$ is the forecasted value to $Y_i$, and n is the number of the observations of the validation set. $\bar{Y}_i$ is average mean value of the target.

## RESULTS AND DISCUSSION

Figure 4 & 5. presents the variation of the Mackerel mean monthly landings, from 1998 to 2009 at Nagapatnam district. Like Sardines, Mackerel landings also experiences strong seasonal patterns, with higher landing values from April to July, having an extended landing period from August to November. A significant peak observed in the Mackerel landings time-series was during 2005 May and August with low landing profile of Sardine for the same month. The same type of dominance also observed from the Sardine Time Series in the month of June 2010 and July 1998,where the Mackerel landings are very meager (Madhavan et.al 2015). This indicates that both species dominated each other during recruitment during the bloom initiation period of previous year which in turn gives the result in next year landings. Another significant reduction in the landings was noted from the year 2006, which was mostly because of the Tsunami effect, over exploitation and indiscriminate fishing of Mackerel brooders after Tsunami during closed season in the month of May 2005.

The landing reduction not only depended on fishing effort but also by mismatching of early spawning and time lag in development of food, creating unfavourable conditions to recruitment. (Madhupratap et al 1994 ). (Antoni Raja 1967) also described that the migratory nature of the species in search of food, spawning and the strong influence of environmental conditions during migration also leads to the chaotic nature of fish landings. The success of Sardine and Mackerel fishery mainly depends on recruitment strength of early juveniles during post monsoon months. The landings mainly depends on the bloom initiation month ( May) in south west coast about 39% inter annual variability in Sardine and Mackerel landings are related to the availability of chlorophyll concentration (George et al 2012). But, in Bay of Bengal the bloom initiation is very less during summer monsoon because of its less productivity due to lack of nitrate in open ocean and upwelling (Prasenna Kumar et al 2002).

**LTS (Merged) Mackerel Neural Network Analysis**

Table 1. summarize the LTS (Merged) NNM sensitivity analysis on Mackerel landings for Nagapattinam coast of Tamil Nadu for both Seasonal and Non-Seasonal models. Figure 6. shows the monthly mean catches of Mackerel compared with NN model prediction in the study area from Jan-Dec 2010. According to Table 1. the best NN model for Non Seasonal and Seasonal model is LTS_MER_MAC_CHL_S, which gives the model accuracy of $R^2$=0.7908, % SEP=40.8295, E=0.6374 and MAPE = 26.4935 in its account. The structure for the best Mackerel, NN is 1:03:01 with 500 epochs. From the result it is obvious that independent variable CHL is having more correlation with Mackerel landings in the study area.

In Non-Seasonal NN modelling the model LTS_MER_MAC_SC_NS stood 8$^{th}$ in the rank among both seasonal and non-seasonal models, but stood first among Non-Seasonal. The regression performance obtained for all models is higher than 0.6 in all the Multivariate Seasonal Model, whereas in the case of Non-Seasonal models the regression performances are less than 0.6. For Non-Seasonal models except LTS_ MER_MAC_CSP_NS, all other models are performed with four layers NNM with hidden layer neurons of 15 each.

**LTS (Merged) Mackerel Non Seasonal Models**

The NNM developed for Non Seasonal has 4 layers except the LTS_MER_MAC_CSP_NS, where the NNM is designed with three layers. The model LTS_MER_MAC_SC_NS has performed well among all Non Seasonal models and has values as $R^2$=0.2068, %SEP=102.1769, E =-1.2710 and MAPE=0.0097. Other than LTS_MER_MAC_SC_NS all other NS models are found with a low $R^2$ value and even the higher model performance also not considered as acceptable level of model prediction. In the case of LTS_MER_MAC_CP_NS model, has a $R^2$ value of 0.0200 but the % SEP value is (102.0668) slightly lesser than that of LTS_MER_MAC_SC_NS model. Hence it is inferred that even though the Coefficient of Determination is poorer than LTS_MER_MAC_SC_NS model, a better performance is found in LTS_MER_MAC_CP_NS model.

Almost all NN NS models underestimate the prediction and not even coincide with the observed landings except the winter months of November and December and May month in summer. The LTS_MER_MAC_CHL_NS and LTS_MER_MAC_CSP_NS models have over estimation in the month of May, whereas other NN NS models exactly coincide in May month. Other than May, in November and December months, all other predictions are under estimated and produce high variation in long TS non seasonal Mackerel NN analysis.

**LTS (Merged) Mackerel Seasonal Models**

In Sardine NNM seasonal analysis, SST played a major role and stood first for the entire 14 NN Models Madhavan. et.al. (2015). But in Mackerel the seasonal CHL has performed well with the sensitivity values of $R^2$=0.7908, % SEP=40.8295, E= 0.6374 and MAPE =26.4935 % when compared to SST NNM values with $R^2$=0.67, % SEP=50.3526, E= 0.4485 and MAPE =34.3799 %. At the same time, the combination of SST and CHL seasonal NNM stood second for Mackerel, which gives an inference that when CHL combinely performed with SST, the combined model's prediction efficiency has performed better than that of individual SST model has increased from 0.67 $R^2$ to 0.75 $R^2$.

Same time when it combines with PAR the combined model's prediction efficiency is lesser than that of PAR's individual model performance (0.6996 $R^2$ to 0.6595) $R^2$. LTS_MER_MAC_PAR_S model exactly predict with high and low profile landings in the study area particularly in the months of May, Nov and December and the high profile month of June 2010. From the Figure 7. it is observed that when the PAR associated with other two environmental parameters such as LTS_MER_MAC_ SP_S, LTS_MER_MAC_CP_S and LTS_ MER_ MAC_ CSP_S, the June month prediction is overestimated. The month June prediction was under estimated only in LTS_MER_MAC_CHL_S model, which stood first in the model rank.

The PAR seasonal NN model predict the high landing profile month June effectively, and concluded that the only environmental variable predict the June value effectively. The May month is always having low profile even though the climatic conditions are conducive to Mackerel fishery, because of closed season implementation of local Tamil Nadu government. The LTS_MER_MAC_SST_S, LTS_MER_MAC_PAR_S, LTS_ MER_ MAC_ SP_S and LTS_MER_MAC_CSP_S overestimates the September month landings and the remaining three CHL related models prediction are close to September month observed value. Apart from that, the months January, February, March and April, landing prediction are under estimated.

## CONCLUSION

Previous reports shown that Neural Networks prediction have been performed well for nonlinear fisheries data when compare to traditional ARIMA model prediction. H. Raman et.al. (1995). Among seasonal and Non-Seasonal models the seasonal NNM have predicted well when compared to Non-Seasonal NN Models, (Madhavan et.al. 2015). In this study also the seasonal Neural Network models as a whole is giving good correlation and stood first eight positions out of fourteen models. However The seasonal model performed well when compare to multivariate Non-Seasonal models. The results from LTS_MER_MAC_CHL_S, on the Mackerel fish landings have shown 79% correlation and a minimum MAE of 0.0033 between observed and estimated Mackerel landings in Nagapatnam district. This gives the Mackerels in the study area are closely associated with Chlorophyll-a when compare to temperature in Bay of Bengal.

Comparative results showed that the application of all Multivariate seasonal Neural Network for Optimal prediction improved significantly than the Non-Seasonal prediction performance of Multivariate Neural Network models. Good model performance for Multivariate analysis on Mackerel landings seems related to the low level of catches in winter season against the results already quoted by Stergiou et al (1996), stating that the low level of landings is associated with high absolute percentage error of model performance in temperate region.Success of the obtained model suggests that further and more accurate studies focusing on relationships between environmental parameters and landings of study area should be developed. These future studies should give further attention to the role of salinity, dissolved oxygen, turbidity and other physical and chemical parameters, plus the interactions and synergies between them, plus the inclusion of new parameters In terms of craft and gear information, fishermen population involved in fishing and life-history characteristics.

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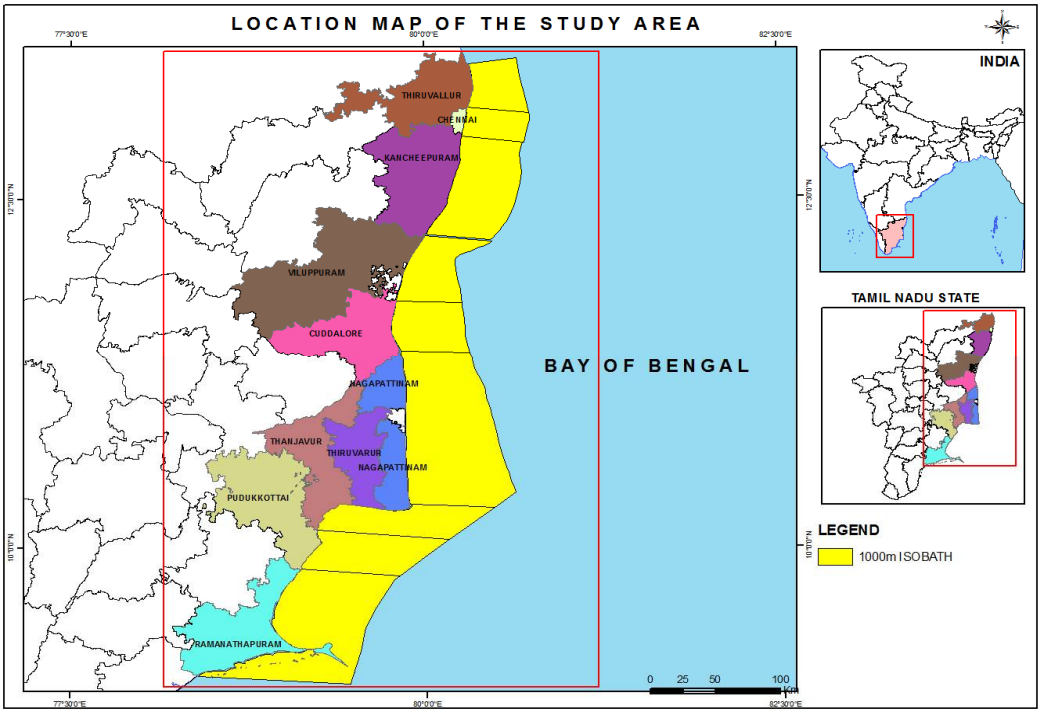


**Figure 2.Study Area Details Of Nagapatnam District in Bay of Bengal**

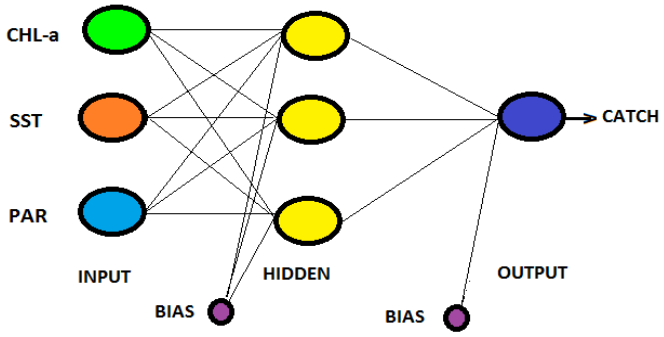


**Figure 2. Schematic representation of three layer Feed Forward Neural Network (3-3-1)**

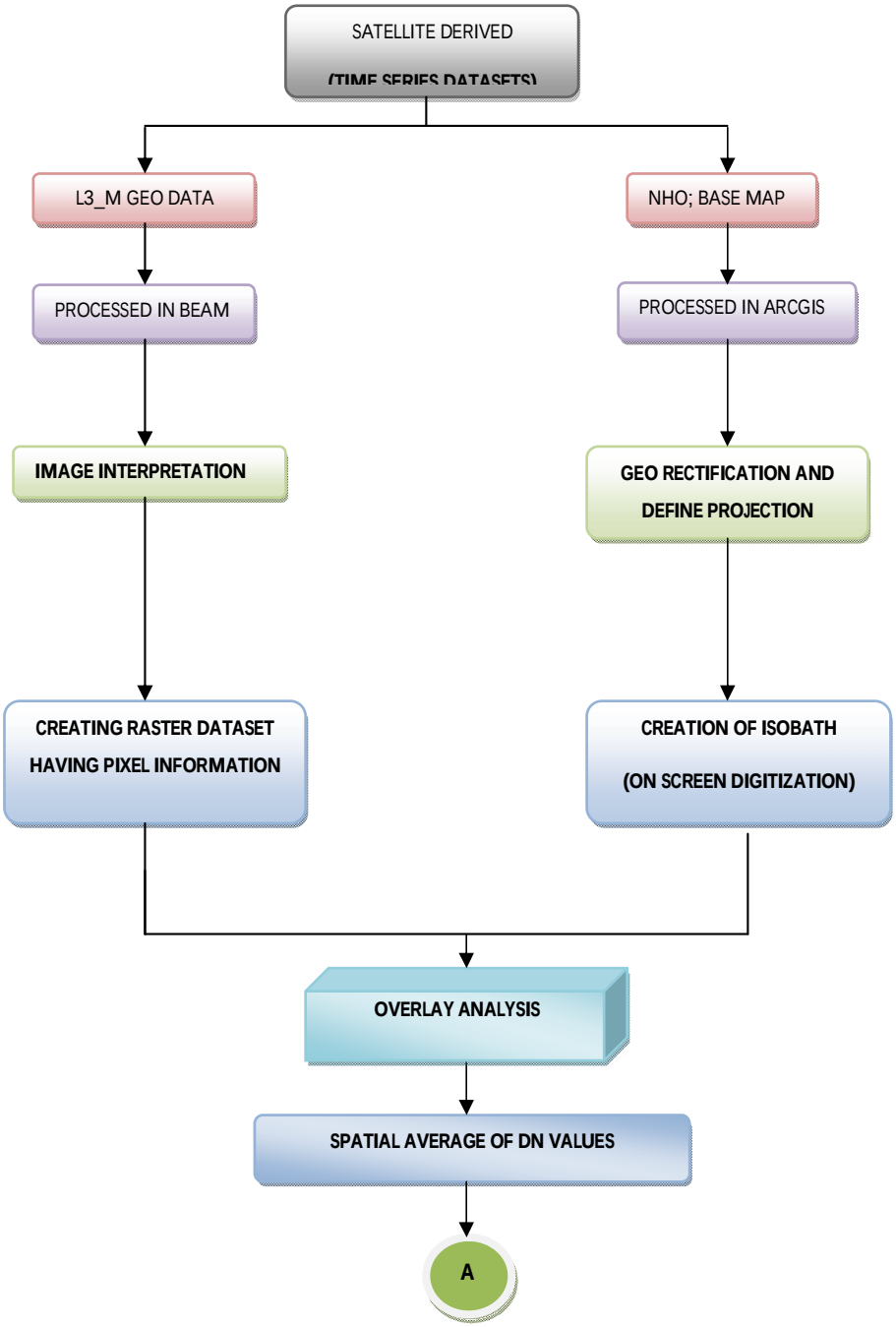


**Figure 3.Flowchart showing methodology for image DN value extraction**

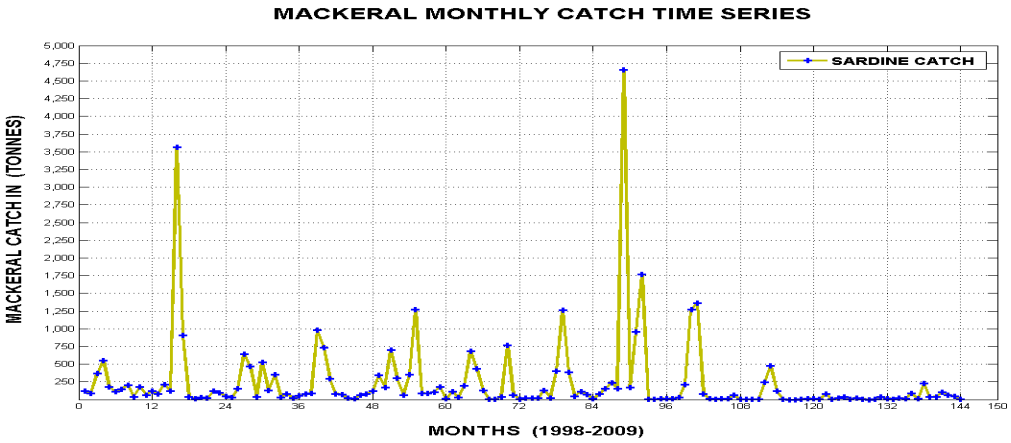


**Figure 4. Graphical Representation of Mackerel monthly landing time series (1998-2009) yearly**

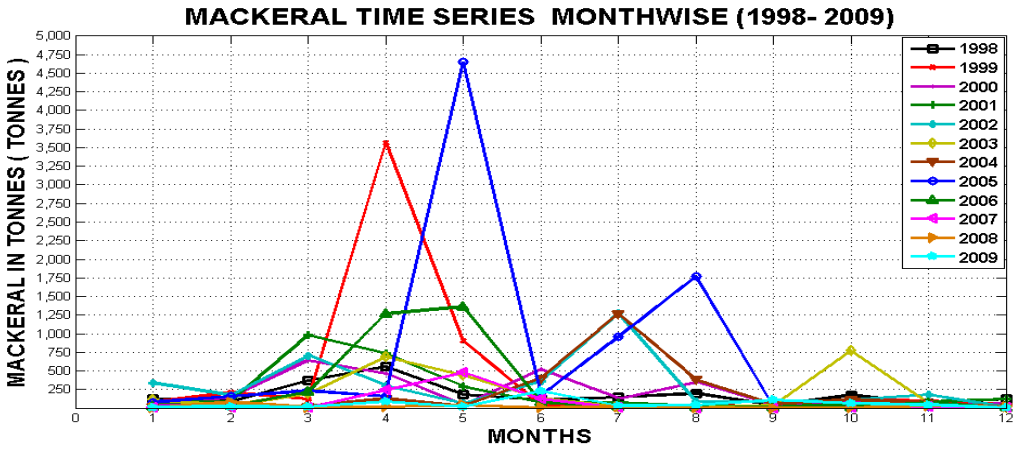


**Figure 5. Graphical Representation of Mackerel monthly landing time series (1998-2009) yearly for Nagapattinam**

**Table 1. Summary of LTS (Merged) Mackerel Neural Network analysis**

| | LTS (Merged) MACKEREL NEURAL NETWORK ANALYSIS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S.NO** | **DESCRIPTION** | **R** | **R2** | **MSE** | **RMSE** | **MAE** | **MAPE** | **E** | **ARV** | **SEP** | **MODEL** | **EPOCH** | **Rank** |
| 1 | LTS_MER_MAC_SST_NS | 0.1013 | 0.0103 | 0.0002 | 0.0127 | 0.0098 | 71.6279 | -1.3515 | 2.3515 | 103.9724 | 1:20:15:1 | 5000 | 11 |
| 2 | LTS_MER_MAC_SST_S | 0.8200 | 0.6724 | 0.0000 | 0.0061 | 0.0042 | 34.3799 | 0.4485 | 0.5515 | 50.3526 | 01:03:01 | 500 | 5 |
| 3 | LTS_MER_MAC_CHL_NS | -0.2232 | 0.0498 | 0.0002 | 0.0128 | 0.0102 | 76.9114 | -1.4005 | 2.4005 | 105.0499 | 1:20:15:1 | 5000 | 14 |
| **4** | **LTS_MER_MAC_CHL_S** | **0.8893** | **0.7908** | **0.0000** | **0.0050** | **0.0033** | **26.4935** | **0.6374** | **0.3626** | **40.8295** | **01:03:01** | **500** | **1** |
| 5 | LTS_MER_MAC_PAR_NS | 0.2223 | 0.0494 | 0.0001 | 0.0122 | 0.0092 | 62.1554 | -1.1730 | 2.1730 | 99.9493 | 1:20:15:1 | 5000 | 9 |
| 6 | LTS_MER_MAC_PAR_S | 0.8364 | 0.6996 | 0.0000 | 0.0052 | 0.0037 | 28.7308 | 0.6029 | 0.3971 | 42.7288 | 01:03:01 | 500 | 3 |
| 7 | LTS_MER_MAC_SC_NS | 0.4547 | 0.2068 | 0.0002 | 0.0124 | 0.0097 | 70.1878 | -1.2710 | 2.2710 | 102.1769 | 2:15:15:1 | 5000 | 8 |
| 8 | LTS_MER_MAC_SC_S | 0.8687 | 0.7547 | 0.0000 | 0.0049 | 0.0034 | 27.7058 | 0.6437 | 0.3563 | 40.4705 | 02:03:01 | 300 | 2 |
| 9 | LTS_MER_MAC_SP_NS | -0.0381 | 0.0015 | 0.0001 | 0.0121 | 0.0093 | 66.0029 | -1.1432 | 2.1432 | 99.2604 | 2:15:15:1 | 5000 | 12 |
| 10 | LTS_MER_MAC_SP_S | 0.8036 | 0.6458 | 0.0001 | 0.0075 | 0.0048 | 31.1743 | 0.1642 | 0.8358 | 61.9878 | 02:03:01 | 300 | 7 |
| 11 | LTS_MER_MAC_CP_NS | 0.1415 | 0.0200 | 0.0002 | 0.0124 | 0.0094 | 61.7148 | -1.2661 | 2.2661 | 102.0668 | 2:15:15:1 | 5000 | 10 |
| 12 | LTS_MER_MAC_CP_S | 0.8121 | 0.6595 | 0.0001 | 0.0075 | 0.0049 | 35.9506 | 0.1733 | 0.8267 | 61.6478 | 02:03:01 | 300 | 6 |
| 13 | LTS_MER_MAC_CSP_NS | -0.0979 | 0.0096 | 0.0002 | 0.0128 | 0.0101 | 73.8390 | -1.3903 | 2.3903 | 104.8282 | 03:15:01 | 5000 | 13 |
| 14 | LTS_MER_MAC_CSP_S | 0.8266 | 0.6833 | 0.0001 | 0.0072 | 0.0049 | 34.9079 | 0.2306 | 0.7694 | 59.4740 | 03:03:01 | 225 | 4 |
| MAC -Mackerel, S-Seasonal, NS-Non-Seasonal, MER-Merged, SC-SST & CHL, SP-SST & PAR, CP-CHL & PAR, CSP-CHL, SST & PAR | | | | | | | | | | | | | |

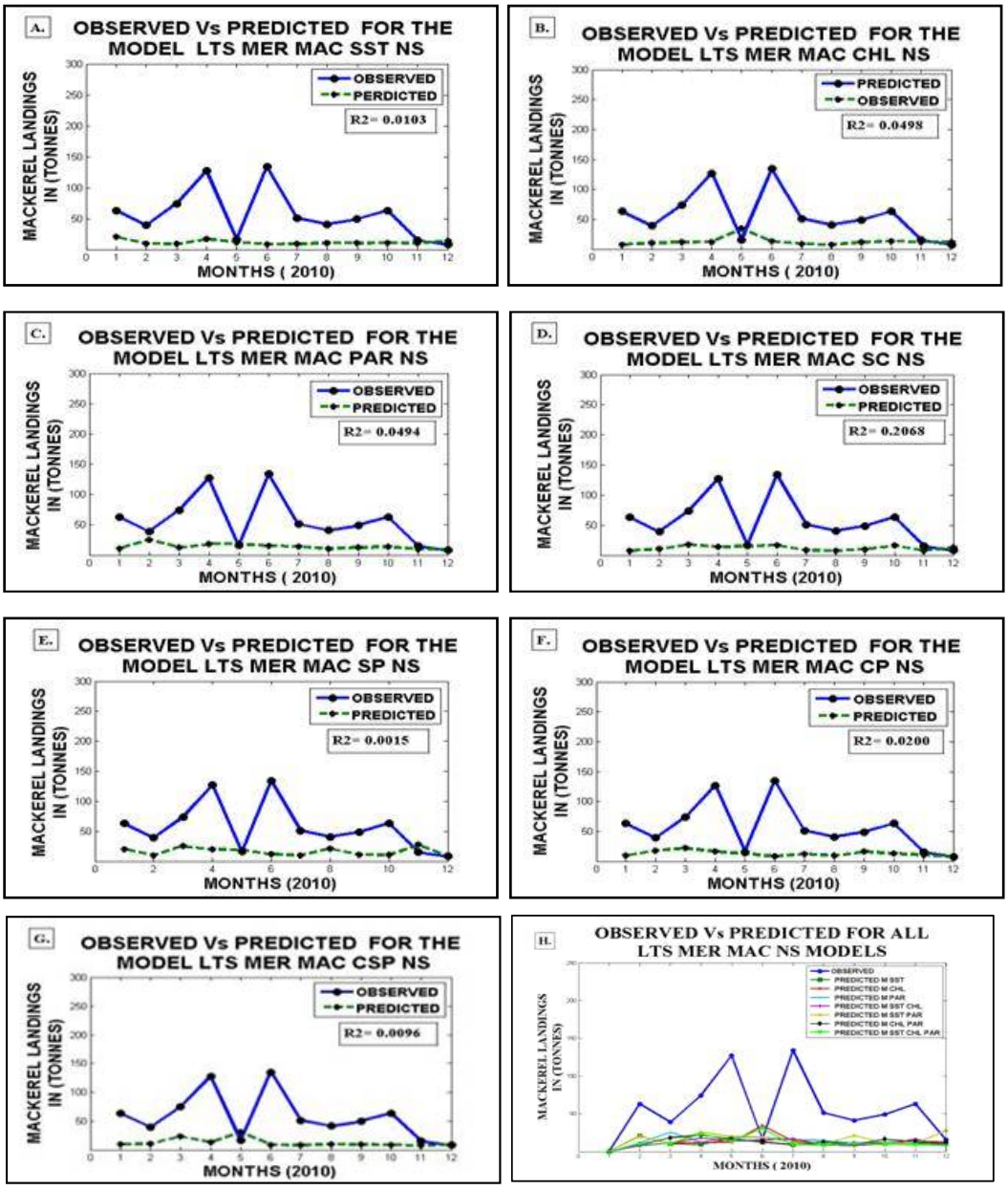


**Figure 6. LTS (Merged) Mackerel Non-Seasonal fit for all model combinations**

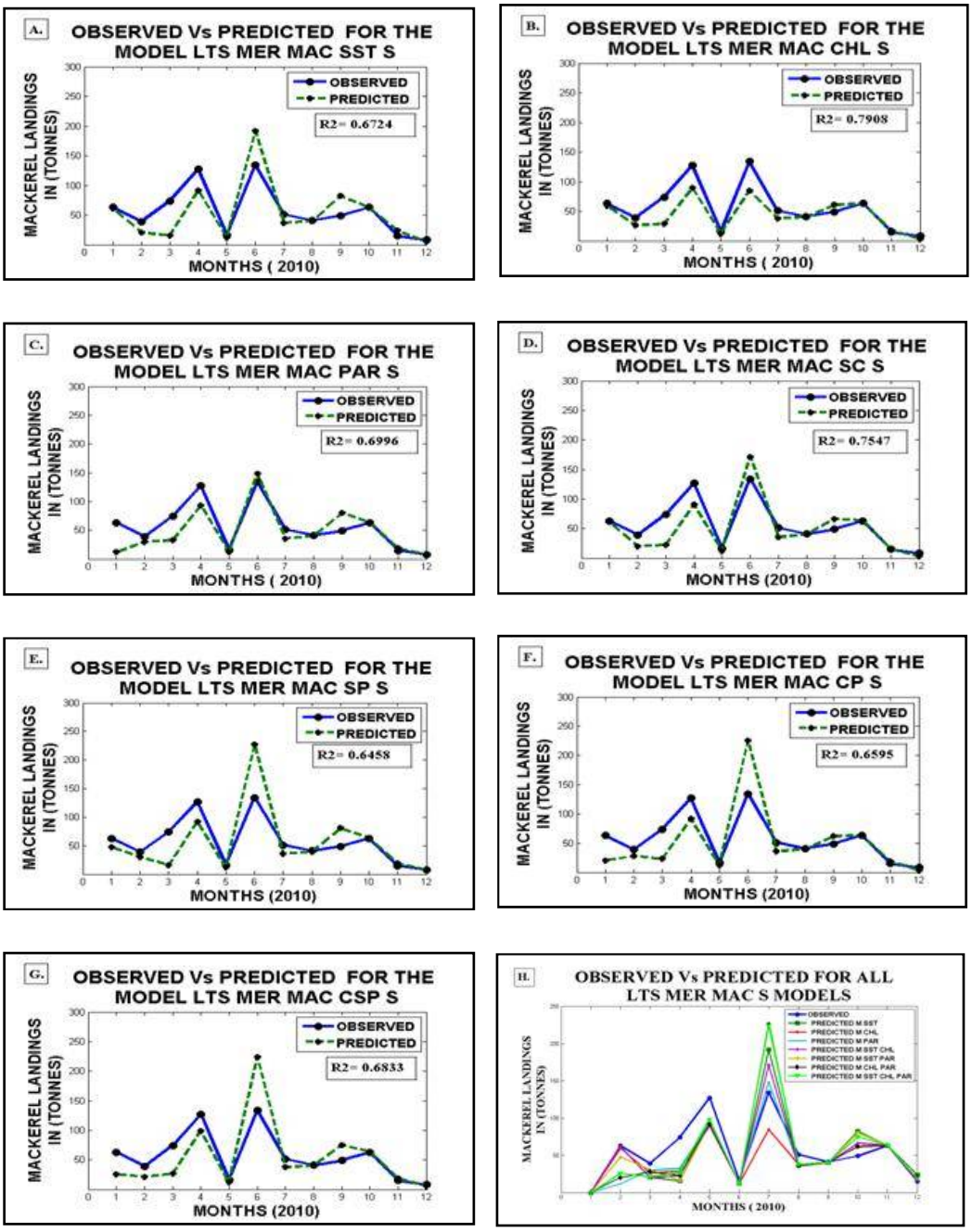


**Figure 7.LTS (Merged) Mackerel Seasonal fit for all model combinations**

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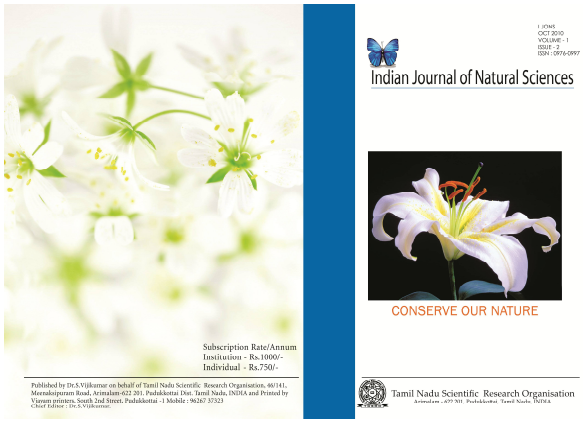


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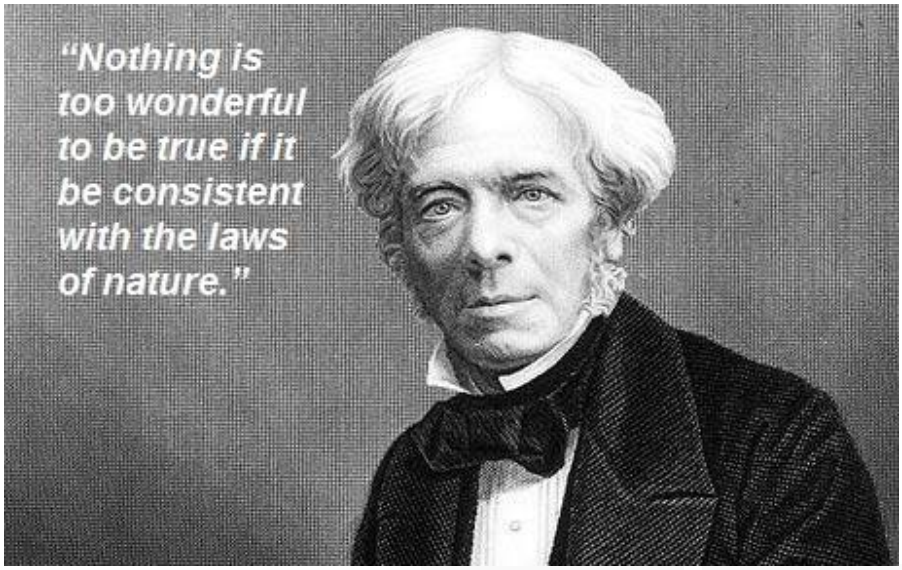


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RESEARCH ARTICLE

# Satire in Dabal Khazaei's Poems

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## ABSTRACT

Humorous poems have dedicated a large portion of Arabic poetry to themselves. Writing satire as a poetic style has been paid attention to by many of Arabian poets and there are remarkable and noticeable works in this context. Dabal Khazaei is among those poets who have written several works and poems in this context. In this research paper we have tried to investigate some of satirical poems of this Arabian poet.

**Keywords:** Satire, Dabal, Poem

## INTRODUCTION

One of important literary styles which have dedicated a significant portion of Arabian poems to it is satirical poetry. Basis of this type of poetry is on humor and based on the purpose, linguistic features and intentions it includes several different types. Dr. Shafiei has categorized satirical words into three groups of satire, parody and irony and he has also pointed out that it is really difficult to provide different definitions for these three types and it's also hard to consider boundaries between them. But in the same time, the need for distinction between these three types has led to presentation of a different definition for each of them. As he believes, irony is defined as artistic image of union of things in contrast with each other and any emphasis on natural obscenities of a thing is satire. Parody is referred to words which are considered as taboo in our formal language (Shafiei, Kadkani, 1994; 25). For considering a boundary between satirical words, Rastgar has considered it as words including humorous subjects and also words which relate bad traits to someone (Rastgar, 1995: 722). Also satire is known as counting someone's flaws (Razmjoo, 2004; 701). Farshid Vard has defined the subject of satirical and parody together and has said that: parody is harsh and furious and it's a humorous word which is not usually featured with any social means and sometimes it is the resultant of greed and cupidity for wealth and in this case, it is called satire (Farshid Vard, 1995; 976). Literary people and cultured people have defined satire is a type of lyrical poetry which is based on explicit and harsh criticism

which sometimes ends with abusiveness or burlesque sarcasm. The authors of the present research are trying to investigate and study the satire in poems of Dabal Khazaei.

**Statement of problem**

With no doubt, the poet is ideological and with his rich talents considers Quran, the tradition of Prophet Muhammad and his followers as the criterion for virtue of people. By dominating a wide range of Islamic concepts, he walks through the life of ignorant people and avoids worldly thinking and goes after righteousness. On this basis, one of poetic features of Dabal is his verbal conflict in terms of satire of rulers and kings. By avoiding conservatism towards his beliefs, he challenges his enemies. In most historical books he is reminded as a satirical poet in a way that no king or ruler was safe from his satires (Ibn Asakar, Bi ta; 17/248). Taking "Hiba" and "Saleh" never prohibited him from talking satirical in cases in which he had to be so (Ibn Asakar, Bi ta; 17/260).

**Satire in poems of Dabal Khazaei**
**Satire in Arabic poetry**

Satire is not limited by a specific boundary and it cannot be easily distinguished and differentiated from parody and other types of harsh and furious words. Still, satire is referred to words which are in contrast to elegy. Dr. Sheikh Amin has pointed out this issue: The art of satire is an old and ancient art which had been present in Arabian poems since the era of ignorance and its existence alongside the phenomenon of eulogy is a natural and logical. Because where ever there are people who deserve to be eulogized and praised, there will also be people who deserve satire and parody (Sheikh Amin, 2004; 641). The intention of satirical poetry is to provide a description of present situations of a person or a thing. Some times this situation and status is realistic and sometimes it's just a claim.Satirical poems are different from each other in terms of intensity or weakness of description of a present situation and on this basis, Ibn Bassam has categorized them into two different categories:

Noble satire: in this type of satire there is no explicit ribaldry or abusiveness but the words are extremely harsh and painful.

Villain satire: this type of satire is usually accompanied by taboo words and lack of consideration for manners and the intention of the poet from writing it is to make fun. This type of satire explicitly expresses the poet's point (Halbi, 1986; 93).

Other groups of critics have also considered a third type for satire which is known as humorous satire. Humorous satire depicts a caricature image of a person in a way that it exposes him or her to sarcasm and humiliation. This image has the advantage of being free and far from abusiveness and is issues by artist's sense of innovation and is based on a genuine type of art and is something higher than vein abusiveness.

Different literary periods are not similar in terms of abundance of satirical poems. Generally, in periods which are also parallel with some social chaos, unworthiness of kings and rulers and moral deviation of people we can see that satirical poetry has been more abundant. In this paper we have tried to discuss the symbols of satire and satirical poetry in Dabal Khazaei's court.

**Satires of Dabal Khazaei**

There are too many satires in Dabal's poems that many historians and authors have recalled him as a harsh poet. This poet has criticized other people in terms of different social, political, economic and domestic aspects. Also in some cases there is a direct correlation between satires of rulers and eulogies and praises of followers of Prophet Muhammad and in fact satirizing the Abbasid kings was the complementary to the eulogy of followers of Prophet Muhammad. The following provides samples of satirizing poems of Dabal Khazaei.

**Satire of Almotasam-Bellah**

After the death of Mamoon in 218 AH, his brother Almotasam-Bellah took over his kingdom. He was a genuine enemy to Alevis and used to pursue and torture them (Al-Isfahani, Bi Ta: 589).In such a situation Dabal wrote pounding poems against the outrageous Caliph and criticized him. The following provides examples of these poems:

بَكـــــى لِشَـــــتاتِ الـــــدين مُكتَئِـــــبٌ صَـــــبٌّ وَفاضَ بِفَرطِ الدَمعِ مِن عَينِهِ غَربُ

)Aldajili, Abdul-Saheb Omran(

A sad lover cried for the sorrow of violation of religion and because of the intensity of his cries, so many tears had fallen from his eyes.

وَقـــــامَ إِمـــــامٌ لَـــــم يَكُـــــن ذا هِدايَـــــةٍ يسَ لَهُ دينٌ وَلَيسَ لَهُ لُبٌّ

)Aldajili, Abdul-Saheb Omran(

An Imam raged who was not worthy of leadership. He neither had a religion nor had any wisdom and perfection.

وَمـــــا كانَـــــتِ الأَنبـــــاءُ تَـــــأتي بِمِثلِـــــهِ لَكُ يَوماً أَو تَدينُ لَهُ العُربُ

)Aldajili, Abdul-Saheb Omran(

News hadn't mentioned his kind. And he was not expected to reach to the throne some day or that Arabs obey him.

وَلَكِـــــن كَمـــــا قـــــالَ الَّـــــذينَ تَتَـــــابَعوا مِنَ السَلَفِ الماضي الَّذي ضَمَّهُ التُربُ

)Aldajili, Abdul-Saheb Omran(

But as the previous generations have joined the earth, they said…

مُلـــوكُ بَنـــي العَبّـــاس فـــي الكُتـــبِ سَـــبعَةٌ يَلَم تَأتِنا عَن ثامِنٍ لَهُم كُتبُ

)Aldajili, Abdul-Saheb Omran(

The heads of Abbasids are seven people according to the documents and there are no signs of any eighth person in these documents.

كَـــذَلِكَ أَهـــلُ الكَهـــفِ فـــي الكَهـــفِ سَـــبعَةٌ خِيارٌ إِذا عُدّوا وَثامِنُهُم كَلبُ

)Aldajili, Abdul-Saheb Omran(

The companions of the cave are also only seven people and their number eight is a dog.

إِنّـــي لَأَعلـــى كَلـــبَهُم عَنـــكَ رِفعَـــةً لِأَنَّكَ ذو ذَنبٍ لَيسَ لَهُ ذَنبُ

)Aldajili, Abdul-Saheb Omran(

Although I think of the dog of the companions of the cave as a being higher than you since you are guilty but that dog was innocent.

أَنَّـــــكَ إِذا مُلِّكتَنـــــا لِشَـــــقائِنا عَجوزٌ عَلَيها التاجُ وَالعِقدُ وَ الإِثبُ

)Aldajili, Abdul-Saheb Omran(

While you became the king through our misery and ruled us, you are like an old woman who has been given the throne and is wearing ceremonial clothes.

لَـــد ضـــاعَ أَمـــرُ النـــاسِ إِذ ســـاسَ مُلكَهُـــم وَصيفٌ وَأَشناسٌ وَقَد عَظُمَ الكَربُ

)Aldajili, Abdul-Saheb Omran(

It is true that peoples' rights are being neglected if two unworthy workers with the names of Vasif and Ashnas are placed at the head of their affairs this is considered as a catastrophe for the people.

In these verses, Dabal considers Motasam as a being lower than the dog of the companions of the cave because of his several sins and obscenities and after this bold and committed shout he ran away and stood hidden until the situation was back to normal.

**Satire of Mamoon**

Also in the following lines, he has tried to satirize Mamoon and also refers to the tribe of Khazae and their courage in removing the Amin Mobahat.

نَـــي مِـــنَ القَـــوم الَّـــذينَ سُـــيوفُهُم ... بَت اَخاكَ وَشَرَّفَتكَ بِمَقعَدِ

)Aldajili, Abdul-Saheb Omran(

I am form the tribe whose sword killed your brother and because of the throne, you became the king.

فَعَـــوا مَخَـــّاكَ بَعـــدَ طـــول خُمولِـــهِ ... وَاستَنقَذوكَ مِنَ الحضيضِ الأَوهَدِ

)Aldajili, Abdul-Saheb Omran(

After that you were in weakness and no one knew your name, you were provided with a high place and status and you were saved from unworthiness.

In satires of a family from the tribe of Khazae who were known as Bano-Moklem Alzaeb, he wrote the following lines

كَيـــفَ لَـــو كَلَّـــمَ اللَيـــثُ الهصـــورَ إِذَن ... اَفَدَيتُم الناسَ مَأكولاً وَمَشروبا

)Aldajili, Abdul-Saheb Omran(

If your father had spoken with a powerful and wild lion, you would have eaten people for that and destroyed them. It means that if instead of a wolf your father had spoken with a lion, because of your pride and arrogance you could have destroyed people.

هَـــذا السُـــذَيدِيُّ لا اَصـــلٌ وَلا طَـــرَفٌ ... يُكَلِّمُ الفيلَ تَصيداً وَتَصويبا

)Aldajili, Abdul-Saheb Omran(

This bastard talks to an elephant while he goes up and down.

اَذهَـــب إِلَيـــكَ فَـــإِنّي لا اَرى اَبَـــداً ... بِبابِ داركَ طَلّاباً وَمَطلوبا

)Aldajili, Abdul-Saheb Omran(

Go your way and I never see someone interested in you at your door step and I will never do so.
To criticize a tribe who were always the first to try to use their facilities but at the time of problems were idol and preferred to do nothing for correction of the situation, Dabal has written the following lines:

سُـــودٌ إِذا مـــا كـــانَ يَـــومُ وَليمَـــةٍ ... لَكِنَّهُم يَومَ اللِقاءِ ثَعالِبُ

)Aldajili, Abdul-Saheb Omran(

On the days of ceremonies and weddings they are like powerful and mighty lions but at the time of confronting the enemy they become a timid fox.

**Satire of Ahmad-Ibn Abi Davad**

Ahmad-Ibn Abi Davad was the companion and the consultant of Mamoon who used to contempt and offence Dabal and used to refer to him with bad words in order to get closer to the caliph. He had married two of the girls of the tribe of Bani-Ajal in one year. When the news was heard by Dabal, he wrote the following lines to criticize him:

صَـــبتَ عِجـــلاً عَلـــى فَـــرجَين فـــي سَـــنَةٍ ... سَدتَهُم ثُمَّ ما اَصلَحتَ مِن نَسَبِك

)Aldajili, Abdul-Saheb Omran(

In one year you imposed your cruelty to the tribe of Bani-Ajal because of two genitals. And in addition to the fact that you led to their destruction and deviation, you also corrected your race. It means that by marrying those two women, you reached your hands to the tribe of Bani-Ajal but by doing so not only you could not correct your own race, you also ruined them too.

وَلَـــو خَطَبـــتَ إِلـــي طَـــوقٍ وَأَســـرَتِهِ  زَوَّلَما زادوکَ في حَسَبِک

)Aldajili, Abdul-Saheb Omran(

And if you wanted to marry a girl from the family of Malik-Ibn Togh and they also agreed with your request, by this means they have not improved your status and therefore, you never obtained any dignity by marrying a girl from this family.

نِک مَن هَویتَ وَنَل ما شِئتَ مِن نَشَبِ  اَنتَ ابنُ زریابَ نسوباً إِلی نَشَبِک

)Aldajili, Abdul-Saheb Omran(

You can sleep with any one you want and you can have as much wealth as you want. Because you are a gold digger and wealth is what you have. It means that you can do whatever you want and you can go after women as much as you want. But still instead of being accompanied by great people, you gain your legitimacy through wealth.

ِن کـــــانَ قَـــــومٌ اَرادَ اللهُ خِـــــزیَهُم  زَوَّجوکَ ارتِغاباً مِنکَ في نَهَبِک،

)Aldajili, Abdul-Saheb Omran(

If the God wants to make a tribe infamous, that tribe will get their girls to marry you because of gold and wealth it means that if the god wants to make a tribe infamous, he will provide the contexts in a way that because of wealth and gold, that tribe gets a girl of their own to marry you and by this means they lead you to the inside of their tribe and family

وَلَـــو سَـــکَتَّ وَلَـــم تَخطُـــب إِلـــی عَـــرَبٍ  ما نَبَستَ الَّذي تَطویه مِن سَبَبِک

)Aldajili, Abdul-Saheb Omran(

If you have stayed silent and you have not given any speech for Arabs, still you cannot conceal your unworthy race and tribe. It means that you cannot hide your indignity and your obscene past through silence.

عُـــدَّ البُیـــوتَ الَّتـــي تَرضـــی بِخُطبَتِهـــا  جِد قُزارَةَ العُکلِيَّ مِن عَرَبِک

)Aldajili, Abdul-Saheb Omran(

If you try to count the people and houses that are willing to speak with you you can only find your own family among the people you have counted.

When Faraze-Alakli saw Dabal, he told him: O, Abu-Ali, what made you mention my name and stain my dignity, while I'm your friend? And Dabal replied: O, Brother, I swear to god that I didn't have any intention to hurt you but the God made the rhyme for me like this.

## CONCLUSION

Although that it is hard and difficult to assume a boundary between humor and satire, still, satire can be considered as the exact opposite of eulogy and praise and it can be referred to poems which exaggeratedly express the obscenities of a person or a social group. Satire writing poets were under the influences of their own personal life and on this basis they tend to write poems with this content and through employment of technics such as humiliation, making allegories and similes to animals, destruction of symbols, condemnation and even abusiveness and through these technics they attack the subject of their poems. Dabal has criticized many people including lusty men, singing women, unfaithful people, tight fisted people, timid people, greedy people, people who did not have any mannersand etc. also in his poems we can find examples of satire for physical defects of people, criticism of arrogant people, comparing the criticized person to an animal, criticism because of personality and behavioral traits and characteristics, criticizing contemporary poets and finally, social criticisms and satires.

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RESEARCH ARTICLE

# Effectiveness of Organizational Management and its Relationship with Management Competency in Public Administrative Organizations: A Case Study

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## ABSTRACT

The present study has investigated effectiveness of organizational management and its relationship with competencies of managers in public administration organizations in the cities of Shushtar and Dezful and Ahvaz in Khuzestan province of Iran. Participants in this study were managers in public organizations of Khuzestan province, which were 350. A questionnaire was used for measuring competencies of managers and effectiveness of organization. Data analyzed in SPSS software. Obtained results from the study indicate that organizations can improve competency of their managers through using mechanism of effectiveness of managers systematically.

**Key words**: effectiveness of managers, competency of managers, Khuzestan

## INTRODUCTION

Today, organizations consider their managers in core of their activities and revise their strategies on this basis. The thing that is being changed today is developing giving authority to the managers. The subject of effectiveness in the organization is a vital element and the organization needs to pay special attention to this issue to continue its activities, since through observance of this element, one can prevent waste of time and energy of human resources and can also develop their power for purpose of progressing organizational goals. One of the main features of the current century is surprising development of Information Communication Technology and using it for purpose of enhancing speed and quality of presenting services. In addition, in sector of services, it can encompass about 20% of total worldwide commerce. Over the past 15 years, it has had 8.5% rapid growth same as commodity trading. The progress has also affected banking industry and has caused wide changes in this industry. Speed of development of

the informatics industry has caused main changes in form of money and resource transfer systems in domain of banking and new concepts of banking industry have been emerged such as Electronic Banking E-banking . It is generally believes that human resources can be considered as the most valuable assets in the organization and have belonged the highest position in effectiveness of the organization. Success of the current organizations is resulted from efficient and experienced and knowledge-oriented human resource. In addition, effectiveness of organizational management has become as the desire of all manufacturing, servicing and academic organizations. For purpose of having successful presence in organizational communities and having presence in organizational competitions, effectiveness of the organization should be enhanced in a manner that resources of the organization can be also applied usefully. The power point of this issue can be competent managers. Hence, the study has been aimed in determining the relationships between competencies of managers and effectiveness of organization's manager. In other words, the study and its results can be applied for purpose of finding probable damages existing in management of the organizations and reason of their failures. Through this, one can also become familiar with management positions and causes of failure of the organizations in regard with achieving predetermined goals. Hence, the main question of the study is that, whether there is significant relationship between effectiveness of organization's management and competencies of managers in public organizations of Shushtar, Dezful and Ahvaz cities?

## METHODOLOGY

The main objective of all sciences is recognition and perception of the surrounding world. In order to become aware of problems and issues of social world, scientific methods have been changed considerably. The processes and movements have made people to use scientific methods to investigate different majors. One of the main features of scientific studies is that the studies seek exploring realities and use of suitable mythology. Choosing suitable methodology is depended on objectives, natures of studied subject and implementation equipment. The main aim by conducting studies can be achieving answers for research questions through a fast and easy way (Khaki. 2000).

At the present study, the author has investigated effectiveness of organizational management and its relationship with competency of managers in public administrative organizations in Shushtar, Dezful and Ahvaz cities in Khuzestan Province. This subject has been interested by the author on one hand; and has been required subject of the university on the other hand. In addition, required cooperation has been provided by managers and authorities of public organizations for purpose of conducting the present study. On one hand, obtained results from the present study and suggestions and strategies have been applied. Hence, the present study is in kind of applied research. On the other hand, the study is a basic study, since the main objective is producing more knowledge and perceiving phenomena and as a result, presenting theories based on results of the research. Applied methodology in this study has been descriptive-survey method. As the study has described and studied existing phenomena, the study is a descriptive research. Descriptive study describes and interprets the existing phenomena and considers existing conditions and relations, common beliefs and current processes and tangible and developing procedures. The focus of this study is at the first on the current time, although mainly it investigated phenomena and events of past times that are related to the present time. As in descriptive studies one can evaluate features of studied population through survey method, the present study is a descriptive study in kind of survey. Survey means collecting data through plans as guidance for description or prediction and for purpose of analysis of relationship between some variables.

**Statistical population and sample**

Statistical population of the study includes all managers (male and female) of public organizations of selected cities of Khuzestan Province, which have been worked on 2014. Sample of the study includes 400 people from the mentioned population, which have been selected using random sampling method and Krejcie & Morgan table. Statistical operations have been also performed on 400 referred questionnaires.

**Collecting data**

In this study a questionnaire was used for measuring competency of managers. it has 10 and 32 options scored based on Likert scale. face validity and consultation with experts were performed for testing validity of the questionnaire and Cronbach's alpha was applied for purpose of determining reliability. The coefficient has been obtained to 0.96 for whole questionnaire, which can generally depict desirable reliability coefficient of the mentioned questionnaire.

**Research hypotheses**

Hypothesis 1: effectiveness of organizational management is in relationship with job development of managers in public organizations of Shushtar, Dezful and Ahvaz cities.
Hypothesis 2: effectiveness of organizational management is in relationship with support of managers for employees in public organizations of Shushtar, Dezful and Ahvaz cities.
Hypothesis 3: effectiveness of organizational management is in relationship with good relation of managers with employees in public organizations of Shushtar, Dezful and Ahvaz cities.
Hypothesis 4: effectiveness of organizational management is in relationship with giving authority to employees by managers in public organizations of Shushtar, Dezful and Ahvaz cities.
Hypothesis 5: effectiveness of organizational management is in relationship with clear goals of managers in public organizations of Shushtar, Dezful and Ahvaz cities
Hypothesis 6: effectiveness of organizational management is in relationship with challenging goals of managers in public organizations of Shushtar, Dezful and Ahvaz cities
Hypothesis 7: effectiveness of organizational management is in relationship with decision making of managers in public organizations of Shushtar, Dezful and Ahvaz cities

**Measurement indexes**

Through having a general review on studies by this time, one can determine 30 different indices as measurement factor of organizational effectiveness. Table 1 has presented these indices.

**Basis of competency model**

Peters and Waterman in the book named "In Search of Excellence" published in 1982 studied 42 sample companies and found 8 common characteristics. The characteristics, which have been presented as excellence and success features, are as follows:

1-having bias on performing assignments and gaining goal 2- becoming close to customers to perceive their needs properly 3- giving independence to employees and empowering their entrepreneurship spirits in them 4- increase in efficiency through attracting participation of employees 5- awareness of employees about nature and philosophy of the company and involvement of managers in problems in all levels 6- presence in domain of competition and sustainability of commercial affairs 7- having simple and elegant organizational structure with least human resources in staff and proposed sector

## RESULTS AND DISCUSSION

**Testing hypotheses**

**Hypothesis 1**: there is a significant relationship between effectiveness in terms of goals and competency of managers.

According to table 2, there is a significant and positive relationship between effectiveness in terms of goals and competency of managers (r=0.70, p=0.0001). Hence, hypothesis 1 has been confirmed. In other words, increase in effectiveness in terms of goals of managers can result in enhancement of their competency.

**Hypothesis 2**: there is a significant relationship between effectiveness in terms of participation and competency of managers**.**

According to table 3, there is a significant and positive relationship between effectiveness in terms ofparticipation and competency of managers (r=0.77, p=0.0001). Hence, hypothesis 2 has been confirmed. In other words, increase in effectiveness in terms ofparticipation of managers can result in enhancement of their competency.

**Hypothesis 3**: there is a significant relationship between effectiveness in terms of emotions and competency of managers.

According to table 4, there is a significant and positive relationship between effectiveness in terms of emotions and competency of managers (r=0.68, p=0.0001). Hence, hypothesis 3 has been confirmed. In other words, increase in effectiveness in terms of emotions of managers can result in enhancement of their competency.

**Hypothesis 4**: there is a significant relationship between effectiveness in terms of leadership and competency of managers**.**

According to table 5, there is a significant and positive relationship between effectiveness in terms of leadership and competency of managers (r=0.59, p=0.0001). Hence, hypothesis 4 has been confirmed. In other words, increase in effectiveness in terms of leadership of managers can result in enhancement of their competency.

**Hypothesis 5**: there is a significant relationship between effectiveness in terms of decisions and competency of managers.

According to table 6, there is a significant and positive relationship between effectiveness in terms of decisions and competency of managers (r=0.79, p=0.0001). Hence, hypothesis 5 has been confirmed. In other words, increase in effectiveness in terms of decisions of managers can result in enhancement of their competency.

**Hypothesis 6**: there is a significant relationship between effectiveness in terms of trust and competency of managers.

According to table 7, there is a significant and positive relationship between effectiveness in terms of trust and competency of managers (r=0.70, p=0.0001). Hence, hypothesis 6 has been confirmed. In other words, improve in effectiveness in terms of trust of managers can be along with enhancement of their competency.

**Hypothesis 7**: there is a significant relationship between effectiveness in terms of using personal resources and competency of managers.

According to table 8, there is a significant and positive relationship between effectiveness in terms of using personal resources and competency of managers (r=0.71, p=0.0001). Hence, hypothesis 7 has been confirmed. In other words, improve in effectiveness in terms of using personal resources by managers can be along with enhancement of their competency.

**Hypothesis 8**: there is a significant relationship between effectiveness in terms of using other resources and competency of managers.

According to table 9, there is a significant and positive relationship between effectiveness in terms of using other resources and competency of managers (r=0.76, p=0.0001). Hence, hypothesis 8 has been confirmed. In other words, improve in effectiveness in terms of using other resources by managers can be along with enhancement of their competency.

## CONCLUSION

Effectiveness and competency of managers, as a systematic and organized mechanism, can be able to guide organizations to use resources optimally. Necessity of using the mechanism can be cleared more than before, when organizations are informed of effects of results using it. Hence, the present study has been aimed in investigating results of using effectiveness of managers on their competency in public organizations. In order to be able to conduct a comprehensive analysis on effects of using effectiveness of managers in the organization, one should have comprehensive view on the organization to consider all parts and sectors of the organization and to be able to investigate effects of effectiveness processes on competency of managers. At the present study, firstly exploratory studies have been applied including literature review and performing interviews to codify hypotheses. Then, survey method has been applied for purpose of evaluating and testing the hypotheses. Data analysis could confirm accuracy of research hypotheses. Obtained results from the study indicate that organizations can improve competency of their managers through using mechanism of effectiveness of managers systematically.

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**Table 1: Indices of organizational effectiveness**

| Row | Index | Row | Index |
|---|---|---|---|
| 1 | Total effectiveness | 16 | Targeting and planning |
| 2 | Proficiency | 17 | Consensus and continuing target |
| 3 | Efficiency and outcome | 18 | Internalization of goals |
| 4 | Profit | 19 | Dominant role and norm |
| 5 | Quality | 20 | Management relationship skills |
| 6 | Events | 21 | Management task skills |
| 7 | Growth and development | 22 | Information communication management |
| 8 | Absence and irregularity | 23 | Preparation and talent |
| 9 | Asset return | 24 | Environment function |
| 10 | Job satisfaction | 25 | Evaluation of external factors |
| 11 | Incentives | 26 | Stability |
| 12 | Spirits | 27 | Human resource value |
| 13 | Control | 28 | Cooperation and share |
| 14 | Integration of conflicts | 29 | Emphasizing education and development |
| 15 | Adaptability and flexibility | 30 | Emphasizing successes |

**Table 2: Simple correlation coefficients between effectiveness in terms of goals and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Management Competency | Effectiveness in terms of goals | 0.70 | 0.0001 | 400 |

**Table 3: Simple correlation coefficients between effectiveness in terms of participation and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Competency | Effectiveness in terms ofparticpation | 0.77 | 0.0001 | 400 |

**Table 4: Simple correlation coefficients between effectiveness in terms of emotions and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Competency | Effectiveness in terms of emotions | 0.68 | 0.0001 | 400 |

**Table 5: Simple correlation coefficients between effectiveness in terms of emotions and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Competency | Effectiveness in terms of leadership | 0.59 | 0.0001 | 400 |

**Table 6: Simple correlation coefficients between effectiveness in terms of emotions and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Competency | Effectiveness in terms of decisions | 0.79 | 0.0001 | 400 |

**Table 7: Simple correlation coefficients between effectiveness in terms of emotions and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Competency | Effectiveness in terms of trust | 0.70 | 0.0001 | 400 |

**Table 8: Simple correlation coefficients between effectiveness in terms of using personal resources and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Competency | Effectiveness in terms of using personal resources | 0.71 | 0.0001 | 400 |

**Table 9: Simple correlation coefficients between effectiveness in terms of using other resources and competency of managers**

| Dependent variable | Predictor variable | Correlation coefficient (r) | Sig. | N |
|---|---|---|---|---|
| Competency | Effectiveness in terms of using other resources | 0.76 | 0.0001 | 400 |

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**RESEARCH ARTICLE**

# Biodiversity of Ornamental Fishes in the Hirakud Reservoir and their Socio-Economic Benefits to Fishers' Communities of the Region

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## ABSTRACT

With the objective of analyzing the fish fauna and gathering vital information on the ornamental fish diversity and species richness of the Hirakud Reservoir, a study was conducted during January to June, 2013. The study envisaged linking of the potential ornamental fish availability to the socio-economics of the fishers' community of this region. The collected data reveals the occurrence of 54 species belonging to 35 genera, 19 families and 7 orders. Among the 54 species, 20 species are classified as indigenous ornamental fishes and 6 species are ornamental as well as food fish. The present socio-economic status of the fishers of Hirakud region is poor. The study concludes that ornamental fish can be one of the alternatives for the fishers of Hirakud region for livelihood enhancement. The fisherwomen can be very well avocationed for collection, rearing and further marketing.

**Keywords:** Species diversity, The Mahanadi river, Hirakud Reservoir, Evenness, Inclusive growth

## INTRODUCTION

India is the second largest producer of fish in the world and contributes 5.43% of global fish production. India is also the second largest producer of fish through aquaculture next to China. Fisheries sector occupies a very important place while we consider socio-economic development in the country [1]. In this scenario, ornamental fish is one of the items among the various types of commercially important fishes marketed nationally and internationally [2].The aesthetic value like multicolour, peculiar body shape and swimming behaviour of ornamental fishes and



mythological believe, attracts hobbyist and in turn become a trade practice globally due to the low operating cost and easy management system. The ornamental aquatic industry is a worldwide business with a trade of approximately US$ 15 billion retail value [3]. Developing nations contributed two third of the total export value [4]. The entire industry, including accessories and fish feed, is estimated to be worth around US$ 18-20 billion. More than 2,500 species are traded internationally. The market is dominated by nearly 30-35 species of freshwater fish. Out of this, more than 90% are developed through captive breeding. On the other hand, only 25 out of nearly 8,000 marine ornamental fish species are bred in captivity [5-6]. The trade of ornamental fish is growing with an annual growth rate of 8%and offers a lot of scope for development of the sector [7].

**Review of Literature**

India is one of the mega-diversity countries in the world and also considered as one of the gold mines for indigenous ornamental fishes. The two mega hubs for freshwater fish diversity in India are the North Eastern region and Western Ghats. Besides, quite a good number of indigenous ornamental fish species are also found in West Bengal [8]. Nearly 806 fish species inhabit in the freshwaters of India [9]. About 52 indigenous species of ornamental fishes are found in North East region of India [10]. Kurup and Radhakrishnan (2006) have reported 79 potential ornamental fishes in Western Ghats with special reference to Kerala [11]. Singh *et al.,* (2013) while reviewing the fish fauna of the Mahanadi Riverine system, has revealed that in the Mahanadi, 38 species are exclusively considered as ornamental and 13 species are recognized for use as ornamental and food both [6].

Hirakud Reservoir, which stands largest man made reservoir in Asia with the longest dam in the world, a major irrigation reservoir, was commissioned in the year 1957 and is situated in Sambalpur, Jharsuguda and Bargarh districts of Odisha with location of 210 30' N Latitude and 800 E Longitude and in the confluence of Mahanadi and the Ib. The reservoir has a water spread area of 463 km2. The catchment area of the reservoir is 83,395 km2 with shore line of 643.6 km [6]. According to Sugunan (1995), the commercial fishery of Hirakud Reservoir comprises nearly 40 species. Hirakud, despite being the longest man made earthen dam in the world, remains one of the least researched in terms of its fishery potential [12]. The fiah production form this large water body is also on eof the lowest.Having its existence for over 60 years, and having passed through the initial phases of trophic burst and trophic depression, however,the Reservior provides bread and butter to more than 4000 fishermen families directly or indirectly dwelling in its periphery[13].

In view of the potential and possibilities of agribusiness through ornamental fishes in the Mahanadi River, the present study has been undertaken to correlate the availability of potential ornamental fish species in the Hirakud Reservoir with the socio-economics of the fishermen community inhibiting this region.

## MATERIALS AND METHODS

Fish species were collected from different landing centres and fish markets of Hirakud region. For taxonomic study, fish samples were preserved in 5% formaldehyde solution. The taxonomic study was done by referring Day (1878), Talwar and Jhingran (1991) and Jayaram (1981). Further, the names of the identified fishes were checked up with the website of fish base [9, 14, 15, 16]. Identifications were further confirmed with the help of Zoological Survey of India, Kolkata. Endemic status of the available ornamental fishes were determined according to the Threatened freshwater fishes of India, National Bureau of Fish Genetic Resources, 2010 and IUCN Red list of Threatened Species, 2012.2 version [17].

For determination of the diversity index for the surveyed and collected samples, Shannon and Wiener (1963) formula was followed, which is:

$$H = -\sum_{i=1}^{S} P_i \ln (P_i)$$

where; H= Shannon-Wiener index of diversity, S= total number of species, P*i*= (N*i*/N) proportion of total sample represented by species *i,* N= total number of individual of all species, N*i*= total number of specimens of each species. Evenness of the diversity index was calculated by using the formula[18]:

$$E = H/H_{max}, \text{where } H_{max} = \ln(S)$$

For analysis of important hydrological parameters, water samples were collected from certain identified landing centres with the help of Directorate of Fisheries, Government of Odisha. Water temperature, dissolved oxygen and pH were measured *in situ* with the help of digital sensors, while free $CO_2$, total alkalinity, hardness, inorganic nutrients, viz., ammonia, nitrite, nitrate and phosphate were measured using standard methods by following APHA (1998) [19].

Information on the habitat and economic aspect of fishes was also collected from fishermen and local fish retailers. To study socioeconomics of the fishermen communities, interviews were conducted with the fishermen families from different regions as well as the fish retailers in the market of the Hirakud region including Sambalpur town. The minimum sought information especially on the fishing gear used by them, mechanism of operation and types of fish caught, marketing of the catch fish and income earned therefrom, etc .[13, 20].

## RESULTS AND DISCUSSION

**Species diversity and percentage of ornamental fishes**

The entire collected specimen were identified and arranged according to their taxonomic order, family, genus and species. Besides, the economic importance and their conservation status were taken into consideration. The survey recorded 54 species belonging to 35 genera, 19 families and7 orders (Table-1). It was observed that Cyprinidae is the most abundant family contributing 37% of the total species of the different families found in this region (Fig. 1).Among the orders, Perciformes topped the list followed by Siluriformes with less abundance (Fig.2). As regards diversity indices, the Shannon–Weiner diversity index ranged between 3.23 and 3.92 which showed a strong relationship with overall species richness. The result indicated that the species variation among the different selected sites is very less. The evenness varies between 0.84 and 0.91.

Presently, native fish species are in demand as ornamental fishes for trade in national and international markets. These species are *Chanda nama*(Ham.)*, Mystus vitatus*(Bloch)*, Notopterus notopterus*(Pallas)*, Colisa fasciatus*(Bloch &Schn.)*, Colisa laila* (Ham.),*Mastacembeluspuncalus* (Ham.)*, Brachydanio rerio*(Ham.)and *Botia lohachata* (Chaudhuri.)**,** etc. [21] (Ghosh *et al.,* 2003).Among the 19 families of the collected fishes, all other families, except 4 families, namely: Channidae, Cichlidae, Clupeidae and Synbranchidae have ornamental fish representatives. Out of the reported 54 fish species, 20 species are considered as only ornamental fishes, 28 species as only food fishes and 6 species as both ornamental and food fish (Fig.4). Ornamental fish species like *Parambassis lala* (Ham.), *Chanda nama* (Ham.),*Chanda ranga* (Ham.),*Amblypharyngodon mola* (Ham.), *Danio devario* (Ham-Buch.), *Osteobrama cotio* (Ham.), *Puntius sophore* (Ham.),*Puntius ticto* (Ham.),*Rasbora daniconius* (Ham.),*Glossogobius giuris* (Ham.) and *Notopterus notopterus*(Pallas) etc. documented good abundance in this region. In addition, some larger food fishes like *Labeo gonius*(Ham.)*, Channa marulius*(Ham.) and *Rita rita*(Ham.) can also be treated as ornamental fishes during their juvenile stages and are non-classified ornamental fishes [2] (Mandal *et al.,*2007).

**Water Quality Parameters**

The values of water quality parameters of the Hirakud Reservoir showed that the productivity level falls in the range between the medium and high productive Reservoirs described by Yadava and Sugunan (2009) (Table-2) [22]. However, despite having a huge potential in terms of production, the actual production of Hirakud Reservoir is only 5-6 kg per hectare. The total catch composition revealed that the percentage of small catfishes, major carps and big cat

fishes is nearly the same (Fig.5) as reported by Directorate of Fisheries, Government of Odisha, for the Hirakud Reservoir.

**Socio-economics of the fisher community of Hirakud region**

The study was undertaken covering100 families with population of 647 persons. The population studied was categorized in three age groups viz., 0 – 15 years, 16 – 45 years and 46 – 60 years. It was observed that fishers in the age group of 16 – 35 years were more in number with more active role in fishing activities. The fishers in the age group of 46 – 60 years are although not directly engaged in fishing, most of them are involved in ancillary activities including making and repairing of craft and gear. Individuals below 15 years of age are occasionally working in the fishing activities along with their elders. Besides fishing, the fishers are also engaged in agricultural activities. In the sample survey, the average sex ratio of the fisher family members is 83 females per 100 males. In the social structure of local fishers, it was found that most of them belong to Kewat caste and follow Hindu religion. The socio-economic survey indicated that the fisher population is educationally backward. Women form the most illiterate group among the fisher population. The age group under 15 years has the highest number of literates forming a little more than 50% of the group while the least literate fishers belonged to the age group of 46-60 years with less than 5%. The average income of a fisher family is in the range between Rs.100-120 per day which is quite low. There are 32 major fish landing centres around the Hirakud Reservoir.

For a judicious fisheries management and security of the Dam, the Hirakud Reservoir has been demarcated into 6 different sectors. Out of these, 5 sectors (I, II, IV,V& VI) have been allotted to five Primary Fishermen Co-operative Societies (PFCS) for commercial fishery on annual lease basis. The Sector–III is retained under Fisheries Department for experimental fishing [13]. It is observed during the study that, out of all the above PFCS, Thebra PFCS (now in Jharsuguda Disttict) is the bease managed one followed by Tamdei. But the other three PFCS are not properly managed due to internal politics and vested interest.

## CONCLUDING REMARKS

Inland fishers are more vulnerable in comparison to their counterparts in marine sector or aquaculture farmers [22, 23, 24]. Considering fishery as an industry, the fishermen are the primary stakeholder group. Their capacity to toil and labour provide the platform for the prospective growth of the fishery sector substantially. Without inclusive growth and improvement of their socio-economic condition, the growth of the fishery sector shall not be at the desired level. Poor condition of living standard, unequal access to monetary income, lack of basic amenities and most importantly the education may lead to terrible consequences for the sector. Hence, there is a greater need to enhance the socio-economic conditions of the fishermen so that the fishery sector can augment productivity and enhance income status of fishers [23, 24, 25, 26].

Systematic collection and marketing of native ornamental fishes from the wild alongwith captive breeding and rearing of exotic ornamental fish species can render enormous agribusiness opportunities to the poor fishermen as native ornamental fishes are being recognized and demanded in domestic as well as in international markets [2,21,27]. Hence, this is a realistic approach to suggest that the indigenous ornamental fish species identified in this study have the potential for being a main component of the said agribusiness focusing on the economic potential of the indigenous ornamental fishes and their market value suggested by earlier authors viz. Mandal *et al.*(2007) [2, 27].

Government of India, as per its current policy, allows import of 92 varieties of ornamental fishes in accordance with Guidelines for import of ornamental fishes into India [28]. However, FAO and OIE deliberate that there is always a risk of trans-boundary disease associated with import of an exotic aquatic animal into a country. Such risk can be minimized by facilitating the trade of indigenous ornamental fishes as a result of which import of exotic species will be reduced. However, collection of wild indigenous fishes may also pose risk in terms of stock depletion due to over exploitation of the natural stock. Thus, the best possible design would be the agribusiness of both indigenous and exotic fishes which can be taken up by developing rearing centres for trading and marketing by the local fishers. This

will help in steady supply of ornamental fishes in the market and regular income for the fishers. In turn, this will reduce the fishing pressure on the wild stock and would, therefore complement the conservation efforts of native ornamental fishes.

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**Table-1. Different Fish Species Found at Hirakud Region**

| Order | Family | Species | Food/ Orn.Fish | IUCN Status |
|---|---|---|---|---|
| **1. Perciformes** | 1. Ambassidae | *Parambassis lala* (Ham.) | Orn.[1] | LRnt[2] |
| | 2. Anabantidae | *Anabas testudineus* (Bloch) | Orn. | VU[3] |
| | | *Colisa fasciatus* (Bloch&Schn.) | Orn. | LRnt |
| | 3.Centropomidae | *Chanda nama* (Ham.) | Orn. | LRlc[4] |
| | | *Chanda ranga* (Ham.) | Orn. | LRlc |
| | 4. Channidae | *Channa gachua* (Ham.) | Food | VU |
| | | *Channa marulius* (Ham.) | Food | LRnt |
| | | *Channa punctatus* (Bloch) | Food | LRnt |
| | | *Channa striatus* (Bloch) | Food | LRlc |
| | 5. Cichlidae | *Oreochromismossambicus* (Peters) | Food | Intrd.[5] |
| | 6. Gobiidae | *Glossogobius giuris* (Ham.) | Orn. | LRlc |
| | 7. Nandidae | *Nandus nandus* (Ham.) | Orn. | LRnt |
| **2.Beloniformes** | 8.Belonidae | *Xenentodoncancila* (Ham.) | Orn. | LRlc |
| **3.Clupeiformes** | 9.Clupeidae | *Gudusiachapra* (Ham.) | Food | LRlc |
| **4. Cypriniformes** | 10.Cobitidae | *Lepidocephalichthysguntea* (Ham.) | Orn. | LRlc |
| | 11. Cyprinidae | *Amblypharyngodon mola* (Ham.) | Orn. | LRlc |
| | | *Catla catla* (Ham.) | Food | VU |
| | | *Cirrhinus mrigala* (Ham.) | Food | LRlc |
| | | *Cirrhinus reba* (Ham.) | Food | VU |
| | | *Ctenophryngodonidella* (Val.) | Food | Intrd |
| | | *Cyprinuscarpio* (Linn.) | Food | Intrd. |
| | | *Danio devario* (Ham-Buch.) | Orn. | LRlc |
| | | *Danio (Brachydenio) rerio*(Ham.) | Orn. | LRlc |
| | | *Hypophthalmichthysmolitrix*(Val.) | Food | Intrd. |

| | | | | |
|---|---|---|---|---|
| | | *Labeo bata* (Ham.) | Food | LRlc |
| | | *Labeo calbasu* (Ham.) | Food | NT[6] |
| | | *Labeo fimbriatus* (Bloch) | Food | LRlc |
| | | *Labeo gonius* (Ham.) | Food | LRlc |
| | | *Labeo rohita* (Ham.) | Food | LRlc |
| | | *Osteobrama cotio* (Ham.) | Orn. | VU |
| | | *Puntius sarana* (Ham- Buch.) | Food | VU |
| | | *Puntius sophore* (Ham.) | Orn. | LRlc |
| | | *Puntius ticto* (Ham.) | Orn. | LRlc |
| | | *Rasbora daniconius* (Ham.) | Orn. | LRnt |
| | | *Salmostomabacaila* (Ham.) | Food | LRlc |
| **5. Siluriformes** | 12. Bagridae | *Mystus (Aorichthys) aor* (Ham.) | Food | DD[7] |
| | | *Mystus (Aorichthys) seenghala* (Sykes) | Food | LRlc |
| | | *Mystus tengara* (Ham.) | Orn. | LRlc |
| | | *Mystus vitatus* (Bloch) | Orn. | LRlc |
| | 13. Siluridae | *Ompok bimaculatus* (Bloch) | Orn./Food | VU |
| | | *Ompok pabda* (Ham.) | Food | VU |
| | | *Ompok pabo* (Ham.) | Food | LRnt |
| | | *Wallago attu* (Bl. &Schn.) | Food | LRnt |
| | 14.Saccobranchide | *Heteropneustes fossilis* (Bloch) | Orn./Food | VU |
| | 15. Claridae | *Clarias batrachus* (Linn.) | Orn./Food | VU |
| | 16.Schilbeidae | *Ailiacoila* (Ham.) | Food | NT |
| | | *Clupisomagarua* (Ham.) | Food | VU |
| | | *Eutropiichthysvacha* (Ham.) | Food | LRlc |
| **6.Osteoglossiforms** | 17.Notopteridae | *Chitala chitala* (Ham.) | Orn. | LRnt |
| | | *Notopterus notopterus*(Pallas) | Orn. | LRnt |
| **7.Synbranchiforms** | 18.Mastacembeliae | *Macrognathusaral*(Bloch &Schn.) | Orn./Food | LRlc |
| | | *Mastacembelusarmatus*(Laceped) | Orn./Food | LRlc |
| | | *Mastacembeluspuncalus* (Ham.) | Orn./Food | LRlc |
| | 19. Synbranchidae | *Monopteruscuchia*(Ham.) | Food | VU |

[1.]Ornamental, [2.]Low Risk near threatened,[3.]Vulnerable, [4.] Low Risk least concern, [5.] Introduced, [6.] Near Threatened,[7.]DD-Data Deficient

**Table-2. Water Quality Parameters of Hirakud Reservoir**

| Sl.No. | Water Parameters | Minimum | Maximum | Mean |
|---|---|---|---|---|
| 1. | Temperature $^0$C | 19 | 39.6 | 32.2 |
| 2. | pH | 7.8 | 8.2 | 8.1 |
| 3. | Dissolved Oxygen (mg/l) | 6.2 | 9.2 | 7.9 |
| 4. | Total Alkanity (ppm) | 39.6 | 82.2 | 60.2 |
| 5. | Total Hardness (ppm) | 41.2 | 72.3 | 54.75 |
| 6. | Carbon Dioxide(ppm) | 4.2 | 5.6 | 4.8 |
| 7. | Nitrate –N( mg/l ) | 0.05 | 2.05 | 0.56 |
| 8. | Nitrite-N (mg/l) | 0.001 | 0.42 | 0.11 |
| 9. | Phosphate (mg/l) | 0.025 | 0.04 | 0.032 |

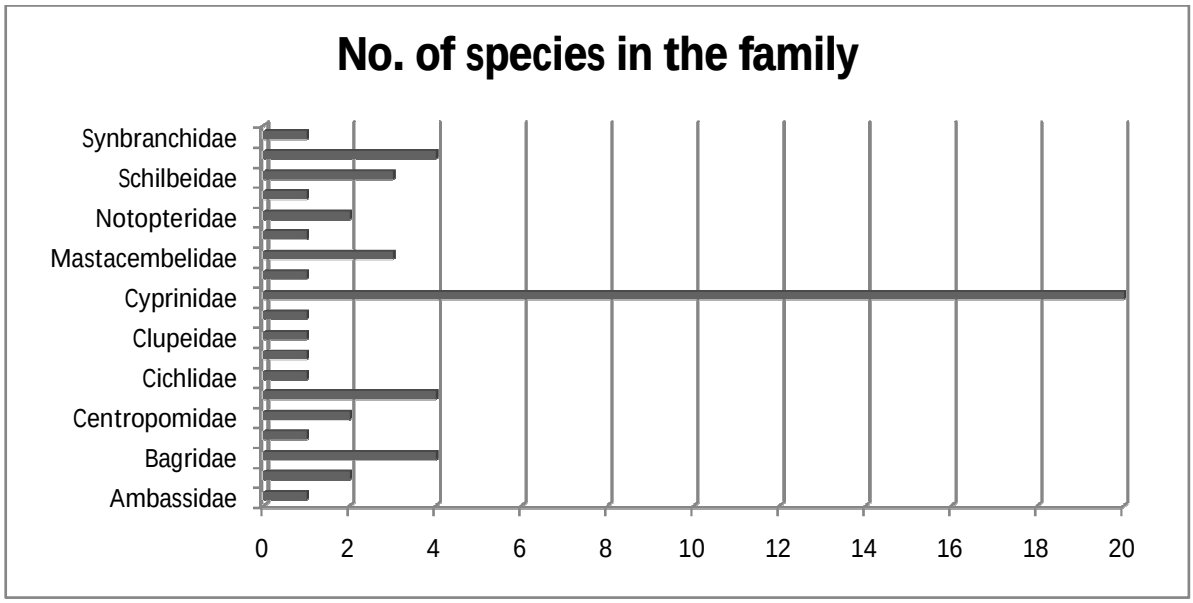


**Fig. 1 .Distribution of fish species within different families in the Hirakud Reservoir**

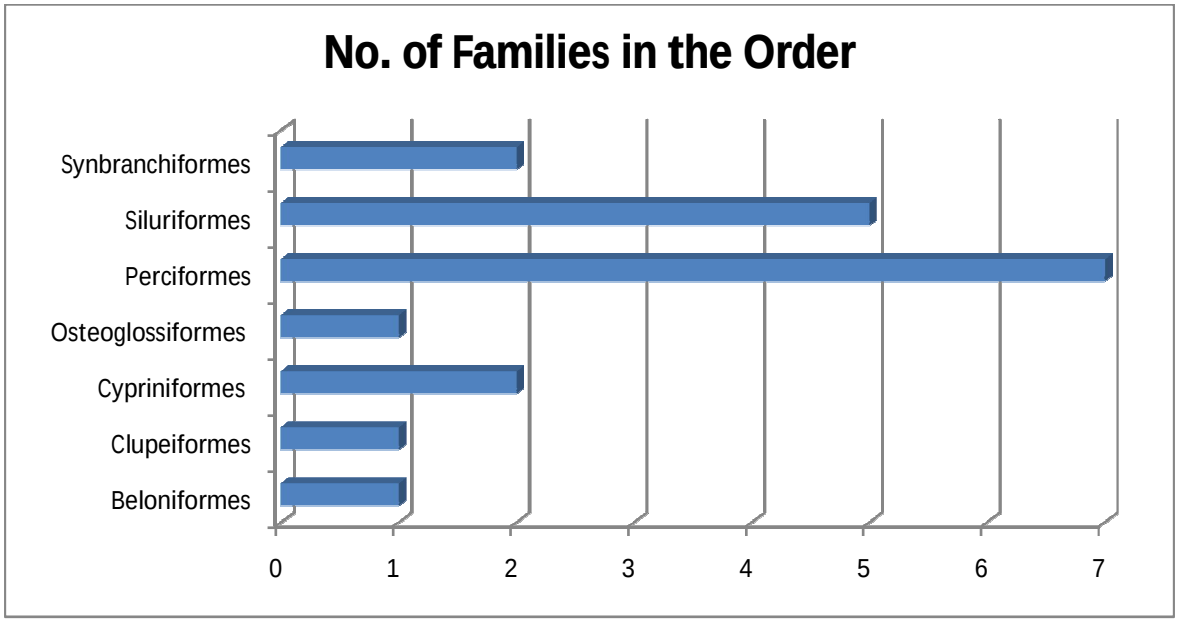


**Fig.2.Distribution of fish families within different orders in the Hirakud Reservoir**

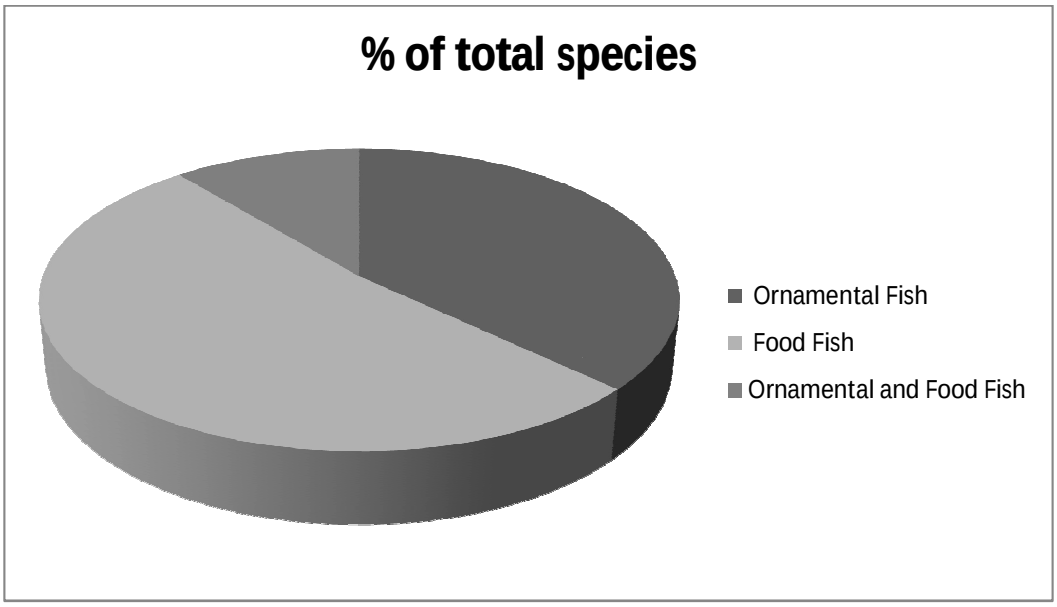


**Fig. 3. Percentage of Ornamental fish species to the total fish varieties of Hirakud Reservoir**

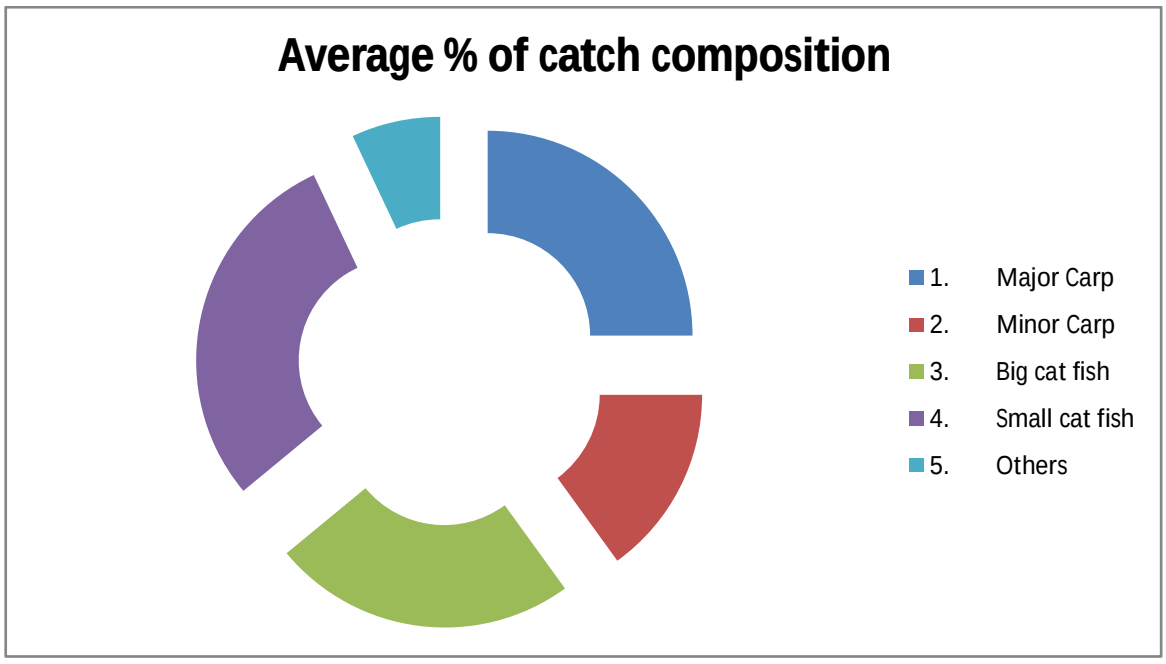


**Fig. 4. Catch composition of Hirakud Reservoir**

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REVIEW ARTICLE

# Nutrient Management for Sustainable Rice Production

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## ABSTRACT

Soil fertility maintenance is essential for sustainable rice production.The excessive and imbalanced use of inorganic fertilizers led to decline in productivity and degradation of natural resources such as soil and water. Balanced and integrated application of nutrients holds a key to better sustenance of soil quality which tends to improve and sustain the rice productivity.

**Key words:** Rice, green manure, organic manure, biofertilizer, inorganic fertilizers, INM

## INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for nearly three billion people, and demand continues to grow as population increases [1]. India has produced 131 m t of rice with the productivity of 3.37 t $ha^{-1}$ [2]. It is estimated that by the year 2020, in India 170 to 180 m t (115-120 m t milled rice) of rice has to be produced with an average productivity of 4.03 t $ha^{-1}$ to maintain the present level of self sufficiency [3]. To achieve this target, nutrient deficiency status of rice growing belt and adoption of imbalanced nutrient management practices were major constraints to tap the potential yield of rice. At the same time, the excessive and imbalanced use of inorganic fertilizers led to decline in productivity, degradation of soil and water resources, diminishing biodiversity and increase in environmental pollution [4]. Due to escalation of fertilizer prices and associated environment problem of inorganic cultivation, it is necessitated to exploit the available resources of nutrients under the theme of integrated nutrient management. Under this approach, the best available option lies in the complementary use of biofertilizers, organic manures in suitable combination of inorganic fertilizer [5].

**Organic Manures**

Addition of organic manures in the soil plant ecosystem is an essential component of sustainability in nutrient exhaustive rice cropping systems. It influences the microbial activity in the soil and subsequent nutrient transformation [6]. Application of organic manures favoured the microbial population which in turn helped to release bounded or unavailable form of nutrients to available form [7]. Highest organic carbon (0.84 %) was observed when managed organically [8]. Organic carbon and infiltration rate were high with the application of organic manures through pressmud and *dhaincha* green manure under continuous submergence of sodic soil [9].

Under different organic sources, the total and individual population of different microorganisms was higher in wheat straw amendment which was followed by green manure and FYM application, respectively in the long term experiment [10]. Farm yard manure is being used as major source of organic manure in field crops and its role in crop production can not be overlooked, in addition to supplying all essential nutrients, it increases the activities of bacteria or microbes in soil [11]. Organic sources with moderate C/N ratio and high lignin content (green gram) resulted in high rice yield compared to wide and narrow C/N ratio sources with low lignin content (straw and *dhaincha)* [12].

**Green Manures**

Green manuring is the cheapest locally available resource for building up soil fertility and supplementing plant nutrients, especially N. The practice of ploughing in of un-decomposed green plant material into the soil for improving the physical condition as well as fertility of the soil is called as “green manuring.” Green manures may be grown *in situ* by raising a legume such as *Sesbania aculeata* or *Crotolaria juncea* for a period of 45 to 60 days [13]. *Sesbania aculeate* (dhaincha), *Crotolaria juncia* (sunnhemp) and *Vigna unguiculata* (cowpea) are capable of accumulating 4-5 t $ha^{-1}$ of dry mass and about 100 kg N $ha^{-1}$ in 50-60 days. Integrated use of green manures with recommended inorganic fertilizers indicated that increase in rice and wheat yields was largest in case of *Sesbania* along with 100 per cent NPK doses in both the crops than *Crotolaria juncia* and cowpea green manure crops [14].

**Biofertilizers**

Biofertilizers are cost effective, ecofriendly and renewable source of plant nutrients to supplement fertilizers sustainable agriculture development. Hence the use of biofertilizers becomes an integral part of plant nutrient management for maximum crop production. Soil microorganisms colonizing the rhizosphere assist the plants in uptake of several vital nutrients from soil [15]. Higher population of total bacteria (52-79 x $10^6$ $g^{-1}$), fungi (56-125 x $10^6$ $g^{-1}$), and actinomycetes (18-39 x $10^4$ $g^{-1}$) in the soils of biofertilizers inoculated plots than initial sample indicating an enhanced soil biological activity [16].

***Azospirillum***

*Azospirillum* sp. produced phytohormones which could stimulate root growth and induce changes in root morphology resulting in enhanced nutrient assimilation. The major hormone produced by *Azospirillum* was indole-3-acetic acid (IAA), indole lactic acid, indole-3-butyric acid (IBA), indole-3-methanol, unidentified-indole compounds, gibberellins, abscisic acid (ABA) and cytokinins [17]. The shoot dry matter production of rice variety IR 50 was more with *Azospirillum* (12.71 g) followed by *Pseudomonas* (10.93 g) and *Azotobacter* (10.33 g) in the sandy loam soil [18]. *Azotobacter* and *Azospirillum* helped in better seed germination, differentiation of root system and realization of higher yields in crops like wheat, rice, maize, sorghum, cotton, sunflower and mustard [19].

**Phosphobacteria**

The normal soil contains about 0.05 per cent phosphorus but only one tenth of this is available to the plants due to its poor solubility and chemical fixation in the soil [20]. Many microbes in the soil are able to solubilize the unavailable form of calcium bound phosphate by excreting organic acids and can dissolve rock phosphate by chelating calcium

ions to bring phosphorus into solution and makes phosphorus available to plants and increases root growth [21]. Phosphorus solubilizing microorganisms help to solubilize the chemically fixed phosphorus in the soil and thereby reducing the dependence on chemical fertilizers [22].

***Azophos***

Inoculation with bacterial mixture of $N_2$ fixing and phosphorus solubilizing bacteria provided a more balanced nutrition for the plants [23]. The dual inoculation of *Azospirillum* and phosphobacteria resulted in higher root biomass in cotton [24]. Mixed cultures provided conditions more suitable for $N_2$ fixation than those present in pure cultures [25].

**Pink-Pigmented Facultative Methylotrophs (PPFM)**

The facultative methylotrophs exhibiting distinct pink pigmentation are referred as pink-pigmented facultative methylotrophs and popularly called PPFMs [26] which are ubiquitous in the phyllosphere and rhizosphere of the plants [27]. Facultative methylotrophs can utilize various multi-carbon compounds in addition to single carbon compounds unlike obligate methylotrophs that can utilize only single carbon compounds [28]. The PPFM bacteria removed metabolic waste products like methanol from the apoplast of the host and using them as a nutritional source, degraded them into simple compounds, which were eventually returned to the plant [29].

Combined application of PPFM with 75 per cent NP and 100 per cent K increased the growth and physiological parameters in terms of total chlorophyll, protein and phenol and also the activity of urease enzyme in ADTRH 1 hybrid rice [30]. The inoculation of rice cultivar CO 43 with facultative methylotrophs increased the total chlorophyll content of 1.44 mg $g^{-1}$ and soluble protein of 7.45 mg $g^{-1}$ over the uninoculated control [31]. The beneficial effects of PPFM on growth and development of crop plants had been attributed to the production of vitamin [27] and phytohormones such as IAA, cytokinins and gibberellic acid [29].

***Azophosmet***

Beneficial bacteria such as *Azospirillum*, *Phosphobacteria* and methylotrophs colonizing in the rhizosphere region had the ability to fix nitrogen, solubilize phosphorus and stimulate plant growth [32]. A comprehensive application of *Azophosmet* to seed, then to soil and as pink pigmented facultative methylotrophs to phyllosphere in addition to scheduled fertilizer and farm yard manure produced higher biomass of rice than combined application of scheduled fertilizer and farm yard manure [33].

**Azolla**

*Azolla-anabaena* association is a live, floating N factory using energy from photosynthesis to fix atmospheric N, amounting to 100-150 kg $ha^{-1}$ annually from about 40-60 tonnes of biomass and requires temperature around 25°C and high relative humidity. It helps to the increase of crop yields by 15-25 per cent in rice crop. On an average, decomposed *Azolla* contains N (4-6%), P (0.5-0.9%), K (2-6%), Ca (0.4-1.0%), Mg (0.5%), Mn (0.11-0.16%), Fe (0.06-0.16%) and $H_2O$ (>80%) [14].

**Blue green algae (BGA)**

BGA is predominant in submerged rice soils which provided an ideal condition for their growth and fixing atmospheric N. A judicious use of BGA could provide to the country's entire rice acreage as much N as obtained from 15-17 lakh tonnes of urea. It is estimated that at farm level [34], it can contribute about 25-30 kg N $ha^{-1}$. A field experiment conducted at Bilaspur, Madhya Pradesh in rice-wheat sequence revealed that rice yields under treatments of BGA @ 5 kg culture $ha^{-1}$ and FYM @ 5 t $ha^{-1}$ were comparable with each other. Organic manures and BGA combined with 60 kg N + 37.5 kg $P_2O_5$ + 22.5 kg $K_2O$ $ha^{-1}$ as chemical fertilizers proved superior to other treatments for rice yields and their residual effect on wheat yields

[35]. Among the described bio-fertilizers, BGA and *Azolla* have great significance in N economy of rice cultivation under waterlogged condition. They may contribute 25-50 kg N $ha^{-1}$ to rice [36].

**Inorganic Fertilizers**

Several long term experiments all over India indicated a decrease in rice productivity due to continuous use of chemical fertilizers [37]. Under a continuous cropping, the decline in yield may either be reversed or minimized by application of complete doses of fertilizer NPK [38]. Continuous application of inorganic fertilizers affected the microbial population and leads to clod formation and reduced the fertility status of the soil by affecting the multiplication of microbial population in soil [7].

Application of inorganic NPK alone registered lower NPK uptake at harvest than integrated nutrient management practices [39]. Available phosphorus and potassium were higher in inorganic plots as compared to organic and integrated plots [8]. Application of balanced fertilisation in the long term experiment at Ludhiyana improved the average (0-30 cm) root length density (RLD) of rice from 0.28 cm $cm^{-3}$ in $N_{120}$ to 0.34 cm $cm^{-3}$ in $N_{120}P_{30}$ to 0.38 cm $cm^{-3}$ in $N_{120}$ $P_{30}$ $K_{30}$ [40]. Higher NPK levels decreased the recovery and agronomic efficiency as compared to recommended dose. Applying 250:55: 104 kg N, P and K $ha^{-1}$ with NPK split application up to beginning of grain filling stage recorded higher N uptake and resulted in higher grain yield of 7.02 and 8.03 t $ha^{-1}$ in *kharif* and summer, respectively than recommended practice of applying 150:33:62 kg N, P and K $ha^{-1}$ with N split application up to panicle initiation (5.78 and 6.19 t $ha^{-1}$ in *kharif* and summer, respectively) at Dharwad [41].

**Integrated Nutrient Management**

Integrated nutrient supply is important as a soil ameliorant in alleviating the adverse soil ecological conditions and in improving soil fertility and productivity [8]. Enhanced NPK levels up to 105 : 52.5 : 52.5 kg $ha^{-1}$ and sulphur levels up to 25 kg $ha^{-1}$ along with organic manures either as 10 t $ha^{-1}$ farmyard manure or vermicompost @ 5 t $ha^{-1}$ were good in producing better grain yield of rice [42]. An increase in microbial (actinomycetes, bacteria and fungi) population and soil enzymatic activity at rice harvest stage under Integrated Plant Nutrient Supply (IPNS) compared to sole chemical fertilizer application [43]. Farm yard manure @ 12.5 t $ha^{-1}$ in combination with the scheduled fertilizer dose of 150:50:50 kg $N:P_2O_5:K_2O$ $ha^{-1}$ registered significantly the highest nutrient uptake of 154:25:172 kg NPK $ha^{-1}$ and post harvest nutrient availability of 197:38:171 kg NPK $ha^{-1}$ [33], dry matter production (10902 kg $ha^{-1}$), grain yield (5538 kg $ha^{-1}$) and straw yield (8693 kg $ha^{-1}$) [44]. Integrated nutrient management practices showed significantly higher grain yield (5.77-7.56 t $ha^{-1}$) than chemical fertilization alone (4.32 t $ha^{-1}$) due to the presence of humic acid compounds which helped in dissolution of minerals and chelation of micro nutrients [45].

The total microbial population was minimum in the absolute control and maximum where 50 per cent nitrogen was substituted by wheat straw in the long term experiment [10]. Incorporation of FYM @ 12.5 t $ha^{-1}$ along with *Panchakavya* and *Amuthakaraisal* remarkably increased the rice grain yield of 7245 kg $ha^{-1}$ which was comparable with application of *Sesbania rostrata* @ 6.25 t $ha^{-1}$ along with *Panchakavya* and *Amuthakaraisal* [46]. Application of *Azophos* along with NPK (75:75:100% recommended fertilizer dose) to rice cv. PMK 3 recorded the highest grain yield of 3.6 t $ha^{-1}$ and straw yield of 6.8 t $ha^{-1}$ due to increased nutrient uptake from deeper layers at Paramakudi [47]. Application of 300:17.6:33.3 kg $N:P_2O_5:K_2O$ $ha^{-1}$ and 5 t $ha^{-1}$ FYM to rice crop recorded the highest quantity of available soil N, P and K (219:31:246 NPK kg $ha^{-1}$) after crop harvest [48].

Under reclaimed sodic soil conditions, application of 100% NP recommended dose with farm yard manure or sulphitation pressmud or green manure or wheat residue increased the grain yield of rice over the recommended NP dose (120 kg N and 26 kg P $ha^{-1}$) by 1.06, 1.23, 1.25 and 1.04 t $ha^{-1}$ [49]. Application of 50 per cent N through urea + 25 per cent N through green leaf manure (*Glyricidia*) + 25 per cent N through FYM + *Azospirillum* recorded highest the availability, concentration and uptake of nutrients at all the stages of rice growth over other treatments during *kharif* in sandy loam soil [50]. Yield and post harvest soil available nutrients were higher under integrated nutrient

management practices consisted of recommended dose of fertilizer (150:50:50 kg NPK $ha^{-1}$) along with 12.5 t $ha^{-1}$ FYM and biofertilizers *viz*., *Azophosmet* as soil and seed treatment and PPFM as foliar spray in transplanted and direct seeded rice [51].

**Economics of different nutrient management practices**

The highest net income of Rs. 49,945 $ha^{-1}$ was obtained with the application of recommended fertilizer (150: 50:50 kg $N:P_2O_5:K_2O$ $ha^{-1}$) along with 12.5 t $ha^{-1}$ FYM and biofertilizers whereas the scheduled fertilizer under direct planting system gave the highest B: C ratio of 3.7 [33]. Application of 300:17.6:33.3 kg $N:P_2O_5:K_2O$, 50 kg ZnO and 40 kg bentonite sulphur $ha^{-1}$ recorded higher net return (Rs. 58,982 $ha^{-1}$) and B: C ratio (1.99) which was followed by application of 300:17.6:33.3 kg $N:P_2O_5:K_2O$ $ha^{-1}$ and 5 t $ha^{-1}$ FYM (Rs. 55,723 $ha^{-1}$ and 1.92) [48]. The SRI planting with rotary weeder weeding in association with combined application of recommended dose of fertilizer (150:50:50 kg NPK $ha^{-1}$) along with 12.5 t $ha^{-1}$ FYM and biofertilizers *viz., Azophosmet* as soil and seed treatment and PPFM as foliar spray resulted in higher net return [52]. Application of the inorganic fertilizers alone recorded lower cost of cultivation (Rs. 17,780 $ha^{-1}$) and higher net return of Rs. 22,440 $ha^{-1}$ and B: C ratio of 1.26 over inorganic fertilizers with organic manures in the long term experiment at Vyara during *kharif* [53].

## CONCLUSION

Exploitation of the production potential of high yielding rice varieties through agronomic management is the only alternative to fulfill the growing food needs of the large expanding population. The crop productivity increases by means of the combined application of chemical fertilizers organic manures and biofertilizers. Such combination contributed to the improvement of physical, chemical and biological properties of soil.

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RESEARCH ARTICLE

# Effect of Nitroxin Biofertilizer on Morphological and Physiological Traits of *Cicer arietinum* L.

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## ABSTRACT

Drought is one of the major obstacles to the production of crops in arid and semiarid regions of the world. Nitroxin as a bio-fertilizer containing nitrogen-fixing bacteria strains contain Azotobacter and Azospirillium can be effective in stress conditions. In order to investigate the effect of Nitroxin biofertilizer on morphological and physiological traits, the experiment was carried out in a completely randomized design with three replications in the research field in Mahan city in Kerman province in 2013-2014. Two level of water stress including control (irrigation 6 days and 9 days of watering once) and two levels of Nitroxin was used. The results showed Seed inoculation with bacteria under water stress increased seed yield, biological yield, plant height, number of pods.

**Keywords**: Nitroxin, Drought stress, *Cicer arietinum.*

## INTRODUCTION

Nitroxin as a bio-fertilizer containing nitrogen-fixing bacteria strains contain Azotobacter and Azospirillium isolated from farms. These bacteria provide plant need for nitrogen by air nitrogen fixation and transferring it to the plant. Biological fertilizers release active precursors like gibberellin, auxin, cytokinine, vitamins, amino acids, polypeptides, anti-bacteria and anti-fungi especially exo polysaccharides to have a positive effect on yield of crops. Applied microorganisms as biological fertilizers have effects on growth of the plant to provide food elements by colonization in rhizosphere environment or in cooperation with symbiotic (Elanwar., 2010). Nitroxin biological fertilizer and chemical fertilizers (N, P) were reported to increase the active ingredient artemisinin in Artemisia annua L (Bijeh keshavarzi et al., 2011). In another study, application of nitroxin biological fertilizer had significant effects on most of the studied traits - including plant height, bush dry weigh, amount of head seeds, the number of bush heads and seed yield- except the number of branches (Moghimi et al., 2011). It was also reported that nitroxin has a positive

effect on the quality of forage sorghum (Saeed nejad et al., 2011). Finally, the bio-fertilizer Super Nitro Plus was shown to have a significant effect on height and diameter as well as fresh and dry weight of Hyssopus officinali (Koocheki et al., 2008). Drought stress is one of the most important environmental stresses affecting agricultural productivity around the world and may result in considerable yield reductions (Farahani et al, 2009). Drought as a multidimensional stress affected plants at various: sub cellular compartment, cell, organs and whole plant levels of their organization (Choluj et al, 2004). Thus drought negatively affects quantity and quality of growth in plants. Since there is need to achieve better understanding of its coping with this stress. The objective of this study was to determine the response of growth,yield, and some morphological and physiological traits of *Cicer arietinum* to the application of nitroxin biofertilizer.

## MATERIALS AND METHODS

The experiment was carried out as a factorial completely randomized design with 3 replications in Mahan region of Kerman (30°18N, 57°07'E) Iran in 2013. In this experiment two levels of Nitroxin biofertilizer include without using (control) and 2 Liter/h as seed treatment usage and three levels of drought were used. The effective material of Nitroxin is sum of bacteria from Azosprilium and Azotobacter genuses that amount of alive cells of each bacterium are 108 in each milliliter of Nitroxin. Irrigation water were applied in two levels: control (6 days) and drought stress (9 days) . Pea seeds (Pyrooz CV) were evaluated for viability before planting. m. The seed were planted in a 6 rows in each plot with row distance of 25cm and seed depth of 3cm. Immediately after planting the experiment irrigated. Watering was done at an optimal level until six to eight leaves plants. After this the irrigation treatment were carried out in experimental plots. Before harvesting, the number of pods per plant, seed weight and plant height, were evaluated randomly in 20 plants from each plot. The data was analyzed with SPSS software and the mean comparison was done by Duncane multiple test range.

## RESULTS AND DISCUSSION

As shown in the Figures 1-3, drought stress decreased significantly (at 5% level), biological yield, plant height and number of pods per plant in pea. Use of bio-fertilizer (Nitroxin) significantly increased biological yield, plant height and number of pods.

Biological yield strongly was influenced by water stress. Biological fertilizer significantly increased it under non stress condition but in condition of drought stress, Nitroxin did not increase biological yield.In drought stress the number of pods per plant, weight of 100 seeds and root dry weight, Seed yield and 100 grain weight reduced significantly. In stress condition nitroxin fertilizer application significantly increased the number of pods and root dry weight (fig.4, 5).

Many researchers have been done for surveying the effect of biologic fertilizers on Vegetative and reproductive specifications. In a research by Leithy et al (2006) on rosemary in water stress conditions it was showed that using nitrogen fixation biological fertilizers can improve the growth of branches, number of brunches and the weight of the plant. In another research on fumitory by nitrogen fixation biological fertilizer it was showed that they improved growth, number of branches and the weight of the plant. Meanwhile absorption of other food elements and effective materials improved (Manfouz and Sharaf-Eldin, 2007). In a study, using of biological fertilizers improved biomass in stevia plant (Kochakiet al., 2008). In a survey using of nitrogen fixation fertilizers caused improvement of yield and growth in hyssop.Detailes of bacteria mechanism of action on plant growth still in not clear and is arguable but the results of several studies indicated that Azosprilium and Azotobacter with Nitrogen stabilization potential will develop plant roots, help to absorb water and nutrients, some vitamin production and finally can improve some quantitative and qualitative traits of crop such as rice that culminated in higher crop production(Khalili et al, 2007). Some of bacteria that are applicable as biofertilizer include, Azotobacter, Pseudomonas an Azosprilium (Yasari and Patwardhan, 2007). Their beneficial effect are such as, hormone, sidrofors , antibiotic production and biological Nitrogen fixation (Bashan et al., 2004). Ahmad et al (2006) reported that some kind of Bacillus, Azotobacter and

Pseudomonas produced materials such as sidrofor that help to provide plant iron. Nezarat and Gholami (2009) in a study reported that Azotobacter and Pseudomonas increased significantly nutrient absorbent such as, Nitrogen, phosphorus.According to Das and Saha (2007) combined inoculation of Azotobacter and Azospirillum in presence of partial application of farmyard manure increase crop productivity. The microbial inoculants as Azotobacter, Rhizobium and Trichoderma, which have been given more attention in recent days, are responsible to plant growth and yield of crops under field inoculation (Rouzbeh et al., 2009). Inoculation of seeds with Azotobacter and Azospirillum in the present of chemical fertilizers resulted in improving both growth and yield of anise (Gomaa and Abou-Aly, 2001).

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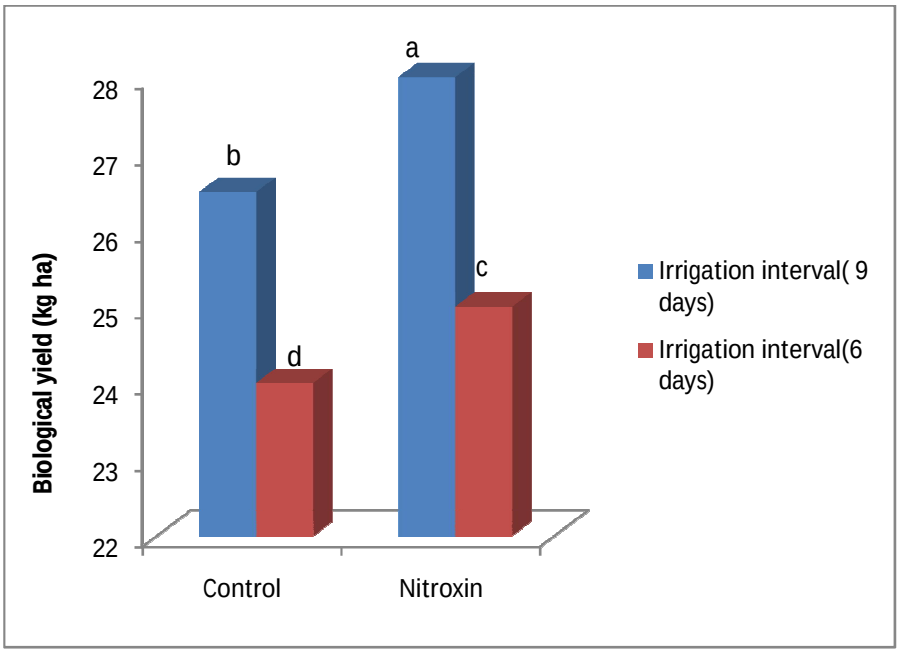


**Fig.1. Effect of nitroxin biofertilizer on biological yield of *Cicer arietinum***

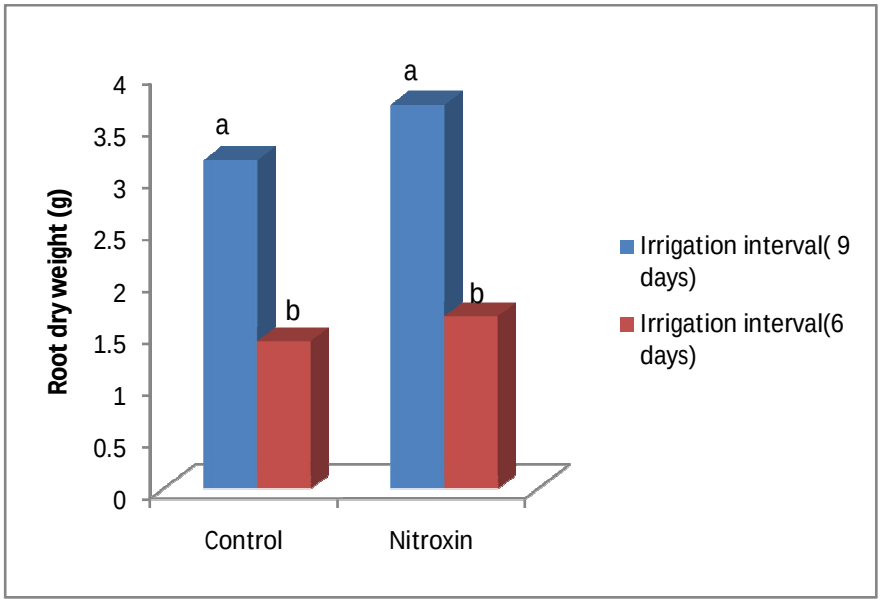


**Fig. 2. Effect of nitroxin biofertilizer on root dry weight of *Cicer arietinum***

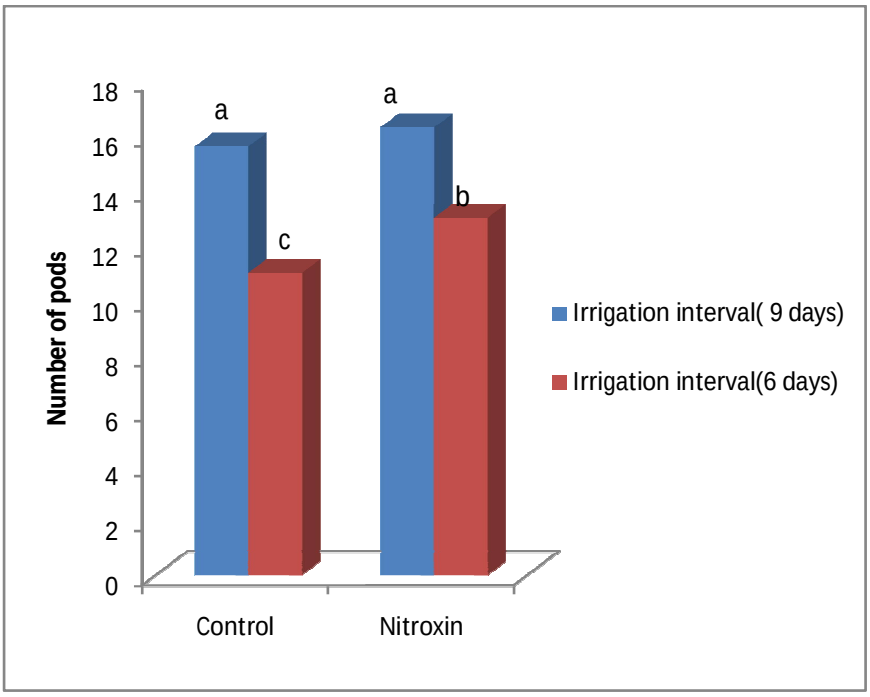


**Fig. 3. Effect of nitroxin biofertilizer on number of pods of *Cicer arietinum***

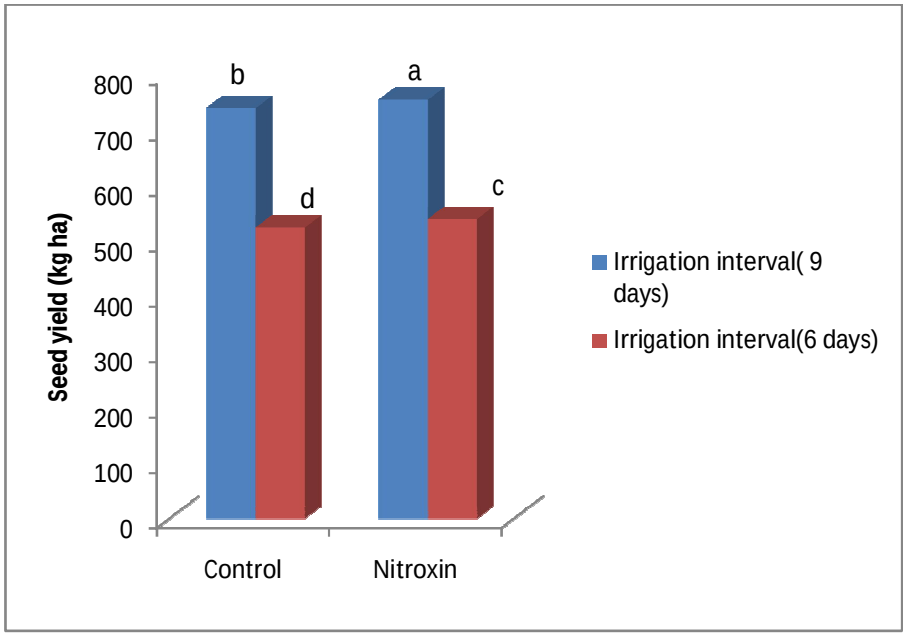


**Fig.4. Effect of nitroxin biofertilizer on seed yield of *Cicer arietinum***

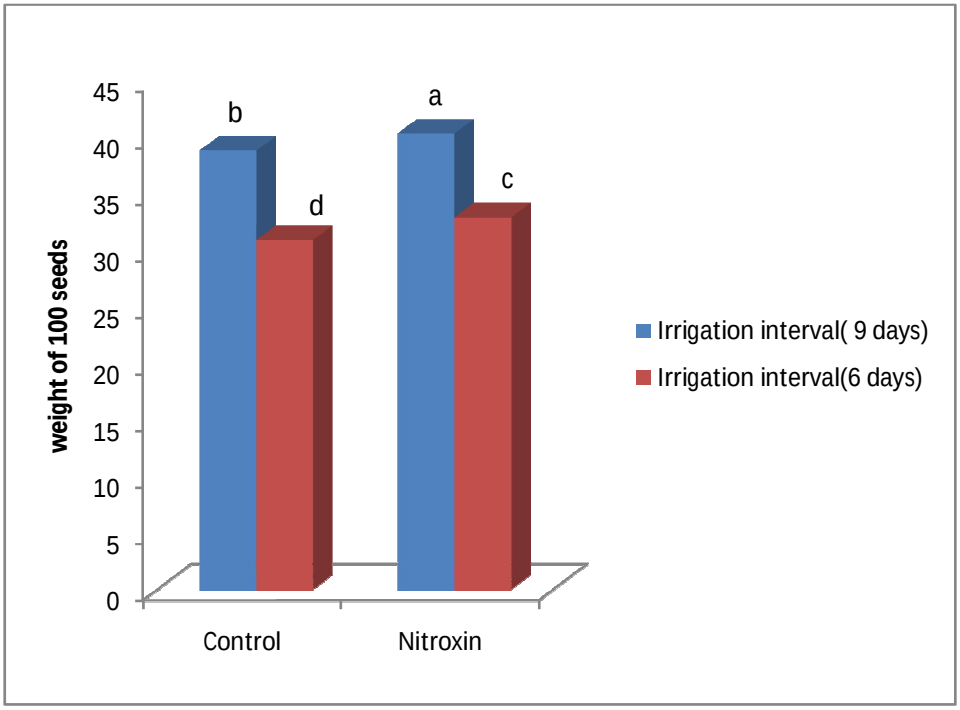


**Fig.5. Effect of nitroxin biofertilizer on weight of 100 seeds of *Cicer arietinum***

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**RESEARCH ARTICLE**

# Garlic Juice as a Green Capping Agent and Reductant for Synthesis and Characterization of Lead Selenide Nanostructures

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## ABSTRACT

In the present work garlic juice was applied as reductant because of the presence of anthocyanin molecules in its ingredients, PbSe nanostructures have been synthesized by using $Pb(NO_3)_2$ as lead precursor in the present of microwave method with water solution. Besides, the effects of time and power of irradiation, surfactant and microwave radiation on the morphology and particle size of products were studied by SEM images. It was found out that the size and morphology of the products were greatly influenced by these parameters. The size of the sample as prepared was calculated by Debye-Scherrer formula according to XRD spectrum to be about 12 nm. The XRD studies indicated the production of pure cubic PbSe nanostructures could only happen in the presence of microwave radiation.

**Keywords:** Nanoparticles. Microwave method. Lead selenide (PbSe). Inorganic materials

## INTRODUCTION

Synthesis of inorganic nanostructures with different sizes and morphologies has recently received great attention due to their novel optical and electric properties and potential applications in the fields of electronic and photonic devices .There has been a growing interest in the synthesis of inorganic semiconductor nanomaterials due to their potential applications in various fields of catalysts, electronics, luminescent devices, solar cell and biological markers [Tian m, (2010). Controllable growth of semiconductor heterostructures mediated by bifunctional $Ag_2S$ ]. Now-a-days, lead chalcogenide nanocrystalline semiconducting materials have attracted the attention of many researchers because of their potential applications in solar energy conversion devices [Fartu n, (2007). Formation of various morphologies of covellite copper sulfide submicron crystals], photosensors (or) photodetectors [Hasen n, (2011). Controllable growth of semiconductor heterostructures mediated by bifunctional], thermo- electric devices and nonlinear optical devices. PbSe belongs to IV–VI compound semiconductor, possessing excellent optoelectronic properties and it exhibits cubic structure with face centered phase. In the past decade, many different PbSe nano/micro structures have been

reported by using various synthetic methods such as microwave-assisted preparation methods, electrochemical deposition and the solution-phase solvothermal methods . Lead selenide has a wide range of applications including optical switching, optical computing, telecommunication components, photovoltaic cells, sensors for infrared radiation, solar cells, and thermoelectric devices. In addition, PbSe nanocrystals have major industrial uses such as infrared detectors, light emitting devices, field effect transistors etc. Due to their unique electronic, optical, and physical properties. Emphasis has been devoted to the preparation of selenides in the nanophased form. This is due to the modern trend of miniaturization, on the one hand, and the unique properties associated with the nanostructure, on the other. Unfortunately, there is an immense delay in the development of synthetic methods for the preparation of these compounds. A variety of methods can be used for the formation of selenides, such as hydrothermal process sonochemical method , electrochemical method and sono electrochemical method . Currently, the sonochemical method has been used extensively to generate novel materials with unusual properties, since they form particles of a much smaller size and higher surface area than those reported by other methods. The chemical effects of ultrasound arise from acoustic cavitation, that is, the formation, growth, and implosive collapse of bubbles in a liquid. The implosive collapse of the bubbles generates a localized hotspot through adiabatic compression or shock wave formation within the gas phase of the collapsing bubble. The conditions formed in these hotspots have been experimentally determined, with transient temperatures of B5000 K, pressures of 1800 atm, and cooling rates in excess of 1010 K/s. Herein, a new lead-organic precursor was prepared via a chemical precipitation procedure by sodium salicylate ($C_7H_5O_3Na$), and $Pb(NO_3)_2$. Furthermore, we report controllable size synthesis of PbSe with sonochemical method by aid of the lead precursor and $SeCl_4$ in the presence of ultrasonic irradiation. During the synthesis method, some important factors such as reaction time, surfactant, and ultrasonic radiation on the particle size and morphology of the final product was studied by using scanning electron microscopy (SEM). The produced nanostructures were characterized by SEM, PI, XRD, and EDS.

**Experimental**

**Materials and physical measurements**

All chemical reagents in this experiment were of analytical grade and used without further purification. The precursor complex, $[Pb(sal)_2]$, $Pb(NO_3)_2$; was prepared as mentioned in literature . The XRD patterns were collected from a diffractometer of Philips Company with X′pertpro monochromatized Cu K$\alpha$ radiation ($\lambda$ = 1.54 Å). A LEO 1455VP scanning electron microscope (SEM) was used to investigate the morphology of PbSe nanoparticles. TEM images were obtained on EM208 Philips transmission electron microscope with an accelerating voltage of 200 kV. EDS spectrum was recorded on a XL30, Philips. Room temperature photoluminescence (PL) properties of product were studied on a Perkin-Elmer (LS 55) fluorescence spectrophotometer.

**Synthesis of PbSe nanostructures**

PbSe nanoparticles were chemically prepared by reaction between $Pb(NO_3)_2$ and $SeCl_4$ with molar ratio of 1:1. At the first, 0.5 mmol of $SeCl_4$ were added to 50 ml of distilled water and stirred for 30 min. Second, $KBH_4$ (0.25 gr) was added to the above solution under magnetic stirring. The solution was stirred while keeping the pH value at about 12 with NaOH 1.00 M. Then, 0.5 mmol of lead source was add to the solution under magnetic stirring for 25 min. Finally, the solution was irradiation at various conditions. The resulting black powder was centrifuged and washed several times with distilled water and ethanol, and dried at 80°C for 3 h under vacuum. Table 1 shows the conditions of reactions in details.

## RESULTS AND DISCUSSION

The XRD patterns ($10^\circ<2\Theta<80^\circ$) of the PbSe nanostructures synthesis in the present and absent ultrasonic wave are shown in Fig. 1a and b, respectively. Extremely broaden reflection peaks were observed in Fig. 1a, which indicated fine particle nature of the obtained PbSe nanoparticles, corresponding to the JCPDS database nos. 77-0245. XRD spectra (Fig. 1b) was specified as PbSe nanoparticles which has composite diffraction peaks arising from both cubic phase PbSe (JCPDS no. 77-0245) and hexagonal phase Se (JCPDS no. 73–0465). The results showed that pure PbSe is

obtained only in the presence of ultrasonic radiation, and ultrasound-as-sisted method is a convenient and quick one to prepare PbSe. From XRD data, the crystallite diameter (Dc) of PbSe nanoparticle obtained from sample 1 was calculated to be 12 nm using the Scherer equation [Zeng d, (2001) Excitation-power dependence of the nearband-edge photoluminescence]:

$Dc=K\lambda/\beta\cos\theta$ Scherer equation

where $\beta$ is the breadth of the observed diffraction line at its half intensity maximum, K is the so-called shape factor, which usually takes a value of about 0.9, and $\lambda$ is the wavelength of X-ray source used in XRD. To further study the purity and chemical composition of the PbSe nanoparticles, EDS spectrum of the sample 1 formed at 70 W for 40 was taken and shown in Fig. 2. Fig. 2 reveals that there exist only elements in the sample 1 are Pb and Se. In addition, neither N nor C signals were detected in the EDS spectrum, which means that the product is free of surfactant or other impurity. SEM image of sample 1 prepared at 70 W for 40 min is shown in Fig. 3a. The product is principally composed of nanoparticles with average size of about 15 nm, and these PbSe nanoparticles with irregular shapes were easily aggregated together. The influence of ultrasonic irradiation on the size of PbSe nanoparticles was also studied. When the ultrasonic irradiation was removed, the products mainly composed of micro PbSe with average size of about 200 nm, as shown in Fig. 3b. The size and microstructure of the product were further examined with transmission electron microscopy. Fig. 3 shows the SEM images of the samples 4-6 that are related to the effect of the reaction time, surfactant, and ultrasonic power on the morphology of PbSe nanoparticles prepared using sonochemical method. Fig. 5a shows the SEM image of the sample 3. According to Fig. 3a, it was found that the morphology of PbSe obtained from sample 3 is mixture of nanosheets and nanoroad.

To understand the influence of ultrasonic power and time on the size of PbSe nanoparticles, several experiments were carried out on the basis of power and time variable, and the products obtained at different stages were investigated using SEM techniques. SEM images of the as-prepared products at 40 and 100 W after ultrasonic irradiation for 40 min (sample 4 and 5) are shown in Fig. 3b, respectively. It was found that the average particle size of nanoparticles increased with increasing or decreasing ultrasonic power. Therefore we need optimum power for synthesis PbSe nanoparticles. Furthermore, decrease in reaction time to 20 min (sample 6) result in increasing particle size of PbSe nanoparticles. To investigate the photoluminescence properties of the as prepared products, room temperature PL spectra of PbSe nanostructures was measured by luminescence spectrometer. The room temperature photoluminescence (PL) spectra of the as-prepared sample 1 shown in Fig. 4. The scan rate is set at 1500 nm/min. The emission peak at 503 nm attributed to the second excitonic transition (el→hl) in PbSe [Leschkies m, (2010) Facile one-step microwave to prepare $CuS_2$/CuS nanocomposite].

## CONCLUSION

In the present work garlic juice was applied as reductant because of the presence of anthocyanin molecules in its ingredients, PbSe nanostructures with different morphologies have been successfully synthesized via a sonochemical method. The reaction timeand ultrasonic irradiation have an important effect on the purity, size and morphology of the products. By comparing this method and other works, it was found that the present method is simple, low cost and fast. Furthermore, we have used a non-toxic precursor and solvent. The XRD results indicated that pure cubic PbSe without any impurities could be obtained in the presence of ultrasonic irradiation.

### ACKNOWLEDGMENTS

The authors are grateful to Islamic Azad University, Kerman Branch, for financial assistance of this work.

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**Table 1** Reaction conditions for PbSe nanostructures

| Sample No. | Power (W) | Time (min) |
|---|---|---|
| 1 | 70 | 40 |
| 2 | — | — |
| 3 | 70 | 40 |

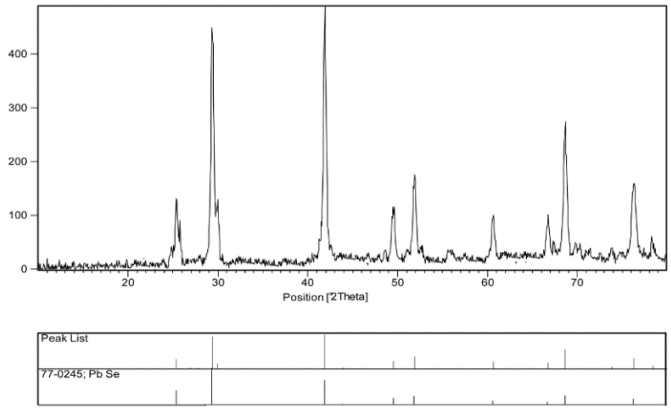


**Fig. 1. XRD pattern of the as-synthesized PbSe (sample no. 1)**

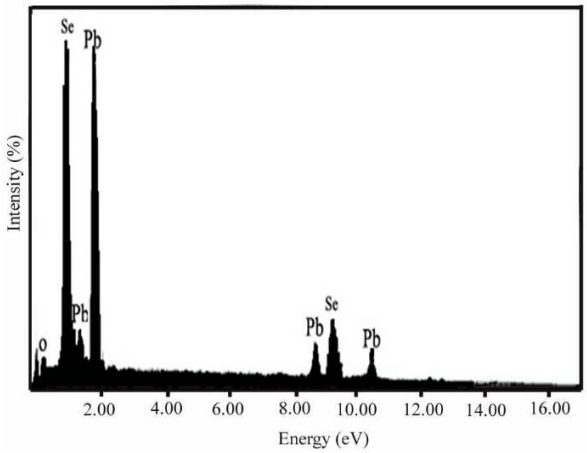


**Fig. 2. EDX analysis of the as-synthesized PbSe at 70 W for 40 min (sample no.1)**

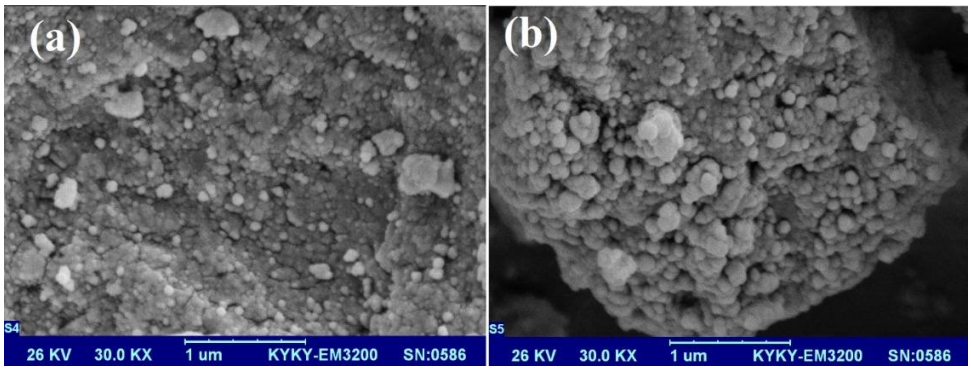


**Fig. 3. SEM images of the as-synthesized PbSe in the (a) present ultrasonic (sample no. 1) and (b) absent ultrasonic (sample no. 2)**

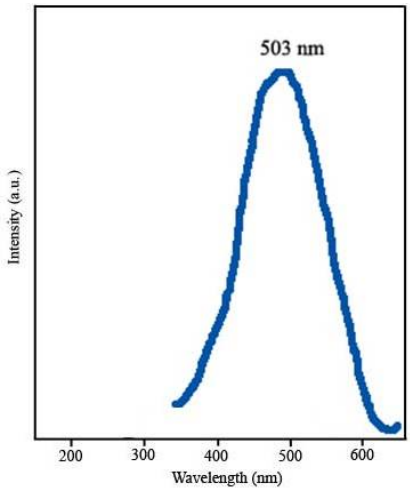


**Fig. 4. Room temperature PL spectra of the as-synthesized PbSe at 70 W for 40 min (sample no.1)**

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**RESEARCH ARTICLE**

# Green Synthesis and Characterization of Strontium Carbonate Nanostructures via Simple and Fast Microwave Approach

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**ABSTRACT**

Strontium carbonate ($SrCO_3$) nanostructures were synthesized successfully via simple microwave approach by $Sr(NO_3)_2$, carbonate powder and sodium hydroxide (NaOH) as reagents. The effects of microwave time and power were investigated on product size and morphology. The products were characterized with X-ray diffraction pattern (XRD), scanning electron microscopy (SEM).

**KEY WORDS**: Strontium carbonate; Microwave; Nanostructures.

## INTRODUCTION

In the past few decades, the nanostructures materials have shown increasing research interest due to their unique physical and chemical properties. These properties are greatly affected by the morphology, size, shape and crystallography of nanomaterials [Artw n, (2010). Synthesis and Characterization of ZnS Kilchör B, Wullschleger J.]. Strontium carbonate ($SrCO_3$) and barium carbonate ($BaCO_3$) are very important materials for a number of industries. $SrCO_3$ is used as a constituent of ferrite magnets for small direct current motors, an additive in the production of glass for color television tubes, modern electric industries, and for the production of iridescent and special glasses, pigments, driers, paints, pyrotechnics, strontium metals and other strontium compounds. A variety of processes for the preparation of $SrCO_3$ have been reported. So far, SrCO3 particles with different morphologies have been produced, such as nanowires, flowerlike nanostructures and hexahedral ellipsoids. Furthermore, strontium carbonate has only one crystal-phase, so it has been widely studied as a model system for bio-crystallization. Various processes for the preparation of $SrCO_3$ including, hydrothermal method, self-assembled monolayers, ball milling of celestite microemulsion, mediated solvothermal method, sonochemical method homogeneous precipitation by enzyme-catalyzed reaction biological synthesis and solvothermal methods have been reported. Recently, microwave method has attracted wide interest in material science which helps to increase the nucleation rate, reduce the synthesis time



and provide the small particles with narrow size distribution and high purity. Hence, it is quite promising and easy to use for industrial applications [Rrys m, (2006). Controlled synthesis of Ag2S, Ag2Se, and Ag nanofibers]. In this experimental work, $SrCO_3$ nanostructures were synthesized via a smile microwave approach [Eryu k, (2008). Annealing effects on the structural and optical properties]. Different parameters such as microwave time and power were investigated on the product size and morphology. Optical properties of the product were studied. Different analysis such as XRD, SEM, TEM and PL were used to characterization of the synthesized products.

## MATERIALS AND METHODS

### Materials and physical measurements

All the chemical's reagents used in experiments such as $Sr(NO_3)_2$, carbonate powder and NaOH were of analytical grade and used as received without further purification. For characterization of the products XRD patterns were recorded by a Rigaku D-max C III, X-ray diffractometer using Ni filtered Cu Ka radiation. SEM images were obtained by scanning electron microscope (SEM) (Philips XL- 30ESM).

### Synthesis of $SrCO_3$ nanostructures

In a typical experimental procedure equal mole of $Sr(NO_3)_2$ and carbonate powder were dissolved in water, separately and then two solutions were mixed together. Then certain amount of NaOH was dissolved in final solution to adjust pH of the solution. After that the solution was transferred to beaker and exposed to microwave irradiation for different times and powers. After that obtained powders were centrifuged and washed several time with water and absolute ethanol for removing probably by products. Finally, the products were dried at 80 for 10 h. Experimental conditions of $SrCO_3$ formation was shown in table 1.

## RESULTS AND DISCUSSION

Fig. 1 shows XRD pattern of sample No. 5. As shown in this figure, the main diffraction peaks were observed at 25.2°, 26°, 37°, 44.5°, 48°, 50.5° in the XRD pattern of the $SrCO_3$ which confirm the formation of $SrCO_3$ with orthorhombic structure (JCPDS No. 71-2393). Also lattice constants of the product were a= 5.0900 $A^0$, b= 8.3580 $A^0$ and c=5.9970 $A^0$. Fig. 2 (a-c) shows SEM images of S1-S3, respectively. As shown in this figure, microwave power has important role in determination of product size and morphology. When the reaction was done at 600 W, aggregated particles were obtained that can be attributed to low produce energy of the microwave in this power (Fig. 2a). In fact, at 600 W microwave can't prepare require energy for synthesis of separate tiny particles. By increasing microwave power to 750 W, required energy is prepared and very tiny particles are created (Fig. 2b). SEM images of samples prepared at 6min in different powers are shown in Fig. 3. It can be seen that at 600W microwave power (Fig. 3a) aggregated particles are obtained that by increasing microwave power to 750W these particles are separated and very tiny particles are achieved (Fig. 3b). So microwave power in this time has also significant effect on product size and morphology and by choosing the best microwave time, it is capable to synthesizing very tiny particles. Fig. 4(a-c) shows SEM images of S6–S9 respectively. The effect of microwave power on product size and morphology in this time is similar to previous times. At initial power of microwave for preparation of the product, lump-like and bulk structure with some tiny particles are synthesized that indicate 600W power at this time cant prepare required energy for creation of separated nanoparticles. By increasing microwave power to 750 W, aggregated particles are appeared that shown in this time 750 W prepared more energy than other times and subsequently lump-like structure formed from very small particles are achieved .The effect of microwave time on product size and morphology is similar to microwave power effect. Fig. 2a, 3a show the effect of microwave time on product size and morphology at 600W microwave power. It can be seen that at 4 min microwave irradiation (Fig. 2a), aggregated particles are obtained that by increasing time to 6 min (Fig. 3a), the particles become separated and nanoparticles are synthesized. In fact in 6 min microwave can prepared required energy for synthesizing of small and separated particles. When microwave time was selected to 8 min, more energy of microwave was prepared that led to aggregation of particles and so bulk

and lump-like structure was obtained . It can be concluded that in this power, 6min irradiation is optimum microwave time for creation very small particles. The effect of microwave time at 750 W power is shown in Fig. 2b and 3b. The observation in this power is similar to 600W microwave power. As shown in Fig. 2b, using microwave irradiation at 750W for 4 min prepares tiny particles that some of them are aggregated together. By increasing microwave time to 6min (Fig. 3b), separated and tiny particles are achieved that can be attributed to more produce energy of the microwave at 6 min irradiation. The influence of microwave time ion product size and morphology at 900W power was investigated. Schem. 1 shows the influence of microwave power and time on product size and morphology.

## CONCLUSION

It can be concluded that microwave time and morphology have significant effect on product size and morphology and by choosing the best microwave time and power we can obtain very tiny particles. Each microwave powers have optimum time and each microwave times have optimum microwave power that can produce sufficient and appropriate microwave energy for creation of separation and tiny nanostructures. Also it was found that synthesis condition affect on optical properties of the samples.

## ACKNOWLEDGMENTS

The authors are grateful to Islamic Azad University, Kerman Branch, for financial assistance of this work.

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[2] Rrys m, (2006). Controlled synthesis of Ag2S, Ag2Se, and Ag nanofibers.
[3] Eryu k, (2008). Annealing effects on the structural and optical prope.

**Table 1. Samples preparation conditions.**

| Sample No. | Microwave Time (min) | Microwave Power (W) |
|---|---|---|
| 1 | 5 | 600 |
| 2 | 5 | 750 |
| 3 | 10 | 600 |
| 4 | 10 | 750 |

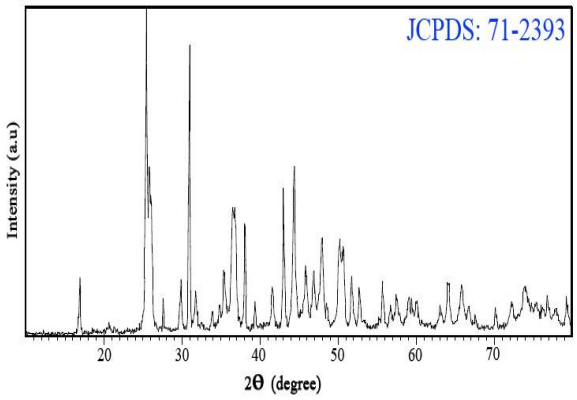



**Fig. 1. XRD pattern of sample No. 5.**

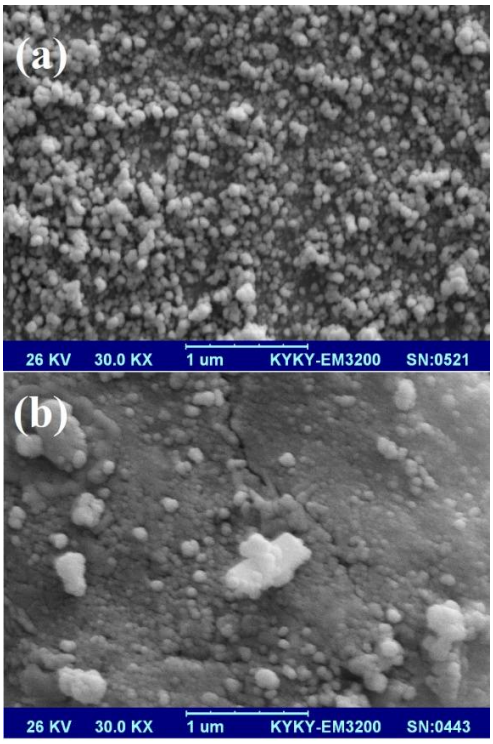



**Fig. 2 (a-b). SEM images of S1 – S2, respectively.**

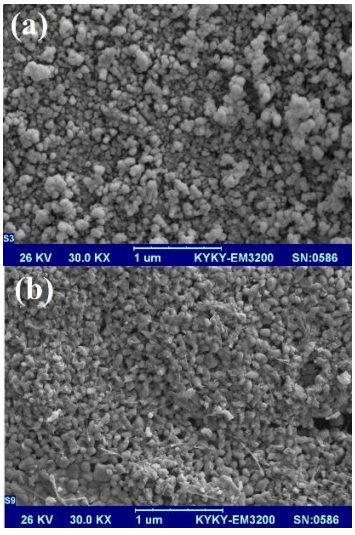
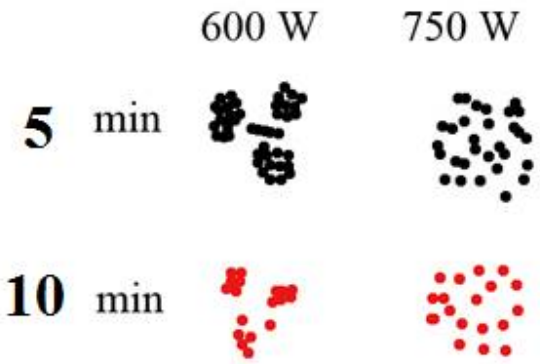



**Fig. 3 (a-b). SEM images of S3 – S4, respectively.**




**Schem. 1. Schematic of the influence of microwave power and time on product size and morphology.**

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**RESEARCH ARTICLE**

# Synthesis and Characterization of $ZnIn_2S_4$ , $ZnAl_2O_4$, $CuInSe_2$ Nanoparticles via Facile Sonochemistry Approach

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## ABSTRACT

$ZnIn_2S_4$, $ZnAl_2O_4$, $CuInSe_2$ nanoparticles were synthesized successfully via a facile sonochemistry approach. The nanoparticles powder have been prepared using Zinc acetate $(Zn(OAC)_2$, $InCl_3$, NaOH, $Al(NO_3)_3.9H_2O$ , $Cu(NO_3).5H_2O$ and thiourea as precursors. The obtained products with different morphology and size were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), and photoluminescence (PL) spectroscopy.

**Keywords:** $ZnIn_2S_4$; $ZnAl_2O_4$; $CuInSe_2$ Nanoparticles; Sonochemistry

## INTRODUCTION

$ZnIn_2S_4$, $ZnAl_2O_4$, $CuInSe_2$ as an important semiconducting material of ternary chalcogenides, has attracted considerable attention because of its outstanding electrical and optical properties. The ternary metal chalcogenide bulk particle are the only member of the $AB_2X_4$ group semiconductor with a layered structure and this nanoparticles has very important application in different fields such as charge storage [Hong et al, (2010). Microwave-assisted synthesis of graphene–ZnO nanocomposite], thermoelectricity and photoconduction. The ternary metal chalcogenide, $ZnIn_2S_4$, $ZnAl_2O_4$, $CuInSe_2$ conventionally synthesized via hydrothermal, solvothermal (Ferrara et al., 2005) and microwave-solvothermal (Fukumori et al., 2006) methods is an important semiconducting material of the $A^{II}B^{III}{}_2X^{IV}{}_4$ family. The synthesis of $ZnIn_2S_4$ $ZnAl_2O_4$, $CuInSe_2$ microspheres (Fuoui et al., 2005) porous microspheres, hierarchically porous submicrospheres, hollow microspheres, nanotubes, nanoribbons, and nano/micropeony using the hydrothermal or solvothermal methods have been reported. nanotubes, nanoribbons, nanowires, and microspheres have been prepared by Gou et al. on the basis of hydrothermal/solvothermal processes at more than 433 K [Lang et al, (2004). Ultrasound assisted miniemulsion synthesis of PANI/Ag] . In the present study, nanoparticles were synthesized via a simple microwave method. Several effects on product size and morphology

were studied. Optical properties were measured by photoluminescence spectroscopy and bangap value was calculated [Ann et a, (2007). Cu–Al2O3 nanocomposite via solution combustion].

## MATERIALS AND METHODS

**Spectroscopy and physical measurements:** X-ray pattern was recorded by a Rigaku D-max C III,X-ray diffractometer using Ni-filtered Cu K$\alpha$ radiation for determine the solid phase and the compositional analysis was done by energy dispersive X-ray (EDX, Kevex, Delta ClassI). Morphology of particles was observed through Scanning electron microscopy (SEM) images that were obtained using Philips XL-30ESEM.

**Synthesis of $ZnIn_2S_4$ nanoparticles:** All chemical were analytical grade and used as received without further purification. In a typical synthesis procedure a stoichiometric mixture of $Zn(OAC)_2$ (1 mmol), $InCl_3$ (2 mmol) and thiourea (4 mmol) and $SeCl_4$ (2mmol) were dissolved separately in 30 ml propylene glycol under stirring for 20 min until each of the solutions were clear and without any solids of precursor. Then these solutions mixed together and stirred for 30 min. Finally solution was transferred to 100 ml beaker and the contents were exposed to microwave irradiation in a domestic microwave oven, operating at 2450 MHz, for different output power and time. Obtained powders were washed with distilled water and absolute ethanol for several times to remove any possibility contamination. In final step precipitates were dried in vacuum oven at 50 $^oC$ for 48 h

## RESULTS AND DISCUSSION

X-ray diffraction pattern: Fig. 1a,b.c shows the XRD spectra of $ZnIn_2S_4$, $ZnAl_2O_4$, $CuInSe_2$ nanoparticles respectively. Some peaks are broad that show the product is composed of small particles. SEM images*:* The effect of microwave power and time were investigated by SEM image. In this work the experiment was done at 3 different times and at each time three powers were selected. In other words 9 reactions were designed for studying the power and time influence on product morphology. Furthermore, the surfactant effect on product size and morphology was investigated.

**Power effect**

600 W irradiation power: Fig. 2 shows the effect of microwave time on product size and morphology at 600W irradiation. As shown in Fig. 2a at 4 min microwave for $ZnIn_2S_4$ nanostructures operation the product is mainly composed of aggregated particles indicating at this time, microwave irradiation can't create the sufficient energy for synthesis of $ZnIn_2S_4$. An appropriate energy to obtaine nanosized morphology has been supplied by increasing power. Hence at 4 min irradiation for $ZnAl_2O_4$ nanostructures the product was compose of small particles so that they were fused together (Fig. 2b). By irradiation microwave time to 4 min, $CuInSe_2$ nanostructures the smallest and separated particles were obtained (Fig. 2c). It should be noted that due to low energy of microwave at 600W irradiation, higher irradiation times are required to obtaine desired products.750 W irradiation power: Fig. 3 shows the morphology of products prepared at 750 W fixed power in three different times. As seen in Fig. 3a at earlier stage of reaction due to little microwave energy, large particles with 200-300 nm diameters obtained. When the reaction was done at 8 min (Fig. 3b), microwave energy has been increased and subsequently particles collisions in microwave medium become high. Hence obtained product is mainly composed of very small and separated particles. At 12 min microwave irradiation, aggregated masses were obtained that can be attributed to very high microwave energy at this time (Fig. 3c). 900 W irradiation: The influence of microwave time on $ZnIn_2S_4$ morphology at 900 W irradiation was depicted at Fig. 4. When the time of reaction was selected 4 min (Fig. 4a), some nanoparticles and bulk masses was created. The increase of time at this power does n't lead to good result and at 8 min (Fig. 4b) and 12 min (Fig. 4c) of irradiation time bulky masses with micrometer size were produced. It can be concluded, due to very high microwave energy at 900 W the lower time is suitable for creation smaller particles.

**Time effect**

4 min: Here the microwave power effect at fixed time on product size and morphology has been studied. The experiment was carried out in 4 min at three different powers. The dependence of morphology to microwave time is similar to microwave power. At 600 W irradiation (Fig. 2a), enough energy was not created and therefore large masses have been obtained. When the power was changed to 750 W (Fig. 3a), the particle size has been decreased. The achieved product at 900 W (Fig. 4a) was composed of agglomerated masses that indicating the size of product at high power has been increased. 8 min: At 8 min microwave operation, the best morphology was obtained at 750 W (Fig. 3b). At 600 W (Fig. 2b) and 900 W (Fig. 4b) powers, energy of microwave for preparation nanostructures is low and high respectively. Therefore in these powers, desired product size is not obtained. 12 min: Studying the effect of microwave time on product morphology at three irradiation powers indicated that 600 W power will lead to the production of desired morphology (Fig. 2c). Due to high ability of microwave irradiation for creation of energy, the efficiency of nanoparticles formation has been increased and $ZnIn_2S_4$ with small sized particles was achieved. The microwave energy at 750 W (Fig. 3c) and 900 W (Fig. 4c) powers was very high and aggregated particles and bulky masses were achieved.

Due to high surface area to volume of nanostructure materials, they have active surface. In addition, at high microwave power, the nucleation rate become high that is thought to be result from the incident flux increase. So in high microwave power the nucleation rate is high and due to diffusion process of the reactants to the surface of the growing crystallite led to growth proceeds through the new nucleations and increasing the number of particles (Vuillemin et al., 2005). Thus with increasing the microwave power, size and number of particles changed and consequently morphology of product varied.

Intrinsic reason for microwave time effect on morphology can be attributed to influence of creating microwave irradiation and microwave heat. By increasing microwave time, microwave heating has been increased and so, surface particles collision will increase that can play significant role in product size and morphology.

## CONCLUSION

In this work $ZnIn_2S_4$, $ZnAl_2O_4$, $CuInSe_2$ were synthesized successfully via microwave approach. The effects of microwave power and time on product morphology were investigated and it was concluded that these parameters have significant role in product size and morphology. Also the influence of surfactant was studied and it was found that cationic surfactant was lead to best morphology.

## ACKNOWLEDGEMENTS

The authors are grateful to Islamic Azad University, Kerman Branch, for financial assistance of this work.

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2. [Lang et al, (2004). Ultrasound assisted miniemulsion synthesis of PANI/Ag]
3. [Ann et al, (2007). Cu–Al2O3 nanocomposite via solution combustion.

**Table 1. Experimental condition for the preparation of $ZnIn_2S_4$, $ZnAl_2O_4$, $CuInSe_2$**

| Sample No | Figure No | Microwave Time (min) | Microwave Power (W) |
|---|---|---|---|
| 1 | 3(a) | 4 | 600 |
| 2 | 3(b) | 4 | 600 |
| 3 | 3(c) | 4 | 600 |
| 4 | 4(a) | 8 | 750 |
| 5 | 4(b) | 8 | 750 |
| 6 | 4(c) | 8 | 750 |

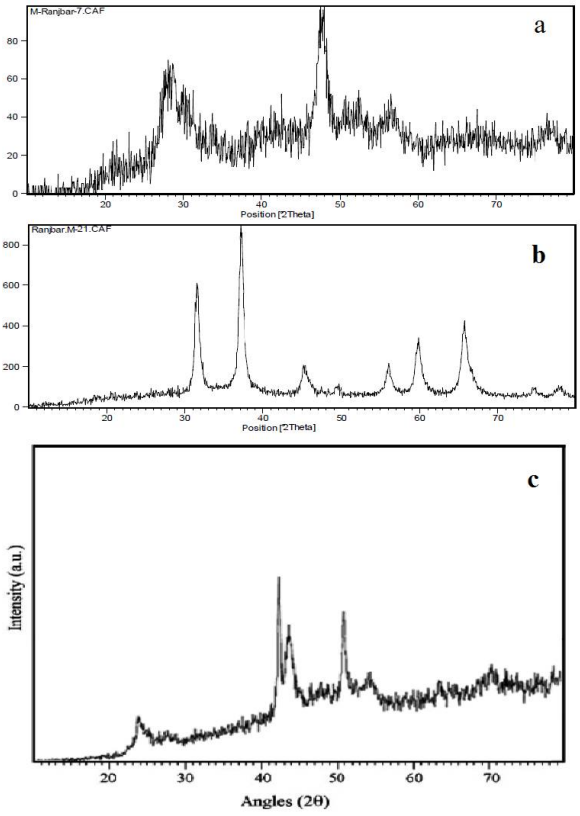


**Figure 1. XRD pattern of a) $ZnIn_2S_4$,b) $ZnAl_2O_4$, b) $ZnInSe_2$**

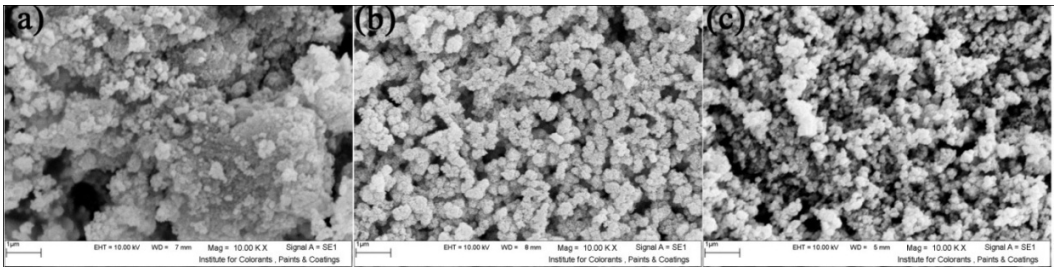


**Figure 2. SEM images of (a) sample no. 1, (b) sample no. 2 and (c) sample no.3.**

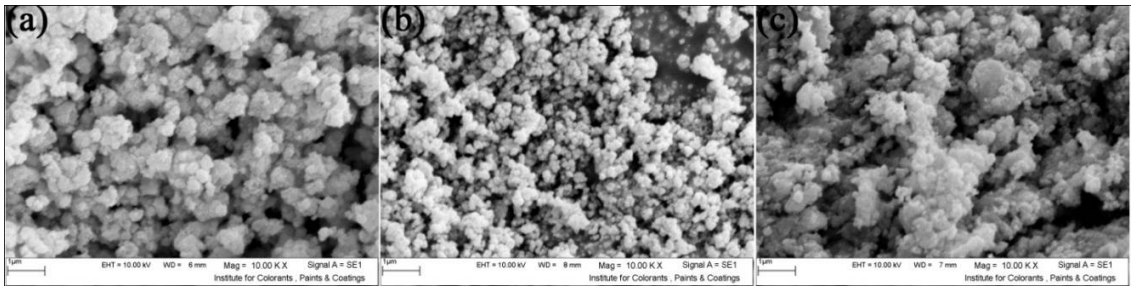


**Figure 3. SEM images of (a) sample no. 4, (b) sample no. 5 and (c) sample no.6.**

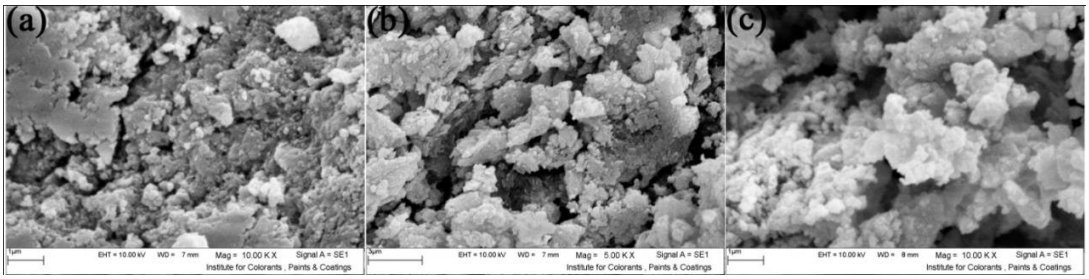


**Figure 4. SEM images of (a) sample no. 7, (b) sample no. 8 and (c) sample no.9.**

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RESEARCH ARTICLE

# Evaluation of Parturition Process based on Friedman Curve in Nulliparous Pregnant Women in Amiralmomenin Hospital of Zabul in 1392

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## ABSTRACT

Due to the direct impact of parturition management on the fate of the mother and fetus and to the use of certain standards in the administration of Friedman's birth in 1950 is analyzed schematic - statistics parturition process based on observations in 1000 maternity Nulliparous and Multiparous term. This study reviews the history of parturition in Nulliparous women in Amiralmomenin hospital in Zabul and drawing Partogramm of parturition was based on Friedman curve. In this descriptive - analytical study, population was 300 people. All information of patients included age, pregnant women, gestational age, cervical dilation speed, station, active phase and BMI were recorded, and the data was analyzed after collecting Spss software and using descriptive statistics, independent t-test and also partogramm graph was drawn. The results show with an average age of 24.6, mean GA 38 weeks and 5 days, average of BMI 27.7, average station 2- and average dilatation was 4.25 at the beginning of the active phase that compared to the average age dilation showed a significant improvement, but in the mean cervical dilatation progress on GA, active phase and BMI had no significant difference. In terms of average station GA, active phase, pregnant women age and BMI was not significantly different. In comparison, the average duration of the active phase on the basis of BMI, GA and pregnant women age was not significant difference. As a result, the HBM-based educational programs have been successful to raise awareness and attitudes of pregnant women in parturition. The combined use of partogramm is prevented the amendment to intervene in the course of parturition time and reduce the length of parturition from complications of prolonged parturition, and as a tool to control the parturition process to make correct decisions and how to care during childbirth has helped.

**Keywords:** parturition, Friedman curve, Nulliparous women

## INTRODUCTION

Each year more than 150 million women in developing countries become pregnant and pregnancy often leads to the birth of a live baby to a healthy mother. But for some women, pregnancy and childbirth are accompanied with pain, fear, suffering and even death. In developing countries, reason of 8 percent of maternal mortality is long parturition, and the most important reason is the lack of proportionality of head of the fetus in the maternal pelvis and abnormal uterine contractions. According to studies in Indonesia and Guatemala, the prevalence of abnormal parturition has been 8.4 and 8.2 percent respectively.

Friedman in 1954 to study on a large number of American women described natural plot of cervical dilation. Studies show that the use of Partograph on parturition results has the desired effect. Aforementioned diagram has been a reliable tool to assess the mother, the fetus and the progress of parturition, and is an early warning system for early detection of parturition problems and doing appropriate action. This is a unique tool for evaluating the parturition at home is also very useful.

Rapid detection of abnormal development of the labor process is important to make good decisions, correct time and referred to medical intervention and pharmaceutical treatment to higher levels and ultimately helps the mother and baby. One of the patterns of Friedman curve is recommended to view it labor progress and fetal status and identify normal and abnormal is possible.

Several studies have emphasized the need for interpretation and review the Friedman curve included in the study Bayat Makuyi and colleagues at Bandar Abbas on women who had not received any obstetric intervention in population Friedman, the duration of the active phase of labor in nulliparous showed no significant difference, but the long Multi parks and the difference was significant. Also during the second stage of parturition was shorter and during the third stage of parturition was longer. In the study of doctor Islamian in Tehran, age and parity and weigh increasingly affect on the duration of their labor. In the study of Khani in Surrey, plot of cervical dilation showed that the clinical course of the first stage of labor does not comply with Friedman curve because the latent phase and stationary phase was not observed in the graph, as well as duration of the first phase was the Friedman charts. It is noteworthy that none of the studies cited in Iranian women have tried to draw the standard curve at different stages of parturition and only time in ages, ethnic and regional studies have compared Friedman.

The midwifery skills, delivery and monitoring its movement is beginning to recognize that this problem is solved by parturition chart. Swedish researchers one major cause of the lack of maternal mortality - neonatal continuous use in the country Partograph in monitoring labor and know the importance of the role of the midwife in this regard.Studies show that % 40 of cesarean parturitions, while the mother was imposed that because of the incubation stage and there is no ample opportunity for natural childbirth. Detection of early pregnancy complications causes the decrease in hospital length of stay decreased from 12 days to 1 day. By reducing hospitalization time, take advantage of the facilities, specialists and hospital beds to serve more mothers will be provided. Mothers can return with fewer side effects, less cost and fruitful exposure to the family.

According to studies cited, the aim of this study is determination of parturition process based on Friedman curve in Nulliparous pregnant women in Amiralmomenin hospital of Zabul that accordingly, to determine the average duration of the active phase of the first step in pregnant women to determine the average speed of the descent, determine the average speed dilatation, determine the average Station in active phase, comparing the parturition process based on Friedman curve, according to gestational age and BMI, and finally draw Paratvgram parturition of the objectives of this research are proprietary. The specific objectives, hypotheses have been proposed.

**The literature of the study**

A study by Amidi and Akbarzada to investigate the effect of education on knowledge and attitude of pregnant women in childbirth and observe the principles referred to in a timely manner and reduce the length of parturition, before the intervention, there was no significant difference between knowledge and attitude but after training and increase awareness by drawing partogramm cooperation more patients and significantly reduced the length of parturition. The research findings of tavasoli and associates, Rahimi Kia et al, Gangi and colleagues, Ghaba and colleagues, Fathi and Sharifirad and are consistent with similar results. The results of Shakiba zade also showed that in deciding labor management by using the partogram during parturition significantly reduced.

Peterson et al. suggest that one of the reasons for the low rate of infant mortality in the country of Sweden is partogramm in parturition monitoring. College of Obstetricians and Gynaecologists of America also concludes that active management of labor may reduce the length of labor, but in all cases cannot to reduce the rate of cesarean section.

Lavender and colleagues suggest that the labor office with or without the use of partogram in terms of parturition were not statistically different from the results of studies and research while the results of Jawed studies and WHO research showed the use of partogramm in labor progress office, reduce a small amount of parturition interventions, however, labor control with or without using partogramm, there were no differences in terms of parturition.

Bablyt and colleagues in their study in America, finally study labor in women admitted in the latent phase and active phase and found the cesarean parturition in women admitted in the latent phase is significantly more than women admitted in the active phase. Holmes and colleagues in Canada in their study found that a significant relationship exists between the dilation of admission and type of parturition. In a study conducted by Turkt and colleagues Age, Height, Weight, cervical dilation at admission was associated with the type of parturition.

## METHODOLOGY

This study is descriptive-analytic, the statistical population and its sample has been Nulliparous pregnant women admitted to Amiralmomenin hospital in Zabol that the sample size will grow to 300 over one year. Patient information such as age, gestational age, Nulliparous, the underlying disease and BMI by taking the form of hospital records and information about the stages of labor and time hospitalized pregnant women were collected through the records. Then, according to Friedman curve, data has been derived from their records, and the curves were plotted.

Inclusion criteria included:

1. One twin Nulliparous women with vaginal delivery
2. between 32- 18 years
3. Gestational age between 42-37 weeks
4. Less than 9 cm cervical dilation at admission
5. The minimum distance between acceptance and parturition of more than 3 hours
6. Do not receive any housing material or parturition induction

Exclusion criteria included: certain underlying diseases such as preeclampsia and heart disease.
Analyze data by using SPSS software and ANOVA tests and test one sample t- test was used to compare the average in sub-plot for multilevel regression models were used.

## RESULTS

Demographic and epidemiological findings of this study show that with an average age of 24.6 with a standard deviation of 3.97 that the lowest age of 18 and maximum age was 32 years. The average BMI 27.7 to 3.62, the lowest standard deviation was 19 and the maximum 36. The average station -2.03 SD 1.47 with minimum -3 and maximum

was+ 3. GA 74/38 average SD 1.42 with minimum 34 and maximum was 42 weeks. Average dilation is in active phase 4.25 with a standard deviation of 0.73, the least 3 cm and maximum was 5 cm.
As a result of the research hypothesis is as follows:
According to Table 1, compared to the average dilation showed a significant difference by age. So that with increasing age of mothers, the average of dilatation was significantly increased.

## DISCUSSION AND CONCLUSION

The study on 300 Nulliparous women with an examination of the first visit took place in the latent phase, showed that some of the cases were admitted in the active phase while significantly were admitted in the dilatation of 4 cm or less that there was no significant difference between mode of delivery and cervical dilation at admission. And also by increasing the time interval until the time of first diagnosis of fetal distress is a significant amount of Meconium and has not increased significantly which is probably due to the small sample size. In this study, duration of delivery was similar to Friedman Study, and parturition curve was similar to Friedman curve.

As the curve (Figure 1) , can be seen a rapid change in velocity gradient between the dilation of 3 to 5 cm dilation. So in our study cervical dilation of 3 to 5 inches in the presence of uterine contractions can be a valid indication of the threshold considered active labor in accordance with the theory of Friedman's theory in this field.

Lavender and colleagues argue that the labor office without or with use Partogramm were not statistically different in terms of parturition while the results of Jawed studies and WHO research showed that the use of partogramm in labor progress office reduce a small amount of parturition interventions. However, labor control with or without the use of partogramm, there were no differences in terms of parturition that is in accordance with the results of our study.It is suggested that the combined use of partogram with modified intervention in the process and reduction of duration of parturition is prevented long parturition complications, and as a tool to control the parturition process to make correct decisions and how to care during childbirth has helped.

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**Table 1: Comparison of dilation by age**

| Statistical test result | Standard deviation | Average | age group |
|---|---|---|---|
| F =3.093 | 1.218 | 5.45 | Less than 22 |
| Df = 2 | 1.231 | 5.65 | 22 to 26 |
| P = 0/047 | 1.379 | 5.90 | More than 26 |

Comparison of the average dilation in GA, no significant difference was observed in regard to Table 2.

**Table 2: Comparison of dilation according to GA**

| Statistical test result | Standard deviation | Average | GA |
|---|---|---|---|
| F =2.381 | 1.212 | 5.50 | Less than 38 |
| Df = 2 | 1.304 | 5.82 | 38 to 40 |
| P = 0.094 | 1.465 | 5.83 | More than 40 |

Comparison of the station average age pregnant women did not show significant differences.

**Table 3: Comparison of station by age women**

| statistical test result | Standard deviation | Average | age group |
|---|---|---|---|
| F =1.710 | 1.636 | -1.90 | Less than 22 |
| Df = 2 | 1.655 | -1.92 | 22 to 26 |
| P = 0.163 | 1.072 | -2.25 | More than 26 |

Comparison of the average station according to BMI women did not show a significant difference.

**Table 4: Comparison of pregnant women according to BMI station**

| statistical test result | Standard deviation | Average | BMI |
|---|---|---|---|
| F =1.710 | 1.231 | -2.25 | 19 to 25 |
| Df = 2 | 1.584 | -1.89 | 25 to 30 |
| P = 0.183 | 1.402 | -2.13 | More than 30 |

Comparison of the average station in the active phase of pregnant women did not show a significant difference.

**Table 5: Comparison of Active Phase station in pregnant women**

| statistical test result | Standard deviation | Average | Normal phase |
|---|---|---|---|
| F = 1.159 | 1.476 | -1.89 | Less than 4 |
| Df = 2 | 1.432 | -2.18 | 4 |
| P =0.315 | 1.510 | -1.94 | More than 4 |

Comparison of the average station did not show significant differences in terms of GA.

**Table 6: Comparison of station by GA**

| statistical test result | Standard deviation | Average | GA |
|---|---|---|---|
| F = 0.643 | 1.502 | -1.99 | Less than 38 |
| Df = 2 | 1.376 | -2.12 | 38 to 40 |
| P = 0.527 | 1.723 | -1.83 | More than 40 |

Comparison of the average dilation did not show a significant difference in the active phase.

**Table 7: Comparison of dilation in active phase**

| statistical test result | Standard deviation | Average | Active phase |
|---|---|---|---|
| F =0.151 | 1.329 | 5.75 | Less than 4 |
| Df = 2 | 1.267 | 5.64 | 4 |
| P =0.860 | 1.303 | 5.69 | More than 4 |

Comparison of the average active phase according to BMI women did not show a significant difference.

**Table 8: Comparison of active phase of pregnant women according to BMI**

| statistical test result | Standard deviation | Average | BMI |
|---|---|---|---|
| F =0.113 | 0.891 | 4.83 | 19 to 25 |
| Df = 2 | 1.030 | 4.85 | 25 to 30 |
| P =0.893 | 0.986 | 4.91 | More than 30 |

Comparison of the average duration of the active phase of age, pregnant women did not show a significant difference.

**Table 9: Comparison of the active phase in terms of age, pregnant women**

| statistical test result | Standard deviation | Average | Age |
|---|---|---|---|
| F = 2.182 | 1.033 | 4.94 | Less than 22 |
| Df = 2 | 0.949 | 4.95 | 22 to 26 |
| P =0.115 | 0.962 | 4.70 | More than 26 |

Comparison of the average dilation of pregnant women according to BMI did not show a significant difference.

**Table 10: Comparison of dilatation of pregnant women according to BMI**

| statistical test result | Standard deviation | Average | BMI |
|---|---|---|---|
| F = 2.073 | 1.234 | 5.49 | 19 to 25 |
| Df = 2 | 1.323 | 5.81 | 25 to 30 |
| P = 0.128 | 1.230 | 5.53 | More than 30 |