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FOREWORD

I am pleased to put into the hands of readers Volume-5; Issue-2: 2018 (Feb, 2018) of **"International Journal of Advanced Engineering Research and Science (IJAERS) (ISSN: 2349-6495(P) | 2456-1908(O)" ,** an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

Dr. Swapnesh Taterh
Editor-in-Chief
Date: Feb, 2018

Editorial/ Reviewer Board

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Processes proposal for the technology search, reception and analysis for the Intellectual Property management in a Technology Licensing Office from a brazilian Scientific and Technological Institution

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Abstract*—In a Technology Licensing Office (TLO), which deals with issues considered to be complex, decision-making is a relevant factor and should be aligned with the Scientific and Technological Institution (STI) institutional and innovation strategy. To meet this need, the objective of this work is to present a process model for the admission of technologies based on Intellectual Property (IP) to a TLO, as a way to subsidize the elaboration of strategies and the decision making regarding the processes of protection and commercialization Of technologies, and thus leverage the transfer of the technologies invented or developed by an STI to a receiving organization, and, finally, to promote innovation. The process is called Admit Technology and is comprised of sub-processes Search Technology, Receive Technology, and Analyze Technology. This developed organizational process is composed of activities and tools with capabilities to make TLO more proactive and dynamic, both to seek new technologies developed in the STI Research and Development (R&D) units that can be appropriated through IP as well as to receive such technologies And to proceed with an in-depth analysis of its technical and commercial aspects and to indicate its main applications and markets where this technology should be protected and the marketing effort should be applied.*

Keywords*—*intellectual property, technological innovation, echnology admission, technology evaluation, technology search, technology reception, technology lisencing office.

I. INTRODUCTION

Santos (2011) describes Intellectual Property (IP) as a topic that has gradually been growing in importance in private organizations that seek both to use it for commercial purposes and to guarantee a competitive position in the globalized economy and also in public organizations, Especially in Scientific and Technological Institution (STI), which increasingly face a new reality, composed of processes of technology transfer and innovation.

For Amadei and Torkomian (2009), the strengthening of IP related policies in a Scientific and Technological Institution (STI) has a direct impact on technology protection activities, while facilitating the commercialization and, finally, transfer of technologies to the productive sector. However, Buchele et al. (2015) and Dias and Porto (2013) describe that the activities of the Technological Licensing Office (TLO) take place in a constantly changing environment and that stimulating and supporting the innovation process is still a challenge. In turn, the application of good management practices, with the effective use of methods, techniques and tools is fundamental to support the process of managing innovation, efficiently and effectively.

In this way, the objective of this work is to present a process model for the admission of technologies, based on IP, for a TLO, as a way to support and/or subsidize the processes of protection and commercialization of technologies, and thus to leverage Technologies developed or developed by an STI for a recipient organization, and, finally, to promote innovation.

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To achieve this objective, an action research was carried out in a TLO of a Brazilian STI, aerospace and defense sector. Observing and carrying out the activities of this TLO, it was possible to understand that it was a set of activities of a bureaucratic nature, without the capacity to elaborate strategies or to make decisions about the diverse options to protect or to commercialize a technology. This justified the proposal of the model of processes presented in this article.

In a department such as a TLO, which deals with issues considered to be complex, decision-making is a relevant factor and should be aligned with STI institutional and innovation strategy. Specifically in relation to the protection and commercialization of technologies, these decisions must take into account the potential of each technology, individually, to become an innovation and the markets where this technology will be more attractive, only to define the best format for its Protection and the necessary actions for its commercialization, and, thus, make the protection add value to the technology and facilitate its commercialization and transference.

This article is structured in four parts. The second concerns a review of the literature that deals with the concepts of admission of technologies, based on IP. The third presents the proposed technology protection process, and finally the fourth part presents the final considerations of this study.

II. ADMISSION OF TECHNOLOGY BASED ON PI IN A TLO

The PI, according to WIPO (2015) and INPI (2014), refers to the legal branch dealing with legal protection granted to all creations of the human mind, such as inventions, literary and artistic works, symbols, names and images used with Purpose. In Brazil it is divided, based on Jungmann e Bonetti (2010), into three categories: author protection, industrial property and sui generis protection, as presented in below:

- Intellectual Property
  - Author Protection
    - Copyright
    - Related Rights
    - Computer Program
  - Industrial Property
    - Trademark
    - Patent
    - Industrial Design
    - Geographical Indication
    - Industrial Secret & Unfair Competition Repression
  - Sui Generis Protection
    - Topography of Integrated Circuit
    - Plant Varieties
    - Traditional Knowledge

For Lichtenthaler (2011a), IP management processes should not be simplified. On the contrary, to be successful, you need to create active and strategic processes. Such processes must have vision turned in and out of the STI. This is important, given the dynamics and complexity involved in processes related to IP management. Thus, for Conley, Bican and Ernest (2013), Shahraki (2012), Germeraad (2010), Jannuzi et al. (2008), O'Hearn (2008), Chesbrough (2007), Jain and Sharma (2006), Vives I Gràcia (2005) and Feldman et al. (2002), one of the challenges for TLO is to use multiple mechanisms to delineate strategic decisions for IP management, especially in relation to the protection and commercialization of technologies, considering the STI innovation strategy.

Considering Spivey, Munson and Wurth (2014), Gonzalez-Gelvez (2013), Pine (2012) and Chen and Wang (2010), to protect the created technologies is a key action for STI, inclusive, is one of the basic assumptions to ensure the marketing and transfer rights. Ritter Junior (2015) and Kelm et al. (2014) indicate that the technologies created must be protected in the way that is most appropriate for STI without ignoring issues related to the promotion of innovation. Thus, to make the protection it is necessary that the managers of the TLO devote time to the formulation of strategies to make the best decision about the format the most suitable protection for each technology.

The commercialization of the technology, according to Bandarian (2007) and Shane (2002), involves a set of skills to negotiate the transfer of technology of STI to another organization, and also considering Lichtenthaler (2011b), Haeussler (2008), Chesbrough (2007) and Teece, Pisano, and Shuen (2000), to commercialize a technology is a strategic issue that is linked to the competitive forces of an STI.

Thus, strategies for protection and commercialization must be integrated in order to transform the opportunity offered by a new technology into a competitive advantage. According to Arora and Ceccagnoli (2006), a strong protection strategy translates into greater reward in the commercialization of technology and considering Bezerra (2010), the protection and commercialization of technologies, based on IP, is presented as a way to facilitate technological innovation, among other possibilities.

In this context, considering the indications of Najmaei (2014), the strategic management of IP requires a careful and comprehensive interpretation of the environment in which the organization and technology will operate. Also, Canongia, Santos and Zackiewicz (2004) and

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Wheelwright and Clark (1992) indicate that decisions about innovation strategies need adequate tools to deal with issues that arise from the very essence of innovation processes: focus, uncertainty, The time to market, the ability to analyze alternative routes, the mobilization of skills, the valuation of knowledge or technology, among others. Still, Archila (2015), Markman, Gianiodis and Phan (2009), Dechenaux et al. (2008), Andrade (2007) and Lin and Kulatilaka (2006) describe that in order to promote innovation, speed is important to analyze and consider the various economic variables, among them the market trends and behavior in which the technology will be inserted. Also, for Aparecido Dias and Silveira Porto (2013) the technology must be understood in detail, including its purpose or the problems it aims to solve, the possible applications, the identification of its differential in relation to other existing technologies, among other issues.

According to Jungmann and Bonetti (2010) and Rocha, Sluszz and Campos (2009), from an analysis of information on technologies, and also on the interests of STI, it is possible to define the format of protection and the most suitable form of provision for technology.

Altuntas and Dereli (2012), Rocha, Sluszz and Campos (2009) and Rahal and Rabelo (2006) present some of the points that should be considered in the analysis: the technology itself; the scope of technology; the stage of development of technology; the availability of a prototype; technical feasibility; the inherent risks; ease of copying by third parties; the time needed to finalize the development of technology for the market; the nature and sophistication of technology; compatibility with other technologies; the points where the technology is more fragile or higher than the others in the market; the qualitative and quantitative advantages or benefits perceived by the potential user; the legislation applicable to the technology and investments to finalize or place the product on the market; the type of innovation (radical or incremental); the diffusion speed of innovation; market needs for technology; the demand and type of market; the size and rate of growth of the potential market; barriers to entry; the short time for technology to penetrate the market; the short-term return on investment; and the developer organization.

Based on the previous paragraphs and considering Archila (2015), Kotha, George and Srikanth (2013), Mohan (2012) and Dong-Hyun et al. (2007), it is possible to conclude that the intellectual property management process requires a reliable method of evaluating the technical and commercial potential of the incoming technology in TLO. Closs et al. (2012) indicate that the TLO is the organization that has as attribution carry out this evaluation.

Thus, it is important that the TLO has a structured process for the admission of the technologies created by the R&D units of the STI, in order to give the appropriate treatment for each of the technologies that are forwarded to the TLO, or even for those technologies that Were in the R&D units and the researcher did not envisage potential for transfer.

III. PROPOSAL FOR A MODEL OF PROCESSES FOR THE ADMISSION OF TECHNOLOGIES BASED ON IP IN A TLO

The present proposal was conceived through an action research carried out in a Technology Licensing Office (TLO) of a Brazilian Scientific and Technological Institution (STI) of the aerospace and defense sector, as already described.

In summary, according to Andrade, Soto Urbina and Follador (2016) and Andrade, Soto Urbina, Follador and Neves (2016), the flow of activities for the protection and commercialization of the TLO technologies studied at the beginning of this action research is described below: an STI researcher invents or develops a technology and if this STI has an interest in protecting it and transferring it to the productive sector, it communicates this invention to the TLO in an appropriate form; upon receipt of the notice of invention, TLO searches for priority to verify that the technology developed meets the requirements for the type of protection requested (eg patent, utility model patent, software registration, etc); it is possible to protect the technology, it goes to the writing of the request for intellectual protection and submits the request for protection to the protection body (in Brazil, INPI); besides submitting the request for protection, also, starts to control the "demands" and the remunerations to be paid, and gives them provisions; finally, the technology is included in the TLO technology portfolio and displayed on its website; and is available to companies for commercialization.

Looking at the above paragraph, it is possible to notice that the TLO does not make an evaluation of the technology, neither the technical nor the market characteristics. Also, there is no concern to assess what are the best ways to protect technologies or markets to which technology should be protected, to ensure greater value-added to technology. Still, TLO operates only on the demand of STI researchers. Thus, it can be noted that TLO plays a passive role in the management of intellectual property.

To reverse this situation, as seen in Item 2, it is necessary to equip the TLO with well-defined processes and tools. Such processes should be capable of proactively admitting a technology developed by STI researchers and devising appropriate strategies for protection (as Andrade,

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Soto Urbina and Follador (2016)) and for commercialization (according to Andrade, Soto Urbina, Follador and Neves (2016)) of technologies, with the objective of supporting the management of intellectual property.

Thus, an organizational process called "Process Admit Technology" was developed, consisting of activities and tools with capabilities to make TLO more proactive and dynamic. The dynamics of this proposed process considers that an STI, in its R&D activities, invents or creates a technology, and with that, it communicates the invention/creation to the TLO. TLO receives the communication of the invention/creation, checks if the information is correct and performs an analysis of the technology, evaluating its technical aspects, to identify the technical potential of the technology and the feasibility of legal protection, as well as the market, With a view to identifying market potential and potential interested in the technology developed. If there is technical and marketing potential, the technology is sent for protection and commercialization. If the technical or marketing potential of the technology is low, STI should be communicated for the continuity of research or development, in an attempt to provide the technology with innovative aspects or that meet the market demand.

The representation of this process is shown in Figure 1.

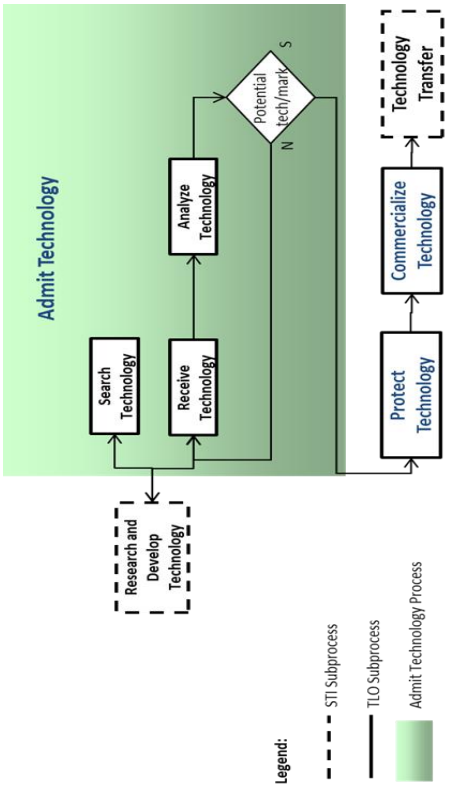

Fig.1: Admit Technology Process

The Admit Technology process is comprised of the sub-processes: Search Technology, Receive Technology, and Analyze Technology. The Sub-process Analyze Technology is critical within this model, since it is from the evaluations and analyzes carried out in this subprocess that all the strategies for the protection and commercialization of the technologies are formulated. The strategies are formulated and defined according to the technical and market potential of each technology, that is, for each technology, a different strategy must be formulated, which requires dynamic process capability. According to Hall (2014), each of the technologies developed by an STI has its own opportunities and threats, due to its dynamic nature, and it is therefore a challenge to introduce them to the market. Still, according to Arora and Ceccagnoli (2006), decisions on the protection and commercialization of technologies must be taken at the same time. Therefore, this subprocess can be considered as critical in this structure, and in this context, it is important that it be executed with high efficiency and effectiveness, to allow reliable information to elaborate the strategies of the other subprocesses.

This process model was successfully implemented on TLO of this STI. Thus, it was possible to identify, accurately, the characteristics of each new technology subject to the TLO for protection and thus develop the most appropriate strategy for their protection. As a result, the TLO from this STI commercialized its first technology, ie promoted the first transfer technology.

The subprocess of Admit Technology will be detailed in the following sections.

3.1 SUBPROCESS SEARCH TECHNOLOGY

This subprocess consists in carrying out a diligence to the STI to evaluate if it has invention or intellectual creation, here denominated technology, not yet protected.

This diligence should be carried out by a team of TLO professionals and members of the STI R&D areas. The team, in conducting the diligence, interviews the STI researchers, verifies the results of the developed R&D projects, including those developed jointly with companies, and at the end of the diligence, describes a report, indicating or not, technologies invented or created Still unprotected, and which may present potential for protection and transfer. This report is sent to the person in charge (upper level) by the STI, who must decide on the adoption of the recommendations, that is, to request or not to protect the technologies to the TLO. For Santos (2011), it is important that the TLO has a tool that is able to identify the new technologies that can be appropriated. Silva et al. (2015b) complement this issue, showing that this is a great challenge.

In the event that STI decides to protect the technologies found, it must request the protection and transfer of technology to the TLO, which will follow the process of Receiving Technology.

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This subprocess is justified by the possibility of identifying technologies invented or created within the scope of the STI, which the researcher has not identified potential for application, and thus has not requested its protection. Once the subprocess is finished, it is passed to the following: Receive Technology.

3.2 SUBPROCESS RECEIVE TECHNOLOGY

This subprocess consists of receiving, registering and formally verifying documents that are part of requests for protection and transfer of technology and of opinions in joint R&D contracts with other organizations submitted to TLO.

In the receipt of the Request for Protection and Transfer of Technology, all requirements defined in the specific TLO standards/procedures/instructions to be observed by the requesting STI must be verified. The receipt of the technology consists of:

- Record the request for protection and transfer;
- Perform formal verification of forms and documents;
- Check for complete and correct completion of forms;
- Check the instruments of formalization (contract, agreement, protocol of intentions, power of attorney, etc.) of the contribution and division of the IP, if there is participation of members of entities external to the STI, that is, a joint R&D project with other organizations;
- All patents and academic publications found must be attached, with their respective summaries and explanations of the differences in relation to the invention/creation communicated;
- Check the scientific and technical publications made by the inventors, among other relevant disclosures, of the invention/creation, If there are; and
- Check other relevant documents.

If situations that differ from those specified are found, corrections or clarifications should be requested from STI. The technology should only be routed to the Analyze Technology subprocess after meeting all procedural requirements for adoption of the technology by TLO.

As for the opinions on joint R&D contracts with other organizations, including in situations characterized as open innovation, according to Chesbrough (2007), careful evaluations should be carried out to identify or propose clauses that define, according to AlbieroBerni et al. (2015), the division of ownership of the intellectual property of future technologies to be developed, not to become the object of future dispute or to damage the relationship between the STI and the organization.

Such a subprocess is important to identify, preliminarily, if all the elements necessary for the requested protection request are met, and to subsidize the subprocess Analyze Technology, regarding the technical and marketing analysis. Reaffirming in this subprocess, in addition to the other items, it is important to evaluate all contracts or research agreements that STI has signed with other organizations, in order to ensure that the rights to IP, potentially resulting from this interaction, are safeguarded. Regarding the request for protection and transfer of technology, it is necessary to evaluate whether all documents necessary to promote the drafting of the protection request (Process Protect Technology) have been attached to the request, in order to avoid wasted time with documentation returns, impacting in TLO productivity. After completing this subprocess, the following is passed: Analyze Technology.

3.3 SUBPROCESS ANALYZE TECHNOLOGY

This subprocess consists of the technical and marketing analysis of the technologies received, according to the subprocess Receive Technology.

The analysis is carried out with the purpose of characterizing the technology in detail and indicating its technical-marketing potential, so that it can subsidize the decision making process of the protection and commercialization of technology. According to Chagas Júnior (2009), to achieve success in a process related to technological innovation is necessary to consider technical progress and market forces. Thus, it is necessary to understand the operation of technology and its insertion in the market. According to Rozenfeld et al. (2006), good market research is the rigorous and adequate compilation of data from various sources. For Fujino and Stal (2004), an important issue to be identified during the analysis of the technology is whether it is "attractive" from a commercial point of view. However, Bianchi et al. (2011) warn that the analysis of emerging technologies can be difficult due to present strong technical/scientific content, which makes it necessary to interact with the researchers or inventors of the technology. Fujino and Stal (2004) indicate some factors that impact the evaluation of a technology:

- Potential for application of technology in other areas;
- Benefits or differentials of the technology, when compared to the predominant or concurrent technology;
- Time needed to finalize technology development (production scale);
- Production and distribution costs, compared to prevailing or competing technology;

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- Possibility of expansion of the current market or opening of new markets;
- Market potential of technology; and,
- Adequacy of technology to the STI portfolio.

Thus, in addition to the provisions indicated in the item Receiving Technology, one or more meetings with the representatives of the STI research unit and the responsible inventor should be scheduled in order to remedy any differences and resolve procedural doubts, and thus, properly analyze the technology. The technology analysis consists of:

I. Analyze the documents presented;
II. Interview(s) with the inventor responsible for the technology, to better know the technology;
III. Conduct desk research to complement the information collected during the interview;
IV. Perform technical characterization and proof of concept of technology. At this point, an assessment of the technical and marketing potential of the technology should be carried out to support the decisions to be taken, that is, the elaboration of protection and commercialization strategies;
V. Prepare a draft on the conclusions of the analysis;
VI. Present the draft to the responsible inventor so that any suggestions or modifications may be proposed;
VII. Make the final adjustments to the content of the analysis draft, if necessary;
VIII. Elaborate a proposal of Technological Profile, which consists of a kind of pamphlet, with the main characteristics of the technology, without, however, revealing the novelty aspect of the invention/creation. The profile should include a brief explanation of the technology, its differentiation from the other technologies available in the market that solve the same problem as the technology, its benefits and its applications;
IX. A Technology Analysis Committee should be created, with the participation of fixed members (TLO members) and flying members (depending on the technology to be analyzed). The committee has the function of deliberating on the recommendations proposed by the analysis, corroborating the proposals presented or making new proposals. It should also be composed of at least the following members: the TLO manager, the official responsible for managing the subprocess Admit Technology, the official responsible for managing the subprocessTechnology Protection, the officer responsible for managing the sub-process Technology Commercialization, the person responsible for the Research unit Of STI and an External Member with technical or market knowledge on (guest) technology. The inventor responsible for technology should not participate in this committee to avoid bias;
X. To prepare a Technical Opinion on the Technical and Market Analysis of Technology, based on the deliberations presented by the Technology Analysis Committee. If the resolution is to protect and/or transfer the technology, the Technical Analysis of Technology Analysis should be sent, in a degree of secrecy, to the officer responsible for the Subprocess Format Protection. If the decision is not to protect or transfer the technology, the opinion should be sent to the requesting research unit of the STI, with additional justifications, if applicable.

This subprocess is of fundamental importance for the success of all other processes and subprocesses indicated in this proposal, since it is through this that the strategies for protection and commercialization are elaborated. Because of this, special attention must be given, because an error or misunderstanding in the technical or marketing analysis may mislead the actions of protection and commercialization of the technology, including directing for protection a technology that does not have the technical or marketing potential for it (Protection of a technology that already has similar ones that generate better results, for example) and vice versa. Finished the subprocess, the technology having technical and marketing potential, it goes to the processes of protection (Andrade, Soto Urbina e Follador (2016)) and the commercialization of technology (Andrade, Soto Urbina, Follador e Neves (2016)).

IV. CONCLUSION

The Admit technology process, presented in this article, proposes a more proactive performance of the TLO, both to seek new technologies developed in STI R&D units that can be appropriated through IP, as well as to receive such technologies and proceed with a Depth analysis of its technical and commercial aspects, and thus indicate its main applications and markets where this technology should be protected and the marketing effort should be applied.

Reaffirming what has already been described in this article, before beginning the formatting of technology protection and commercialization mechanisms, based on PI, it is necessary to carry out a detailed analysis on the technical questions about the technology created or developed and on the market aspects of this technology. This is essential to support the formulation of strategies

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for the protection and commercialization of technologies adopted by TLO, and thus to be successful.

In other words, this process supports the processes to protect and to commercialize a technology, helping TLO to perform its functions related to the management of intellectual property.

As a result of the application of the model, the TLO management practices under study were changed, and internal procedures were created to standardize this process. These procedures guide the TLO performance in achieving its institutional objectives.

To conclude, it can be considered that this proposed process model was adequate, since it was executed coherently, being applied in 10 technologies, and, until the present moment, a technology transfer contract was marketed.

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Technology for Innovating the Amazon's Fish-Farming Activity

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Abstract**—** *This work is about the innovation with focus in the competitive strategy for the fish´s production in Amazon´s captivity. The assumption is the axis of the systemic analysis of contingencies in order to reduce operating costs and gain competitiveness. It is based on the Contingency Theory from the Joan Woodward´s perspective. The research questioning is: how is characterized the innovation in the competitive strategy context of the Amazon fish-farming. It was used the Case Study Method. The methodology of this work is both quantitative and qualitative, involved consulting experts and focus groups. As a result, it concluded that innovation in the competitive strategy context of the Amazon fish-farming, characterized by the breakdown of tradition that perpetuates unproductive or high-impact practices. It´s recommended that these idealizers would be internalize in the policies of the development agencies. This research provides information to the development of public policies for integrated local development and managers who wish to develop competitive strategies in sustainable fish farming.*

Keywords— Amazon. Innovation. Contingency theory. Competitiveness. Strategy.

I. INTRODUCTION

This work is about the strategic competitive in the Amazon fish farming, based on the Joan Woodward´s contingency approach. The focus of innovation is direct for technologies in production processes traditionally developed in the Amazon fish farming, proposing sustainable use of environmental attributes aimed at the commercial impact of productive activity. Brings survey of structural and technological situation in the fish farming scene in Rolimde Moura city, Rondônia State, Brazil, for strategic and competitive context of the research scenario. Statistical analysis of these data lead the prevalence treated secondarily with support from the SWOT tool.

II. JUSTIFICATION AND OBJECTIVES

The justification of this task is the needing to innovate for competitive excellence in fish farming activity. The objective here is to study the innovation by Joan Woodward, focused in the Amazon strategic competitive approach. It´s bringing as specific objectives to point proficient creators for sustainable innovation in the scenario under study (1); contextualize the manufacturing strategy in the face of competitive convenience of Amazon attributes (2), and analyse the innovation required in the face of tradition disruption about the trade impact of new demand (3).

III. THEORETICAL REVIEW

The Contingency Theory brought as a base to this task, following the Joan Woodward´s conceptions like as indicated

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by Pereira, Rodrigues and Gessi (2014). For the authors, Woodward has shown that the technology contingency the structure and organizational behavior, showing the functional relationship between the environment and organizations, and inspiring the search for management models appropriate to the achievement of organizational objectives.

Fagundes (2010) and Pereira (2014) also describing that to Woodward available technology determines the structure and performance in the organization. Given the above, aims to sustainable innovation from the link between natural resources and traditional knowledge, focusing on technology as a competitive strategy in the Amazon context, and focusing on productive practices undertaken in fish farming in the face of the needing for proficient idealizers to its competitive convenience.

3.1 Concepts About Proficient Idealizers for Sustainable Innovation

Pedro Filho (2015) proposes an efficient and effective way to promote Amazon enterprises, by the innovation based on Amazon attributes. The author believe that the attributes include biotic and abiotic resources of the biome, and influence in traditional practices. Given the occurrence of undesirable anthropogenic effects on human-ecosystem interface, it´s accompanied by Piacentini, Pedro Filho and Almeida (2015) understanding.

These understandings aligned to the perception of innovation in processes according to Andrade (2014), provide the view that the introduction of significant improvements in processes from a Contingency vision may involve sustainable approach to the Amazon attribute as described in Table 1.

Table.1: Construct sustainable innovation processes in the study setting.

Elements	Concepts	Idealizer for sustainable innovation in processes
1 Contingency approach	1.1 Appropriate format to achieve the organization goals resulting from the functional relationship between the environment and the organization.	New or significantly improved method through the appropriation of Amazon attributes taken from the analysis of technological contingencies,aiming the reduction of operational costs and gain competitiveness guided by a sustainable perspective.
2 Nature´s Attribute	2.1 Set of traditional knowledge that involve the use of biotic and/or abiotic resources available in the biome.	
3 Process Innovation	3.1 New or significantly improved production method in order to reduce production cost and improve the competitiveness.	
4 Sustainability Approach	4.1 Interaction viable, equitable and endurable between the ecological, economic and environmental, to provide continuous constant or stable activity.	

Source: Authors.

In this perspective, sustainable innovation in the processes can obtained through the nature's attributes, taken based on systematic and continuous analysis of the variables that affect the technological and strategic organization's framework.

3.2 Concepts Required for Manufacturing Strategy and Competitiveness of the Amazon Attributes

In Pereira (2014), the strategy is the means by organizational managers can influence the external environment, the organization´s technologies, structures and control mechanisms and management. The above author accompanies Chiavenato (2003) in his taxonomy to present the strategic perspective of Design, which involves among others, the internal assessment of the organization as a competitive strategy.

Competitiveness in this scenario can read in order to associate innovation and strategy as Leão(2014) understanding, which considers competitiveness as the organizational ability to perceive changes and to prepare to face them taking a proactive stance.

3.3 Concepts of Innovation, Tradition and Demand Focusing on Business Impact.

Cyrino (2010) advert for the impacts caused by commercial fish farming´s effluents, revealing that the productive effort in fish farming may result in increased environmental

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degradation if are not implemented some preventive measures.

The definition of traditional knowledge presented in Castelli and Wilkinson (2015) indicates that local communities have knowledge, technologies, and innovations and practices that taken part of in their lifestyles. Thus, management customarily developed by farmers as their traditional practice is the result of a historical process, which in last instance define them as a collectivity.

Pereira (2014), it appears that technology can have a flexible profile associated with the technical expertise and raw materials that can used in different products or services. In this context, a product may be described as abstract, whether characterized as one that has adaptability to the environment and the technological flexibility; strategy for external and internal consensus; and emphasis in research and development, marketing and human resources.

Therefore, the improvement of production practices traditionally developed in the face of new demands with business impact, it´s represent the revision of knowledge, technologies and practices according to precepts proficient to study setting.

IV. METHODOLOGY

In this study, we sought to inference by quantitative strategy to support qualitative data analysis, following the indications in Coimbra and Martins (2013). According to these authors, Yin (2011) calls for the case study as a thorough analysis method of the aspects of a phenomenon, situation or problem; and Punch (2010) recognizes the combination of different paradigms in a common methodological platform. The research based on the Contingency Theory according structural and technological aspects resulting from Joan Woodward´ studies indicated in Pedro Filho (2015).

The study involved consulting for group of experts composed by professors from the of Rondônia´sFederal University (Brazil), to debate and setting ideal parameters for sustainability in fish farming. Delphi technique used by the expert, like indicated in Landeta and Barrutia (2011) and Vanzetto (2012). It consulted to focus group for strategic and competitive context of the scenario following Dias (2015). The group made up of six fish farmers with higher productivity in Rolim Moura city, Rondônia State, Brazil and twenty stakeholders. The methodological matrix applied in the study is showing in Figure 1 and Table 2 as described.

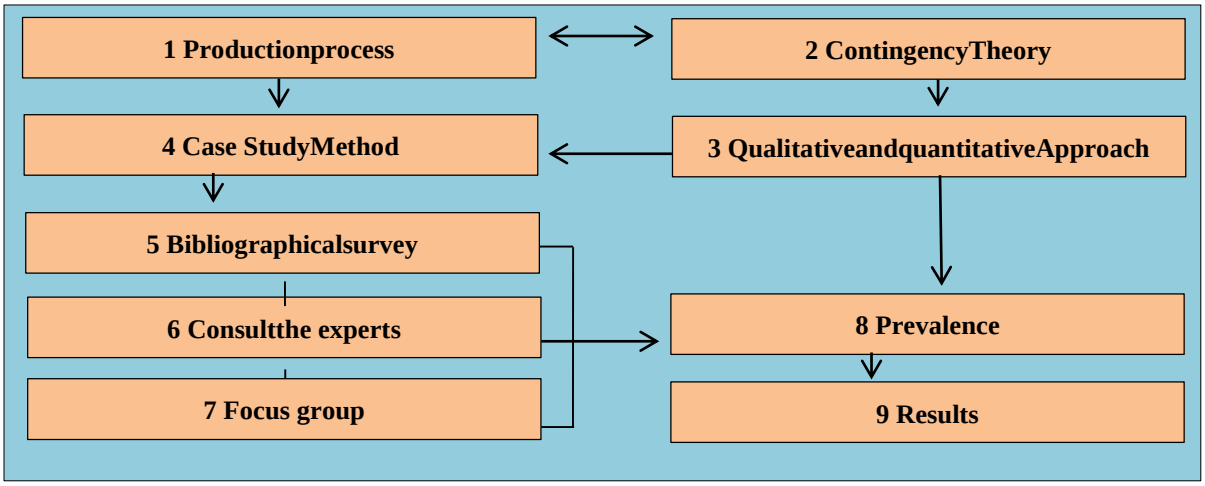

Fig.1: Methodological Matrix research.

Source: Authors.

Table.2: Descriptive of methodological matrix research.

Element	Description
1 Production process	Research subject: innovation in production processes in fish farming.
2 Contingency Theory	Basic theory for the task, following the technological approach resulting conducted by Joan Woodward´s studies.
3 Qualitative and quantitative Approach	Paradigm approach that guides the nature of the study.
4 Case Study Method	Methodological approach to the research.
5 Bibliographical survey	Theoretical categorization to support of the study.

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6 Consult the experts	Survey desirable parameters and variables to categories involving Amazon attributes taken sustainably.
7 Focus group	Identification of the factual context according to fish farmers and stakeholders, based on the categories listed in theory.
8 Prevalence	Relevant measures that stand out in the study scenario, identified based on statistical assessment of the data collected.
9 Results	The elucidation of the prevalence aimed at reconciling between strategy and the structural of organization´s adjustment.

Source: Authors.

It was used secondarily SWOT tool, as shown in Chiavenato (2014), to consider competitive strategy aspects in the fish farming scene. The consulting experts provided the ideal state descriptive for the variables in the Amazon scenario, and the attributes of nature as parameters of pro-innovation action, according to the design in Table 3. The focal group offered to identify the factual context as traditionally practiced and perceived by the respondents.

Table.3: Data collected on the experts 'consultation and structured as SWOT tool.

Strategic dimensions and indicators		Variables
External	**1 Opportunities (opportunities).**	1.1 New lines of products; 1.2 New technologies; 1.3 New processes;
	2 Threats (Threats).	2.1 Substitutive products; 2.2 New customer demands; 2.3 Competitive pressures;
internal	**3 Forces (strengths).**	3.1 Natural resources available; 3.2 Advanced technologies; 3.3 Efficient processes;
	4 Weaknesses (weakness).	4.1 Operating limitations; 4.2 Obsolete technologies; 4.3 Inefficient processes;

Source: Authors.

The auxiliary instrument applied Likert scale with Statistical Package Software support for the Social Sciences for Windows (SPSS) for the treatment of correlation according to Pearson coefficient. Based on Almeida (2014) and Vale, Teixeira and Sant'Anna (2015), we used the average ranking for treatment of measurements obtained via Likert scale, and correlation analysis using Pearson correlation coefficient, to determine the strength of association between the variables and infer the prevalence of significant elements that can be innovated. The providence indicated identified the variables, the ideal matrix in face of the conceptual elements considered, the assessment and critical analysis.

V. INNOVATION BY JOAN WOODWARD´S APPROACH FOCUSING ON A FISH FARM IN THE AMAZON

The Ministry of Fisheries and Aquaculture in Brazil issued the Development Plan of the Brazilian Aquaculture 2015/2020 (BRAZIL, 2015), which analyzes the Brazilian fish production on the basis of 2013 year. In this period, we obtained a production of 1.241.807 tons, and of this total 61,6% were from fishing and just 38.4% originated in fish farming.

According to official data published by the Brazilian Institute of Geography and Statistics (IBGE, 2015), the Northern region of the country accounts for only 15,32% of fish captivity production, in which prevail Tambaqui, Pirarucu and Pirapitinga (*Colossomamacropomum*, *Arapaima gigas* and *Piaractusbrachypomus*). The fact that the Amazon Basin, the largest river basin in the world, lie in this region may help explain the fact prevail marketing from the fishing instead more than captive production. However, the anthropic pressure on this watershed, not only for fish extraction but also for other activities such as navigation, could cause the depletion of fish stocks, leading to economic, environmental and social fragility in the region.

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It is in this scenario that discusses the situation of the Rolim de Mouracity, whose location is showing in Figure 3. The fish production in this municipality is predominant in captivity, having sold about 1.5 tons. to supply local fairs and in the surrounding cities and supermarkets.

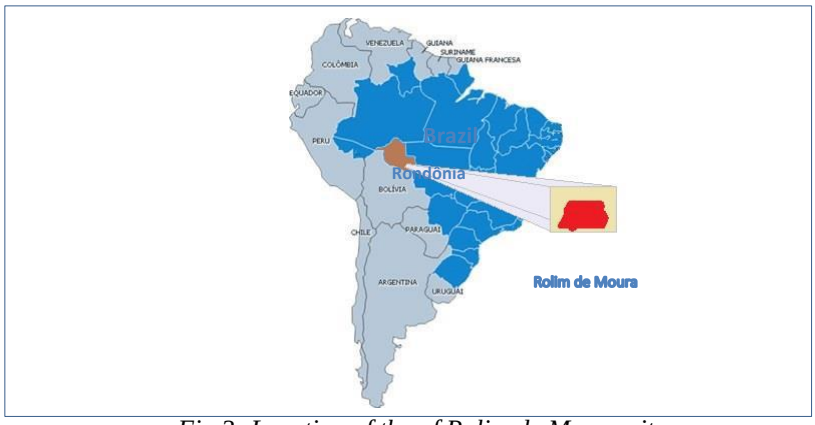

Fig.3: Location of the of Rolim de Moura city.

Source: Authors.

Considering that in its Aquaculture Development Plan (BRAZIL, 2015) Country outlines the expansion of its fish production through commercial aquaculture, and considering the need for increased food production to meet the world's population. As well as the growing demand for healthier foods, it is understood that it is appropriate to propose the expansion of fish production in confinement in the Rolim de Moura city, not only by abundance of natural attributes now underutilized as well as notorious commercial and nutritional quality of the species there consolidated.

However, the presence of state agencies for development and technification of rural production, aquaculture in the locality uses predominantly traditional, inefficient means the production, marketing and control of environmental impacts. Whereas these elements are in the environmental organizations' context, the approach is supported by the Contingency Theory as the same idea that Woodward to provide impact on competitive strategy. In this session, we list up creators to sustainable innovation in the study context; the manufacturing strategy contextualized in the face of competitive convenience of Amazon attributes, and analyses the innovation required in the face of tradition disruption on the commercial impact of the new demand.

5.1 Proficient Idealizers for Sustainable Innovation in the Scenario Study

Experts were consulted about indicative for taken as representative of the parameters for the guidance of the pro-innovation intervention according to the drivers part listed in Table 5.

Table.5: Benchmarks for pro-innovation intervention.

Strategic dimensions and indicators		Variables	Drivers for pro-innovation intervention with sustainability
External	**1 Opportunities.**	1.1 New product lines; 1.2 New technologies; 1.3 New processes;	1.1.1 Filleting: differentiated cut the fish as an alternative to traditional in whole pieces. 1.2.1 Amazon Attributes: waste processing and creation in dams networks. 1.3.1 Sanitary control: Sanitizing production-turning sub products in feed.
	2 Threats.	2.1 Substitutive products; 2.2 Customers´demands; 2.3 Incoming pressures;	2.1.1 Competitiveness: advantageous price in relation to the offered. 2.2.1 Consumer preferences: demand decline to the consumer demand. 2.3.1 Impairmentby competition: Deficiencies negatively affecting the business.

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Internal	**3 Forces.**	3.1 Natural resources available; 3.2 Advanced technologies; 3.3 Efficient processes;	3.1.1 Availability of specimens: it´s no necessary import or adaptation of exogenous species. 3.2.1 Fish cub technique, polyculture and consortium: breeding and rearing of other animals. 3.3.1 Semi-intensive breeding and cooperative Creation: Emphasis on intensive control of production and cooperation or collaboration between producers.
	4 Weaknesses.	4.1 Operating limitations; 4.2 Obsolete technologies; 4.3 Inefficient processes;	4.1.1 Organization and qualification: Disqualification of stakeholders playing traditional practices inefficient impactful. 4.2.1 Extensively creation: traditional low system technification and productivity. 4.3.1 Lack of livestock and livestock planning control: creation of structure planning Absence, profitability and biometric measurements undertake the activity.

Source: Authors.

Regarding the Opportunities indicator, filleting indication constitutes an alternative to traditional management, although there is a factual reality that is the lack of technology or training for innovation in itself the product transformation process under the requirement of the modern market. This lack of technology also reflects the performance of the technical assistance agency and even the consolidation of public policies in this sector.

The use of Amazonian attributes, optimization may occur with the use of natural resources such as river or reservoir hydroelectric dams, generation of inputs such as organic fertilizers and others, from the breeding with environmental control of the activity. The sanitization will provide cost savings through the transformation of production waste in reusable food in the production process.

As for the threats, the rise in production costs do not reflect the competitive quality gain, the quality of the consumer search can also result in declining demand, front products from other regions or substitutive products to offered. Loss-making processes can undermine market positions conquered earlier, due to pressure from new competitors.

Among the factors to provide the fish farming strengthening are availability of water resources and the diversity of species from the Amazonian habitat. Together, these factors are to support the success of production and matrix creation, as well demand and product are accept in the market place.

The fingerling production technology increases qualitatively and quantitatively the creation possibility, which can be expanded by fish group creation of different species or in interaction with other animals, that provide useful inputs to production, increasing competitive and productive efficiency of the process. The semi-intensive farming proves to be suitable for search productivity with quality, having emphasis on control of biotic and abiotic resources that interact with the production, as well as fish increase and improve feed to speed up the production process.

About weaknesses identified in the sector, producer´s limitations in the organization of productive activity and the lack of skilled labor, contribute to use practices considered unproductive or highly impactful to the environment. In some cases, the fact that the activity considered secondary in the productive context result in an amateurish tract to conducting business. Emphasizing the choice of obsolete technologies such that: extensively creating, adopting less complex processes in planning the activity, the choice of species and definition of target group, in livestock control, monitoring water quality, biometric control, weighing and measuring fish.

5.2 Manufacturing Strategy Context

The manufacturing strategy come from the competitive convenience of Amazon attributes. The search results conducted to evaluate competitive convenience of activity were analysed statistically to answers systematization. It was used a General Eastern rank of the responses of each group, as shown in Table 6 is. 7

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Table.6: Evaluation parameters.

Evaluation	Conditioning	
Below 3	Activity Negatively affects.	
Between 3 and 4	Activity Indifferent.	
Above 4	Activity positively affects.	

Source: Authors.

Table.7: Results achieved.

Strategic dimensions		Variables	Fish farmers	stakeholders	General
			Average ranking	Average ranking	Average ranking
1 External	1.1 Opportunities	1.1.1 New product lines.	3.50	3.75	3.63
		1.1.2 New Technologies.	4.00	3.25	3.63
		1.1.3 New processes.	3.50	3.30	3.40
	1.2 Threats	1.2.1 Substitutive products.	1.33	2.10	1.72
		1.2.2 New client demands.	1.33	1.80	1.57
		1.2.3 Competitive pressures.	1.00	2.75	1.88
2 Internal	2.1 Forces	2.1.1 Available natural resources.	5.00	4.60	4.80
		2.1.2 Advanced technologies.	2.67	2.60	2.63
		2.1.3 Efficient processes.	4.00	3.40	3.70
	2.2 Weaknesses	2.2.1 Operational limitations.	2.00	3.00	2.50
		2.2.2 Obsolete technologies.	2.17	3.25	2.71
		2.2.3 Inefficient processes.	2.17	3.00	2.58

Source: Authors.

The results provide analysis in the strategic dimensions that impact competitiveness in the study setting. In foreign strategic dimension, the variables related to the category Opportunities were not indicated as elements that affect organizational performance, which could pose limitations in the perception of respondents as the industry environment, if the category Threats had not been highlighted as significant, indicating that market variables have great influence on the industry.

The Internal strategic dimension, the Forces category highlights the variable Natural Resources as the most important factor that positively affects the results of the activity. The result of variable Advanced Technologies, indicates these resources has adversely affected the performance of the sector, conciliated with that shown in Weaknesses Category, the variable Technologies Obsolete as responsible for weaknesses in the competitive performance. Variables Limitations Operating and Inefficient Processes also considered critical, although these elements have been well evaluated only the perspective of fish farmers.

5.3 Analysis about Required Innovation

The required innovation as result of this study involves the breaking of tradition in the face of commercial impact of the new demand.SPSS software generated the Pearson´s correlation coefficient for variablesin the Table 7, indicated in the previous session, assessment was transformed into indicative of similarity and difference or approximate distance between the values vectors; these steps have allowed reveal the prevalence, with the highest strength of association, as shown in Tables 8 and 9 below.

Table.8: Evaluation parameters.

Concept	Representation
Variables with a stronger association.	
Variables with stronger association articulated in the strategic dimensions.	
Variables with weaker association.	

Source: Authors.

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Table.9: Prevalence obtained by correlation of Pearson´s coefficient.

Variables	Similarity Correlation between variables and values											
	1.1.1	1.1.2	1.1.3	2.1.1	2.1.2	2.1.3	3.1.1	3.1.2	3.1.3	4.1.1	4.1.2	4.1.3
1.1.1 New product lines.	1.00	, 667	, 667	, 667	1.00	, 667	1.00	, 667	1.00	, 667	, 667	1.00
1.1.2 New Technologies.	, 667	1.00	0.00	, 667	0.00	0.00	, 667	0.00	0.00	, 667	, 667	, 667
1.1.3 New processes.	, 667	0.00	1.00	, 667	0.00	0.00	, 667	0.00	0.00	0.00	0.00	, 667
2.1.1 Substitutive products.	, 667	, 667	, 667	1.00	, 667	, 667	, 667	, 667	, 667	, 667	, 667	, 667
2.1.2 New client demands.	1.00	0.00	0.00	, 667	1.00	, 667	, 667	0.00	0.00	0.00	, 667	, 667
2.1.3 Competitive pressures.	, 667	0.00	0.00	, 667	, 667	1.00	, 667	0.00	0.00	0.00	, 667	1.00
3.1.1 Available resources;	1.00	, 667	, 667	, 667	, 667	, 667	1.00	0.00	, 667	, 667	, 667	, 667
3.1.2 Advanced technologies.	, 667	0.00	0.00	, 667	0.00	0.00	0.00	1.00	, 667	, 667	0.00	, 667
3.1.3 Efficient processes.	1.00	0.00	0.00	, 667	0.00	0.00	, 667	, 667	1.00	, 667	, 667	, 667
4.1.1 Operational limitations.	, 667	, 667	0.00	, 667	0.00	0.00	, 667	, 667	, 667	1.00	, 667	1.00
4.1.2 Obsolete technologies.	, 667	, 667	0.00	, 667	, 667	, 667	, 667	0.00	, 667	, 667	1.00	1.00
4.1.3 Inefficient processes.	1.00	, 667	, 667	, 667	, 667	1.00	, 667	, 667	, 667	1.00	1.00	1.00

Source: Authors.

The prevalence represent the perspective between the structural and technological environment of the traditional scenario study, as recommended in Woodward, in the face of competitive strategy in the Amazon. The prevalence proven by variables correlation is the great point in the dimensions articulation, featuring the ideal arrangement for intervention effect, according to prevalence of drivers as shown in Table 10.

Table.10: Prevalence data statistics as credible drivers' intervention.

Strategic dimensions		Variables	Drivers of pro-innovation prevalence with sustainability
1 External	**1.1 Opportunities.**	1.1.1 New product lines;	Filleting: the fish cut in differentiated form, as an alternative for a traditionally sold in whole pieces.
	1.2 Threats.	1.2.1 New customer demands;	Consumer preferences: It may result in the decline of demand in the consumer demand for quality.
2 Internal	**2.1 Forces.**	2.1.1 Available resources;	Availability of arrays of fishing specimens, and plenty of aquifers means: It is not necessary to import or adaptation of matrices associated with water abundance in the Amazon.
		2.2.1 Efficient processes;	Semi-intensive farming and operational arrangement cooperative system: Emphasis on productivity through intensive control of production and the sharing or collaboration between producers involved in cooperative system.
	2.2 Weaknesses.	2.2.2 Inefficient processes;	Lack of planning and zootechnical control: Planning Lack of production and business profitability; the biometric measures lack and other controls linked to the production cycle compromise the success of the activity.

Source: Authors.

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Breaking the tradition in its negative sense, perpetuates unproductive or high impact practices, occurs in the interaction axis between the new product lines parameters, new customer demands, available resources, and the relationship between efficiency and inefficiency processes. Therefore, the new demand impact will occur in the prospect of offering new products aligned to customer interests without, however, disfigure knowledge and effective production practices.

The fish filleting is an opportunity to innovate the product offered, provided it includes the quality perception required by customers. This offer can extended through diversification of specimens of the Amazon habitat, making use of the competitive force provided by the available natural resources.

The diversification prospect in species surpasses the traditional monoculture, by implementation of semi-intensive farming system, promoting the production process based on a consortium with other fish species. At the time that meets the demand for quality required by the customer cancels the parameter inefficient processes.

Notwithstanding this, the qualitative and quantitative increase in production can also occur by sharing or collaboration between producers involved in cooperative system, although it is essential to implement the livestock planning and zootechnical control. This proposed joint can increase production and promote the sharing of good practice not to compromise the quality, favouring the emergence a stronger and more coordinated economy, disrupting production methods traditionally practiced.

VI. CONCLUSION

This research studied innovation by Joan Woodward focused approach in the Amazon strategic competitive considering natural attributes as technological variables in the organizational environment in which they operate to fish farmers. Therefore, it has provided consulting experts to survey the structural and technological situation in the fish-farming scenario; focus group heard for strategic and competitive context of the research context; and statistical analysis led the prevalence treated secondarily with the SWOT tool.

Based on these results it can be said that sustainable innovation based on the proposed creators realigns production to market and innovation processes in fish farming valuing and incorporating the attributes of nature and favourable historical elements.

In order to respond to questions that guided this study, innovation in the competitive strategy context of the Amazon fish characterized by disruption of tradition that perpetuates unproductive or high impact practices. The study scenario occurs in the interaction axis between the parameters of new product lines, new customer demands, available resources, and the relationship between efficiency and inefficiency process.

However, although the proposed creators have proven to be compatible with the factual context in the study setting, providing valid operating indicative producers, it is understood that overcoming amateurish treatment that accentuates the option of obsolete technologies in conducting business, demand also the internalization of these creators in state development agencies to fish farming. This study will serve for reflection among stakeholders in the development of public policy for the integrated development of the Amazon and fish farmers.

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Impact of Deficit Irrigation (DI) and Root-Zone Drying Irrigation Technique (PRD) under Different Nitrogen Rates on Radiation Use Efficiency for Potato (*SolanumTuberosum L.*) in Semi-arid Conditions (II)

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Abstract*—The study was carried out at the Technical Center of Potato and Artichoke CTPTA located in the lower valley of Medjerda river of Tunisia during the season of 2017. The purpose was to estimate the impact of deficit irrigation (DI) and the root-zone drying irrigation technique (PRD) under different nitrogen rates on photo synthetically active radiation absorbed and radiation use efficiency for Potato (SolanumTuberosum L. VS. Spunta). Three water treatments (T_1= 100% ETC, T_2 = DI = 75% ETC and T_3 = PRD_{50}) and three nitrogen rates (F_1 = N_{150}: 150 kg N ha^{-1}, F_2 = N_{75}: 75kg N ha^{-1}, F_3 = N_0: 0kg N ha^{-1}) were applied since the tuber initiation (55 days after planting) to maturity (100 days after planting).The deficit irrigation T_2 has no effect on PARabs. Besides, the PRD_{50} has led to a reduction in PARabs. This decrease compare to T_1 was equal to (8.9; 9.9 and 7.9%) respectively for the three treatments (F_1; F_2 and F_3). The nitrogen deficit affects negatively the PARabs. An improvement of 13.2%, 11.2% and 12.2% of the F_1 compared to the F_3, respectively for the three water treatments (T_1, T_2 and T_3). The T_2 has no effect on RUE_{TDM}. Conversely, the PRD_{50} has led to a reduction in RUE_{TDM}. This decline referee against T_1 was equal to (12.7; 17.4 and 21.5%) respectively for the three treatments (F_1; F_2 and F_3). For RUE_{GY} statistical analysis showed significant ($P < 0.05$) difference between the three irrigation treatments (T_0, T_1 and T_2) for the three nitrogen treatments (F_1; F_2 and F_3). The T_2 and the PRD_{50} has led to a reduction in RUE_{GY}. This decrease judge against T_1 respectively for the two treatments (F_2 and F_3) was equal to (14.9 and 21.5%) and (19.6 and 31.2%).*

***Keywords*—*Deficit Irrigation, Root-Zone Drying Irrigation, Leaf Area Index, Photosynthetically Active Radiation Absorbed, Radiation Use Efficiency*.**

I. INTRODUCTION

Increasing crops productivity and saving irrigation water are two interrelated issues raising a lot of concern these days in Tunisia. Deficit irrigation is an optimization strategy in which irrigation is applied during the drought-sensitive growth stages of a crop. Outside these times, irrigation is limited or even unnecessary if rainfall provides a minimum water supply. Restriction of water is limited to drought tolerant phenology. In other terms, deficit irrigation aims to stabilize yields and achieve maximum water gain rather than maximum yields (Zhang and Oweis, 1999). Deficit irrigation practices differ from traditional water supply follow. The manager needs to know the level of permissible sweating deficit without significant yield reduction of the crop. The main objective of deficit irrigation is to increase the water use efficiency of a crop with no impact on yield. According to English et al., (1990), Partial Root-zone Drying (PRD) is a modified form of deficit irrigation (DI), which consists of watering only a part of the soil of the root zone in each irrigation event, leaving the other part to dry to certain soil moisture content before re-wetting by moving the irrigation to the dry side. Therefore, PRD is a new irrigation strategy in which half of the roots are placed in soil drying and the other half grow in irrigated soil (Ahmadi et al., 2010a). Wetting and drying on both sides of the roots depend on the crop, stage of growth, evaporation, crop requirements, soil texture and soil moisture balance (Saeed et al., 2008). The PRD irrigation has been the subject of many researchers (Samadi & Sepaskhah, 1984; Bahrun et al., 2002; Kang & Zhang, 2004; Gencoglan et al., 2006; Shahnazari et al., 2007; Shayannejad, 2009; Wang et al., 2013).Potato (Solanumtuberosum L.) is a water demanding crop, requiring from 450 to 800 L to produce 1 kg of tuber dry matter (Wright & Stark, 1990). Several studies have

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been done to analyze the dry matter growth of a crop based on the intercepted radiation. Monteith (1972) is the first to discover the role of crop in the solar radiation absorption and in the transformation of intercepted energy into biomass. The efficiency of this transformation is known as the radiation use efficiency, which is defined as the ratio of the biomass produced to the amount of energy received (Bonhomme, 2000). Indeed, in the absence of any source of stress (water, nutrition or sanitation), several authors have reported the existence of a strong linear relationship between the development of a given crop and the radiation intercepted for several plant species (Scott et al. al., 1973). The water deficit significantly affects radiation use efficiency as well as total dry matter production and photosynthetically active radiation absorbed. Deficit irrigation causes leaf curl and reduced leaf number and size which cause reduction in total leaf area. It also reduces photosynthesis by inducing leaf senescence, which in turn leads to a decrease in the light use efficiency. Nitrogen and water limitation affected biomass yield, the efficiencies of radiation, water and nitrogen use in maize crops (Teixeira et al., 2014). Fletcher et al. (2013) affirmed that over nitrogen deficit the RUE, decreased by 22% when no N-fertilizer was applied. Wilson and Jamieson (1985) observed in arid environments, that water stress tends to reduce RUE progressively by preventing utilization of photosynthates for growth as lower PAR occurs from reduced LAI. Likewise, the reductions in RUE due to water deficits have been reported by Hughes and Keatinge (1983) in grain legumes. Beneath water deficit, the photosynthetically active radiation absorbed and leaf area index were frequently used to estimate the effects of drought stress on crops (Collino et al., 2001). Hamzei and Soltani (2012) confirmed that the higher RUE was marked under moderate deficit irrigation and optimum nitrogen rate. Nevertheless, the combined effect of deficit irrigation and nitrogen application on the radiation use efficiency of potato need more detailed studies. Also, no information is available on the interactive effects of nitrogen and irrigation regimes on biomass accumulation and radiation interception for potato in Tunisia. Therefore, the objective was to investigate the suitable irrigation regime and N rate to improve potato biomass accumulation and RUE under the semi-arid conditions of Tunisia. This investigation will discard the potential of reducing water and Nitrogen fertilizer utilization.

II. MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Technical Centre of Potato situated in the low valley of Medjerda river at Saida, Tunisia (10°EST, 37°N, Alt. 28 m), during the season 2017.

The climate is semi arid. The average annual rainfall is about 450 mm, concentrated from December to April with irregular distribution.

The soil had a clay-loam texture with 180 mm m-1 total available water and 2 g l^{-1} water salinity. The bulk density varies from 1.34 to 1.60 from the surface to the depth (Rezig et al., 2013a).

Plant Material and Experimental Design

Plant material consisted of one potato variety (Solanumtuberosum cv. Spunta). The potato planting was conducted on 02 March 2017 with a mechanical planter machine. The Planting density was 41667 plants ha^{-1}.

The experiment covered two treatments (T: water regimes and F: nitrogen rates). T consisted of three water regimes (T_1 = 100% ET_C, T_2= 75% ET_C and T_3= PRD_{50}).

F consisted of three nitrogen rates (F_1 = 150 kg N ha^{-1}, F_2 = 75 kg N ha^{-1} and F_3 = 0 kg N ha^{-1}).

At the beginning of the potato cycle (during the first stages) irrigation and fertilization were started without any difference between the treatments (with the exception of the F_3 which did not receive nitrogen from the beginning), from which the crop was given 100% of the water needs and nitrogen requirements in a homogeneous way over the entire plot.

The experimental protocol was started 26 April 2017 (**55** DAP) at the stage of the initiation of tuberisation to potato harvesting and they were irrigated by drip irrigation. The experimental design was Split Plot with 3 replications. The main factor is irrigation regime and the secondary factor is nitrogen rates.

Field measurements

Climatic Data

Weather data were recorded daily by automatic agrometeorological station. Collected data were minimum and maximum temperatures (T_{min} and T_{max}), minimum and maximum air relative humidities (HR_{min} and HR_{max}), wind speed (V) and rainfall (P). Reference evapotranspiration (ET0) and solar radiation (Rs, MJ m^{-2} d^{-1}) were estimated by the Cropwat 8.0 software using the FAO-Penman-Monteith approach (Allen et al., 1998). The daily Rs were used to calculate the daily photosynthetically active radiation incident (PAR_0 = RS/2) (Monteith&Unsworth, 1990).

Leaf Area Index, Total Dry Matter Production

The observations were made on Leaf Area Index (LAI) and total dry matter (TDM g m^{-2}). The sampling was collected for growth analysis at 40, 56, 69, 85 and 96 days after planting Potato (DAPP). Each sample was placed separately in a plastic bag with an identification tag. After separation of the various parts, the quantity of fresh material was determined immediately. As for the amount of dry matter, it was measured after drying at 80 °C to a

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constant mass. The weightings were carried out using a precision scale (Model PB3001, Mettler Brand, Switzerland). Leaf area was measured using planimeter type CID Inc-Cl-202.

Theoretical Formulations

Estimation of the Daily Photosynthetically Active Radiation Intercepted

The fraction of intercepted radiation (Fi) was calculated from measurements of LAI using the exponential equation as suggested by Monteith and Elston (1983).

$$Fi = 1 - e^{(-K * LAI)} \quad (1)$$

Where k is the extinction coefficient for total solar radiation. The k value of 0.60 was used for potato as described by Rezig et al., (2013a).

Photosynthetically active radiation intercepted by potato (PARabs) was calculated using the formula of Beer (Manrique*et al*., 1991):

$$PARabs = PAR_0 * Fi \quad (2)$$

PAR_0 is photosynthetically active radiation incident, which is equal to half of the solar radiation (Monteith&Unsworth, 1990).

Estimation of the radiation use efficiency

RUE of total dry matter (RUE_{TDM}) and RUE of potato yields (RUE_{GY}) were calculated using the following equation:

$$RUE_{TDM}\ (kg\ m^{-3}) = TDM / PARabs \quad (3)$$

$$RUE_{GY}\ (kg\ m^{-3}) = GY / PARabs \quad (4)$$

Where, RUE is the radiation use efficiency (g MJ^{-1}), TDM is the total dry matter production (g m^{-2}), GY is the potato yields (kg) and PARabs is the total Photosynthetically Active Radiation Intercepted over the whole potato growing season (mm).

2.6. Statistical Analysis

The results were subjected to variance analysis of one factor by General Linear Model (GLM). This analysis was performed using SPSS 20.0 software. The set was completed by multiple comparisons of means with Student Newman Keuls test (S-N-K).

III. RESULTS

Effect of Deficit Irrigation (DI) and Partial Root-Zone Drying Irrigation (PRD) and on Leaf Area Index.

The impact of irrigation treatment (T_1 = 100% ETC, T_2 = 75% ETC and T_3= PRD_{50}) in the leaf area index (LAI) of potato was given in figure 1. In order to make out the effect of water regime on the evolution of leaf area index. The LAI was followed for the three treatments T_1, T_2 and T_3. The results illustrated that during the primary 65th DAP, the LAI curves of all treatments track the same pace.

Indeed, the differences between irrigation treatments are observed after applied the water stress. It is noted that the LAI increases gradually to reach its maximum at the 77th DAP, and from this date, the value of the LAI decreases until the end of the cycle.

For the three nitrogen treatments F_1, F_2 and F_3, the maximum values of the LAI are recorded respectively in the T_1 (3.8; 3.5 and 3.1) followed by the T_2 treatment (3.3; 2.9 and 2.7) and finally the treatment T_3 (2.9; 2.5 and 2.3).

From these results, we observed that the deficit irrigation T_2 (ETC = 75 %) and the Partial Root-Zone Drying Irrigation (PRD_{50}) has led to a reduction in LAI_{max}.

This decline compare to T_1 for the three treatments (F_1, F_2 and F_3) was equal respectively to (13.1; 17.2 and 12.9%) and (23.7; 28.6 and 25.8%). To observe the deficit nitrogen effect of on the evolution of LAI. The evolution of LAI was followed according to days after planting for the three treatments F_1, F_2 and F_3.

The results obtained showed that the increase of the nitrogen dose led to an improvement of the LAI_{max}. The greatest values of the LAI are recorded in the F_1 (3.8; 3.3 and 2.9) followed by the F_2 treatment (3.5; 2.9 and 2.5) and finally the treatment F_3 (3.1; 2.7 and 2.3) for the three irrigation treatments T_1, T_2 and T_3 respectively. The results show that the nitrogen deficit affects negatively the LAI_{max}. An enhancement of 18.4%, 18.2% and 20.7% of the F_1 treatment compared to the F_3 treatment, respectively for the three water treatments (T_1, T_2 and T_3).

Table.1: the leaf area index (LAI) of potato under the three irrigation treatments and the three nitrogen rates.

DAP	42	55	62	70	77	84	92
T_1 F_1	1.3a	2.0a	2.6a	3.1a	3.8 a	2.9 a	1.8a
T_2 F_1	1.2a	1.9a	2.4a	2.9b	3.3 b	2.7 b	1.4a
T_3 F_1	1.1a	1.7a	2.2a	2.7b	2.9 c	2.4 c	1.3a
LSD	0.5	0.7	0.8	0.2	0.41	0.2	0.6
T_1 F_2	1.1a	1.9a	2.3a	2.9a	3.5 a	2.7 a	1.6a
T_2 F_2	0.9a	1.8a	2.1a	2.6a	2.9 b	2.4 b	1.4a
T_3 F_2	0.8a	1.7a	2.1a	2.4a	2.5 c	2.2 c	1.3a
LSD	0.47	0.8	0.9	0.9	0.40	0.3	0.5
T_1 F_3	0.9a	1.6a	2.1a	2.5a	3.1 a	2.3 a	1.3a

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DAP	42	55	62	70	77	84	92
T_2 F_3	0.8a	1.5a	2.7a	2.4a	2.7 a	2.3 a	1.3a
T_3 F_3	0.7a	1.4a	1.9a	2.3a	2.3 a	2.1 a	1.2a
LSD	0.5	0.7	0.9	0.8	0.9	0.5	0.5
T_1 F_1	1.3a	2.0a	2.6a	3.1a	3.8 a	2.9 a	1.8a
T_1 F_2	1.1a	1.9a	2.3a	2.9a	3.5 a	2.7 a	1.6a
T_1 F_3	0.9a	1.6a	2.1a	2.5a	3.1 a	2.3 b	1.3a
LSD	0.7	0.9	0.9	1.1	0.7	0.4	0.8
T_2 F_1	1.2a	1.9a	2.4a	2.9a	3.3 a	2.7 a	1.4a
T_2 F_2	0.9b	1.8a	2.2b	2.6a	3.0 b	2.4 b	1.4a
T_2 F_3	0.8b	1.5b	2.1b	2.4b	2.7 b	2.3 b	1.3a
LSD	0.3	0.3	0.3	0.35	0.30	0.3	0.6
T_3 F_1	1.1a	1.7a	2.2a	2.7a	2.9 a	2.4 a	1.3a
T_3 F_2	0.8b	1.7a	2.1a	2.4a	2.5 b	2.2 ab	1.3a
T_3 F_3	0.7b	1.4b	1.9a	2.3b	2.3 b	2.1 b	1.2a
LSD	0.3	0.3	0.7	0.35	0.40	0.2	0.6

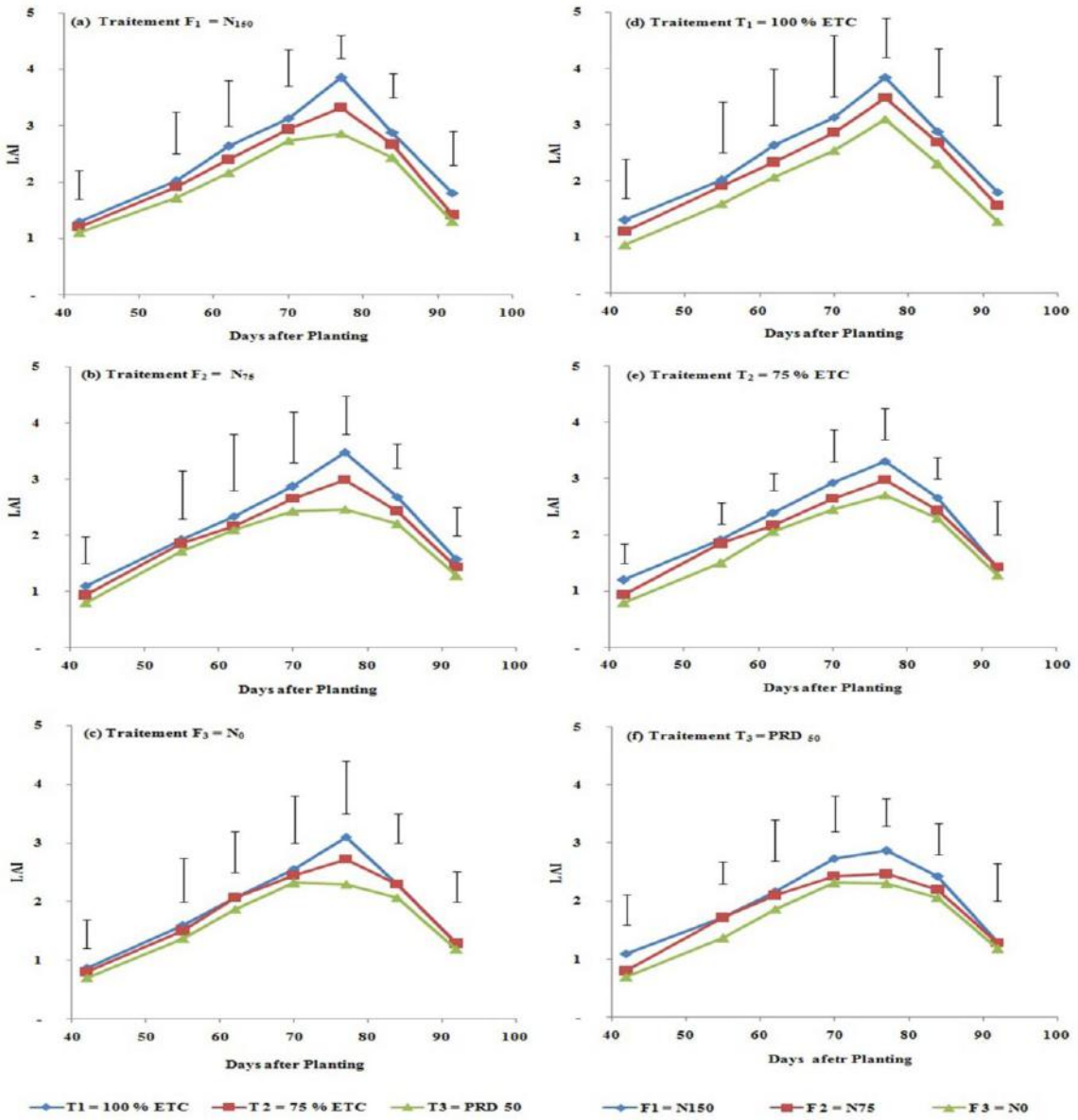

Fig.1: The Leaf Area Index (LAI) of potato under the three irrigation treatments (T_1, T_2 and T_3) and the three nitrogen rates (F_1, F_2 and F_3).

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Effect of PRD and DI on Photosynthetically Active Radiation Absorbed.

The effect of three irrigation treatments (T_1 = 100% ET_C, T_2= 75% ET_C and T_3= PRD_{50}) and the three nitrogen rates (F_1 = 150 kg N ha^{-1}, F_2 = 75 kg N $ha^{-1}$and F_3 = 0 kg N ha^{-1}) in the photosynthetically active radiation absorbed (PARabs) of potato was given in figure 2. ANOVAs analysis (Table 2) confirmed that the cumulative PARabswere significantly ($P < 0.05$) affected by the irrigation treatment (T_1; T_2 and T_3). For the three treatments F_1, F_2 and F_3, the highest PARabswas recorded respectively under T_1 (516.5; 490.1 and 448.4 MJm^{-2}) and T_2 (494.9; 467.6 and 439.7 MJm^{-2}). The smallest was observed under T_3 (470.3; 441.8 and 412.9 MJm^{-2}). From these outcome, we observed that the deficit irrigation T_2 (ETC = 75 %) has no effect on PARabs. Moreover, the Partial Root-Zone Drying Irrigation (PRD_{50}) has led to a reduction in PARabs. This decrease compare to T_1 was equal to (8.9; 9.9 and 7.9%) respectively for the three treatments (F_1; F_2 and F_3). In order to examined the effect of deficit nitrogen on the cumulative PARabs. It's was measured for the three treatments F_1, F_2 and F_3.The results obtained showed that the increase of the nitrogen dose led to an improvement of the PARabs. The greatest values of the PARabs are recorded in the F_1 (516.5; 494.9 and 470.3 MJ m^{-2}) followed by the F_2 treatment (490.1; 467.6 and 441.8 MJ m^{-2}) and finally the treatment F_3 (448.4; 439.7 and 412.9) for the three irrigation treatments T_1, T_2 and T_3 respectively. The results show that the nitrogen deficit affects negatively the PARabs. An improvement of 13.2%, 11.2% and 12.2% of the F_1 treatment compared to the F_3 treatment, respectively for the three water treatments (T_1, T_2 and T_3).

Effect of PRD and DI on Radiation Use Efficiency.

The relation between the cumulative photosynthetically active radiation absorbed (PARabs) and the total dry matter production (TDM) over all potato growing season and under the nine treatments is given in Figure 3. From these outcomes, we observed for different treatments that the TDM increased linearly with the cumulative PAR absorbed. The slope of this regression is the conversion efficiency of radiation interception into total dry matter production (RUE). We distinguished that, for the treatment F_1, the highest amount of RUE was recorded in the T_2 treatment 1.53 g MJ^{-1} and after that in T_1 1.47 g MJ^{-1}. However, the smallest amount was recorded in the T_3 treatment 1.24 g MJ^{-1}. In detail, the RUE in T_2 has demonstrated respectively an increase of 3.9% and 18.9 % compared to T_1 and T_3. Nevertheless, for the two treatments F_2 and F_3, the highest RUE was recorded in the T_1 treatment (1.35 and 1.28 g MJ^{-1}) and after that in T_2 (1.31 and 1.17 g MJ^{-1}). The least was recorded in the T_3 treatment (1.30 and 1.10 g MJ^{-1}). In denote, for the two nitrogen rate (F_2 and F_3) the RUE in T_2 and T_3 has demonstrated respectively a decline of (3.7 and 8.6%) and (3.7 and 14.1 %) compared to T_1. The radiation use efficiency of total dry matter production at harvest (RUE_{TDM}) and the radiation use efficiency of yield (WUE_{GY}) of the nine treatments were exposed in Table 3.

Table.2:the photosynthetically active radiation absorbed (PARabs) of potato under the three irrigation treatments (T_1, T_2 and T_3) and the three nitrogen rates (F_1, F_2 and F_3).

DAP	**62**	**70**	**77**	**84**	**92**
T_1 F_1	208.2a	288.0a	368.7a	443.5a	516.5 a
T_2 F_1	200.0a	277.6a	355.3a	427.2a	494.9 a
T_3 F_1	187.9a	262.7a	337.1a	405.6a	470.3 b
LSD	25.8	30.1	32.7	43.6	24.6
T_1 F_2	193.7a	270.1a	348.2a	420.7a	490.1 a
T_2 F_2	183.9a	257.9a	332.6a	401.7b	467.6 ab
T_3 F_2	172.7a	244.5a	314.7a	379.5c	441.8 b
LSD	36.6	39.8	59.5	19.5	23.2
T_1 F_3	170.4a	242.6a	316.8a	385.2a	448.4 a
T_2 F_3	165.6a	237.5a	309.5a	376.5a	439.7 a
T_3 F_3	153.3a	222.3a	290.3a	353.3b	412.9 b
LSD	26.6	32.3	54.8	23.2	26.8
T_1 F_1	208.2a	288.0a	368.7a	443.5a	516.5 a
T_1 F_2	193.7a	270.1a	348.1a	420.7a	490.1 ab
T_1 F_3	170.4a	242.6a	316.8a	385.2a	448.4 b
LSD	45.2	101.9	52.9	33.1	67.2

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T_2 F_1	200.0a	277.6a	355.3a	427.2a	494.9 a
T_2 F_2	183.9b	257.9b	332.6b	401.7b	467.6 b
T_2 F_3	165.6c	237.5c	309.5c	376.5c	439.7 c
LSD	20.6	20.5	23.1	25.7	27.3
T_3 F_1	187.9a	262.7a	337.1a	405.6a	470.3 a
T_3 F_2	172.7b	244.5b	314.7b	379.5b	441.8 b
T_3 F_3	153.3c	222.3c	290.3c	353.3c	412.9 c
LSD	17.5	23.8	22.9	25.9	28.4

Table.3: Radiation use efficiency (g MJ^{-1}) of total dry matter at harvest (RUE_{TDM}) and radiation use efficiency (g MJ^{-1}) of yield (RUE_{GY}) under the three irrigation treatments and the three nitrogen rates.

DAP	**TDM**	**Yield**	**PAR abs**	**RUE $_{TDM}$**	**RUE $_{YD}$**
T_1 F_1	1539.3 a	20.3 a	516.5 a	2.98 a	3.94 a
T_2 F_1	1511.2 a	20.7 a	494.9 a	3.05 a	4.18 a
T_3 F_1	1223.5 b	13.0 b	470.3 b	2.60 b	2.77 b
LSD	88.0	3.6	24.6	0.36	0.76
T_1 F_2	1493.7 a	20.7 a	490.1 a	3.05 a	4.23 a
T_2 F_2	1382.4 b	16.8 b	467.6 ab	2.96 a	3.60 b
T_3 F_2	1111.4 c	14.6 c	441.8 b	2.52 b	3.31 b
LSD	110.6	2.2	47.2	0.38	0.85
T_1 F_3	1463.4 a	22.4 a	448.4 a	3.26 a	5.00 a
T_2 F_3	1311.1 b	17.7 b	439.7 a	2.98 a	4.02 b
T_3 F_3	1055.2 c	14.2 c	412.9 a	2.56 b	3.44 b
LSD	132.8	2.7	83.8	0.41	0.80
T_1 F_1	1539.3 a	20.3 b	516.5 a	2.98 a	3.94 b
T_1 F_2	1493.7 ab	20.7 b	490.1 ab	3.05 a	4.23 b
T_1 F_3	1463.4 b	22.4 a	448.4 b	3.26 a	5.00 a
LSD	75.8	1.6	67.2	0.67	0.6
T_2 F_1	1511.2 a	20.7 a	494.9 a	3.05 a	4.18 a
T_2 F_2	1382.4 b	16.8 b	467.6 b	2.96 a	3.60 b
T_2 F_3	1311.1 c	17.7 b	439.7 c	2.98 a	4.02 a
LSD	70.2	3.0	27.3	0.22	0.40
T_3 F_1	1223.5 a	13.0 a	470.3 a	2.60 a	2.77 b
T_3 F_2	1111.4 b	14.6 a	441.8 b	2.52 a	3.31 a
T_3 F_3	1055.2 c	14.2 a	412.9 c	2.56 a	3.44 a
LSD	56.1	3.0	28.4	0.41	0.50

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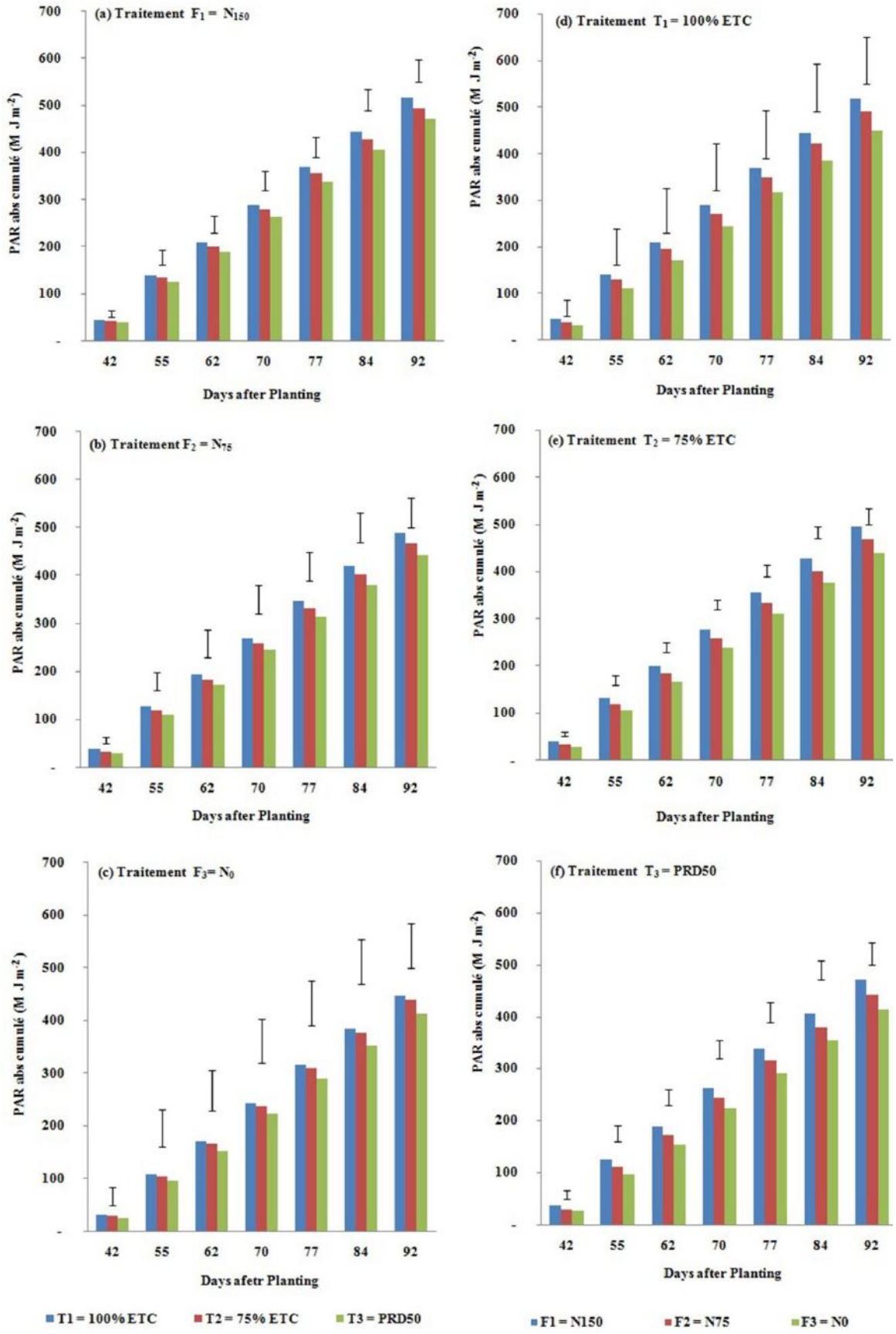

Fig.2: The radiation interception (PAR abs) of potato under the three irrigation treatments (T_1, T_2 and T_3) and the three nitrogen rates (F_1, F_2 and F_3).

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ANOVAs analysis (Table 3) affirmed that at final harvest, the RUE_{TDM} and RUE_{GY} were significantly ($P < 0.05$) affected by the irrigation treatment (T_1; T_2 and T_3).

For the three treatments F_1, F_2 and F_3, the highest RUE_{TDM} was recorded respectively under T_1 (2.98; 3.05 and 3.26 g MJ^{-1}) and T_2 (3.05; 2.96 and 2.98 g MJ^{-1}). The lowest was marked under T_3 (2.60; 2.52 and 2.56 g MJ^{-1}). From these results, we can make out that the deficit irrigation T_2 (ETC = 75 %) has no effect on RUE_{TDM}. In addition, the Partial Root-Zone Drying Irrigation (PRD_{50}) has led to a reduction in RUE_{TDM}. This decline referee against T_1 was equal to (12.7; 17.4 and 21.5%) respectively for the three treatments (F_1; F_2 and F_3).

For RUE_{GY} statistical analysis showed significant ($P < 0.05$) difference between the three irrigation treatments (T_0, T_1 and T_2) for the three nitrogen treatments (F_1; F_2 and F_3).

For the treatment F_1, the highest RUE_{GY} was recorded under the treatment T_2 (4.18 g MJ^{-1}) followed by the treatment T_1 (3.94 g MJ^{-1}). The lowest WUE_{GY} (2.77 g MJ^{-1}) was obtained in treatment T_3.

For the two treatment F_2 and F_3, the maximum RUE_{GY} was marked respectively under the treatment T_1 (4.23 and 5.00 g MJ^{-1}) after that by the treatment T_2 (3.60 and 4.02 g MJ^{-1}). The lowest RUE_{GY} (3.31 and 3.44 g MJ^{-1}) was obtained in treatment T_3. From these consequences, we can concluded that the deficit irrigation T_2 (ETC = 75 %) and the Partial Root-Zone Drying Irrigation (PRD_{50}) has led to a reduction in RUE_{GY}. This decrease judge against T_1 respectively for the two treatments (F_2 and F_3) was equal to (14.9 and 21.5%) and (19.6 and 31.2%).

IV. DISCUSSION

The effect of the deficit irrigation and partial root-zone drying irrigation technique (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3 = PRD_{50}) under different nitrogen rate (F_1 = 150 kg N ha^{-1}, F_2 = 75 kg N ha^{-1} and F_3 = 0 kg N ha^{-1}) on the leaf area index (LAI), the Photosynthetically active radiation absorbed (PARabs), the radiation use efficiency for total dry matter production (RUE_{TDM}) and the radiation use efficiency for potato yield (RUE_Y) were studied. The results obtained show that the water deficit negatively influences the evolution of the leaf area index. These results are in agreement with those of Debaeke et al. (1996), Erchidi et al (2000) and Slama et al (2005) who showed that lack of water is reflected in plants by reducing the leaf area by acting on reducing the rate of cell expansion and on the other hand by increasing the rate of leaf senescence. If the plant is under water stress, the stomata are closed to reduce perspiration and water loss. According to Boutraa et al. (2010), the decrease in leaf area can be explained as a method of adapting to water shortage conditions to limit transpiration rate and in order to maintain the water supply in the soil around the roots for increase the chances of survival of the plant. This mechanism is achieved by reducing the elongation of the cell, which leads to the reduction of cell size and consequently the reduction of the leaf area. Thus the results of Sarda et al. (1992) showed that the water deficit decreased the leaf area index and the stomatal conductance of wheat and consequently its photosynthetic capacity.

From the results obtained (figure 2, table 2), it was found that the highest values of PAR abs was recorded at the T_1 treatment for the three nitrogen treatment (F_1, F_2 and F_3). Hence for the total PARabs cumulated at harvest, the T_1 has presented an improvement over the T_3 of 8.9%, 9.8% and 7.9% respectively for the three nitrogen treatments F_1, F_2 and F_3. In fact, the water deficit causes a decrease in PARabs. The application of deficit irrigation reduces the interception of light, which is in agreement with the work of Rezig et al. (2015a), in which they reported that PAR abs decreased from 1041.5 to 907.3 MJ m^{-2} in the wheat crop under water stress conditions. Also, CheikhM'hamed (2015) showed that the decrease in the PARabs cumulated for wheat crop in the I_0 (rainfed) compared to the I_3 (irrigated regime) was in the order of (13, 14 and 11%), respectively for the campaigns (2005-2006, 2006-2007 and 2007-2008). Numerous researchers affirmed that the reduction in the LAI, caused by water deficit and nitrogen deficiency, weaken photosynthetic active radiation (PARabs) and consequently reduce photosynthesis (Gosse et al., 1982, Durand et al. 1991, Akmal and Janssens 2004). Also, the results in table 2 revealed that whatever the water regime (100% ETC, 75% ETC or PRD_{50}) the highest values of PARabs was presented in F_1 treatment then in F_2 and finally in the F_3 treatment. In fact, the F_3 treatment resulted in a reduction of the cumulative PAR abs at harvest relative to F1 of 15.2%, 12.6% and 13.9% respectively for the nitrogen treatments T_1, T_2 and T_3. As a result, the decrease in the nitrogen dose negatively influences the PARabs. Nitrogen plays an important role in the growth of the potato and the deficiency of this element leads to a reduction of the leaf surfaces of the plants and consequently the reduction of the capacity of the plant to intercept the solar radiation. The results obtained are in agreement with those of Dreccer et al. (2000) who observed a reduction in wheat radiation interception under nitrogen deficiency conditions. The results (Figure 3) showed that the water regime (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3 = PRD_{50}) affected negatively the RUE for total dry matter production. The lowest values are recorded at the water treatment T_3 (PRD_{50}), hence a reduction with respect to T_1 was equal to 18.3%, 4% and 14.8% respectively for the treatment of nitrogen F_1, F_2 and F_3. Our results are in agreement with those of Rezig et al. (2015a and b) who reported that deficit irrigation reduces the efficiency of

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light use. In fact, the water deficit negatively affects the development of the leaves (leaf curl, reduction in the number and sizeof leaves, leaf senescence) which causes a reduction in the amount of radiation intercepted and consequently the diminution of the radiation use efficiency.

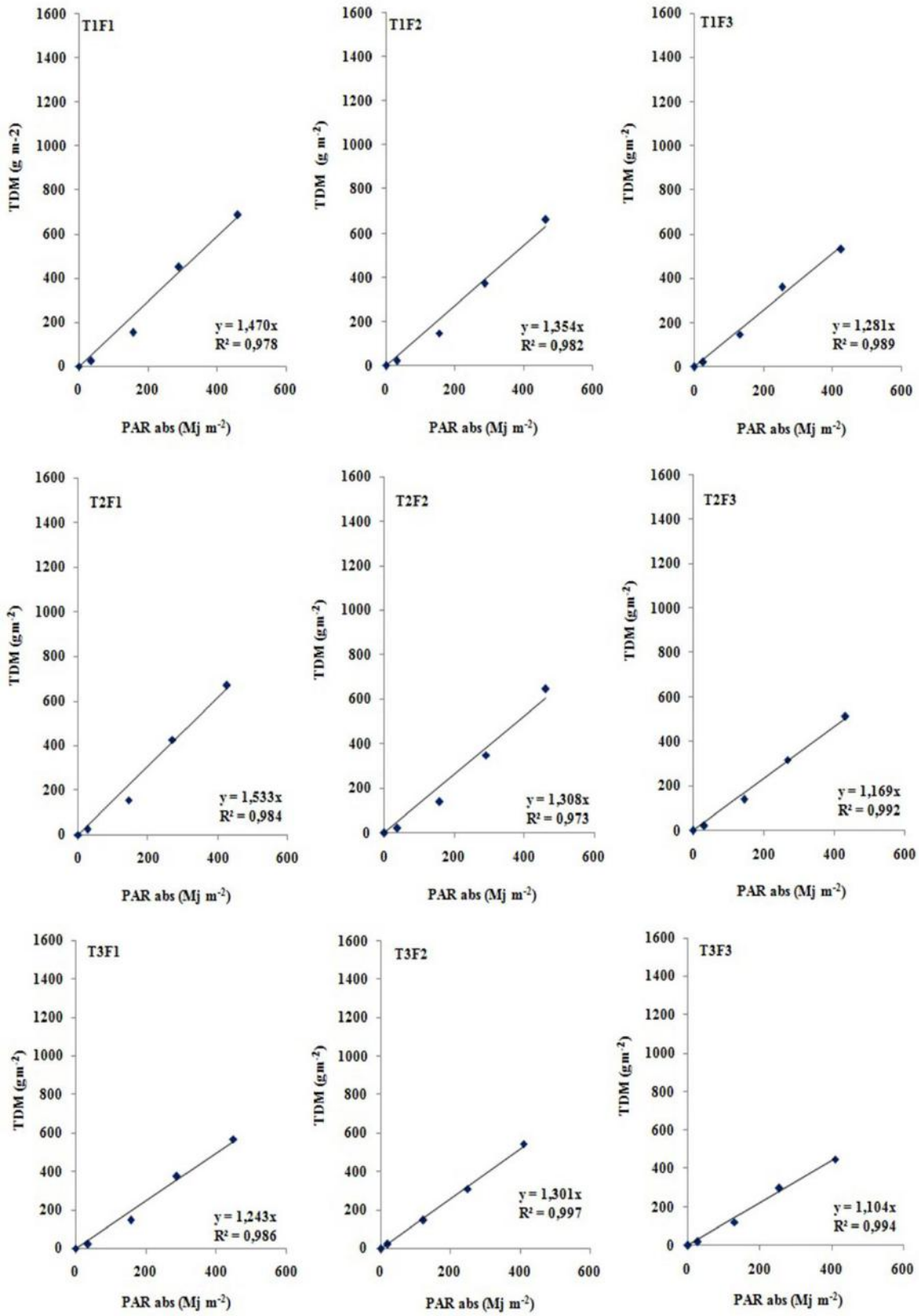

Fig.3: The radiation use efficiency (RUE) of potato under the three irrigation treatments (T_1, T_2 and T_3) and the three nitrogen rates (F_1, F_2 and F_3).

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Also, Cornic (2008) showed in the case of soybean that foliar growth is inhibited in drought which causes a decrease in the amount of radiation interception, which leads to a decrease in photosynthetic activity and consequently a decrease in the RUE.The results obtained (figure 3) showed that nitrogen restraint had a negative influence on the RUE regardless of the applied water regime (T_1, T_2 and T_3). In fact, the least values were recorded at the F_3 treatment (where no nitrogen supply was made) from which there is a reduction with respect to F_1 of (14.8%, 30.7% and 11.4%). Similar results have been reported by several researchers (Caviglia and Sadras 2001, Muurinen and Peltonen-Sainio 2006, Stöckle and Kemanian 2009) who attributed the RUE reduction in wheat by lowering the nitrogen dose. Rezig et al. (2015a), have shown that the accumulation of aerial dry matter, PARabs and RUE vary according to the nitrogen regimes applied. Indeed, they increase with enhancing the nitrogen doses. CheikhM'hamed (2015) also found that RUE during the growth cycle was improved by nitrogen fertilization and irrigation. Similarly, Shah et al. (2004) reported that RUE increased from 1.8 to 28 g MJ^{-1} over a range of five nitrogen levels from 0 to 250 kg ha^{-1}. The increase in RUE in high nitrogen rate can be explained in terms of the relationship between leaf nitrogen content and photosynthesis. In plants with low nitrogen content, chlorotic and nitrogen contents in the leaves are reduced. For potato, RUE's response to nitrogen availability has been studied with models that incorporate carbon assimilation of leaves and environmental gradients (Muchow and Sinclair, 1994). Based on these models, Sinclair and Horie (1989) developed the theoretical relationship between RUE and leaf-specific nitrogen as hyperbolic. Indeed, RUE can increase from 1 to 20% in peanut or even more in soybean (Sinclair and Shiraiwa 1993). The availability of water and nitrogen for the plant improves its ability to intercept active photosynthetic radiation and therefore improves the efficiency of light use (Muurinen and Peltonen-Sainio 2006).

V. CONCLUSIONS

From this study, it was demonstrated that the deficit irrigation (DI) has no effect on PARabs. Moreover, the partial root-zone drying irrigation technique (PRD) has led to a reduction in PARabs. The nitrogen deficit affects negatively the PARabs. The deficit irrigation (DI) has no effect on RUE_{TDM}. On the contrary, the partial root-zone drying irrigation technique PRD_{50} has led to a reduction in RUE_{TDM}. The DI and the PRD has led to a reduction in RUE_{GY}. In turn, the use of (DI) from the initiation of tuberization stage to harvest is beneficial compared to full irrigation in terms of improving the radiation use efficiency only for total dry matter production.

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Effect of Deficit Irrigation and Root-Zone Drying Irrigation Technique under Different Nitrogen Rates on Water Use Efficiency for Potato (*Solanum Tuberosum L.*) in Semi-arid Conditions (I)

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Abstract**—** *An investigation was carried out at the Technical Center of Potato and Artichoke CTPTA in the region of Saida, located in the lower valley of Medjerda river during the season of 2017. The objective was to evaluate the effects of deficit irrigation (DI) and the root-zone drying irrigation technique (PRD) under different nitrogen rates on total dry matter production (TDM), water consumption (WC) and water use efficiency of potato (Solanum Tuberosum L. VS. Spunta). Three water treatments (T_1 = FI = 100% ETC, T_2 = DI = 75% ETC and T_3 = PRD_{50}) and three nitrogen rates (F_1 = N_{150}: 150 kg N ha^{-1}, F_2 = N_{75}: 75kg N ha^{-1}, F_3 = N_0: 0kg N ha^{-1}) were applied since the tuber initiation (55 days after planting) to maturity (100 days after planting). The results showed that the water regime affected negatively the total dry matter accumulation. A decline of 7 and 18.6% was registered in the two treatments T_2 and T_3 compared to the control T_1. The WC decreased during water restriction respectively by 16; 33 and 29% for the T_2 and T_3 (PRD_{50} left) and T_3 (PRD_{50} right) compared to T_1. For the three nitrogen treatments (F_1, F_2 and F_3) the water restriction has increased the WUE. The best values was recorded in the treatment T_2 and then in the treatment T_3 from where this increase compared to T_1 was equal to (22.6% and 12.9%), (24.1% and 12, 4%) and (21.9% and 15.3%) respectively.*

Keywords**—** ***Deficit Irrigation, Root-Zone Drying Irrigation, Total dry matter, Water consumption, Water Use Efficiency.***

I. INTRODUCTION

In Tunisia, the potato occupies an important place in vegetable production, after tomato, watermelon and melon. It represents 12% of total vegetable production. In fact, the potatoes area cultivation has increased from 16800 ha in 1994 to 26200 ha in 2014, making 16% of the vegetables area, which amounts to about 370 thousand tons cultivated. Potato, have elevated water stores and supplemental irrigation is necessary for successful production. However, water availability for agriculture is being reduced as a consequence of global climate change. Therefore, great emphasis was placed on water management for dry conditions based on plant and crop physiology, with the aim of increasing water use efficiency. Deficit irrigation (DI) and partial root-zone drying (PRD) are two irrigation methods that attempt to decrease the agricultural demand for water. PRD is an irrigation technique where by half of the root zone is irrigated while the other half is allowed to dry out (Posadas et al., 2008). The PRD is quite simple, requiring only the adaptation of irrigation systems to allow alternate wetting and drying of parts of the root zone (Loveys et al., 2000). Numerous studies have shown a clear improvement in the water productivity by deficit irrigation (Intrigliolo and Castel. 2005; Goldhamer et al., 2006). In Tunisia, Ben Nouna et al. (2005) and Zairi et al. (2003) have shown that in the case of low and medium climatic demand, deficit irrigation in tomato and potato crops is possible without causing major yield losses. Sadras (2009), confirmed that the use of PRD irrigation and deficit irrigation have allowed a productivity increase of 82% and 76% respectively compared to conventional irrigation with a non-significant reduction in yield. Yang et al., (2011) studied for three years (2006-2008), the water use efficiency of durum wheat under three different irrigation regimes of PRD (30, 40 and 50% of the ETM). The results showed a significant improvement in water productivity from 12 to 71.4%. In fact, the use of PRD irrigation as a very ambitious method of water saving in arid regions of China. Liu et al., (2006) studied the effect of PRD irrigation on the yield and productivity of seasonal potatoes during the tuberization stage. The

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results indicated that PRD irrigation led to a significant reduction in yield compared to control with 37% less irrigation water. Shahnazari et al., (2007) indicated that PRD irrigation has improved by 20% the yield of marketable tubers (size 40 to 50 mm) compared to the control. It was concluded in the framework of this study, that PRD irrigation has saved 30% water irrigation and has improved water productivity in seasonal potatoes in the order of 60%. Similar results obtained on the potato and reported by Jovanovic et al, (2010) showed that PRD irrigation led in two successive years to irrigation water saving of the order of 33 and 42% compared to the witness. Several researchers have studied the water use efficiency of potato under PRD conditions (Liu et al., 2006; Shahnazari et al., 2007; Jovanovic et al, 2010; Ben Nouna et al., 2016). However, only few studies concern the effect under different nitrogen rates. Therefore, this study was undertaken to investigate the effects of deficit irrigation and PRD technique under different nitrogen rates on the water consumption and water use efficiency of potato.

II. MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Technical Centre of Potato situated in the low valley of Medjerda river at Saida, Tunisia (10°EST, 37°N, Alt. 28 m), during the season 2017. The climate is semi arid. The average annual rainfall is about 450 mm, concentrated from December to April with irregular distribution. The soil had a clay-loam texture with 180 mm m-1 total available water and 2 g l^{-1} water salinity. The bulk density varies from 1.34 to 1.60 from the surface to the depth (Rezig et al., 2013a).

Estimation of Crop Potential Evapotanspiration (ETc)

The Reference evapotranspiration (ET_0) was estimated by the software CROPWAT V 8.0 using the FAO-Penman-Monteith approach (Allen et al., 1998). In fact, the climatic data: (1) Daily Minimum and Maximum Temperatures (T_{min} and T_{max}); (2) Daily Relative Humidity (HR); (3) Wind Speed (V) and (4) Rainfall (P) were registered during the three growing seasons from 2009 to 2011 by automatic agro-meteorological station. The Crop Potential Evapotanspiration (ETc) was determined means the following equation:

$$ETc = Kc \times ET0 \quad (1)$$

Plant Material and Experimental Design

Plant material consisted of one potato variety (Solanum tuberosum cv. Spunta). The potato planting was conducted on 02 March 2017 with a mechanical planter machine. The Planting density was 41667 plants ha^{-1}. The experiment covered two treatments (T: water regimes and F: nitrogen rates). T consisted of three water regimes (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3= PRD_{50}).

F consisted of three nitrogen rates (F_1 = 150 kg N ha^{-1}, F_2 = 75 kg N ha^{-1} and F_3 = 0 kg N ha^{-1}). At the beginning of the potato cycle (during the first stages) irrigation and fertilization were started without any difference between the treatments (with the exception of the F_3 which did not receive nitrogen from the beginning), from which the crop was given 100% of the water needs and nitrogen requirements in a homogeneous way over the entire plot. The experimental protocol was started 26 April 2017 (**55** DAP) at the stage of the initiation of tuberization to potato harvesting and they were irrigated by drip irrigation.

The experimental design was Split Plot with 3 replications. The main factor is irrigation regime and the secondary factor is nitrogen rates.

Total Dry Matter Production (TDM) and Tuber Yield (Yd)

The observations were made on above-ground dry matter, tuber dry matter, total dry matter and tuber yield. The sampling was collected for growth analysis at 40, 56, 69, 85 and 96 days after planting Potato (DAPP).

At each date, three plants of potato by plot were collected. All material was dried at 85 °C to constant weight and dry weight was measured. The tuber yield was achieved at 96 DAP.

Irrigation Treatment

Table.1: recapitulated the rainfall and irrigation event during the experiment period for the three irrigation treatments.

DAP	**Rain**	**T_1**	**T_2**	**T_3 = PRD $_{50}$**	
				Right	Left
12	0	40.7	40.7	40.7	40.7
22	0	46.2	46.2	46.2	46.2
26	2	23.9	23.9	23.9	23.9
34	0	7.5	7.5	7.5	7.5
42	0	7.5	7.5	7.5	7.5
43	0	25	25	25	25
45	0	15	15	15	15
55	0	22.5	16.87	12.2	0
60	0	24.4	18.3	0	12.2
68	0	20	15	10	0

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DAP	Rain	T_1	T_2	T_3 = PRD $_{50}$	
69	0	20	15	0	10
75	0	25	18.75	12.5	0
82	0	25	18.75	0	12.5
89	0	25	18.75	12.5	0
96	0	25	18.75	0	12.5
Total	2	352.7	306	213	213

The experimental protocol has begun at 55 days after planting Potato (DAPP). For each start date of the protocol, the irrigation treatments (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3= PRD_{50}) have the same soil moisture conditions. The rainfall observed during the experimental protocol is equal to 2 mm.

For the experiment period, we recorded 15 irrigation events. In fact, FI treatment, has entirely received 352 mm. The T_2 treatment, has completely received 306 mm. The two treatments T_3 (Right side) and T_3 (left side), have received the same dose and it was equal to 213 mm.

Table 1. Rainfall (mm) and irrigation water depth (mm ha^{-1}), for different irrigation treatments (T_1 = 100% ETC, T_2 = 75% ETC and T_3= PRD_{50})

Theoretical Formulations

Estimation of the Daily Water Consumption

The monitoring of soil moisture was carried out on experimental units in order to calculate the water consumption over the entire potato cycle. For the water content measurement, the TDR method was used. For this purpose, we have installed 9 probes in different depths (0-20; 20-40 and 40-60 cm) for each treatments. The initial water stock was determined by the TDR method up to 60 cm for the various experimental units. As well, In each test unit, soil samples were collected every 20 cm to 60 cm deep, and TDR measurements every 20 cm were also carried out to establish the calibration equation.

Water consumption is estimated with soil water balance equation as follows (Hillel, 1998):

$$WC = P + I + U + R - D_W - D_S \quad (2)$$

Where P is the effective precipitation (mm), I is the irrigation (mm), U is the upward capillary flow into the root zone (mm), R is the runoff (mm), D_w was the downward drainage out the root zone (mm) and D_S is the change of soil water stored in soil layer of 0–60 cm (mm). The upward and downward flow was estimated using Darcy's law (Kar et al., 2007; De Medeiros et al., 2005). Results indicated that the two items were insignificant at the experimental site. Runoff was also insignificant during the growing season. Soil water content was measured each month with gravimetrically method. Soil water content data were collected for every 20 cm interval in soil depth. Some measurements were added before and after irrigation.

Conversion Efficiency of Water Consumption into Dry Matter Production and Yield (WUE)

WUE of Total Dry Matter (WUE_{TDM}) and WUE of Tuber yields (WUE_Y) were calculated using the following equations:

$$WUE_{TDM} (kg\ m^{-3}) = TDM / WC \quad (3)$$

$$WUE_{GY} (kg\ m^{-3}) = GY / WC \quad (4)$$

Where, WUE is the water use efficiency (kg m^{-3}), TDM is the total dry matter production (kg), Y is the tuber yields (kg) and WC is the total water consumption over the whole growing season (m^3).

Statistical Analysis

The results were subjected to variance analysis of one factor by General Linear Model (GLM). This analysis was performed using SPSS 20.0 software. The ensemble was completed by multiple comparisons of means with Student Newman Keuls test (S-N-K).

III. RESULTS

Effect of Partial Root-Zone Drying Irrigation (PRD) and Deficit Irrigation (DI) on the Total dry matter (TDM).

The effect of three irrigation treatments (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3= PRD_{50}) and the three nitrogen rates (F_1 = 150 kg N ha^{-1}, F_2 = 75 kg N $ha^{-1}$and F_3 = 0 kg N ha^{-1}) in the Total Dry Matter (TDM) of potato was given in figure 1.

For the three water regimes (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3 = PRD_{50}), the effects of three nitrogen rates (F_1, F_2 and F_3) on TDM were represented in (Figure 1a, 1b and 1c). The result showed that from the 56th DAP the TDM of the treatment (F_1) was greater than the two treatments (F_2 and F_3). ANOVA analysis shows that nitrogen application significantly ($P < 0.05$) increased the TDM. The maximum values of potato TDM were achieved in the treatment F_2 and the lowest in F_3. In fact, for the three irrigations regimes (T_1, T_2 and T_3), the maximum amount of TDM was recorded in the treatment F_2 (958.4; 876.5 and 731.4 g m^{-2}) and the lowest in the F_3 (689, 683.2 and 666.4 g m^{-2}). For the three nitrogen rates (F_1 = 150 kg N ha^{-1}, F_2 = 75 kg N ha^{-1} and F_3 = 0 kg N ha^{-1}), the effects of three irrigation regimes (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3 = PRD_{50}) on the total dry matter (TDM) were studied (Figure 1d, 1e and 1f). The results showed that from the 56th day after potato planting

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(DAP), the TDM of the treatment T_1 was higher than that in the two treatments (T_2 and T_3). Variance analysis showed a significant effect at (5%) of the water regime on the TDM and the test S-N-K, confirmed that the three treatments (T_1, T_2 and T_3) were statistically heterogeneous. In fact, for the three nitrogen rates (F_1, F_2 and F_3), the maximum amount of TDM was recorded in the irrigation treatment T_1 (941; 958.3 and 722 g m^{-2}), then in T_2 (871.4, 876.5 and 686.3 g m^{-2}) and finally the lowest was marked in the T_3 (765.6, 731.4 and 666.4 g m^{-2}). The combined effect of irrigation regime and nitrogen application has a significant effect ($P < 0.05$) on TDM. So, the maximum value of TDM (TDM max) was recorded in treatment T_1F_2 (958.3 g m^{-2}). The lowest TDM was equivalent to (666.4 g m^{-2}) in treatment T_3F_3.

Effect of Partial Root-Zone Drying Irrigation (PRD) and Deficit Irrigation (DI) on Water Consumption.

Results (figure 2) showed that the daily water consumption of potato was variable during cropping season. Also, we observed that irrigation regimes (T_1, T_2 and T_3) have affected the daily water consumption of potato during tuberization stage. The water consumption in the treatment (T_1) was higher than that in the two treatments (T_2 and T_3). For the T_1F_1 (Figure 2.a), the curve which represents the daily evolution of ETR and ETC followed the same paces and was exactly superimposed. In fact, during the all growing cycle of potato the ETR and ETC was equal to 371 mm. Similarly, for the T_2F_1 treatment (Figure 2.b), the ETR and the ETC have the same rate until the 56th DAP, and after this date the daily ETR becomes lower than the daily ETC. In detail, the cumulative ETR in T_2F_1 regime was 310 mm (from planting to harvest) and the cumulative ETC was 371 mm. In result, the deficit of water needs (ETR compared to ETC) was 61 mm and was observed from 56 DAP to 89 DAP. For the T_3F_1 treatment (Right side), the ETR and the ETC were equal (Figure 2.c) until the 56th DAP, and after this date the daily ETR come to pass lower than the daily ETC. In circumstances, the cumulative ETR in T_3F_1 regime (Right side) was 248 mm (from planting to harvest). The deficit of water needs (ETR compared to ETC) was 123 mm and was registered from 56 to 67 DAP and from 78 to 100 DAP. For the T_3F_1 treatment (Left side), the ETR and the ETC were equivalent (Figure 2.d) until the 56th DAP, and after this day the daily ETR becomes inferior to the daily ETC.

In indicate, the cumulative ETR in T_3F_1 regime (Left side) was 260 mm (from planting to harvest). In effect, the deficit of water needs (ETR compared to ETC) was 111 mm and was marked since the middle of the season (from 50 to 68 DAP and from 78 to 100 DAP). The results obtained showed that the water consumption of the potato crop under water restriction conditions decreased respectively by 16 and 33% and 29% for T_2 and T_3 (PRD 50 left) (PRD 50 right) compared to the control treatment T_1.

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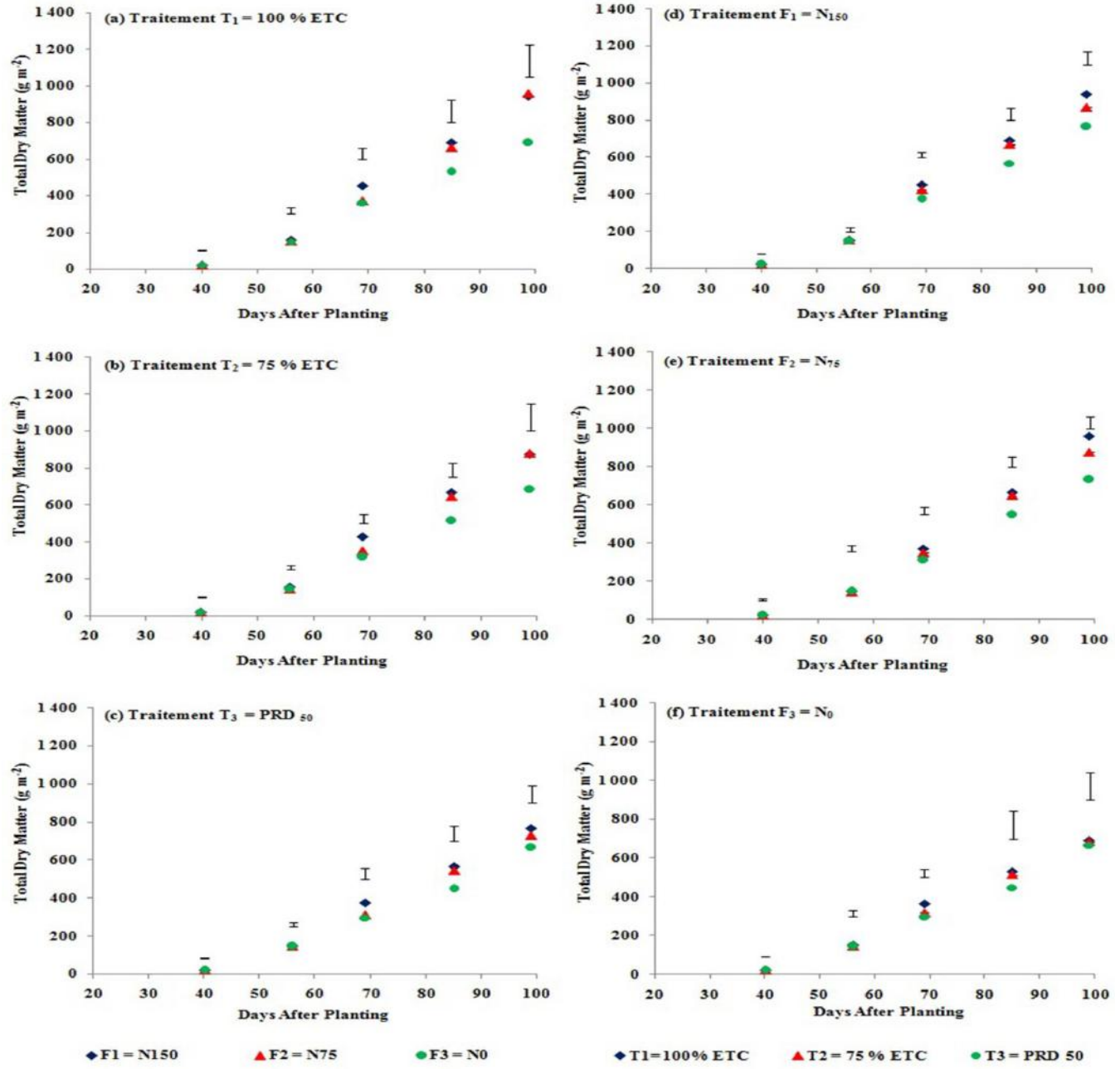

Fig.1: the Total dry matter (TDM) of potato under the three irrigation treatments (a, b and c) and the three nitrogen rates (d, e and f).

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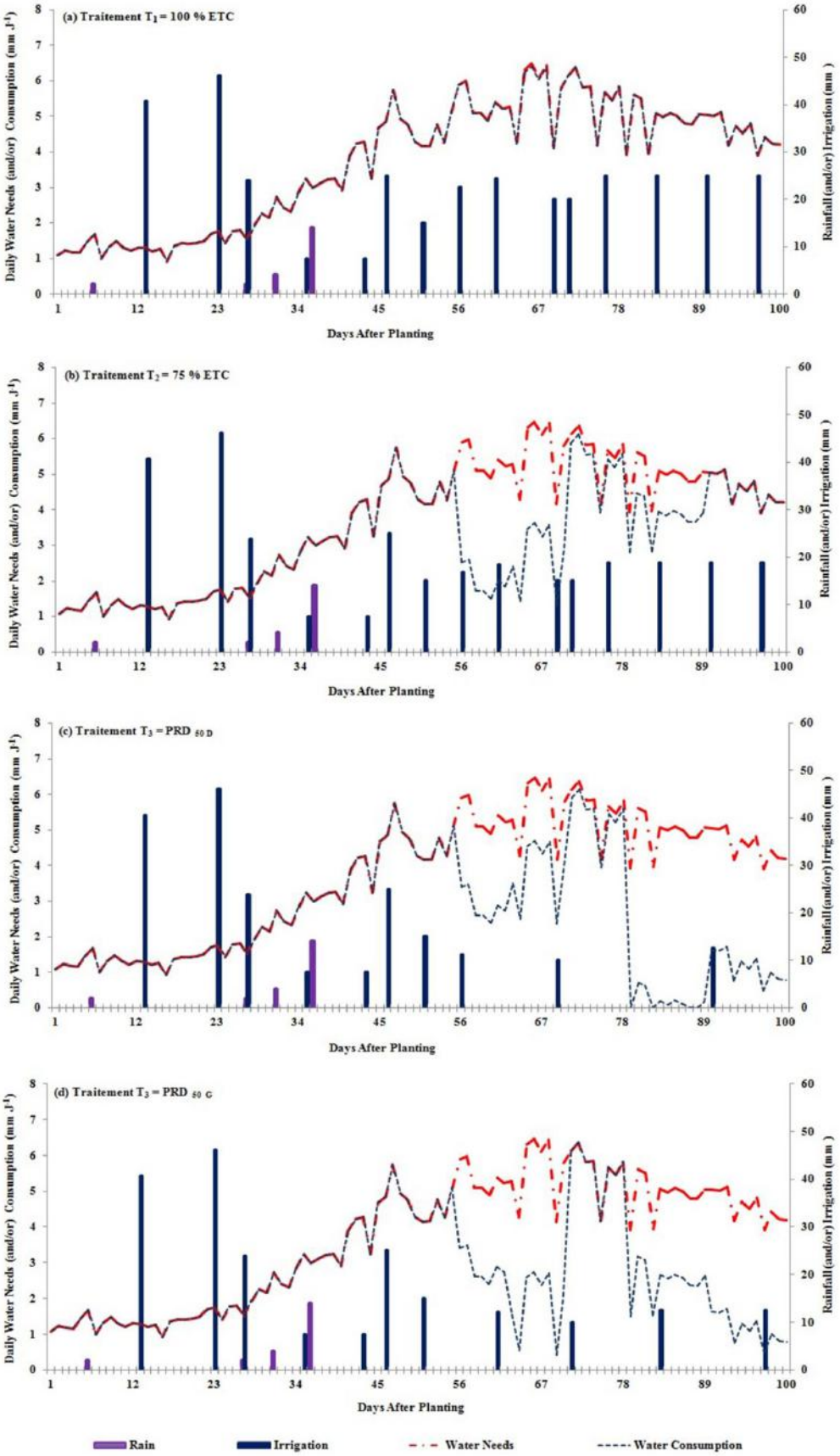

Fig.2: The daily water Needs and Consumption by potato under the three treatments (T_1, T_2, and T_3)

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Effect of Partial Root-Zone Drying Irrigation (PRD) and Deficit Irrigation (DI) on Water Use Efficiency.

The effect of three irrigation treatments (T_1, T_2 and T_3) and the three nitrogen rates (F_1, F_2 and F_3) in the water use efficiency (WUE) of potato was given in Figure 3.

The relation between the water consumption and the total dry matter production over all potato growing season and under the nine treatments is given in Figure 3. From these results, we observed toward different treatments that the total dry matter production increased linearly with the cumulative water consumption. The slope of this regression is the conversion efficiency of water consumption into total dry matter production (WUE). Similarly, we noted that, the highest amount of WUE was recorded in the T_2 treatment (3.9; 3.7 and 2.9 kg m^{-3}) and after that in T_3 (3.5; 3.2 and 2.7 kg m^{-3}). However, the least was recorded in the T_1 treatment (3; 2.8 and 2.3 kg m^{-3}). In detail, for the three nitrogen rate (F_1, F_2 and F_3) the water use efficiency in T_2 and T_3 has illustrated respectively an increased of (23.1; 24.3 and 20.7%) and (14.3; 12.5 and 14.8 %) compared to T_1. Statistical analysis showed that the WUE was significantly ($P< 0.05$) affected by irrigation doses (T_1, T_2 and T_3) for three nitrogen rates.

The water use efficiency of total dry matter production at harvest (WUE_{TDM}) and the water use efficiency of yield (WUE_{GY}) of the nine treatments were exposed in Table 2.

Table.2: water use efficiency (kg m^{-3}) of total dry matter at harvest (WUE_{TDM}) and water use efficiency (kg m^{-3}) of yield (WUE_{GY}) under the nine treatments.

Trait	TDM	Yield	WUE_{TDM}	WUE_{YD}
T_1F_1	1539.29 a	20.35 a	4.15 b	5.49 b
T_2F_1	1511.16 a	20.73 a	4.87 a	6.67 a
T_3F_1	1223.49 b	13.01 b	4.92 a	5.24 b
LSD	88.02	1.5	0.29	0.45
T_1F_2	1493.73 a	20.73 a	4.03 b	5.59 ab
T_2F_2	1382.38 b	16.84 b	4.45 a	5.43 b
T_3F_2	1111.41 c	14.64 c	4.47 a	5.89 a
LSD	28.62	3.4	0.19	0.49
T_1F_3	1463.38 a	22.04 a	3.95 c	5.94 a
T_2F_3	1311.15 b	17.67 b	4.71 a	5.69 a
T_3F_3	1055.17 c	14.21 c	4.25 b	5.72 a
LSD	132.78	3.07	0.28	1.31

TDM: Total dry matter (g m^{-2}), GY: potato yield (t ha^{-2}), LSD: Least Significant Difference (5%).

ANOVAs analysis (Table 2) confirmed that at harvest, the WUE_{TDM} and WUE_{GY} were significantly ($P < 0.05$) affected by the irrigation treatment (T_1; T_2 and T_3).

For the two treatments F_1 and F_2, the uppermost WUE_{TDM} was registered respectively under T_3 (4.92 and 4.47 kg m^{-3}) and next to in T_2 (4.87 and 4.45 kg m^{-3}). The lowest was observed under T_1 (4.15 and 4.03 kg m^{-3}). However, for the treatment F_3, the highest WUE_{TDM} was registered in the T_2 (4.71 kg m^{-3}) and then in T_3 (4.25 kg m^{-3}). The lowly was observed under T_1 (3.95 kg m^{-3}).

Nevertheless, for WUE_{GY} statistical analysis showed significant ($P < 0.05$) difference between the three treatments (T_0, T_1 and T_2) only under F_1 and F_2. For the treatment F_1, the highest WUE_{GY} was recorded under the treatment T_2 (6.67 kg m^{-3}) followed by the treatment T_1 (5.49 kg m^{-3}). The lowest WUE_{GY} (5.24 kg m^{-3}) was obtained in treatment T_3. Conversely, for the treatment F_2, the maximum WUE_{GY} was marked under the treatment T_3 (5.89 kg m^{-3}) after that by the treatment T_1 (5.59 kg m^{-3}). The lowest WUE_{GY} (5.43 kg m^{-3}) was obtained in treatment T_2.

IV. DISCUSSION

The effect of the deficit irrigation and partial root-zone drying irrigation technique (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3 = PRD_{50}) under different nitrogen rate (F_1 = 150 kg N ha^{-1}, F_2 = 75 kg N ha^{-1} and F_3 = 0 kg N ha^{-1}) on the total dry matter production (TDM), the water consumption (WC), the potato yield (Y), the water use efficiency for total dry matter production (WUE_{TDM}) and the water use efficiency for potato yield (WUE_Y) were studied.

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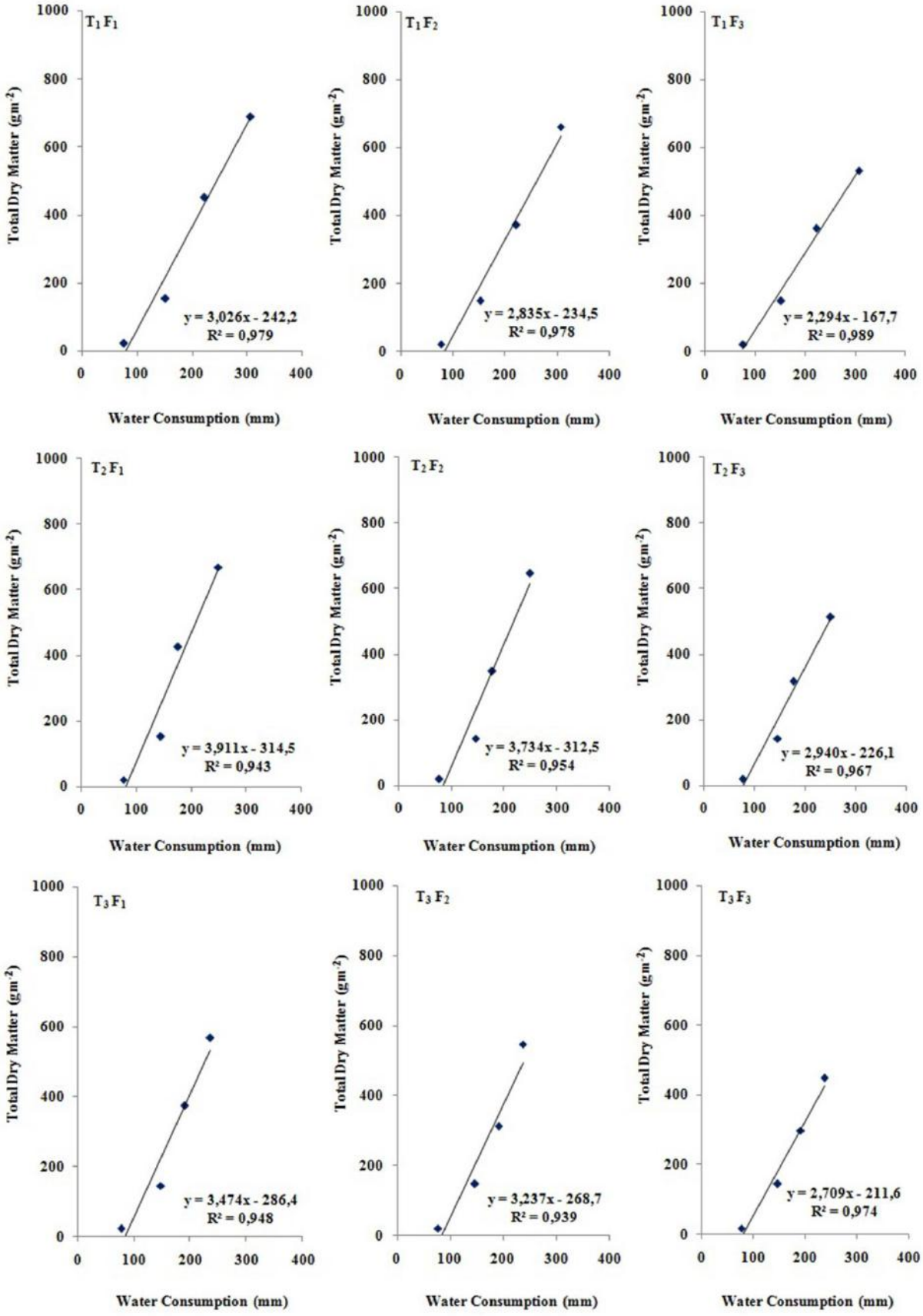

Fig.3: The water use efficiency (WUE) of potato under the three irrigation treatments and the three nitrogen rates).

As illustrated by the outcome in (Figure 1a, 1b and 1c) that for the three irrigation regimes, the nitrogen fertilization affected the accumulation of total dry matter. Hence the accumulation of dry matter is positively

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correlated with the nitrogen application. Indeed, these results are in agreement with those found by Ali et al., (2009), Massignam et al., (2011) and Hamzei (2011), who observed that increased nitrogen improved the biological yield of crops. Similarly, MacDonald (2002) investigated the effect of different nitrogen doses on the yield of several varieties of durum wheat, and observed that TDM at the anthesis stage increased significantly with increasing nitrogen rate. Latiri-Souki, (1994) mentioned that the rate of nitrogen uptake during durum wheat development is linearly related to the development of total dry matter. Moreover, Cheikh M'hamed et al., (2014) showed that the application of nitrogen in N_1 (150 kg N ha^{-1}) and N_2 (100 kg N ha^{-1}) significantly ($P < 0.001$) increased the MST compared to N_3 (50 kg N ha^{-1}) and N_4 (0 kg N ha^{-1}). Indeed, treatment N_1 improved the MST relative to N_3 and N_4 under the three water regimes D_1 (100% ETC), D_2 (70% ETC) and D_3 (40% ETC). Sanaa (1998) reported that controlled nitrogen fertilization (150 or 300 kg N / ha) increased the dry matter content of leaves and stems compared with the unfertilized control.

The same result was reported by Golli (1992) who showed that by increasing nitrogen doses from (0 to 250 kg N ha^{-1}), the cumulative aerial dry matter increased from (16.8 to 48.9 g $plant^{-1}$). Also, Ben Ammar (2007) found that the biomass accumulated at the potato beginning cycle in the 3 nitrogen treatments was the same up to 58 JAP. Then, a difference was observed between the treatments N_1 (15 t ha^{-1}), N_2 (30 t ha^{-1}) and N_0 (without addition of N). Hence, the maximum accumulated biomass was 0.62; 1.06 and 1.32 t ha^{-1} respectively at the N_0, N_1 and N_2 treatments. Also, according to Shah et al. (2004) MST increased from 1442 to 2131 g m^{-2} in the treatment with a high nitrogen content compared to the treatments with low nitrogen content.

The results (Figure 1d, 1e and 1f) showed that the water regime (T_1 = 100% ET_C, T_2 = 75% ET_C and T_3 = PRD_{50}) affected negatively the total dry matter accumulation. A reduction of 7 and 18.6% was recorded in the two treatments T_2 and T_3 compared to the control T_1. Indeed, these results are in agreement with those of Rezig et al. (2015 a and b); Cheikh M'hamed et al. (2014 and 2015). These authors studied the effects of deficit irrigation in wheat and potato crops and showed that the water stress affected the accumulation of total dry matter. According to Rousselle et al. (1996), water stress also influenced tuberization by reducing the number of tubers formed. A water deficit during the tuber growth phase can influence vegetative growth and reduce leaf coverage irreversibly (Deunier et al. 1997). In addition, a lack of water causes the closure of stomata, which results in a rise in leaf temperature, a reduction in photosynthetic activity and consequently a decrease in yield (Rousselle et al., 1996). Similarly, Ben Nouna et al. (2016) reported that for the four water regimes (FI, PRD_{80}, PRD_{70} and PRD_{60}) the dry matter production increases linearly with the cumulative water consumption.

The obtained results in figure 2 showed that the water consumption decreased through water restriction respectively by 16; 33 and 29% for the T_2 and T_3 (PRD_{50} left) and T_3 (PRD_{50} right) compared to with the control treatment T_1. This feedings are in agreement with those of Rezgui et al. (2005); Rezig et al (2015 a and b) and Cheikh M'hamed et al. (2014 and 2015) for wheat. As well, for potato, Ben Nouna et al (2016) found that the cumulative water consumption was marked a reduction of 12.6; 17.9 and 25.1% respectively for the treatments PRD_{80}, PRD_{70} and PRD_{60} compared to the control FI. These authors have shown that the water deficit significantly decreases water consumption.

The results (figure 3) showed that the water restriction has led to an increase in the WUE at any rate of the nitrogen supplied (F_1, F_2 and F_3). The best values was recorded in the treatment T_2 and then in the treatment T_3 from where this increase compared to T_1 was equal to (22.6% and 12.9%), (24.1% and 12, 4%) and (21.9% and 15.3%) respectively for the three nitrogen treatments (F_1, F_2 and F_3). Our results consent with those of Ben Nouna et al. (2016) who showed that PRD_{60} treatment improved the WUE of potato by (10.9 and 10.2%) and (25.8 and 19.7%) compared to full irrigation and PRD_{80}. Also, Saeed et al. (2008) found that PRD irrigation used 29% less water and improved the WUE by 19%. Similarly, Xie et al. (2012) reported that the PRD_{50} treatment used 50% less water and increased the WUE by 48%. Several studies have indicated that deficit irrigation increased the WUE of wheat, potato, maize and rice. Indeed, moderate water stress induces partial stomatal closure, which would lead to an improvement in WUE (Turner, 1997). Ahmadi et al. (2010b) investigated the effect of PRD irrigation on seasonal potatoes, based on soil texture. They found that PRD irrigation resulted in a significant increase in water productivity in seasonal potatoes of 11% for sandy soil and 36% for sandy loam soil. Zairi et al. (2000) proved for wheat and potato that the better water productivity was obtained for the treatments carried out with the ETM. For potato, the consumption efficiency varied from 11.2 (a severe water stress) to 20.1 kg m^{-3} (an unstressed treatment).

From the results in table 2, the variance analysis showed a significant effect at (5%) of water treatment on the WUE_{TDM} at harvest. Indeed, the T_3 treatment presented the highest values of the WUE_{TDM} for the three nitrogen treatment. In fact, at the level of the T_3 water treatment, an increase in the WUE_{TDM} of 15.7%, 9.8% and 7% compared to T_1 for the three nitrogen treatments F_1, F_2 and F_3 respectively. The water restriction led to an

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increase in the WUE_{TDM}. Our results show that deficit irrigation improved the water use efficiency of total dry matter at the end of the cycle which is in total accordance with the studies of Kirda et al., 2004. These showed that there is no significant difference between the WUE_{TDM} in the PRD and the DI. At the level of nitrogen treatment F_1 (Table 2), the T_2 showed a significant increase in the WUE_{GY}, from which we have 6.67 kg m^{-3} compared to 5.49 kg m^{-3} in the T_1. This is can be explained by a decrease of 16.26% in the water consumption in the T_2 compared to T_1. Although variance analysis showed no significant difference between the T_1 and T_3 treatments in the WUE_{GY}, we note that, the decrease in water consumption has led to a significant reduction in yield which was equal to 36% compared to T_1. Similarly, we observed that at the F_2 nitrogen treatment, the T_3 had the highest WUE_{GY}, despite the 29.4% decrease in yield compared to T_1, which is explained by the decrease in the water consumption from 370 mm in the T_1 to 248 mm in the T_3. For F_3 treatment, variance analysis showed no significant differences at (5%) between water treatments. Indeed, the decrease in water consumption has led to a significant reduction in yield. The obtained results show that the deficit irrigation applied at the tuberization stage makes it possible to increase the WUE_{GY}. Thus, these results are in agreement with those of Li et al. (2005), Rezig et al. (2015b) who reported that the WUE for tuber yield increased by decreasing the irrigation dose. Ben Nouna et al. (2016) also showed that the WUE_{GY} was higher in PRD60 than in FI treatments; PRD_{80} and PRD_{70}.

V. CONCLUSION

In the conditions of this study, we were able to assume, that the deficit irrigation (DI) and the partial root-zone drying irrigation technique (PRD) were two prospective water-saving irrigation strategies, especially for the drought sensitive crop such as potatoes and with restricted water conditions. During the all cropping potato cycle, the water restriction has improved WUE. The best values was recorded in the treatment T_2 and then in the treatment T_3. Similarly at harvest, for the two treatments F_1 and F_2, the highest (WUE_{TDM}) was registered under T_3 and then in the T_2. The lowest was observed under T_1. However, for the treatment F_3, the maximum WUE_{TDM} was registered in the T_2 and after that in T_3. Even so, for WUE_{GY} statistical analysis showed significant ($P < 0.05$) difference between the three treatments (T_0, T_1 and T_2) only under F_1 and F_2. For the treatment F_1, the highest WUE_{GY} was recorded under the treatment T_2 followed by the treatment T_1. Conversely, for the treatment F_2, the maximum WUE_{GY} was marked under the treatment T_3 after that by the treatment T_1. In turn, the use of DI and PRD with 50% of Etc from the initiation of tuberization stage to harvest is advantageous compared to full irrigation in terms of improving the water use efficiency.

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Stakeholder Perception in the Organizational Environment Focusing on Behavior

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Abstract— Behavior has meaning for the organizational climate, leading to studies such as this related to stakeholder perception in the institutional environment. This task is based on the Behavioral Management Theory and the additional concepts required. It was sought to know the relation of the intervening factors, from the method of case study of qualitative-quantitative nature, in order to establish comparisons and to produce the results. The general objective is to study the stakeholder perception process in the organizational environment focused on the behavioral effect and it has as specific objectives to treat and identify the relationship of the intervening factors with the organizational climate in the face of data collected among the consulted, to perform the SWOT on the positioning of individuals in the organizational environment and how this perception is characterized in the face of the organizational climate present in the consulted organ. The research indicates that the majority of respondents stated that the organizational climate present in the organ consulted satisfactory, propitiates the good organizational environment in the organ. Confrontation between the theoretical indicatives and the reality identified in the institutional environment allows to affirm that in fact there is internal influence, such as the motivation and external organization, as the possibility of losing the employee attracted by other opportunities outside the institution. Analysis allows to identify the need for physical improvement of the professional space, and in the interaction between stakeholders; redistribution of work that avoids overload; but the motivation and good internal relation between the individuals surpass the expectation. This work interests the managers in public organs and other interested in the subject here treated.

Keywords—Behavior. Organizational Climate. Management. Motivation. Perception. Stakeholder.

I. INTRODUCTION

Managers often face situations of a behavioral nature that can positively or negatively affect outcomes in a variety of organizations. They are motivators that derive from the perceptions of individuals and groups located in the institutional environment, influencing not only the organizational climate, but also the expectations of the stakeholders themselves. The fact justifies studies that contribute to solve problems, as proposed in this task, elaborated in accordance with the prescriptions of Robert P. Vecchio and Stephen P. Robbins.

II. OBJECTIVES

This empirical research has as general objective to study the process of stakeholder perception in the organizational environment with focus on the behavioral effect; and for the results, the main objectives are to identify the main actors involved in the process of perception in the researched environment (1), and to analyze and identify the relationship between the intervening factors and the organizational climate in the face of data collected from stakeholders (2), and to apply SWOT on the positioning of individuals in the organizational environment (3). The question to be answered is: How is the perception of stakeholders characterized by the current organizational climate in the research organization?

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III. THEORETICAL-CONCEPTUAL REVIEW

This study is based on the Behavioral Management Theory discussed in Chiavenato (2014), which seeks a new direction and a new approach to administrative theory. The behavioral sciences approach, studying human motivation, their basic needs, defining management styles, characterizing organizations as cooperative social systems and as decision systems.

A bibliographical search allowed to know Ajzen's (2002) theoretical-conceptual approach, when dealing with planned human behavior, indicating that it is guided by three types of beliefs, namely those of behavioral nature, those normative and those of control. According to the behavioral approach, organizations should not only be observed for their technical and normative sense, but also a social system, formed by human beings with feelings, interests and motivations. The elemental intent of behavioral theory is to understand the social system of the organization, the way it acts and how it develops. For the title of knowledge, organizational behavior is fundamentally the study of groups and individuals and how they relate to each other and to the organization.

3.1 Organizational Environment Concepts

The organizational environment is the content that contemplates and influences the organization, either internally or externally. Some agents act directly in the organization, such as employees, clients, shareholders, society, population, suppliers, government policies. Other agents that are directly linked to the organizational environment; these are called stakeholders, and can be equally internal and external. Stakeholders are the individuals or group of individuals that can affect or be affected by the organization's proposed goals. The organizational environment is an abstract construction that can be seen from a number of perspectives. Reading in authors such as Moresi (2001) allows us to affirm that the degree of complexity and change in environments can vary, from turbulent environments, which constantly change and introduce high degrees of uncertainty in the organization, to a high performance environment with full collaboration and drivers of organizational success. Figure 1 and Table 1 show the graphical and respective descriptive representation of the theoretical components prepared herein.

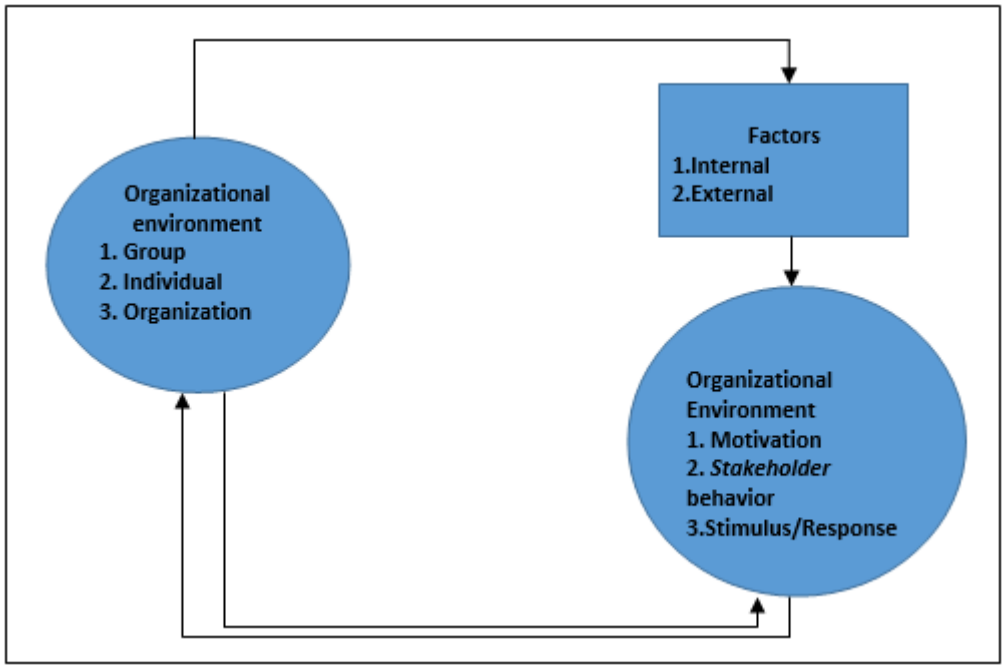

Fig.1: Theoretical representation of the organizational environment

Source: By the authors.

Table.1: Descriptive representation of the elaborated theoretical components

Elements	Descriptive
Organizational Environment	Content that contemplates and influences the organization, either internally or externally. Moresi (2001) states that the organizational environment is an abstract construction that can be seen from a number of perspectives.
Group	Set of people who form the working environment.
Individual	Member who is part of the group in the work environment.

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Elements	Descriptive
Organization	Environment in which the group and individuals are inserted. For Chiavenato (2014) organizations are the lever of economic and social development.
Internal Factors	Events related to the internal environment of the organization, which highlights the strengths and weaknesses linked to the organization.
External Factors	Events related to the external environment of the organization, where the happens becomes more difficult to control. In this environment is where the opportunities and threats linked top the organization are found.
Organizational Environment	For Chiavenato (2014), organizational environment is the set of measurable properties of the work environment perceived, directly or indirectly, by the individuals who live and work in this environment and who influence the motivation and behavior of these people.
Motivation	Robbins (2010) states that motivation has three properties that govern it, one is the direction, the focus of the person on his goal and how to perform, another is the intensity, if the goal is done as something that will bring you satisfaction or will be carried out by obligation, and permanence.
Stakeholderbehavior	How agents interact with the organizational environment. Freeman defines the term stakeholder as being the individual or group of individuals that can affect or be affected by the goals proposed by the organization.
Stimulus/Response	Feeling, emotions, experiences / action, reaction. Robbins (2010) is a process by which individuals organize and interpret their sensory impressions, in order to give meaning to their environment.

Source: by the authors

3.2 Definition of structure and creativity in the organizational environment

The organizational structure for Robbins (2010) is how tasks are formally distributed, grouped, and coordinated. It is also worth mentioning that, in defining the organizational structure, managers should be guided by six elements, namely: the Specialization of Labor, the Departmentalization, the Chain of Command, the Range of Command (Margin of Command), Centralization and Decentralization and Formalization. These elements are essential to the organizational environment in order to obtain an administrative adequacy, providing a standardization to obtain good results.

In the organizational environment, Robbins (2010) admits that for an organization to become creative, it must provide to its collaborators support and security on the creative side, in other words not rejecting ideas that are suggested, encouraging people to commit to development of innovative processes and solve problems that appear in the day to day of the organization

3.3 Concepts about perception and organizational environment

According to Robbins (2010, p.104), the concept of perception is a process by which individuals organize and interpret their sensory impressions, in order to give meaning to their environment. It means assigning interpretations from collecting and organization of information, whether related to people, facts or situations. When applied in the organizational context, perception refers to a sense of observation and analysis of the institution's environment. From the organizational perception, it is possible to identify the needs for improvement in the work environment, as well as the positive factors that can be strengthened. In this way, the formation of the high performance culture is stimulated.

For Chiavenato (2014), organizational climate is the set of measurable properties of the work environment perceived, directly or indirectly, by the individuals who live and work in this environment and who influence the motivation and behavior of these people. Having defined the concepts of perception and environment, it is noticed that the two are intertwined, therefore the need to have a good organizational environment is of vital importance for any organization, because its influence on stakeholders will result in the variation of productivity, in interpersonal relationships, in the level of satisfaction of the team and can still impact the health of employees.

3.4 Definition of factors linked to perception that influence on the organizational environment

There are two types of perception in the organizational scope: internal and external. External perception is identified by behaviors caused by factors or situations originated in the environment in which the individual is inserted, and are usually forced attitudes. Internal perception is identified by behavioral factors represented by personal stimuli, such as feelings, emotions, past

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experiences and expectation of the observed; usually they are attitudes of the individual himself. Figure 2 and Table 2 show a graphical representation and their respective description of the context theorized herein.

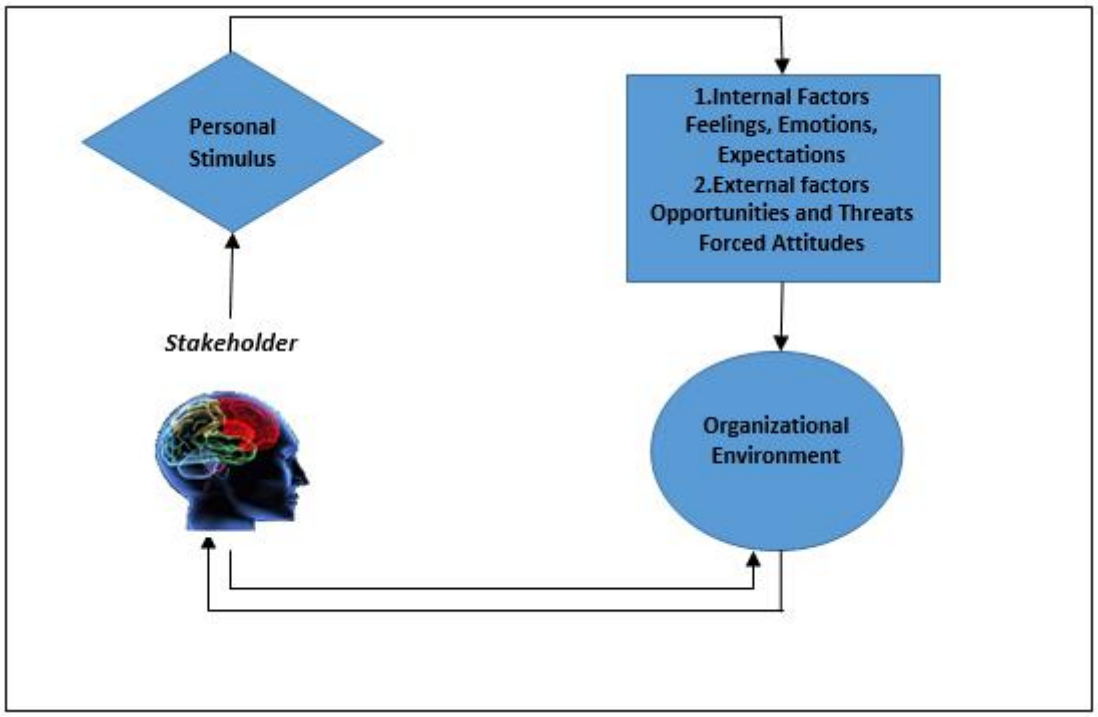

Fig.2: Graphical representation of the perception factors

Source: By the authors.

Table.2: Descriptive of the perception elements

Elements	Descriptive
Stakeholder	Freeman defines the term stakeholder as being the individual or group of people that can affect or be affected by the goals proposed by the organization.
Personal Stimulus	Internal or external change that causes a reaction. According to Robbins (2010) it is a process by which individuals organize and interpret their sensory impressions, in order to give meaning to their environment.
Internal Factors	Events related to the internal environment of the organization, which highlights the strengths and weaknesses linked to the organization.
Feelings, Emotions, Expectations	Social system formed by human beings. According to Chiavenato (2014) Internal perception identified by behaviors performed by personal stimuli, such as feeling, emotions, past experiences and expectation of the observed.
External Factors	Events related to the external environment of the organization, where the event becomes more difficult to control. In this environment is where the opportunities and threats linked to the organization are found.
Forced Attitudes	External perception that is identified by behaviors provoked by situations or the environment in which the individual is inserted and are usually forced attitudes.
Organizational Environment	For Chiavenato (2014), organizational environment is the set of measurable properties of the work environment perceived, directly or indirectly, by the individuals who live and work in this environment and who influence the motivation and behavior of these people

Source: by the authors

According to Robbins (2010) there is an indication that when we qualify other people's behavior, we tend to overlook the influence of external factors and overestimate the influence of internal or personal factors.

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Under this focus it is easier to assign the problem to internal causes than to external causes. Understanding of factors related to perception may be useful in recognizing which can result in significant distortions, such as the constant discussed in Figure 3 and in Table 3 below.

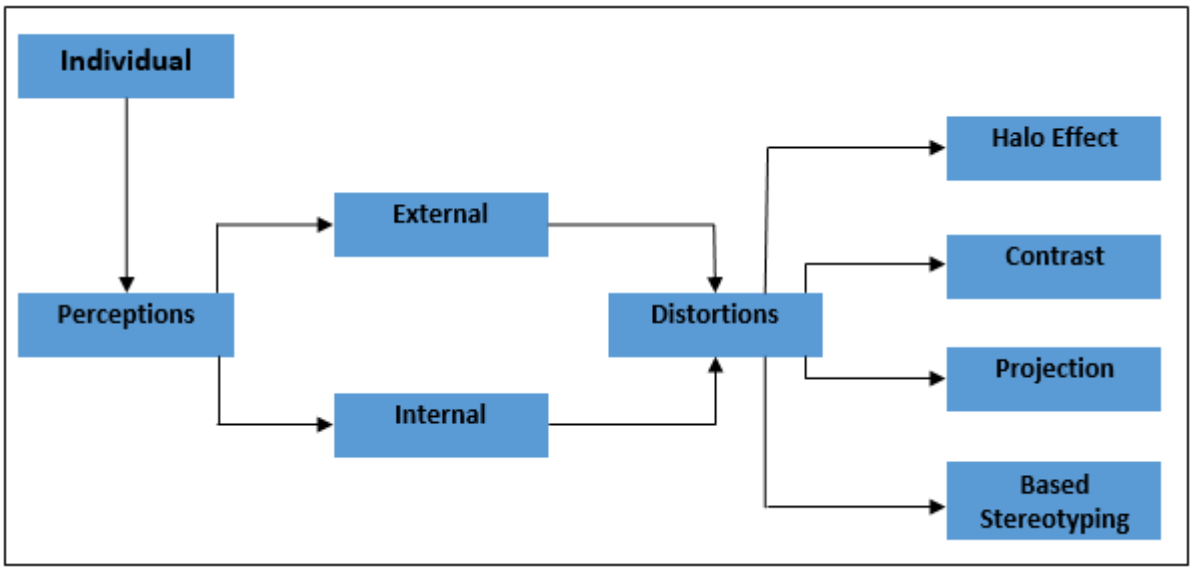

Fig.3: Sequential of Perceived Distortions

Source: by the authors.

Table.3: Proposition of Perceived Distortions in Robbin (2010)

Types of Perception Distortions	Descriptive
Halo Effect	Developed by the American psychologist Edward Thorndike, Halo Effect is a theory that argues that the human brain judges, analyzes, and draws conclusions from a single characteristic, formulating a general concept about another person or situation based only on this factor that can be appearance , speech, posture, dress, etc.
Contrast Effect	In the contrast effect the person is not evaluated in isolation. A person's reaction will always be influenced by others we encounter or relate to frequently.
Projection	The individual is judged as if he were equal to everyone, having the same characteristics. Projectionists tend to see others according to what they are, rather than value their individuality.
Stereotyping	Someone is judged based on the perception of the group to which the person belongs. In terms of perception, if people expect to see these stereotypes, it will be what they will perceive, even if these stereotypes are not part of reality. This means that such observation about the person may cause a misperception based on a false premise about the group.

Source: By the authors based on Robbins (2010)

3.5 Definition of perception, motivation, expectations and *stakeholders* satisfaction

Perception is directly linked to Motivation; in reality, each individual organizes part of their perceptual paradigm by reason of their own needs, interests and adequacy to the social environment in which they live. The concept of motivation according to Klava (2010) is to have a motive to do a certain task, to act with some purpose or reason. Be happy or happy during the task execution period, aided by external factors, but mainly by the internal ones.

Marras (2009) affirms that only good communication between the parties can improve or reduce the consequences of a conflict that may occur in the workplace, among them, the productivity and motivation of those involved, the quality of results, the change in behavior.

Robbins (2010) states that motivation has three properties that govern it, one is the direction, the focus of the person on his goal and how to perform, another is the intensity, if the goal is done as something that will bring you satisfaction or will be carried out by obligation, and permanence. In relation to satisfaction that is linked to a result derived from motivation and expectations, we will direct its focus of study in correlation with job satisfaction. Robbins (2010) has as concept of job

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satisfaction the general attitude of a person in relation to their work, involving the labor relations, even the relations of power; the environment; the organization of work; the company's management policies and programs; their technologies; goals, objectives and interests; its economic-financial environment; its history and the desires of the collaborators in the singular and collective sense.

3.6 SWOT Analysis Concepts

The SWOT Matrix is a tool used in strategic planning and aims to build a panorama of the environment in which the organization is inserted. The term SWOT comes from English and its acronym stands for strengths, weaknesses, opportunities and threats. SWOT Analysis becomes an essential tool for the organization, as it provides a clear and objective view of its strengths and weaknesses in the internal environment and the opportunities and threats in the external environment. According to Chiavenato (2014) the function of the SWOT Matrix is to cross the factors outside the organization that are the opportunities and threats, with internal factors, which are its strengths and weaknesses.

IV. METHODOLOGY

This study stems from empirical social research, from a qualitative-quantitative approach on the process of stakeholder perception in the organizational environment, with a focus on behavior. In the quantitative aspect comparisons were established, in order to generalize the results; and as to the qualitative character was worked the subjectivity, intensity and depth of the fact, by compatible procedure as will be treated in space of this task.

4.1 Method

The Case Study Method was applied in this work which, according to Yin (2015), is an empirical inquiry that investigates a contemporary phenomenon within a real-life context, when the boundary between the phenomenon and the context is not clearly evident and where multiple sources of evidence are used.

4.2 Procedures

In this work, we used Internet search mechanisms and bibliographic surveys to construct their theoretical-conceptual review under which the gathered data were analyzed. To qualitatively measure the intervening factors in the organizational climate through a sample, a questionnaire was used in order to measure by the Likert Scale; this scale was developed by the psychologist Rensis Likert using this technique to measure people's attitudes, where this scale consists of a series of statements about a given object. For each affirmation there is a scale of five points, corresponding in the extremes I strongly disagree. The data collected through the form applied between the respondents were interpreted in the face of the theoretical reference, in order to find the consistency between the practice or the reality in the environmental context, and in this way to produce the research report or results. Samples were analyzed.

V. RESULT OF THE STUDY ON STAKEHOLDER PERCEPTION PROCESS IN THE ORGANIZATIONAL ENVIRONMENT

The body consulted is a permanent institution, essential to the jurisdictional function of the State. It is charged, as an expression and instrument of the democratic regime, with juridical guidance, promotion of human rights and defense, to all judicial and extrajudicial degrees, of individual and collective rights, in an integral and gratuitous way, to those in need. The body supports the mission of guaranteeing the needy the knowledge and the defense of their rights and its vision is to defend the rights of all who need it, wherever they may be, establishing themselves as an instrument of social transformation and a world reference in providing assistance legal basis.

The affirmative form was presented to the respondents, being held in the present federal public agency located in the city of Porto Velho. The data obtained were evaluated and organized using Microsoft Office Excel and later were evaluated with the mathematical and graphical tools of the software.The form presented to the respondents had the sum of 16 consulted in the public agency, corresponding to a sample of 31% of the total employees, being for the most part in an age group of 18 to 25 years, corresponding to 44% of respondents, 56% female, 56% with a medium-level education, 37% with a monthly average income of 2 to 4 minimum wages, 62% with a minimum working time in the 1-year institution, 81% of respondents live with one or three people. The application of the form in this task resulted in Table 4 below; there are 15 affirmations and the options indicated by the respondents in the Likert Scale.

Table.4: Tabulation of query data to focus group of search

AFIRMATIVE	TD (%)	PD (%)	I (%)	PA (%)	TA (%)	TOTAL (%)
1. My organization is made up of people with feelings and motivations.	6	19	18	19	38	100
2. I may be influenced by external and internal factors of the organization.	6	13	18	38	25	100
3. Variations in the organizational environment produce positive or negative	19	13	30	19	19	100

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AFIRMATIVE	TD (%)	PD (%)	I (%)	PA (%)	TA (%)	TOTAL (%)
effects.						
4. I realize there are improvement needs in my work environment.	6	25	12	38	19	100
5. I feel motivated by the organizational climate present in the organization.	0	19	18	38	25	100
6. I feel that I can be more productive if the organizational climate is of good quality.	25	6	19	25	25	100
7. I think, analyze, and draw people's conclusions from a single characteristic.	25	13	19	24	19	100
8. My reaction is influenced by the opinions of the group in which I am a part.	50	31	7	6	6	100
9. I use my behavior as a parameter to play other people.	38	19	24	19	0	100
10. Someone is judged based on the perception of the group to which the person is a part.	19	38	18	19	6	100
11. You feel happy as you perform the inherent activities of your job.	19	13	12	31	25	100
12. You can achieve the goals proposed in my work.	6	6	12	13	63	100
13. The result of my work gives me satisfaction.	6	13	0	0	81	100
14. Feel creative to overcome the difficulties of your job.	6	19	25	12	38	100
15. The administrative structure is adequate.	19	13	6	56	6	100

*TA (Totally Agree); PA (Partially Agree); I (Indifferent); PD (Partially Disagree); DT (Totally Disagree).
Source: Search data.

A percentage of 57% of respondents agree that the environment is composed of people who have feelings, thus away from a mechanical space. It implies that the manager can use the Halo Effect on characters and motivation, for example, in the certainty of obtaining satisfaction and fulfillment among the subordinates, as Robbins (2010) treats. A percentage of 63% affirm that it can be influenced by internal or external factors related to the organization, that is, situations caused by the environment in which the individual is inserted.

The survey also indicates that 38% of the respondents agree with the existence of variations produced in the organizational environment, however 30% indicated indifferent and 32% disagreed, classifying this aspect as irrelevant. Already 57% agree that there is a need for improvement in the environment, evidencing problems related to the lack of communication between sectors, a fact that requires special attention on the part of the managers. A percentage of 63% stated that they feel motivated by the organizational climate in the organ under study; this fact corroborates with the indicative in Chiavenato (2014), in which the author states that the organizational climate is the set of measurable properties of the work environment, contributing directly to the motivation of the people.In this same sense, a percentage of 50% of stakeholders affirm that productivity could be higher, depending on the organizational climate present in the organ; to judge the assertions now contextualized, it is possible to affirm that the productivity is of good quality, which was conferred in the present study.

Regarding the judgment of people from a single characteristic, 38% say they disagree, 43% agree and 19% are indifferent, so there are no major influences on this topic, 81% say they do not have a reaction influenced by the group of which they are part and 57 % does not use its behavior as a parameter to judge other people, just as, in the same way, 57% does not judge someone based on the perception of the group of which it is a part, which contributes to the existence of a good organizational climate in that body.

A percentage of 56% agree that they feel happy in the performance of the activities inherent in their work, which according to Robbins (2010) has as a concept of job satisfaction the general attitude of a person in relation to their work. Already 63% affirm that they can reach the goals proposed in the work, which shows the great degree of commitment of the individuals with the organization.

Regarding satisfaction, 82% affirm that they feel satisfied with the results of their work. According to Robbins (2010), the concept of job satisfaction is the general attitude of a person towards their work. In this sense a high employee satisfaction index is demonstrated. In what concerns the creativity to overcome the difficulties was not very significant because 50% of the interviewees said they felt difficulties to overcome the difficulties of the day to day. Regarding the administrative structure, 62% agree that it is adequate, which can contribute to a good organizational environment present in the consulted body.

5.1. Main elements involved in the process of perception of the researched organizational environment

In the affirmatives of Table 4, there are important the elements that intervene in the process of perception in the organizational environment, such as the organization of people, influences of external and internal factors of the

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organization, changes in the environment, creativity to overcome difficulties and adequate administrative structure are relevant.Considering the organization as complex, not only in its technical and normative sense, but as a system formed by people with feelings, interests and motivations related to internal and external factors and variations in the organizational environment, we get the Graph 1, where the stakeholder's understanding is demonstrated with 57% agreeing with the complexity of the organization according to Ajzen's(2002)behavioral approach. Regarding the influences of internal external factors 67% agrees with its relevance in the organization's environment, observing external factors such as the current economic and internal crisis, such as equal pay regardless of individual performance; these problems act directly in the results as Robbins (2010) states. Regarding the variations in the environment, 30% were indifferent, 38 agree and 32 disagree, pointing out that this aspect of environmental variations does not have great significance in this organ. Graph 1 below demonstrates this data.

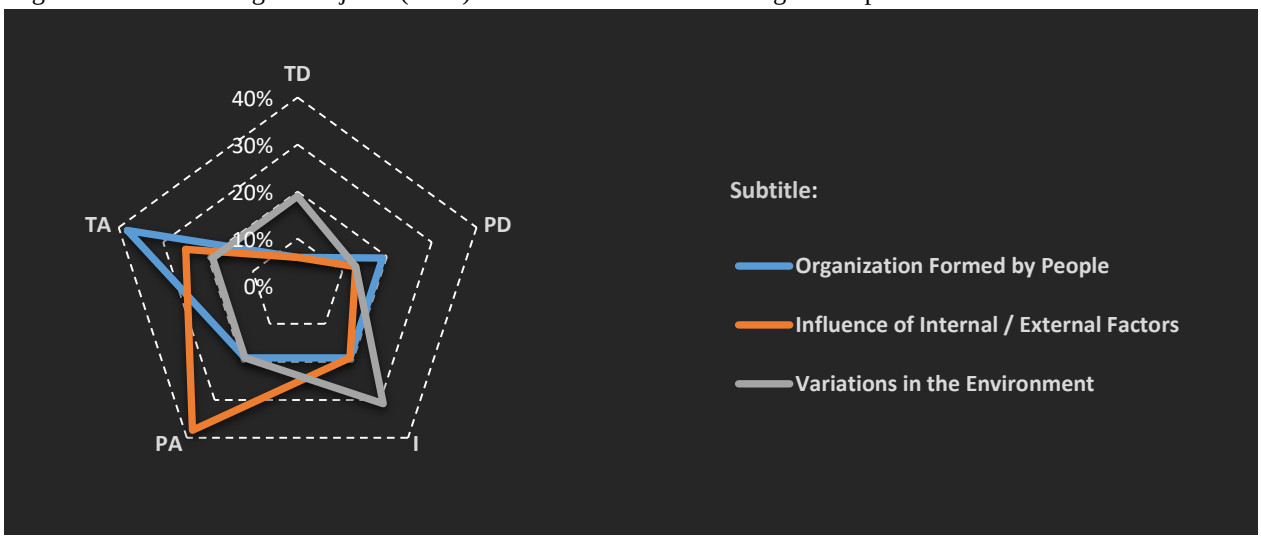

Chart.1: Significant Elements in the Organizational Environment

*TA(Totally Agree); PA (Partially Agree); I (Indifferent); PD (Partially Disagree); TD (Totally Disagree).

Source: Search data

The majority of respondents in a percentage of 62% agree that the administrative structure is adequate, that is, there is the presence departments, administrative decentralization, chain of command, providing, according to Robbins (2010), administrative standardization for better results. Most respondents representing 50% agree that they have the necessary creativity to overcome difficulties in the work environment, thus demonstrating that they have the capacity to find appropriate solutions to problems, according to Robbins (2010). Chart 2 expresses the relation of the data discussed above.

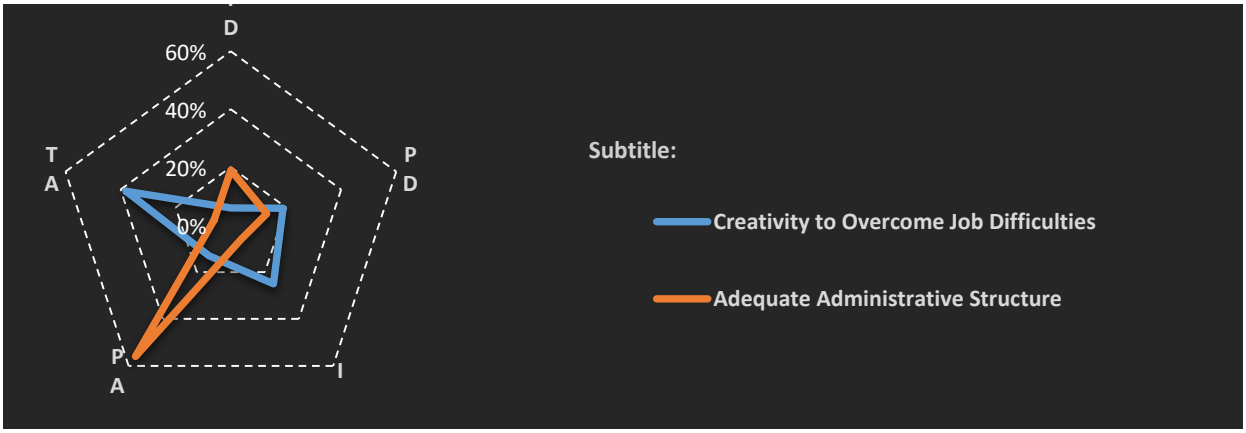

*Chart.2: Structure and Creative in the Organizational Environment**TA (Totally Agree); PA (Partially Agree); I (Indifferent); PD (Parcially Disagree);TD (Totally Desagree).

Source: Search data

5.2 Identification of the relation of the intervening factors with the perception and organizational climate

The identification of the relationship between perception and organizational environment is due to the needs of improvement in the work environment, the motivation provided by the organizational environment, the low incidence of problems related to perceptual distortions, the goals achieved and the satisfaction produced by the work and its results.

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The majority of the respondents, with a total of 57%, agree that there are needs for improvement in the work environment regarding the lack of communication between sectors, and conflicts may occur, according to Marras (2009). In the motivation provided by the current organizational environment, 63% agree that they feel motivated, since in the organ, the consulates enjoy good salaries, stability and flexibility with the employees, showing that it has a good quality, providing good results for the organization and proving Robbins' (2010) statement regarding environment. As for the productivity linked to the organizational climate, the respondents affirmed in a varied and balanced way, but taking into account the degree of agreement of 50%, it can be affirmed that this productivity, although positive, needs improvement, since it was observed that there is a great labor demand, leading to significant declines in productivity. Chart 3 below demonstrates this data.

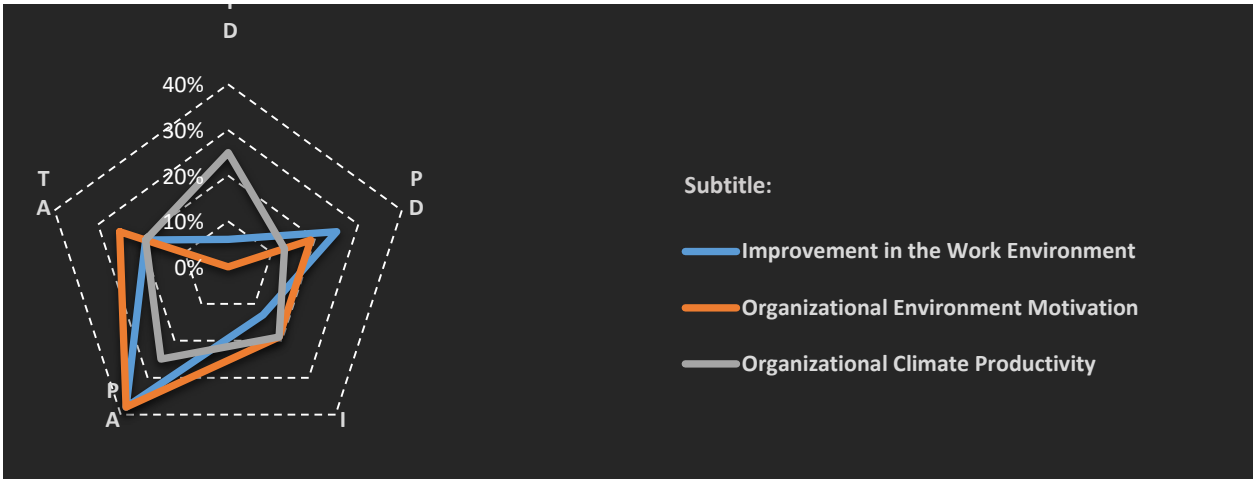

Chart.3: Motivation, productivity and work environment in the organizational climate

*TA (Totally Agree); PA (Partially Agree); I (Indifferent); PD (Partially Disagree); TD (Totally Disagree).

Source: Search data

Taking into account the percentage of the incidence of Halo Effect 38% disagree, 43% agree and 19% are indifferent, so there is no great relevance to this topic; in contrast, 81% disagree about their existence in the organ, projection and stereotyping 57% respectively disagree with their occurrence in the organization, ie, the significant lack of perceptive distortions in this organization contributes to an environment with good quality, according to Robbins (2010). Graph 4 below expresses perceptual distortion data.

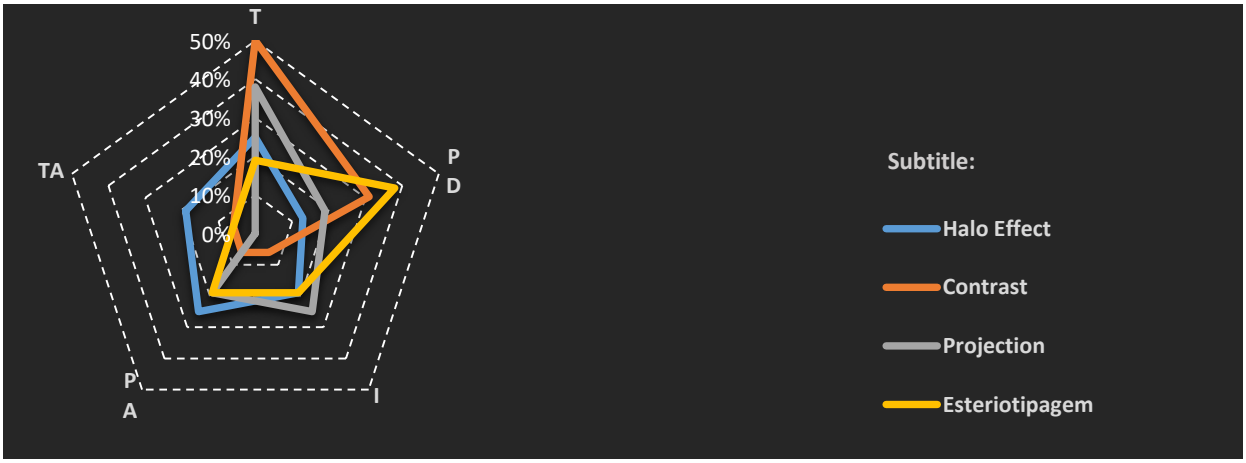

Chart.4: Perceptual Distortions in Organizational Environment

*TA (Totally Agree); PA (Partially Agree); I (Indifferent); PD (Partially Disagree); TD (Totally Disagree).

Source: Search data

The majority of respondents agree that they are satisfied when they carry out their activities at a rate of 56%, achieving the goals in a total of 63% and 82% obtaining satisfaction by the result, indicating that the results in the body are profitable and the collaborators work motivation and happiness, thus providing, according to Robbins (2010), a climate with good quality. It is also noted that the satisfaction of the activities X goals achieved X satisfaction by the result are directly proportional, that is, as one increases the others will also increase. Chart 5 shows the relationship of the data treated above.

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*Chart.5: Satisfaction with activities and results associated with goals *TA (Totally Agree); PA (Partially Agree); I* (Indifferent); PD (Partially Disagree); TD (Totally Disagree).

Source: Search data

5.3 SWOT analysis on the positioning of individuals in the organizational environment

For the treatment of stakeholder perception regarding the organizational environment resulting from the information collected, the SWOT Analysis was concluded here, following a Chiavenato (2014)prescription; this author affirms that it is possible to make an internal and external analysis, in which the strengths and weaknesses in the internal environment, and the opportunities and threats emerge in the external environment; recommends highlighting strengths in the pursuit of implementing them, and correcting or blocking weaknesses that are unfavorable to the organization; and still seek to plan favorable actions to optimize the opportunities or potentially potential threats considered. And Table 5 below contains the recommendations resulting from this analysis.

5.3.1 Internal Environment

In the internal environment, the strengths are highlighted in items such as the satisfaction that produces the result of the work, where 81% of the interviewees affirm satisfaction with the work, as well as those who affirm that they feel happy to do the work with 56% agreeing that Yes. They are important strengths because they contribute to a good organizational environment. In relation to the weak point due to the fact that it is an organ that acts in a short time, there are problems related to the administrative structure, in issues related to insufficient number of employees, lack of administrative decentralization and budgetary planning, thus creating uncertainties in the organizational environment. For Chiavenato (2014) the organizational environment is everything that contemplates and influences the organization, either internally or externally, in this sense the variations and changes introduce a high degree of uncertainty in the organizations affecting the organizational environment.

5.3.2 External Environment

In the analysis of the external environment in collaboration the opportunities stand out the capacity of enlargement of the organ due to the fact of having a structure still young, thus generating opportunities of growth which increases the motivation of the collaborators contributing thus to a quality organizational climate that is of vital importance to any organization. With regard to threats such as economic crisis, where the contingency of expenses contributes negatively and the difficulty of access of the target public generates doubts and uncertainties in the organizational environment causing the influence of external factors will produce negative variations in the organizational environment. In this sense according to Chiavenato (2014) organizational environment is the set of measurable properties of the perceived work environment, either directly or indirectly, therefore factors that influence the external environment are related to opportunities or threats cause direct influence on the organizational environment of the organ.

Table.5: SWOT Matrix

Internal Environment	**External Environment**
Strong points	**Oportunities**
Direct contact with the population	Enlargement and internalization
Creativity to overcome difficulties	Government speech on social inclusion
Strategic assignments: social inclusion	Increased attention of control bodies
Career with constitutional forecast	Internationalization and increase in the provision of services

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Weak Points	Threats
Inadequacy in the administrative structure	Economic crisis
Reduced number of servers	Contingency of expenses
Centralization in administrative management	Difficulty of access to the target public
Lack of budget planning	Breach of prerogatives and encroachment by other organs

Source: By the authors

VI. CONCLUSION

The organizational environment present in the organ searched involves factors such as motivation, influence on the work environment and the variations treated in this study. Positive aspects are evidenced, with emphasis on the motivation that benefits the quality in the current organizational environment. The perception of the respondents with respect to the physical improvement of the professional space, as a reformulation of the layout, can be solved with the simple interaction between the stakeholders. The holding of a public tender and the admission of new employees can bring the redistribution of tasks, solving the overload that stagnates the routine. There is a low relation associated with the other perceptual distortions in this research, meaning a strong point to be maintained. As for the goals and the satisfaction produced by the results of work, it is reasonable to point out as another strong point; positive for the organizational environment in the organ searched. The positive aspects are thus contributing to the growth of the employee, the fixation and his desire to be working in this organization. Confrontation between the theoretical indicatives and the reality identified in the institutional environment allows to affirm that in fact there is internal influence, such as the motivation and external organization, as the possibility of losing the employee attracted by other opportunities outside the institution. Analysis allows identifying the need for physical improvement of the professional space, and in the interaction between stakeholders; redistribution of work that avoids overload; but the motivation and good internal relation between the individuals surpass the expectation. This work interests the managers in public organs and other interested in the subject here treated.

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Extracting and Analysing of Heterogeneous Features for Robust FRS

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Abstract— *Collecting, cleaning, combining and analysing of data are in demand in all the fields for acquiring accuracy in their task. In biometrics, this process is done for smart and secured life by means of extracting and analysing data for recognition task. Huge volume and variety of data are effectively extracted and analysed with Matlab2015 to identify the uniqueness of attributes for better accuracy in recognition process. Heterogeneous set of features that are extracted from ORL face dataset are analysed with Nearest Neighbour Rule in order to identify the unique facial features for robust FRS (Face Recognition System).*

Keywords— Biometrics, FRS, Haralick features, ORL database.

I. INTRODUCTION

Biometrics is an art as well as science of identification and verification of person by his or her behavioural and physical features, not by the belongings of the person such as aadhar card, pan card etc....Finger print, palm print, eye-iris, face and DNA are some of the physiological features used for recognition process in the biometric system. The features which are having strong persistence for long period are marked as best features for recognition. Even though the features of finger-print, palm print and iris have high score of retention period, it is hard to cross check the performance manually in critical cases. CCTV Cameras are playing a vital role in the area of security in the public places, organizations, industries, household activities etc…[19].

Monitoring and controlling is the tough challenge for any management that be done by video surveillance. Image or video of a human face can be easily handled and analysed for the task of identification and verification. Face recognition is a simple and obvious biometric which is inevitable for smart and secured life. Smart life means does not need to carry documents for proof instead face is the identity proof that can be used for identification which did not get lost or stolen.

Researchers are scared of using face for recognition process because of the challenges like pose, illumination, age, occlusion, plastic surgery face, transgender and twins. The interest of using face for recognition is because of the application that it can be used without the co-operation of the user. Face recognition system generally uses the spatial features [2], frequency component [5] and geometric features [10]. Spatial features are more effectively used by haralick in the year 1973 on the satellite images and got accuracy of 83%.

In the field of biometrics, Haralick features are added and shown remarkable improvement in the performance metrics. In this paper, we have effectively utilized the some of the selective Haralick features added with frequency component which produce 92.5% of accuracy. Overview of existing FRS techniques is exposed in the section2. The section 3 has the detail about haralick features. The experiments and results are discussed in section 4. Finally, section 5 has the conclusion and future enhancement of the paper.

II. EXISTING TECHNIQUES

Identification and verification can be achieved through unique features. Important phases of FRS are Feature extraction and classification. Facial features are classified as statistical features, geometric features, spatial features and frequency features. Geometric features [10] are extracted by fixing nodal points in face image. The spatial features are occurred through the parameters[2] like mean, median, entropy, energy, PCA [2][3][4][10] (Principal Component Analysis) etc…Frequency vectors are obtained by Fast Fourier Transform (FFT)[5], Discrete Cosine Transform (DCT)[2], Discrete Wavelet Transform[6] etc…

Nearest neighbour rule [7], Support Vector Machine [8] (SVM) and Neural Networks [9] are efficient classifiers for FRS. Similar sample images are grouped together for flawless classification. Facial features of different subject are classified as different classes. Performance of FRS [11] [12] can be measured with Falsely Accept Rate

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(FAR) and Falsely Reject Rate (FRR). EER (Equal Error Rate) which are calculated using FAR and FRR. ORL [13], CMU PIE [14], FRGC [15], AR [7], FERET [16], YALE [17], FG-NET [18] and MYCT [8] are the globally available databases which are used for analyzing the performance of FRS.

III. HETEROGENEOUS FEATURES

Feature selection is the prominent task of any recognition process. In FRS, features can be acquired from spatial or frequency domain. In the proposed work, spatial and frequency domain are fused by using both Haralick features and FFT which are explained in this section.

3.1 HARALICK FEATURES:-

The information of an image can be represented as f(x,y). The features of the image are classified as spectral, textural and contextual [1] features. Tonal variation in different bands of an image is appeared as spectral features and variation in the same band is textural features. Contextual features are collected from the data outside the region of interest. Textural are the spatial distribution of gray tones which is available in the gray scale images.

Texture features gives the information about the surface with respect to the surrounding which is useful in discriminating one image from other image. Haralick et al., in their work extracted 14 types of features[1] based on homogeneity, gray-tone linear dependencies complexity, contrast, number and nature of the boundaries of the image. The textural features are easy to compute because less number of operations needed for computation. Haralick et al., is experimented the textural features of different type of images varying in resolution and its performance varies from 80% to 90%.

Tone and texture features are available in all the types of images. The image with more variation in the discrete gray tone has dominant texture features and has less variation and also good tone property in the dominant texture features. Texture features are more specific and general than tone features. It depends on angular nearest neighbour gray tone spatial-dependence matrices.

Matrices of gray tone spatial dependence frequencies are generated by measuring the angular relationship between the resolution cells. In the below figure1, the angles of the eight cells with respect to the center cell is represented in degrees. 1 and 5 are 0^o neighbours, 2 and 6 cells are 135^o neighbours, cell 3 and 7 are 90^o neighbours and cell 4 and 8 are 45^o neighbours. The neighbours cells are separated with distance 1.

6	**7**	**8**
5	.	1
4	3	2

Fig. 1: The resolution cells

Thirteen types of Haralick features extracted are angular second moment, contrast, and correlation, Sum of squares, Different inverse moment, sum average, sum moment, sum entropy, entropy, difference variance, difference entropy and Information measures of correlation. The equations from (1) to (13) are utilized for the extraction process.

Angular second moment: Homogeneity of the gray scale image focus on the gray scale distribution which is a measure termed as Angular second moment. It is denoted by the equation (1).

$$f1 = \sum_i \sum_j \{p(i,j)\}^2 \quad (1)$$

where,

p(i,j) is the normalized gray tone spatial dependence matrix.

Contrast: The changes between a pixel and its neighbourhood pixels are denoted as Contrast measure which can be measured with the equation (2).

$$f2 = \sum_{n=0}^{Ng-1} n^2 \{ \sum_{i=1}^{Ng} \sum_{j=1}^{Ng} p(i,j) \} \quad (2)$$

where,

Ng Number of distinct gray levels.

Correlation: It is a measure of correlation between a pixel and the neighbourhood pixels which depends on mean and standard deviation. A flag +1 rise for positive correlation and -1 for negative correlation.

$$f3 = \frac{\sum_i \sum_j (i,j)\, p(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y} \quad (3)$$

here μ_x, μ_y are the mean of the p_x and p_y

σ_x, σ_y are the standard devition of the p_x and p_y

p_x, p_y probability matrix obtained from summing of i^{th} and j^{th} entry respectively

Sum of squares: Sum of squares is the summing up of the extracted values with respect to squaring the overall mean.

$$f4 = \sum_i \sum_j (i-\mu)^2 p(i,j) \quad (4)$$

Inverse difference moment: Analysing the homogenous of an image is vital factor for which higher value will be generated for high homogeneity.

$$f5 = \sum_i \sum_j p(i,j) \frac{1}{1 + (i-j)^2} \quad (5)$$

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Sum average: Summing all the pixel values in the image ranging from Number of distinct gray levels.

$$f6 = \sum_{i=2}^{2N_g} i p_{x+y}(i) \quad (6)$$

Sum variance: Summing all the co-related pixel values in the image ranging from Number of distinct gray levels.

$$f7 = \sum_{i=2}^{2N_g} (i - f8)^2 p_{x+y}(i) \quad (7)$$

Sum entropy: The degree of unordered that occurs in the image is Entropy. The entropy value depends on co-occurrence matrix. It is large for the same co-occurrence matrix and small for different co-occurrence matrix. Sum entropy means summing the entropy values ranging from Number of distinct gray levels.

$$f8 = - \sum_{i=2}^{2N_g} p_{x+y}(i) \log\{ p_{x+y}(i) \} \quad (8)$$

Entropy: Entrpopy can be calculated with the pixel value and the logarithm of the pixel value.

$$f9 = - \sum_i \sum_j p(i,j) \log (p(i,j)) \quad (9)$$

Difference variance: Measuring the pixel value how well it varies from the mean value of the image.

$$f10 = \text{variance of } p_{x-y} \quad (10)$$

Difference entropy: The neighbouring values of the pixel values are different on account of entropy.

$$f11 = \sum_{i=0}^{2Ng-1} p_{x-y}(i) \log\{ p_{x-y}(i) \} \quad (11)$$

Information measures of correlation: To extract more information from the pixel value, additional to the measurement of p(i,j) the other dimension of two set of discrete value $p_x(i)$ and $p_y(j)$ are also considered for trapping a new feature. Information measures of correlation can be retrieved from the following equations (12) and (13).

$$f12 = \frac{HXY - HXY1}{MAX(HX,HY)} \quad (12)$$

$$f13 = (1-\exp[-2.0(HXY2-HXY)])1/2 \quad (13)$$

where,

HX and HY are entropies of p_x and p_y

$p_x(i)$ ith entry in the marginal-probability matrix obtained by summing the rows of p(i,j).

$p_x(j)$ jth entry in the marginal-probability matrix obtained by summing the rows of p(i,j).

$$HXY = - \sum_i \sum_j p(i,j) \log (p(i,j))$$

$$HXY1 = - \sum_i \sum_j p(i,j) \log \{(p_x(i)p_y(j))\}$$

$$HXY2 = - \sum_i \sum_j p_x(i)p_y(j) \log \{(p_x(i)p_y(j))\}$$

Haralick et al., extracted the above features from satellite images and classified different classes by means of piecewise linear distinction function. The maximum accuracy achieved for the satellite images[1] in their work was 83.5%.

3.2 EFT AND MAVFT

The FRS works much better when added with additional features. Here frequency components Energy of Fourier Transformed vectors (EFT) and MAVFT(Mean Absolute Value of Fourier Transformed vectors) are extracted and effectively utilized with Haralick features to equip the FRS for better accuracy.

Energy of Fourier Transformed vectors (EFT): The Fast Fourier is used to convert actual pixel values in to frequency vectors. Energy evolves by summing the real and imaginary values of the Fourier coefficients.

MAVFT(Mean Absolute Value of Fourier Transformed vectors): Mean value calculated for the shifted Fast Fourier Transform(FFT) for all rows and columns of the image.

IV. EXPERIMENTS AND RESULTS:

The experiments and evaluation are performed with the different permutation of the extracted heterogeneous features from the popular public ORL face database[22] that is shown in the figure 2 which includes Frequency dc components, Mean Absolute Value, Energy of FFT and thirteen Haralick features [20].

The ORL database[22] of AT&T Laboratories Cambridge consists of 400 faces of 40 persons with 10 different sample faces for each subject which are with different pose, lighting, facial expressions, accessories and illumination shown in figure 2. The images available are in 256 grey levels per pixel PGM format and it is of size 92x112 pixels. The data base has 40 subjects and each subject hold one separate folder. The subject folder named with s alphabet followed by a number 1 to 40.

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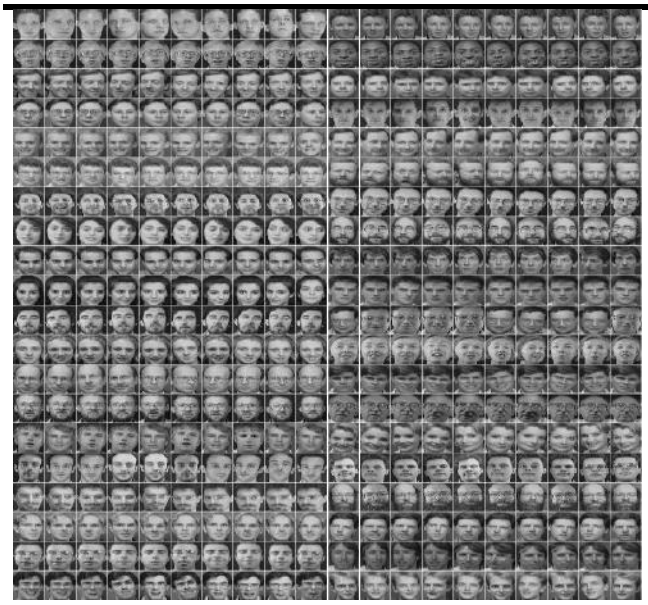

Fig. 2: ORL dataset

The tuples of features collected are appended with a unique class label for each type class. The dataset is partitioned so that one part is for training and other for testing. Cross validation method with five folds is used to construct the model for training and testing. In the proposed work, 400 tuples are collected from 400 face images of 40 individuals from the ORL dataset. The total 400 tuples were divided into 5 parts since five folds cross validation technique is considered for the proposed task. Among the five parts, 4 parts of the dataset are used for training to create a model and the remaing one part for testing. This process repeated for 5 times by changing the testing dataset with training dataset.

The training and testing is done with the KNN classifier.KNN rule (K-Nearest Neighbour Rule) usually uses the similarities among the feature vectors for grouping the similar classes. This rule is very effective for FRS systems. M. Ezoji K. Faez[7] and Randa Atta et al[2] used this KNN rule in their FRS to improve its performance. The extracted features are classified with nearest neighbour rule with different subset of features from the collected heterogeneous set and the performance of the FRS measured with accuracy metric [21]. Accuracy is other words known as recognition rate in pattern recognition. A test dataset used for accuracy measurement is a new dataset that is not trained. The correctly classified test dataset improves the accuracy rate and it can be obtained by the equation (14) given below.

$$Accuracy = \frac{Number\ of\ tuples\ correctly\ classified}{D} \quad (14)$$

Where,

D is the total number of tuples in the testing dataset.

The different permutation of the features gives the different accuracy rate. The training is done carefully and the feature set with best accuracy is recorded obviously which is shown in the table1and figure 3.

Table.1: Diverse Permutation of Facial Features versus Accuracy

Feature set	Facial Features	Accuracy %
1	All the 13 Haralick features	86.30%
2	EFT, MAVFT and selective Haralick features(3,5-8,13)	91.80%
3	EFT, MAVFT and selective Haralick features(2,3,5,6,7,13)	92.00%
4	EFT, MAVFT and selective Haralick features(3-8,13)	92.30%
5	EFT, MAVFT and selective Haralick features(3,5,6,7,13)	92.50%

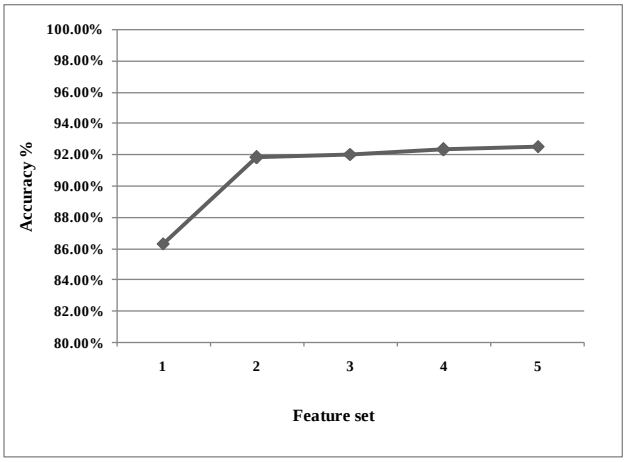

Fig. 3: Diverse Permutation of Facial Features versus Accuracy

The obtained results were compared with the existing systems like PCA, DCT and DWT [2] with the accuracy metric in the table2 and shown in figure 4.

Table: 2 Facial Feature methods versus Accuracy

Facial Features methods	Accuracy with ORL%
PCA	87.50%
DCT	88.80%
DWT	91.10%
Proposed dataset	92.50%

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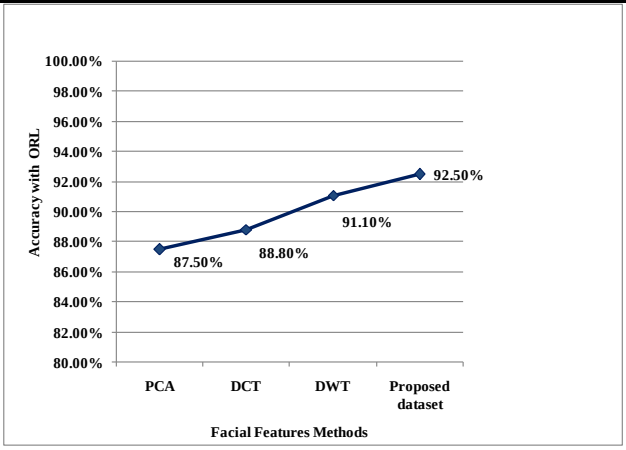

Fig. 4 Facial Feature methods versus Accuracy

The haralick features are spatial features which are significant in all types of images. The following table3 depicts the performance of haralick features on Satellite images and face images. Finally the added features with the selective haralick features are for better by its accuracy rate which is recorded in table3 and depicted in figure 5.

Table.3: Performance comparison between satellite images and face images

Haralick features extracted Data base	Accuracy%
Satellite database	83.00%
ORL face database	86.30%
Proposed dataset	92.50%

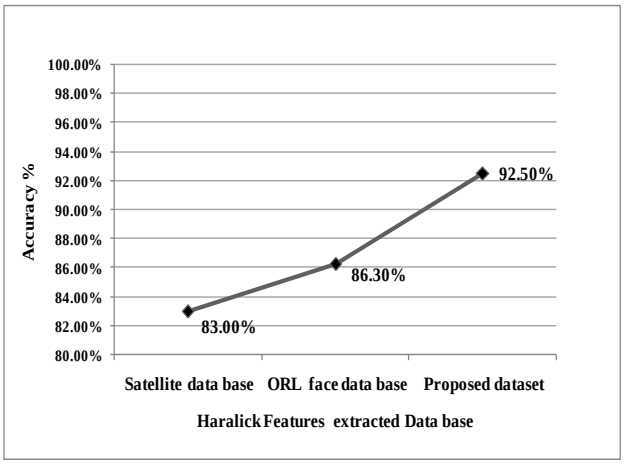

Fig.5: Performance comparison between satellite database and face database

Sensitivity and specificity across a range of cutoffs can be exposed with the ROC(Receiver operating characteristic) curve which has true negative values in the horizontal axis and true positive values in the vertical axis. Trained model of the FRS can be analysed with AUC(Area Under Curve) which is under the ROC curve which is shown in below figure 6. Ideal model achieve 1 and below 0.6 not appreciable. The proposed dataset with cross validation model and KNN classifier produced 1 for AUC.

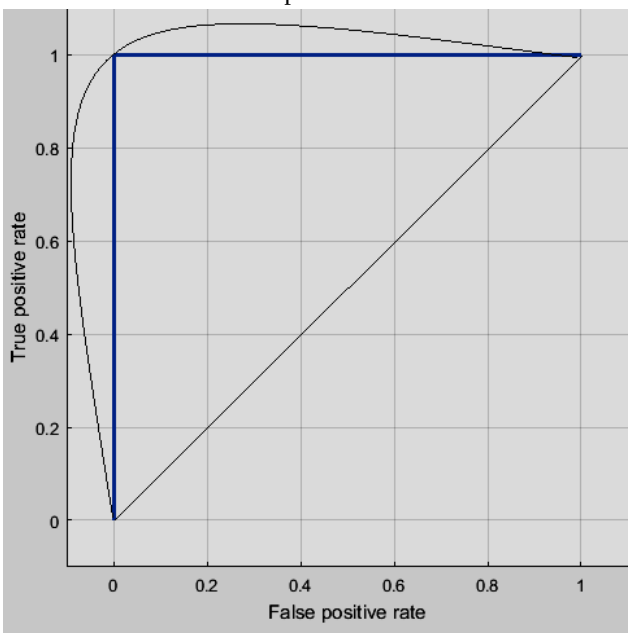

Fig.6: ROC curve for the proposed dataset

V. CONCLUSION

Among several psychological characteristics face attracts the researchers by its uniqueness, geninuity and ease of availability. The acquisition of face need less cost, since, it can be acquired with the any type of available camera. In the proposed FRS, selective Haralick features with frequency vectors of ORL database gives the accuracy of 92.5%. Diverse features with low correlation vectors are further identified and analysed in future to improve the FRS system. The new era of Bigdata and IoT also enhance the utility of Face recognition system in the security and privacy applications by means of effective storage and dense distribution.

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Lemon Juice as a Natural Catalyse for Synthesis of Shiff's base: A Green Chemistry Approach

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Abstract— *The advantages of the use of natural catalysts are eco-friendly, inexpensive, high yields, nonhazardous and short reaction times.*

The utilization of green chemistry techniques is the elimination of solvents during chemical processes or the replacement of hazardous solvents with environmentally friendly solvents. Green chemistry has used for the synthesis of Schiff bases. Synthesis of Schiff base is carried out the mixture of aldehyde (or ketone) and amine in organic medium with or without an acid catalyst. He presents study Uses Lemon juice as a natural and eco-friendly catalyst in the green chemistry investigated.

The synthesized product was characterized by its physical properties, melting point, TLC and then subjected to the in vitro antibacterial activities against gram-positive and gram-negative strains of microbes.

Keywords— Antibacterial activity, Green chemistry, Lemon juice, Shiff's base

I. INTRODUCTION

Green chemistry is defined as environmentally benign chemical synthesis. The synthetic schemes are designed in such a way that there is least pollution to the environment [1]. Green chemistry is focused on the designing of products and processes that minimize the use and generation of hazardous substances. Green chemistry is focused on technological approaches to preventing pollution and reducing consumption of non-renewable resources [2,3,4,5,6].

Green solvents, are normally derived from renewable resources and biodegrade to harmless, often naturally occurring product. [7.8]

Recently fruit juice is used in organic solvents for the synthesis of compounds of pharmaceutical interest. [9]. fruit juices are inimitable solvent because they are readily available, inexpensive, nontoxic, safer, and environmentally benign. Lemon juice is a green alternative to hazardous solvents and natural catalyst for synthesis of Schiff bases. [10,11] A Schiff base is a compound with the general structure R2C=NR' (R' ≠ H) [12]. The formation of carbon-nitrogen double bond plays important role in organic synthesis. Schiff bases can be synthesized from an aliphatic or aromatic amine and a carbonyl compound [13,14]. Schiff bases are known as organic chemicals due to significant biological activity such as anticancer [15], antitumor [16], anti-inflammatory agents [17], antibacterial [18], antibiotics [19], antimicrobial [20], anticonvulsant activity [21].

II. EXPERIMENTAL

2.1 Material and Methods

All chemical purchased from Merck and Aldrich Company and used without further purification. The IR spectra were taken with a Shimidzo 300 spectrometer using potassium bromide pellets. 1HNMR (nuclear magnetic resonance) spectra of ligand were recorded on a Brucker AMX 250 MHz spectrometer in the DMS-d6 solvent using tetramethyl silan as an internal reference. Melting points of compounds were measured with an electro thermal melting point apparatus and were not corrected. The molar conductance of the complexes in DMSO (1×10-3 M solution) was performed at 25 °C using Oakton ECTestr 11 dual-range, conductivity tester. The progress of the reactions was monitored by thin-layer chromatography (TLC) on silica gel Polygram precoated TLC sheets.

2.2 Preparation of catalyst

Fresh lemon was taken and washed it thoroughly with Water and cut by using a knife and then pieces were pressed manually. Then the juice was filtered through cotton to remove solid material and to get clear juice which was used as a catalyst.

2.3 General procedure for synthesis of pyrimidine compounds

A mixture of the selected aldehyde (0.1mmol) and 4,6-diamino 2-thiol pyrimidine (0.1 mmol) and catalyst juice (lemon juice) (10ml) were added and stirred at 55 °C for the appropriate time. The progress of the reaction was monitored by TLC. The product was dried and recrystallized from hot alcohol to obtain the pure product. The product was characterized by melting point, 1H NMR, IR.

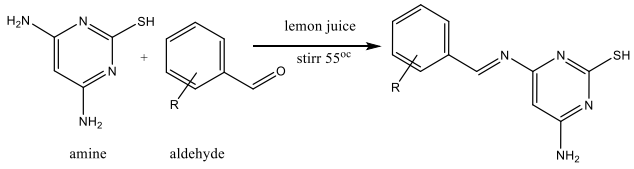

Fig. 1: Synthesis of pyrimidine compounds

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2.4 synthesis of compound and analytical and spectral data of products

2.4.1 4-amino-6-(benzylideneamino)-2-thiol – pyrimidine (3a)

White solide. Yield 75%, mp 240-242 0C.

FTIR (vmax, KBr):3436 (NH_2), 3392 ($CH_{aromatic}$), 2170 (SH),1663 (C=N),1585 (C=C), 1313(C-N) cm^{-1}

1HNMR: (DMSO): δ=5.84 ppm (s,1H, H pyrimidine),6.70 ppm (s,2H, NH2), 7.58-7.72 ppm (m,3H, Haromatic), 7.89-7.91ppm (d of d,2H, Haromatic) , 8.30ppm (s,1H,C=NH),12.71 ppm (s,1H,SH),

13CNMR (DMSO): δ=97.90, 128.80, 129.33, 132.67,137.20, 158.85, 167.02, 181.74, 184.82 ppm

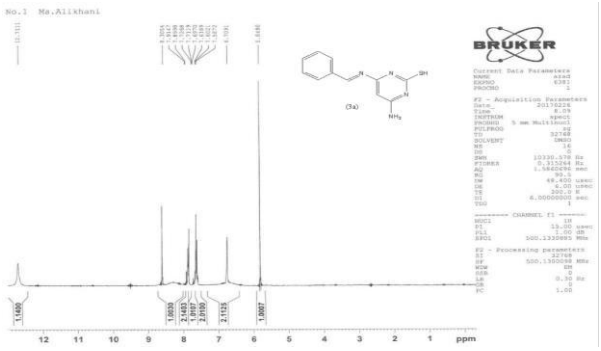

Fig. 2: 1H NMR spectra of 4-amino-6-(benzylideneamino)-2-thiol - pyrimidine

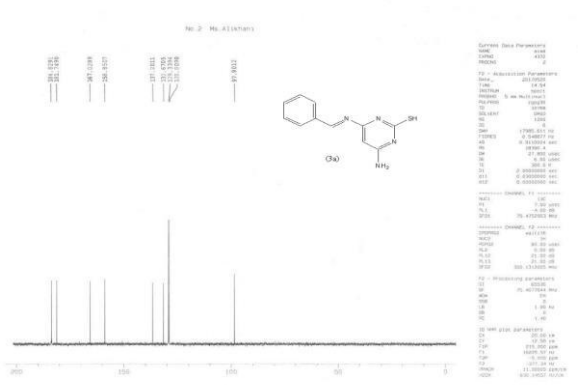

Fig. 3: 13CNMR spectra of 4-amino-6-(benzylideneamino)-2-thiol - pyrimidine

4-amino-6-(2-hydroxybenzylidene) amino -2-thiol – pyrimidine(3b)

Brown solid. Yield 80%, mp 226-228 0C.

F TIR (vmax, KBr):3435 (OH) ,3392 (NH_2) ,3259 ($CH_{aromatic}$) ,2715 (SH),1665(C=N) ,1423(C=C), 1312 (C-N) cm^{-1}

1HNMR: (DMSO): δ=5.78ppm (s,1H, H pyrimidine), 6.50ppm (m,3H, NH2, H aromatic), 6.82-6.83ppm(t,1H,H aromatic),7.09-7.11ppm(t,1H,H aromatic),7.40ppm(d,1H.H aromatic) , 8.80ppm (s,1H,C=NH) ,10.98ppm (s,1H,OH) ,11.80ppm (s,1H,SH).

13CNMR(DMSO): δ=98.79,117.99,118.23,119.94,130.00,130.94,158.86,158.99,165.58,178.97,181.11ppm

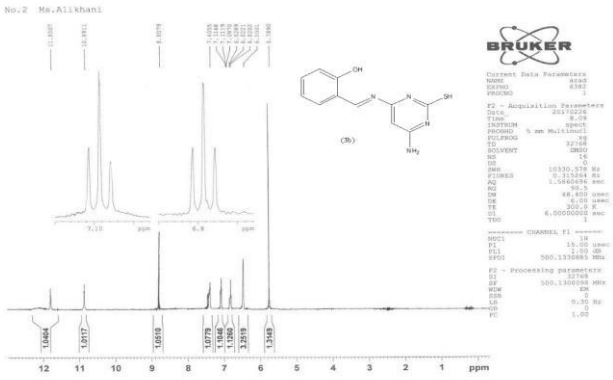

Fig. 4: 1H NMR spectra of 4-amino-6-(2-hydroxybenzylidene) amino -2-thiol – pyrimidine

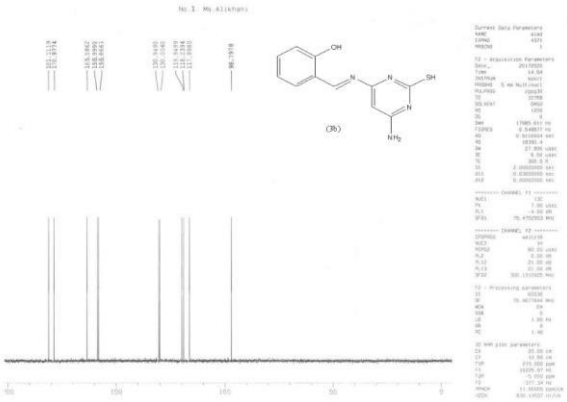

Fig. 5: 13CNMR spectra of 4-amino-6-(2-hydroxybenzylidene) amino -2-thiol – pyrimidine

4-amino-6-(3-nitrobenzylidene) amino -2-thiol – pyrimidine(3c)

Orange solide. Yield 75%, mp 168-170 0C. FTIR (vmax, KBr):3333 (NH_2) ,3172(CHaromatic) ,2975 (SH), 1738(C=C) ,1637(C=N),1528 (NO_2), 1351(C-N) cm^{-1}

1HNMR:(DMSO): δ=6.ooppm(s,1H, Hpyrimidine),6.79ppm (s,1H, NH2),7.47-7.58 ppm (t,1H, Haromatic),7.90-7.99ppm (d,1H, Haromatic), 8.11-8.14 ppm (d,1H, Haromatic),

8.37ppm (s,1H, Haromatic),8.92ppm (s,1H, C=NH), 12.04 ppm (s,1H, SH).

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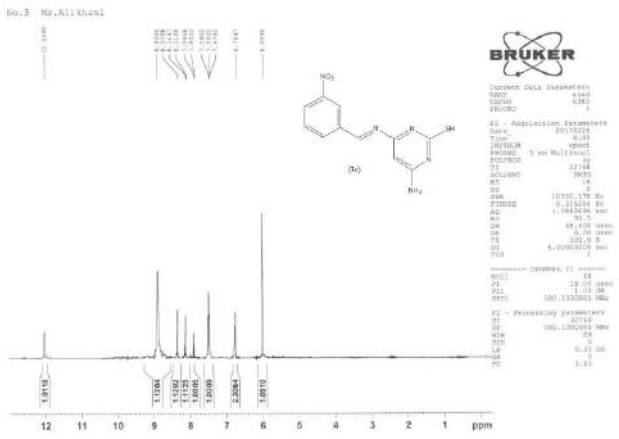

Fig. 6: 1H NMR spectra of 4-amino-6-(3-nitrobenzylidene) amino -2-thiol – pyrimidine

4-amino-6-(3,4-dimethoxybenzylidene) amino -2-thiol – pyrimidine(3d)
Dark brown solide. Yield 75%, mp 110-112 0C.
FTIR (vmax, KBr):3435 (NH_2),2924(CHaromatic), 2852 (SH),1730 (C=C), 1609 (C=N),1513 (OCH_3),1463 (OCH_3), 1258 (C-N) cm^{-1}

1HNMR: (DMSO): δ=3.65-3.67ppm(m,6H,2CH3),5.83ppm (s,1H, H pyrimidine) ,6.69ppm (s,2H, NH2) ,6.95-6.97ppm (d,1H, Haromatic),7.20ppm (d,1H, Haromatic), 7.39ppm(s,1H,Haromatic), 8.84ppm (s,1H,C=NH),11.99ppm(s,1H,SH).

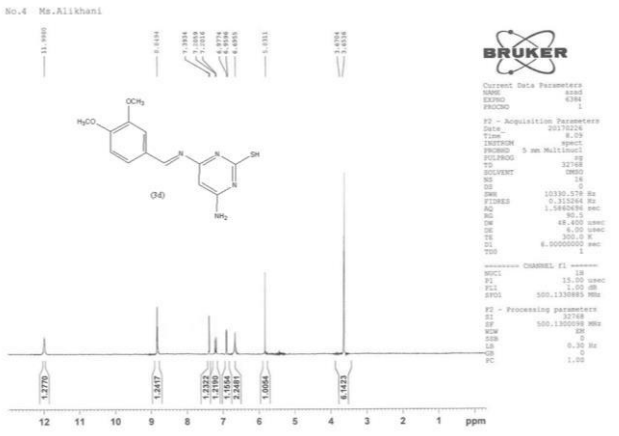

Fig. 7: 1H NMR spectra of 4-amino-6-(3,4-dimethoxybenzylidene) amino -2-thiol – pyrimidine

4-amino-6-(4-chlorobenzylidene) amino -2-thiol – pyrimidine(3e)
Gray solide. Yield 75%, mp 263-265 0C.
FTIR (vmax, KBr):3402 (NH_2) ,3162 ($CH_{aromatic}$) ,2996 (SH), 1657(C=N) ,1555(C=C), 1177(C-N) cm^{-1}

1HNMR: (DMSO): δ=5.94 ppm (s,1H, H pyrimidine),6.8 ppm (s,2H, NH2) ,
7.46-7.48ppm (d,2H, Haromatic),7.82-7.86ppm (d,2H, Haromatic), 9.02ppm (s,1H, C=NH),12.02ppm (s,1H, SH).

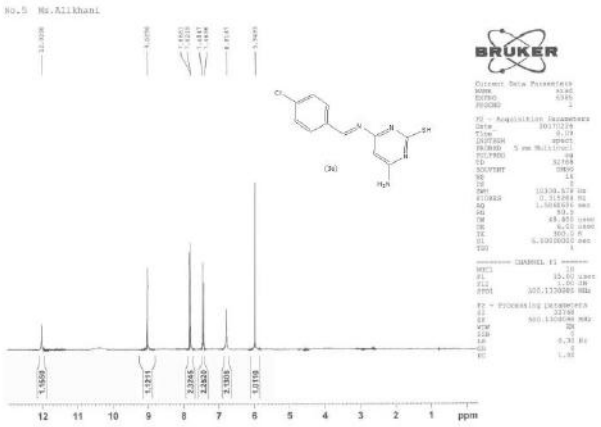

Fig. 8: 1H NMR spectra of 4-amino-6-(4-chlorobenzylidene) amino -2-thiol – pyrimidine

4-amino-6-(4-methylbenzylidene) amino -2-thiol – pyrimidine(3f)
Yellow solide. Yield 70%, mp 60-63 0 C.
FTIR (vmax, KBr):3188(NH_2) ,2925($CH_{aromatic}$) ,2850 (SH) ,1734(C=C), 1628(C=N),1490 (CH_3), 1091(C-N) cm^{-1}
1HNMR: (DMSO): δ=2.39ppm (s,3H, CH3),6.02 ppm (s,1H, H pyrimidine),6.89ppm (s,2H, NH2) ,7.23-7.24ppm (d,2H, Haromatic),7.79-7.81ppm (d,2H, Haromatic) ,9.01ppm (s,1H, C=NH),12.08ppm (s,1H, SH).

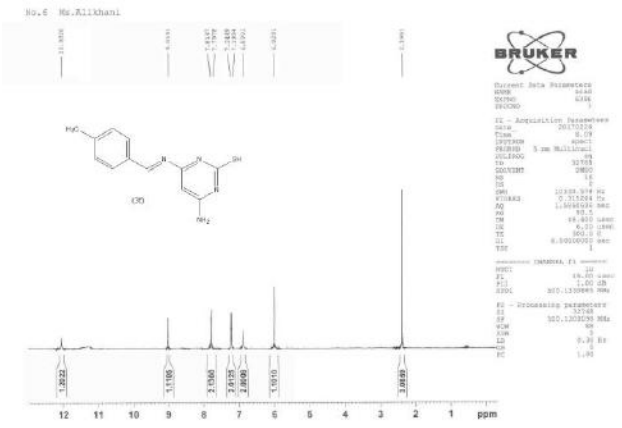

Fig. 9: 1H NMR spectra of 4-amino-6-(4-methylbenzylidene) amino -2-thiol – pyrimidine

2.4 In vitro antibacterial activity
Bacillus subtilisin (ATCC: 6633) and Staphylococcus aureus (ATCC: 6838) as gram-positive bacteria Escherichia coli (ATCC: 25922), Serratia marcescens

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(ATCC: 13880) as gram-negative bacteria as well as were used for the test of antibacterial activity of synthesized compounds.

Microorganisms were cultured onto Muller Hinton Agar (MHA) plate and incubated for 18-24 h at 35 °C. The density of bacteria cultures required for the test was adjusted to 0.5 McFarland (1. 5 ×108 CFU/ml) (CFU = Colony Forming Unit). The antibacterial activity of the synthesized compounds was determined with two methods: minimum inhibitory concentration (MIC) of antibiotic for that bacteria and the disc diffusion methods. The tests were repeated three times to ensure reliability.

2.5.1- Disc diffusion method

The disk diffusion method tests the effectiveness of antibiotics on a specific microorganism. The compounds (0. 02 g) were dissolved in 1 mL DMSO. A bacterial culture (which has been adjusted to 0. 5 McFarland) was used to lawn Hinton agar plates using a sterile swab. The discs had been impregnated with synthesized compounds were placed on the Muller-Hinton agar surface. Tetracycline and cephradine were used as standards for antibacterial measurements. DMSO showed no activity against any bacterial strains. After incubation for 18-24 h at 35 °C, the diameter of each zone of inhabitation was measured (mm). the disk diffusion method values are presented in Table 1.

Table. 1: Inhibition zone of Compounds against bacterial strains

	G (+)		G (-)
Compounds	B.sabtilis	S.aureus	E.coli	S.marcescen
3a	13	14	15	N.A
3b	N.A	10	N.A	N.A
3c	N.A	12	N.A	N.A
3d	15	14	13	N.A
3e	N.A	12	15	N.A
3f	16	15	11	N.A
a	N.A	15	13	14
Tetracycline	10	21	12	9
Polymixin	10	N.A	12	N.A
DMSO	0	0	0	0

2.5.2-Minimal Inhibitory Concentration (MIC) method

In microbiology, the minimum inhibitory concentration (MIC) is the lowest concentration of a chemical which prevents the visible growth of a bacterium. MIC is the lowest concentration of the antimicrobial compound, which inhibits the visible growth of a microorganism after overnight incubation. In this method, the various concentrations of synthesized compounds were made from 2000 to 1. 95µg/ml in a sterile tube. A 1 ml sterile Muller Hinton Broth (MHB) was poured in each sterile tube followed by addition of 1 ml test compound in tube 1. Two-fold serial dilutions were carried out from all the tubes and excess broth (1ml) was discarded from the last tube. To each tube 0. 1 ml of the standard microorganism (1. 5 ×108 CFU/ml) was added. Turbidity was observed after incubating the inoculated tubes at 35 °C for 24 h. the MIC values are presented in Table 2.

Table. 2: Minimal Inhibitory Concentration, µg/ml of Compounds against bacterial strains.

	G(+)	G(+)	G(-)	G(-)
Compounds	B.sabtilis	S.aureus	E.coli	S.marcescen
3a	250	500	1000	16.72
3b	15.62	125	60.5	15.62
3c	15.62	125	15.62	17.50
3d	1000	500	500	15.62
3e	17.50	125	1000	15.62
3f	1000	1000	125	16.72

III. CONCLUSION

The present study concentrates on the importance of fruit juice in organic transformations with natural and biocatalyst exclusivity. The benefit of fruit juice in organic synthesis is based on acidic properties, enzymatic activity, benign environmental nature, cheap material, and commercial usability. The catalyst based activity is consisting of the benefit of fruit juices in various organic transformations including the formation of C-C, C-N bonds in different synthetically important organic compounds that researched before. We can imagine that in next years the chemistry of natural catalysts will continue to attract remarkable research activity.

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Considerations on the Reynolds' Transport Theorem

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***Abstract*—** *The Reynolds' transport theorem deals with the rate of change of an extensive property, N, of a fluid in a control volume. Its purpose is to provide a link between the concepts associated to the control volumesand those associated to systems. The Reynolds' transport theorem is something extremely important in the formulation of the basic laws of fluid dynamics, which are the mass conservation equation, momentum conservation equationsand the energy conservation equation. This paper aims to propose an approach of the Reynolds' Transport Theorem for finite control volume equations for mass, momentum and energy.*

***Keywords*—Control Volume, System, Reynolds' Transport.**

I. INTRODUCTION

In general, the basic laws that the movement of fluids obey are enunciated and therefore lead to the motion equation.Often in the study of fluid flow it is preferred an approach from the control volume because it is easier and very relevant to study the movement of fluids. The question being asked is "How to connect the basic laws to a system with a control volume approach to fluids?". This issue has already been predicted by many. The result is the so-called Reynolds' transport theorem, which relates derivatives of system properties to the control volume formulation.

The equations for mass, energy and momentum are associatedto a system, and we now want to "convert" these equations into equivalent equations for control volume. For this, we will use the symbol N to represent any of the extensive properties of the system. We can imagine N as related to an amount of mass, linear motion, angular motion, or system energy.

The corresponding intensive property (N/m) will be denoted by η.The relationship between the rate of change of an arbitrary extended property, N, of a system and the property variations within a control volume is given by the following equation (1), known as the Reynolds' transport theorem

$$\left.\frac{dN}{dt}\right)_{system} = \frac{\partial}{\partial t}\int_{VC} \eta\ \rho\ d\forall + \int_{SC} \rho\ \eta\ \vec{V}.d\vec{A} \qquad (1)$$

The physical interpretation of each of the terms can be found in several textbooks of fluid mechanics, some of them cited in the references (1,2,3) and it follows below:

$\left.\frac{dN}{dt}\right|_{system}$ Represents the total rate of change of an arbitrary extensive property of the system

$\frac{\partial}{\partial t}\int_{VC}\eta\rho d\forall$ represents the rate of time change of the arbitrary extensive property, N, within the control volume

η represents the intensive property corresponding to N (per unit mass)

$\rho d\forall$ represents a mass element contained in the control volume

$\int_{VC}\eta\rho d\forall$ represents the total amount of the extensive property, N, contained within the control volume

$\int_{SC}\eta\rho\vec{V}\cdot d\vec{A}$: represents the total flow of the general property, N, through the control surface

$\rho\vec{V}\cdot d\vec{A}$ represents the mass of fluid flowing through the area element in the time unit

$\eta\rho\vec{V}\cdot d\vec{A}$ represents the rate of outflow of the extensive property, N, through the area

At this point it is better to make $d\forall$ the volume differential as not to be confused with the velocity V.

II. MASS CONSERVATION

The first physical principle to which we apply the relationship between system formulations and control volume is the mass conservation principle.

The mass of a system remains constant. According to the considerations made in Eq. (1) and, bymaking N = M and η = 1, wehave:

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$$\frac{dm_{system}}{dt} = \frac{\partial}{\partial t}\int_{VC} \rho dV + \int_{SC} \rho(\vec{V}\cdot\vec{n})dA$$

(2)

For $\frac{dm}{dt} = 0$ we have the mass conservation expressed by

$$0 = \frac{\partial}{\partial t}\int_{VC} \rho dV + \int_{SC} \rho \vec{V}.d\vec{A}, \quad (3)$$

as can be seen from references (1), (2) and (3).

III. FLOW IN PERMANENT REGIME

They are flows that do not vary with time, it cannot vary in a certain point, in a certain time, that is, their characteristics and their properties are permanent over time. Therefore

$$\frac{\partial}{\partial t}\int_{VC} \rho dV = 0 \text{ , } (4)$$

withthis comes

$$0 = \int_{SC} \rho \vec{V}\cdot d\vec{A}$$

Solving the integral in question we have

$$\int_{SC} \rho \vec{V}.d\vec{A} = \rho V_O A_O - \rho V_I A_I = 0 \quad (5)$$

It can be concluded that the product of the density by the input area and the input speed is equal to the density times the output area and the output speed. Such a condition leaves the flow in equilibrium; that is, the input flow equals output flow.

IV. INCOMPRESSIBLE FLOW

In some cases, it is possible to simplify the previous equation, as in the case of an incompressible flow (specific mass ρ = constant, generally valid for liquids). When ρ does not depend either on space or time, the equation can be written as:

$$\int_{SC} \vec{V}.d\vec{A} = 0 \quad (6)$$

In uniform flow it implies that the velocity is constant across the entire section area. If, in addition, ρ is also constant in the section, it results

$$V_2 A_2 = V_1 A_1$$

EQUATION OF THE LINEAR MOMENTUM CONSERVATION FOR AN INERTIAL CONTROL VOLUME

This analysis is restricted to an inertial control volume, that is, there is not acceleration relative to a steady reference system or inertial coordinate system. The following text can be verified by references (1), (2) and (3). Recalling Newton's second law for a system:

$$\vec{F} = \left.\frac{d\vec{P}}{dt}\right)_{system}, \quad (7)$$

where $\vec{P}$ represents the linear momentum of the system.The resulting force includes all field and surface forces

$$\vec{F} = \vec{F}_F + \vec{F}_S$$

Considering the Reynolds' transport theorem given by equation (1)

$$\left.\frac{dN}{dt}\right)_{system} = \frac{\partial}{\partial t}\int_{VC} \eta\ \rho\ dV + \int_{SC} \rho\ \eta\ \vec{V}.d\vec{A},$$

and by making N = $\vec{P}$ and $\eta = \vec{V}$, it follows that

$$\left.\frac{d\vec{P}}{dt}\right)_{system} = \frac{\partial}{\partial t}\int_{VC} \vec{V}\rho dV + \int_{SC} \rho\ \vec{V}\ \vec{V}.d\vec{A} \quad (8)$$

As in the initial instant, the system and the VC coincide, from equations (1), (2) and (4) we have:

$$\left.\frac{d(m\vec{V})}{dt}\right)_{system.} = \vec{F} = \vec{F}_F + \vec{F}_S = \frac{\partial}{\partial t}\int_{VC} \vec{V}\rho dV + \int_{SC} \rho\ \vec{V}\ \vec{V}.d\vec{A} \quad (9)$$

For uniform and permanent flow:

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$$\frac{\partial}{\partial t}\int_{VC}\vec{V}\rho d\forall = 0$$

This allows us to write that

$$\vec{F} = \rho_2 A_2 V_2 \vec{V}_2 - \rho_1 A_1 V_1 \vec{V}_1$$

On the other hand, taking into account the continuity equation we have

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2 = \dot{m},$$

where $\dot{m} = \frac{dm}{dt}$

The formulation for VC of the Newton's second law is given by

$$F = \dot{m}\,(V_2 - V_1) \quad (10)$$

ENERGY EQUATION FOR AN INERTIAL CONTROL VOLUME

Again, starting from equation (1) and references (1), (2) and (3) we have

$$\left.\frac{dN}{dt}\right)_{system} = \frac{\partial}{\partial t}\int_{VC}\eta\ \rho\ d\forall + \int_{SC}\rho\ \eta\ \vec{V}.d\vec{A}$$

By making $\eta = e$ and $N = E$, it comes that

$$\left.\frac{dE}{dt}\right)_{system} = \frac{\partial}{\partial t}\int_{VC} e\ \rho\ d\forall + \int_{SC}\rho\ e\ \vec{V}.d\vec{A} \quad (11)$$

On the other hand, it is known that

$$e = e_{\text{internal}} + e_{kinetic} + e_{potential}$$

$$e = u + \frac{V^2}{2} + gz$$

$$\left.\frac{dE}{dt}\right)_{system} = \dot{Q} - \dot{W} \quad (12)$$

Therefore

$$\left.\frac{dE}{dt}\right)_{system} = \dot{Q} - \dot{W} = \frac{\partial}{\partial t}\int_{VC}\left(u + \frac{V^2}{2} + gz\right)\ \rho\ d\forall + \int_{SC}\left(u + \frac{V^2}{2} + gz\right)\rho\ \ \vec{V}.d\vec{A} \quad (13)$$

We know that, for a permanent flow:

$$\frac{\partial}{\partial t}\int_{VC}\left(u + \frac{V^2}{2} + gz\right)\ \rho\ d\forall = 0,$$

What implies in

$$\dot{Q} - \dot{W} = \int_{SC}\left(u + \frac{V^2}{2} + gz\right)\left(\rho\vec{V}\cdot\vec{n}\right)dA \quad (14)$$

Finally, for a non-deformable control volume, it may be written

$$\int_{SC}\left(u + \frac{V^2}{2} + gz\right)\left(\rho\vec{V}\cdot\vec{n}\right)dA = \left[\left(u + \frac{V^2}{2} + gz\right)(\rho VA)\right]_2 - \left[\left(u + \frac{V^2}{2} + gz\right)(\rho VA)\right]_1 \quad (15)$$

where

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$$(\rho VA) = \dot{m}$$

V. RELATIONSHIP BETWEEN THE ENERGY EQUATION AND THE BERNOULLI'S EQUATION

Starting from the energy equation and the references (1), (2) and (3), it may be written

$$\left.\frac{dE}{dt}\right)_{system} = \dot{Q} - \dot{W} = \frac{\partial}{\partial t}\int_{VC} e\ \rho\ d\forall + \int_{SC}(e + \frac{p}{\rho})\rho\ \vec{V}.d\vec{A} \quad (16)$$

By supposing that $\dot{W}$ = 0and by considering the permanent regime

$$\frac{\partial}{\partial t}\int_{VC} \vec{V}\rho d\forall = 0,$$

We have that

$$\dot{Q} = \int_{SC}(e + \frac{p}{\rho})\rho\ \vec{V}.d\vec{A} \quad (17)$$

By developing the integral on the SC control surface, we have

$$\dot{Q} = \int_1(e + \frac{p}{\rho})\rho\ \vec{V}.d\vec{A} + \int_2(e + \frac{p}{\rho})\rho\ \vec{V}.d\vec{A}$$

More specifically, by solving the integral the equation becomes

$$\dot{Q} = \left(u_1 + gz_1 + \frac{V_1^2}{2} + \frac{p_1}{\rho_1}\right)(-\rho_1 V_1 A_1) + \left(u_2 + gz_2 + \frac{V_2^2}{2} + \frac{p_2}{\rho_2}\right)(+\rho_2 V_2 A_2)$$

Taking into account the mass conservation equation

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2 = \dot{m},$$

wehave

$$\dot{Q} = \left(u_1 + gz_1 + \frac{V_1^2}{2} + \frac{p_1}{\rho_1}\right)(-\dot{m}) + \left(u_2 + gz_2 + \frac{V_2^2}{2} + \frac{p_2}{\rho_2}\right)(+\dot{m})$$

This equation can also be written

$$\left(gz_1 + \frac{V_1^2}{2} + \frac{p_1}{\rho_1}\right) = \left(gz_2 + \frac{V_2^2}{2} + \frac{p_2}{\rho_2}\right) + \left(u_2 - u_1 - \frac{\dot{Q}}{\dot{m}}\right)$$

For reversible adiabatic processes, it implies the nullity of the following term:

$$\left(u_2 - u_1 - \frac{\dot{Q}}{\dot{m}}\right)$$

In view of this, one arrives at Bernoulli's equation

$$\left(gz_1 + \frac{V_1^2}{2} + \frac{p_1}{\rho_1}\right) = \left(gz_2 + \frac{V_2^2}{2} + \frac{p_2}{\rho_2}\right)$$

VI. FINAL CONSIDERATIONS

The derivation of the Reynolds' transport theorem (Rtt) may seem very complex, but when the basis of the theorem is understood, it is indeed easy to follow its derivation. Weshould start with a system andthe rate atwhichanextendedproperty N changes in it.

In most contemporary textbooks these equations are derived by transforming the corresponding equations into a control mass using the Reynolds' transport theorem. This theorem is mathematically correct, and mastering its derivation is a good mathematical exercise, but Rtt is a difficult medium for this purpose, since learning and mastering Rtt is not an end in itself, particularly in an introductory course.In addition, it is comforting to have evidence that the laws governing the control masses can be translated into the laws governing the contents of the control volumes.

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Using of Naproxen drug for novel synthesis of 4-thiazolidinone derivatives and application of these drugs as no steroidal anti-inflammatory drug (NSAIDs) and as anti-epileptic agent

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Abstract— *Non-steroidal anti-inflammatory drugs (NSAIDs) are now one of the most frequent drugs used in treatment of pain, inflammation and fever. In this study the aim is the synthesis of derivatives of 4-Tiazolidinon from naproxen with the possible anti-pain effects, and the main purpose of providing these derivatives is to achieve a compound with more anti-pain power and less side effects in comparison with applied drugs in clinics. Synthesis of these derivatives is done on chloride in presence of a group of new liquids like recyclable ionic liquids choline chloride, which the main advantages of these ionic liquids are the cheapness, availability, being non-toxic, and easy recyclability. This reaction was done in four stages. All the structures were verified by using data of spectrum testing, [1]H-NMR, FT-IR.*

Keywords— naproxen, non-steroid, 4-tiazolidinon.

I. INTRODUCTION

To date, Nonsteroidal anti-inflammatory drugs (NSAIDs) are known as one of the most commonly used drugs for treatment of pain, inflammation, and fever [1]. Despite the abundant clinical usage of these types of drugs, some drawbacks including digestive and renal complications encourage scientists to design and synthesize new pain-relievers [2, 3]. In this study, we aimed the synthesize of 4-thiazolidinone derivatives from naproxen with probable analgesic and anti-inflammatory effects. The main goal is the development of new compounds with more therapeutic effects and less side-effects respect to common medications in clinics. Generally, one of the biggest problems for using of NSAIDs is their side-effects, which is mainly due to rising leukotriene levels at inhibition of cyclooxygenase enzyme and leading arachidonic acid to the lipoxygenase pathway.[4] On the other hand, generation of free oxygen derivatives such as superoxide anions through reduction of oxygen provokes producing other activate molecules like hydrogen peroxide (H_2O_2) and hydroxyl radicals. Interference with arachidonic acid causes chemotactic materials production which continues inflammation.[5,6] To diminish the side-effects of anti-inflammatory drugs, synthesis of 4-thiazolidinone heterocyclic compounds was investigated based on various reports about their anti-inflammatory effects. 4-thiazolidinone derivatives compounds show higher anti-inflammatory effects but lower side-effects than conventional drugs.[7] Implying analgesic and anti-inflammatory effects of N-aryl hydrazone naproxen in previous researches, hybrid compounds from 4-thiazolidinone and N-aryl hydrazone naproxen were developed to investigate their pharmacological studies for anti-inflammatory and pain-relieving effects as well as their digestive complications related to commonly used drugs.[9,10] These compounds were synthesized via previously reported methods and general procedures. Chemical structures of the intermediates and final products were confirmed using ^{1}HNMR, ^{13}CNMR, and IR spectroscopy.

II. EXPERIMENTAL SECTION

2.1. General Methods:

All reaction were monitored by "TLC" on pre-coated silica gel plates (60 F 254:Merck) column chromatography was performed on 100-200 mesh silica gel (SRL,India) using 10-20 fold execess (by weight) of the crude product.

IR spectra were recorded on a shimadzu FTIR 300 spectrometer in KBr pellets. Melting points were all determind by open glass capillary method on a melting point apparatus and are uncorrected. All used chemical or solvents were purchased from standard commercial suppliers (sigma Alderich and merck) and used as received without further purification. ^{1}H and ^{13}C NMR spectra were recorded on a bruker ACF-300 machine or a varian 300 or 400 MHZ spectrometer using either DMSO-d6 as a solvent with tetramethylsilane as internal refrence [11].

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2.2. Preparation of Intermediates (I)-(IV)

2.2.1. Synthesis of 2-(6-metoxy-naphthalene-2-yl) ethyl propanionate:

To a solution of 2-(6-methoxy-naphtalen-2-yl) propionic acid methyl ester (500 mg, 0.01 mol) in ethanol (20 ml) was added a few drops of conc.H_2SO_4 dropwise and the mixture was stirred at 85-90 ^oC for 12 h. After the completion of the reaction (indicated by TLC) ethanol was treated with water [12], The separated solid was filtered and dried to give the desired product as a colorless salid (yield .96%) mp 104-106 ^oC- ^{1}H-NMR (400 MHz, DMSO-d_6): δ, 7.78-7.69 (m, 3H, ArH), 7.45 (dd, J = 8.3 and 1.6 Hz, 1H), 7.25-7.24 (m. 1H), 7.13(dd, J=8.8 and 2.5 Hz,1H), 4.21(q, 2H, J=6.4 Hz), 3.86(s. 3H, OMe), 3.66 (q, 1H, J=6.4 Hz), 1.59 (d, 3H, J=5.7), 1.21 (t, 3H, J=5.9); FT-IR (KBr, cm^{-1}) 3310,3250, 2979, 2939, 1656, 1623.

2.2.2. Synthesis of 2-(2- metoxy naphtalen-6-yl)propan hydrazide:

To a solution of 2-(6-metoxy naphtalen-2-yl) propanionate (1mmol-0.23g) in ethanol (5ml) was added hydrazine hydrate (3.0 ml) with vigorous stirring at room temperature. The mixture was then stirred at 85-90 ^oC for 12h [12]. After completion of the reaction (indicated by TLC) ethanol was treated with water [12], The separated solid was filtered and dried to give the desired product as a colorless salid (yield .78%) mp 110-1112 ^oC-FT-IR (KBr) νmax (cm^{-1}): 3284 (NH), and 3093 (CH-aromatic),2998, 2971, 1672 (C=O, keton), 1489 (C=C), 1091(C-C). ^{1}HNMR (DMSO-300MHz) δ ppm: 9.99 (s, 1H, NH, D_2O exchangeable); 9.20 (s, 1H, NH, D_2O exchangeable); 7.23-7.93(m,4H, Ar-H), 7.24 (s, 1H, Ar- H), 383 (3H, s, OCH_3), 3.63(1H, q, J=5.4), 1.59 (3H, d, J= 5.85), 2.11 (s, 3H, CH_3).

2.2.3. General method for synthesis of 1-arylidene-2-(3-(6-methoxynaphthalen-2-yl) but-1-en-2-yl)hydrazine:

To a solution of 2-(2- metoxy naphtalen-6-yl)propan hydrazide (500 mg, 0.01 mol) in dichloromethan (20 ml) was added zinc chloride (0.1 g) and derivatives of aldehyde (1 mmol) and the mixture was stirred at 85-90 ^oC for 12 h. After the completion of the reaction (indicated by TLC) ethanol was treated with water [12], The separated solid was filtered and dried to give the desired product as a white solid; Yield 91%, m.p: 150-160˚C; FT-IR (KBr, cm^{-1}); 3329 (N-H), 3214 (C-H), 1680 (C=O), 1605 (C=N); 1524 (C=C);; 1242 (C-N). ^{1}HNMR (DMSO, 300MHz) δ ppm: 12.18(s, 1H, NH, brs), 7.82-8.16 (m, 4H, $H_{aromatic}$), 7.69 (s, 1H, C=CH), 6.51-7.39 (m, 4H, $H_{aromatic}$), 3.71(s, 3H, OCH_3). (Scheme 1)

2.2.4. Synthesis of 2-(6- metoxy naphtalen-2-yl)propanoil)-propamido-N-(2-hydroxy phenyl)-6-mercapto-thiazolidine-4-one:

To a solution of 1-arylidene-2-(3-(6-methoxynaphthalen-2-yl)but-1-en-2-yl)hydrazine (1mmol) in dichloromethan (5ml) and zinc chloride (0.1 g) was added 2,2-dithiopropanoic acid (1mmol) with vigorous stirring at room temperature. The mixture was then stirred at 85-90 ^oC for 6h. Yield 78%, m.p 110-120 °C. FT-IR (KBr) νmax (cm^{-1}): 3233 (NH), and 3093 (CH), 1672(C=O), 1489 (C=C), 1091(C-C), ^{1}HNMR (DMSO-300MHz) δ ppm: 9.99 (s, 1H, NH); 7.23-7.93 (m,4H, Ar-H); 7.24(s, 1H,Ar-H); 2.11-2.27(s, 3H, CH_3).

2.3. Antibacterial Activity:

To examine the antibacterial activity of some synthesized compounds, one gram negative bacteria: Escherichia Coli (ATCC, 6538). One gram positive bacteria: Staphylococcus Aureus (ATCC, 25922), were selected and tested by the disc diffusion method [15] using Mueller–Hinton Agar against. Tetracycline was used as standard. Normal saline was used for preparation of inoculants having turbidity equal to 0.5 McFarland standards. Tested compounds were dissolved in dimethyl sulfoxide (DMSO) for the preparation of stock solution. The solvent control was included, although no antibacterial activity has been noted. Culture was carried out with sterile swab and microtube suspension was cultured for 24 h and then inoculated onto Mueller Hinton agar. Blank discs with a diameter of 6 mm and containing 30 µg of the concentration of these compounds (D_3) were placed on Muller Hinton agar medium.

After 24 h incubation at 37 °C, area of growth inhibition was measured. Disks containing 10 µg of 5 dimethyl sulfoxide were used as the negative control. Each concentration was repeated 4 times for each of the bacteria and the average results of inhibitory effects are show in Table 1.

Determination of the minimum inhibitory concentration (MIC) values for some synthesized compounds against six microorganisms was carried out using disc diffusion method. In this method, concentration of 10, 20, 30, 50, 150 µg /mL were used for all bacteria per disc and there were incubated at 37 °C for 24 h. MIC value was defined as lowest concentration of compound for inhibition growth of the tested bacteria.

3. Results & discussion:

In this study in the presence of deep eutectic solvent as environmentally friendly catalyst and reaction medium, synthesize of some thiazolidine-4-one derivatives from naproxen has been discussed (scheme2). This reaction was more efficient in good yield in short time duration. Finally, after completion the reaction, that's possible to separate the

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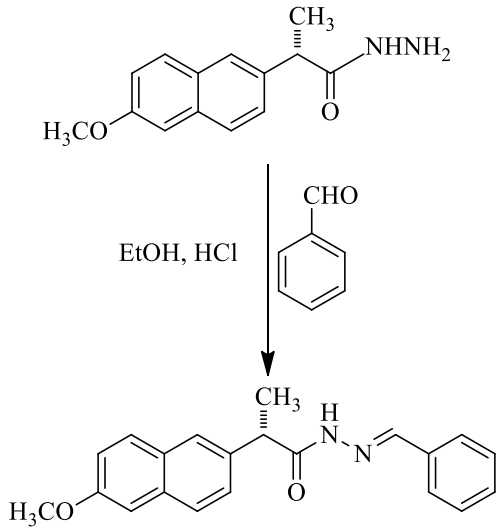
catalyst. The results led to the synthesis of 3-(2-(2- metoxy naphtalen-6-yl)propanoil)-1,3,4 tiadiazolidin-2-ones substances with possibly particular biological and medicinal properties. The structure of synthesized compounds (f-g) was confirmed by FT-IR, ^{1}H-NMR, ^{13}C-NMR spectroscopic methods. All the physical, chemical properties, IR, NMR of the compounds are reported in experimental parts. All the compounds display antibacterial effect against Gram positive bacterias, S. aureus, and E. coli Gram negative bacteria. Specifically, the synthesized compounds screened for their biological study which displayed moderate to good activity.



Scheme1: General method for the synthesis of 1-benzylidene-2-(3-(6-methoxynaphthalen-2-yl)but-1-en-2-yl)hydrazine

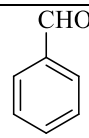
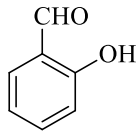
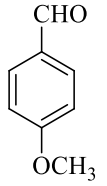
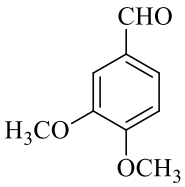
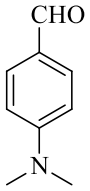
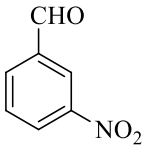
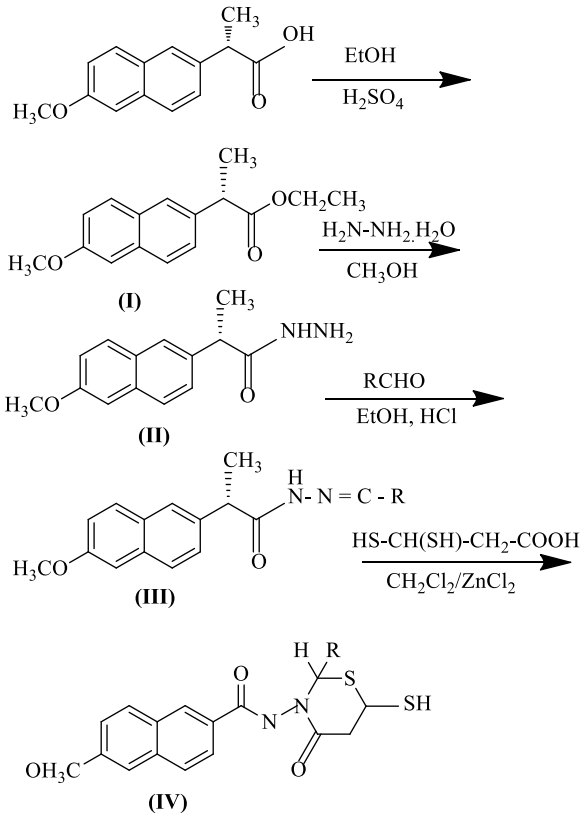
Entry	R= aldehyde	Time(hr)	*Yield (%)*	m.p(^{O}C)
1		6	95	157-159
2		3	90	182-185
3		3	70	160-162
4		4	80	170-172
5		3	40	190-193
6		3	50	200-202

Table 1. Synthesis of some 2-(6- metoxy naphtalen-2-yl)propanoil)-propamido-N-(2-hydroxy phenyl)-6-mercapto-thiazolidine-4-one with some aldehydes



R: C_6H_5, 2-OH-C_6H_4, 4-OCH_3-C_6H_4, 3,4-di-OCH_3-C_6H_3, 4-$(CH_3)_2N$-C_6H_4, 3-NO_2-C_6H_4

Scheme 2: Synthesis of some 2-(6- metoxy naphtalen-2-yl)propanoil)-propamido-N-(2-hydroxy phenyl)-6-mercapto-thiazolidine-4-one in the presence of some aldehydes

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Design, Analysis and Testing of Square Bar Welded and Bent Chasis for Indonesian Rural Transport Vehicles

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Abstract— *The chassis design has been done for rural transportation vehicles in Indonesia with welding and bending methods. The result of static analysis using ANSYS software shows that the chassis produced by the welding and bending method has the same performance if seen from bending load and torque. Likewise with the results of construction tests, welded chassis and bent chassis has a linear approaching deformation characteristic, proportional to the force load. However, the characteristic of chassis deformation of bent chassis is only linear up to 3.3 Nm load, then decreases drastically at more than 3.3 Nm of loading. In torsional tests, welded chassis and bent chassis have the same linear deformation characteristics, but the performance of the welded chassis is better than the bent chassis. Overall, ANSYS simulation and Static test results for a 250 Nm load indicates that the welding chassis and bent chassis are both still under the permitted critical conditions or it is secure against the provided loads.*

Keyword—Bending chassis, welding chasis, bending test, torsional test

I. INTRODUCTION

The frame is defined as a fabricated structural assembly that supports all functional vehicle systems. This assembly may be a single welded structure, multiple welded structures or a combination of composite and welded structures [1]. The materials used for the construction of the frame must be rigid and strong so that it can withstand shocks, bends, pressures and vibrations during operation on the road. As it is known that some of the main functions of the chassis frame are as below:

1. To carry all stationary loads attached to the chassis and load of passengers and transported goods.
2. To withstand the torque and vibrations caused by the movement of the vehicle.
3. To resist the centrifugal force that occur when the vehicle is cornering.
4. To control the vibrations that occur when the vehicle is operating.
5. To withstand the bending stress due to up and down and/or front and back axles movements.

The type of chassis that is created and analyzed is ladder frame type made by using 2 (two) methods involving welding and bending. The performance between ANSYS structure simulation and the real construction test of chassis prototype will be compared. Depending upon application of loads and their direction, chassis is deformed in respective manner briefed as follows Longitudinal Torsion, Vertical Bending, Lateral Bending, Horizontal Lozenging [2]. To calculate the structural strength, some assumptions are made which are:

1. The loads that work on the chassis are considered to be evenly distributed.
2. The welding and bending joints on the chassis are considered to be perfectly bonded.
3. The strength and deflection that occur are calculated based on the total load.

The research was conducted in order to learn the chassis production technique of rural transport vehicles, which is currently being run by the Indonesian government.

II. RELATED WORK

A. Hari Kumar CS [3] used ANSYS 14.5 Softwareis to find out best material and most suitable cross-section for an Eicher E2 TATATruck ladder frame chassis with the constraints of maximum shear stress, equivalent stress and deflection of the chassis under maximum load condition. Dhandapani Cs [4] performs a torque load analysis by providing a load on the front and the back of the dump truck chassis, diagonally vertical upward and vertical downward directional loads acts on the chassis. In this research the torque load test is performed only on the front of the chassis, by giving the load on two sides of the frame opposite, while the back of the chassis is clamped.

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To measure the torsional stiffness, Mr. Navnath V. Cs [5] used two dial indicators was used at front end to measure the opposite resultant vertical deflection at the left and right front knuckles and two at rear end. The load was added at load at the side rear right to avoid the tilting of test rig and fixed the rear part of test rig. .The chassis is twisted in increments by loading masses at load at the side front left in steps with deflection data recorded by using dial indicator at each step at front and rear side. After adding the load equal to require torque final deflection was measure and then the twist angle is reversed until reaching zero by unloading masses in steps. In this research, to know the magnitude of deformation and strain occurring on the chassis as a result of static load bending and torque, it will be measured with a strain gauge and dial indicators sensor. Placement of strain gauge sensors on chassis is done based on the critical position obtained from ansys simulation result.

III. MODEL DESIGN AND FINITE ELEMENT ANALYSIS OF CHASIS D

Taking into consideration: the strength in load support, light construction, and ease of manufacturing process; the material to be used in manufacturing chassis is Structural carbon steel SS 400 ≈ ASTM A36. The properties of this material can be seen in Table 1.

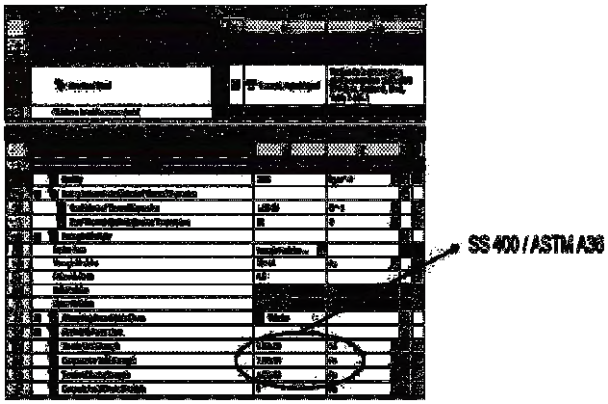

Table 1. Mechanical properties SS 400

The CAD software used for 3D modeling of chassis components (welding and bending) was CATIA. The 3D model is then exported to ANSYS software for FEM analysis.

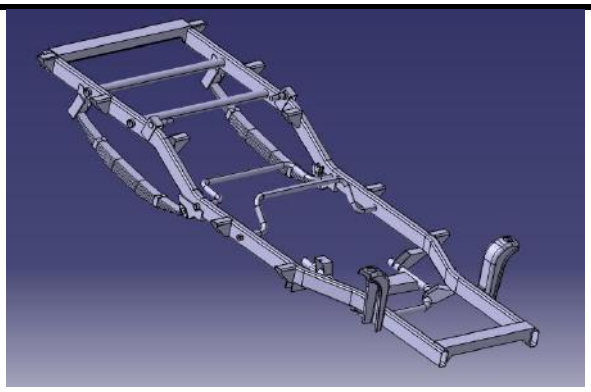

Fig.1: 3D model Chassis

3.1. Meshing and Boundary condition

The chassis is modeled as a square hollow beam element and the determination of the boundary condition is given evenly over the chassis range. For practical reasons, it is recommended that the load on the chassis frame, including its own weight should be applied at the joints (nodes) of structural members. These point loads were statistically equivalent to the actual distributed load carried by the vehicle [6]. Figure 2 shown chasis load distribution. The analysis was performed with some limitation as follows:

1. Bending load was 250 kgf or 2500 N (see area C in figure below).
2. Fixed support was on the front suspension holder area (see area B in the picture below)
3. Roll support was on the rear suspension mounting area (see area D in figure below).

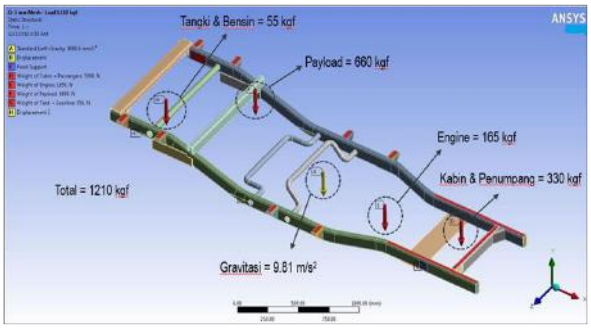

Fig.2: Chasis Load Distribution

The mesh used on the model was a combination of the tetrahedron and hexagonal. The mesh density used for welded chassis was 828,143 elements, 1,977,273 nodal, and 5,931,819 degrees of freedom, while for bent chassis was 853,764 elements, 2,033,171 nodal, and 6,099,513 degrees of freedom.

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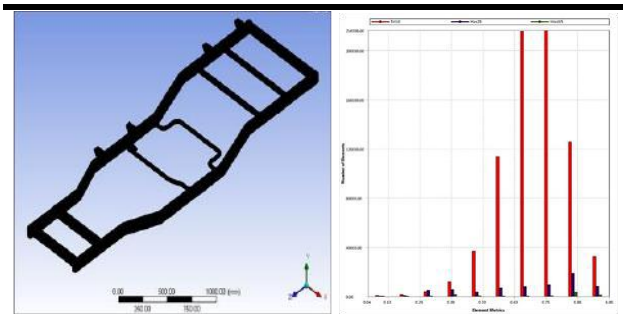

Fig.3: a. Mesh condition and quality matrix of welded chassis.

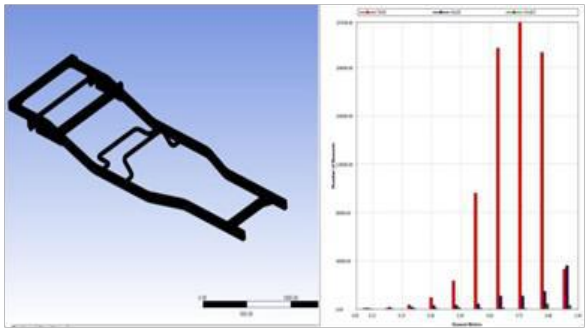

Fig.3: b. Mesh condition and quality matrix of bent chassis.

3.2. Total Deformation Analysis Due to Bending Load

The analysis results for maximum deformation on welded chassis and bent chassis with load up to 250 kg are as seen in Figure 4 and 5.

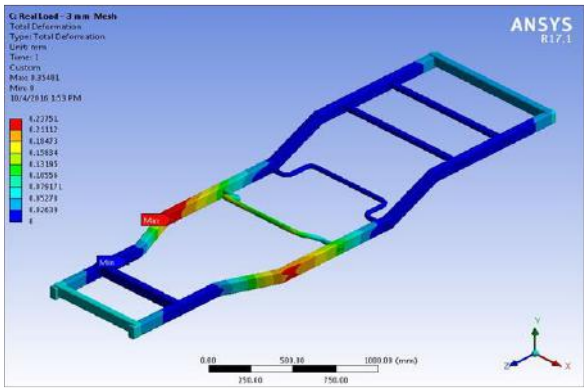

Fig.4: The result of total deformation for welded chassis

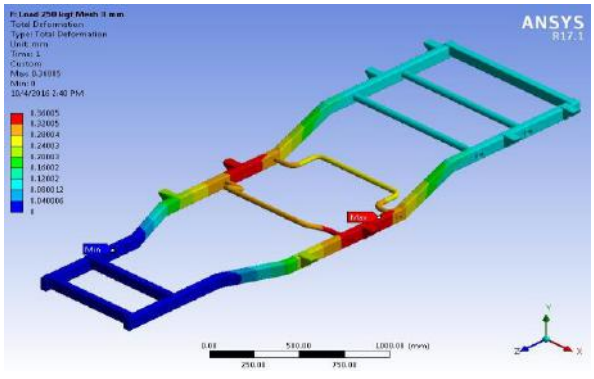

Fig.5: The result of total deformation for bent chassis

From figure 4 and 5, maximum deformation for welded chassis is 0.23751 mm, while for bent chassis is 0.36005 mm.

3.3. Equivalent Stress Analysis

Based on figures 6 and 7, the maximum equivalent stress obtained for the welded chassis is 110.97 MPa. While for the bent chassis is 66.681 MPa.

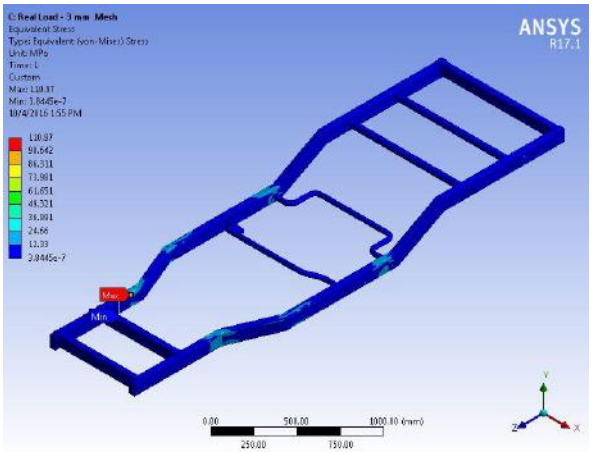

Fig.6: The result of equivalent stress for welded chassis

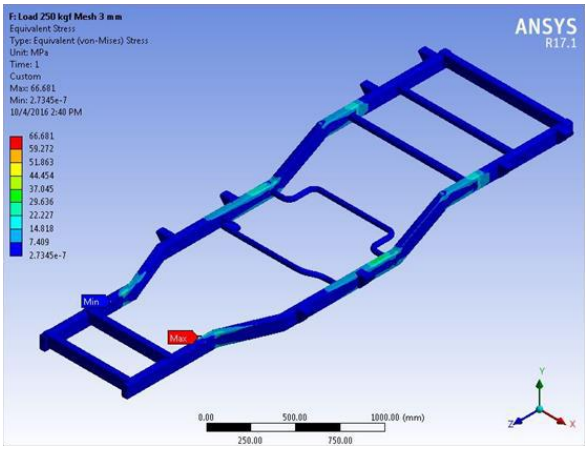

Fig.7: The result of equivalent stress for bent chassis

The ANSYS analysis of Welded and Bent chassis can be seen in Table 4.

Tabel. 2 ANSYS Bending load analysis

No.	Description	Welded Chassis (W)	Bent Chassis (B)
1	Load	250 kgf	250 kgf
2	Meshing		
	- Density	828,143	853,764
	- Nodes	1,977,273	2,033,171
	- Degree of freedom	5,931,819	6,099,513

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3	Maximum Total Deformation	0.2375 mm	0.3600 mm
4	Maximum Equivalent Stress	110.97 Mpa	66.68 MPa

3.4. Deformation Analysis Due to Torque Load

The torque load is given at the front end of the chassis frame in opposite directions (up and down by 250 Kgf) The analysis results with ANSYS software is shown in Figure 8 and Figure 9.

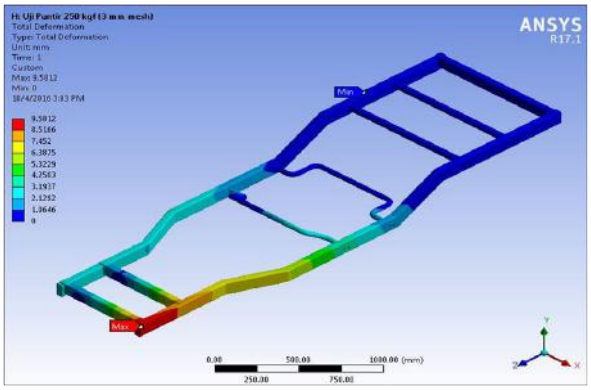

Fig.8: The result of total deformation for welded chassis due to torque load

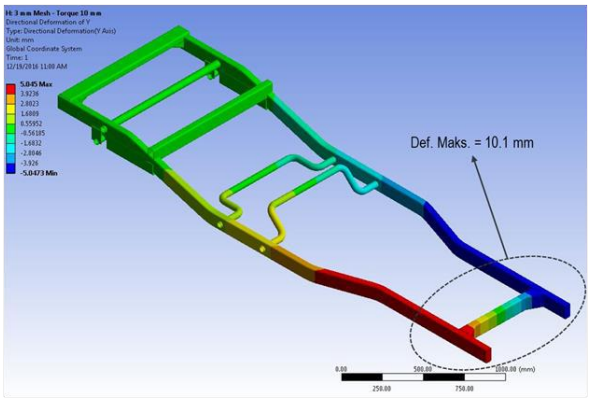

Fig.9: The result of total deformation for bent chassis due to torque load

From Figures 8 and 9, it can be concluded that the maximum total deformation due to torque load for the welded chassis is 9.5812 mm. while for the bent chassis is 10,090 mm.

The ANSYS results of Welded and Bent chassis due to torque load can be seen in Table 5.

Table.3: ANSYS Torque load analysis

No.	Description	Welded Chassis (W)	Bent Chassis (B)
1	Load	250 kgf	250 kgf
2	Meshing		
	- Density	828,143	853,764
	- Nodes	1,977,273	2,033,171
	- Degree of freedom	5,931,819	6,099,513
3	Maximum Total Deformation	9.5812 mm	10.0900 mm

From the analysis result of bending load, it can be concluded that the performance of welded chassis is equivalent with bent chassis. Similarly, for the torque load, the performance of welded chassis is also equivalent with bent chassis. This can be seen from the maximum total deformation value of both chassis is not so much in different.

IV. CONTRUCTION TEST OF PROTOTYPE CHASIS

The prototype chassis construction testing is intended to compare and verify the design and simulation results with its real condition. The test was performed in the same condition with the simulation, by providing static load (bending) and torque load on the chassis construction.

To know the amount of strain that occured, strain gauges were mounted at some critical areas of chassis which location was determined from ANSYS analysis result. While the magnitude of deformation was measured by placing two dial indicators under the loading position (hydroulic). The position of the strain gauge sensors and the dial indicators can be seen in Figure 10.

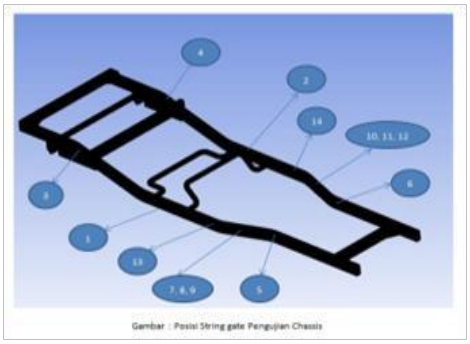

Fig.10: The Position of strain gauge sensors on the chassis

4.1. The Bending Test of Welded and Bent Chassis

The bending load was applied on the center of the chassis or at the Center of Gravity (CoG) position of the vehicle, with a deformation limit of 2.5 mm. The test configuration can be seen in Figures 11 and 12. The strain and deformation values that occurred were recorded with the data record equipment as shown in Figure 13. The test results then plotted in graphic of load versus deformation that can be seen in Figure 14.

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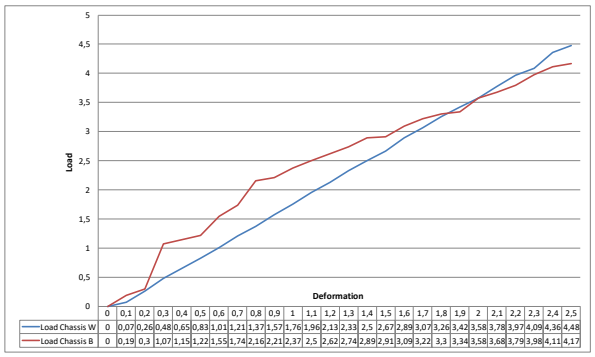
Fig.11: Bending test on welded chassis

Fig.12: Bending test on bent chassis

Fig.13: Data loger / recorder



	0	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	2	2,1	2,2	2,3	2,4	2,5
Load Chassis W	0	0,07	0,26	0,48	0,65	0,83	1,01	1,21	1,37	1,57	1,76	1,96	2,13	2,33	2,5	2,67	2,89	3,07	3,26	3,42	3,58	3,78	3,97	4,09	4,36	4,48
Load Chassis B	0	0,19	0,3	1,07	1,15	1,22	1,55	1,74	2,16	2,21	2,37	2,5	2,62	2,74	2,89	2,91	3,09	3,22	3,3	3,34	3,58	3,68	3,79	3,98	4,11	4,17

Fig.14: Bending Test Graph of load versus deformation

4.2. The Torque Test of Welded and Bent Chassis

In torque test, the position of the strain gauge sensors were the same as the bending test, but the dial indicators position were moved to the under of torque load. The torque load was applied on the front side of the chassis, with a deformation limit of 6 mm. Figures 15 and 16 shown the torque test process. The test results then plotted in graphic of load versus deformation that can be seen in Figure 17.

Fig.15: Torque test on welded chassis

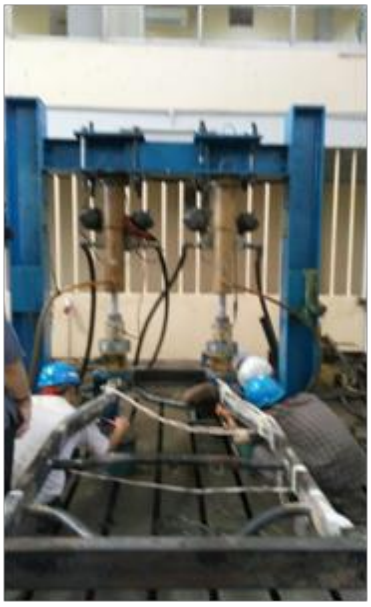
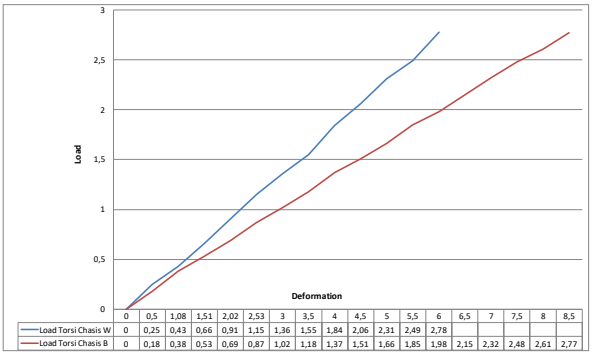


Fig.16: Torque test on bent chassis



	0	0,5	1,08	1,51	2,02	2,53	3	3,5	4	4,5	5	5,5	6	6,5	7	7,5	8	8,5
Load Torsi Chasis W	0	0,25	0,43	0,66	0,91	1,15	1,36	1,55	1,84	2,06	2,31	2,49	2,78					
Load Torsi Chasis B	0	0,18	0,38	0,53	0,69	0,87	1,02	1,18	1,37	1,51	1,66	1,85	1,98	2,15	2,32	2,48	2,61	2,77

Fig.17: Torque Test Graph of load versus deformation

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4.3. Test Result Analysis

Based on the above test results, can be obtained information as follows:

1. For the bending test, the deformation took place on both welded and bent chassis has linear characteristics.
2. Based on the graph, at a force level less than 3.3 kN, the deformations happened on bent chassis had a lower value than welded chassis, but at a force level greater than 3.3 kN, the deformations received by welded chassis had a lower value than bent chassis.
3. For the torque test, the deformation occurred on both chassis was linear and increased proportionally to the load increment. Nevertheless, the performance of welded chassis was better than bent chassis.

V. CONCLUSION

Based on the results of finite elements analysis and construction test of the prototype chassis, can be concluded that:

a. The FEM analysis result with 250 kgf bending load has shown that the welded chassis had less total maximum deformation value (0.2375 mm) than bent chassis (0.351 mm).
b. The FEM analysis result with 250 kgf torque load has shown that the welded chassis had less total maximum deformation value (9.6 mm) than bent chassis (10.09 mm).
c. Both welded and bent chassis are still safe against given loads and boundary conditions, according to the result from FEM analysis and construction test.
d. The decreasing of bent chassis performance at force level above 3.3 kN in the construction test was allegedly due to microstructural change developed during hot bending process. The structural, fatigue, and wear strength were affected by this heat exposure.

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Sustainability Assessment Method GEITEC: An interdisciplinary technology based on the Theory U

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Abstract— *This paper aims to develop a method for assessing the sustainability of sustainable use units through indicators. The specific objectives are to identify the characteristics of sustainability assessment criteria in Extractive Reserves (1), to elaborate a method for sustainability evaluation to those Extractive Reserves (2) and to develop a critical analysis bout the efficiency of the proposed method (3). The focus on Theory U, present in the work, allows an adequate operational interpretation about the use of indicators for the evaluation of sustainability. As a result, the GEITEC Method of Sustainability Endogenous Assessment was elaborated, in which the logical convergence of the object searched was pointed out. In this way, it presents the alignment of the academy, through strictosensu programs, in a search for means that guide appropriate technologies to be applied, not only as a phatic interpretation, but also to support actions to benefit the environment, to the social that should be adequately protected, to the economy in view of its importance for endogenous development and to the organizational structures that must be managed with skill for the success of the common interest. This research is a contribution to those involved in decisions related to sustainability.*

Keywords—Assessment method; Sustainability; Extractive Reserves.

I. INTRODUCTION

The discussion addressed in this article deals with the management of sustainability in Brazilian Conservation Units, specifically in the category of Extractive Reserves (RESEX), questioning the viability of the considered evaluation parameters for the people quality of life residing in these areas. In the specific case of RESEX, the economic production is based on traditional extractivism, combining precarious level of technologies, rural labor and low remuneration, resulting in an inefficient development model. The absence of modern ways of production results in significant difficulties to the population established there and their socioeconomic condition, even if there is an abundance of raw material offered from nature. These requirements provide the understanding necessary for the initiation of an in-depth investigation.

II. OBJECTIVES

In the Brazilian context, Conservation Units represent territorial space and its environmental resources, including jurisdictional waters, that should promote sustainable development though conservation of natural resources. Those areas have as main purpose to protect the natural resources necessary for subsistence of the traditional populations, respecting and valuing their knowledge, their culture and fomenting them socially and economically. The academy contributes with technology to manage natural resources and to qualify environmental services to

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be managed by individuals. So, This paper aims to develop a method for assessing the sustainability of Sustainable Use Units through indicators. The specific objectives are to identify the characteristics of sustainability assessment criteria in Extractive Reserves (1), to elaborate a method for sustainability evaluation to those Extractive Reserves (2) and to develop a critical analysis bout the efficiency of the proposed method (3).

III. THEORETICAL BACKGROUND

The literature review involves a theoretical-empirical approach or theme which identifies and constitutes a doctrinal framework to support a research work. It strengthens the discussion, guarantees the results related to the facts, phenomena or processes. Literature review is an effect of a bibliographical research, whose essence is the selection of themes, reading the contents, sorting the pertinent elements, analyzing their contents and criticizing their usefulness. This section is structured in subtopics and deal with assessment of sustainability, U Theory and conservation units in the Brazilian context.

3.1 Sustainability Assessment

The studied subject is the sustainability assessment of conservation units for sustainable use. In order to make possible the analyze was adopted as reference the conception that every conservation unit is a set of elements that needs management to reach its ends in an organizational perspective.

The sustainability analysis of conservation units has significant changed in terms of social participation, dynamics of the economy and the need to protect the environment, inserting these aspects in the normative context, or even under the perspective of social forces in the resources management. The literature indicates that in the elaboration of sustainability assessment methods is fundamental to solve the aggregation of indicators, since it is necessary to contemplate different dimensions, as Figure 1 presents.

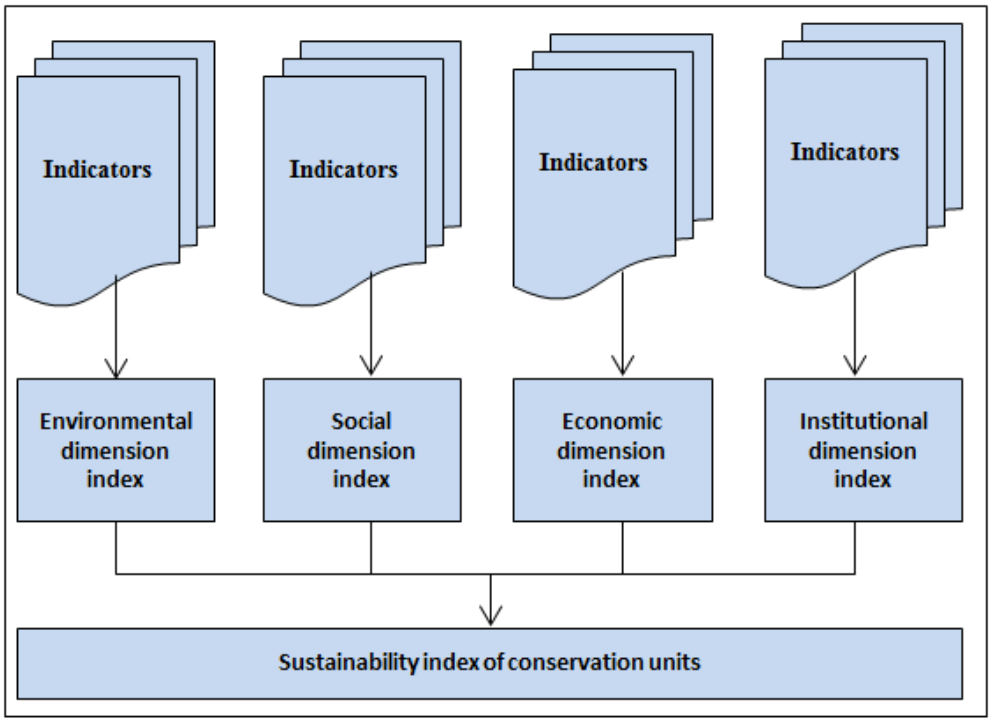

Fig.1: Diagram of indicators applicability
Source: adapted from IBGE (2012)

In order to the relationship among indicators occur in a logic system, it's necessary they have a uniform measure configuration that allows the relation analysis. In this context there is a severe difficulty in establishing criteria for the aggregation of indicators. Thus, according to Siche (2007), there is no possibility to be sustainable considering only one or two indicators that refer to a single aspect of the system, which commonly falls within the environmental perspective.

Indicators of IBGE allow monitoring the sustainability of Brazilian development standard in the environmental, social, economic and institutional dimensions, providing a comprehensive information overview to support policy decisions for sustainable development. In general terms, they measure environmental quality, population quality of life, economic performance and governance for sustainable development in biodiversity, sanitation, freshwater, health, education, safety, production and consumption patterns, and institutional capacity, among other aspects. The matrix

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of relationships between the different indicators facilitates an overall view, necessary for the understanding of this complex and multidimensional theme (IBGE, 2012).

3.2 Theory U

In the context discussed by Tinti (2014), Theory U can be a reference for the solution in a path of a new paradigm for conservation units. This could begin with the reflection on reality aligned with the evaluations that enable, through their leaderships, the adjustments required for integrated and sustainable local development. Theory U focuses on a management method for change, aiming the leadership in a process of innovation through social knowledge. The theoretical design is clear in three essential approaches to its validation: the answer to questions about what to do, how to do and what to do. The theoretical reading makes it possible to understand its applicability in the systematization of practices such as those involving the use of indicators for evaluation of sustainability in conservation units.

In order to face the current complex conceptual state in which conservation units are inserted, the individuals involved with this areas need to uncover and treat their blind spot, and rediscover how to do, what to do, and especially what to do. The first step is to establish indicators for evaluation, and later to take the management adaptations that meet the reflection of why doing management in conservation units. This process of unfolding is already foreseen in Scharmer (2010). According to the author, organizational leaders face levels of complexity. It is evident at present a systematic distance in the causal relation, which results in temporal acts without considering future effects. On the other hand social complexity is a product of diverse interests and conceptions of those involved. And a third way would be the emerging complexity where challenges are concentrated in the face of known problems. Figure 2 shows the components of Theory U and Table 1 their respective details.

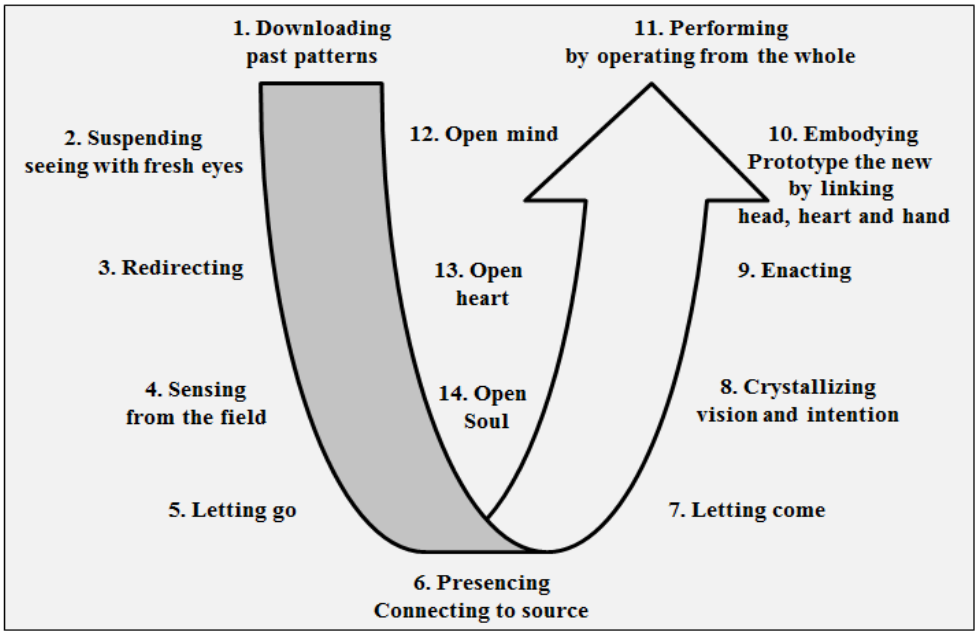

Fig.2: Theory U in a diagram of managerial perspective
Source: Adapted by the authors from Scharmer (2010)

Table.1: Operational perspective of Theory U specifications

Items	Specifications
Theory U	Theory that induces reflection about what to do, how to do, and especially why to do.
1. Downloading	Analysis of the adopted paradigms.
2. Suspending	To observe the environment to question reality beyond your own vision.
3. Redirecting	To look to the system from the outside and realize how your own actions contribute to the ecosystem.
4. Sensing	To feel the system dynamics and its contribuition to the ecosystem.
5. Letting go	To detach from current patterns and seek new paradigms.
6. Presencing	To unlearn and learn again.
7. Letting come	To assimilate the intention of the new paradigms.

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Items	Specifications
8. Crystallizing	To consolidate the vision and intent of new paradigms.
9. Enacting	To materialize the practices of new paradigms.
10. Embodying	To compromise with the future that emerged through new practices
11. Performing	To realize the desire and multiple interests of those involved.

Source: Adapted by the authors from Scharmer (2010)

In view of the above considerations, the conceptions about structural models and organizational strategies are always seeking the ideal way of development so they are inserted in the environment in order to perpetuate. These models and strategies shape the theories that define the directions of decision-making.

3.3 Conservation Units in the Brazilian Context

Brazil has established several public policies to reduce environmental impacts using education and inspection, such as the National System of Conservation Units. According to Milaré (2011), although protected areas exist since 1937, only the National Environmental Policy did it possible to erect a grouping of conservation units, even if they were casuistically and without a proper direction, always managed with few resources and without a defined public action of environmental policy. Obviously, such imprecise circumstances make difficult to achieve the purpose proposed for such units. In this period of historical evolution of conservation units in Brazil, processors of the 1988 Constitution were designated only to launch the challenge of regulation of what has been termed as specially protected territorial spaces. However in the edition of Law 9.985/2000 the National System of Nature Conservation Units was instituted.

Conservation Units represent territorial space and its environmental resources including jurisdictional waters. It must promote sustainable development of natural resources by practicing nature conservation. Its main purpose is to protect the natural resources necessary for subsistence of traditional populations, respecting and valuing their knowledge and culture, and promoting it socially and economically. Those areas are structures for solutions of maintenance and balance in the system of economic, environmental, social and institutional development; and like any other organization they must be sustainable.

The conservation units of sustainable use are part of a system where they have the function of contributing to the balance of the environmental, economic, social and institutional relationship, as well as to sustainability. However, the mere institutional existence with administrative structure of the conservation unit does not give them sufficient attributes to characterize as sustainable. In order to assign such quality, mechanisms are needed that allow the minimization of their references in the ecosystem paradigm.

For a conservation unit to be sustainable, it is necessary to integrate the different dimensions of the context they were created for. As these dimensions are dynamic, they influence and are influenced by social pressures. Because of this, it's necessary to construct capable assessment methodologies to monitor the sustainability in order to achieve the goals and objectives proposed in their creation. Miguel (2007) indicates that conservation units are structures with sufficient resources available for production and commercialization, since the physical-biotic formation represents an important natural heritage that can be understood in two different perspectives. The first to be configured in an ecosystem complex relevant to the global environment, and the second is the possibility of using the environmental resources in a sustainable way. These resources can be applied as surplus, without prejudice to the natural environment. However, the classic management model for these structures has predominantly adopted a conception focused on the environmental dimension. This way, the norm admits the existence of people, equipment of use, productive force, solidary economies and other required ways of subsistence.

IV. METHODOLOGY

This research aims to study assessment methods in conservation units, specially the category of Extractive Reserve of Sustainable Use. In this research the variables considered came from recurrent complexities to understand the social problem in study. The data treatment follows the operationalization from prevalence, analysis, critique, benchmark test, solutions of asymmetries, among other situations common to the method. It should be noted that, in order to comply with the prevalence criterion, the tabulation and the demonstration are significant elements when analyzing the data. It was used the software excel and its supplement Solver in data statistical analysis which made it possible to perform complex calculations and visualize results. The methodology describes the various processes or tools used to sustainability assessment. The methodology and procedures required are shown in Figure 3 and Table 2.

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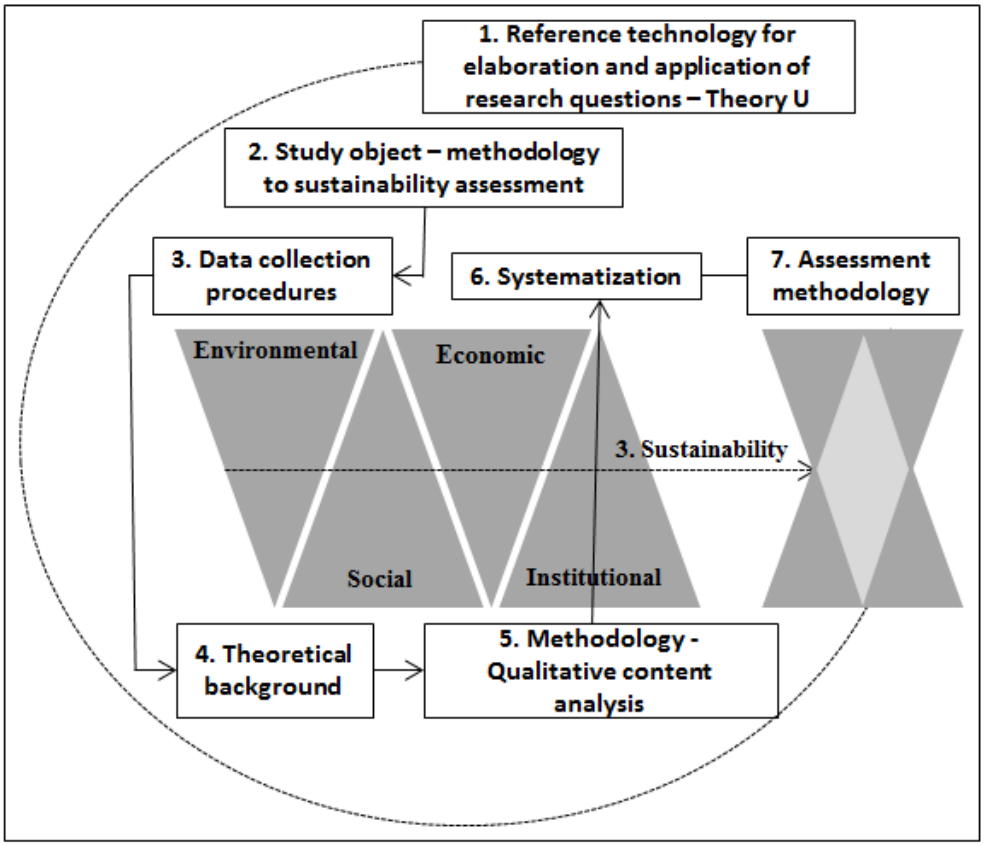

Fig.3: Methodology diagram
Source: Adapted by the authors from Pedro Filho et al (2014)

Table.2: Methodology diagram specifications

Items	Specifications
1. Theory U	Theory that induces reflection about what to do, how to do, and especially why to do
2. Study object	Researched phenomenon to search for an answer or description
3. Procedures and data collection	Phase of the research that guides the processes in time, form and criteria of selection of variables to be considered in the research.
4. Theoretical background	Concepts that will be supported in the standardization of the solution
5. Method	Group of procedures to be followed in search to the answer of the research problem
6. Systematization	Consistent organization of procedures to answer the research question.
7. Assessment methodology	Proposal considered as hypothesis of the study

Source: Adapted by the author from Pedro Filho et al (2014)

V. RESULTS

The scenario where the research intervention occurred was defined in the methodological scope. Thus, technical visits were done at Rio Ouro Preto Extractive Reserves in the Municipality of GuajaráMirim (A), at Lago do Cuniã in the Municipality of Porto Velho (B) and at Ouro Preto - Jacundá RESEX in the Municipality of Machadinho do Oeste (C), all in the State of Rondônia, Brazil, as can be seen in Figure 4.

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Fig.4: Research Locus

Source: Adapted by the authors from Medrado, et al. (2014)

5.1 Characteristics Identification for Sustainability Assessment

The first characteristic indicates the environment with natural and unnatural attributes. The second characteristic concerns the social aspect indicating relations and norms capable of limiting the behavior in face of other dimensions. The third characteristic is the economic dimension which enables the consumption of natural goods for the satisfaction and survival of humanity from their consumption demands. The fourth characteristic is the institutional dimension that composes the various institutions that regulate environmental, economic and social relations, seeking the best efficiency use of natural resources. The characteristics were presented according to the four dimensions of sustainability, as can be seen in Figure 5 and Table 3 in below.

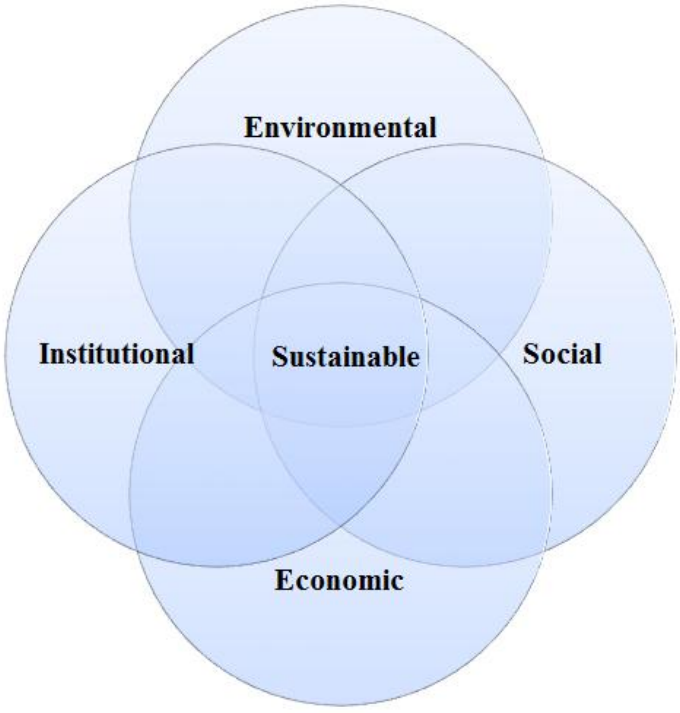

Fig.5: Basic paradigm diagram

Source: Adapted by the authors from IBGE (2012)

Table.3: Basic Paradigm Diagram Specifications.

Items	Specifications
1. Environmental	Elements of quality of life patterns to maintenance for present and future generations, involving the use of natural resources.
2. Social	Elements of social justice, satisfaction of human needs and improvement of the quality of life linked to equity and living conditions of the population.
3. Economic	Elements of production and consumption related waste, use of natural resources and energy.
4. Institutional	Elements of political positioning of the sectors and capacity to implement changes for sustainable development through new technologies

Source: Adapted by the authors from IBGE (2012)

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These methodological criteria allow monitoring the sustainability of the Brazilian development standard in the environmental, social, economic and institutional dimensions. They provide a comprehensive information overview that supports policy decisions in sustainable development. In general terms, they measure environmental quality, population quality of life, economic performance and governance for sustainable development in biodiversity, sanitation, freshwater, health, education, safety, production and consumption patterns, and institutional capacity, and other aspects.

The changes in the RESEX's scenarios are driven by the management of social actors, especially local residents, who are take decisions about their reality. It is possible to affirm that support for decisions, even at the local level, emerges from theories, tools and practices that assist leaders and organizations in coping with social problems. Here the actions sculpted in new ideas, which add to the quality of the critics of the social actors involved in the relation of the local issues emerge. This pathway demonstrated in this research would be the most adequate, not only for reflection, but also for the necessary endogeny. So, it is characterized the material sequence proposed by Theory U, as learning, collective dynamics, reflection on the state of order, and other logical attributes that are supported in that theoretical approach.

In the researched scenario was registered that residents and stakeholders face circumstances that demand decisions in varying degrees of importance. These decisions do not sufficiently include the required solutions, since they will always be influenced by contemporary paradigms. In addition, it will be necessary to consider the behavioral dynamics differentiated of the resident in the RESEX's in face of its culture, tradition and experience that delineate each moment of the cognitive process in the paradigm of the sustainability.

A simple request from a stakeholder to access the RESEX is already sufficient reason for a decision. This is because the formal requirements for such a procedure are considered. The counter-raid would be an affront to the pre-established criteria necessary for local maintenance. In this way, both residents and stakeholders should due to the need for attention to the sustainability paradigm, adopt organizational criteria capable of leading to sustainability efficiency.

The technical visits at the studied RESEX's allowed to identify that residents adopt well-delineated procedures in Theory U. The contemplative self-inquiry presupposed in that approach, such as what to do, how to do and why to do it was sufficiently revealed, as abstracted from obtained, and that they constitute the collection collected in this investigative task. Concluding this subtopic of this paper, the operative demonstration of Theory U is inserted here. These criteria are consonant with the formal logical values of the RESEX that is configured as an organization of these traditional peoples.

5.2 Assessment Method Construction

The proposed method, called GEITEC Sustainability Assessment Method, is based on qualitative and quantitative verification. Initially, quantitative indicators were collected from official publications offered by IBGE. In a second phase, the perceptions of residents and stakeholders were collected. In the third phase, the perceptions collected were qualitatively described and, in order to make possible their composition in the GEITEC Sustainability Index identification system, it was necessary to transform it into an indicator, which is solved by mathematical operation with its division by the base 100. The formulation mathematics of the GEITEC Index of Endogenous Sustainability Assessment is demonstrated using the following formula.

$$\boldsymbol{GEITEC\ Index} = \frac{\left(\sum_{i=1}^{20} \boldsymbol{IA_i} * \boldsymbol{RA_i} + \sum_{i=21}^{41} \boldsymbol{IS_i} * \boldsymbol{RS_i} + \sum_{i=42}^{53} \boldsymbol{IE_i} * \boldsymbol{RE_i} + \sum_{i=54}^{62} \boldsymbol{II_i} * \boldsymbol{RI_i}\right) * \mathbf{100}}{\mathbf{4}}$$

In which:

IA_i represents the values in percentages of the perception indicators of environmental *dimension.*

RA_i represents the values in percentages of the environmental dimension indicators extracted from the Relationship Matrix prepared by IBGE.

IS_i represents the values in percentages of the indicators of the perception of the social dimension.

RS_i represents the percentages of the social dimension indicators extracted from the Relationship Matrix prepared by IBGE.

IE_i represents the values in percentages of the perception indicators of economic dimension.

RE_i represents the percentage values of the economic dimension indicators extracted from the Relationship Matrix prepared by IBGE.

II_i represents the values in percentage of the perception indicators of institutional dimension.

RI_i represents the percentage values of the institutional dimension indicators extracted from the Relationship Matrix prepared by IBGE.

The formulation has a real divisor of four. The value of the divisor represents the amount of dimensions entered in the proposed model that are environmental, social, economic and institutional. The method adopts the paradigm proposed by UN (United Nations) that is adopted by IBGE in Brazil, which implies the divisor of this model can contain any number of dimensions, and only have to keep a mathematical relationship that makes it possible to infer the index to be evidenced. The Table 4 indicates the possibilities of indices for the degree of sustainability resulting from the calculation using the formula above.

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Table.4: Index range by level of sustainability

Index	Level of sustainability
≤ 0,0≤ 0,25	Unsustainable
≤ 0,26≤ 0,5	Insufficiently sustainable
≤ 0,51≤ 0,75	Sustainable
≤ 0,76≤ 1	Very sustainable

Source: elaborated by the authors

Considering Table 3, note that the four indexes together complete the totality of 100% of the percentage of levels of sustainability. In these conditions, there is a minimum percentage for a credible sustainability which allows to assign as relevant a percentage above the average until a suit of this totality with being sustainable. Below this percentage there is an insufficient metric until unsustainable; above this same metric will be more than sustainable.

The endogeny enters this mathematical model with the measurement of the stakeholder's perception on the intensity of sustainability of each indicator proposed by the UN/IBGE as considered in this research. This perception was measured by the Likert Scale. An average of the sample surveyed was inferred to each dimension and the individual number of indicators of these dimensions was also considered. This procedure was also adopted to infer the average indicator of each dimension proposed by the UN/IBGE; the endogeny in this model is in the approximation of published national indices; in this calculation a cross-check was made between the two listings; this crossing allowed us to find the new index of sustainability, which is now considered as ideal in terms of the assessment in the context of the Endogenous Development prescribed in this research.

These variables will take the values 1 if the indicator is selected or 0 if it is not selected. The environmental dimension is represented by $A_i,\ i = 1, 2, \cdots, 20$; the social dimension is represented by $S_i,\ i = 21, 22, \cdots, 41$; the economic dimension is represented by $E_i,\ i = 42, 43, \cdots, 53$; and the institional dimension is represented by $I_i,\ i = 54, 55, \cdots, 62$.

For the interconnection of the variables in their operability, the decision maker will need a logical function that indicates the efficiency in the matrix relationship evidenced, as well as to measure proportionality in the application of financial resources in RESEX among other measurements. Thus, we propose the objective function (FO), which is defined here as the sum of all variables.

$$FO = \sum A_i + \sum S_i + \sum E_i + \sum I_i$$

The objective function defines the minimum number of variables necessary to reach all the indicators of the dimensions. This is because an indicator can infer from one or more other indicators. The constraints for the indicators are represented by the expressions:

$$C_j = \sum_{j=1}^{20} A_i M_{ij} + \sum_{j=21}^{41} S_i M_{ij} + \sum_{j=42}^{53} E_i M_{ij} + \sum_{j=54}^{62} I_i M_{ij} \geq 1$$

In which $A \geq 1;\quad S \geq 1;\quad E \geq 1;\quad I \geq 1$ represents the Matrix of Relationship between the indicators adapted to the model by the authors. The element $C_j \geq 1$ means that each indicator must be reached at least once in the relationship with selected variables. The constraints for the indicators are represented by the expressions:

$$A = \sum_{j=1}^{20} A_i \geq 1;\quad S = \sum_{j=21}^{41} S_i \geq 1;\quad E = \sum_{j=42}^{53} E_i \geq 1;\quad I = \sum_{j=54}^{62} I_i \geq 1$$

In which A≥1; S≥1; E≥1; I≥1 means that for each dimension of sustainability at least one indicator must have been selected. This restriction can be modified according to the model of the decision maker. For the solution of the model described above, the Solver Excel software supplement was used. The decision maker, when verifying the index proposed by the GEITEC Method is indicating low sustainability of the researched scenario, might use the indicators of the mathematical model outlined here. In this way, it will define the area indicated in the variables where it will apply the resources, focusing on absorption of the positive reflection in the application of the projected resources. This providence implies in the logic of the relationship matrix that supports this synergistic effect. means that for each dimension of sustainability at least one indicator must have been selected. This restriction can be modified according to the model of the decision maker. For the solution of the model described above, the Solver Excel software supplement was used. The decision maker, when verifying the index proposed by the GEITEC Method is indicating low sustainability of the researched scenario, might use the indicators of the mathematical model outlined here. In this way, it will define the area indicated in the variables where it will apply the resources, focusing on absorption of the positive reflection in the application of the projected resources. This providence implies in the logic of the relationship matrix that supports this synergistic effect.

The GEITEC Endogenous Sustainability Assessment Method is a tool that can help managers of environmental resources. It provides support in the measurement of other systems that have sustainability indicators as a variable. The methodology is an auxiliary as a factor of endogeny, since it infers in values contained in the perception of the social actor, evidencing his interest in interventions directly related to his life goals.

5.3 Critical analysis of the model efficiency

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The research on RESEX's indicates that each resident is a manager with shared responsibility, while their actions depend on a set of other activities that reflect the objectives of RESEX. This way the local actors reflect about organizational adhesion clearly exposes the phenomenon studied and proves the fundamentals of Theory U.

With the new way of residents thinking, it was possible to maintain the stability in the RESEX area, since the construction of organizational system became a necessary element, starting to operate the structures of entry, processing and exits. The new attitude reflected directly on stakeholder attitudes. These have come to adhere to the thinking and manner of acting irradiated by the leaders and subjects of the RESEX, operating significant changes in the local scenario that culminated with operational regulations of conservation unit maintenance where it is possible, for example, to understand the capacity of individuals who may be present at the same time in the RESEX, assuming no more than the number accepted as being bearable by nature.

This number of visitors, carefully studied and delimited by residents indicates, for example, indicates a control over the quantity and type of vessels that can concomitantly navigate the lakes and rivers. This way, residents understand that the backwaters arising from the impact of the barges can be supported by the vegetation and soil from the shore. It remains evident that the conversions of thought congregate the constellations of stakeholders modeling a future in the collective. In this way, the innovation promulgated by the attitude of the residents operating the organization is able to emerge ideas that take shape and develop to integrate to the paradigm of sustainability.

The residents' practice integrated with the use of RESEX resources is oriented towards the evolution of governance. The sense is to make ecosystemic consciousness emerge, evidencing the innovation of reflexive thinking, in order to process the resources contained in the dimensions of sustainability.

VI. CONCLUSION

This research has its theoretical foundation in the organizational theories to configure innovation in RESEX in favor of sustainability. The scenario investigated is located in the conservation units of sustainable use Extractive Reserves. These units represent an important system of environmental protection, but there is a clear lack of efficient methods that can demonstrate their sustainability, especially methods that can be applied as a management tool for the application of resources in the most diverse sectors of society.

The Brazilian reality in general, and in particular in the Amazon indicates that the sustainability indicators do not reach the perspectives of the citizens that somehow have interests in this relation. Thus, in the euphoria to find a method of evaluation through indicators, we seek to rely on those offered by the United Nations Organization incorporated by the Brazilian Institute of Geography and Statistics.

It is through the search for the elimination of vices like this that serious studies are promoted for the methodological and technical convergence, in support of the decision for the endogenous development of the communities established in Extractive Reserves.

The support of Theory U allowed not only the adequate operational interpretation of the management method to the changes, in the route required by the leaderships; also made aware of the process of innovation from the social knowledge, the questions about what to do, how to do and why to do; and allows to understand the use of indicators to the assessment of sustainability, considering the cognitive trade off of information of reality.

In response to the research problem, it is possible to state technically and scientifically that the GEITEC Method of Endogenous Sustainability Assessment is adequate to what is provided, since the usual methods, which rely on indicators hitherto known and pointed out in this document, do not reach the perspectives, since they are alien to the reality of the context. Therefore, the contribution of the GEITEC Method of Endogenous Sustainability Assessment comes as an essential solution, pondering the state of order, promoting equity, and directed to efficiency by the satisfaction of stakeholders, thus serving as the benchmark in sustainability measurements. In the method concluded here it is possible to infer, from the relationship matrix of the indicators, an incidental logical coalition of one indicator that affects others, combining synergic efficiency over the others.

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Diagnostic pro-innovation methodology for socio-environmental responsible organizations

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Abstract— *Organizational managers seek to align their strategies in order to keep their business in the competitive environment. This qualitative research is based on the Theory of Planned Behavior, the concepts of innovation and other related required. The expectation of this task is to interpret the client's perception as a driver for the innovation required in the operating system of supermarkets in the city of Porto Velho, capital of Rondonia State, Brazil. It has as main objective to develop a valid methodology to the monitoring of change required in the face of the behavior of the consumer. For this, specific objectives are required: Identify the elements of innovation that promote changes in the behavior of the consumer (1), describe the innovations perceived by the consumers in organizations socially and environmentally responsible (2), and develop a methodology to diagnose the organizational innovation (3). It was adopted the Case Study Method, with bibliographic research, focus groups, questionnaires, data tabulation, analysis and critique of the content and preparation of the results obtained. As an additional instrument was used the Table Likert in the measurement of five options, in order to understand the satisfaction of the respondent. The research shows that supermarkets satisfy the purchase item, but that the organization needs to focus on four elements to improve their performance; when considering these elements forward the strategic functional activities, it is possible to identify the challenges of innovation focused on the excellence of the organization's operating system; the methodology proposes the performing of diagnostic processes that drive the innovation processes for an efficient and effective strategic performance in organizations dedicated to the customer. It is expected to recognize the consumer's perception and, based on this parameters, guide the processes of innovation strategically. This study is a contribution to organizations seeking competitive advantage through continuous innovation focused on the customer.*

Keywords— Amazon. Innovation. Environmental Management. Methodology. Sustainability.

I. INTRODUCTION

The strategic management practices in organizations require responsible relationships in the dynamics of cultural, social and also environmental changes. The performance in a complex and globalized market in which competitors innovate themselves through significant dynamics, requires the perception of the managers on these changes to position themselves in front of customers eager for innovation of the goods and services of their interest . So the innovation is the competitive advantage because it brings the differential that improves the results for the organization and the consumer.

In this context, it is necessary to insert continuously practices of innovation that are strategically set in the competitive environment where the organizations participate. It is questioned what the consumers, at the time of purchase of goods and services, consider to choose the organization. As well as the cultural, social and environmental aspects of an environmental

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organization perceived by these consumers to influence their purchase intention at the time of decision. It is possible to structure innovations in line innovations with stakeholders.

II. OBJETCTIVES

This study aims to present a methodology in which the organization can align its strategy, in an innovative and continuous manner, generating a competitive advantage to be perceived by its customers, consumers and the society in general. Where the tool that leverages the search for innovation is the customer perception and the guiding questions are correlated with the functional activities of the companies. This way, stablish the difference in their organizational skills in the competitive landscape. This study is pioneer front the lack of methodology that points scenarios capable of innovation as drivers of strategies.

Therefore, this study has as general purpose the elaboration of a valid methodology for monitoring the required change in the face of the consumer behavior; and to reach this objective, the following specific objectives are necessary: identify the elements of innovation that promote change in the behavior of the consumer (1), describe the innovations perceived by consumers in the organizations socially and environmentally responsible (2), develop a methodology for organizational innovation in the face of the changes required (3).

III. THEORETICAL FRAMEWORK

Organizations are increasingly focused on people management able to develop strategies which ensure its legitimacy in society. The social dynamics follows the evolution of its concepts and trends and in the universe where they exercise the high performance, seeking to innovate in order to keep themselves competitive. To understand this changing landscape, it will be used the Planned Behavior Theory as the basis for the preparation of organizational pro-innovation idealizers; The expectation here is to generate behavioral inductors of the consumer of goods and services offered by organizations socially and environmentally responsible; as response there will be an operational action toward the excellence to be offered in the market. In addition, concepts of innovation are introduced to the sustainability, and its inference in the processes, in the functional strategies, and typology; it also sets concepts about the consumer perception in order to allow the measurement of trends.

3.1 Planned Behavior Theory

The research of Martins, Serralvo,and John (2014) indicates that the Theory of Reasoned Action (TRA) was developed by Martin Fishbein through the collaboration of Icek Ajzen and other scholars of the behavioral implications resulting from the information about a causal relation. This theory was modified and expanded through proposals supported by influential motivational focuses of personal attitudes, whose central element is the intention to perform an action; it is sustained by the belief of behavioral, normative or control nature. The Theory presents a clear definition and a solid attitudinal concept; it shows a direct relationship between the behavioral intentions and attitude of the subject in an independent way of his evaluation, regarding to the specific act practiced by him.

3.2 Innovation and the Functional Strategy

Literary appropriation in Jones and George (2007) points out that the process of decision of the administrator to a model of efficiency and high performance must be linked to a structured planning process, covered by a strategic design in order to lead the organization to its excellence, which may guide its employees for successful results in general, and in particular in the complexity of the methods involving innovation, and business processes. At the functional level, this strategy allows the effectiveness and efficiency in functional tasks, following the ideal of the researchers cited that portray five levels, namely, Manufacturing (1) Marketing (2); Service (3); Information System (4) Materials Management (5) and the respective expected results. The table 1 below describes the functionality of these levels in the organization, as well as the expected result regarding to the efficiency of this component.

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Table.1: Responsibility of the operating system and expected result.

Functional Activities	Responsibility of the activity	Expected result of activity
1. Production function	1.1 Create the good or the service related to physical or manufactured products (a); service offered to the customer (b).	1.1.1 Decreases the cost if done efficiently. 1.1.2. Expands the quality with differentiation when consistent
2. Marketing function	2.1 Position the brand and optimize the advertising (a); favor the preference in the customer perception (b).	2.1.1 Increases the perception of the value. 2.1.2 Creates impressions related to the brand.

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Functional Activities	Responsibility of the activity	Expected result of activity
3. Service function	3.1 Provides service and aftermarket support.	3.1.1 Creates value impression in the minds of the customers. 3.1.2 Makes closer the relationship between the company and consumer.
4. Material management function	4.1 Controls the movement of physical materials through the value chain; since the acquisition to production and distribution.	4.1.1 Lowers the costs regarding to the efficiency of the management of materials. 4.1.2 Enriches the product offered.
5. Information System function	5.1 Controls the electronic systems. 5.2 When added to the internet communication tools, they are able to alter the efficiency and the effectiveness.	5.1.1 Increases the efficiency when it involves the functional strategies. 5.1.2 Establishes effectiveness of all strategies of the operating system.

Source: Adapted from Jones and George (2008; 2012).

By discussing the functions of the Operational System, Jones and George (2008; 2012) highlight the Marketing. This function plays an important role in the value chain, allowing a definition of the company´s business in terms of the customer necessities that are being met. Joining yet the prospect of Garcia et al. (2008), by clarifying the meaning of the measurement and disclosure of environmental initiatives undertaken by organizations; since correct, consistent and transparent, reflecting positively on the strengths of the company; this perspective becomes a tool that influences the consumer behavior. The result is the new organizational setup of the project

3.3 Innovation Concepts in face of the consumer´s perception

The organizations that are positioned in the market as innovative, necessarily has a culture of business innovation, establishing a continuous improvement of the processes, technologies and products. This improvement can be based on the customer behavior that, according to the studies done by Garcia et al. (2008) suggest seven elements for the decision making by the consumers. On table 2 the elements are described and linked to the behaviors presented and systematized by scholars.

These elements of decision of the consumer may be a guideline in developing a strategic diagnosis. For this, it was considered the use of the Theory of Planned Behavior, once it states that the attitude of the person can be influenced by her intention of acting. Therefore, in the face of the possibility of generating a continuous innovation, the perception of the consumer expresses in the steps of decision shown above may develop idealizers in an organizational pro-innovation diagnosis.

IV. METHODOLOGY

Ventura (2007) classifies the case studies according to the purpose of the investigation; thus they can be private, instrumental, collective or naturalistic. The naturalistic case study prioritizes the qualitative approach and it has three basic procedures: The exploratory procedure, which comprises the time to locate the data sources necessary for the study (a) the delimitation procedure of the study, i.e., the determination of the research focus and the establishment of the procedures for gathering information, using research on focus group (b) and the procedure of systematic analysis and report elaboration with an theoretical and practical analysis , starting from the exploratory phase (c). According to those steps, this study was performed, as it is shown on Figure 1.

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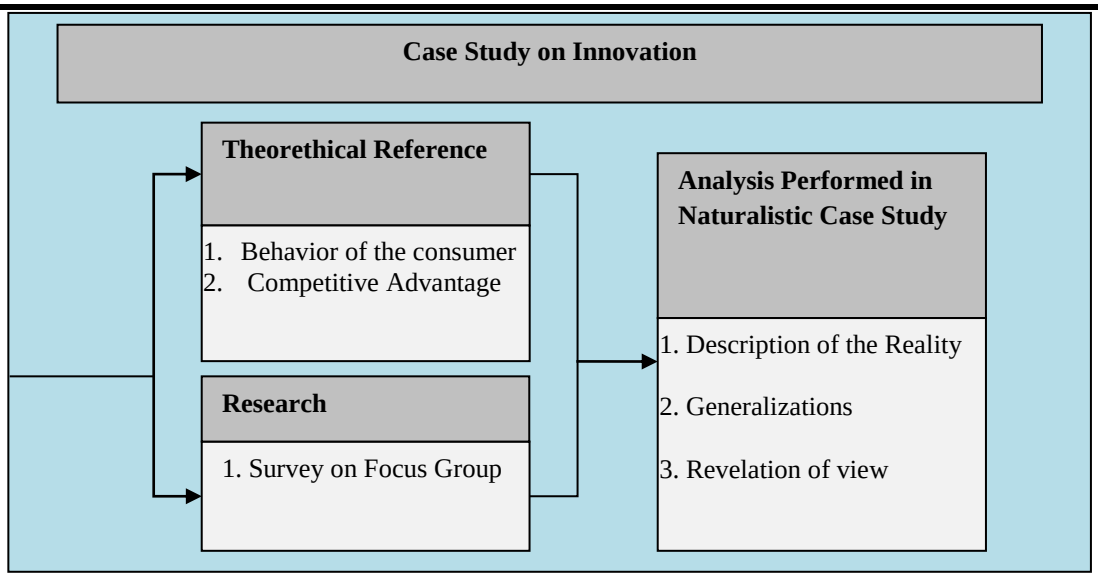

Fig.1: Diagram of the case study Method.

Source: Prepared by the author.

The next step was the coding of primary data. For this, a focus group in order to give testable subsidies was provided. For the accomplishment of this task it was established as a focus group, some residents in Porto Velho potential consumers of the supermarket services in this municipality, randomly consulted and that agreed to contribute to this task by answering a questionnaire.

It was considered the possibility to measure the trends of the respondents of the Focus Group, in order to evaluate subsidies in diagnostic pro-innovation in the grocery business branch. The questionnaire applied to the respondents contains structured responses, according to the Likert Scale in five options. It was acknowledged the assumption that the process of innovation can be stimulated by the entrepreneur, from the performance perceived by the customer; the more he perceives the company, the more will grow his Competitive Differential. However the negative assessments may impose significant improvements in organization, now through a requested innovation.

A study in Rea (2000) makes clear that no questionnaire is ideal to obtain all the information needed in a research and that its complex multidisciplinary requires professionalism at the moment of the questionnaire elaboration. It must be clear, comprehensive and acceptable, as well as to consider the size of the sample. Therefore, in the preparation of the questionnaire applied, in other words, based on the results expected by functional operating system of the organizations according to studies in Jones and George (2008; 2012), it was drawn up questions and they were correlated to the decision-making elements of consumer in accordance with the study done by Garcia et al. (2008). The questions proposed firstly were tested before of its application with a group of researchers and adjusted front to the theoretical concepts mentioned above. The table 2 presents the result of the questions used in the research and its respective correlation with theoretical elements also described above.

Table.2: Correlation of the issues surveyed with the Functional level and Elements

Functional Level of the Organization	Questions applied to the consumers	Elements of the consumer decision
1. Production function	1.1 The company offers new products of its own creation and / or new brands.	1.1.1. Search for information;
2. Marketing function	2.1 The company supports social projects	2.1.1. Recognition of the necessity;
3. Marketing function	3.1 The company supports environmental projects	3.1.1. Search for information;
4. Production function	4.1 The company maintains an adequate communication channel with the customers (news, products, promotions, offers)	4.1.1. Recognition of the necessity;
5. Marketing function	5.1 The company offers typical products of the Amazon (alligator meat, fruits, almonds, etc.)	5.1.1. Evaluation of the alternatives or pre-purchase;

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Functional Level of the Organization	Questions applied to the consumers	Elements of the consumer decision
6. Information System function	6.1 The customer finds the prices of product easily.	6.1.1Purchase;
7. Material management function	7.1 The company staff is helpful and courteous in service.	7.1.1. Consumption;
8. Material management function	8.1 The company exposes the products on the shelf in order to facilitate the comparison of products.	8.1.1. Consumption
9. Service function	9.1 The company provides opportunity to exchange the products purchased.	9.1.1. Post-consumption evaluation
10. Service function	10.1 The company assists in the disposal of products through own selective collection (batteries, packaging, etc.)	10.1.1.Disposal

Source: Prepared by the author.

V. RESULTS AND CONCLUSION

40 consumers were consulted. From these, 73% have responded to the questionnaire. Regarding to the gender 34% were women and 66% men, 55% of whom reported having a gain greater than $ 1,800 (US dollar). The percentage of the responses which organizes the performance regarding to the perception of the respondents, a fact that allows to introduce the proposed results for the specific objectives outlined in this study.

5.1 Identification of the innovation elements that promote changes in the behavior of the consumers

Studies in Garcia et al. (2008) suggest seven elements considered in this task: The recognition of the necessity through the questions 2 and 4; Information seeking, through the questions 1 and 3; and the consumption through the questions 7 and 8. The pre-purchase, purchase, post-consumer and disposal elements were observed respectively in questions 5, 6, 9 and 10.

Consider the Recognition of Necessity phase. It expresses the consumer perception about the determinant of consolidation of the possibility of purchase. The fact is an indicative for business innovation, according to a study of the typology of innovation. It was noticed that the supermarkets provide unsatisfactory services, shown on Figure 2.

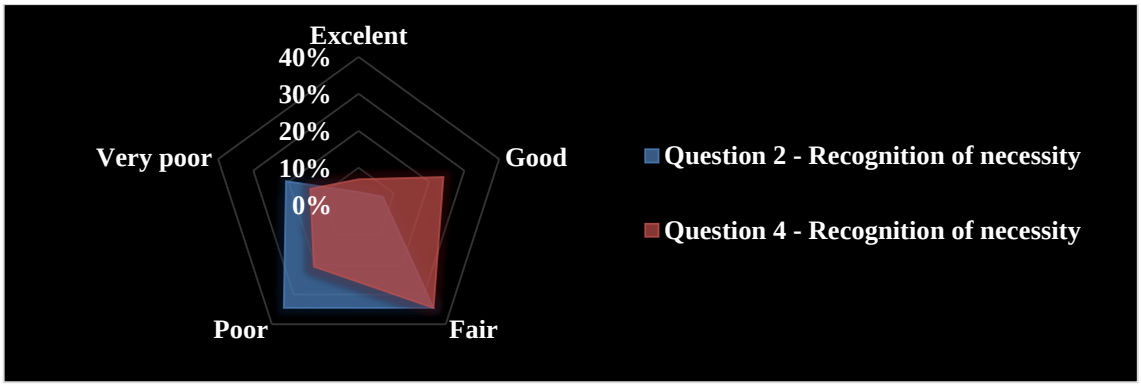

Fig.2: Elements Recognition of Necessity

Source: Prepared by the author. Based on the data provided by the Focus Group.

5.2 Description of the innovations noticed by the consumers in the company surveyed

It was considered as descriptors the operating system of the organizations that, according to Jones and George (2008; 2012) is the combination of different functional activities in order to acquire inputs and convert them into products. The functional activities presented by the authors are: Production Function (1); Marketing Function (2); Service Function (3); Materiel Management Function (4); and Information System Function (5). At this stage of the study we will do transversal analysis between the functional activities and the elements of perception in order to diagnose the location in the operating system that should receive a stimulus to be innovated.The questions prepared for the marketing function were developed to show the environmental image of the companies surveyed

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considering this image as a competitive differentiator treated by Garcia et al. (2008). The responses suggest a low socio-environmental responsibility; more than 55% of respondents perceive it as average or bad, shown in Figure 3.

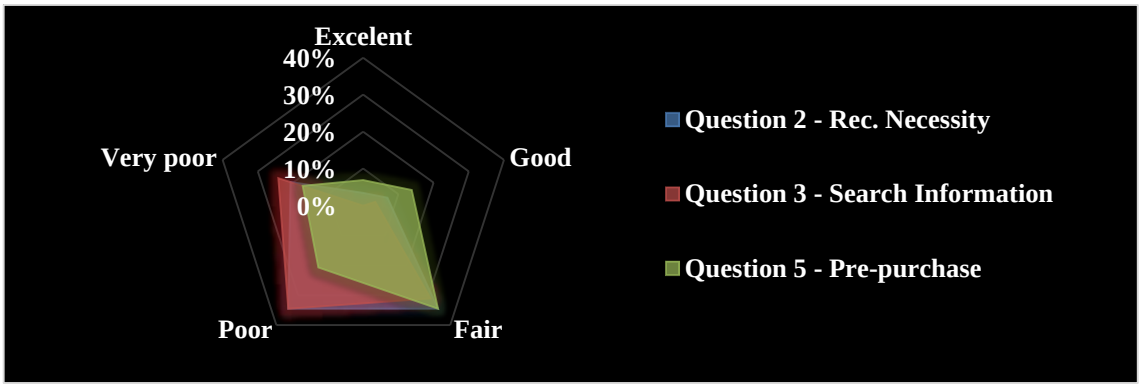

Fig.3: Marketing function – Socio-environmental Image.
Source: Prepared by the author. Based on the data provided by the Focus group

In this research, the production Function assessed in Questions 1 and 4, reaches 83% and 79% respectively in the sum of the responses "good", "fair" and "poor" . This may mean that the consumers are undecided or that the service tends to dissatisfaction. The theoretical basis of the Competitive Advantage presents the factors of efficiency and quality added to an rapid customer response. Soon, this functional activity may be the main focus of innovation to be worked by the organization, show on Figure 4.

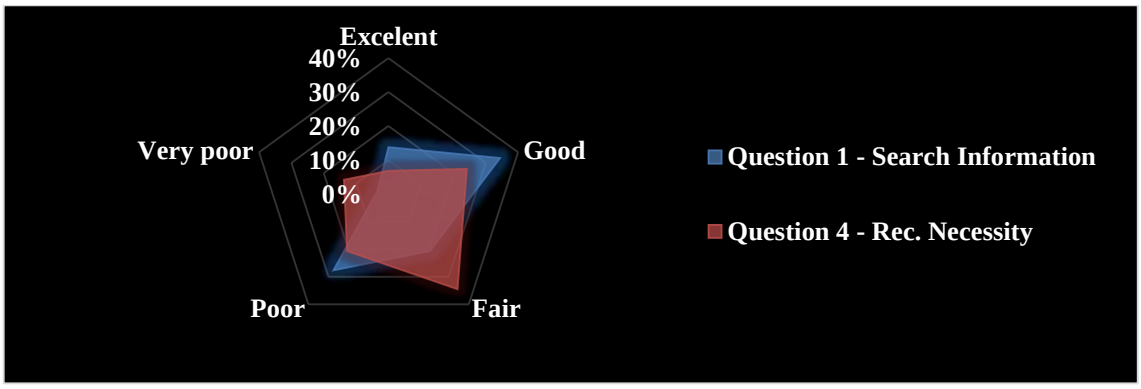

Fig.4: Production Function
Source: Prepared by the author. Based on the data provided by the Focus group.

5.3 Methodological proposal for diagnostic organizational pro innovation

The diagnosis is based on a consultation of the research base, which are the consumers and their perception regarding to the service provision and offering of the organization's products. These responses will be analyzed and considering an organization dedicated to the client, they will guide a decision process now from the top to the bottom, since the perception, apex of the process, will generate elements for the assessment of the functional strategies in view of innovation. Figure 5 shows the idea of diagnosis for the pro-innovation intervention and the Table 3 describes each element that composes this diagram.

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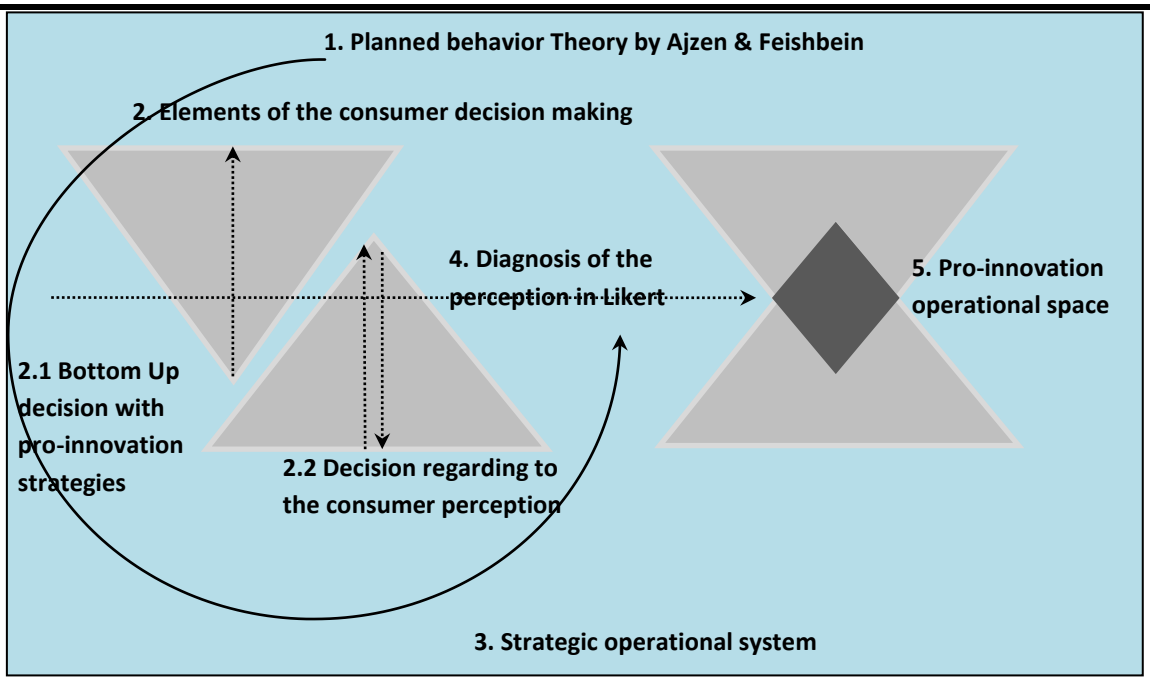

Fig.5: Diagram for diagnosis of intervention.

Source: Pedro Filho et al.(2013)

Table.3: Description of the intervention elements

Intervention elements	Description
1. Planned behavior Theory by Ajzem and Feishbein	1.1. This theory is circular role because it treats both employees as agents, as well as the consumer as protagonists.
2. Elements of the consumer decision making	2.1. In this space, the seven elements of the consumer decision making for research development are considered.
2.1. Bottom up decision involving pro-innovation strategies	2.1.1. The organization position itself with a focus on the customer, in this inversion, which brings the consumer perception as a guideline in the process of innovation proposed to the operating system.
2.2. Decision regarding to the consumer perception	2.2.1. It treats the consumer perception with the guiding basis to establish the innovation processes in the organization.
3. Strategic operational system	3.1 At this moment the elements of the consumer and the functional strategies of the company are considered concurrently.
4. Diagnosis of perception in Likert	4.1. Systematization of the planned responses with basis idea formers for orientation for decision making.
5. Pro innovation operational space	5.1. Organizational learning space where the formation of ideas and construction of ideas stimulators for implantation will occur.

Source: Prepared by the author

The diagnosis requires the identification of idealizers that promote the identification or the fomentation of the innovation in the organization, i.e., it is necessary to stimulate a keen eye of the business, process and service provided by the organization. The constructs considered for the questionnaire are the strategies of the operating system and the respective qualification of excellence expected for each functional activity, as demonstrated in our studies; as well as the elements of the consumer decision-making as credible and guiding steps for objective surveys. Figure 6and Table 4 show what was expected by the elaborator of the questionnaire, which aims to the intervention on the pro-innovation process.

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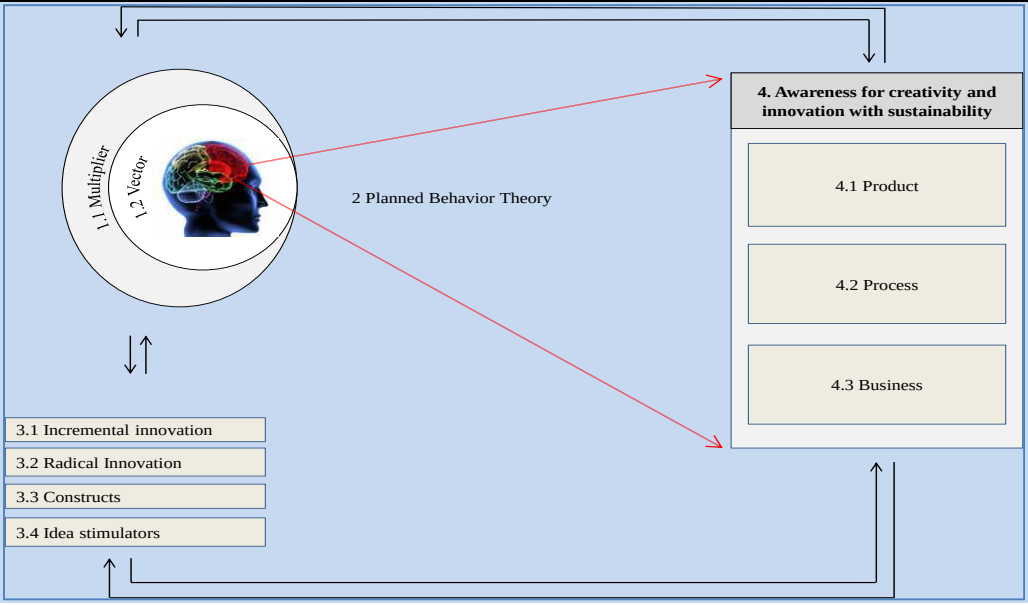

Fig.6: Diagram of the elements involved in the construction process of idea formers.

Source: Pedro Filho(2014).

Table.4: Description of the elements involved in the construction process of idea stimulators

Elements	Description
1 Agents	These are the actors involved in the sensitization and innovation processes responsible for process structuring and for the engagement of the stakeholders.
1.1 Multiplier	It is the operating agent that manages the process of awareness with the other actors involved. It's up to him to apply the dynamics in the procedure involving the other actors.
1.2 Vector	For this study, the vector is the agent that structure the process of raising awareness to the creative and innovation platforms; it is involved in the commitment with the required changes.
2 Planned Bevavior Theory	It brings the attitude as a central element of the individual in the process of performing actions, being a motivational focus able to engage and influence people.
3 Idea forming	These are primary elements on the ideals created by the friction of the creative individuals. It is derived from its reflection and depends on reflection, discussion, maturation and targeting.
3.1 Incremental Innovation	Improvements made in products, services and / or business without interfering in its essence or performing structural changes in their characteristics.
3.2 Radical Innovation	It is when there are structural changes in the product or in the allocation of the product, causing losses in its initial characteristics. It's a new or completely product redesigned by the process.
3.3 Constructs	These are mental constructions of the idea formation process to the maturity and consideration. They may be informal, which are the subject submitted to discussion and formal, which are considered adequate for testing
3.4 Idealizers	These are formal constructs tested, checked, verified and confirmed as sufficient. They are useful as applicable instruments in believable scenarios.
4 Sensitivity to creativity and innovation with sustainability	Act to educate the subject to the necessity for creativity and innovation in products, processes and / or business. In view of this study, it must adhere to sustainability.

Source: Pedro Filho (2014)

The constructs considered for the elaboration of the questionnaire are the strategies of the operational system and the respective qualification of excellence expected for each functional activity, as demonstrated in our studies, as

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well as the elements of the consumer decision making as credible and guiding stages of objective survey. To measure the responses, it will be used the Likert Scale, stablishing responses of satisfaction with 5 or 7 response options, defining the relation of the response and the respective evaluation of this response. This questionnaire will be applied to a test group of maximum 3 people, and it will be validated the intention of response with the proposed evaluation, as well as the necessary adjustments to the adequacy of the instrument and the idealizers test; followed by the application, tabulation and analysis.

In summary, these idealizers passed by the following steps: (a) develop questions based on the elements of the consumer and correlated to the business and their respective functional activity - constructs; (b) Establishment of a satisfaction scale and understanding of perception for evaluation - Likert Scale; (c) Questionnaire test with a validation group in order to set instrument - Idea stimulators; (d) Instrument application - Focus Group; (e) tabulation and analysis (response x assessment understanding).

These elements must be discussed within the organizational learning space, however, their treatment should consider the interrelationship of the operating system, the customer perception as a pro-innovation encourager, the tangible aspects of the organization, for example, products and services; and the intangible aspects such as employees relationship, organizational culture and reputation. The Theory of Planned Behavior is the central element in the process of performing these actions, therefore, taking the attitude as the central element, it will be a tool to work the motivational aspects of involvement necessary for the sake of the continued innovation. Figure 7shows the connections keys of this study to establish a diagnosis director to the organization's functional levels.

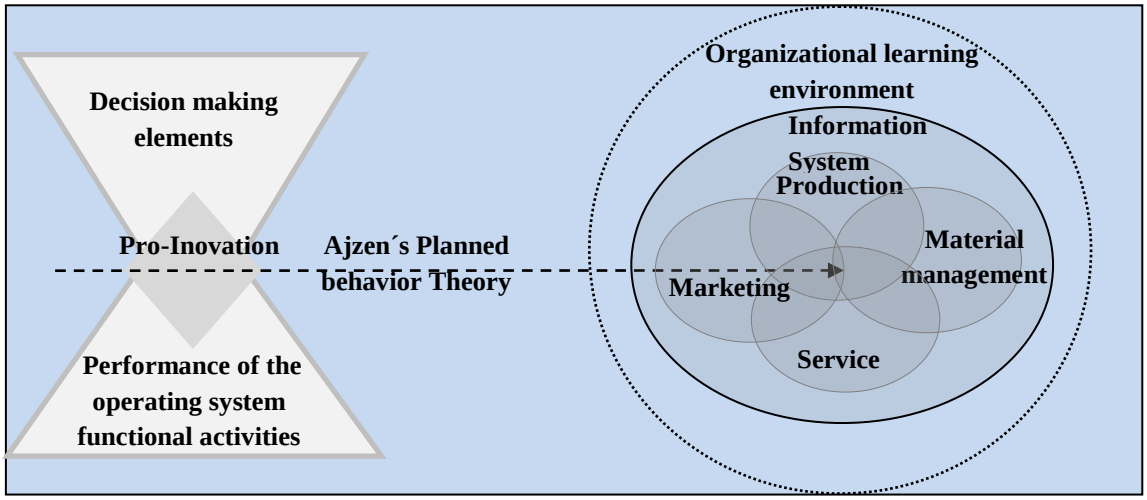

Fig.7: Application of pro-innovation diagnosis Methodology.

Source: Prepared by the author

VI. CONCLUSION

The process of continuous innovation obliges the organization to seek for excellence, however this process to be implemented successfully has to be part of the company culture. The atmosphere among the employees to generate ideas, discussion and adjustments of a team has to be propitiated by the leaders of the company, valued by the stakeholders and celebrated among the employees.

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Strategic Paradigms of Social and Environmental Balance

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Abstract *- Complaints about the socio-environmental relationship have become prominent, requiring the academy to deepen its studies on the strategic paradigms of sustainability. The objective of this essay is to study the conceptions of strategic paradigms along the path of social and environmental balance, with the specific objectives of raising the paradigms under social, economic, environmental and institutional aspects (1), analyzing the strategic paradigms that can favorably promote equilibrium (2), and critiquing the discourse of society, aiming at social and environmental balance (3). The elaboration of this work is based on the Institutionalist Theory that prescribes the set of individual behaviors, beliefs and values, processed in accordance with the individuals' perception, and in their interpretative capacity of the reality in which they are inserted. This qualitative research is elaborated through the Method of Content Analysis, and applies procedures of bibliographical survey and documentary treatment of the social discourse that substantiates sustainable paradigms. As a result of the critical analysis, it is verified that the discourses and behaviors of the social agents do not contribute to the social-environmental balance. Then, new proposals of strategic paradigms which are useful for reflective actions and universal meanings are incorporated here. The expectation is to redirect the individual to behavioral reflections, through a learning that is coherent with the confrontation of the planetary emergency. It is also indicated for the spirit of preservation and conservation of the environment, in which the relationship with the social, economic and institutional will bring the desired balance for generations. This study represents those interested in the discussion about the socio-environmental relationship, and those involved in learning about sustainability and orientation towards ethical posture.*

Keywords–Balance, Institutionalism, Management, Strategy, Paradigms.

I. INTRODUCTION

The socio-environmental balance has been the planetary concern, mobilizing efforts in the generation of knowledge for the safeguard and survival of humans and other living species on Earth. Conferences and symposia continue to try to create collaborative solutions of collective sustainability on a fragmented planet; these

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measures have subsidized scholars, bringing together researchers, their doctrines and leading technologies in the area of socio-environmental management. However, the solutions depend on well-worked paradigms, as an exclusive aspect for sustainability, with a focus on the social, economic, environmental and institutional aspects.

Inquiries are shared by scholars and their groups, who address the implications of virtues and meanings for coping with the global emergency. Here, discourses and criticism centered on the correct path that guides the behavior of individuals thrive. This is a justification for studies as the one proposed here, which may lead to adherence or remodeling by strategic paradigms, possible to establish applicability with answers or challenges; and that can incorporate positive attitudinal measures with multiple benefits. In this outline, the following question arises: How can we promote socio-environmental strategic paradigms? In order to answer this question, we propose to study the conception of strategic paradigms along the path of social and environmental balance; and as the specific objectives to raise the paradigms under the social, economic, environmental and institutional aspects (1), to analyze the strategic paradigms that can favorably promote the socio-environmental balance (2), and to make a critique about the discourse of society in the vision for the socioenvironmental balance (3). The work is composed of topics and sub-topics, with a theoretical-conceptual review, a methodological treatment, and the results reported following the objectives proposed here.

II. THEORETICAL AND CONCEPTUAL REVIEW

This essay is based on the Institutionalist Theory, which, according to Crubellate and Silva (2016), addresses the set of rational behavior of beliefs and values. The theoretical arguments are intrinsic in the shape of the individuals' perception, in the sieve of their understanding from their reality. Therefore, it presupposes the existence of a relation to dominant patterns, besides requiring the emergent contextual recognition, of multiple complexities, divergent, and logical. This theory is translated by paradigmatic characteristics, such as, for example, how society understands sustainability and its convergence in actions that can bring them proposals or solutions, among which are those of a strategic nature within socio-environmental balance outlined in the present study.

2.1 Concepts of strategic paradigms

This compartment of the task brings the approach to the essence, in dealing conceptually with paradigms under the social, economic, environmental and institutional aspects. And it does so in an integrated way for the socio-environmental management, following Burgelman's prescription (2012). This scholar considers that such a providence provides the involvement of enriched potentials, especially in an organizational process that brings together specializations directed at opportunities in corporate strategy, for example. It can join planned efforts, taking advantage of the surroundings of the possibilities visualized and guaranteed by adjacent forces, with advantage to the social-environmental balance.

Kuhn (2011) indicates that paradigm is the main order or the basis of common sense among practitioners of a given action, which becomes routine and then a reference act, and is then incorporated into the knowledge of everyone in the group or in the community. It can be divided into particularities or nuances in processes and beliefs, and may still provide classification in aspects that reveal a differential of the being, who begins to identify or constitute an identity, as in dogmas, ceremonies, rites and processes in general. Additional features may occur to a paradigm, and in this case they are incorporated as a logical context reference to the set, maintaining the identity that is peculiar to it. The paradigms are revealed as a historical process of a society, independent of the perception of the actor involved. But throughout its existence as known among social actors, its influence permeates the conduct of individuals, being able to reach the way of being and thinking, acting and evaluating, establishing common sense in this way.

A survey carried out by Araújo et.al (2017) allows us to affirm that strategy is a complex process involving several factors in four phases, namely, identification, diagnosis, conception and realization. This ritual put into repetitive act becomes a paradigmatic strategy, provided that such routine practice is incorporated into the knowledge of those committed to learning. And the innovations added, as long as they are learned, can enrich the variants of knowledge over time. Therefore, the paradigm becomes a strategic norm of conduct, used as a source of support in the operationalization of acts, such as social and environmental management.

Bachega and Filho (2014) conceptualize strategic environmental paradigms as the principles of integrated standards of specific contexts, contributing to the sustainable balance of performance goals. They are mechanisms to support the proposed solution, on issues such as those of an environmental nature. This will be the format to be accepted for the conceptualization of strategic social, economic, environmental and institutional paradigms in this task. Sustainable paradigms permeate the conception and performance of society; however, in the individualized way in which actions are operationalized, demands on managerial practices tend to impede results in the application of strategic paradigms.

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Consequently, the balance in the socio-environmental management makes the efforts of the stakeholders impracticable, implying asymmetries; so much so that in Brazil (2014) it is stated that sustainability seeks to promote stability between what people want, what they can acquire, and what is ecologically sustainable. This would be a triangulation of integrated progress of a transformational nature, if an option is stablished in the face of strategic paradigms of balance.

2.2 Concepts about social criticism and discourse

Criticism usually comes from people's conceptions; but Baêta (2016) treats criticism as a dialectic of facts analyzed, which contributes to the strengthening of the ability of judgement of social subjects, or of the phenomena that modify a structure of reality. They are manifested through discourses and, as Maciel (2016) affirms, criticism is word connector process with an interpretive meaning; it conceives the contextual relationship between man and society, through this language reproduced in the discourse; when it is accepted, it provides the tendency over the aspects of neutralization. However, when it does not generate negative significance that causes regression, the criticism results in prospecting the change of context.

The assessment of the truth in order to understand the facts is admitted in the Social Sciences; it is when we contemplate the critic or sociocritic, argued by Maria Pilar Colás Bravo and Leonor Buendía Eisman, when they prescribe on the interpretation of the phenomenon in a stage that precedes the investigation. In this sense, Pedro Filho (2009) criticizes the socio-environmental contingency that prevents the training of traditional Amazonian peoples for indigenous ecotourism. The cited researcher, adopting the original paradigm of the Massai People of Africa, admits after cleavage, the emergency that modifies the conceptual meaning of the Indian. He pointed out in his study that the retention of tribal people in demarcated areas contradicts their right to progress; it is much more serious because, while trapped, they are the victims of a precarious assistance, far from the governmental discourse of protection to the indigenous people, in a circumstance that imposes the intervention of international human rights organizations.

For the development of critical rationality, Baêta (2016) presents a connection between the critical approach and the transformational process. It would be an investigative field based on social daily problems; this vertex indicates to that perspective elaborated from the critical thinking, once it is emergent from the mature cognitive mechanisms. Because it involves the intrinsic relations of the knowledge acquired there in the experience in society, in an environment where the discursive phenomenon occurs, such commitment becomes authorizing in the construction and transformation for a better future of individuals and their community. Thus, in order for the event to promote action among those involved, they issue their discourses, in the format treated by the cited author, based on Norman Fairclough codes, in their form of expression for the world. It would be an indicative of action mediated by individuals who transmit their social reality, while contextualizing the proper history of this relationship with the society in which they are inserted; there the visions of the microssocial and macrossocial environment are translated including the comprehension of knowledge about the operant power in the subject discussed. Then criticism and discourse converge, contextualizing each other to give the reasoning of conduct form in the perception of individuals.

2.3 Concepts about socio-environmental balance

The issue of socio-environmental balance goes beyond the knowledge of past achievements; it is important to know what are the actions of the present that may impact in the future, to commence main concepts about a paradigm used by society today. Mendes (2014) shows that, in order to ensure that the socio-environmental balance between present and future generations, it is fundamental to reflect actions guided by integrative instruments, from which emerge the leading roles of environmental protection. It is as Dmitruck (2016) proposes when pointing out the scope of environmental balance; it adopts the implications of the collective will, expressed in a meaningful attitude of a conscious and valuable characteristics of nature´s attributes; and it refers to the minorities and to the diversity contained in the scenario in which externalities are installed. Consider, for example, certain types of acquisition of good or service in which the consumer does not know the source but which in fact aggravates the planetary emergency because it is harmful. In all situations, the information will be the deciding sieve in order to avoid harmful mistakes in the face of socio-environmental impacts. Consider that the path of balance will be directly linked to the process of awareness and formation of the critical mass, essential in the construction of those validated integrating paradigms for the protectionism and conservationism of the ecosystem.

III. MATERIALS AND METHODS

This essay is elaborated through the Content Analysis Method, which, according to Bardin (2009), is the set of discourse analysis techniques, carried out with discipline, aiming at describing what is relevant in the theme to be discussed. It allows the reconstruction of meanings related to the interpretation of the reality studied. This method, according to Cooper (2016), represents an approach guide for solving the research problem. It

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implies a procedure capable of performing the data processing for the emission of results and the conclusion of the research. This procedure contemplates the transposition of the general question to the specific one, in order to know the elements that compose the context from which the desired information is extracted, avoiding distortions on the initial data. The bibliographical survey focused on the related approach, such selection of common dichotomous aspects in qualitative research used in this premise. Cooper (2016) emphasizes the understanding of the events which occurred in society, requiring interpretation techniques useful to the small details of the investigated problem. In addition it is reccommended the capture of the environment in which the event is inserted, as well as the subjective factors surrounding

the inherent characteristics, capable of bringing the consistency of reality, as in the script that culminated in the results of this essay.

This task is addressed by the Software Nvivo, which contributes to the qualification of data processing and analysis, thus distinguishing the researcher's interpretative capacity; in addition, it contributes positively to the search of satisfactory results, mainly in the moment of the discernment between what is valid or not in this research. Figure 1 represents a systematic diagram of the application of the content analysis method for the construction of strategic paradigms, based on the bibliographic documents selected and operated on the topic of this report. Table 1 below shows the diagrammed elements and their respective description.

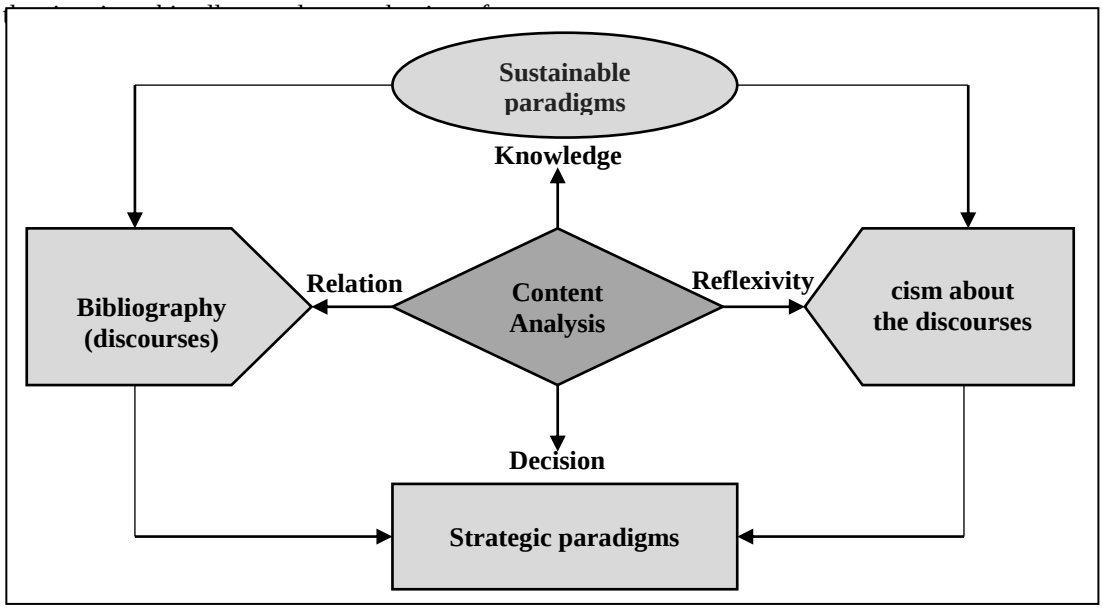

Fig. 1: Diagram of the Content Analysis Method considered in this research.

Source: Elaborated by the authors.

Table.1: Specification of the Diagram of the Content Analysis Method considered in this research.

Elements	Descriptive
Content analysis	Set of message content decomposition techniques for reconstruction of meanings.
Sustainable paradigms	Basis of study on the conceptions and values of the society on the sustainability.
Bibliography (discourses)	Theoretical reference of the paradigmatic discourses about the social, economic, environmental and institutional context.
Criticism about the discourses	Interpretive technique of qualitative research the analysis of the social actors' discourses.
Strategic paradigms	Proposals for paradigms that favorably promote the socio-environmental balance.
Knowledge	Information about sustainable paradigms for evaluation in content analysis is presented.
Relation	It represents the search of discourses for the theoretical conceptual revision, procedure of content analysis.
Reflexivity	Analytical critical consideration of the discourses as representative for the results of the content analysis method.
Decision	Proposal of action relating to socio-environmental strategic paradigms, changing the meanings in the final considerations of content analysis.

Source: Elaborated by the authors.

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IV. RESULT OF THE STUDY OF THE CONCEPTION OF THE STARTEGIC PARADIGMS IN THE PATH OF SOCIAL AND ENVIRONMENTAL BALANCE

In this compartment are the results of the study, in accordance with the proposed objectives. In Table 2 are shown the phases of the processes of this task, converted into categorization, cleavage, corpus, convergence, divergence, element of analysis, substance into the paradigm, and systematization of data collection and selection with a focus on Institutionalist Theory.

Table.2: Content analysis process for the conception of strategic paradigm.

Elements		Critical analysis of the indicative
Indicative	**Authors**	
Categorization of aprioristic and non-aprioristic elements.	Bachega and Filho (2014); Mendes (2014) and Dmitruck (2016). Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015); Brasil (2015); Maciel (2016); Baêta (2016) and Pedro Filho (2009).	Survey of approaches by authors, through linking to the topic, which were classified as primary information, not as priori or secondary.
Cleavage - coding of meanings that meet the research objectives.	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015); Dmitruck (2016); Silva (2015); Bachega and Filho (2014); Baêta (2016); Maciel (2016); Mendes (2014).	Interpretation of the meanings of the words of the objectives and of what the authors depicted.
Discourse integrating factors	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015);	Verification of the common elements of the discourses that have relevance to the objectives.
Recognition of the discourses that impact on the Institutionalist Theory.	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015); Crubellate (2016).	Validation of the paradigms that led to Interpretation and the context of the social actors.
Convergence of the elements in line with the discourses.	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015);	Emphasis on the paradigms that match the socio-environmental balance.
Verification of negative aspects that back environmental processes.	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015);	Elimination of negative discourses that impede ecological development.
Classification of relevant assets argued.	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015);	Extraction of the important elements for the substance of strategic paradigms.
Consistency test constitutive of the strategic paradigm.	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015);	It represents the main extract of the text, proposals of reflexive actions for the people in the path of balance.
Paradigms that relate to the Institutionalist Theory.	Marques (2013); Polli (2012); Vianna (2014); Matta and Schmidt (2014); Silva (2015);	Process of linking the consistency of the strategic paradigm with the collection/selection of the data conferred in the Institutionalist Theory.

Source: Elaborated by the authors.

Figure 2 contains the conceptual diagram of the strategic paradigms of social and environmental balance; and Table 3 below shows the diagrammed elements, with the respective description of these sequential and cyclic integrators.

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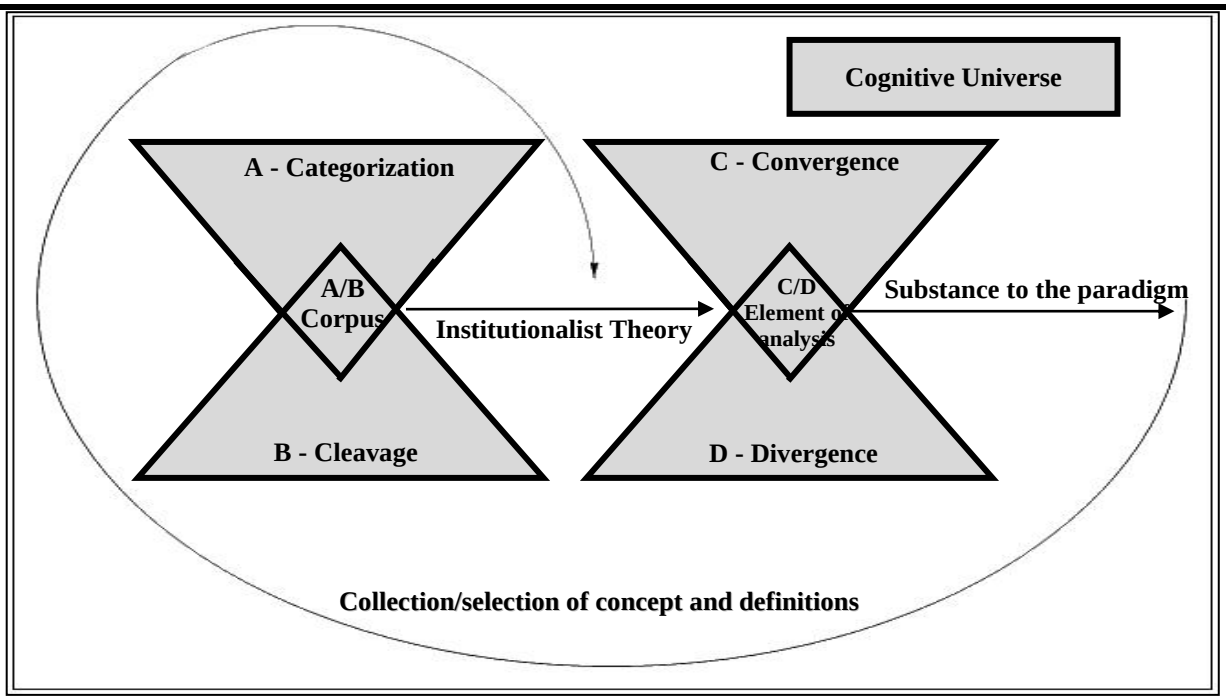

Source: Elaborated by the authors.

Table.3: Specification of the Diagram of the method of analysis considered in this research.

Elements	Description
Cognivtive Universe	Process of knowledge acquisition.
Categorization	Initial procedure of classification of significant statements based on the theoretical framework that meets the objectives of the study.
Cleavage	It has the function of guiding and coding the process of categorization relevant to the content.
A/B or Corpus	It represents the intermediate phase between categorization and cleavage that has the challenge of establishing clarity of the reasons for choosing the elements and the guiding principles of the study.
Institutionalist Theory	It studies the conceptions of the individuals, analyzing the emerging context in which they are inserted, categorizing and refining to change this reality.
Convergence	The contributions of the paradigms that translate into benefits for the social agents are verified.
Divergence	The aspects that neglect the posture of social subjects for elimination are evaluated.
C/D Element of analysis	Critical analysis of convergent and divergent discourses that produce relevance for the study.
Substance to the paradigm	Condenses the main elements for the formation of strategic paradigms with solutions for the sustainable environment.
Collection and selection of concepts and definitions	Bibliographic procedure characterized in the conceptual formation of the study.

Source: Elaborated by the authors.

4.1 Surveys of the strategic paradigms under social, economic, environmental and institutional aspects.

The paradigms to be focused in this subtopic are of a social nature, which refer to a relationship between the individual and the community where they work; economic, which involves the production and consumption system; environmental, which depicts the domain of the human over nature, and the response that imposes balance in this relationship; and institutional, that turns to the integrative character of a structural, political and organizational nature. In the unfolding below are the strategic paradigms; they are those that result in the intelligent integration between the other paradigms imposing the expected balance for sustainability. This

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typology of paradigm is essentially practical, and its consequence presupposes the occurrence of sustainability advantage, as long as they are converted into operations that result in the force of balance.

4.1.1 Social paradigm

Marques (2013) points to the social paradigm as a determining risk in the face of the possibility of returning to a level that goes beyond individualist-subjective thinking. According to the author, these risks are integral, and are not limited to time and space; they include consequences of a conjunctural and idealistic nature. In general, the modern paradigms are characterized by the support to consumerism, reference to the technological advance, and other immediate tendencies that become discards. Unfortunately, the quality of life that should meet society is far from the expectations, making social life a future of uncertainty with regard to ecology. Polli (2012) recognizes the social paradigm as dominant; according to this author, it is the view in which humanity is in the center of attention, this has led to the inconsequent destruction of the environment, nature being seen as a mere agglutinator of inert elements.

The strategic social paradigm includes respect for the culture of peoples in their diversity and subjectivity; this reveals the differential that serves to promote socializing without conflict. This paradigm typology guides the participation of humans with their citizen autonomy, through the exchange of knowledge, including those generated from the imaginary. It establishes ties of egalitarian justice based on sustainability fundamentals, which is why it results in endogenous development, besides contributing to the exogenous progress of the beneficiary society.

4.1.2 Economic paradigm

According to Vianna (2014), the economic paradigm turns into values contained in the conceptions of society. It may be unfeasible if it is concealed by a system that causes torment to society. For example, wealth promotion provoked by exasperated consumerism, or by the obsession of possession of a good whose production exceeds the carrying capacity in the environment. So much so that Matta and Schmidt (2014) affirm that economic theory results from paradigms of ideological-theoretical-political nature, captained by the dominant market power, no matter the ecological imbalance that it may cause to the planet. The power manifested for the achievement of high profits acts with inexpensive measures to respond to the market dynamics that feedback and constantly require the availability of capital.

The strategic economic paradigm aims, therefore, to ensure fullness in the satisfaction of the needs of individuals. It implies ensuring a healthy relationship with the environment from which basic subsistence resources are extracted. It should guide the application of tooling and energy that does not degrade the environment, nor decharacterizes its essence. This paradigmatic typology has a systemic nature and should be feasible, and the outcome of its application should result in benefits.

4.1.3 Environmental paradigm

Polli (2012) sees the environmental paradigm as a configuration of elements that are consistent with the beliefs in the right to life, regardless of their form. Preservation is required in the face of the limitation of resources in the ecosystem; this paradigmatic character submerges the function of social and environmental balance as an essential consequence. This induction represents the form of treatment with the environmental issue, highlighting a mismatch between the excessive withdrawal of natural resources by man, forgetting the slowness of nature to reconstitute and that we must consecrate the sustainability of the right to life. Dmitruk (2016) argues that the paradigmatic environmental issue involves a rivalry between conservation of the environment and the use of natural resources for economic purposes, this dichotomy reflects in disastrous environmental consequences, in which nature has no power of manifestation and is slaughtered by man to the benefit of their needs.

The environmental paradigm, to be strategic, must serve as a reference for man in order to measure in advance the effects of the interventions practiced in its surroundings. It has knowledge as the first element, leading the individuals to reflect on the implications of their act on other life specimens. Each environmentally correct action includes the adaptation of charitable practices to nature. In this circular thinking, the operator of this paradigm must manage the environment with a perspective of full durability, as if continuously projecting the desired place for himself and for generations to come.

4.1.4 Institutional paradigm

Studies by Silva (2015) address institutional paradigm as a structural, political and organizational pairing. It evidences considerable strand in the intervention for the sustainable development, through technological resources with the support of the popular representatives. There, it gathers computerized measurement mechanisms and methodologies aimed at the performance of socio-environmental control. They are useful devices as an instrument of discussion, formulation of critical mass, and construction of coercive means against inappropriate actions that are harmful to the ecosystem.

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The strategic institutional paradigm is that which is guarded by the logic of organizational interests, but is qualified in the light of the interests of stakeholders internal and external to the institution. These actors are the collaborators, the clients, suppliers and all of those who somehow maintain some relation with the organization, or who are affected by the actions carried out by such paradigm. The application of this paradigm can include adjustment of conduct, in the face of the amplified vision with respect to the interests in common. Therefore, the managed businesses cease to be of interest only to the institution, and become of general interest. In general, these businesses are backed by norms and policies guided by preservationist and conservationist principles.

4.2 Analysis of the strategic paradigms that can favorably promote the socio-environmental balance.

This sub-topic presents the challenge of sustainable paradigmatic conception problems; it would be the ideal horizon required by the community in the perspective of sustainable balance. In this treatment, the strategic paradigms with a dimensional and practical look result in the consistency of behaviors and attitudes of a transformative character of reality, in this way a new mental design is configured that recognizes the causes and impacts on actions that subsidize benefits for all social actors.

In view of the comprehensiveness of communication at the present time, and that people feel empowered to express their position in favor of causes, be it national mobilization or the neighborhood itself, almost immediately, they even seek to challenge the authorities, to obtain answers. Considering this as a basic process to consolidate these actions of strategic paradigms, it is recommended the development of an integrative communication channel of discussion, such as the one that reaches audience of the masses, mobilizing the critical argumentative, supervising and idealized sense. This procedure performs meanings of registration, validation and inter-relational feedback. In addition to the central aspects, it is worth mentioning the revolution that the articulated power infers in the planning, organization, direction and control of the socio-environmental management. This articulation legitimizes the reconstructive modeling with the solid structures. Figure 3 and Table 4 below highlight the operationalization and prescriptive nature of this theoretical essay as a contribution in the teaching-learning process, or in encouraging methods, techniques, creative and innovative skills in the tutorial development of practices for sustainability. As shown, these conceptual elements can induce transformative measures in different contexts and applicability.

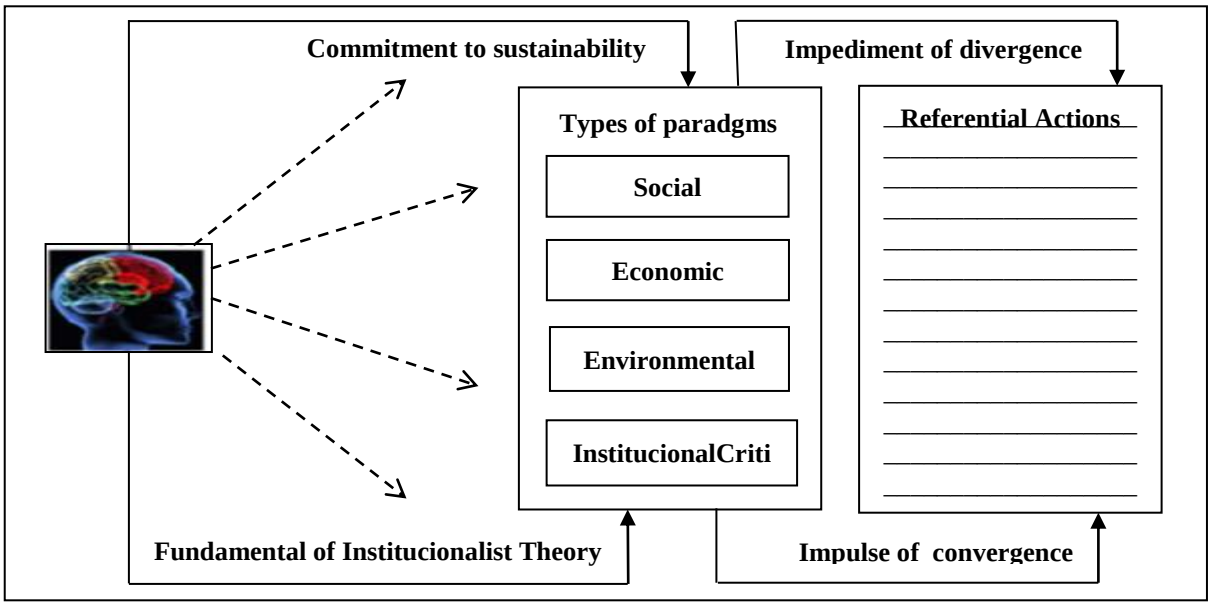

Fig. 3: Conceptual and operational diagram of strategic paradigms.

Source: Elaborated by the authors.

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Table.3: Treatment of strategic paradigms.

Types of paradigms	Referential actions / Predictable reflexes in individual or group actions
1. Social	1.1 Creation of a bank of ideas with awards from individuals and public and private organizations. 1.2 Collaboration and sharing of sustainable knowledge. 1.2 Empowerment with critical sense, inspectors, claimants and collaborators of new environmental attitudes. 1.4 Encouragement of the development of patents that promote efficient solutions for society. 1.5 Re-education for home sustainability posture.
2. Economic	2.1 Collaboration in civil society partnerships and in the public and private sectors. 2.2 Involvement of consultants to diagnose and implement sustainable certified systems in public and private organizations. 2.3 Transformation of socio-environmental strategy into everyday tasks of all in organizations. 2.4 Requirements of consumers to know the provenances of the products that are acquired, in order to strengthen green purchases. 2.5 Obligation of qualitative rather than quantitative growth of the economy, with emphasis on environmental issues.
3. Environmental	3.1 Awareness of the thought that man is not the dominator of nature, but a beneficiary of it. 3.2 It portrays the world view, affected in values, beliefs, attitudes and moral positions in relation to the conservation of the environment; 3.3 Overcoming the dichotomy of man and nature. 3.4 Understanding of the population about the true meaning of the word sustainability. 3.5 Relation of maintenance and reconstruction of natural resources, based on the ethical commitments of sustainability.
4. Institutional	4.1 Institution of models by an evaluating team through a bank of feasible ideas. 4.2 Standardization of execution of administrative principles. 4.3 Standardization, through specializations and union of similar public bodies responsible for the environment in the governmental spheres. 4.4 Development of public policies for transformative education with the inclusion of Socio-environmental Education in school curricula. 4.5 Establishing priority in studies addressing innovation and sustainability in integrated development actions.
Integrative discussion channel	

Source: Elaborated by the authors.

4.3 Criticism about the discourse of society aiming at the socio-environmental balance

Social paradigm is exclusionary of the individualistic character, a dominant view of humanity centered on attentions and lack of concern for the uncertain future. This requires a self-assessment of anthropocentrism similar to colonialism, in which behavior and lifestyle oriented toward personal achievement are called into question. People should be included as responsible as citizens and never as simple spectators of what the community rejects. The actions in *start* is followed by critical sense, evaluating the relations of cause and effect. The integrated view of co-responsibility must have a significant impact on individual awareness and attitudes, in addition to the whole. They are feasible considerations of the protagonists of the transformations for the emerging future that result in a real and sustainable balance.

The economic paradigm implies the support of capitalism, values of society and imbalance; it represents the cause of the socio-environmental collapse, reflected in the alienation and submission of the conditioned social agents to march in the decisions of the dominant class, becoming slaves of this setting. In this context, nature is seen as an object of transformation, reversed in monetary value, bringing with it the gradual elimination of resources, causing an imbalance. It produces an area of social and cultural exclusion and environmental externalities as a result of the devaluation of nature, of over exploitation, degradation and disintegration of natural resources, without proper internalization of the damages caused by the processes of production and consumption.

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The environmental paradigm reflects on the belief of the right to life, challenging the rivalry between conservation of the environment and exclusively economic interests; it serves the discipline for the conquest of the human space in the face of that feeling of domination over the nature common to all who inhabit the Earth; its premise will then be the very relation of exchange of the attributes of integrated enjoyment. By this paradigm, the exploratory process of excessive production and reproduction of the environmental resources of capitalist interest. How to deal with this question if what we see is a competition between the rational being that properly dictates the rules and the irrational that only receives the consequences of human actions, without being able to manifest itself.

The institutional paradigm concerns political, structural and organizational issues; it refers to inert governmental positioning. The reality is of a scenario in which the population is discredited of the public policies, where the representatives misuse the money and it is left at the mercy of luck, this is how the challenge for the governmental representatives is, to break this paradigm and to foment its action of form integrating with society, with a holistic and dynamic vision for all sectors to create effective socio-environmental balance measures, since society urgently needs leaders who are capable of overcoming sectoral barriers and personal interests and who face reality having in mind the future generations.

As we can see in the discourses, with the allusive social paradigms, the pillars of social-environmental relations tend to develop in isolation. This stems from the human behavior of acceptance of the set of principles, and from positions outside the critical thinking of the form. It is worth saying that this phenomenon breaks valid paradigms, and refers the beneficiary to the impediments for reconstruction and empowerment. So much so that Pedro Filho (2009) recalls the maxim that one can not accuse the poor of degrading the environment where they live, since it is from there that they extract their subsistence; and the author proclaims that strategic paradigms should be promoted rationally, erected from sustainable practices, in the light of the socio-environmental balance, through a conservative and preservationist philosophy.

V. CONCLUSION

The paradigmatic concepts should not subsist under the individualist seal, but rather exposed to the circular thought that reshapes them. This is a time when the virtues of an ontological, epistemological and axiological character are revealed, with sustainability as a common route. The design of this study and the results of this research can serve as a basis for new insights guided by institutionalist theory; criticism and social discourse dynamize the concepts of theoretical and conceptual revision, in the daily dialectic of monitoring in socio-environmental management. Here the result answers the research question, when it refers to proposals for reflexive actions that drive socio-environmental strategic paradigms through circular thinking. The model currently followed by social actors, as described in the literature review exposed in this task, indicates that they do not correspond to the ideal behavior. The race for consumption above nature's carrying capacity, the armed confrontations between nations, and the accumulation of wealth under the control of minorities still causes catastrophes. It is clear that the meaning for the social interest remains against sustainability. A study like this one extracted from the academy can encourage an emergent position in the relation man and nature, subsidizing reflexive actions of convergence. In this essay emphasis should be given to the production of knowledge without ideology, thus contributing with effectiveness in the construction of pillars for sustainable strategic paradigms of social, economic, environmental and institutional interest. This study may be of interest not only to the academy that proposes it here, but also to others involved with the cause that is instigating the course of ethical responsibility among nations.

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Histopathological Study of Canine Mammary Tumours with Different Stain Tecniques

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Abstract— *Mammary gland cancer is the most frequent malignant tumor in human females and bitches and morbidity and mortality due to it continue to increase. Mammary gland carcinomas are quite heterogeneous in terms of morphology and biological behavior. Twenty-three female dogs were confirmed affected by mammary tumors during the period January 2014 - June 2015. In this study were used different stained technuques in mammary gland tumors of bitches to help us in diagnosing of them.*

The aim of this study was to compare H-E technique and Masson Trichrome staining technique in mammary gland tumors, in order to differentiate histological types of neoplastic lesions.

Keywords— cancer, mammary gland, histological techniques, dog.

I. INTRODUCTION

Breast cancer is the most frequent malignant tumor in females and its morbidity and mortality due to it continue to increase, despite remarkable progress in the field of early diagnosis and therapy [10]. Mammary gland neoplasm are the most commonly seen tumors in female dog [6, 8, 13]. These neoplasm are the second ones after skin tumors [10]. Nearly 40% - 50% of the mammary tumors that occur in the bitch are malignant [6].

Mammary gland carcinomas are quite heterogeneous in terms of morphology and biological behavior, and they have been the focus of intensive research over the last few decades [6].

A lot of literature has been compiled on the different factors that predispose canines to mammary tumors which are attributed to factors such as age, breed, sex, glandular wise, etc.

Dog has maximum risk of developing mammary tumor (MTs) at 9 - 11 years of age, which is defined as the "cancer age" [9].

Mammary tumors in bitch are classified as "complex" when myoepithelial cells and secretory epithelial cells are present and "simple" when only one type of these cells is present.

Malignant tumors are classified as carcinomas, sarcomas and the combination of them. In practical terms, malignant mammary tumors can be epithelial (carcinomas), mesenchymal (sarcomas) or mixed (carcinosarcomas) [4].

Based on histopathological study, all mammary tumors were classified in accordance with the WHO Histological Classification of Mammary Tumors of the Dog and Cat [5].

Keeping in view the above, the aim of this study was to compare H-E technique and Masson-Trichrome special staining technique in mammary gland tumors, in order to differentiate histological types of neoplastic lesions.

II. MATERIALS AND METHODS

Specimens of mammary gland tumors from twenty-three bitches of different age, breed, and glandular wise submitted to Small Animal Clinic at Faculty of Veterinary Medicine, Agricultural University of Tirana, Albania, were included in this study. Study was carried out at the Department of Clinical Subjects, Faculty of Veterinary Medicine, Tirana, Albania.

Tissues samples for light microscopy were fixed in 10% neutral buffered formalin, paraffin embedded, and sectioned at 5µm thickness. The tissues were deparaffinized in xylene, rehydrated in 100%, 95%, and 70% alcohol, and washed in distilled water. Biopsied mammary tissues stained by Hematoxylin - Eosin method (H&E) (Merck – Darmstadt – Germany), [2]. Duplicate sections were colored with Masson - Trichrome to detect to the deposition of collagen fibers. All mammary tumors were classified in accordance with the WHO Histological Classification of Mammary Tumors of the Dog and Cat (Misdorp et al., 2001). Mammary gland tumors were observed under the MOTIC, BA 210 microscope.

III. RESULT AND DISCUSSIONS

Mammary tumors are the most common tumors in female dog [6, 8, 13]. Despite intense clinical and pathological investigation, little is known about the etiology and prognosis of these tumors. In this sense it becomes a priority to determine prognostic factors that can function as an aid in identifying high-risk ones [1].

Twenty-three female dogs were confirmed affected by mammary tumors during the period January 2014- June 2015 in the Department of Clinical Subjects, Faculty of Veterinary Medicine. The highest number of tumors is

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encountered above the 9-12 years old animals. This interval of risk age is in agreement with other studies [7, 9].

Based on the histopathological findings mammary gland tumors were classified as benign and malignant. Benign tumors were identified as simple adenoma and ductal papilloma.

Simple adenoma of mammary gland observed micro granules separated from fibrotic stroma (figure 1).

Tumor tissue slides were stained with Masson Trichrome, which shows the added amount of deposited collagen (colored in blue figure 2).

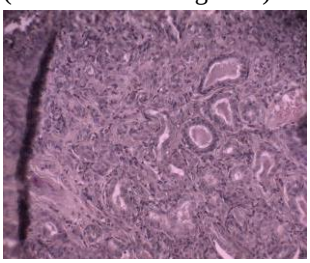
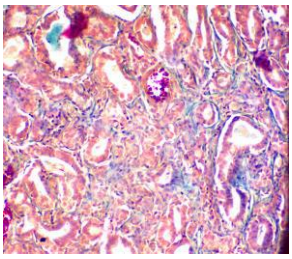

Fig. 1: Mammary gland. Adenoma. H - E. 20X.
Fig. 2: Mammary gland. Adenoma. Masson Trichrome. 20X.

The second form of benign neoplasm was diagnosed as a ductus papillomae in which there were evidenced cystic spaces and glandular epithelial proliferation in papillary form of growths usually lined in one or more layers over thin to thick connective tissue stroma (Figure 3). Malignant tumors are found as apocrine adenocarcinoma intermediate differentiated (G2) and tubular papillary carcinoma.

Apocrine adenocarcinoma intermediate differentiated (G2): it was observed a lobular lesion which infiltrated the connective tissue, irregular lobule, atypical nuclei and stratified epithelia (X20). Apocrine adenocarcinoma (G2) is formed by cylindrical or cubic cells, which take papillary form and a stroma of connective tissue. In this figure were observed pleomorphism and mitotic figures (figure 4). The slides were staining with Masson Trichrome as well, and it is detected the great amount of collagen in the tumor. It is stained with blue. Tumor cells, in red, differentiate from other cells; it highlights areas in dark blue corresponding to fibrosis (figure 3).

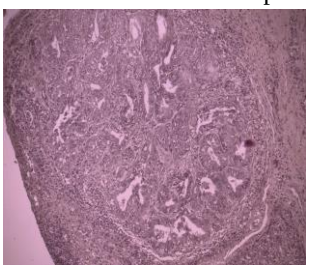
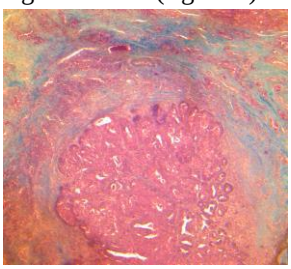

Fig. 3: Mammary gland. Apocrine adenocarcinoma. H - E. 20X.
Fig. 2: Mammary gland. Apocrine adenocarcinoma. Masson Trichrome. 4X.

Carcinoma **(**Tubulopapillary): Based on the histological findings of tubulopapillary carcinoma, are noted tubule eschorozes that infiltrated the mammary tissue. It was observed galactofores structures and infiltrations from ducts and irregular solid islands (figure 4).

Histopathological findings of a tumor is essential in order to obtain consistent information on the prognostic factors of mammary cancer and considered it as a basic step for the therapeutic and diagnostic orientation of lesions and concluded that histopathological technique is a more viable alternative for attaining a meaningful and cost-effective prognosis of malignant tumors in dog [12]. The histopathologic examination is considered the gold standard for the diagnosis of canine mammary tumors (CMT).

The incidence of malignant tumors varies widely from 39 to 91% according to different reports [3, 14, 15] whereas, in contrast to Misdorp [5].

IV. CONCLUSION

Based on the histological and biological criteria, mammary gland tumors are very heterogeneous in terms of morphology and biological behavior.

The study included all cases with spontaneous mammary tumor in bitch and it is classified them according to the nature and type of their histological characteristics.

Benign tumor was classified by histological type in adenoma, cystic hyperplasia and ductus papilloma. Malignant tumors were adenocarcinoma intermediates grade and carcinoma classification.

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Study of Properties of Al LM-25/SIC fabricated by using Stir Casting Method and Wear Analysis by RSM

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Abstract— *Aluminum MMC's are widely used in various applications because of their higher mechanical and physical properties when compared with their base Al alloy. This paper focuses on the change in mechanical properties of various Al/SiC composites fabricated by using stir casting method. Effect of SiC reinforcement in different Al alloys on mechanical properties like hardness, tensile strength, wear test, percentage elongation, residual stress measurements are discussed in detail. For this purpose various reinforcement of SiC with 0,4,8 percent weight and different particle sizes are considered along with Al alloys. Variations in process parameters of stir casting are also made and taken into consideration.*

Keywords— Al/SiC, Al LM-25, Hardness, MMCs, Tensile Strength, Wear Resistance, Response Surface Methodology.

I. INTRODUCTION

A metal matrix composite (MMC) is a composite material with a mixture of two or more constituent parts, one being a metal, other material may be a different metal such as a ceramic or organic compound. If three materials are present, it is called as hybrid composite. The unique characteristics of the composite materials for the specific requirements make these materials more popular in a variety of applications like aerospace, automotive and structural components, resulting in savings of material and energy. Metal matrix composites (MMCS) have become an important class of materials for structural, wear, thermal, transportation and electrical applications. This is due to their ability to exhibit superior strength-to-weight and strength-to-cost ratio when compared to equivalent monolithic commercial alloys. The strength of the composites depends on the amount, arrangement and type of reinforcement in the resin.

Aluminium-based particulate reinforced metal matrix composite has high class of performance material for which it is used in aerospace, automobile, chemical and transportation industries because of its improved strength, high elastic modulus and increased wear resistance over conventional base alloy. To improve different properties of the main material, such as wear resistance, hardness, fatigue resistance, friction coefficient, thermal conductivity and others, reinforcement is used. As from recent studies, MMCs have found a lot of application in automobile industry for the production of brakes and parts of engines and in aerospace industry for the production of structural components, as well as in electrical and electronic industry and in many other applications Composite materials which main constituent part is a metal are called Metal Matrix Composites (MMCs). The other compounds may be metals too, ceramics or even organics. They are well known for their excellent thermo-physical and mechanical properties.

II. EXPERIMENTAL SET UP

Work Material

In this study the AL LM-25 is used as a matrix material and SiC as a reinforcement material. The Al LM-25 + volume percentage of SiC MMC is fabricated by using a stir casting method. Chemical composition of Al LM-25 is as shown in table 1.

Table 1 Chemical composition of AL LM-25

Element	Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb	Tin	Ti	Al
Wt. %	0.1 max	0.2 – 0.6	6.5 – 7.5	0.5 max	0.3 max	0.1 max	0.1 max	0.1 max	0.05 max	0.2 max	Remainder

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Fabrication of Al MMC (AL LM-25 + Vol. % of SiC) by Stir Casting

In this study the matrix material used is Al LM-25 and SiC is used as reinforcement material. The liquid metallurgy technique i.e. Stir Casting is used to prepare composite specimens, because it is most economical to fabricate composites. In this process, matrix alloy was firstly super heated over its melting temperature (800ºC) and then temperature was lowered gradually below the liquidus temperature to keep the matrix alloy in the semi- solid state at this temperature, the preheated SiC particles were introduced into the slurry and mixed. The temperature of the composite slurry was increased to fully liquid state and automatic stirring was continued for 12 min at an average stirring speed of 400 rpm. Alloys were melted in an electrical furnace and poured at a temperature of 750ºC in to a steel mould at room temperature and finally poured into the cast iron permanent mould of 18 mm in diameter and 200 mm in height.

Wear Testing (PIN-on-Disc Wear Testing TR-20 Standard)

A single pin type pin-on-disc apparatus was used to carry out dry sliding wear characteristics of the composite material as per ASTM G99-95 standards. The tests were carried out at the room temperature under dry operating conditions. Wear specimen (pin) of size 12 mm diameter and 25 mm length was cut from as cast samples machined and then polished metallographically. A single pan electronic weighing machine with least count of 0.0001 g was used to measure the initial weight of the specimen. The cylindrical pin flat ended specimens of size 12 mm diameter and 25 mm length were tested against EN31 steel disc by applying the load. After running through a fixed sliding distance, the specimens were removed, cleaned with acetone, dried and weighed to determine the weight loss due to wear.

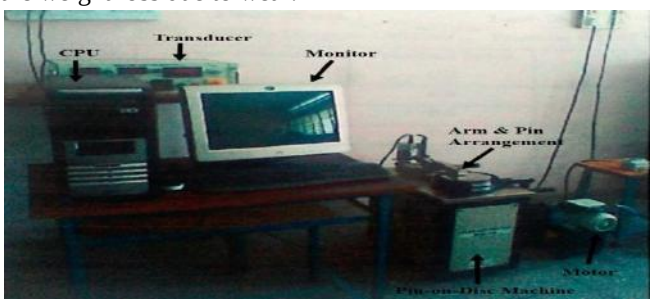

Fig.1: Pin On Disc Apparatus

The difference in the weight of the material measured before and after test gave the sliding wear of the composite specimen and then the weight loss was calculated. The sliding wear of the composite was studied as a function of the weight percentage of the SiC composite, Sliding distance, applied load and rpm.

Plan of Experiments using Orthogonal Array

Tribological behaviors of the samples were studied by conducting the dry sliding wear test as per the standard orthogonal array. The wear parameters chosen for the experiment were: Sliding Velocity (m/sec), Pressure (mpa) and time (Min). The non-linear behavior of the process parameters if exists can only be revealed if more than two levels of the parameters are investigated. Therefore, each parameter was analyzed at three levels. The process parameters along with their values at three levels are given in Table 2.

Table.2: Levels and Values of input parameters

Level	**Low**	**Medium**	**High**
Pressure (mpa)	0.3747	0.7494	1.1242
Time (Sec)	30	60	90
Sliding Velocity (m/s)	1.0472	2.0944	3.1416

III. RESULTS ANALYSIS AND DISCUSSION

The tests were conducted with the aim of relating the influence of Time, Pressure, Sliding Velocity and percentage of SiC with dry sliding wear of the composite material. On conducting the experiments as per orthogonal array the following results were obtained for the wear of various combinations of parameters

Experimental Results and Analysis by Taguchi Method for AL LM-25 & 0% SiC Composite

Analysis of Variance

This analysis was carried out for a level of significance of 5%, i.e. the level of confidence 95%. Table 4 shows the result of ANOVA analysis. One can observe from the ANOVA analysis that the value of P is less than 0.05 in all three parametric sources. Therefore it is clear that sliding distance is most influential followed by sliding speed and load.

Table.3: Wear for AL LM-25 0% SiC Composite

Sr. No.	**Sliding Velocity (m/s)**	**Pressure (Mpa)**	**Time (min)**	**Actual Value**	**Design Expert Predicted Value**
1	1.0472	0.3747	30	22	22.317
2	1.0472	0.7494	60	52	50.222
3	1.0472	1.1242	90	96	96.126
4	2.0944	0.3747	60	42	42.507
5	2.0944	0.7494	90	84	85.269
6	2.0944	101242	30	30	30.888
7	3.1416	0.3774	90	72	71.555

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8	3.1416	0.7494	30	28	27.746
9	3.1416	1.1242	60	77	76.365

Table.4: Analysis of variance table using quadratic approach

Std. Dev.	2.47	R-Squared	0.9990
Mean	55.89	Adj R-Squared	0.9917

Experimental Results and Analysis by Taguchi Method for AL LM-25 & 4% SiC Composite

Table.5: Wear for AL LM-25 - 4% SiC Composite

Sr. No.	Sliding Velocity (m/s)	Pressure (Mpa)	Time (min)	Actual Value	Design Expert Predicted Value
1	1.0472	0.3747	30	18	18.063
2	1.0472	0.7494	60	50	51.015
3	1.0472	1.1242	90	94	93.682
4	2.0944	0.3747	60	38	36.730
Sr. No.	**Sliding Velocity (m/s)**	**Pressure (Mpa)**	**Time (min)**	**Actual Value**	**Design Expert Predicted Value**
5	2.0944	0.7494	90	82	82.253
6	2.0944	101242	30	32	31.492
7	3.1416	0.3774	90	68	68.253
8	3.1416	0.7494	30	15	15.634
9	3.1416	1.1242	60	69	68.873

Table.6:25 Analysis of variance table using Quadratic Approach

Std. Dev.	0.62	R-Squared	0.9990
Mean	51.56	Adj R-Squared	0.9995

Experimental Results and Analysis by Taguchi Method for AL LM-25 & 8% SiC Composite

Table.7: Wear for AL LM-25 & 8% SiC Composite

Sr. No.	Sliding Velocity (m/s)	Pressure (Mpa)	Time (min)	Actual Value	Design Expert Predicted Value
1	1.0472	0.3747	30	11	10.111
2	1.0472	0.7494	60	58	58.634
3	1.0472	1.1242	90	97	97.730
4	2.0944	0.3747	60	49	51.920
5	2.0944	0.7494	90	102	98.444
6	2.0944	101242	30	28	27.982
7	3.1416	0.3774	90	69	69.158
8	3.1416	0.7494	30	30	28.539
9	3.1416	1.1242	60	76	77.777

Table.8:38 Analysis of variance table using quadratic approach

Std. Dev.	3.39	R-Squared	0.9985
Mean	57.78	Adj R-squared	0.9883

Hardness

Table.9: Hardness of the Samples

Sr. No.	Sample	Wt. %	Hardness (BHN)
1	A	4	112
2	B	8	115
3	C	12	116

Tensile Test

Table.10: Tensile strengths

Sr. No.	wt. %	Tensile strength (N/mm^2)
1	4	160.33
2	8	161.73
3	12	180.43

IV. CONCLUSIONS AND EFFECTS OF WT. % OF SIC ON AL LM-25

It was found that Pressure, sliding Velocity, time are most influencing parameters on wear. The highest wear resistance can be found out with the Al/ SiC alloy composite. From wear test, it is observed that the sliding velocity is the wear factor that has the highest physical properties as well as statistical influence on the dry sliding wear of the composites. For dry sliding wear of Al SiC alloy metal matrix composites, the time has moderate influence on the wear. The pressure has least influence on dry sliding wear of the composites. It is observed that the uniform distribution of SiC in all samples is not possible by Stir Casting technique, so that some of the properties and results are almost same. Wear resistance of tested alloy increased with increasing SiC weight percentage. Hardness of alloy decreased with SiC content. Tensile strength increases with increase in weight percentage of SiC same for 117ehav strength and percentage elongation.

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Speed and Current Limiting Control Strategies for BLDC Motor Drive System: A Comparative Study

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Abstract**—***As a result of increasing the use of the brushless direct current (BLDC) motor in many life applications instead of the traditional motors, it is important to list and specify the more for its controlling methods. This paper presents a number of speed and current controlling methods as hysteresis band, variable dc-link bus voltage and pulse width modulation (PWM) controlling methods. These controlling methods have proportional integral derivative (PID) gains which are optimized by using particle swarm optimization (PSO) algorithm. By using fast Fourier transform (FFT) analysis to study the controller behavior from frequency analysis of the output signals and compute total harmonic distortion (THD), it can specify the more useful controlling method. The framework is modeled and fabricated by using Matlab/Simulink.*

Keywords—BLDC Motor Drive Model, FFT Analysis, Mathematical Representations, Matlab/Simulink, PSO Algorithm.

I. INTRODUCTION

The BLDC motor applications turn into most requests and the rapid rising such as aerospace, automotive, office automation, household appliances and different industries. It has important advantages like, long operation life, noiseless operation, high efficiency, high dynamic response, wide speed range, low temperature and can withstand vibrations and shock, this will get better stability of the drive [1,2]. BLDC motors are really a type of permanent magnet synchronous motors in spite of its name. The commutation of the currents is done by electronically switches inverter which is driven by a DC power supply. The commutations are resolved by rotor position; this is detected either by sensorless mechanisms or position sensor. This motor type is consisting of permanent magnets in the rotor and three phase publicized windings in the stator that are wound as trapezoidal b-emfs. The induced currents in the rotor can be lapsed due to the high resistivity of both stainless steel and magnet. No damper windings are modeled because they will reduce the magnetic force [3]. The stator current must be semi-square in order to synchronize with b-emfs to make stable and higher torque at steady speed. The operation of this motor is done when two phases are ON state and the third is floating for every 60 electrical degrees [4-6].

Different simulation models are done by many searchers to anatomize the behavior and operation of the arrangement to give the accurate torque rate that is identifying with current and b-emfscorresponding to suitable set point speed, they work on tuning PID parameters as based on Ziegler-Nicholas, genetic algorithm tuning methods and other work on adjusting PID parameters by fuzzy optimized algorithm or using fractional order PID controller and PID controller with two degrees of freedom [7-13].

Speed control of BLDC motor takes a necessary role in the modern control. In this paper, different control strategies; hysteresis band control, variable dc-link control and PWM control are performed and tested on the BLDC motor and their PID gains are obtained by PSO algorithm using MATLAB software program. The different controlling methods are tested and the results are compared and discussed. Finally, the frequency analysis for the motor current is implemented using FFT analysis and the THD is also computed to study the effect of controlling methods.

II. MATHEMATICAL MODEL OF BLDC MOTOR

BLDC motor modeling cans appear in the parallel attitude as a synchronous machine with three-phase windings. As any model multi-phase motors, one style of them is fed by three-phase voltage source as a BLDC motor is as shown in Fig. 1. The peak voltage must not to be overtaken the

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ultimate voltage frontier of the motor and not to be lower than the back-emf induced voltage [14, 15].

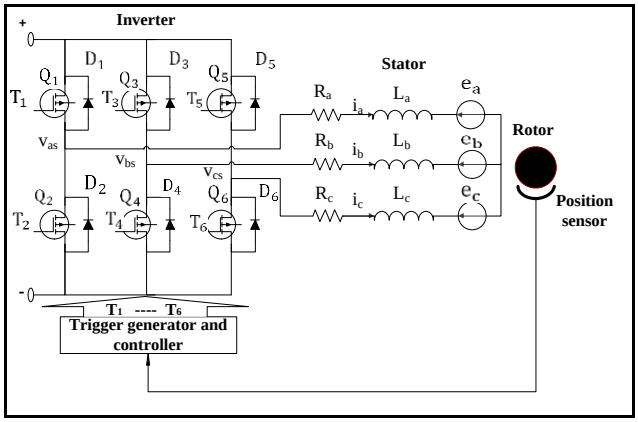

Fig. 1: Three-phase BLDC motor equivalent circuit.

Based on Kirchhoff's voltage law the matrix shape of the phase voltage equations of the BLDC motor can be extracted as:

$$\begin{bmatrix} v_{as} \\ v_{bs} \\ v_{cs} \end{bmatrix} = \begin{bmatrix} R & 0 & 0 \\ 0 & R & 0 \\ 0 & 0 & R \end{bmatrix} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} + \begin{bmatrix} L-M & 0 & 0 \\ 0 & L-M & 0 \\ 0 & 0 & L-M \end{bmatrix} \frac{d}{dt} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} + \begin{bmatrix} e_a \\ e_b \\ e_c \end{bmatrix} \quad \ldots\ldots (1)$$

where v_{as},v_{bs} and v_{cs} are the stator voltages; R is the per phase stator resistance, it has assumed to be equal for all windings; i_a, i_b and i_c are the stator phase currents and e_a, e_b and e_c are the back-emf 's phase voltage.

By subtraction calculations of the phase voltages equations the line voltage equation can be obtained as [12, 14]:

$$\begin{bmatrix} v_{ab} \\ v_{bc} \\ v_{ca} \end{bmatrix} = \begin{bmatrix} R & -R & 0 \\ 0 & R & -R \\ -R & 0 & R \end{bmatrix} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} + \begin{bmatrix} L-M & M-L & 0 \\ 0 & L-M & M-L \\ M-L & 0 & L-M \end{bmatrix} \frac{d}{dt} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} + \begin{bmatrix} e_a - e_b \\ e_b - e_c \\ e_c - e_a \end{bmatrix} \quad \ldots\ldots (2)$$

Since each voltage equation is a linear combination of the other two voltages equations. So that only two equations are needed for simplifying the later construction system model. By disposal away one equation and ignoring one variable using the following balance relationship:

$i_a+i_b+i_c=0$ …… (3)

Then from above equations can modify the following equations:

$$\frac{d}{dt} i_a = -\frac{R}{L-M} i_a + \frac{2}{3(L-M)} (v_{ab} - e_{ab}) + \frac{1}{3(L-M)} (v_{bc} - e_{bc}) \quad \ldots\ldots (4)$$

$$\frac{d}{dt} i_b = -\frac{R}{L-M} i_b - \frac{1}{3(L-M)} (v_{ab} - e_{ab}) + \frac{1}{3(L-M)} (v_{bc} - e_{bc}) \quad \ldots\ldots (5)$$

The trapezoidal back-emfs are related to a function of rotor position. It has 120° phase shift, so the equation of each phase can be expressed as [2, 14]:

$$e_a = \frac{k_e}{2} w_m F(\theta_e) \quad \ldots\ldots (6)$$

$$e_b = \frac{k_e}{2} w_m F(\theta_e - \tfrac{2\pi}{3}) \quad \ldots\ldots (7)$$

$$e_c = \frac{k_e}{2} w_m F(\theta_e + \tfrac{2\pi}{3}) \quad \ldots\ldots (8)$$

wherek_e is the back-emf constant;w_m is the rotor speed andθ_e is electrical rotor angle which is equal to:

$$\theta_e = \frac{p}{2} \theta_m \quad \ldots\ldots (9)$$

where p is the number of poles and θ_m is the mechanical rotor angle which is equal to:

$$\theta_m = \int_0^t w_m \, dt \quad \ldots\ldots (10)$$

The function $F(\theta_e)$ gives the trapezoid waveform of the back-emf, the function can be written for one period as:

$$F(\theta_e) = \begin{cases} 1 & 0 \le \theta_e < \frac{2\pi}{3} \\ 1 - \frac{6}{\pi}(\theta_e - \frac{2\pi}{3}) & \frac{2\pi}{3} \le \theta_e < \pi \\ -1 & \pi \le \theta_e < \frac{5\pi}{3} \\ -1 + \frac{6}{\pi}(\theta_e - \frac{5\pi}{3}) & \frac{5\pi}{3} \le \theta_e < 2\pi \end{cases} \quad \ldots\ldots (11)$$

Based on Newton's 2nd law and identical to the DC motor, the anatomy of BLDC motor power and torque can be accomplished from the energy transfer standpoint, the generality of the power is transferred by the torque effect to the rotor through the air-gap which is pleaded the electromagnetic power as[16]:

$$p_e = e_a i_a + e_b i_b + e_c i_c \quad \ldots\ldots (12)$$

By eliminated the stray and mechanical losses; the electromagnetic power is completely converted to kinetic energy so [17]:

$$p_e = T_e w_m \quad \ldots\ldots (13)$$

whereT_e is the electromagnetic torque, so that from equations (6-8, 12 and 13) the electromagnetic torque can be extracted as:

$$T_e = \frac{k_t}{2} [F(\theta_e) i_a + F(\theta_e - \tfrac{2\pi}{3}) i_b + F(\theta_e + \tfrac{2\pi}{3}) i_c] \quad \ldots\ldots (14)$$

And the motion equation has to be included as:

$$T_e - T_L = J \frac{dw_m}{dt} + k_f w_m \quad \ldots\ldots (15)$$

whereT_L is the load torque, k_t is the torque constant, k_f is the viscous friction constant and J is the rotor moment of inertia.

III. SPEED CONTROL STRATEGIES OF BLDC MOTOR

Comparing with other motor types, the BLDC motor has more intricate control algorithm. There are three general methods to control the speed of BLDC motor as mentioned before. Typically, dual-closed-loop speed control is common in control system. The inner loop is used to adjust the current as well as the torque to the suitable value, while the outer loop is the speed loop,

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that's used to control the motor speed. The speed controller is a portion of a closed-loop control that the actual speed is measured and draw an analogy with the set-point speed to find the error speed which its treatment by the controller to provide the better signal to the plant to obtain the measured speed as more closed to the set-point speed.

3.1 **Hysteresis Band Speed Control Method**

This is the simplest closed-loop control method, where the amount of the controlled speed is forced to pause within a certain limit (hysteresis band) around a set-point amount. Fig. 2 shows the schematic diagram of the BLDC motor hysteresis band speed control. As to control the speed of the motor, the motor will turn-off if the speed arrives at a certain level over the set-point speed and back turn-on when the speed declines below a certain level below the set-point speed [2, 18].

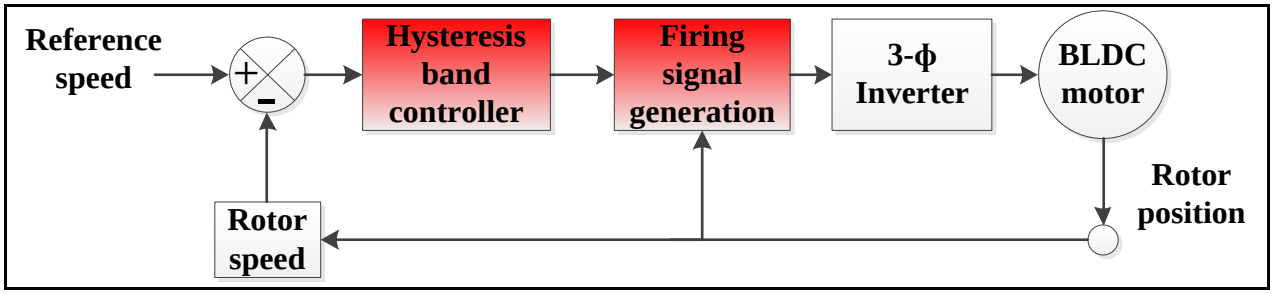

Fig.2: Schematic diagram of the BLDC motor drive hysteresis band speed control system.

3.2 **Variable DC-Link Voltage Speed Control Method**

By this method, the control of the DC bus voltage is used for obtaining the controlling speed. The motor voltage variation can be achieved by changing the PWM duty cycle signal of the voltage controller (DC-DC converter) [19]. The buck converter connection is used here which is converting the fixed voltage into a mutable voltage to confirm the required speed of the BLDC motor speed control drive. Fig. 3 shows the schematic diagram of the BLDC motor drive variable dc-link speed control system. The rotor speed is subtracted from reference speed and the error signal is fed to the speed controller that its output is limited by the reference current. The value of the reference current is derived from the reference torque by the following relationship [2]:

$$I_{ref} = \frac{T_{ref}}{k_t} \quad \text{..... (16)}$$

The equivalent signal of the DC-link current is synthesized from the three-phase stator currents then subtracted from the speed controller output. After that, the error signal is fed to the torque controller. The output signal from the torque controller is limited by an applied voltage source. Then the final control signal is supplied to the DC-DC converter to control the duty cycle using PWM technique by comparing it to the triangular wave which will give the voltage amplitude required to the inverter to maintain the desired speed.

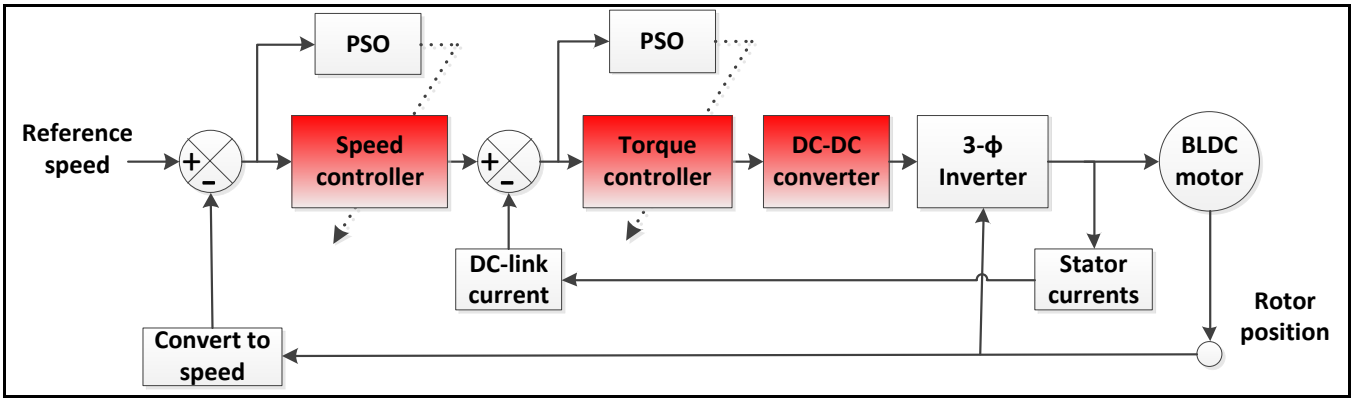

Fig.3: Schematic diagram of the BLDC motor drive variable dc-link voltage speed control system.

3.3PWM Speed Control Method

The schematic block diagram of the command system used in this method is same as that in Fig. 3 but the DC-DC converter block is replaced by the Pulse Width Modulation (PWM) block not to modify the dc bus voltage but to modify the duty cycle of switches firing signals as shown in Fig. 4. The BLDC motor speed directly changes by modulation the duty cycle of the inverter switches firing signals depends on the control error. In this control method, the motor will turn on and

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off at a high rate, the chopping frequency is fixed but the control error will change the duty cycle's length [2]. The truth that the frequency is fixed lets that the electromagnetic noise and acoustic filtering easier. The switching frequency is usually 20-50 KHz where the higher frequency will give low variation in current and also smoother torque. The suggest control system consists of proposed currents sensors to apply the necessary three phase currents to obtain dc link current. This is useful for retaining the motor current at the desired value at starting and step change speed by presence the torque controller. By this method, the control of the firing signals duty cycle length of a PWM; obtaining a controlling speed. Here the torque controller output is fed to the PWM block to compare it with the triangular waveform where the output of the comparator is a low or high signal which turns as a chopping signal for the inverter.

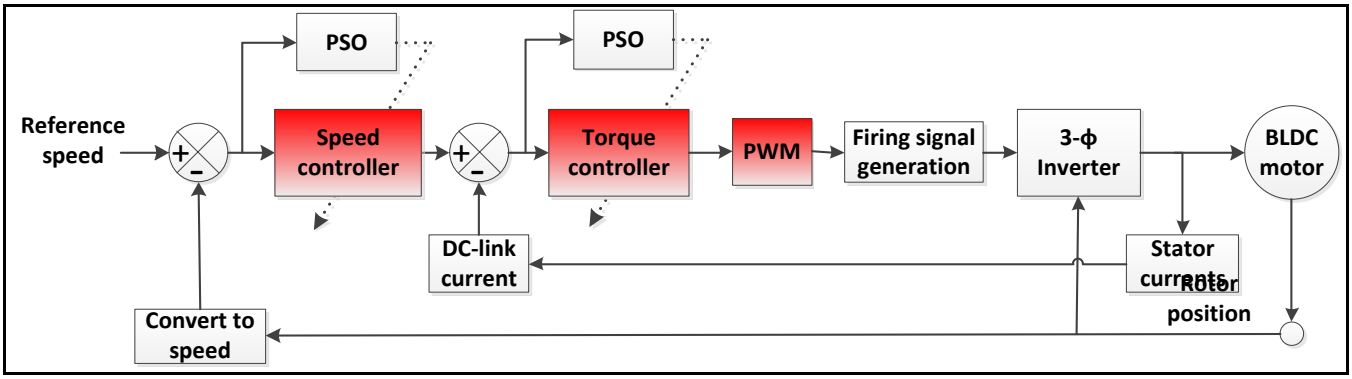

Fig. 4: Schematic diagram of the BLDC motor drive PWM speed control system.

IV. EMPLOYMENT OF PARTICLE SWARM OPTIMIZATION FOR BLDC MOTOR CONTROL SYSTEM

Particle Swarm Optimization (PSO) is an investigative algorithm first come in 1995 as a mohair amount by Russell Eberhart and James Kennedy [20]. They look that the bees swarm will job altogether to detect an area with ultimate food. Each demarcation bee in the swarm seeking a casual area and gets the area for the ultimate plenty food. The demarcation bee will then pass this location to the whole swarm then compare this demarcation position of food among the other positions informed by the other bees. Eberhart and Kennedy convert the biological notions of the swarm attitude to engineering converge by using the nature idea; a swarm will find the better solution from the swarm intelligence [21].

In the engineering systems, the particles in the swarm are demarcation elements in the swarm accountable for moving to their personal best values (pbest) and the swarm (global) best value (gbest) all the however continually seeking their current position to observe for good values than what the block has. The blocks' position is the location given a particular border for which to seek in it. Estimation of the position is completed during a fitness function that responds the optimal solution. The basic PSO algorithm is below as described in the flowchart that is shown in Fig. 5 [22-24]. For PID controller system, there always four fitness functions to depict the system response which are Integrated Square of Error (ISE), Integrated Absolute Error (IAE), Integrated Absolute Time weight Error (IATE) and Integrated of Time weight Square Error (ITSE). They are used to minimize the steady-state error, maximum overshoot, reference tracking error, settling time and rise time for the PSO-PID controller system. Here, is used multi-fitness functions based on the (ISE) and overshoot (Mp) criterions as follow:

Function for Fitness = min (ISE) + min (Mp) …… (17)

where:

$ISE = \int e^2(t)\, dt$…… (18)

$Mp = \max(n) - (n_{ref})$ …… (19)

$e(t) = n(t) - n_{ref}(t)$ …… (20)

where n(t) is the output speed of the model and $n_{ref}(t)$ is the desired speed.

Equations (21-22) shows the updating of velocity $v_i(t)$ and the current position $x_i(t)$ respectively for each swarm particle. Then the main loop and the fitness function begin to perform their calculations for updating the position of particles. If the new amount is superior to the previous lbest then the new amount is adjusted to lbest. Compatible, gbest amount is also updated as the better lbest. The velocity of any rep can be adjusted by the equation:

$$v_i^{k+1} = W * v_i^k + C_1 * R_1 * (lbest_i - x_i^k) + C_2 * R_2 * (gbest_i - x_i^k) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (21)$$

and the current position can be adjusted by the equation:

$$x_i^{k+1} = x_i^k + v_i^{k+1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (22)$$

where v_i^k is the velocity at iteration k of particle i, x_i^k is the current position at iteration k of particle i, W is the weight of inertia which can be represented by equation (3.7) below, C_1, C_2 are positive constants of acceleration, R_1

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and R_2 are casual variables uniformly extend in range (0-1).

$$W = W_{max} - \left(\frac{W_{max}-W_{min}}{k_{max}}\right) * k \quad \text{..... (23)}$$

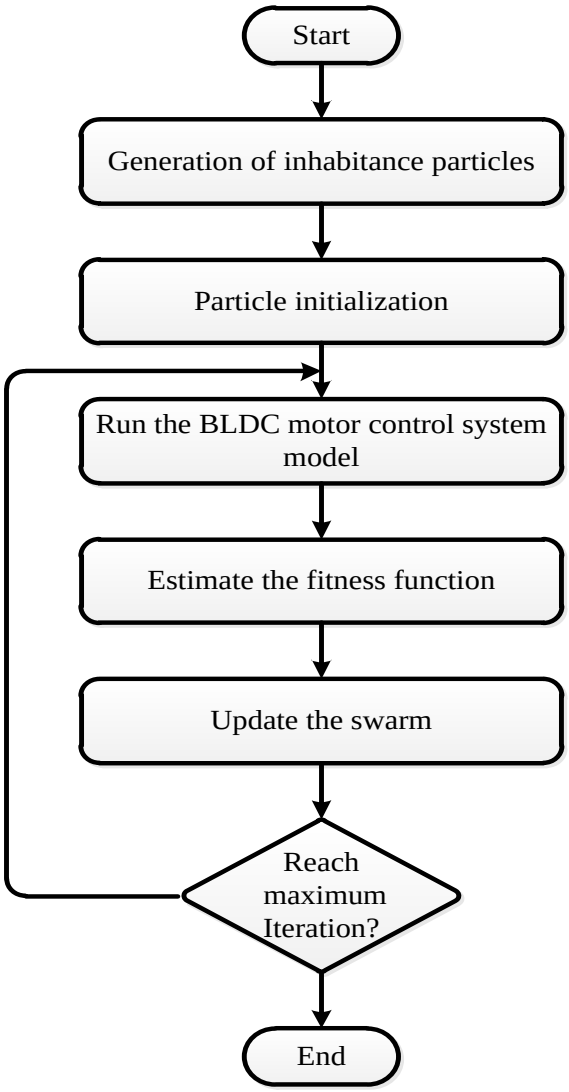

Fig. 5: The general flowchart of PSO.

If the predetermined maximum iteration number is reached, then stop the algorithm. Otherwise, do another initialization for any particle and repeat the operation.

The PSO algorithm is performed in MATLAB with its parameters shown in Table 1. Among Linear Quadratic Regulator (LQR) and Genetic Algorithm (GA) methods, PSO algorithm is greater efficient to get better the characteristics of step response as reducing the rise time, steady-state error, settling time and maximum overshoot and undershoot for controlling the speed [25].

Table.1: PSO parameters values.

PSO-Parameters	Values
Size of the swarm (no. of bees)	50
Maximum iteration number (k_{max})	50
Dimension	3
C_1	1.2
C_2	1.2
W_{max}	0.9
W_{min}	0.01

V. SIMULATION AND RESULTS

The plenary BLDC motor drive Simulink model has been performed using MATLAB/SIMULINK software. Each part of the BLDC motor drive model is finalized by a set of mathematical model. As a set of equations (1-15) for the motor block when combined together outline the complete system model as shown in Fig. 5. The motor parameters used here are shown in Table 2.

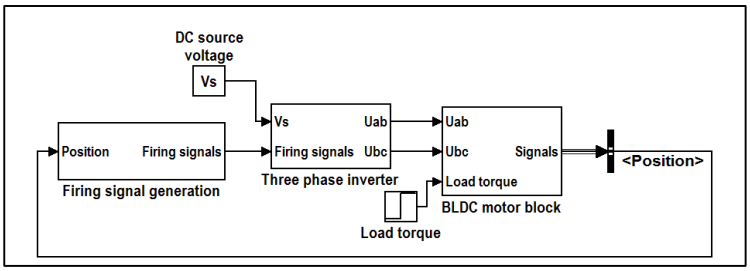

Fig. 6: Simulink model of BLDC motor drive system.

Table.2: Data of BLDC motor.

Parameters types	Parameters values	Units
Rated power	1200	W
Rated voltage	76	V
Rated current	16	A
Rated torque	2.9	N.m
No load current	0.66	A
No load speed	3500	rpm
Torque constant	0.207	Nm/A
Voltage constant	0.207	V.s/rad
Terminal resistance	0.110	Ω
Inductance(L-M)	0.6	mH
Viscous damping factor	$1.3x10^{-4}$	N.m s/rad
Rotor inertia	$1.7x110^{-3}$	$kg.m^2$
Number of poles	8	

Fig. 7 shows the simulink model of BLDC motor drive with hysteresis band speed controller block. The rotor speed is fed to the relay block and the set-point speed

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value is the input to the relay block upper and lower limits plus and minus half of the hysteresis bandwidth respectively. The width of the hysteresis band is 1.2% of the set-point speed. Fig. 8 shows the rotor speed through a set-point of 2500 rpm and the load torque 2.9 N.m is applied at 0.5 seconds. The speed stays within the hysteresis band of ±30rpm around the set-point speed. The electromagnetic torque and phase current i_a are shown in Figs. 9 and 10 respectively.

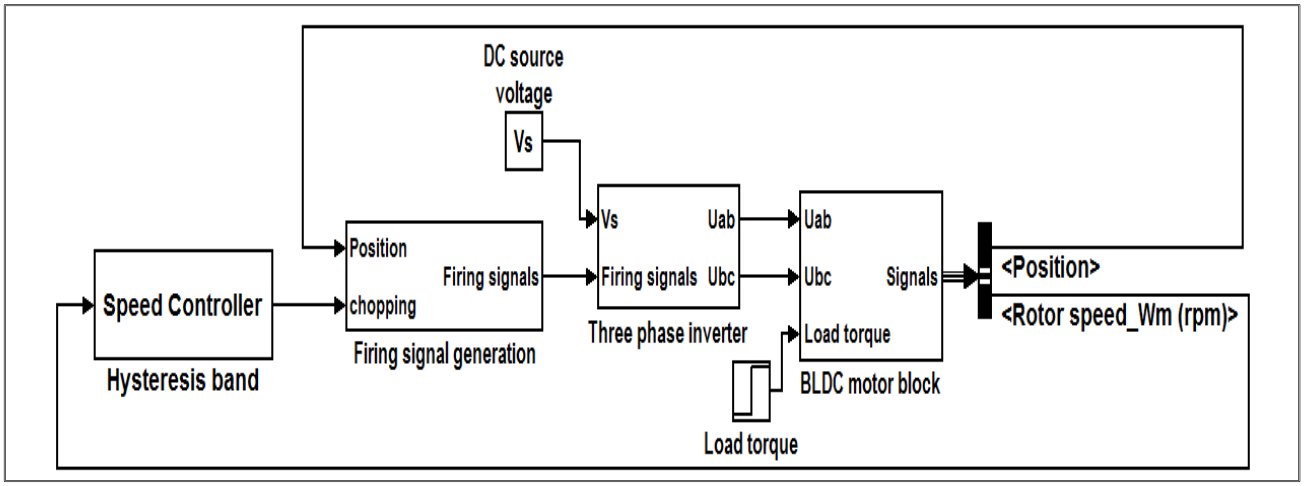

Fig. 7: Simulink model of BLDC motor drive with hysteresis band speed controller.

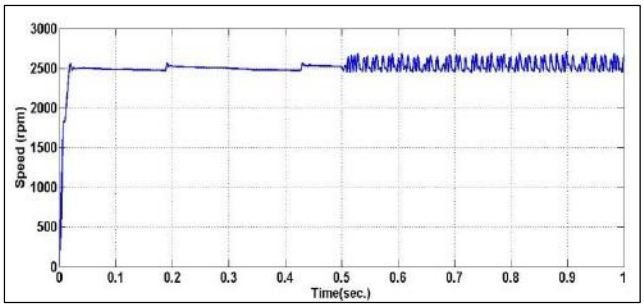

Fig. 8: BLDC motor speed using hysteresis band control.

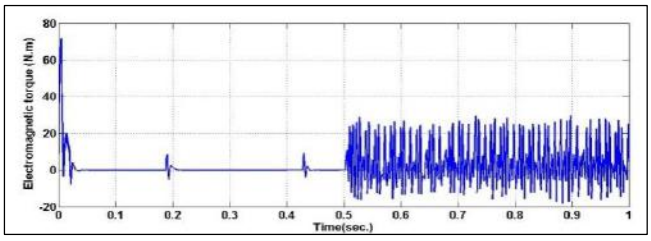

Fig. 9: BLDC motor electromagnetic torque using hysteresis band control.

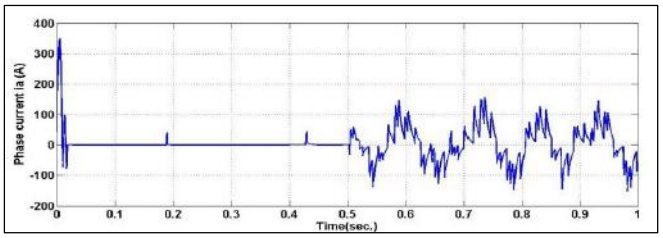

Fig. 10: BLDC motor phase current using hysteresis band control.

The BLDC motor Simulink model based on dual closed loop for speed and current limiting control using PID controllers and controlled DC bus voltage has been enforced using MATLAB/SIMULINK software (R2015a) with Bogaki-Shampine (ode3) fixed step type solver by fundamental sample time is $3*10^{-6}$ seconds as shown in Fig. 11. The dual control loops are used; where the outer loop is used to control the rotor speed and the inner loop to control currents or torque. The PID controllers' gains are optimized using PSO algorithm.After iteration 37, the gains are shown in Table 3.

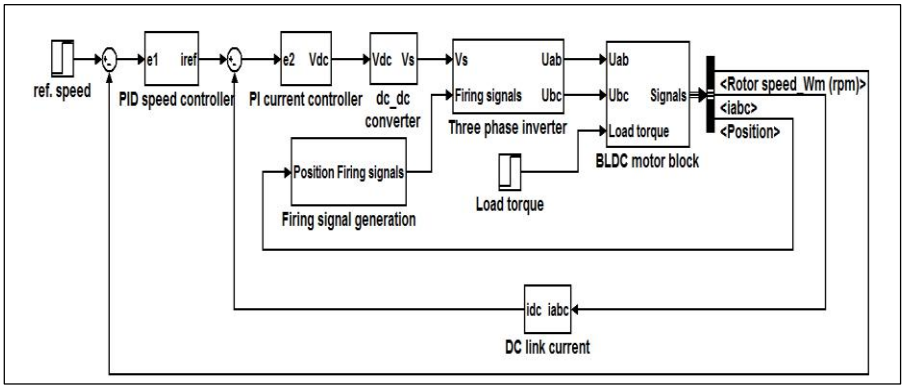

Fig.11: Simulink model of BLDC motor drive with variable DC bus voltage dual loop PID controller

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Table.3: PID optimized parameters.

Parameters	Values
Speed controller	
Proportional (k_p)	2.779
Integral (k_i)	0.9898
Derivative (k_d)	0.03751
Current controller	
Proportional (k_p)	2.996
Integral (k_i)	1.391

Fig. 12 shows the speed response for 2000 rpm reference speed starting with no load and the full load 2.9N.m is applied at 0.5 seconds.The electromagnetic torque and phase current i_a are shown in Figs. 13 and 14 respectively. The variable DC link voltage controlling method has some merits. A linear power stage is cheaper but at high current and low voltage, the losses can be high.

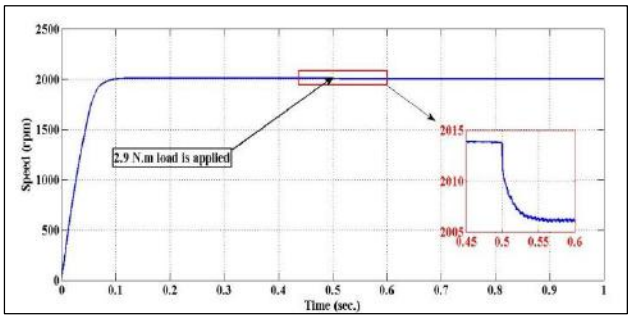

Fig.12: Speed response for variable DC link controller.

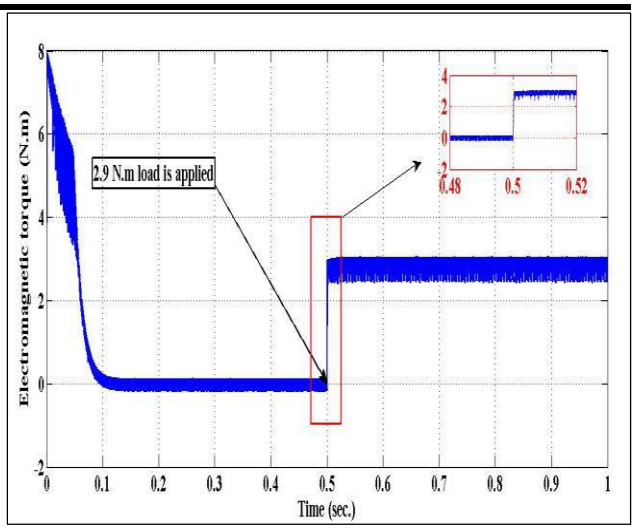

Fig. 13: Electromagnetic torque for the variable DC link controller

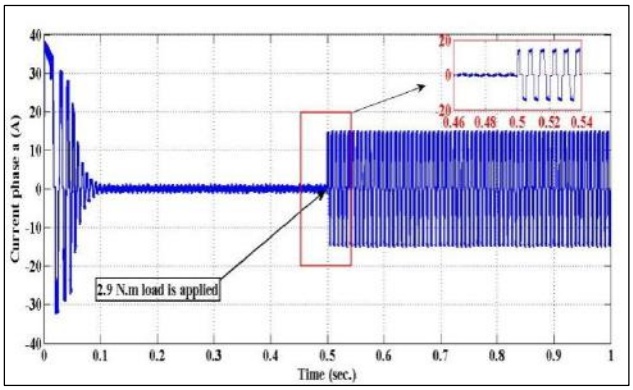

Fig. 14: Current phase (a) for the variable DC link controller.

PWM's technique with the same details in the previous controlling method is shown in Fig. 15. The gains of PID speed controller and PI current controller blocks diagrams are same as that used in the variable DC link control.

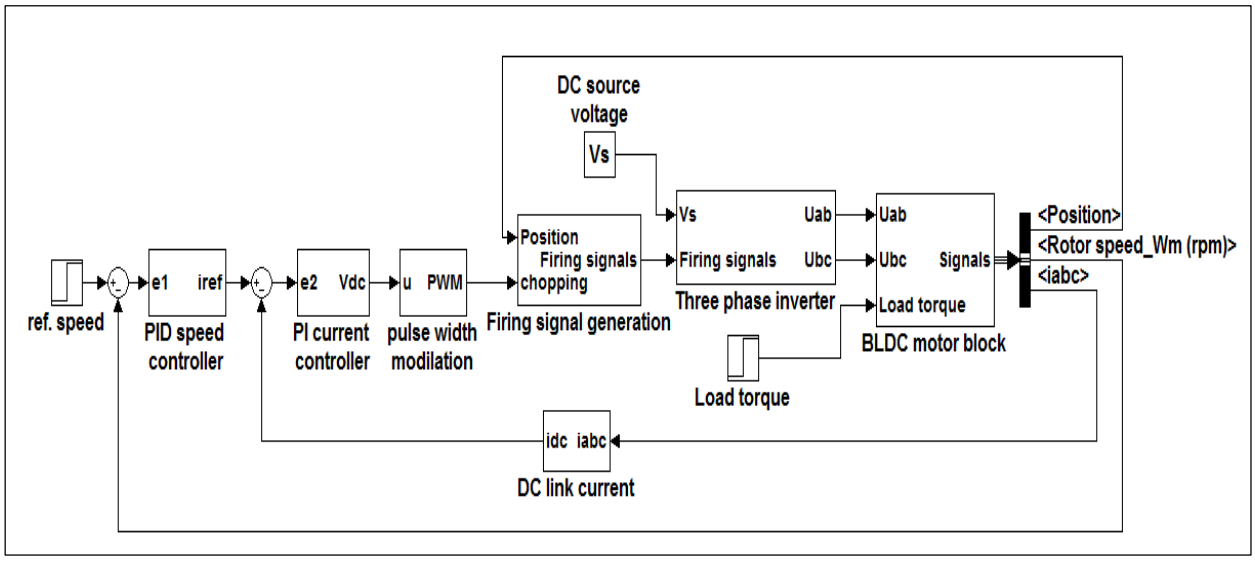

Fig. 15: Simulink model for BLDC motor drive with PWM dual loop PID controller.

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Fig. 16 shows the speed response for 2000 rpm reference speed starting with no load and the full load 2.9N.m is applied at 0.5 seconds.The electromagnetic torque and phase current i_a are shown in Figs. 17 and 18 respectively.

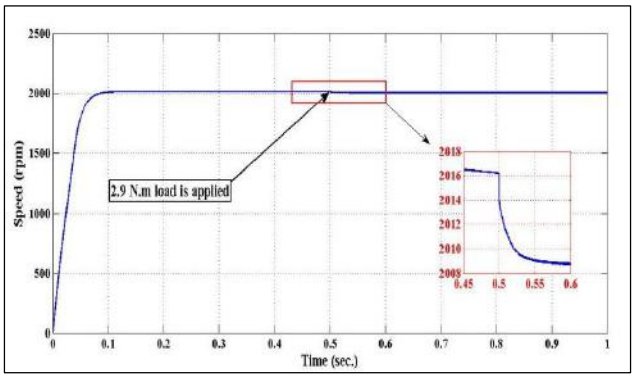

Fig. 16: Speed response for PWM controller.

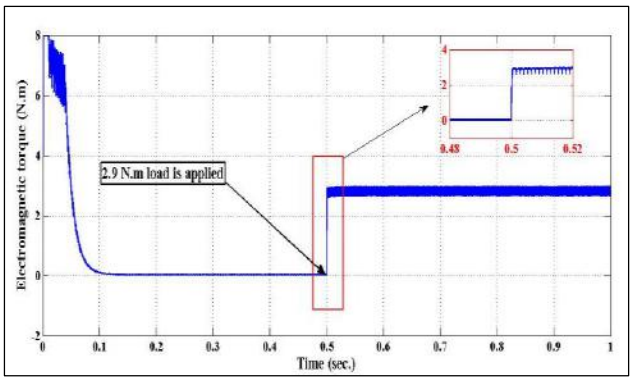

Fig. 17: Electromagnetic torque for PWM controller.

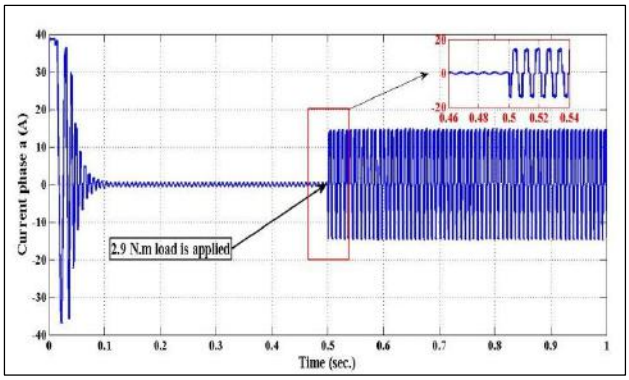

Fig. 18: Current phase (a) for PWM controller.

VI. FREQUENCY ANALYSIS

The current frequency spectrum is a significant factor in the electrical systems. The BLDC motor is nonlinear load has non-sinusoidal current and voltage waveforms, which will produce harmonics in the power line system. Harmonic is a periodic wave component having an integral multiple of the fundamental frequency. Harmonic distortion is a dirty power particular type usually linked with industrial plants that used adaptable power supplies, speed drives, and other equipment's use solid-state switching[2, 26].

The harmonic distortion level of current or voltage can be extracted by the total harmonicdistortion (THD) term of voltage or current waveform as[27]:

$$x_{THD} = \frac{\sqrt{x_2^2+x_3^2+\cdots+x_n^2}}{x_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (24)$$

where x is any of current or voltage, x_1 is fundamental value and x_n (n = 1, 2, 3, … etc.) is the harmonics values. Harmonic distortion of voltage and current have existed together (current harmonic distortion causes voltage harmonic distortion). Harmonic distortion increase voltage peaks that make extra stress on motor and wire insulation leads to breakdown and failure. Over and above, harmonics increase RMS current, leads to increase operating temperature of the motor so reducing its life. Many methods are found to identify the harmonics. In this paper, Fast Fourier Transform (FFT) analysis is used because of quick response and easy in implementation [26, 27].

Figs. 19 and 20 show the hysteresis band control phase current $i_a$frequency spectrum at no load and full load respectively. The fundamental frequency is 8Hz and THD is 569.14% for no-load while fundamental frequency is 10Hz and THD is 57.96% for a full load. It is clear that the switching frequency varies with varying load and the harmonics of the fundamental frequency are quite strong which are the main disadvantage of hysteresis control because it makes difficult to filter out the undesired harmonics.Figs.21 and 22 show the same frequency spectrum as the previous conditions but now for variable dc-link control. The figures show that the frequency content is constant at no load and full load by 125Hz and THD is 62.69% at no load and 33.16% at full load.Figs. 23 and 24 show the same frequency spectrum as the previous conditions but now for PWM control. The fundamental frequency is also constant 125Hz and independent on the varied load but here the THD is 8.94% at no load and 28.49% at full load for that this method is more popular than the other two methods as filtering becomes more easier.

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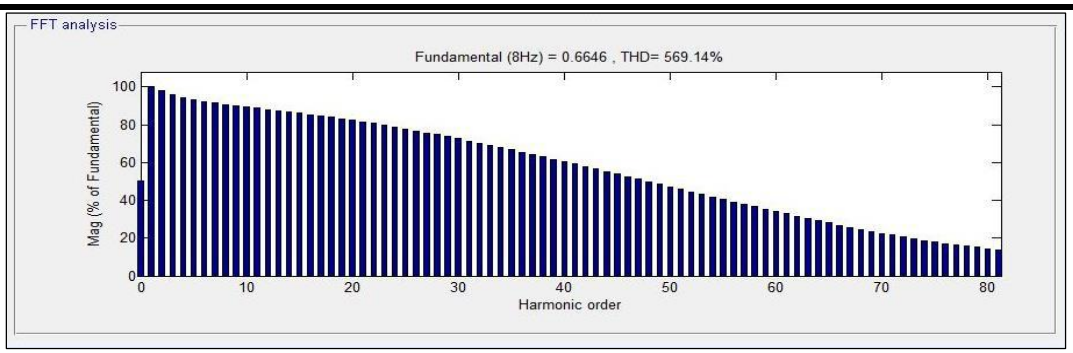

Fig. 19: The frequency spectrum of current for hysteresis control motor at no load.

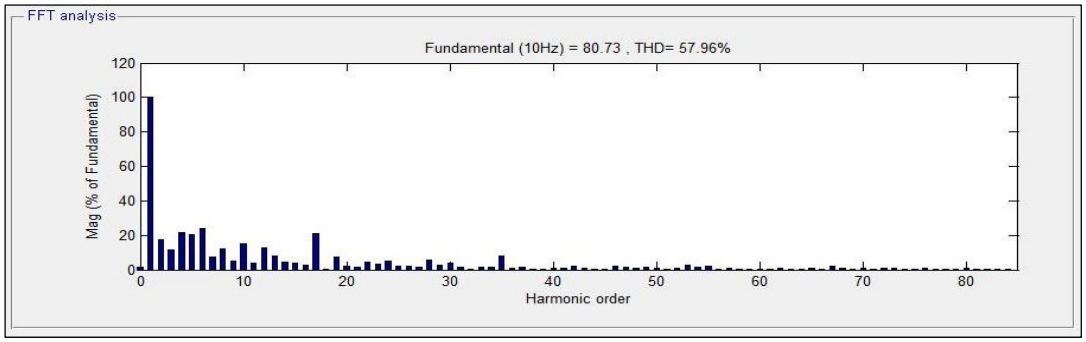

Fig. 20: The frequency spectrum of current for hysteresis control motor at full load.

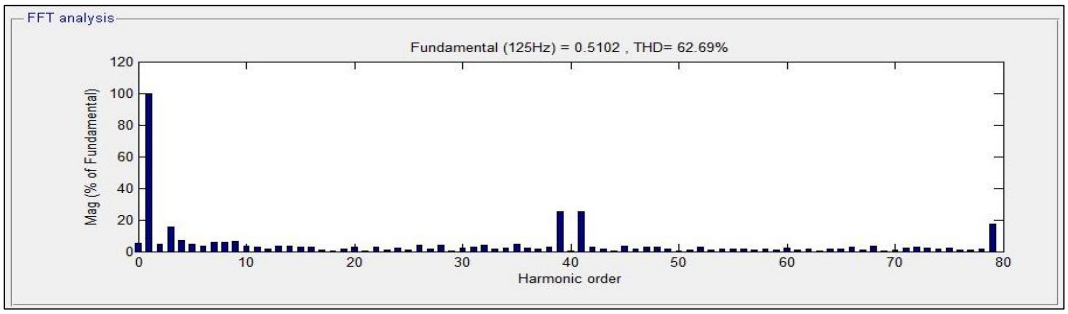

Fig. 21: The frequency spectrum of current for variable dc-link voltage control motor at no load.

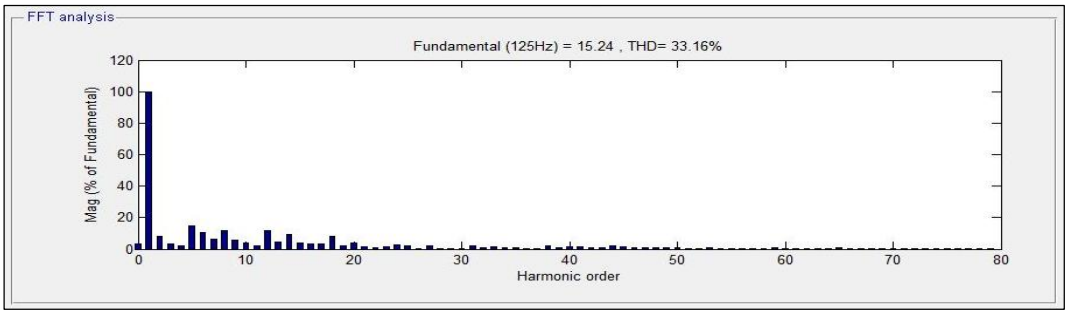

Fig. 22: The frequency spectrum of current for variable dc-link voltage control motor at full load.

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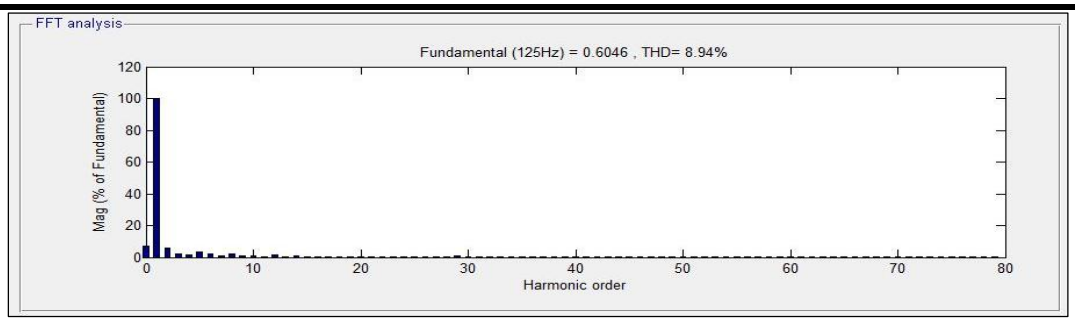

Fig. 23: The frequency spectrum of current for PWM control motor at no load.

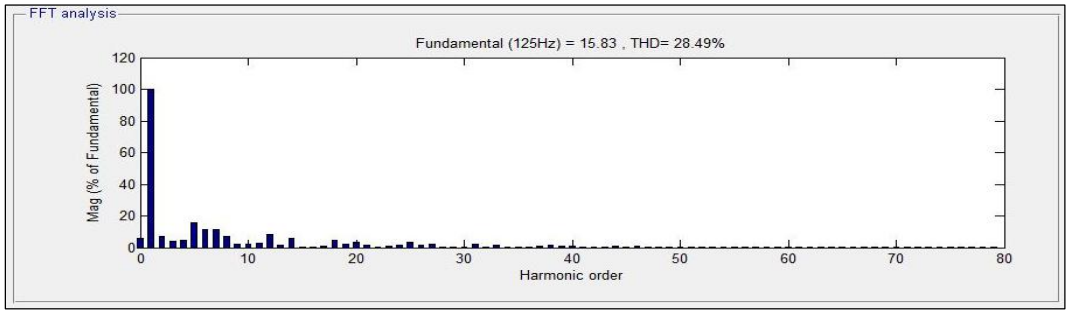

Fig. 24: The frequency spectrum of current for PWM control motor at full load.

VII. COMPARISON BETWEEN CONTROLLING METHODS

The comparison is done with respect to the operation and results from the output waveform of the performing models and the FFT analysis results as shown in Table 4 below:

Table.4: Comparison between controlling methods.

Methods / Subject		Hysteresis band	Variable dc-link	PWM
Signal's ripple		**Very high**	**Medium**	**Low**
Current THD	At no load	569.14%	62.69%	8.94%
	At full load	57.96%	33.16%	28.49%
Applicable		Very easy	Easy	Difficult
Output RMS current A	At no load (0.66) A	0.6646	0.5102	0.6046
	At full load (16) A	80.73	15.24	15.83
Operation frequency		Variable with load (8-10)Hz	Constant with load 125Hz	Constant with load 125Hz

VIII. CONCLUSION

In this paper, the BLDC motor speed and current control was performed using three various control methods: hysteresis band, variable dc-link voltage and PWM speed control methods. All of them are performed well and discussed its drawbacks. The PID parameters are optimized using PSO algorithm which gives optimal values with stable operation. All the mentioned controllers expect the hysteresis controller are attached to the current controller to limit the starting and operation current in order to protect the motor and other connected devices. Frequency analysis was implemented using FFT analysis and found that the hysteresis control has uncontrolled switching frequencies that may be unacceptable in more situations as narrow hysteresis band high switching losses. Because of a fixed frequency in variable dc-link voltage and PWM speed controller makes the most popular in speed control. But the PWM technique is more preferably above two methods.

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Effective Methods of using of the Water Resources of Mountain Rivers with high turbidity

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Abstract*—The article focuses on the solution methods of the problems arising from the rational use of the water resources of mountain rivers with high turbidity.Technical and operational indicators of water reservoirs constructed on mountain rivers characterised by high turbidity have been analysed and measures preventing stagnation of water reservoirs have been investigated.Issues related to the construction of a water reservoir outside the river bed and the prevention of stagnation of this water reservoir were investigated. The option of building a water receiving reservoir providing partial regulation and limpidity of the flow in the river valley was proposed. Hydraulic washing installation was proposed to remove sediments from the water reservoir equipped with the water tank. The working principle of washing installation with hydro-technical and hydraulic parameters are listed.*

Keywords*— mountain rivers, water resources, sediment, hydraulic irradiation, water reservoirs,water grubbing dam, water receiver/tank, washing corridor,directional walls.

I. INTRODUCTION

Recently, acceleration of joining of fertile soils located in the foothills zone to the sowing cycle has led to the extensive use of the water resources. As a rule, a water reservoir is being constructed in its scope to enable annual or perennial adjustment on the riverbed to use the water resources of the mountain rivers efficiently.The operational experience of the water reservoirs built in last 70 years in the world shows that reservoirs built on many mountain rivers lose their volumes while silting and become useless for exploitation.Sediments in the flow enter to the water management systems along with water during the withdrawal of water from such reservoirs. Sediments lead to the disruption of water management systems and complicate the process of exploitation. River sediments basically silt the water reservoir, decreases its useful volume, shortens the service life, complicates the exploitation of the water intake junction, reduces the submersible ability of channels by siltation.

Anti-siltation measures in water reservoirs are mainly carried out in passive form, i.e. after siltation of the reservoir by hydraulic washing or hydro mechanical methods. As the sediments in the water reservoir become solidified, the use of these methods is observed with great energy and water loss and is not considered economically viable.

II. CURRENT STATE OF THE PROBLEM AND FINDINGS OF THE RESEARCH

There are many water reservoirs that built in North America, Africa, including Central Asia, and Azerbaijan in the world, which have stopped their operations before the end of exploitation because of siltation.Water reservoirs in the United States are estimated to be silted 1.2 billion cubic meters a year, and this indication in China's Shanghai province is 80 million cubic meters.2 % of water reservoirs in Japan, and 1 % of in India and Portugal lose its volume annually due to siltation.[5]

The Khashm Roseires water reservoir in the Sudanese Republic has lost about 50-55 million cubic meters, or about 60% of the total volume, during the first decade. In the United States, the volume of Garrison, Saxe, Fort water reservoirs decreases by 30-45 million cubic meters per year as a result of intensive sedimentation.

There are many water reservoirs located on the mountain rivers flowing through the North Caucasus and Central Asia which silted up to 70-90% in 5-10 years.[5]

Pirsaatchay, Bolgarchay, Javanshir, Jeyranbatan, and Ayrichay are examples of water reservoirs exposed to the over siltation in the Republic of Azerbaijan. The Ayrichay water reservoir, which was commissioned in 1986 with a useful volume of 80 million m^3, was silted up to 80%. Pirsaatchay and Bolgarchay water reservoirs constructed in 1964-1965 generally stopped their activities.(photo 1). The main reason for rapid siltation of all these reservoirs is the high turbidity of rivers and the lack of preventive measures during the exploitation

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period. In the territory of the Republic of Azerbaijan, there are several mountain rivers with high turbidity, which is why they are not used effectively for their water resources. An example of these rivers is Sumgayitchay, Kazluchay, Turyanchay, Jeyrankezmez, Karachay, Girdimanchay, Goychay Gobuchay.

Girdimançay is relatively exuberant but very turbid among these rivers. Girdimanchay's water resources are currently used in very small quantities incoherently. The reason for this is that the water of the river is high turbid and often occurs destructive floods. The problem of constructing a reservoir on the river has been repeatedly tried and therefore no work has been done.

Fig.1: Pirsaatchay water reservoir built in 1964 with a total area of 16.9 million m^3(2017)

S.T. Altunin, N.F. Lapshenkov, G.I. Shamov, D.I.Mukhammedov, L.G. Gvelesiani, V.A. Skrillnikov, G.T. Macharadze, F.B. Bashirov and A.M. Mammadov conducted wide research in the rivers located in Central Asia and the South Caucasus related to the forecasting reports on the sedimentation of the water reservoirs and prevention from that [5,7,10].

V.A. Skrilnikov conducted extensive research on the dynamics of sedimentation and the deposition of sediments of the water reservoirs built on the territory of Central Asia. He proposed removing slimes that collapse in the valley usingslime washing equipment with hydromechanical method. It should be noted that this cleaning method is considered to be feasible for regions with low water resources.

G.T. Macharadze examined the reasons of the sedimentation of many water reservoirs built in the territory of the Republic ofGeorgia and proposed the following method for the cleaning of collapsing slimes. (Figure2)

Adjusting unit in the riverbed of the upper part of the water reservoir has been designed in the method proposed by G.T. Macharadze. Binding sluices regulated with the lifting crane attached to the unit to control the river flow. The working principle of the unit is as follows. Initially, binders 6 and 8, shown in Figure 2, are kept closed, the binder 7 is opened to pump water in that direction and the slime sediments are removed from the area by the bottom water discharger. In the next stage, the bottom discharge unit is closed and water is collected inside the valley washed by the channel 12. In this case, a certain amount of sediments in the upper parts are washed and removed from the area with the bottom discharge unit.Then, alternately, the other binders are opened and the sediments are washed in the same direction. The proposed method has the following disadvantages:

- the water reservoir should be completely discharged to wash the sediments, in this case, large quantities of water losses occur;
- the river flow cannot be controlled as the mechanism cannot be brought to the surface of sediment;
- because the river flow is not controlled, the established erosion valley is usually formed by passing the parts where the relatively small amounts of slimes deposited. This causes a small amount of slime washing;
- The flow of water discharged from the gateway at the entrance of the water reservoir enters into the initial erosion valley after a short distance and covers only a small part of the sedimentary area inside the water reservoir;

During washing process in the subsequent years, it is not possible to go beyond the erosion valley at the initial stage, and only a small part of the water reservoir can be cleaned from the slimes;

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Even though there is more turbidity is observed in the initial stage of washing time, in the ongoing process the amount of turbidity in the wash water is dramatically decreasing causing large quantities of water losses;

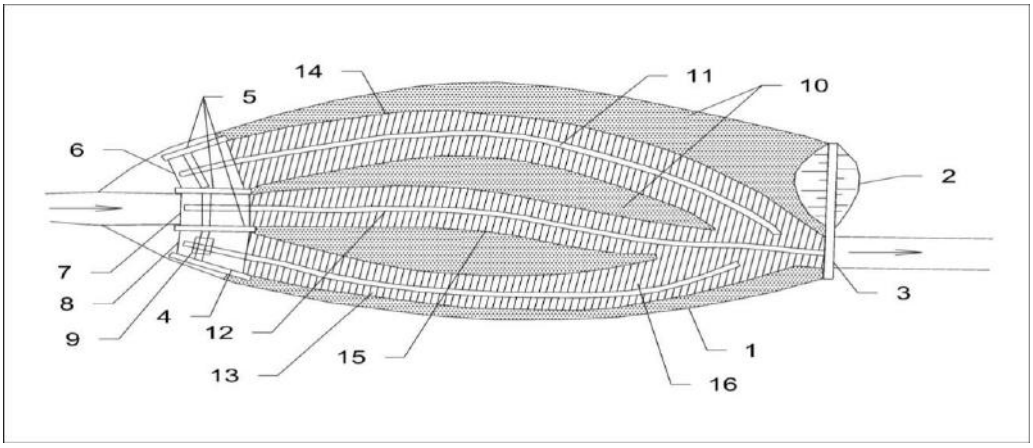

Fig.2: Hydraulically wiping the lions in water reservoirs.

1-water reservoir, 2-dam, 3- bottom water pumper, 4-Sluice gate, 5-directional walls, 6,7,8-binders, 9-lifting crane for the control of binders, 10-slime sediments, 11,12,13-erosion valleys after cleaning, 14,15,16-the islands after the wash, respectively.

F.B.Bashirov conducted extensive research on washing of deposited slimes in Siyazan water reservoir with a volume of 6.6 m^3, designed to prevent sedimentation of the Samur Absheron Channel in the territory of the Republic of Azerbaijan, and proposed a method for intensifying the washing process.(Figure 3)

In the proposed method for washing Siyazan water decanter by F.B. Bashirov, the channels were laid along the coast of the basin in the direction of the dam. Special cuts and binding gates are placed on the channels to provide the washing water. Coastal channels are supplied with water through the gates 9, 11 and 14.Washing operations are carried out through the cuts on the channels and, in addition, washing operations are carried out by the release of water in sluices # 10 and 13. In this method, washing water is partially controlled, unlike the previous one. However, in this method, the water flows released for subsequent washings reaches to the erosion valley emerged from the previous wash, and parts that are not washed remain in the form of the island.

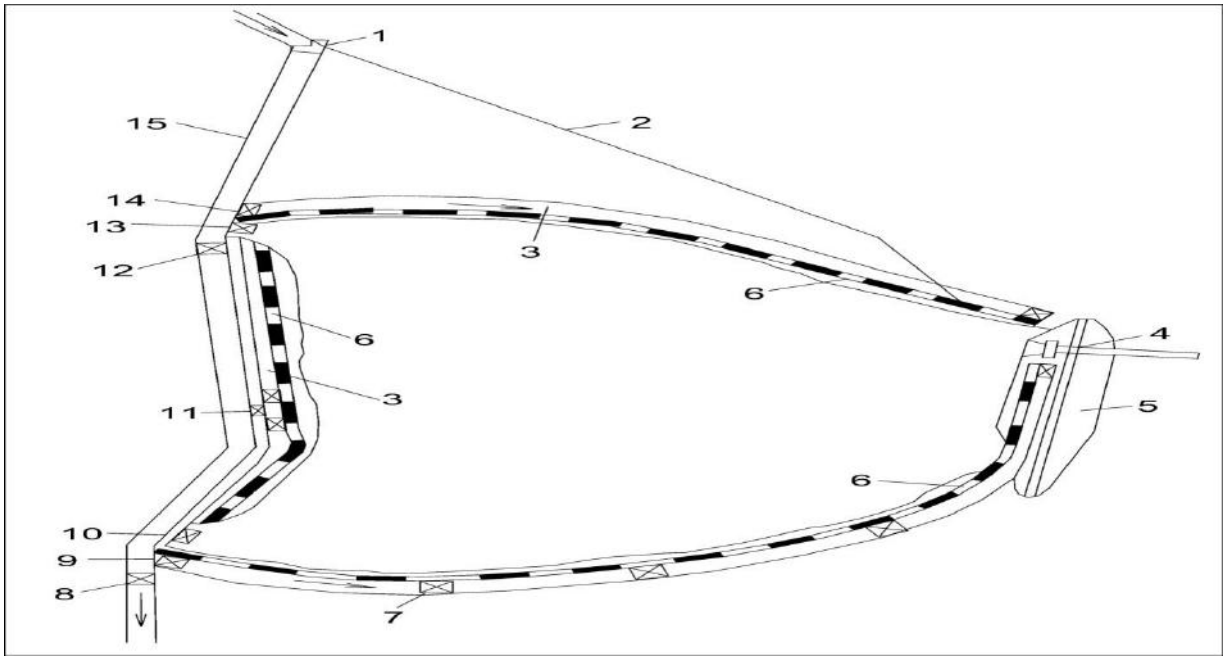

Fig.3: Basin of Siazan water reservoir and washing unit.

1. *Sluice, 2. leading channel, 3. washing channel, 4. water discharge device, 5.dam, 6.water discharge cuts on the washing channel; 7,8 və 12 binding gates, 9,10,11,13 və 14 control gates, 15 Samur Absheron channel.*

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A. Sh. Mammadov, in contrast to existing approaches, proposed a method for preventing siltation during the operation of water reservoirs. He proposed a new constructive solution to discharge the more turbid flows, floods and water that flow from the river to the water reservoir to lower canal pound without mixing in the water of the reservoirIn order to discharge more turbid waters to the lower canal pound without siltation in the water reservoir decanter equipment has been removed by means of a special pipe to the entrance of the water reservoir.The water discharge tower is provided with multi-stage washing gates, which ensures the discharge of more turbid flows from the river into the lower canal poundand allows to prevent siltation of the water reservoir. The proposed installation complexes are considered to be more favourable for the waterreservoirs which are not long but are deep (1-2 km).

It should be noted that existing methods and designs do not allow to solve the problems arising from the effective use of the waters of exuberant mountain rivers characterised by the high turbidity.

There are several shortcomings of existing methods:

1. There are not taken anti-siltation measures in the water reservoirs;
2. Larger water losses occur during hydraulic washing of sediments;
3. Ignore the volume of flood bringing in siltation reports;
4. Deterioration of the quality of water collected in the water reservoir due impact of the flood bringing;
5. Accidents occurring when floodwater enters rapidly into the water reservoir (occurrence of fluctuations in full water reservoir due to floods is dangerous as dam can collapse due to wash);

We developed a new reporting method to prevent such cases and to use more efficientwater resources of rivers with high turbidity. While developing a new method, it was preferred to use water resources of mountain rivers with high turbidity more efficiently and eliminate the major shortcomings of existing methods.

In order to effectively use water resources of rivers with high turbidity and fight against the turbidity, A.Sh. Mammadov recommends the construction of water reservoirs outside the riverbed. Herecommends that the water is taken from the river by the intake facility and transferred to the water reservoir to be constructed outside the mold by focusing on the drainage device. It should be noted that the fight against lilies in high-lush rivers is not economically viable and more water and electricity (for opening and closing of doors) are used to hydraulically wash the collapsing lanes. [10]It is recommended to take the water from the river by means of the water intake facility and to transfer to the water reservoir to be constructed outside the riverbed by discharging into the drainage equipment. It should be noted that the fight against slimes in rivers with high turbidity is not economically viable and more water and electricity (for opening and closing of gates) are used to hydraulically wash the silted slimes. [10]

The newly developed method in comparison to mentioned one allows minimising water and energy losses. The small adjustable water regulator dam at the riverbed is directly used to clarify and take the water of the river with high turbidity. The water grubbing concrete dam water intake and slime washing corridors are included in this dam junction. The complex of hydro-technical installations consisting of these units allows relatively to regulate flow in the riverbed, to precipitate the main part of the slimes and subsequently to transfer them to the riverbedwashing by the hydraulic method. Thus, this process ensures the discharge of the limpid river water into the water reservoir to be built out-of-the-riverbed.

The proposed hydraulic equipment complex should be designed within the following parameters:

- a small water intake reservoir fulfils lake type water-purification function;
- The dead pool of the water intake reservoir is determined by the hydrological regime of the river in accordance with the volume of annual or quarterly bringing of the river;
- In the water intake reservoir, high turbid river water is mainly purified and then discharged into the out-of-the-riverbed water reservoir through the open channel or pipe;
- when the floods occur in the river and where the turbidity is high, the river flow is discharged directly into lower canal pound without being stored in the water intake reservoir
- The silted sediments in the water intake reservoir without full compaction (without the colmatage) are periodically washed by thehydraulic method and discharged intothe lower canal pound.

The proposed solution for eliminating the above-mentioned shortcomings is a comparative study of Girdimanchay located in the territory of the Republic of Azerbaijan, which is considered a sample for thehigh turbid river where the frequent floods are characteristic. A comparative analysis of the technical solution was conducted by comparison of existing and new methods.

III. BRIEF HYDROLOGY OF GIRDIMANCHAY

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Girdimanchay starts at 2900 m above the southern slope of the Babadag summit (3632 m) of the Greater Caucasus Mountain Range. After leaving the mountains, the river creates a large bringingcone in the Garamaryam Plateau and breaks into many branches. By breaking this plateau, the river flows into the Shirvan plain with six branches. In 1950-60s Girdimanchay and Agsuchay were merged and discharged into the Kur River through the Shirvan Plain via single artificial riverbed. The average width of the Girdimanchay basin is 812 km and the average elevation is 1212 m. There is 64 km2 forest area in the basin. The average river slope is 32.80 / 00 and the density of the river network is 0.48 km / km2. Girdimanchay is exuberant in thespring season and flooded in autumn due to water regime. There were four hydrometric stations in Girdimanchay. (Table 1)

According to the data of the Garanour Hydrometric Station of Girdimanchay, the average perennial water flow is 6.5 m^3/sec. Floodsaredangerous events occurring frequently in the river. Flood sources cover more than 50% of the basin. Flood accidents were observed in Girdimanchay on July 27, 1915, August 11, 1926, June 14, 1930, July 15, 1947, October 18,1951, June 22, 1953, July 7, 1963, May 24, 1975, May 16, 1982. According to the data of the Garanour Hydrometric Station of Girdimanchay, the largest water flow was 201 m3 / sec on July 15, 1988.

Table.1: Hydrological indicators according to the stations operated on Girdimanchay

Rivers	Stations	Water collection areain km^2s	Average annual flow m^3/sec	Operation Period
Girdimanchay	Bruydal	78,8	1,2	1960-1962
	Gandab	326	3,03	1949-1962
	Kulullu	453	2,6	1929-1940
	Garanour	352	6,5	1966-h/h

It is currently operational.

The main measurements on the dependent bringing in Girdimanchay were carried out in Garanour station (is located in the area where the water reservoir to be constructed)in 1966-1970s. Based on observations on the dependent bringing, the amount of annual flow was 2.0-3.5 million tons. (Table 2)[1,2,3,4]

Table.2: Prices of bringings flow on Girdimanchay(Garanour station), kg/sec

Observation Period	Average flow of bringing, kg/sec												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average annual
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1966	0,89	3,3	7,1	77	320	17	10	50	410	76	140	0,98	93
1967	0,37	0,35	13	440	530	77	9,6	0,43	110	110	61	1,2	110
1968	0,27	2,2	4,1	76	26	660	27	0,52	1,8	0,36	0,43	0,84	64
1969	0,1	0,26	23	310	180	25	190	15	17	5,5	0,95	3	64
1970	1,3	3,1	39	260	25	83	13	120	2,1	3,4	0,43	0,23	46
Average	0,59	1,8	17	233	216	172	50	37	108	39	41	1,2	75

1. **The option of constructing a water reservoir with traditional method on Girdimanchay.**The option of constructing a water reservoir at the absolute level of 830 meters on Girdimanchay was studiedin order to irrigate fertile soils at the foothills of the Shirvan zone. Based on hydrological data from Girdimanchay, the reports show that the complex of hydro-technical facilities made of the dam to be constructed on the river by thetraditional method will be within the following parameters.

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Hydro-technical calculations to find the volume of newly constructed water reservoir wereconducted according to the 75% guaranteed (Q = 4.69 m^3/sec) water flow of Girdimanchay. According to the 75% guaranteed water flow of Girdimanchay, the amount of water to be collected per year is 149,76 million cubic meters, and the annual volume of bringing is 1.5 million cubic meters (Table 3). The flood rate of the water discharge tower will be Q max = 350 m^3/sec.

The water reservoir to be constructed on the riverbed can be between 830 and 970 m of height. The water surface area of the water reservoir valley in the mentioned altitude ranges from 27109 m^2 to 2400000 m^2, and the capacity of the water reservoir valley at these elevations reaches 127843 million square meters.

Based on the water balance calculations the required useful amount of water reservoir is 49,493 million m^3Accumulative slime volume was estimated at 75.18 million m^3 during the 50-year service of Girdimanchay. Thus, the full volume of the reservoir will be as follows.

$$W_t = W_f + W_{dead} = 49{,}493 + 75{,}18$$
$$= 124{,}673 mln.\, m^3$$

Thus, in the option of constructing a reservoir in the Girdimanchay riverbed, the height of
the earth dam will be 140 m. If the floods are taken into account, the dead pool of the reservoir will increase, causing the height of the dam to rise sharply. Finances are required up to 20% of the construction cost (20-30%) of the dam to discharge safely the water flow of 350 m^3/sec. To the lower canal pound.

Table.3: Average annual water flow and average perennial bringing volume in accordance with the 75% guaranteed water flow ofGirdimanchay

Indicators	**Months**												**Total annual mln.m^3**	**In 50 years mln.m^3**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		
Turbidity kg/m^3	0,3	0,76	5,3	28,7	47,7	70,2	4,95	11,3	9,47	7,6	19,7	0,52		
Water flow m^3/sec	2,02	2,38	3,19	8,12	4,53	2,45	10,1	3,26	11,4	5,12	2,08	2,27	149,7	
Monthly discharge m^3/month	10014	2735	283022	377531	3617720	2786244	8369292	6166 67	1748492	651 139	663 81	1976	1,50	75,18

Apparently, 75.18 million cubic meters of the water reservoir is used for the collection of dead pool, and the construction of the dam at this height in the river valley with strong floods cannot be considered as economically and operationally expedient and is very risky. Given the seismicity of the area, the construction and special exploitation costs of the dam at this altitude require considerable funding.

2. The option of the construction low-pressure water intake reservoir on Girdimanchay.

a) The construction of a water intake reservoir is intended for the aim of siltation of the river bringing between 830-845 meters on Girdimanchay and discharging to the lower canal pound by washing through the hydraulic method with the interruptions.

b) It is envisaged to construct a water reservoir with a height of 620-680 m on the right bank of Girdimanchay to collect partially limpid water to be taken from the river.

Main characteristic of water intake reservoir:The planned water intake reservoir can be constructed between the altitudes of 830-845 m on Girdimanchay.

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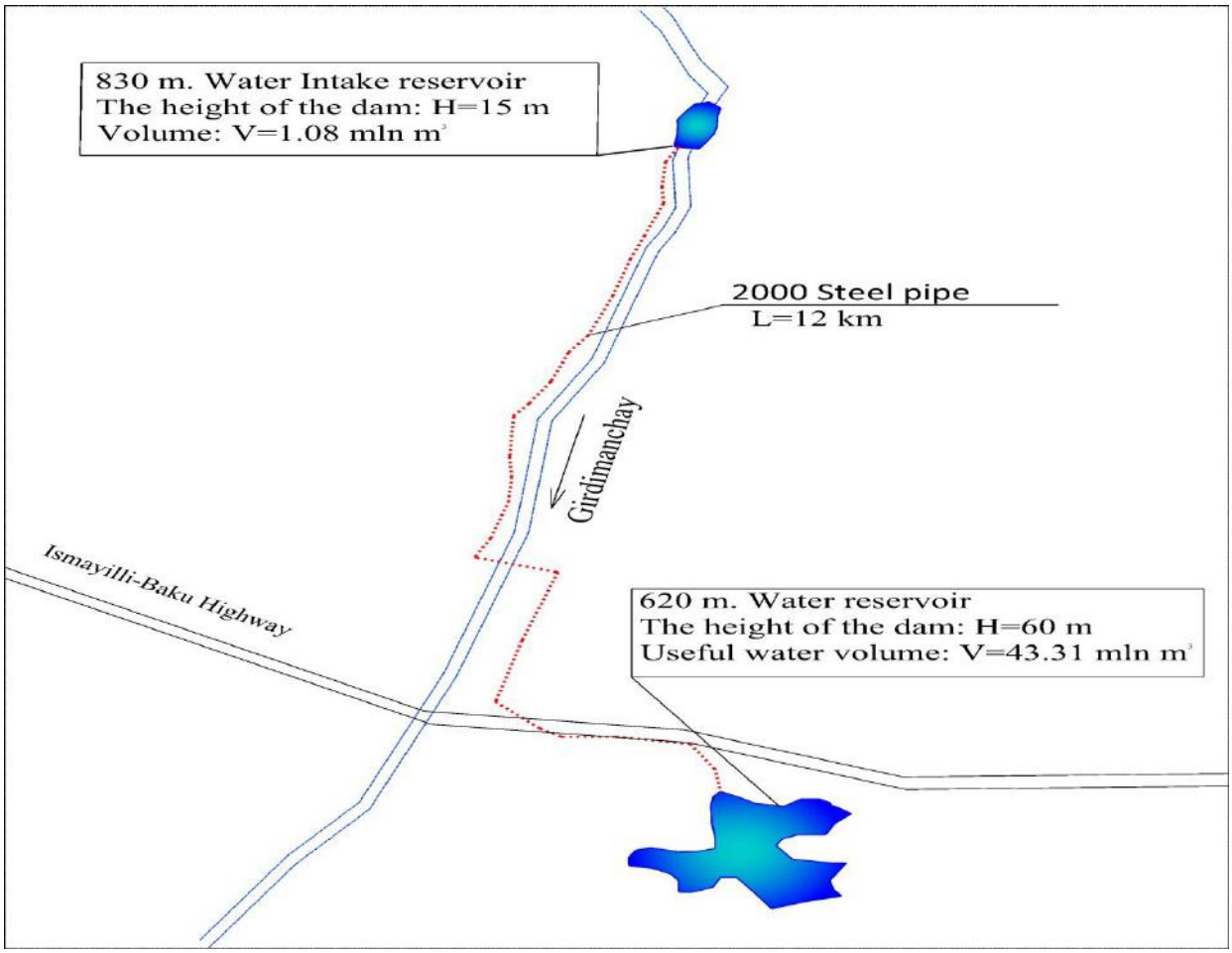
The area of the water mirror at the level of 830 m and 845 meter in the river valley varies from 54217 m^2 to 115218 m^2, and the water volume limited to those elevations reaches 1,085 million cubic meters (Figure 4).

Water intake reservoir can be constructed from a gravel-sand and ground blend. The maximum height of the dam is 15 m and the total length is 220 m. The washing sluice, water grubbing dam and water intake sluice are installed in the body of the dam. The height of the dam is 12 m in the direction of its longitude. The soil dam of the water reservoir is made of the sediments of the riverbed, its pressed slope coefficient is m_1 = 3,0, downstream canal pound slope coefficient is m_2 = 2,5.

The volume of the water intake reservoir is determined by taking into account the hydraulic regime, which ensures complete displacement of the intended particles of river bringing. This volume may vary depending on the hydraulic gradient and volume of sediments to be precipitated here. The hydraulic calculations carried out at Girdimançay were carried out in accordance with the precipitation of the particles with a diameter of 0,5-0,001 mm.

The volume of water collected and partially to be limpid in the water intake reservoir will be discharged through the water intake gutter\sluice in the body of the dam and will be discharged into the water reservoirs outside the riverbed with a steel pipe of the total length L = 12000m and the diameter D2000.



***Şəkil 4**. Placement plan of a water intake reservoir and a water reservoir outside riverbed on Girdimanchay.*

The volume of the water intake reservoir should be chosen so that a number of sediments which is not silted up there can create aminimum dead pool in the reservoir outside the riverbed. Otherwise, part of these sediments will lead to an increase in total volume of the water reservoir outside the riverbed and this will not be either technically or economically viable.

The total sedimentation dynamics in the water intake reservoir were carried out according to the formula of Y.A.Ibadzadeh and Ch.C.Nuriev:[6]

$$\rho_{вх} = \frac{\rho_0}{\upsilon H / {}_0 + L_x} \cdot \frac{\upsilon H}{{}_0}$$

$\rho_{вх}$-turbidity of water discharging into the water intake sluice, kg/m^3;

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ρ_0- turbidity of water of the river discharging into the water intake sluice, kg/m^3;
L_x-the length of limpidity zone, m;
$\square_0$- average hydraulic irradiation of slimes, m/sec;
υ- average flow velocity, m/san;
H-the average depth to water, m;
The turbidity of the water at the entrance of the water purifying reservoir was taken from perennial observation data on Girdimanchay. The length of the limpidity is taken in accordance with the sedimentation distance of the slimes in the water intake reservoir.
The average hydraulic irradiation of the sediment is calculated by the following formula [6]:

$$_0 = \frac{0{,}5(\ _{max} - \ _{min})}{\ln(\ _{max}/\ _{min}) - 1}$$

$\square_{max}$ və $\square_{min}$- is the maximum and minimumhydraulic irradiation of the sediment particlesand depending on the size is taken from the special tables (Ibadzade, Yu.A., & Nuriyev, C.G., (1979), Отстойники речных водозаборов.[Sedimentation of river water intakes.]).[3]
By using the above formula, monthly siltedslime volumes are calculated for the cases of the height of 10, 15 and 20 m of the water reservoir, and the results are shown in Figure 7. If the height of the dam is H = 10 m, the volume of bringing to be precipitated will be 799282 m^3 per year, non-silted bringing volume is 704391 m^3, when the height of the dam is H = 15 m, the sedimentation volume is 1131145 m3, the non-silted volume is 372528 m^3, and when the height of the dam is equal to the H = 20 m, thesediment volume is 1295066 m^3 , the non-silted volume is 208607 m^3(Figure 5).

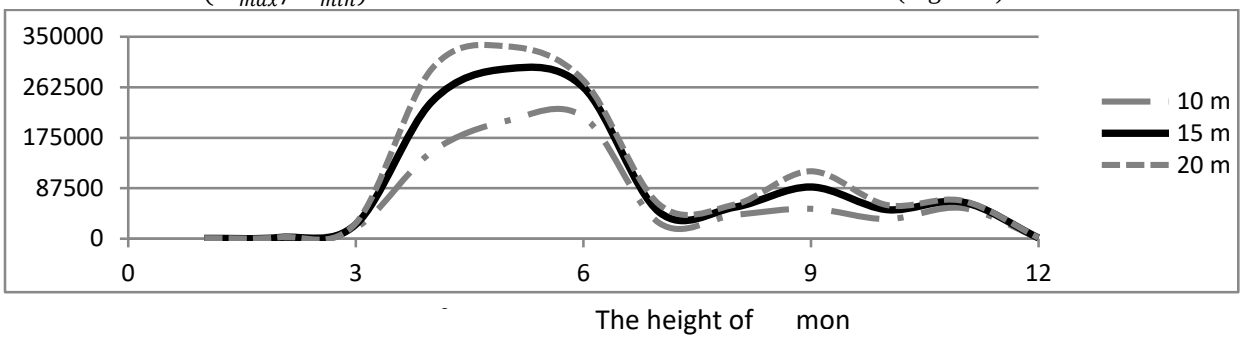

Fig.5: The monthly volume of precipitated slimes in water intake reservoirs depending on the height of the dam.

If the height of the dam is 10 m, the non-silted slime volume will be very large, which will significantly increase the dead pool of the out-of the-riverbed water reservoir. In the case of the height of the dam at a height of 20 m and above, the relative change in the size of the silted slimeat a height of 15 m is not economically viabledue to thelarge volume of the dam and the greater loss of water for the washing of silted sediments. Given the above, the 15 m height of the water intake reservoir was considered as a basis.
The diameter of a large amount of the not-silted slime is <0.001 mm which requires a long time to silted in the out-of-the-riverbed of the water reservoir. These particles are mainly observed in May and October, in thiscase,water intake will be intensive from the reservoir to be built out-of-the-riverbed. The dynamic movement of the water collected in the water reservoir outside of the riverbed does not create conditions for the sedimentation of these particles.
The sedimented slimes in the water reservoir should be periodically hydraulically washed and discharged into the lower canal pound. This periodicity should be performed taking into account the hydrological characteristics of the river, and the clean water accumulated in the water reservoir must be dumped before the spring floods and the sediments of the reservoir should be washed using spring flood water.

IV. WASHING OF THE SILTED SLIMES IN THE WATER RESERVOIR

It is recommended to use different methods and means to eliminate silted slimes in water reservoirs by existing literature materials. [5,7,9]Taking into consideration local conditions, the method of removing the silted slimesin the reservoir is selected. The hydraulic wash method is used mostly as one of the economically efficient methods for cleaning slime in water reservoirs. [5,7] In this method, the water reservoir is completely discharged to ensure the washing of the slimes and the river flow is directed toward the sediments in the reservoir valley to ensure the wash of the slimes. Numerous large-scale field studies have shown that at the beginning of the process, the wash is intensive and then it is weakening, which results in a large amount of water loss. [5,7]
As water flow in water reservoir cannot be controlled in case of the washing with this version it is possible to wash the slimes onlyalong with one stripe and washing water cannot be directed to the slimes in other areas. A new washing system has been proposed in order to eliminate all these shortages and use the washing water

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more efficiently to direct and manage the river flow. The new facility will allow to intensify the washing of the slimes in the water intake reservoir and significantly reduce water losses.

In order to intensify the washing process by managing the river flow and to direct the water flow to the whole area of the sedimentation site, it is recommended to place flow-oriented concrete walls in an intensive sedimentary zone of the upper canal pound. In order to guide river flow through these directional walls, a system of shields has been installedat their entrance. These flat shields along the width of the river allow to fully close its width and is controlled by the bridge above the maximum water level that will be formed in the river. When the water from the water intake reservoir is taken, all shields are lifted upward and the river flows into the water reservoir valley bypassing all of the directional walls.

During the wash, the water reservoir is discharged and all other shields are lowered by keeping one of them above to ensure the flow of river intensively from one side. This hydraulic regime ensures the intensive wash of slimes over there and the water losses are minimal in this case. The sediments in other parts can be washed intensively by regulating the river flow.

Calculations made for the water intake reservoir to be constructed at the selected site at Girdimanchay valley allowed to determine the parameters of the washing installation. The length of the wash channels has been adjusted to the area to be washed. The first 500 m part of water intake reservoir is intended as a washing area. The washing channels are not considered in the area close to the dam of the water intake reservoir, i.e. in the first 100-150 m section. There will be precipitated slimes with smaller diameters. Part of these slimes will be washed away when the water reservoirs discharged and the rest will be washed away during the washing of the other parts. Washing channels are constructed at a distance of 200 meters starting from the 150 meters at a distance of the dam, and as large slime particles dominate in the rest of the 150 m section of the riverbedthere is no concrete channels are provided. The bottom sediments at the entrance of the water intake reservoir can be transported from the area to the construction site with special vehicles at the time of washing (Figure 6).

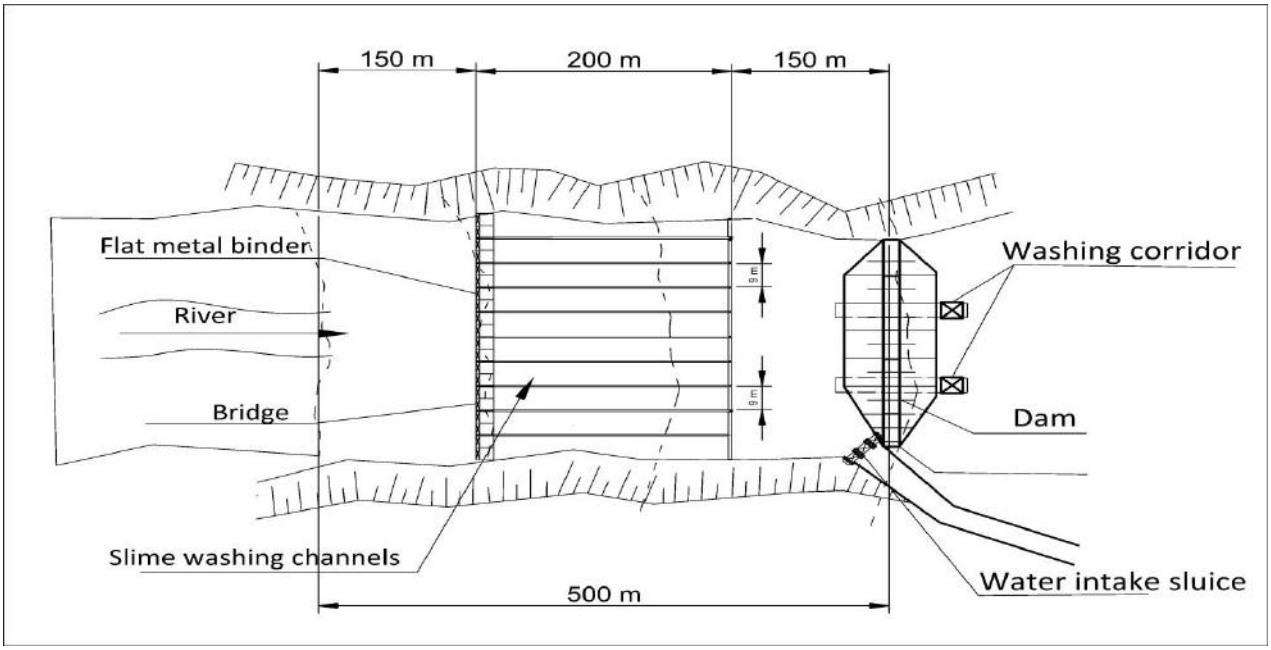

Fig.6: Layout scheme of slime washing channels in the water intake reservoir.

In order to control the water supply to the slime drainage channels, special flat metal binders are placed on their entrance thresholds. It is always kept in an open position, i.e. above the maximum water level, in order to prevent the slime assembly in front of flat metal binders.All of them are closed only during the wash, and open one-by-one to wash intensively the slimes between the directional walls. In the period of excessive water flow several binders can be kept open in several channels simultaneously to intensify the washing process. A bridge designed for the regulation of flat metal binder (Figure 7)

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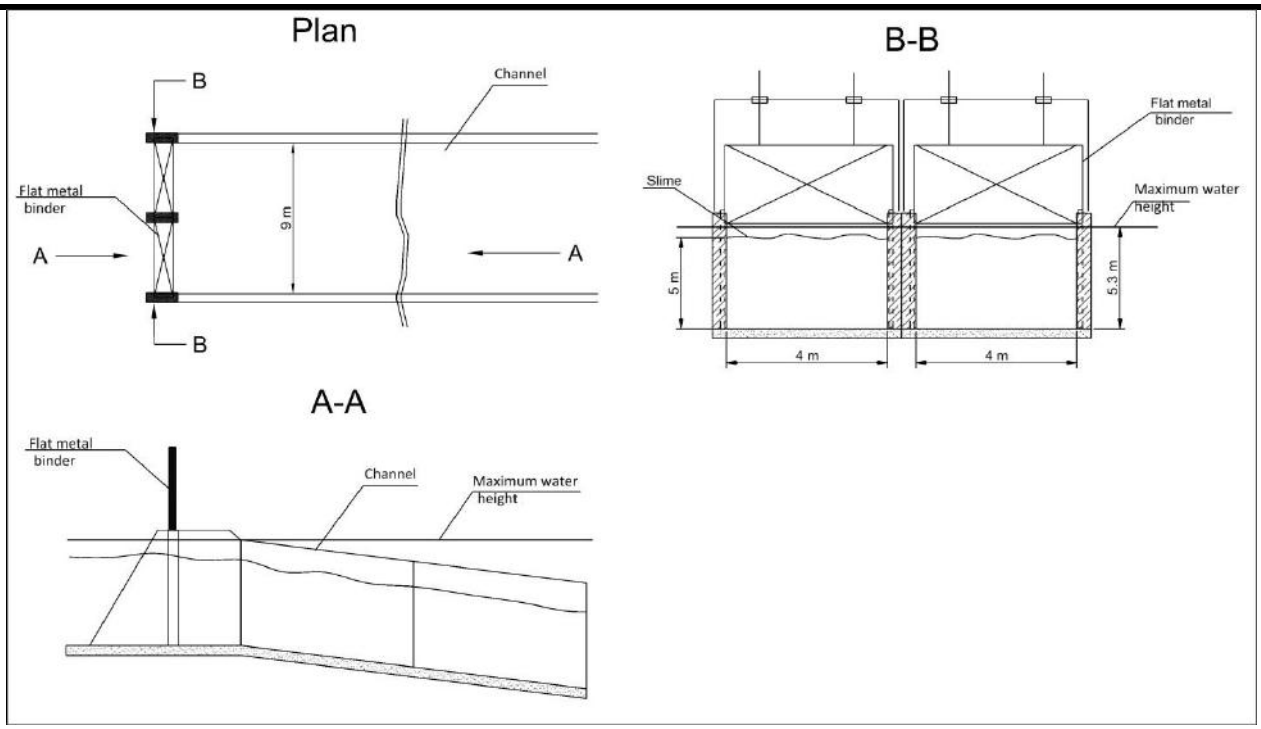

Fig.7: The layout scheme of flat metal binders on the channels located in the water intake reservoir.

The proposed washing installationto wash the silted slimesintensively and with minimum use of the water in the water intake reservoir to discharge into the lower canal pound should be designed depending on the height of the dam, the distance of the sediment particles and the thickness of the precipitatedslime layer. The sediments in the upper canal pound of the dam can be washed several times a year considering hydrological regime of the river in case of need.The washing should be conducted using the spring and autumn floods.

The value of turbidity to be arising during the washing in the wash canals was calculated by the formula proposed by B.K.Shkundini for the washing of thesettling.[8]

$$\rho_{tr} = g\frac{(\vartheta_{\text{пр}} - 0{,}35)^3}{h_{\text{пр}}^2}$$

ρ_{tr}-slime transportation capacity of the flow, kg/m^3;

$\upsilon_{\text{пр}}$-washing speed, m/sec;

$h_{\text{пр}}$-the height of the water in the chamber during the washing, m;

The hydraulic parameters of the washing channels are calculated according to the maximum turbidity to be arising during washing. Based on The above-mentioned expression the value of the turbidity to be arising as a result of washing the channels with the rectangular cut of width from the bottom 7 m, 9 m and 11 m in width, from the bottom was calculated and the results are shown in (*Figure 8).*

As it is seen from the calculations, the turbidity caused by washing in all the channels increased to a certain amount of water flow and then started to decline. The maximum density of the turbidity is 139.04 kg/m^3 for the channel with 7.0 m width at the bottom, and the water flow rate is 26.96 m^3/m^3. When the width is 9 m the maximum turbidity is 155.83 kg/m^3, water flow rate is 51.58 m^3/m^3 and in case of the 11 m, the maximal turbidity amount is 169.33 kg/m^3 with 64.67 m^3/sec water flow rate. However, because of the lack of water flows in the examined river, it is not possible to wash a number of slimes in the indicated amount.

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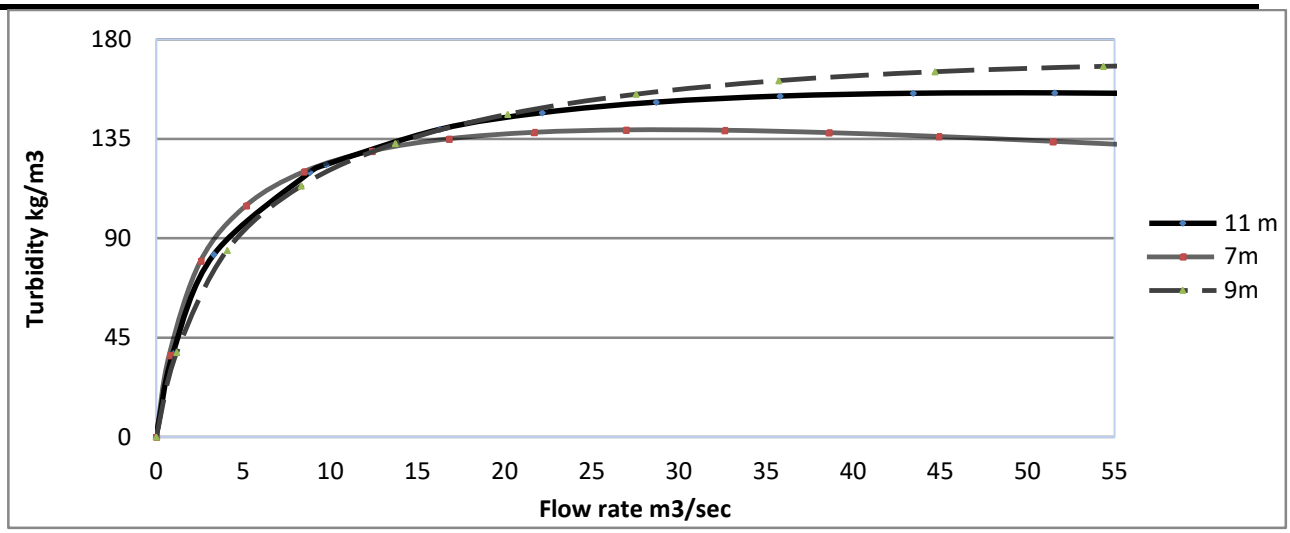

Fig.8: The change in the turbidity depending on the water flow during the washing in the channels with the bottom width of 7 m, 9 m,and 11 m.

The maximum turbidity during the wash period For Girdimanchay is possible within the water flows in the period of the floods. Since the average monthly water flow in the exuberant period of Girdimanchay is between 8-11 m^3/sec, the maximum turbidity that can occur during the wash can be adjusted to this range. As seen from Figure 8, the flow of the channelwith 7 m width at the bottom is 8.48 m^3/sec with the turbidity of 120.13 kg/m^3. In case the bottom width of the channel is 9 mwith the flow of 8.62 m^3/sec the turbidity is 120 kg/second the bottom width of the channel is 11 m with the flow of 8.32 m^3/sec the turbidity is 113,62 kg/m^3. As can be seen from the above-mentioned water flow, slime discharge ability of the channel with the 11 m bottom width is less than other channels, and turbidity in the channels with a width of 7 m and 9 m is very close to each other. However, if the channel with the 7 m bottom width is accepted, the number of channels to be installed in the riverbed will be relatively high and this can not be considered economically viable. For this purpose, a channel with a bottom width of 9 m was considered as the most viable channel during washing.

Table 4 presents the estimated amount of water required for washing the slimes in the water intake reservoirs with channels with a bottom width of 9m in the exuberant months and results.

Hydraulic calculations 10, 11, 12 shows that April water exuberant of the spring is more useful to wash the total volume of the silted slimes in the 1st, 2nd, 3rd, 4th months and autumn exuberant is more effective to wash the total volume of the silted slimes in the 7th, 8th and 9th months. In May, calculations on the volume of silted slime volume were carried out for the same month. In the 6th month, where the turbidity is the highest, it is planned to discharge the flow of water from the river without storing into the lower canal pound. Thus, it will have a positive impact on the flora and fauna as well as hydrogeological conditions of the river.

According to the calculations, the amount of water used to wash 262338 m^3 total slime volume in the 6th month is 7.34 million cubic meters and the monthly flow of the river is 6.35 million cubic meters per year. As you can see, the amount of water used for washing is relatively high from the monthly flow of the river and this can not be considered effective. Taking this into account, the precipitation of the slimes in the 6th month in the water intake reservoir was not considered appropriate.

As can be seen in Table 2, the time spent for the year is 30 days, and the amount of water required for the 6th month is 24,06 million m^3.

The number of wash channels has been adjusted to the width of the riverbed. The average width of the valley where the water intake reservoir located is about 90 m. As the bottom width of washing channels are about 9 m, 10 washing channels will be installed in the riverbed.

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Table.4: Washing flow of sediments in water intake reservoir (with channel)

Indicators	Months												
	10	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
Water flow, m^3/sec	5,12	2,08	2,27	2,02	2,38	3,19	8,12	4,53	2,45	10,1	3,26	11,4	
Slimevolume to be washed, (m^3/sec)	50749	63780	1880	958	2586	25407	237502	294534	262338	46420	55092	89899	
							382862	294534				485945	
Turbidity in the river during the cleaning, (ρ_0 kg/m^3)	7,6	19,7	0,52	0,3	0,76	5,3	28,7	47,7	70,2	4,95	11,3	9,47	
Washing capacity of the channel, ($\rho_1$kg/m^3)							120	120				120	
The amount of silt washed,(m^3 /san)							0,463	0,205				0,788	
The time spent for washing, (day)							5,9	16,6				7,14	30
Water used for washing, (mln.m^3)							4,16	6,52	6,35			7,03	24,06

The height of the wash channels has been adjusted to the size of the silted slimes. As the slime cleaning in the water intake reservoir is carried out in accordance with the flow regime of the river,the thickness of the silted slime here is determined in accordance with the silted amounts. According to the calculations, the volume of the first wash cycle is 382862 m^3, the second cycle of washingis 29,4534 m^3 and the volume of the third wash cycle is 191411 m^3. However, as the volume of silted slimes during the wash month is included, the thickness of the slime layer could not be determined according to this amount. The thickness of the slime layer was determined according to the maximum silted slime volume at the time of the wash cycle.

As can be seen, the amount of the silted sediments till the time of the first wash cycle, i.e. in the 1st, 2nd, 3rd, 10th, 11th and 12th months is 14,3360 m^3. The removal of thesilted sediments during the second wash period, i.e. during the 5th month is possible anytime, that is, it is not correct to determine the height of the washing channels corresponding to the thickness of the siltedsediment. The amount of the precipitated slime during the 7th and 8th months, that is, until the beginning of the third washing is 101512 m^3. The height of the sidewall of the channel is equal to the thickness of the silted slime layer formed during the first wash cycle. Thus the amount of the silted sediments in the first wash cycle is more than other cycles.

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The volume of silted slimesin 10th, 11th, 12th, 1st, 2nd, and 3rd monthsduring the first wash cycle in the water intake reservoir is given in Table 5.

As can be seen in Table 3, the maximum displacement volume at distances during the first wash period occurred at the distance from the entrance of the water reservoir at a distance of 150 to 220 meters, i.e. at a height of 70 meters. The volume of precipitated slimes in this part is 3,1181 m^3. Considering that the width of the riverbed is 90 m, the thickness of the slime layer to be formed here will be approximately 31181/70/90 = 4.95 m. According to the calculations, the maximum turbidity in the wash water happens in the 0.35 m depth of the flow. According to the above-mentioned, the height of the channel will be 4.95 + 0.35 = 5.3 m.

Table.5: The amount of precipitated slimebased on the distances during the first wash cycle

Distance, m	The amount of precipitated slime on months (m^3)						Total Volume of silted slimes, m^3	Thickness of precipitated slime layer,m
	January	February	March	October	November	December		
50	82	223	1757	2580	6118	168	10928	2,43
100	147	401	3294	5074	10756	300	19971	4,44
150	155	420	3636	5951	10958	312	21431	4,76
220	215	580	5496	10058	14410	423	**31181**	**4.95**
290	154	415	4347	9001	9790	297	24004	3,81
360	101	270	3136	7388	6030	190	17115	2,72
430	63	169	2186	5878	3574	117	11988	1,90
500	41	108	1556	4819	2144	73	8740	1,39

As can be seen in Table 3, the maximum displacement volume at distances during the first wash period occurred at the distance from the entrance of the water reservoir at a distance of 150 to 220 meters, i.e. at a height of 70 meters. The volume of precipitated slimes in this part is 3,1181 m^3. Considering that the width of the riverbed is 90 m, the thickness of the slime layer to be formed here will be approximately 31181/70/90 = 4.95 m. According to the calculations, the maximum turbidity in the wash water happens in the 0.35 m depth of the flow. According to the above-mentioned, the height of the channel will be 4.95 + 0.35 = 5.3 m.

Main characteristics of the water reservoir outside riverbed designed on the right bank of Girdimanchay:

The anticipated out-of-the-riverbed water reservoir is being built between 620 and 680 m on the right bank of Girdimanchay. According to the calculations, the useful volume of the reservoir is 43,312 million cubic meters. Part of the small slime particles that do not silt in the water reservoir will lay in the floodwater reservoir, which will increase the full volume of thewater reservoir. At the altitudes of 620 m and 680 m level of the water reservoir valley area of the valley, mirrors vary from 61498 m^2 to 2390000 m^2, and the water volume limited to those heights reaches 53.837 m^3. Thus, the height of the dam will be 60 m. in the in case of the construction of a water reservoir.

Technical indicators of the water reservoir constructed on Girdimanchay by traditional method and water intake reservoir and reservoir constructed outside of the riverbed proposed by the new method are given in Table 6.

If we compare current market prices, the construction cost of new installations will be 1,199 billion AZN or 85% lower than the conventional method of construction of the dam with a height of 140 m. Taking into account operational costs and the arising technical risks it is not recommended to build high-altitude dams in the riverbed of mountain rivers with high turbidity.

It is expedient to use the newly developed methodology for efficient use of water resources of such rivers. It should be noted that the water reservoirs constructed directly in the river valleys have a serious ecological impact on the environment. The river's hydrological regime that formed over the years is damaged, and this causes the collapse of the fauna-flora of the river valley. The trees and bushes in the river valley are destroyed by

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thirst, the hydrogeological conditions of the river valley are damaged, and the level of underground waters is reduced. As a rule, the ecological flows from the dams built on the river are not allowed, for example Sirab, Arpachay, Aghstafachay, Khanbulanchay, Ayrichay, Akhincachay and other water reservoirs built in the territory of the Republic.

Table.6: Technical indications of water reservoirs

Name of Reservoir	Location level, m	The height of the dam, m	Full volume of water reservoir mln.m^3	Effective volume of water reservoir mln.m^3	The value of water reservoir, mln.doll
Girdimanchay(in riverbed)	830-970	140	124,673	49,443	295.0
Girdimanchay (outside of riverbed)	620-680	60	53,312	43.310	67.5
Water Intake Reservoir (in the riverbed)	830-845	15	1,085	1,085	3.5

In the proposed new method the flow of the river is discharged fully into the river during the wash of the silted slimes in the water intake reservoir. This will allow to partially protect the ecological system surrounding riverbed in the downstream of the river and maintain hydrogeological conditions under the water.

V. FINDINGS

1. The article examines the methods of the effective use of water resources of mountain rivers with high turbidity. For this purpose, the Girdiman River, which is located in the territory of the Republic of Azerbaijan, has been selected as a sample and a comparative analysis of the technical and economic parameters of the construction of reservoirs by the traditional and the proposed new method was carried out by conducting hydrological reports.
2. The reports revealed that the dead pool of the water reservoir built on Girdimanchay by traditional method is 75 million cubic meters, and the total volume is 124,673 million cubic meters. The height of the dam of the water reservoir will be 140 m. The construction of the dam in the area being observed with frequent large-scale floods and high seismicity is dangerous in terms of exploitation.
3. In the proposed new method, it is proposed to silt Girdimanchay's bringing flows directly on the river bed and to build a water intake water reservoir outside of the riverbed to collect partially limpid water. In the water intake reservoir, where the height of the dam is 10 m, 15 m, 20 m, the volume of precipitated slimes and the amount of water required for the washing of the slimes in this volume was calculated and compared. 15 m height of the dam of water intake reservoir was accepted economically viable.
4. The design of the new washing installation has been developed with the aim of discharge of silted sediments in the water intake reservoir to the lower canal pound with the use of less water. The method of sedimentation dynamics of the slimes in the water intake-water reservoir and the report method of hydraulic wash mode has been developed.
5. It is recommended to construct a water reservoir for collecting partially limpid water in the river bed and the hydro-technical parameters of this reservoir (useful volume - 43,312 million m^3, theheight of the dam 60 m)were calculated.
6. According to the calculations, the value(with current market prices) of the water reservoir constructed on Girdimanchay is 295.0 million dollars, and the construction cost of the proposed hydro-technical facility is 71.0 million dollars. As we can see, the value of the huge water reservoir built on Girdimanchay is much higher than the value of the hydro-technicalfacility complex created by the proposed new method.

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Petrography and Mineralogy of Amphibolite Rocks in Penjween Complex, Northeastern Iraq

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Abstract— *Penjween igneous complex is situated in the northeastern part of the Iraqi Zagros Thrust Zone (IZTZ) which is considered as integral part of the Alpine-Himalayan Orogenic Belt of Cretaceous age. The amphibolite rocks exist in Penjween as pods of lensoid-shape of variable sizes (2-3m). These amphibolite pods are surrounded by sheared tectonized serpentinite and peridotite and one is in contact with amphibole-bearing gabbro dike. In addition, there is an albitite dyke in contact with the amphibolite. These amphibolites exhibit deformation and alteration which is evident by the existence of chlorite veins cutting through or as patches within these rocks. Petrographic observations reveal that the main mineral constituents are amphibole; both primary and secondary, plagioclase with accessory clinopyroxene, quartz, titanite, apatite, zircon and iron oxides. Secondary minerals include chlorite, epidote, secondary amphibole and iron oxides as a consequence of alteration. Dominated textures are porphyroblastic, poikiloblastic, nematoblastic , blasto-ophitic and blasto-subophitic which are inherited from the original rocks. Accordingly, two mineral assemblages are identified:*

1- *Hb. + plag. + cpx.± qtz. ± titanite ± zircon ± apatite ± iron oxides,*
2- *Hb. + plag. ± qtz. ± titanite ± apatite ± zircon ± iron oxides ± chl. ± sericite ± ep.*

The secondary assemblage is more altered. On the basis of Mg/(Mg+Fe)-Si per formula of the analyzed amphibole, two types of amphibole are observed; Mg-hornblende and tschermakite. Chemical analyses of the plagioclase grains give two types; oligoclase (An23.9 Ab75.9) and albite (An1.7 Ab97.9).

Keywords— Petrography, Amphibolite Rocks, Penjween Complex.

I. INTRODUCTION

Penjween area is located within the Zagros Thrust Zone (ZTZ) which is considered part of the main Zagros Orogenic Belt (ZOB) that extends northwest-southeast from eastern Turkey through northern and northeastern Iraqi-Iranian border into northern Oman (Jassim and Goff, 2006; Moghadam and Stern, 2011). The Zagros Thrust Zone marks the boundary between the Zagros Folding in the west and the Zagros Suture Zone (ZSZ) in the east (Stocklin, 1968). It is 2000 km long deeply rooted possibly to the Moho depth according to geological and geophysical data (Agard et al., 2005, and Azizi and Moineraziri, 2009). Along this zone magmatic activity, dismembered ophiolite are apparent within Penjween area. The so-called Penjween ophiolite consists of both mantle sequences (ultramafic) and oceanic crustal sequences accumulate gabbros and volcanic rocks, (Al-Hassan and Habbard, 1985).

The study area is located in the northeastern part of Iraqi Zagros Thrust Zone and southwestern part of Penjween igneous complex. The Penjween igneous complexe is situated to the southwest of the Penjween Malkawa village about 40 km to the east of Sulaimani City, between latitude 35° 36′ 16.4″ - 35° 37′ 15.6″N and longitude 45° 54′ 40.4″ - 45° 55′ 59″ E (Fig. 1).

Twenty-five rock samples of amphibolite were studied using polarized microscope. XRD analysis for some of this amphibolite was also performed for further identification of minerals. Microprobe analysis was carried out to determine the chemical composition and to classify the samples.

II. PETROGRAPHY AND MINERALOGY OF AMPHIPOLITE ROCKS

Petrographic study showed that these rocks were subjected to different degrees of alteration, which resulted in the formation of secondary minerals such as chlorite, epidote and sericite. The secondary minerals replaced the primary ones and some of filled them vesicles and veins, within primary minerals using have lost some of their original characteristics. plagioclase (25-45%) and the accessory minerals is between (5-15%) of the total volume of the rocks.

The modal mineral abundance which are estimated by point counting are listed in table (1), and the details of XRD analysis are shown in figures (2) which carried out in Dalhousie University Earth Science department. In addition to microprobe analysis was carried out (at the cooperation research for center, Kanazawa University, Japan) to determine the chemical composition and to

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classify the samples. Characteristics of each mineral in the rock samples, are discussed as follows:

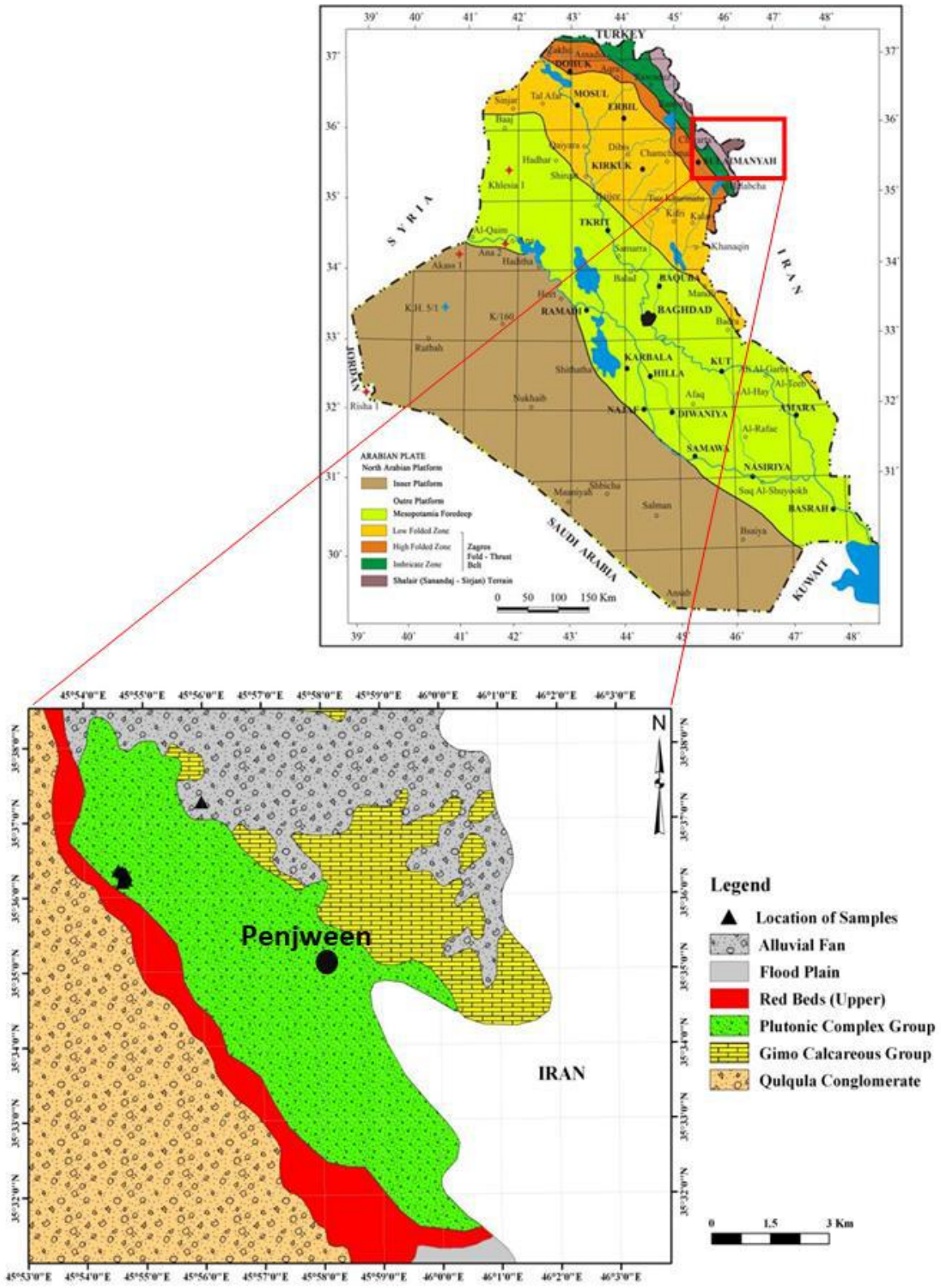

Fig. 1: Geological map of Penjween igneous complex, showing the location of study samples, after Jassim and Goff, 2006

III. AMPHIBOLE MINERALS

Petrographic study show that amphibole minerals, both primary and secondary are the major phases of these amphibolites with an average of 50%. The primary amphiboles are characterized by euhedral to subhedral grains, coarse to medium, with well-developed cleavage.

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The presence of primary and secondary amphiboles is supported by geochemical analysis of these minerals which will be discussed in mineral chemistry. According to the extinction angle and XRD analysis, hornblende is the main amphibole mineral. Prismatic hornblende crystals occur as mostly subhedral to euhedral, with pleochroism mostly brown to green, and high relief. Cross basal section shows two sets of cleavage, rhombic crystals few or no inclusions and oxidation with limited or no sub-grain development at margin (Plate 1.a & 1.b).

On the other hand, secondary amphiboles are found as subhedral to anhedral crystals and show remnant of original pyroxenes with opaque oxidation mark along the rims and the cleavage traces, (Plate 1.c & 1.d). Thirty-two amphibole spots were analyzed (Table 2). The results were plotted on (Mg/Mg+Fe+3) vs. Si diagram of Leak et al. (1997) in order to determine the amphibole type. Accordingly two compositionally distinct amphiboles were recognized; hornblende rich in magnesium (magnesium hornblende) and tschermakite (Fig. 3) .

Table.1: Modal analyses of the studied rocks in Penjween complex

Sample No.	pA1.1	pA1.2	pA2.1	pA2.2	pA2.3	pA4.1	pA4.2	pA4.3	pA5.1	pA5.2	pA5.3	pA8	pA9
Amphibole	59	60	60	66	60.89	60.2	58.9	57.7	55	60	55.8	63	50
Plagioclase	31.2	31.2	30.1	30.6	30.46	25	25.9	25.3	40.1	28.9	38.2	35.2	40.28
Clinopyroxene	3.1	3.1	3	0	2.8	10.2	5.2	8.93	1.2	5.2	1.00	0	0
Quartz	2.1	2.8	2	2.8	0.88	1.6	0.6	3.4	0	1.6	0	1.8	0
Zircon	0	0	0	0	0.6	0	0	2.1	1.9	0	1.5	0	2.3
Apatite	2.3	3	2.1	1.2	0	0	0	3.3	0	0	0	0	0
Sphene	1.3	2	0	0	3.71	2.2	3	1.9	0	2.2	0	0	0
Opaque minerals	1	2	1.9	1.2	0.8	0	0	0	1.8	0	2	1	1.2
Sum	100	100	100	100	100	100	100	100	100	100	100	100	100

Sample No.	pA10.1	pA10.2	pA11.1	pA11.2	PA11.3	pA12.1	pA12.2	pA14	pA15	pA16	pA17	pA20
Amphibole	58.6	60.6	59.3	60	59.9	55.6	50.6	55.6	50	55	42.6	65
Plagioclase	35.8	30	37.2	35.2	35	42	42	27.8	45	45	36.3	31
Clinopyroxene	0	0	0	0	0	1.2	1.2	10.2	1.2	1.2	15.1	2.7
Quartz	1.3	1.3	1.2	1.2	1.2	1	1	2.9	1.8	1.8	0	1.4
Zircon	0	0	0	0	0	0	0	1.3	0	0	0	1.3
Apatite	4.3	5	2	2	2	0	0	1.2	1	0	2.9	0
Sphene	0	0	1.3	2	2	0	0	0	0	1.7	1.8	0
Opaque minerals	0	0	1	1	1	0	0	1	1.2	1.3	1.3	0
Sum	100	100	100	100	100	100	100	100	100	100	100	100

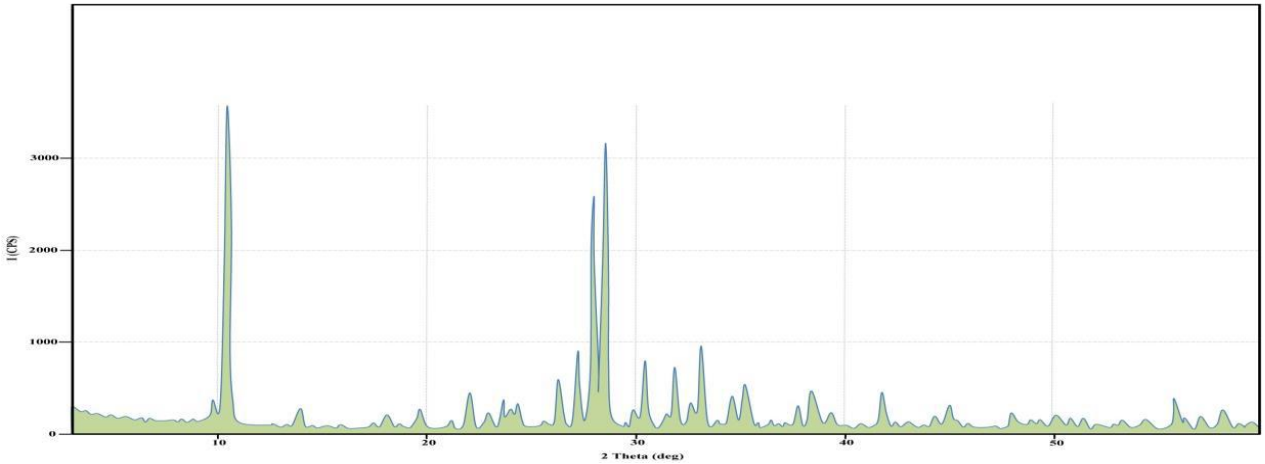

Fig.2 XRD analysis of amphibolite rock in Penjween complex for sample (pA11).

Table.2: Amphibole chemical analyses. Formula calculated on the basis of 23 oxygenes.

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Element	A1.1	A1.2	A1.3	A1.4	A1.5	A1.6	A1.7	A1.8	A2.1	A2.2	A2.3	A2.4	A2.5	A2.6	A2.7	A2.8
SiO2	39.68	40.04	41.07	39.38	41.21	45.30	48.40	45.13	38.98	38.92	41.28	39.77	40.37	42.35	43.05	40.99
TiO2	3.08	2.40	2.68	1.76	1.96	0.43	0.28	0.56	2.36	2.37	0.72	1.82	1.60	0.61	0.73	1.67
AL2O3	14.15	13.71	12.85	14.93	13.52	10.70	7.97	11.52	15.43	15.51	12.10	14.59	14.86	14.07	13.18	13.65
FeO	12.78	12.84	12.59	13.40	12.51	10.53	9.45	10.79	12.39	12.54	12.00	11.81	11.85	11.39	10.78	11.50
MnO	0.19	0.20	0.19	0.20	0.20	0.17	0.13	0.19	0.15	0.18	0.19	0.15	0.19	0.19	0.17	0.16
MgO	12.09	12.33	12.68	12.03	12.67	15.04	16.20	14.50	12.08	12.18	13.40	12.45	12.42	13.80	13.90	12.96
CaO	11.52	11.66	11.14	11.47	11.61	12.01	12.46	11.76	11.47	11.55	11.01	11.40	11.27	11.71	11.58	11.35
Na2O	3.37	3.16	3.45	3.36	3.32	2.97	2.16	3.10	3.61	3.55	3.16	3.58	3.79	3.81	3.50	3.68
K2O	1.08	1.11	1.02	0.90	0.75	0.21	0.15	0.20	0.82	0.83	0.53	0.69	0.45	0.20	0.20	0.55
Total	97.95	97.45	97.68	97.44	97.77	97.59	97.61	97.81	97.32	97.64	94.47	96.30	96.80	98.48	97.27	96.53
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.20	0.39	0.02	0.03		0.02	0.01	0.01	0.33	0.13	
Si	5.84	5.82	6.31	5.99	6.03	6.19	6.33	6.13	6.40	6.48	5.82	5.99	5.93	5.98	6.01	5.92
Al	2.72	2.73	2.18	2.59	2.62	2.42	2.28	2.41	2.09	2.01	2.73	2.76	2.76	2.68	2.64	2.49
Fe	1.55	0.02	1.53	1.49	1.48	1.39	1.33	1.44	1.23	1.19	1.56	1.34	1.38	1.36	1.37	1.59
Ti	0.27	0.27	0.08	0.21	0.18	0.07	0.08	0.19	0.09	0.06	0.27	0.09	0.11	0.10	0.10	0.35
Mn	0.02	2.71	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mg	2.69	1.85	3.05	2.79	2.76	3.00	3.04	2.89	3.30	3.34	2.71	2.92	2.90	3.01	2.99	2.69
Ca	1.84	1.03	1.80	1.84	1.80	1.83	1.82	1.82	1.80	1.78	1.86	1.79	1.85	1.81	1.85	1.84
Na	1.05	0.16	0.94	1.04	1.10	1.08	1.00	1.07	0.99	0.99	1.01	1.16	1.17	1.17	1.13	0.97
K	0.16	0.16	0.10	0.13	0.09	0.04	0.04	0.10	0.03	0.03	0.14	0.05	0.05	0.05	0.08	0.21
Mg/(Mg+Fe+2)	0.63	0.99	0.67	0.65	0.65	0.68	0.70	0.67	0.73	0.74	0.63	0.68	0.68	0.69	0.69	0.63
Type	Tscher makite	Tscherm akite	Tscher makite	Tscher makite	Tscher makite	Mg-Hb	Mg-Hb	Mg-Hb	Tscher makite	Tscher makite	Tscher makite	Tscher makite	Tscher makite	Tscher makite	Tscher makite	Tscher makite

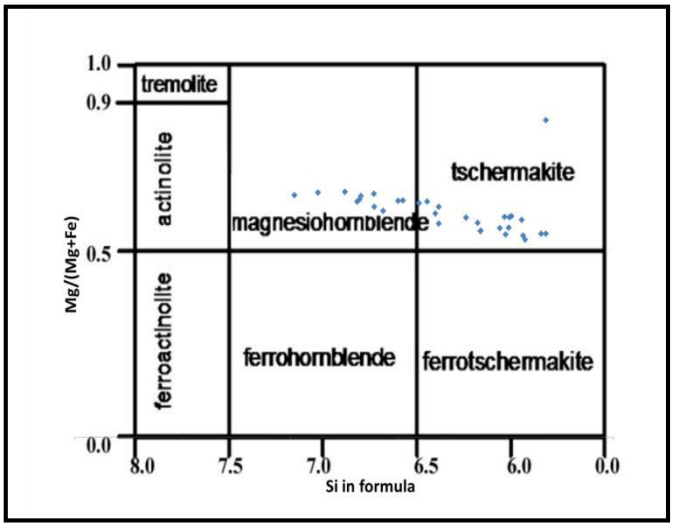

Fig.3: Amphibole classification diagram in the analyzed amphiboles of study rocks, proposed by Leak et al. (1997), Mg, Fe+3, Si are per formula.

Some of the hornblende crystals show zoning due to the change of the composition from the core toward the rim, (Plate 1.e). Hornblende generally show undulose extinction, and secondary twining (Plate 1.f). All these are deformational features.

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Table.2: Plagioclase chemical analyses. Calculated on the basis of 8 oxygens.

Element	P1.1	P1.2	P1.3	P1.4	P2.1	P2.2	P2.3	P2.4
SiO2	60.52	61.33	57.40	61.02	66.90	66.31	66.36	65.30
TiO2	0.02	0.00	0.03	0.00	0.05	0.00	0.03	0.04
AL2O3	24.82	24.14	21.84	24.16	20.87	20.357	21.02	20.4
Cr2O3	0.01	0.00	0.03	0.00	0.02	-	-	-
FeO	0.03	0.18	0.06	0.13	0.25	0.19	0.15	0.17
MnO	0.00	0.00	0.01	0.01	0.01	0.01	-	0.01
MgO	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.02
CaO	5.68	4.60	4.18	4.21	0.22	0.42	0.58	0.38
Na2O	9.28	10.33	9.22	10.65	13.17	12.43	12.33	12.98
K2O	0.04	0.05	0.06	0.05	0.07	0.18	0.08	0.07
NiO2	0.01	0.00	0.00	0.00	0.01	-	-	-
Total	100.42	100.63	92.82	100.24	100.74	100.41	99.87	99.96
Si	2.69	2.72	2.75	2.72	2.93	2.91	0.02	2.89
Ti	0.00	-	0.00	0.00	0.00	0.00	-	-
Al	1.30	1.26	1.23	1.27	1.03	1.08	1.31	1.10
Cr	0.00	-	0.00	-	0.00	-	-	-
Fe	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01
Mn	-	-	0.00	-	0.00	0.00	0.00	0.00
Mg	0.00	-	-	0.00	0.00	0.00	0.00	0.00
Ca	0.27	0.22	0.21	0.20	0.01	0.02	0.00	0.02
Na	0.80	0.89	0.86	0.92	1.12	1.06	0.01	1.11
K	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Nl	0.00	-	-	0.00	0.00	-	-	-
Total	5.06	5.10	5.06	5.11	5.11	5.08	5.33	5.12
Type	Oligoclase	Oligoclase	Oligoclase	Oligoclase	Albite	Albite	Albite	Albite
An, Ab and Or %	An_{38} ♀Ab_{62} $Or_{0.3}$	An_{20} ♀Ab_{80} $Or_{0.2}$	An_{20} ♀Ab_{80} $Or_{0.3}$	An_{18} ♀Ab_{82} $Or_{0.2}$	An_{1} ♀Ab_{98} $Or_{0.3}$	An_{2} ♀Ab_{97} Or_{1}	An_{6} ♀Ab_{97} $Or_{0.4}$	An_{2} ♀Ab_{98} $Or_{0.4}$

Both secondary and primary amphibole grains in studied samples show partial alteration and oxidation along the rims and cleavage traces (Plate 1.d, 2.a & 2.b). Altered hornblende shows granular inclusions of epidote and some of them are partially or completely altered to chlorite (Plate 2.b & 2.c).

IV. PLAGIOCLASE MINERALS

Plagioclase minerals are the prevalent component next to hornblende with an average of 35% and occurs as prismatic anhedral - subhedral crystals of irregular shapes and variable sizes (Plate 3.a & b). According to the extinction angle, the composition of plagioclase ranges from albite to oligoclase (Fig.3), which is confirmed by electron microprobe and (XRD) analysis and chemical analysis where the formula was calculated on the basis of 8 oxygens (Table. 2). Plagioclase grains show polysynthetic twining but some lack twinning due to small size of grains. This agrees with that was mentioned by Nesse (2000) that twining in plagioclase may be absent in small grains particularly in metamorphic rocks (Plate 3.c). Some plagioclase grains show alteration partially into kaolinite (Plate 3.d), sercite and epidote (Plate 3.e & 3.f).

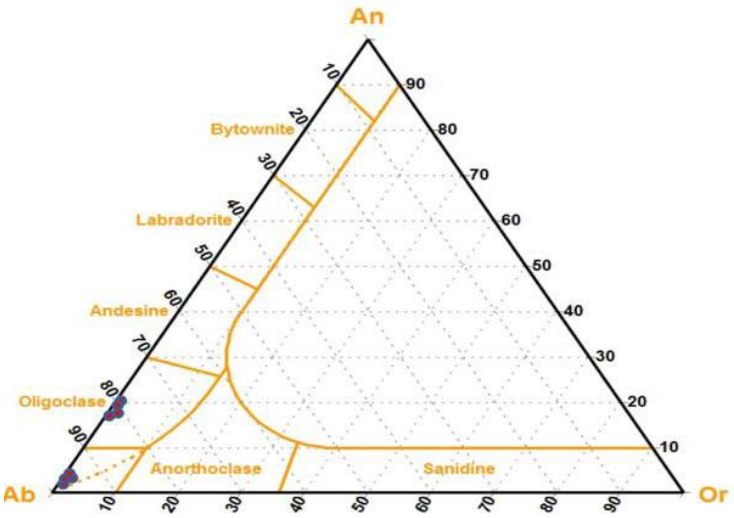

Fig.3: Ab - An - Or triangle diagram for plagioclase classification, proposed by Deer et al. (1963).

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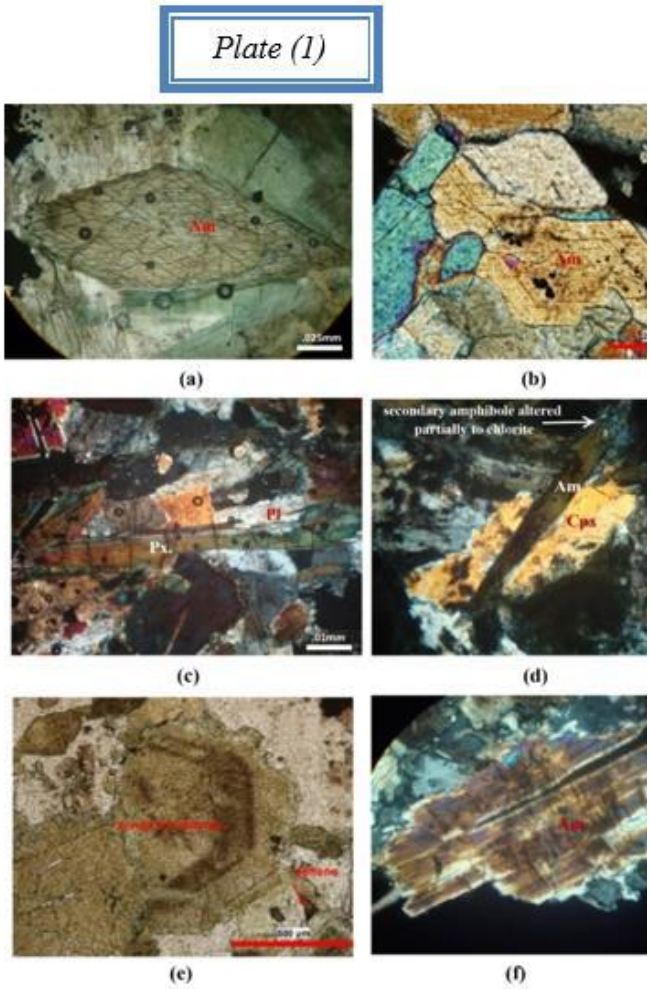


Plate (1.a): Photomicrograph of sample (pA4) , (X.N.) showing primary amphibole enclosed by secondary amphibole.

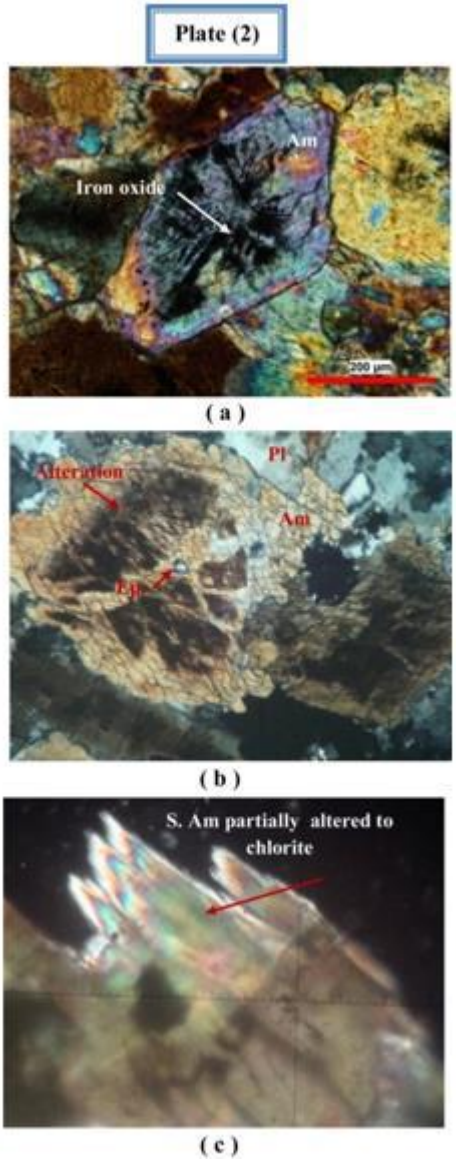
Plate (1.b): Photomicrograph of sample (pA5) , (X.N.) showing primary amphibole partially altered along the cleavage .

Plate (1.c): Photomicrograph of sample (pA11) (X.N.) showing secondary amphibole enclosed by partially in plagioclase .

Plate (1.d): Photomicrograph of sample (pA12) (X.N.) showing secondary amphibole altered partially to chlorite , interestial clino-pyroxene crystals.

Plate (1.e) : photomicrograph of sample(pA2) (X.N.) , showing zoning with brown core and a green rim similar to the fibrous amphibole in the matrix.

Plate (1.f): Photomicrograph of sample (pA1) (X.N.) , showing secondary twining in amphibole.



Plate(2.a):Photomicrograph of sample (pA1) (X.N.), showing oxidiation along the cleavage of amphibole.

Plate(2.b): Photomicrograph of sample (pA2) (X.N.) , showing alteration of amphibole to chlorite with fine epidote grains.

Plate(2.c):Photomicrograph of sample (pA2) (X.N.), showing amphiboles grain partially altered to chlorite.

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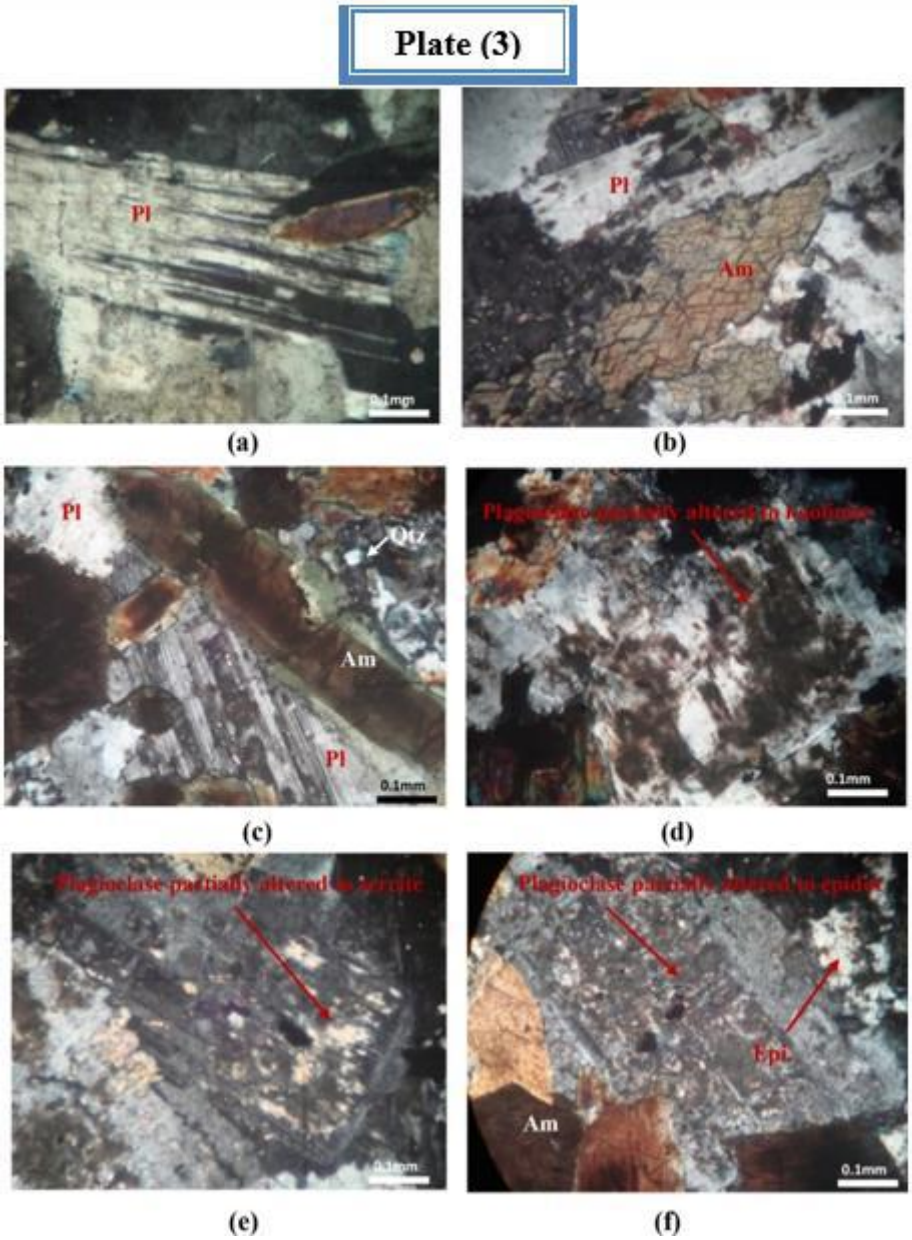

Plate (3.a): Photomicrograph of sample (pA12) (X.N.), showing relatively fresh plagioclase crystal.
Plate (3.b): Photomicrograph of sample (pA11) (X.N.), showing polysynthetic twining in plagioclase crystals which surrounding of secondary amphibole .
Plate (3.c): Photomicrograph of sample (pA2) (X.N.), showing coarse and fine grain plagioclase enclosed by partially secondary amphibole, and fine quartz grains.
Plate (3.d): Photomicrograph of sample (PA1) (X.N.), showing phenocrystalls of plagioclase crystals are partially altered to kaolinite.
Plate (3.e): Photomicrograph of sample (PA2) (X.N.), showing plagioclase crystals altered to sericite.
Plate (3.f): Photomicrograph of sample (PA1) (X.N.), showing plagioclase crystals are altered to epidote .

V. ACCESSORY MINERALS

The accessory minerals include clinopyroxene, quartz, zircon, apatite, titanite (sphene) which are found frequently associated with hornblende and plagioclase (Plate 4). In addition the mineral pyroxferroitte is found as few grains in some sample (PA1, PA2 and PA11). Clinopyroxene (augite) is rare and uncommon in studied rocks, making about 7.5% of the total volume of the rocks, it characterized by prismatic and subhedral to anhedral-shaped crystals and fine to medium grain size. According to the optical properties it is augite. The clinopyroxenes are mostly altered into secondary amphibole and the relics of the original clinopyroxene are very rare (Plate 4.a & 4.b). Quartz is subequant, with

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gently curved boundaries making not more than 3% by volume of the rock. They are very fine scattered within the amphibolite (Plate 3c & 4d). Zircon occurs as an accessory mineral in the studied samples with an average of about 1 % and it is very fine elongated grain. It is colorless under transmitted light microscopy with very high interference colors (Plate 4.c).

Apatite are fine grains, high relief parallel extinction, making about an average of 1.6 % (Plate 4.d).

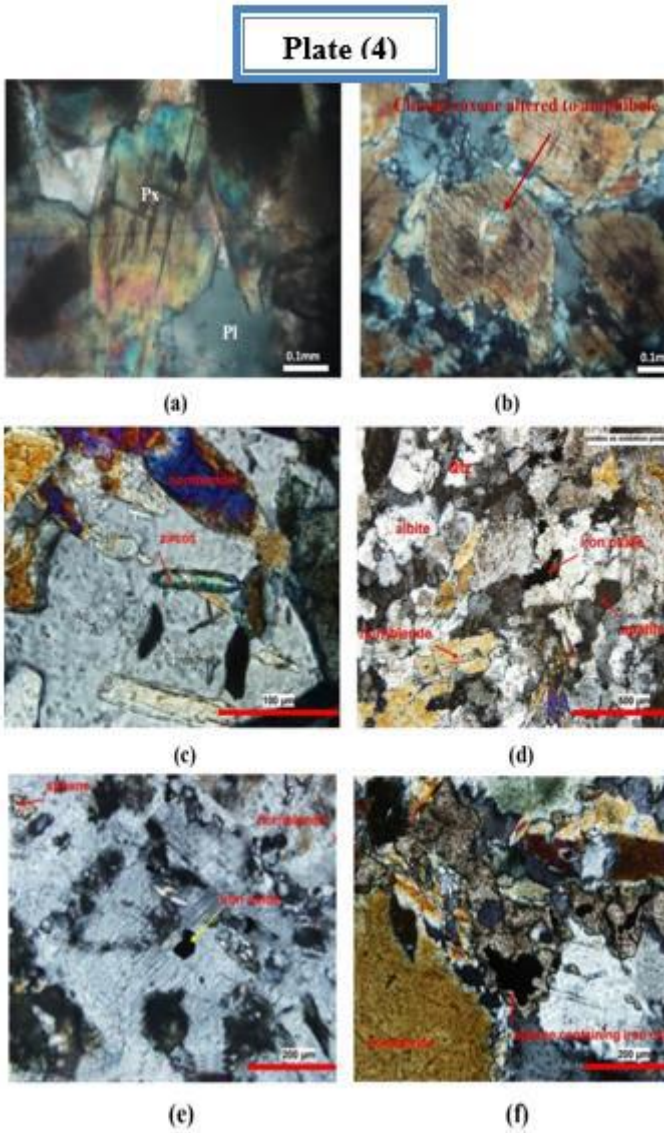

Plate (4.a): photomicrograph of sample (PA1) (X.N.), showing fresh clinopyroxene crystal.

Plate (4.b): photomicrograph of sample (PA1) (X.N.), showing clinopyroxene partially altered to secondary amphibole.

Plate (4.c): photomicrograph of sample (PA12) (X.N.), showing elongated crystals of zircon.

Plate (4.d): photomicrograph of sample (PA10) (X.N.), showing enhedral crystals of apatite, quartz, and secondary iron minerals.

Plate (4.e): photomicrograph of sample (PA14) (X.N.), showing subhedral grain of sphene , also showing primary euhedral grain of iron oxide .

Plate (4.f): photomicrograph of sample (PA14) (X.N.), showing sphene containg iron mineral .

Sphene is characterized by being anhedral to subhedral with very high relief and dark brown color, ranging about 1% (plate 4.e, f). Sphene presence of indicates high temperature condition. Raase et al., 1986 in Celik and Dal, 2006 have proposed that as temperature rises amphibole will be enriched in Ti, thus, sphene could be a temperature indicator. Opaques including iron oxides are of two types; primary euhedral-subhedral (Plate 4e) and secondary disseminated aggregates of very fine grain associated with alteration of pyroxene to secondary amphiboles. There is generally a strong association between oxide- rich regions and highly deformed and altered regions (plate 4.c &4.f).

VI. ALTERATION MINERALS

The main alteration product of the mafic minerals that are found in the studied rocks, is chlorite which appeared as patches of platy shape scattered in the ground mass. It appears in the majority of studied rocks as alteration product of pyroxene and amphibole, due to chloritization process (Plates 2.c & 5.a). Also appeared as veins (Plate 5.b), as well as xenoliths within amphibolite pods (Plate 6). Petrographic study indicates that these xenoliths are chlorite "clinochlore" apparently derived from the alteration of diopside which is found as small remnants within the chloritized grains. This is enhanced by XRD analysis (Fig. 4). Epidote is appeared as small anhedral crystals or sometimes as a small patches in the groundmass, and as inclusions in altered plagioclase and hornblende (Plate 3.f). Sericite as alteration product of plagioclase is colorless and appears as small patches inside plagioclase (Plate 3.e). Sometimes, the plagioclase is completely replaced by sericite.

Sericite forming process starts with the beginning of plagioclase alteration where the hydrothermal fluids penetrate, leading to the formation of sericite. When sericite growth halts, other minerals like epidote forms by increasing alteration intensity and temperature of hydrothermal alteration (Al- Cholmaky, 2002) .

VII. TEXTUREW OF AMPHIBOLITES

Although Penjween amphibolite rocks were subjected to secondary processes, they are characterized by preserving some of their protolith textures and mineralogical properties. In general the amphibolite rocks in the study area are characterized by coarse, holocrystalline,

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hypidiomorphic grains (Plate 7). The textures recognized in these rocks are:-

- Porophyroblastic texture

The prophyroblastic texture is one of the most common texture in metamorphic rocks, referring to grains of distinctly different sizes. Where large porphyroblasts of hornblende and plagioclase embedded in a fine grained groundmass (Plate 7.a & b).

- Granoblastic texture

Granoblastic texture is common in these rocks where well-developed coarse amphibole grains appeared surrounded by unoriented arrays of tabular plagioclase (Plate 7.c & 7.d).

Porphyroblastic texture and granoblastic textures are considered a common textures in amphibolite from Beysehir ophiolitic melange Central Taurides; Turkey, (Gelik and Dela Loye, 2006)

- Blasto-ophitic texture

Ophitic and sub-ophitic texture in studied rocks is regarded as relict texture which gives useful information about the origin and pre- metamorphic history that inherited from the parent of igneous rocks. It occurs when a relatively large crystal of amphibole completely encloses individual plagioclase laths (Plate 7.e), or plagioclase enclosed completely by the secondary amphibole (Plate 7.f).

- Grano-nematoblastic texture

This texture appeared as hornblendes grains aligned in such a way that impart sort of lineation with interstitial plagioclase (Plates 3.b & 4.b). Some hornblende porphyroblasts contain numerous small randomly oriented very fine inclusions forming poikiloblastic texture (Plate 2.b). Grano-nematoblastic textures are considered common in amphibolite from the ophiolitic mélange beneath the Yarlurg Zangbo ophiolites, Xigoze area, Tibeti, (Carl Guilmelte, 2005).

VIII. MINERALS ASSEMBLAGES OF AMPHIBOLITE ROCKS

According to petrographic study, the amphibolite rocks have variable mineral parageneses, which are affected by secondary processes. The primary minerals were partially altered due to these processes, which produce new minerals that replace the primary ones. However, the primary mineral assemblages can be observed as primary amphiboles and relicts of clinopyroxene. Accordingly these amphibolites are characterized by the following mineral assemblages:

1. Hornblende+plagioclase+clinopyroxene ∓ quartz ∓ sphene ∓ zircon ∓ apatite ∓ ironoxide minerals.

This mineral assemblage is characterized by the presence of fine prismatic xenomorphic clinopyroxene crystals which are subhedral to anhedral. The textures of this assemblage are porphyroblastic and blastophitic.

2. Hornblende + plagioclase ∓ quartz ∓ sphene ∓ apatite ∓ zircon ∓ iron oxide minerals ∓ chlorite ∓ sericite ∓ epidote.

This mineral assemblage is widespread in the studied amphibolite rocks. The rocks that have this assemblage show different textures such as porphyroblastic, granoblastic and nematoblasic textures, and the grains are medium to large in size. Hornblende is partially altered to chlorite and plagioclase which appears in prismatic euhedral - subhedral form altered to sericite, and epidote that exist as fine crystals, scattered within the major phases. The intensity of alteration in this assemblage is more than that in the first assemblage by the presence of alteration products (chlorite, sericite, epidote).

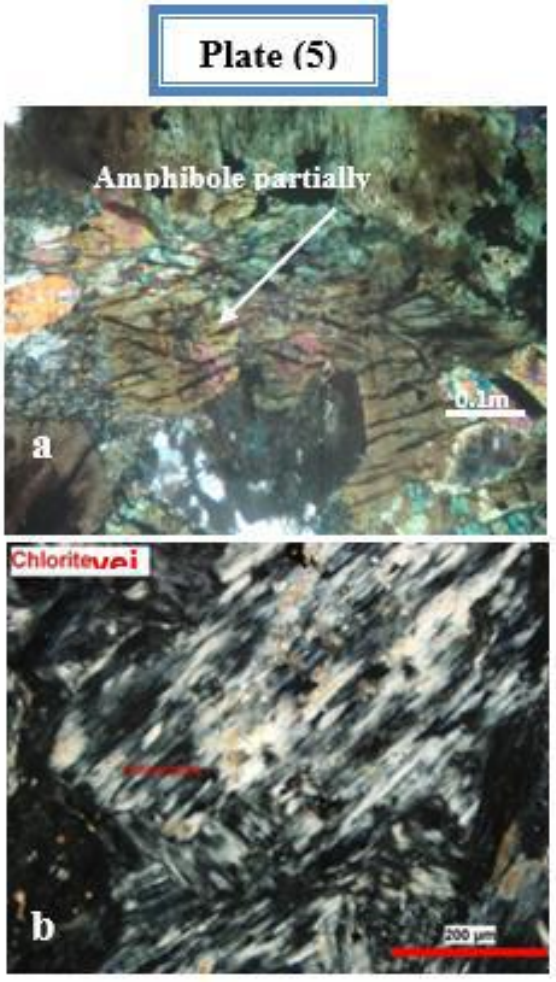

Plate (5.a): photomicrograph of sample (PA2) (X.N.), showing secondary amphibole partially altered to chlorite
Plate (5.b): photomicrograph of sample (PA4) (X.N.), showing chlorite veins.

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Plate (6)

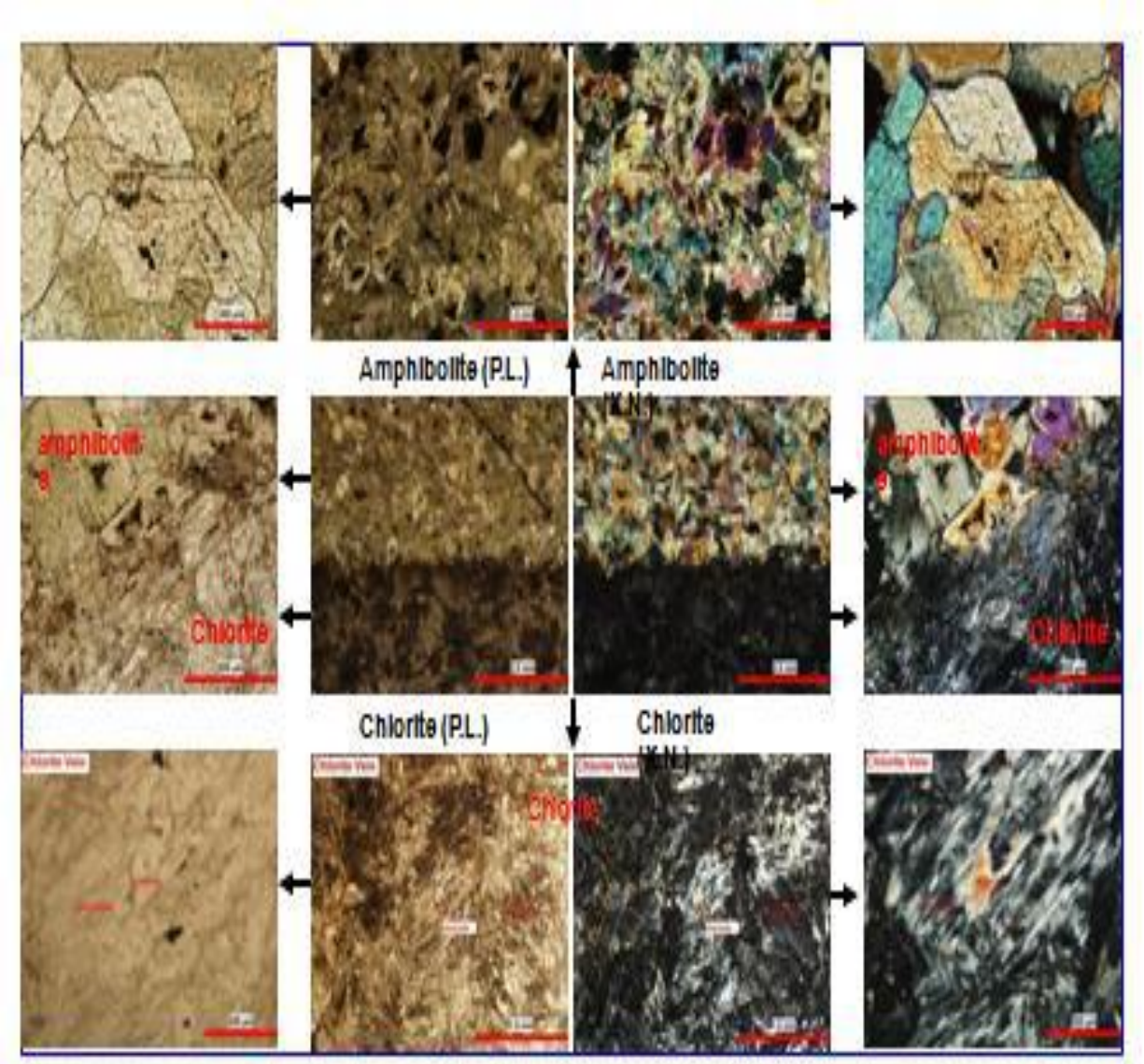

Plate (6) photomicrograph of different parts of the sample (PA5) (X.N.), showing the rock consists of two parts the main rock is amphibolite in sharp contact with chlorite xenolith .

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Plate (7)

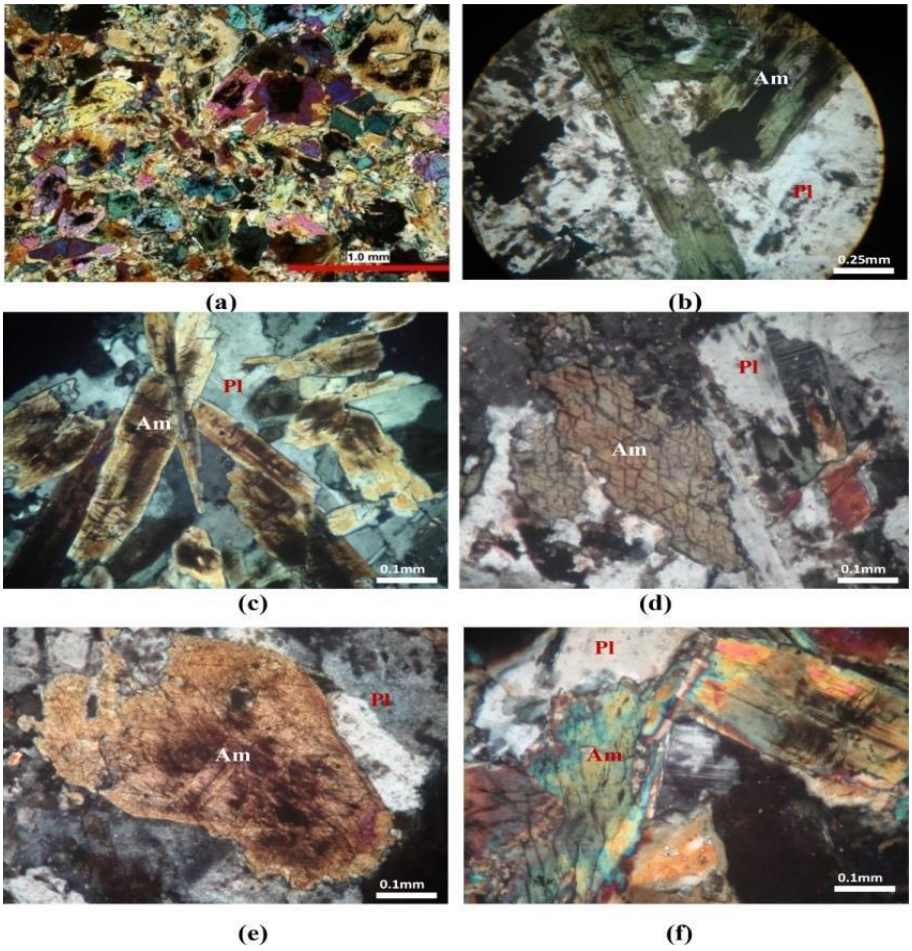

Plate (7.a): Photomicrograph of sample (PA1) (X.N.), showing hypidomorphic, granular, porphyeroblastic texture in amphibolite rocks.

Plate (7.b): Photomicrograph of sample (PA11) (X.N.), showing porphyroblastic texture. Phenocrysts of hornblende embedded in plagioclase groundmass.

Plate (7.c): Photomicrograph of sample (PA12) (X.N.), showing granoblastic texture, secondary amphibole surrounded by unoriented tabular plagioclase.

Plate (7.d): Photomicrograph of sample (PA16) (X.N.), showing ganoblastic texture, phenocrysts of primary amphibole surrounding the plagioclase crystals.

Plate (7.e): Photomicrograph of sample (PA11) (X.N.), showing blasto ophitic texture, primary amphibole is completely enclosed in the plagioclase .

Plate (7.f): Photomicrograph of sample (PA1) (X.N.), showing blasto sub-ophitic texture, amphibole partially enclosed by the plagioclase.

IX. CONCLUSIONS

Petrographic study revealed that the major mineral constituent are amphibole(hb) + plagioclase(Ab87 An12.8) + some accessory minerals such as sphene, zircon, apatite, iron oxides and rarely quartz. These rocks had been subjected to hydrothermal alteration losing their primary component with the appearance of cilnopyroxene as a relict. Secondary minerals are chlorite, epidote, sericite and secondary amphibole. The main texture is granoblatic, porphyroblastic, blasto-ophitic, nematoplastic and poikiloblastic textures and some hornblende show zonation .Microprobe analyses show that the amphiboles have a calcic composition and are represented by tschemercite and Mg-hornblende. Plagioclase composition ranges between albite and oligoclase.This diagram revealed two types of plagioclase ranging between oligoclase (An23.9 Ab75.9 Or0.2) and albite (An1.7 Ab97.9 Or0.4). Based on petrographic study and

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chemical analyses, this range of plagioclase composition is considered the dominant and characteristic of amphibolite rock composition.

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