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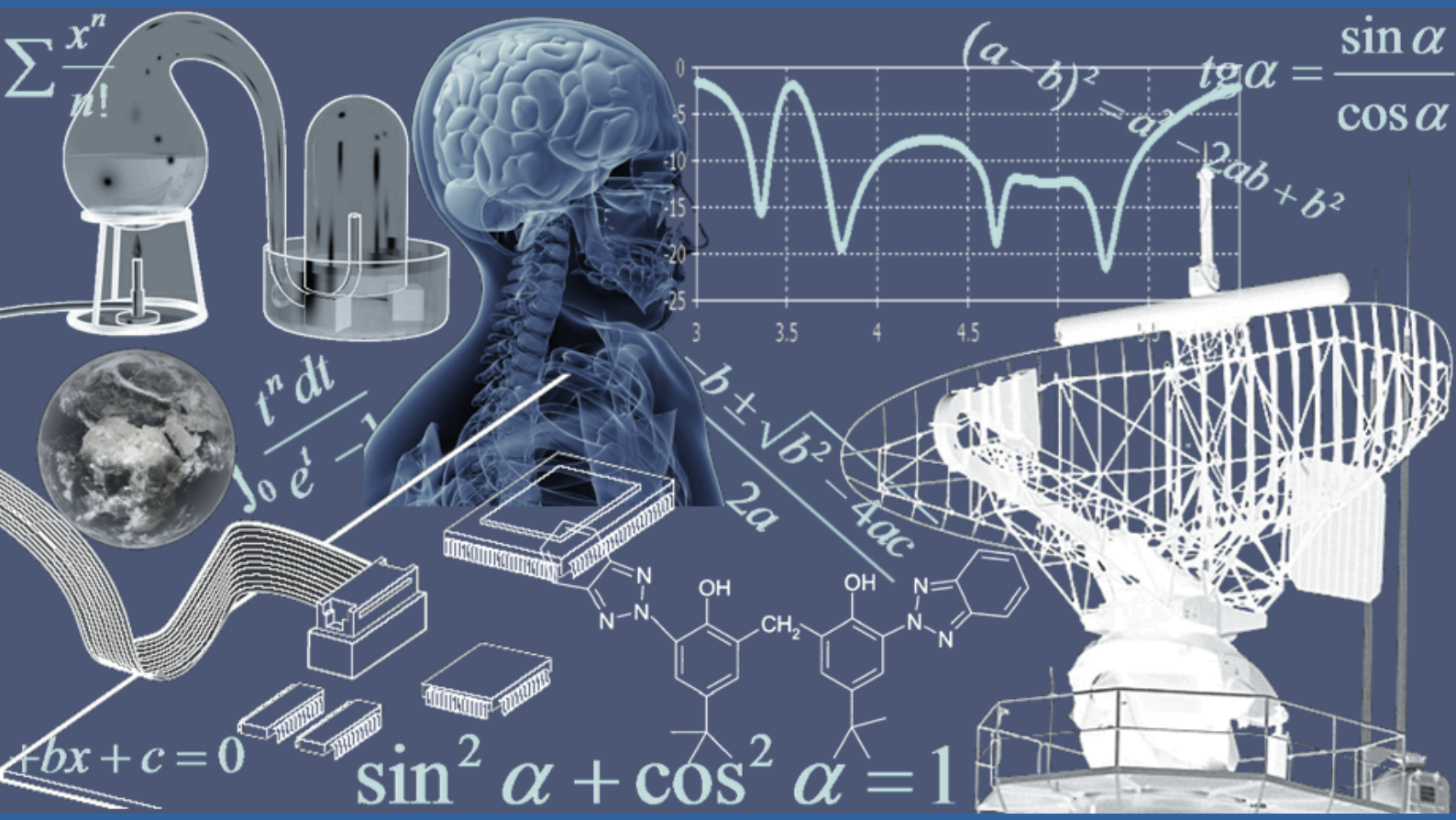

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A Neuro-Fuzzy Application Proposal of an Individual Intelligent Driving Behavior Predictor Device

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ABSTRACT: Ever since automobiles evolved as the dominant transportation mode, road safety emerged as one of the governments' greatest concerns. A number of surveys highlight the fact that unpredictable reaction of drivers is one of the major accident reasons, especially on highways and major roads. Researchers have not made many efforts to tackle this issue, which leaves this a rather untouched problem requiring more research. Intelligent transport systems (ITS) technologies are increasingly being accepted by traffic authorities and people. This paper attempts to offer an ITS solution which can help to learn and predict drivers' behaviors which can be useful for predicting their actions and reactions during driving. This approach consists of three major phases: Learning, Modeling and Predicting. An artificial Neural Network (ANN) has been applied for learning phase and then the learned parameters are utilized in generating a fuzzy model of the driver behavior which can be a basis for the third phase which is prediction. In other words, this research uses a neuro-fuzzy approach to learn, model and predict a driver's behavior. Previously, researches have been conducted in providing safer roads by using intelligent systems and inter-vehicle communication. The aim is to implement this process in personal devices, each located in every car, which are inter-connected.

KEYWORDS: ITS, Neural network, Fuzzy systems, Neuro-fuzzy, Driving behavior simulation.

BACKGROUND:

There have been some efforts in providing safer roads by using intelligent systems and inter-vehicle communication as in [1-2]. There are also some materials on using a neuro-fuzzy approach toward driving simulation as in [3-6]. However these methods were limited to traffic simulations which can only be usable for traffic authorities and they do not provide a personal use. This research tries to propose a device which can be used in personal cars in order to increase roads' safety.

1 INTRODUCTION

Intelligent transport systems (ITS) technologies are being more and more accepted by traffic authorities [7]. ITS has even entered personal use domain; Advanced Transport Telematics (ATT) and Advanced Traveler Information Systems (ATIS), in particular, allow travelers to make informed travel decisions and are increasingly being recognized as a potential strategy for influencing driver behavior and improving traffic quality [3], [8].

There is a long list of reasons recognized as major causes of car accidents; however, in most studies 'distractions' and 'unpredictable actions of other drivers' are at the top of this list [9]. Distraction can be avoided, or at least reduced, by

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driving more carefully or being more cautious. But it is not easy, or even possible in some cases, to predict other drivers' actions and reactions! Such a prediction needs to be carefully derived from a driver's driving behavior and road condition. Obviously, this is a complicated analysis which cannot be easily managed by a driver's mind and requires a more intelligent mechanism to be taken care of. An intelligent traffic behavior simulator might be a good idea to ameliorate the number of accidents caused by this phenomenon; a device which can learn and model a driver's habits and warn other drivers by predicting his or her actions and reactions.

There have been a lot of materials discussing different approaches toward driver behavior modeling. Driver behavior models that can be used to dynamically estimate or predict the drivers behavior can be thought of as a classification problem where the inputs to the model comprise drivers' individual socio-economic characteristics and other variables that may influence their behavior; and the output a binary integer (1,0) representing whether drivers comply with travel rules or not, respectively. Two of the approaches available for developing such models include discrete choice models and artificial neural networks [10]. However, these models have major limitations:

- They cannot efficiently handle fuzziness of the phenomenon as they tend to result in crisp values
- They require inputs such as socio-economic characteristics which cannot be practically provided
- They require a large amount of resources for processing which makes them inefficient for individual uses
- They work better in large scales (e.g. modeling driving behavior of a society) rather than individual use

2 SIGNIFICANCE AND CONTRIBUTIONS OF PROPOSED MODELING APPROACH

This previous discussion shows that existing models lack the necessary features to allow for modeling driver behavior in the context of Advanced Traveler Information Systems. The desired models should have capabilities for modeling the behavior of individual drivers, the uncertainty inherent in driver decision making and the vagueness in information received from ITS devices and the road environment.

One benefit of fuzzy systems is that the rule base can be created from expert knowledge, used to specify fuzzy sets to partition all variables and a sufficient number of fuzzy rules to describe the input/output relation of the problem at hand [11-14]. However it usually requires high expert knowledge and the defined parameters may not be necessarily correct in all cases. To be more specific, in driving case, each driver has a different driving behavior which is formed by a series of factors such as experience, personality, expertise and etc. Accordingly it is somewhat impossible to define a model which is accurate for all driving types.

Fuzzy logic and artificial neural networks [15-16] are complementary technologies in the design of intelligent systems. The combination of these two technologies into an integrated system is a promising path toward the development of Intelligent Systems capable of capturing qualities characterizing the human brain [14], [17].

The neuro-fuzzy method is a way to create a fuzzy model from data which has been collected via some kind of learning process motivated by learning procedures used in neural networks. In other words, the neural part collects data via learning and the fuzzy part creates a fuzzy model using the alleged data. This application can be quite useful in this case as it can be integrated in a device which learns about the drivers' driving habits and notify other drivers about his or her possible actions or his dangerous driving behavior.

3 NEURO-FUZZY APPROACH FOR EXTRACTING DRIVER BEHAVIOR RULES

One technique which gained considerable acceptance in the design of complex transport algorithms is the use of artificial neural networks, these have been successfully used to overcome limitations of existing analytical approaches [18]. The main advantages of ANNs include the ability to deal with complex non-linear relationship; fast data processing; handling a large number of variables and fault tolerance in producing acceptable results under imperfect inputs [15], [19].

Given only a set of inputs and outputs during the training process, the neural network is able to determine all the rules relating input and output patterns based on the given data [20], [15]. In this paper, each driver is modeled as an agent with a set of preferences and knowledge about the environment. It is hypothesized that the use of neuro-fuzzy models, where fuzzy logic is coupled with neural networks, would be a viable approach for incorporating human decisions and capturing the uncertainty in drivers' behaviors [4]. In Figure 1 a general scheme of a neuro-fuzzy system and its major parts can be seen.

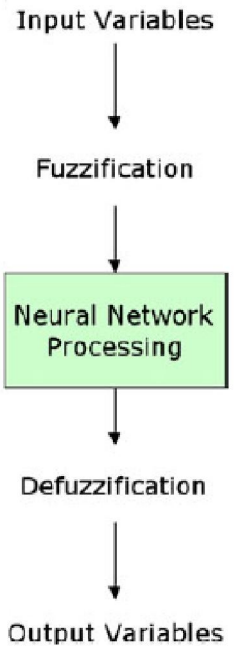

Fig. 1. Neuro-fuzzy Network (Hussein Dia and Sakda Panwai, 2010)

As the driver drives, the neural network sets its parameters so that the prediction becomes continually precise over the time. For example there is an exit on the highway; based on the drivers habits at turns (e.g. When one reduces speed, does one use flashers, its current lane, …) the algorithm can predict how likely it is that the driver changes the lane or takes the exit.

In Figure 2 There is a sample neuro-fuzzy network prediction sudden lane changes. The whole system consists of a number of networks each providing different predictions.

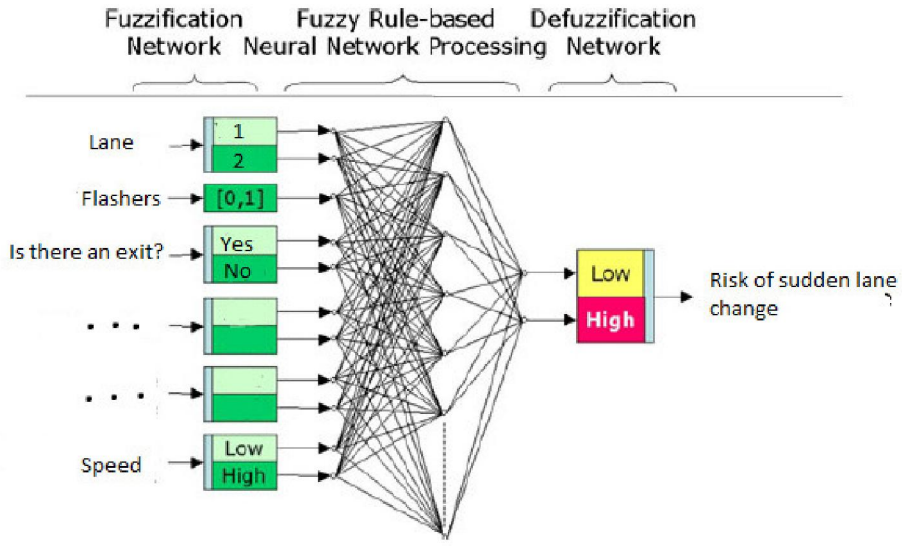

Fig. 2. Neuro-fuzzy interface—compliance model

3.1 FUZZIFICATION

This step describes the conversion of the collected data (crisp data collected by sensors while driving) into the fuzzified inputs shown at the interface to the neural network processing. Fuzzy logic uses a "membership function" to transform input variables into the set [0, 1]. A "possibility" function is defined to have values between 0 and 1 indicating the degree of belief that a certain element belongs to a set. This is a mathematical representation of linguistic information used in fuzzy set theory [15].

3.2 NEURAL NETWORK PROCESSING

The simple feed-forward neural network with three layers is used to learn the relationships between the fuzzified input and output patterns as presented in Figure 2. Input variables are fed into the network and the fuzzification sub-network transforms these real inputs into fuzzified inputs in term of "high" and "low" or '0' and '1' or numerical values. Therefore, the input layer will consists of the sum of possible answers. For instance if we have 5 inputs and each contain two possible values as "high" or "low", we will have 10 neurons.

In this case the output layer has only two neurons predicting whether the driver takes the turn or not. Every neuron in the input layer is connected to every neuron in the hidden layer with a weighted arc. Similarly, every neuron in the hidden layer is connected to every neuron in the output layer with a weighted arc. The weights of these connections will be determined and updated as the training of the neural network continues. The determination of the neural network parameters mainly involves establishing the weights of these connections. This is similar to other statistical modeling approaches such as regression analysis where the modeler determines the parameters of a regression equation [4].

The neural network, let's simplify it as N, may be regarded as a machine which is capable of taking on a number of states, each of which represents a function computable by the machine. These functions map from the input space A (the set of all possible patterns) to an output space *B.* The inputs are encoded as vectors of real numbers indicating parameters such as speed, lane, distance to the next exit and etc. (A∈R), and these real numbers lie in a bounded range, such as 1 to 3 for lanes or 0 to 200 km/h for the speed [21]. In this study we are interested in binary outputs such as: will the driver take the exit? Yes (1) or No (0); how much is the risk of sudden lane change? High (1) or Low (0) and etc., so, there, we have $B = \{0,1\}$.

Formalizing mathematically, we may regard N as being characterized by a set Δ of states, a set *A* of inputs, a set *B* of outputs, and a parameterized function $F : \Delta * A \rightarrow B$. For any $\alpha \in \Delta$, the function represented by state α is $h_\alpha : A \rightarrow B$ given by:

$$h_\alpha(x)=F(\alpha,x)$$

Where the function *F* describes the functionality of the network: when the network is in state α it computes the function h_α. The set of functions computable by N is $\{h_\alpha : \alpha \in \Delta\}$, and this is denoted by H_N. For instance, if we have a state $\alpha = (\alpha_1, \alpha_2, \bullet\bullet\bullet, \alpha_n, \beta)$, and the function it represents is:

$$\begin{aligned} h_\alpha(x) &= F(\alpha,x) \\ &= F((\alpha_1, \alpha_2, \bullet\bullet\bullet, \alpha_n, \beta),(x_1, x_2, \bullet\bullet\bullet, x_n)) \\ &= sgn\left(\sum_{j=1}^{n} \alpha_j x_j - \beta\right) \end{aligned}$$

Where:

$$sgn(F(x)) = \begin{cases} -1 & when\ f(x) < 0 \\ 0 & when\ f(x) = 0 \\ 1 & when\ f(x) > 0 \end{cases}$$

3.3 DEFUZZIFICATION

This step is the most important in the construction of the neuro-fuzzy network as it give the final results which are the predictions. It aims to compute the crisp result by using a threshold. The main consideration of this method is to represent membership functions of a fuzzified output and to perform defuzzification. The defuzzification consists of two layers: the first layer is the membership functions of the fuzzified output while the second layer is the defuzzification layer (crisp values) [15].

3.4 PERFORMANCE MEASURES

One of the most important indicators for evaluating the performance of a neural network classifier is the Classification Rate (CR) [4] which provides a measure of the correctly predicted outputs and is best depicted using the classification rate matrix as shown in Figure 3. The columns of the classification rate matrix represent the actual results whereas the rows represent the neural network predictions. In the body of the matrix consists of values of 1 and 0 for any given cell where value of 1 means that all desired outputs for that category were correctly predicted and value of 0 in a cell means that none of the desired outputs were predicted. Classification rates obtained during the training stage provide a measure of the calibration results which can help the model to improve and recalibrate itself [22].

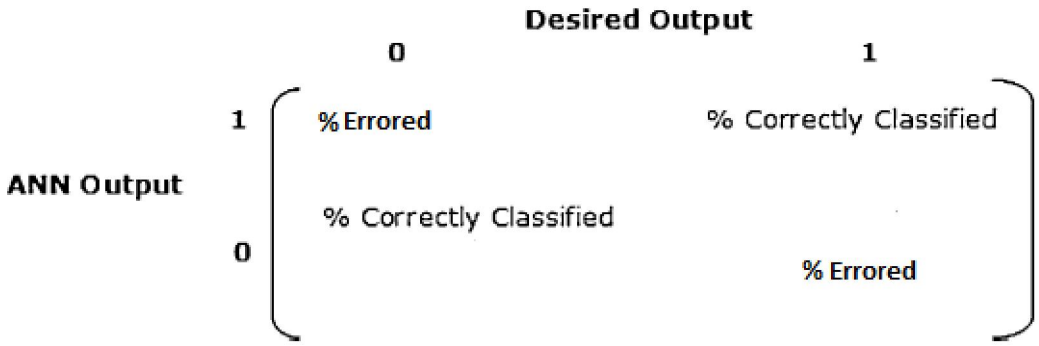

Fig. 3. Classification rate matrix – a measure of ANN prediction accuracy

The whole process discussed in previous sections can be summarized as in Figure 4 where neural and fuzzy aspects of the process have been specified. However, in practice the two aspects are hardly distinguishable.

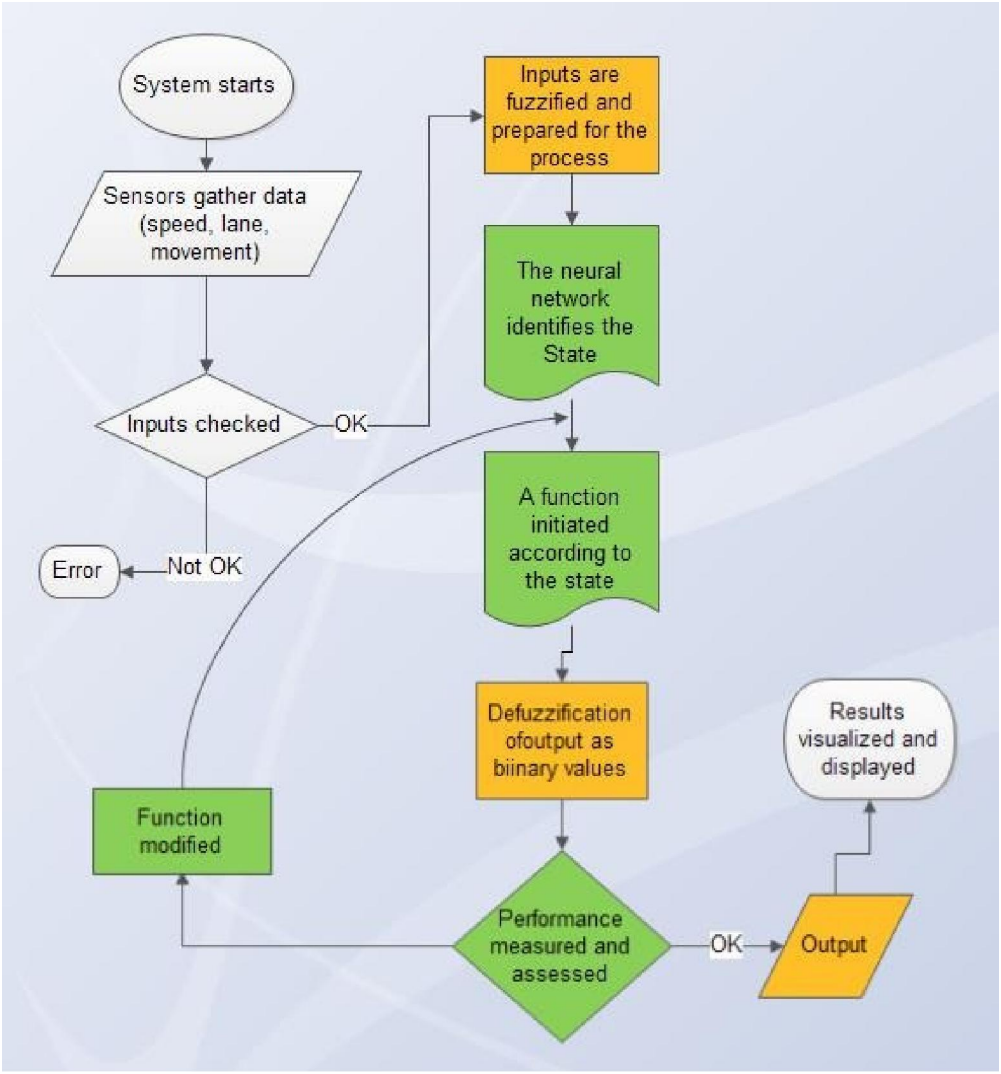

Fig. 4. The whole process flowchart (Green objects form the Neuro part of the process and the orange objects the Fuzzy aspect of the process)

4 IMPLEMENTATION OF METHOD

As mentioned earlier in this paper, an individual Advanced Traveler Information Systems (ATIS) is proposed in this research which is a device that can be implemented in cars.

4.1 HOW DOES THE DEVICE WORK?

The device must consist of following major parts:

1. The device needs to be equipped with a navigation device, such as GPS, to provide a spatial basis for the prediction. Each action on the road is caused by road condition. Therefore, we need to know where we are and what we have ahead of us (a connection with the traffic servers).
2. A screen displaying the road, adjacent cars and notifications.
3. A Gyroscopic sensor to sense car movements on the road [23].
4. A processor capable of learning and modeling processes.
5. A small data storage device for recording calculated (or learned) parameters.
6. An inter-vehicle communication system for receiving and sending parameters to and from other cars.

4.2 WHAT CAN IT DO?

The device learns more as the driver drives the car, accordingly the parameters get continually more precise over time and can answer following questions which are considered as potential characteristics of dangerous driving. In other words each car will be represented as an intelligent agent that imitates that car's behavior on the map.

- Does one usually drive aggressively? (Going too fast or racing)
- Does one ignore traffic lights, road signs or other warnings?
- Does one overtake dangerously or on insight?
- Does the car have dangerous faults?
- Does one turn into the path of another vehicle?
- How far before an exit does one take aside or slow down? Does he or she use flashers beforehand?
- How often does one make sudden brakes?

These and many other questions can be answered using such a modeling technique. Although it may not be one hundred percent accurate but it definitely can reduce the risk of accidents caused by sudden and unpredictable actions in following ways:

- It flags the dangerous driver and it notifies other drivers in case of adjacency to a dangerous driver.
- It warns if there is a high possibility that a nearby car may turn or change the lane suddenly or without flashers.
- It informs the driver to keep a certain distance if the front car has the habit of making sudden brakes.
- It can predict a driver's reaction, given the road conditions.
- It can predict a driver's reaction based on his habits in driving.

5 PUBLIC DEMAND AND EFFICIENCY ANALYSIS

In order to assess the public demand for such a device two surveys were done in two countries where traffic behavior and conditions are completely distinct. The first survey was done among 150 people in Tehran, Iran and the second one was done in Helsinki, Finland.

5.1 A SURVEY IN IRAN

A survey was done in June 2013 in Tehran, the capital city of Iran. Tehran is a big city with a population of more than 12 million. There are a lot of traffic jams and long rush hours. People tend to drive aggressively and many rules are not taken seriously.

In this survey people were asked:

- Question 1: If they have had any accidents caused by another drivers unpredicted action?
- Question 2: How helpful to them can this technology be?

The questioner was distributed among 150 people who had driving experience and the results can be seen in Table 1.

Table 1. Result from survey 1 (Tehran, Iran)

	Number of people with positive answer	Percentage of Positive answers
Q1	127	84.6
Q2	98	65.3

The results show that unpredicted driving actions are considered as a major cause of accident among people and about sixty five percent of people have a positive idea on such a technology.

5.2 A SURVEY IN FINLAND

A survey was done in August 2013 in Helsinki metropolitan area, Finland. Helsinki is a rather big city with a population of slightly more than 1 million. There are few traffic jams and short rush hours. Most people respect traffic rules.

Similar to the first survey in this survey people were asked:

- Question 1: If they have had any accidents caused by another drivers unpredicted action?
- Question 2: How helpful to them can this technology be?

The questioner was distributed among 150 people who had driving experience and the results can be seen in Table 2.

Table 2. Result from survey 2 (Helsinki, Finland)

	Number of people with positive answer	Percentage of Positive answers
Q1	53	35.3
Q2	87	58

Although Finnish people drive more regularly and lawfully, many people complained about people (mostly drunk) break laws and drive aggressively at nights which causes accidents.

Similar to the first survey, people find such a technology useful in increasing roads safety.

5.3 PRIVACY ISSUES

One of the main concerns which were mentioned by a large number of test subjects was the privacy. People are concerned that their information might be misused by authorities, and most specifically police, which can cause them problems. One of the most important steps which must be taken into account prior to any national development of such technologies is to define a Privacy Act which prohibits authorities from accessing this information for certain purposes. The information must be only conveyed between cars and it will not be stored on any server. Such and other similar approaches can help people to trust this technology without being afraid of their privacy being violated or receiving any tickets.

5.4 SURVEY CONCLUSION

The results show that demand and need for this technology are higher in developing countries and more populated cities because:

- The traffic rules are less respected, therefore unpredictable and offensive actions are more common.
- Higher population results in more crowded roads, so the driver needs to be more careful about adjacent cars.
- Developed countries have been more successful in improving driving culture among their people which helps to decrease aggressive behavior by drivers.

6 CONCLUSION

In this paper a device was proposed that can learn the driver behavior and create a model which can be used as a basis for sudden actions prediction. There are three major phases in this process which are: Learning, Modeling and Prediction. Most common approaches in this field are a kind of classification problem which result in discreet values after receiving appropriate inputs. Due to fuzzy nature of our case these approaches cause limitations therefore we offered a new approach; a neuro-fuzzy approach where a neural network is responsible for the learning phase and a fuzzy model is created which keeps on getting updated as the neural networks learns. The final result will contain a number of neuro-fuzzy networks, each responsible for predicting a certain action of driver.

Finally results of two surveys were discussed in this paper, which were done in two completely different situations; a developing country with rather large population and a developed country with small populations. More surveys and analyses need to be done in order to come into a concrete result; however the results from these surveys state that the need for such an 'Advanced Traveler Information Systems' (ATIS) is more outstandingly observed in developing countries.

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Wireless Sensor Networks for Industrial Applications: Practical Approach

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ABSTRACT: Wireless Sensor Networks (WSN) provides information for data acquisition and data distribution. It is a network that consists of spatially distributed and automated wireless sensor nodes which are capable of monitoring several physical environmental fields such as air pressure, luminosity, vibration and temperature. This paper focuses on the design of a WSN utilising ZigBee protocol and Waspmote technologies; the purpose is to provide telemetry services for industrial applications which will be required to collect data about light bulb luminosity as well as its associated surroundings. At the end of the processes, WSN framework was designed showing initial results of bulb luminescence reading, temperature and accelerometer; the designed system has the capability of sending real-time data over a network platform utilising the ZigBee 802.15.4 protocol with sensor nodes attached to the circuit board; this will provide radio frequency telemetric services, utilising a cost effective platform that has the benefits of overcoming the cumbersome measures presently in operation. Sensor networks methods of development overtime have suffered setbacks for lack of well-defined practical approach that will produce results patterned for industrial acceptance; this paper measures on this area using a model that is environmental and eco-friendly.

KEYWORDS: Wireless Sensor Networks, Waspmote, Nodes, ecology, data, ZigBee.

1 INTRODUCTION

The technological advancement in the world has over time taken a new turn and measures to monitor activities in industries are being developed to provide free access to information and support for end users [1]. This is as a result of the high demand for resources capable in assisting industrialists to accomplish set goals and develop programs for the establishment of time delivery of materials and create opportunity for increased knowledge [2].

The importance of providing a well detailed prototype Wireless Sensor Network (WSN) in an industrial application cannot be over-emphasised; hence this project focuses on bridging the gap between the availability of adequate monitoring data reporting to improve on the existing systems and the conventional method of operations.

WSN are technologies in which characteristically constrained nodes assists each other in transmitting packets of data through the network from source to destination. The WSN consists of nodes that can send and receive messages in a mesh pattern and a node that can function as a router and can also relay messages for its neighbour. Through this process, [3] wireless packet data will find its way to the predetermined destination, passing through intermediate nodes with reliable communication channels.

WSN application varies from one location to another. Various fields such as fire, military installations, pollution, machine health and environment monitoring have experienced expanding revolution in the implementation of this technology in manning activities encompass them. In most network design, basic routing is used as the network architecture, while new flooding-based technology provides the opportunity and advantages especially in large networks [4].

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2 RESEARCH CONTEXT

There have been notable challenges in monitoring the light build luminosity with a view to ascertain its level of use which may result to instant maintenance or replacement; with these, this paper work and methods employed will develop a new and improved system to overcome these challenges [5],[6]. The goal is to design a prototype WSN system capable to test for light bulbs luminosity which will be measured in lumen. There is need for an integrated system with automation which is required to assist the process that will bring about clarity and cost effective in implementation [7], [8]. This designed prototype will improve further research in this area utilising more sophisticated wireless sensor devices.

The research methodology adopted for this process follows a well thought after procedures in development a complex system of this nature [9]. The in-lab experience has been conducted with results which are in line with the challenges being faced and design specifications [10]. Wireless Sensor Networks is an increasing aspect of networking technologies which scholars have identified as the new evolution in the information and communication technology industry [11]. This network consists of tiny nodes with sensor technology used for wireless communications across different networking topology.

This kind of network was developed to truncate the barrier of wire networking design, although security in wireless sensor networking is a challenging height; a portion of this research highlights areas on how these challenges can be curbed [12].

3 SENSOR TECHNOLOGIES

Sensor Technologies functions in highly powered high-speed and low-cost electronic circuits. In a developing world, the need for sensor technologies with a view to support systems automation, security and information dissemination is on the increase [13]. The application of sensor technology in diverse ways has eventually enforced the increase of the requirement for the implementation [14]. The design of smart homes and environment is made possible by the use of sensor devices. Sensor technologies in this respect are expected to provide novel approaches and solutions as required.

Sensor can be considered as complex devices that can be used to detect and respond to signals being produced. A sensor primarily converts physical parameters into signal. These parameters can be; temperature, humidity, and speed. The signal produced can be measured electronically.

When deciding on a particular sensor to use in a given task, the following consideration will be employed; Cost, Range, Accuracy, Environmental consideration, and Resolution [15].

4 WIRELESS SENSOR PROTOCOL

Currently, sensor networks are widely gaining ground because of its numerous applications ranging from environment monitoring, industrial machine and home appliances monitoring. Such network is best described as a network that consists of sensor nodes assigned for a specific function [16].

The sensor node will have full computational ability for sensing and transmitting data in wireless communications model. Inter-connective protocol is considered suitable for wireless sensor networks. Inter-connective protocol is capable of detecting damaged node on time through the help of another node closed to the faulty one. For the purpose of this project, the 802.15.4 and ZigBee standards will be discussed for its peculiarity and reliability.

The 802.15.4 and ZigBee standards are considered as a wireless technology with open global standard, addressing the area of power, cost and high radio frequency [17].

5 AIM AND OBJECTIVES

The main aim and objective of this paper is to support the developmental scale WSN in a development world of technlogical advancement and design processes to build capacity for new skills.

The paper aims to help non-professionals to setup WSN systems and to make decisions on pressing issues relating to monitoring the health conditions of industrial applications [17], [18]. The following outlined specific areas in the objectives;

- Learning the technology and applications of wireless sensor networks.
- Analysing the current system and make possible solutions where appropriate.

- Understanding the limitations of sensor network technology and to evaluate possible solutions based on these limitations.
- Providing strategic alternatives for the systems to be improved.
- Evaluating the suitability of the implemented sensor system utilising *Waspmote* and ZigBee technology.
- Analysing different WSN development techniques and methods.

6 MAIN TASKS

Table 1. Tasks Schedule And Requirements Involved In Designing The System

Tasks	Requirements	Solutions
Device movement	Accelerometer	*Waspmote*
Power provision	Solar panel	Power harvesting
Light tensity measurement	Photocell Light Sensor 3K-11K 5.10ohms	Light sensor
Wireless Communication	xBee adapter with 2.4Ghz RF	Device interaction
Wireless transmission	*Waspmote* device	Nodes interaction
Programming	*Waspmote* IDE v2.0	Serial monitor
Signal transmission	Relay device	
Device firmware configuration	X-CTU	Firmware uprade andconfiguration.

Each systems design requirements are carefully chosen as a means of developing the program to meet the expected results. The entire system will generate the data and transmit simutanously over the network design using the *Waspmote* interface. The processed data will be stored in an external device for further interpretation.

6.1 DESIGN COMPONENTS

As stated in Table 1 the components required to design this system are products from *Libelium* and from *Digi Tech* working with the device configurations requirements. Below are listed components that will be used for the designing phase to achieve the objectives of the tasks.

- Waspmote - this is the network now with embedded system capabilities.
- X-CTU - xBee device firmware configuration platform.
- Light Sensor - electronic device used to determine the intensity of light.
- SD CARD - Mini SD Card used for external storage purpose for data analysis.
- Waspmote IDE - the programming platform as the compiler for the Waspmote product.
- USB cable - used to connect the network node to the system for programming purposes.
- XBee Adapter - serves as the gateway, receives data and transmits it to the base station.

6.2 DEVICE SETUP AND TESTING

Devices are connected and programmed using Waspmote program library support in C++ platform. The platform comes with a user friendly interface and compatibility for expansion and flexibility. The choice of using this program ranges from easy error correction and dubbing. The implementation of elements detailed above follows some critical phase for efficient results taking and to make any form of fault finding process less difficult. This includes;

- Assessment of requirements
- Components evaluation
- Setup and configuration
- Validation
- Testing

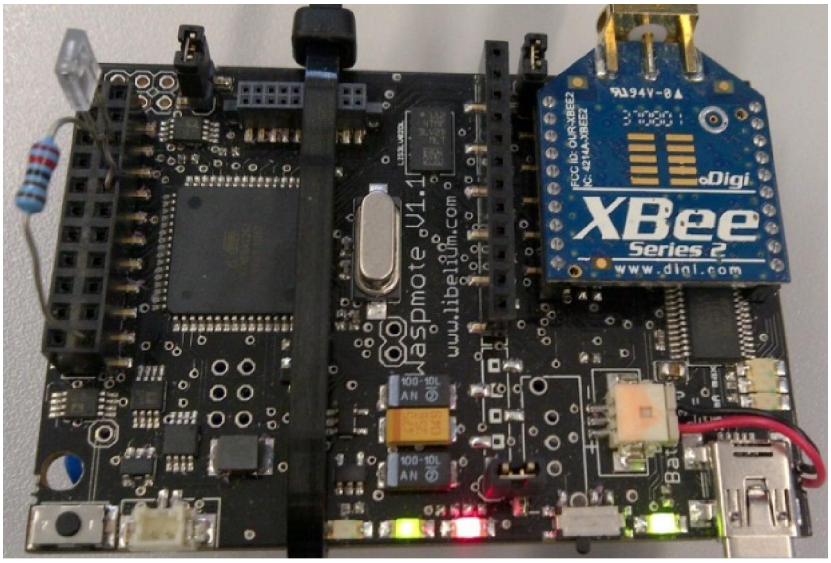

Fig. 1. Actual sensor board used

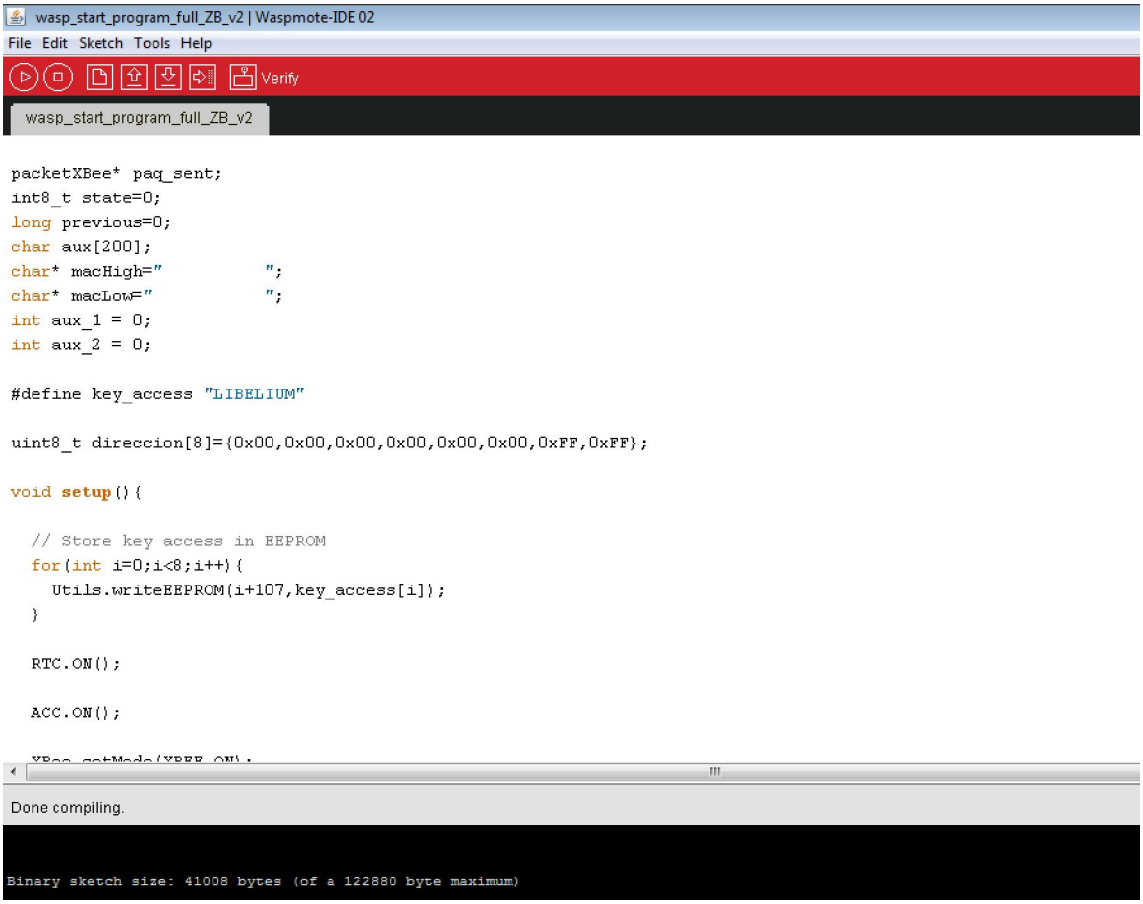

Fig. 2. Waspmote IDE programme session

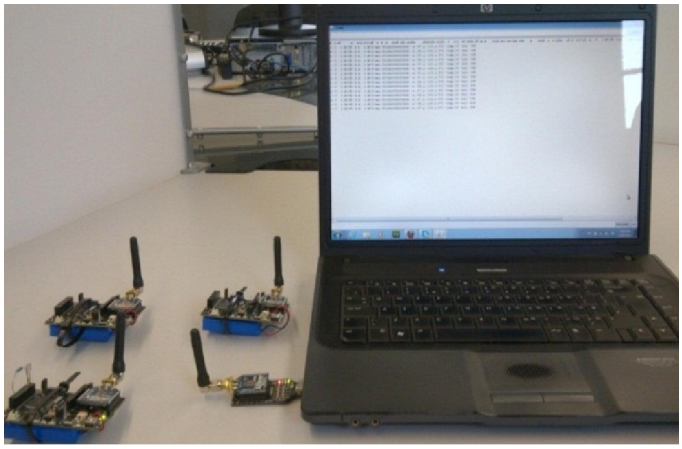

Fig. 3. Actual Setup and Program monitoring session

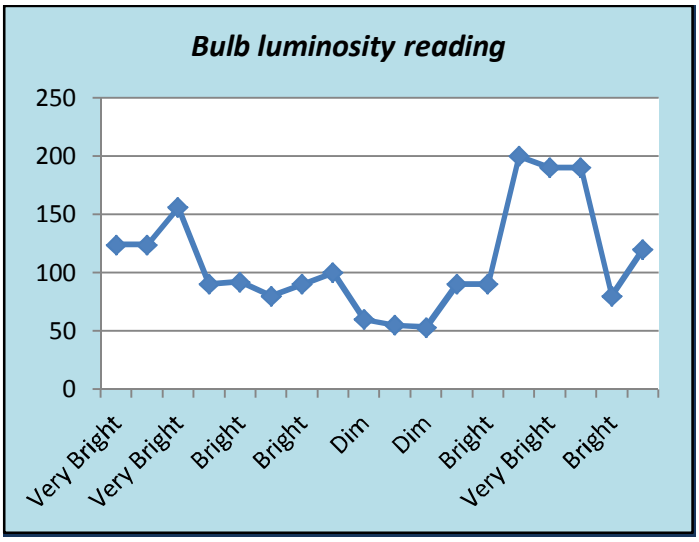

Fig. 4. Data collection graph for bulb luminosity

```
COM7

Temperature: 26
~   R }3 R # VxSensor Light Reading!È  woke up
Landing Light Readings =223 - Very bright
Temperature: 26
~   R }3 R # VxSensor Light Reading!È
Landing Light Readings =222 - Very bright
Temperature: 26
~   R }3 R # VxSensor Light Reading!È woke up
Landing Light Readings =221 - Very bright
Temperature: 26
~   R }3 R # VxSensor Light Reading!È woke up
Landing Light Readings =221 - Very bright
Temperature: 27
~   R }3 R # VxSensor Light Reading!È woke up
Landing Light Readings =221 - Very bright
Temperature: 27
~   R }3 R # VxSensor Light Reading!È woke up
Landing Light Readings =220 - Very bright
Temperature: 27
```

Fig. 5. Light Sensor readings output

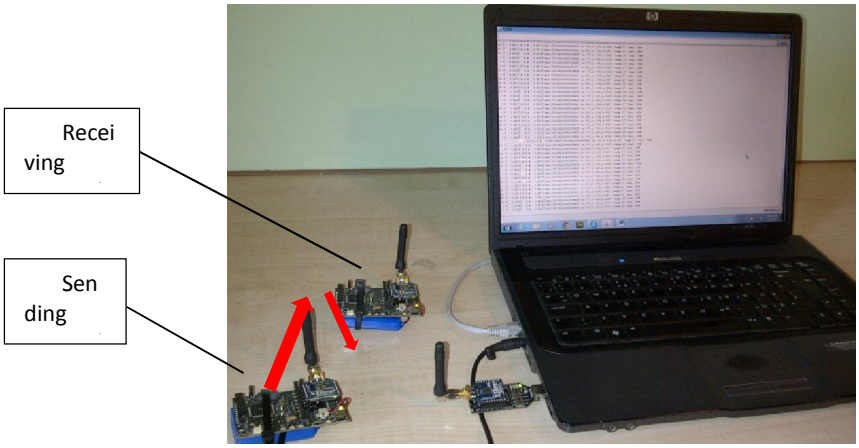

Fig. 6. Nodes communicating with each other

7 CHALLENGES AND RECOMMENDATIONS

Setting up an industrial based WSN standard through practical approach requires elaboration to a large extent stating the challenges encountered and the possible recommendations within the same framework in ensuring that a range of improvement is visible. The following challenges and recommendations have been identified as significant;

- To ensure that devices are securely deployed to meet global standard for WSN deployment with regards to the environment; it is recommended that each node be secured with a specialised plastic casing to keep a standard enclosure.
- Power supply to the nodes after being developed is limited as the inbuilt battery of the Waspmote can only be in operation between 4 – 6 hours; therefore an alternative power supply is recommended which will consist of tiny Solar panels that will be attached to each node on the field for power harvesting purposes aiding energy saving needs. For example, IEEE 802.15.4 and ZigBee standards can run for years on self-provision batteries by limiting the amount of data received and the transmitted frequency respectively.
- Date storage and security are also key areas which recommendations are being made for future data encryption using cryptographic techniques. And in storage, recommendation is based on the need for a secured storage location which can automatically expand itself and strong enough to resist unauthorized interference. Security in wireless communications is viewed as the most important aspect of wireless technologies. *Encryption* and *Authentication* are part of the critical areas where high wireless security measures should be addressed.

8 CONCLUSION

The primary goal of this paper is to show a design of a system that can provide automated monitoring assistant for industrial application; it focuses on learning the technology and applications of wireless sensor networks, to understand the limitations of sensor network technology and to evaluate possible solutions based on these limitations and to evaluate the suitability of the implemented sensor system using Waspmote and ZigBee technology. Progressively, a Wireless Sensor Networks prototype designed with the ZigBee network protocol was deployed to the site after due success achieved with the program testing stage as shown in this paper. Testing procedures were carried out with results output attached accordingly.

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Variation and Challenges in the Global Practice of Environmental Impact Assessment (EIA)

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ABSTRACT: Rapid project development in human societies across the globe has led to the need to strengthen environmental regulation in order to protect the environment, its features and inhabitants from the negative consequences of development without stifling urbanisation. Environmental Impact Assessment (EIA) is therefore, a legally-recognised measure of controlling the excesses of developers or proponents. This study investigated the wide variation in global EIA practice in terms of screening, scoping and administration. The current underlying challenges associated with the practice of EIA across the globe such as inadequate monitoring, bribery, excessive bureaucracy and obsolete environmental legislations were also studied. Some of the challenges were country or region-specific due to the following factors: geographical location, project type, socio-economic pattern and legal institutional framework; however, recommendations were offered on how these challenges can be managed effectively considering the environmental-specificity of the affected countries. The recommendations include: merging identical EIA administrative authorities to reduce bureaucracy; EIA should be carried out by the competent authority in each country and proper post-development monitoring should be encouraged as these would help curtail bribery and reduce bias; check and balance mechanisms must be set in place so as to reduce the excesses of the proponents since they fund the monitoring process; old legal EIA documents in affected countries should be reviewed to meet current needs.

KEYWORDS: Environmental Impact Assessment, global EIA practice, variation in EIA, EIA challenges, Screening in EIA, Scoping in EIA, EIA administration.

1 INTRODUCTION

Humans have begun to appreciate the value of the environment due to their inevitable reliance upon it [1]. Development is one of the major causes of environmental devastation [2] and, as a result, it has become imperative to conduct some kind of environmental assessment before approving any major development project. As early as 1969 in the United States, environmental assessment (EA) had become a practice with legal provisions [3]. A few years later, other countries around the world followed suit and, today, Environmental Impact Assessment (EIA) has become the general term used to describe the process.

EIA or EA (the term used by some countries) is the process of determining the environmental effects of proposed projects based on information gathered, which will be taken into account by the proponent as part of the project design/plan, and by

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the decision-making body in authorizing the execution of the project [4]. EIA sets out to achieve two objectives. The first is to determine whether the project will have a significant impact on the environment [5] and the second is to support sustainable development [6]. In other words, EIA was not established to stifle development, but to ensure that the environment is insignificantly affected even in the face of monumental development projects.

The procedural framework of EIA practices differs slightly but not fundamentally, across the globe. Therefore, the objective of this study is to reveal the existing variation in the global practice of EIA and suggest possible improvements. Figure 1 shows a generalised EIA framework; No country possesses all the stages but certainly has the basic components.

EIA is practised according to national law in most countries whereby the legal documents state the regulatory authority (for decision-making) and spell out the entire EIA process. In most cases, the process is fairly simple while in few others, the process is very complex.

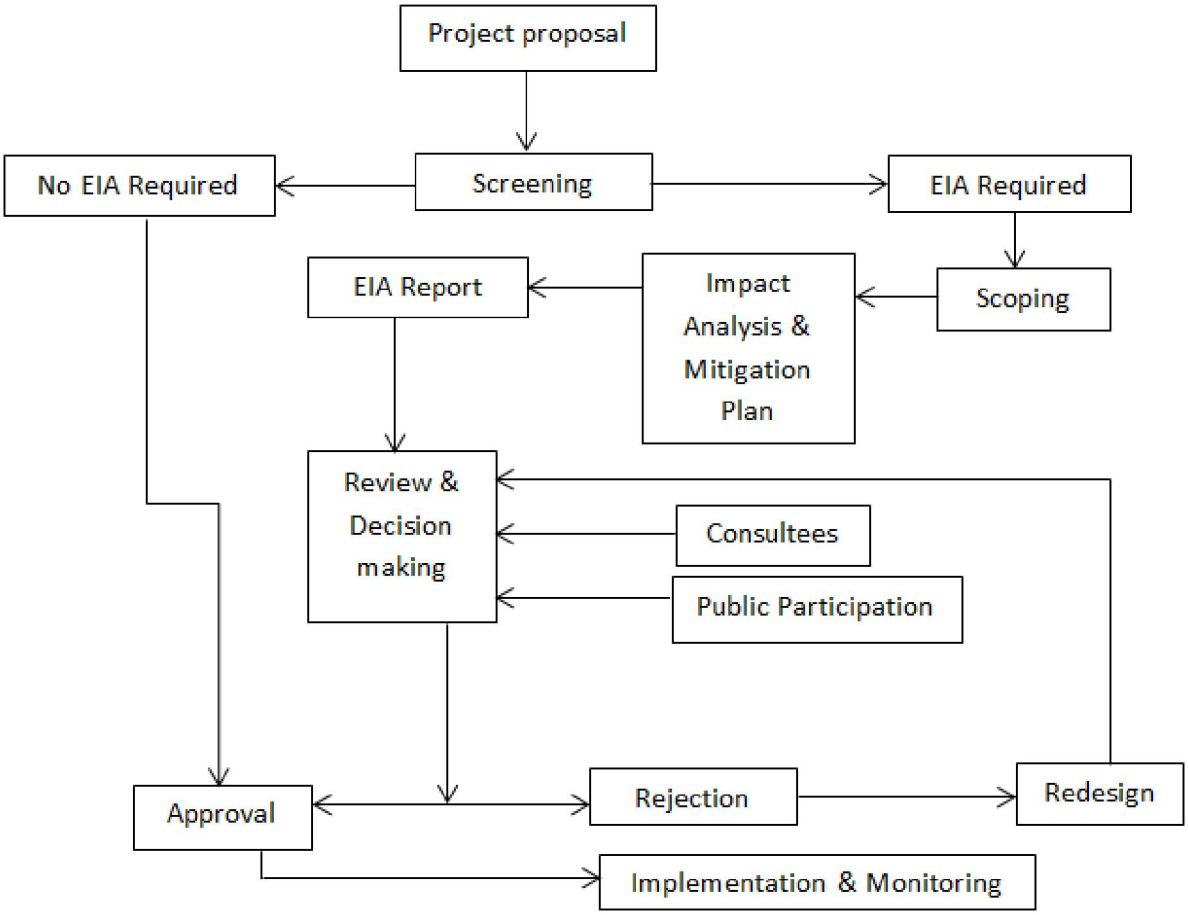

Fig. 1. A Generalised EIA Process [7]

2 THE GLOBAL PRACTICE OF EIA

The similarities and differences in EIA practice around the world will be examined on the basis of three important EIA stages which are as follows:

- Screening
- Scoping
- Administration

2.1 SCREENING

Screening is carried out to ascertain whether a development project requires an EIA or not because not all projects require an EIA. The method of screening varies from one country to another. Screening is carried out through the provision of

one of the following; listing approach (which involves the use of inclusion and/or exclusion lists) and a case by case study of proposed projects. The combination of both screening methods is used in some countries. Furthermore, there is a large variation in the use of the listing approach by many countries. Most countries have on their listings, project capacity thresholds, some have financial thresholds whilst others have no threshold. Some countries represented their listings with colours where each colour code for exclusion (requires no EIA) or inclusion (approved with a condition or requires full EIA).

An inclusion list is a standard list of projects which require EIA. In the countries where inclusion lists are used, thresholds (the minimum production capacity for individual projects, above which EIA will be required) are often established. For example, in France, a hydroelectric plant generating over 500KW requires an EIA [8]. Similarly, in the UK, a thermal/nuclear power station with a heat output of 300MW or more requires an EIA [9]. Exclusion lists on the other hand, are standard lists of projects which do not require EIA. Some countries use a single inclusion list, e.g., Canada, China, Brazil and Australia. In China, the inclusion list is contained in the *Classification Catalogue Management of Environmental Impact Assessment for Construction Projects* [3]. However, in some other countries, two inclusion lists are used, where one of the lists represents the projects that require mandatory EIA whilst the other represents the projects that require EIA only if the threshold is exceeded or projects that may be approved based on conditions.

A good example of the two-listing system is found in the UK, Germany and Turkey, as 'Annex I and Annex II listings', where Annex I listing represents a list of projects that require mandatory EIA and Annex II listing represents a list of projects that require EIA only if the threshold is exceeded. In Belgium, the two inclusion lists used are referred to as, list A and list B. List B requires minimal impact assessment whilst list A requires a full EIA [10]. In France, screening decisions are made based on two project categories, which are; projects requiring EIA (i.e., projects which always require EIA and projects which only require EIA when a standard threshold is exceeded) and projects with a smaller environmental impact which only require a *notice d' impact sur l'environment* (NIE) – an impact statement on the environment [8]. In Japan, large-scale development projects that could threaten the environment are categorised as 'Class 1' (requires full EIA), Class 2 (EIA necessity depends on a case-by-case study of individual project) and others (no EIA required) [11].

Thresholds help to standardize and reduce time wastage in the screening process. Thresholds may be based on production capacity or set in financial terms. In Canada and Brazil, production capacity thresholds are employed. For example, in Canada, the extention of a fossil fuel-fired electrical generating station with production capacity of 50% and above or 200MW and above will require an EIA [12]. Similarly, in Brazil, the following require EIA: activities using 10 tons of charcoal per day; power plants over 10MW; transmission lines over 230KV [13]. On the other hand, financial thresholds are used in France and India. In France, projects with a construction cost of 1.9 million Euro requires an EIA [8] and in India, investments on new projects which require more than 100 crores (i.e., 1 billion rupees) and refurbished projects involving an investment above 50 crores (i.e., 500 million rupees) both require an EIA (This threshold does not apply to Indian industries which process hazardous chemicals) [14]. However, there are countries which use listings but do not set any form of threshold, e.g., Turkey, Tunisia, China, and Australia. In order to augment the screening process in Australia and make it less ambiguous, a referral form from the proponent is sent to the regulatory officer who then decides whether the project requires an EIA or not [15].

In some countries where listings are used, there is no provision for exclusion lists (e.g., China and Brazil) whilst in some others both inclusion and exclusion lists are provided (e.g., Canada, Australia, France and the United States). In many countries, projects which do not require EIA (or projects on the exclusion lists) are granted approval without further assessment (e.g., Canada and United States) but in Ghana projects which do not require EIA still undergo inspection before an Environmental Permit (EP) is issued [16]. In the United States, only government-sponsored projects require an EIA; all private projects are exempted [9]. In India and Bangladesh, an NOC (No objection certificate) is issued for projects which do not require EIA [17] whilst in the United States, a FONSI (finding of no significant impact) is issued for projects which do not require EIA and an NOI (notice of intent) for projects which requires EIA [9].

Colour bands are used in some countries to simplify the screening process. Both inclusion and exclusion lists of projects in such countries are divided into categories represented by colours. For example, in Bangladesh, projects are divided into four coloured categories – Green, Amber A, Amber B, and Red – based on the location and environmental significance of the proposed project. Green projects do not require any initial assessment or EIA (an NOC will suffice), Amber A and B projects require limited assessment, and Red projects require both initial assessment and EIA. In addition, projects are divided into three coloured categories in Egypt – Black, Grey and White. Projects on the black list require full EIA; projects on the grey list do not require EIA but approval is based on conditions; projects on the white list do not require EIA or approval conditions [18]. For example, in the oil and gas sector in Egypt, petrol/natural gas stations proposed to be built in environmentally non-sensitive zones are included in the white list [19]. Environmentally non-sensitive zones are areas outside residential, protected and agricultural zones including specified areas by the regulatory authority (EEAA – Egyptian Environmental Affairs

Agency). In addition, a fuel (i.e., petrol, gas and diesel) storage tank with a storage capacity of 15, 000m^3 or less is included in the grey list but if the storage capacity of the fuel tank is exceeded, it will be included in the black list [19].

However, in Nigeria, a case by case approach is adopted in the screening process which is carried out by the regulatory authority. The regulatory authority conducts an IEE (Initial Environmental Evaluation) to determine the significant environmental impact of a project, which reveals whether an EIA will be required or not [20], but in Ghana, IEE is a post-screening process that determines the aspect of a project which requires scoping [16]. Unlike most countries, Nigeria has no provision for a standard inclusion or exclusion list. In Mexico, screening is based on the discretion of the state and local environmental authorities to classify projects into two categories – regional projects and particular projects. Regional projects are those with potential regional impacts whilst all other projects are particular projects which require less extensive assessment [21]. Egypt and Germany have listings but also apply the case by case method for projects that are insufficiently screened by the provided listings.

2.2 SCOPING

At the end of the screening exercise, those projects that do not require EIA will move over to the regulatory authority for approval. However, if the project has the potential to threaten the environment, then scoping is likely to be carried out (as it is not a mandatory process in few countries, e.g. UK and Spain). Scoping involves the decisions that will be made about which impact categories will be included in the EIA. It is considered as a critical element in the EIA process and therefore, requires clear guidance to be provided to those who will carry out the EIA [8]. The variation in scoping cannot be critically examined without determining who carries out the scoping, what the scoping will cover, the result of scoping, the provision for an alternative and site selection/approval.

The regulatory officer, or authority, carries out the scoping in Canada, UK, United States, India, and Australia, with the help of consultees or special agencies. In Canada, consultation with the Aboriginal group (natives of the land) is carried out during scoping [22]. In Australia, the regulatory officer consults with the appropriate Advisory Committee before concluding the scoping process. It should be noted that if measures to mitigate impact are well spelt out by the proponent and satisfactory to the regulatory officer, the project may be approved without an EIA [15]. In the United States, the competent authority (EPA – Environmental Protection Agency) is solely in charge of scoping [9]. In the UK, the proponent requests for a 'scoping opinion' (detailing the information to be provided) from the competent authority [9]. In contrast, scoping is carried out by the proponent in China, Ghana, Tunisia, Belgium, Nigeria and Brazil, with the help of a multi-disciplinary team or a consultant whose services are paid for by the proponent. In these countries, Terms of Reference (TOR) – in the form of a document which embodies the parts of the project which requires to be measured for environmental impact – is prepared by the proponent in conjunction with the consultant and then sent to the regulatory authority for further assessment. In Egypt, the proponent carries out scoping for projects on the black list but the competent authority carries out scoping for projects on the grey list. In Bangladesh, scoping is not well-defined. The proponent presents an application which contains; a feasibility study report, IEE, EIA, EMP (Environmental Management Plan – which reveals mitigation measures), NOC and PMP (Pollution Minimisation Plan) following which a site clearance may be given if the relevant authorities are satisfied [23].

In most countries, scoping covers similar areas with slight variations or minor additions. For example in the UK, scoping covers biodiversity, air, water, soil, climate, landscape and cultural heritage, which are contained in the scoping opinion [8]. Similarly in Egypt, scoping covers the biosphere (including living organisms, air, water, soil and establishments set up by man), public place (closed or semi-closed) and environmental resources [24]. In Canada, scoping covers physical and biological components (such as, air, water, vegetation, terrain, fish, wildlife and migratory birds), cultural heritage, historical structures and the socio-economic and health implications of the proposed project on the inhabitants of the area [25]. Scoping covers similar areas in Australia with the addition of wetlands of international importance, threatened species and impacts on the environment (both terrestrial and marine, commonwealth and aboriginal lands) [15]. In Belgium, scoping specification is designed by the Brussels Administration for Environmental Management (IBGE). This body sends to the proponent, the proposed content of the Environmental Impact Statement, detailing the areas that require scoping and the list of registered consultants who are allowed to carry out the EIA [8].

Scoping leads to the production of an Environmental Statement (ES) or a Draft EIA Report (DER), although the time span between scoping and ES/DER production is lengthy and varied. Both carry similar information – an analysis of the project, the risks involved and mitigation measures – useful for decision making. Some countries have multiple ES or EIS while some others have just one. Two EISs (draft EIS and final EIS) are used in Ghana, Denmark and US whilst three EISs (draft EIS, EIS and Final EIS) are used in Japan [11]. On the other hand, a single EIS is used in China [3]. Countries using DER often have two versions of EIA reports – DER and Final EIA report, e.g., Nigeria [20].

In Finland, Assessment Schedules – which reveals investigations to be taken –are submitted (rather than EIS or DER) by the proponent to the coordination authority. The coordination authority then distributes it to other relevant authorities for comments (including the public). The opinions gathered from the review are then sent to the proponent for the changes to be effected before approval can be made [8].

A development project with a highly significant environmental impact which has no sustainable mitigation plan is likely to face rejection. In some countries, there are provisions within the EIA framework for an acceptable alternative. In India, UK, Netherlands, Egypt and Turkey, alternatives are considered. India carries out the alternative study at the scoping stage [26]. In contrast, Tunisia does not consider alternatives [18].

In Addition, not many countries have project site selection or approval as part of the EIA process, but in India, UK, Bangladesh and Germany, there are provisions for it. In Bangladesh, Amber A, Amber B and Red projects all require site approval [27]. In Germany, site selection is carried out by the 'Landers' (the German land authorities) [28]. In India, site clearance is administered by the competent authority (MoEF – Ministry of Environment and Forest) and required for projects such as: mining and exploration of valuable minerals; thermal power machinery; multi-purpose river valley projects and important ports and harbours. Approval from Airport authority and State forest departments are required as well if the project is to be sited close to an Airport or in forestland [17].

2.3 ADMINISTRATION

The legal document which supports the practice of EIA in every country also states clearly who administers the EIA and who carries out the EIA. In some countries, the regulatory body performs both functions; in some others, the regulatory body administers whilst the proponent carries out the EIA through a hired consultant/team of experts. In addition, Consultees/review panels are often needed by the regulatory authority for better decision-making. In many countries, the review of the EIA report is carried out by consultees/review panels whilst in few others, the review is carried out solely be the regulatory authority. Public review or participation is a basic component of EIA in many countries but in quite a few numbers of countries, EIA reports are treated as confidential and kept away from the public. The right to appeal in case of a project proposal rejection is legally provided in some countries but absent in many others.

In Canada, United States and Australia, the regulatory authorities carry out the EIA but in slightly different ways. In Canada, the EIA is carried out by three regulatory bodies; Canadian Environmental Agency (CEAA), the Canadian Nuclear Safety Commission (CNSC) and the National Energy Board (NEB). The project assessed by each regulatory body depends on the speciality of the project. Nuclear related projects are assessed by CNSC, energy-based projects are assessed by NEB and every other project is assessed by CEAA [22]. In Australia, the responsible officer (The Minister, Department of Sustainability, Environment, Water, Population and Communities) carries out the EIA by assessing the referral information/ES or by public inquiry [15]. In the UK and the United States, the competent authorities, the Planning Committee and EPA respectively, carry out the EIA study.

In Nigeria, Phillipines, Bangladesh, India, Ghana, China and Brazil, the project proponent carries out the EIA through hired consultants, but the practices differ slightly among these countries. In Nigeria and China, the consultants hired by the proponent must be certified by the regulatory authorities, Federal Environmental Protection Agency (FEPA) and Ministry of Environmental Protection (MEP) respectively. In Brazil, Japan and Phillipines, the consultant needs no certification by the regulatory body, but the services provided (i.e., the EIA study) must be paid for by the proponent.

EIA administration (including decision-making and enforcement) in some countries is carried out by a single competent authority, usually with the help of consultees. In Canada Tunisia, Bangladesh, Germany and Australia, the sole administrators are as follows: the Minister of Environment; Agence Nationale de Protection de l'Environment (ANPE); Director General of the Department of Environment; Minister of the Environment, Nature Conservation and Nuclear Safety; and the Minister, Department of Sustainability, Environment, Water, Population and Communities respectively.

In other countries such as Nigeria, China, India, Egypt, Turkey and Brazil, multiple administrators are involved. In Nigeria, there are three regulatory authorities; Directorate for Petroleum Resources (DPR) (for petroleum-based projects), Urban and Regional Planner's Development Control (for state and local level construction projects) and FEPA (for general projects) [20]. Similarly, three regulatory bodies are involved in India at the central, state and provincial levels – They are: Ministry of Environment and Forest (MoEF), State Pollution Control Board (SPCB) and Department of Environment (DoE) respectively. In China, MEP is the national regulatory body while at the local level, Environmental Protection Bureau (EPB) administers the EIA [3]. In Brazil, an environmental protection agency, IBAMA (Instituto Brasileiro de Meio Ambiente e Recursos Naturais Renoraveis), is the national regulatory authority while the State Environmental Agency and the Municipal Environmental Authority administer EIA at state and local levels respectively [13]. In Egypt and Turkey, the regulatory bodies are: Egyptian

Environmental Affairs Agency (at the national level) and the sectoral competent authorities (at the local level); Ministry of Environment (at the national level) and local environmental committees respectively.

In many countries, there is no legal provision for the proponent to appeal in case the proposed project is rejected by the regulatory authority. In such countries, the decision of the regulatory body is final. Examples of these countries include: Turkey, Tunisia, South Africa, Nigeria, China, Canada and Brazil. However, in some other countries such as Egypt, UK, India and Denmark, the proponent has a legal right to appeal if the need arises. For example, in Denmark, the Nature Protection Board of Appeals is in charge of the Appeal process and the decision made by the Board is final (i.e., binding on both the competent authority and the proponent) [29]. Also, in the UK, the proponent has the legal right to make an appeal to the Planning Inspector if the competent authority (Planning Committee) rejects his project proposal [9].

In Nigeria, China and Brazil, a review panel – comprising a multi-disciplinary team of experts – is employed whilst in Australia multiple consultees make up the EIA process. In Australia, four advisory committees are consulted based on the speciality of the project. These committees are: the Biological Diversity Advisory Committee; the Indigenous Advisory Committee; the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development; and the Threatened Species Scientific Committee [15]. In the UK, the Planning officers serve as the consultees employed by the regulatory authority. In Canada, however, only aboriginal group participation is required (which is funded by the Canadian government); consultees are not part of the EIA process because three specialised regulatory authorities are already involved [22].

In some countries (Ireland, Denmark and France), the review stage has no legal provision, although a form of review is carried out during the EIA, but in Italy there is a mandatory review stage which is well represented by law. The review (of the EIS) is carried out by the EIA Commission – a 20 member team nominated by the competent authority for a term of three years [30]. In Tunisia, a review panel/consultee is not involved in the EIA process, instead, the competent authority (ANPE) reviews and makes decisions at its own discretion [18].

Many countries of the world (Canada, Brazil, Nigeria, China, Australia, Turkey, Ghana and India) have 'public review/participation' as a basic component of the EIA process, simply because the public will be the most affected if the proposed project has a significant impact on the environment. In contrary, EIA reports in Egypt are considered as confidential, therefore, public participation is not allowed [18]. Similarly, there is no provision for public review or participation in Tunisia [18].

3 CHALLENGES AND RECOMMENDATIONS

The variation in global EIA practice has led to a number of shortcomings. The following are suggested ways by which the challenges can be managed:

- In Nigeria, there is a problem with role-definition among the three legally-recognised competent bodies, which may lead to excessive bureaucracy and the duplication of duties. This can be solved either by merging two identical authorities or by clearly defining their duties and jurisdiction.
- The case by case approach for screening in Nigeria may be too time-consuming. This calls for the need to have an inclusive (with threshold levels) and exclusive lists which will likely help to save time and standardize the screening process.
- In China, Nigeria and Brazil, if the proponent must be the one to carry out scoping (based on the Terms of Reference defined by the competent authority), then the EIA study must be carried out by the competent authority in order to check the excesses/tendencies of the proponent.
- In Scotland and Brazil, the monitoring process is funded by the proponent and this may stir up bribery and a biased result. Therefore, a check and balance mechanism must be set up to regulate the excesses/tendencies of the proponent. The Canadian government can as well adopt this method since the monitoring exercise is currently not carried out in the country.
- In Brazil, the EIA study is carried out by an independent multi-disciplinary team hired by the proponent but may stir up bribery and a biased result. A possible solution is for the competent authority to certify the multi-disciplinary teams in order to regulate their activities and ascertain their integrity, as done in Nigeria and China.
- Scotland, Australia, Brazil and Nigeria all have old legal documents (14 years and even older) which certainly requires review. With the recent advancement in science and technology, new development projects that were not catered for in the document may have been proposed (e.g., Brazil's document does not address nuclear energy projects). Therefore, a more recent review of the legal documents will help protect the environment better.

4 CONCLUSION

It appears that the generalised EIA framework is idealised as no country in the world possess all the stages from project proposition to monitoring/auditing, although the overall objective of the process is not lost. Countries around the world selected independent EIA procedures that best suits them on the basis of geographical location, project type, socio-economic pattern and legal institutional framework. However, the variation in EIA practice has led to a number of shortcomings. One major challenge is the insufficient monitoring (which is completely absent in some countries) of the project after approval and commissioning, probably as a result of lack of funds or the lack of clarity as to who should carry it out. If the challenges associated with this stage can be resolved, it will help to ascertain whether the proponents are complying with environmental regulations which will serve as a reliable means of testing the level of success of EIA practice in each country.

However, it is recommended that 'monitoring' should be carried out by the regulatory authority and funded by the federal or central government as the case may be. Also, mechanisms should be put in place to check the activities of the proponent (in countries where the proponent carries out the EIA) whilst fairness should be considered by countries that disallow the legal appeal by proponents whose projects were rejected. In addition, countries with the use of EIA legislative documents that are out-of-date and insufficient to meet current trends, should review their legal documents to meet the demands of modern development in a rapidly changing society. It is expected that all these would generally improve the quality of EIA practice across the globe.

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Theoretical Studies of Automatic Generation Control Technology

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ABSTRACT: This paper presents new techniques of Automatic Generation Control (AGC) technology which are employed to increase the certain demand of power system stability and control. Today, power system control operation is fully automated with an Automatic Generation Control (AGC) technology and improves the reliability, productivity and efficiency of power industry. The power generating equipment can be controlled by maintaining the power system frequency at constant value. And power system frequency control is achieved by Automatic Generation Control (AGC) and governing systems of individual turbine-generators. This achieves the automation of whole power plant based on automatic control of water-turbine generator. Therefore the mechanism of Automatic Generation Control (AGC) makes operation limitation condition units that ensure the safe operation of power plant with the principle of Energy Management System and primary functions. At the time of carrying out these functions, it is necessary to avoid the frequent start/stop of units caused by short-term load fluctuation of power system and detail problems are discussed in the paper. At the end study is also focused in engineering problems and target function of Automatic Generation Control (AGC) in hydropower plant.

KEYWORDS: AGC, Power System, Hydropower Plant, load distribution, active power control engineering problems.

1 INTRODUCTION

Automatic Generation Control (AGC) is an integral part of Energy Management System and primary function of the Automatic Generation Control (AGC) is to balance the total power system generation versus system load and losses [1]. In 1989 the Automatic Generation Control (AGC) technology was first introduced which had an operation in continuously and successfully. In this account power plant operation security was significantly improved and it raised the plant automation control and operation function level [2]. Therefore huge demand of Automatic Generation Control (AGC), eventually reasonable economic benefits were obtained. In short way, this paper initially presents the Control technical levels of Automatic Generation Control (AGC) in the manner of theoretical study and focus on mode of operation of AGC, Frequency adjustment of power system, engineering problems and as well as load and no load disturbance. This paper also examined the Automatic Generation Control (AGC) method in power system of hydropower plant [3].

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1.1 FREQUENCY ADJUSTMENT OF POWER SYSTEM

The frequent load change of each power station results to imbalance power of whole power grid, thus leading to frequency fluctuation of power grid. Function of frequency adjustment of power system, When the system frequency fluctuates, adjust generator output to reach new balance, so as to keep the frequency deviation be within allowable range [3].

Variation of three kinds of load:

- Random load component: variation period is less than 10s, small amplitude and short period.
- Impactive load change: variation period is 10s to 2~3 minutes, large amplitude.
- Long period component: the period is about 2~3 minutes to 10~20 minutes; it is load change caused by production, daily life and meteorology and so on, has its regularity and can be forecasted.

1.2 PRIMARY FREQUENCY ADJUSTMENT

The primary frequency adjustment is for first kind of load change component. It is finished under the combined action of generator prime mover and load regulation effect. Therefore, it has the highest response speed.

The primary adjustment refers to differential regulation. The more load changes, the more frequency deviates. Therefore, it is impossible to meet requirement of frequency quality only by means of primary adjustment.

1.3 SECOND ADJUSTMENT OF FREQUENCY

The secondary frequency adjustment is for the second kind of load change component. This kind of adjustment has to be realized through automatically or manually changing the synchronizer (also called as frequency modulator) of FM generator. The change of synchronizer position will translate the static characteristic of speed governing system and change generator output, so as to modulate frequency.

Un-differential regulation can be achieved if the capacity of FM unit is large enough. As for the secondary adjustment, in addition to requirement for reserve capacity of system, it is still required that the regulation speed can adapt to load change and the regulation course must be stable.

1.4 THIRD ADJUSTMENT OF FREQUENCY

The third adjustment is for the third kind of load change component. It regulates unit output as per time to execute power generation plan or redistributes output every once in a while (e.g. 1 minute) in accordance with principle of economical dispatching.

Forecast the short-term load of system correctly and arrange power generation program (including unit start/stop) reasonably to ensure the economical operation of whole system and achieve AGC control requirement in advance, thus avoiding frequent regulation of unit by AGC. At present, a large number of units still cannot take part in AGC. If these units can be strictly operate on schedule, they actually also take part in generation control, but in form of manual generation control (MGC). The output can be redistributed to AGC controllable units in accordance with result of online economical dispatching, so as to achieve economical operation.

2 AUTOMATIC GENERATION CONTROL (AGC) LOAD DISTRIBUTION PRINCIPLE

In proportion to capacity, as a simple load distribution principle, this kind of principle is usually used when some characteristic curves of water turbine set are incomplete or not precise enough

$$P_i = P_{AGC} \times \frac{P_{i\max}}{\sum_{i=1}^{n} P_{i\max}} \qquad (i = 1, 2 \cdots, n) \tag{1}$$

n : n set of units which take part in AGC

$P_{i\max}$: the unit number i taking part in AGC with maximum output under current head

$\sum_{i=1}^{n} P_{i\max}$: Sum of maximum outputs of all units taking part in AGC under current head

P_i : Active power distributed by AGC to unit number i taking part in AGC

2.1 DISTRIBUTION ACCORDING TO EQUAL INCREMENT

The total water consumption of hydropower plant is minimized on the premise that AGC target function has meet related restrictions. When the active power undertaken by hydropower plant is fixed (PL), it is necessary to distribute load among all generator sets according to equal consumption increment, so as to make the total water consumption be minimum.

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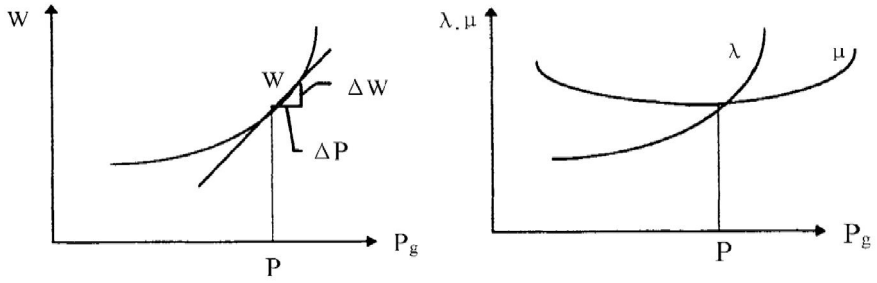

(a) (b)

Fig. 1. (a) Consumption Characteristics & (b) Variation of Specific Consumption and Consumption Increment

On the consumption characteristic curve, the specific valve of vertical coordinate and horizontal coordinate of some point is just the ratio of input energy and output power in unit time, which is called as specific consumption μ.

$$\mu = \frac{W}{P} \tag{2}$$

The tangent slop of some point on consumption characteristic curve is called as consumption increment λ, which refers to the specific value of input energy increment and output power increment in unit time, i.e.

$$\lambda = \frac{\Delta W}{\Delta P} = \frac{dW}{dP} \tag{3}$$

2.2 PRINCIPLE OF MULTI-OBJECTIVE PROGRAMMING

The in-plant AGC has to meet following objectives in order:

(1) Make provincial water generate more power;

(2) Make AGC distributed value close to set value as far as possible;

(3) Prevent units from frequently passing through the vibration area;

(4) The load fluctuation of units caused by two adjacent load regulations is minimized.

2.2.1 INTUITIONAL INTERPRETATION OF AGC

The ultimate purpose of hydropower plant AGC is to generate maximum electric energy with minimum water consumption on the premise of ensuring the safe and reliable operation of units. In power plant, each unit consumes different water amount even if with the same water regimen and same generation power due to its specific capacity and operation characteristics. Therefore, it is necessary to comprehensively consider multiple factors as water regimen, unit capacity, area where units cannot operate (cavitation area and vibration area), unit consumption characteristics, and operating conditions and so on for Automatic Generation Control, so as to achieve economical operation. Strategy of unit startup/shutdown

- Unit startup algorithm:

1. Theoretical startup condition: PAGC+Pb＞∑PT In the formula, Pb standards for rotation reserve capacity of whole plant; ∑PT is adjustable capacity of whole plant units which take part in AGC and is generating.
2. Theoretical number of operating units: Nk = (PAGC+Pb - ∑PT)/Pm + 1, In the formula: Nk is theoretical number of operating units; Pm is maximum capacity of single generator.

- Unit shutdown algorithm:

1. Theoretical shutdown condition: ∑PT －（PAGC+Pb）＞ Pm
2. Theoretical number of stopped units: Nt = (∑PT －(PAGC+Pb))/Pm

In the formula: Nt is theoretical number of stopped units

2.2.2 MEASURES TO AVOID FREQUENT STARTUP/SHUTDOWN OF UNITS

Set coverage area at both sides of adjusting range corresponding to theoretical number of operating/stopped units. In consideration of load change tendency of power plant, try best to avoid stopping unit which has operated only for a moment or immediately starting unit after it is shut down. Calculate the optimal number of operating units of each kind of unit in the next time interval according to forecasted load curve; then, compare number of units which has been in operation, optimal number of operating units required to operate in this time interval and optimal number of units to be operated in next time interval. If it is found that some units have to be shut down in current time interval and also some units have to start in next time interval, the optimal number of operating units in current time interval equals to that of next interval

2.2.3 PRINCIPLE OF UNIT STARTUP/SHUTDOWN SEQUENCE

- Priority set manually;
- Time of unit startup/shutdown and total cumulative time of startup/shutdown;
- Limit for shortest time of startup or shutdown;
- Requirement of plant service power and grounding requirement of main transformer neutral point;
- Priority of units with failed startup or shutdown automatically descends.
- The startup/shutdown priority of units is obtained through comprehensive calculation as per above principles. If you want to start or shut down units according to the manually set priority, please increase the priority coefficient manually set and make it be far more than priority coefficient of other factors, i.e. the startup/shutdown sequence of units is only related to manually set priority

3 AUTOMATIC GENERATION CONTROL OPERATION MODE

The establishment of automatic generation control operation mode is becoming increasingly significant element in view of increased load demand & reducing generating resources [4]. Therefor increasing load demands are seriously threats to reliable operation of power systems and due to control strategies are chiefly realized in power plant to maintain the generating unit [4].

3.1 SWITCH ON/OFF

Unit AGC switch-on means that the unit takes part in AGC and AGC program will carry out load distribution and startup/shutdown guidance. Unit AGC switch-off means that the unit doesn't take part in AGC and AGC program treats the

unit as unit with fixed load and will not carry out load distribution and startup/shutdown guidance for it. AGC function of whole plant can be manually switched on/off and will switch off automatically when there is no unit taking part in AGC. Whole plant AGC switch-on refers to start the function of unit load distribution and startup/shutdown guidance. Whole plant AGC switch-off refers to not start the function of unit load distribution and startup/shutdown guidance.

3.2 BLOCKING CONDITIONS OF AGC FUNCTION

When AGC function is switched on, if one of following blocking conditions is destroyed, switch off whole plant AGC, alarm and log in. No unit takes part in AGC; System frequency is more than upper limit of failure frequency or less than lower limit of failure frequency; Accident happens in power plant; When AGC control right is remote, there is communication failure between host and communication unit or between communication unit and provincial dispatching; The quality of system frequency measuring point is bad; When AGC control right is remote, the quality of remote setting value is bad.

3.2.1 POWER/FREQUENCY REGULATION MODE

AGC regulation mode can be divided into power regulation mode and frequency regulation mode. In case of AGC power regulation mode, the setting of whole plant given value includes two modes, i.e. curve and constant value. Curve mode: When the value setting mode is set to curve, the given load of whole plant tracks and sets the current value of curve. Constant value mode: Sometimes, the daily load curve cannot be provided due to difficulty to forecast future load. The general method is to receive the load dispatching command of cascade dispatching and adjust total load. Therefore, AGC provides whole plant active adjustment of given whole plant load.

3.2.2 FREQUENCY REGULATION MODE

Set function of frequency regulation for some FM power plants. This function can monitor bus frequency at all times, but cannot ensure the total active power of whole plant. When the frequency is out of normal FM section, AGC increases or decreases the load of units taking part in AGC according to KfEΔf until system frequency returns to normal FM section, or until load of units taking part in AGC reaches to upper and lower limit values of load with current head. When frequency (f) is within normal FM section:

$$P_{AGC} = P_{ACT} + K_{fN}\Delta f - \overline{P_{AGC}} \tag{4}$$

When frequency (f) is out of normal FM section:

$$P_{AGC} = P_{ACT} + K_{fE}\Delta f - \overline{P_{AGC}} \tag{5}$$

Adjustment open-loop/closed-loop: In case of open loop, AGC program only provides load distribution guidance for units taking part in AGC. In case of closed loop, AGC program provides active setting value of units taking part in AGC, which is transmitted to units for execution through LCU. In this case, the setting value of units traces AGC setting value. Control open-loop/closed-loop: In case of open loop, AGC program only provides startup/shutdown guidance for units taking part in AGC. In case of closed loop, A GC program provides startup/shutdown guidance for units taking part in AGC, automatically start unit startup/shutdown sequence control flow and automatically executes the flow. The flow cannot be interrupted manually. In this case, operators have no need to operate unit startup/shutdown.

3.2.3 REMOTE/LOCAL CONTROL RIGHT

When the control right is set to “Remote”, both remote startup/shutdown command and remote whole-plant active setting value are valid; while the local manual startup/shutdown and whole-plant active setting value of power station are invalid. When the control right is set to “Local”, both remote startup/shutdown command and remote whole-plant active setting value are invalid; while the local startup/shutdown and whole-plant active setting value of power station are valid.

4 ENGINEERING PROBLEM OF TARGET FUNCTION

The minimum total water consumption of hydropower plant is just a general guideline. For various actual conditions, there are still various variations or rectifications. For example, in flood season, the actual target function can be that make the total generation of hydropower plant be maximum in case that amount of available water is present. As for system with joint dispatching of water, fire and electricity, it is necessary to meet the generation task defined by joint dispatching and make the total coal consumption of system be minimum in case that there is some accessible water. With regard to hydropower plants for peak regulation, frequency regulation and undertaking reserve and impact load in case of emergency accident, it is necessary to sacrifice partial economic benefit of the power plant to ensure the economic and safe benefits of whole power system, e.g. the power generation of whole power system is maximum and outage time and range minimum. Besides, we still have to consider line loss of long transmission line and difference of working head of different units for multi-unit power station, e.g.: the maximum difference between water heads of left and right banks can reach to 1~2 m.

4.1 LOAD REGULATION AND AVOIDANCE OF VIBRATION AREA

When hydropower plant AGC is carrying out optimal distribution of unit load, it is necessary to pay special attention to load transfer and distribution at the time of unit startup or shutdown and avoiding frequent adjustment of unit load caused by small fluctuation of setting value. In other words, AGC shall try best to ensure that the whole plant load stably closes to setting value of system at full speed. Furthermore, in actual project, different units have different power regulation characteristics and regulation time. Therefore, it is necessary to especially consider units with long regulation time, transfer of unit load under condition of balance load and fluctuation and response time of whole plant total power at the time of rapid load regulation. In distribution of small load when the setting value of two adjacent grid dispatching is small, we can select one unit for adjustment of small load. If one unit cannot meet requirement of small load adjustment, we can increase another unit to take part in the adjustment. In case of No disturbance of load there are functions are involved such as switching of host and slave, Machine reboot (host and communication unit), AGC switch-on/off, Local/remote switching

4.2 LIMITING CONDITIONS AND OTHER PROBLEMS

At the time of realizing AGC of hydropower plant, in addition to meet the load balance conditions of power system, it is still necessary to consider many other limiting conditions, such as water consumption limit for downstream industry and agriculture, limit for water-flow change rate required by shipping, limit for water consumption during reserving partial reservoir capacity before flood season and storing water to normal water level after flood season, limit for operation mode of hydropower plant with grouping (regional) power transmission and without electrical connection among groups and preferential startup requirement of units with plant service power or reactor grounding, i.e. units with plant service power which starts firstly and then shuts down, etc. Meanwhile, we still have to pay attention to the load change tendency of power system after some time intervals, so as to avoid unnecessary startup or shutdown caused by rise or fall of power system load in short term, which may result to waste of no load flow.

5 CONCLUSION

In conclusion, the study was focused at the issue of the main characteristics of the Automatic Generation Control System adopted for hydropower plant and theoretical puts a step forward in the technology of the automatic control configuration for the power system of hydropower plant [5]. Therefore this paper also realizes the frequency adjustment of power system along with load disturbance principle of Automatic Generation Control (AGC). The short description of operation mode of AGC and engineering problems are discuss and realizing the limitation conditions AGC of hydropower plant as well.

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Beliefs concerning human nature among university students and high school teachers twenty-four years ago and today

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ABSTRACT: Beliefs concerning human nature are widely examined in a series of past studies (1945, 1956, 1988, 1989). This study aimed to investigate Greek (high school and university) students' and teachers' current beliefs about human nature. A total of 307 participants: 83 beginning Greek undergraduate psychology and 94 medical students, 100 high school students and 30 high school teachers completed a 20-item questionnaire about superstitious beliefs. These data were compared with previous data from psychology first-year university students and high school teachers. The mean percentage of superstition per item for the undergraduate psychology students group was similar to the medical students, showing no statistically significant differences between the two groups. A dramatic drop was found in comparison to results on a similar first year undergraduate group of psychology students 24 years before. The same questionnaire showed a similar spectacular decline in superstitions concerning a group of high school teachers in the present study and 21 years before. The fourth study group of high school students gave a similar general disbelief in superstitions. The radical change in the way that young adults perceive human nature highlights the importance of direct or indirect time-changing cultural, scientific, and mainly educational influences. Future research should elucidate the factors influencing beliefs about human nature.

KEYWORDS: Superstitions, education, science, adults, adolescents.

1 INTRODUCTION

The interest in knowledge, beliefs and superstitions of students in social science classes has a relatively long history during the twentieth century. Strange beliefs about human nature of young adult university students, also known as superstitions, were first examined with the use of a True-False questionnaire, in a class of first year psychology students in America in 1925 [1]. Twenty-five years later, the same questionnaire was re-used in a male sample in the same country, with a profound drop in the average wrong answers [2]. A similar study 30 years later in Australia [3] found that instead of a steady decline, superstitious non-scientific beliefs were moderately stable in comparison to Nixon's data [1] and increased in comparison to Levitt's data [2].

Following the previous attempts, Ralya devised a 53-item questionnaire and found that in a group of 141 prospective pre-medical students in the U.S.A. there was a moderate incorrect belief in superstitions (see Table 1) [4]. In Britain, eleven years later a group of psychology students examined before and after a year long psychology course, showed a slight decrease on these beliefs (the mean percentage of incorrect responses fell from 29 to 23 per cent) [5]. Thirty-two years later students attending interviews for the psychology university program showed that they came with fewer 'incorrect' ideas at the beginning of their studies [6].

The purpose of this study was to examine the beliefs that young Greek students (undergraduate university students following psychology and medicine courses and high school students) and their high school teachers share about human nature in comparison to previous data. At the same time an attempt is made to examine these data in the light of possible advancement of educational theory and practices in the Greek educational system.

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2 METHOD

2.1 PARTICIPANTS

The sample consisted of a total of 307 participants from Greece. The first group included 83 first year undergraduate psychology students (73 girls and 10 boys), all of whom were admitted to three psychology departments after attending an obligatory high school secondary educational program (focusing on ancient Greek, Latin, literature and optional science courses) and after passing state examinations on these subjects. This school was chosen because of previous findings on a similar first year psychology class with educational and age equivalence (in 1989, who also entered tertiary education, Aristotle University of Thessaloniki, School of Psychology on the basis of the attendance and examination of the same lessons) [7]. The ages of the students in both studies (1989 and 2012) ranged from 17 to 25 (M = 18.26, SD = 0.95), the geographic location of origin (place of birth and primary and high school attainment) and socio-economic status (according to the students' family income) were also similar for both studies. The students completed the questionnaire anonymously.

The second group of participants were 94 first year undergraduate medical students (64 girls and 30 boys, 17 to 25 years of age, M = 18.08, SD = 0.81), all of whom were admitted to three Medical Schools in Northern Greece, after attending an obligatory high school educational program (focusing on mathematics, physics, biology, chemistry and optional literature courses) and after passing state examinations on these subjects.

Similar to the Houssiadas' study [8], the third group of participants consisted of 30 working high school literature teachers (all women, M = 57.16, SD = 4.79). The teachers were examined at the beginning of an educational seminar. They had an average of 15 years of educational experience and were recruited from the same geographical district as in the 1991 study.

The fourth study group consisted of adolescents, who in comparison with the previous groups could be characterized as having a lower educational attainment: 100 high school students (60 girls and 40 boys, M = 15.96, SD = 0.68), with a range between 15 and 17.

2.2 PROCEDURE

All participants completed a 20-item questionnaire about human nature and relevant superstitions. The 20 questions were copied and translated exactly from Ralya's 53-item questionnaire [4]. The choice of the 20 questions was made on the basis of the possibility of classifying them as True or False according to modern scientific data, their cultural appropriateness for the Greek society and because the same information about superstitions from the extended questionnaire could be gathered using half the questions.

3 RESULTS

The results of previous studies from English-speaking countries on a time continuum showed an overall reduction of errors.

Table 1. The 20 questions and the incorrect answers from various studies showing changes over place and time

	True/ False	Ralya 1945	Warburton 1956	Furnham 1988	Houssiadas 1989 psychology students	Houssiadas 1991 high school teachers	Giannouli 2012 psychology students	Giannouli 2012 medical students	Giannouli 2012 high school students	Giannouli 2012 high school teachers
		N=141	N=143	N=98	N=95	N=30	N=83	N=94	N=100	N=30
1.The position of the stars at the time of a man's birth determines, in part, his character.	F	12.76 % (18)	4.19 % (6)	22.44 % (22)	54.73 % (52)	53.33 % (16)	6.02 % (5)	4.25 % (4)	5% (5)	0 % (0)
2.The ancient Greeks were born with better intellects than people are endowed with today.	F	14.89 % (21)	6.99 % (10)	4.08 % (4)	3.15 % (3)	10 % (3)	2.40 % (2)	1.06 % (1)	1% (1)	0 % (0)
3.Man is biologically descended from a species of existing apes.	F	43.26 % (61)	39.86 % (57)	56.12 % (55)	36.84 % (35)	50 % (15)	0 % (0)	0 % (0)	0 % (0)	0 % (0)
4.Some of the higher apes are as intelligent as the average man.	F	7.80 % (11)	6.99 % (10)	11.22 % (11)	18.94 % (18)	33.33 % (10)	0 % (0)	0 % (0)	0 % (0)	0 % (0)
5.Animals depend to a greater extent on inherited ways of doing things than does man.	T	7.09 % (10)	12.58 % (18)	28.57 % (28)	25.26 % (24)	23.33 % (7)	0 % (0)	0 % (0)	0 % (0)	6.66 % (2)
6.The conscience is part of man's natural equipment at birth.	F	25.53 % (36)	37.76 % (54)	46.93 % (46)	67.36 % (64)	46.66 % (14)	3.61 % (3)	2.12 % (2)	5 % (5)	10 % (3)
7.Mothers instinctively know the best ways of caring for their children.	F	32.62 % (46)	24.47 % (35)	46.93 % (46)	73.68 % (70)	66.66 % (20)	22.89 % (19)	14.89 % (14)	14 % (14)	23.33 % (7)
8.All people reach physical maturity by the age of eighteen.	F	7.09 % (10)	26.57 % (38)	16.32 % (16)	23.15 % (22)	46.66 % (14)	0 % (0)	0 % (0)	2 % (2)	0 % (0)
9.A person may be coward in one situation and not in another.	T	4.25 % (6)	1.39 % (2)	8.16 % (8)	9.47 % (9)	16.66 % (5)	0 % (0)	0 % (0)	2 % (2)	3.33 % (1)
10.If the tails are cut off of generation after generation the rats, there will eventually be born rats without tails.	F	29.78 % (42)	34.96 % (50)	25.51 % (25)	33.68 % (32)	36.66 % (11)	2.40 % (2)	1.06 % (1)	3 % (3)	3.33 % (1)
11.Human progress is due to increased native intelligence from age to age.	F	52.48 % (74)	30.06 % (43)	55.10 % (54)	40 % (38)	16.66 % (5)	0 % (0)	0 % (0)	2 % (2)	0 % (0)
12.All men are born with equal powers.	F	6.38 % (9)	1.39 % (2)	15.30 % (15)	28.42 % (27)	20 % (6)	18.07 % (15)	13.82 % (13)	14 % (14)	0 % (0)

	True/ False	Ralya 1945	Warburton 1956	Furnham 1988	Houssiadas 1989 psychology students	Houssiadas 1991 high school teachers	Giannouli 2012 psychology students	Giannouli 2012 medical students	Giannouli 2012 high school students	Giannouli 2012 high school teachers
		N=141	N=143	N=98	N=95	N=30	N=83	N=94	N=100	N=30
13. People cannot be sharply differentiated into blondes and brunettes in many cases.	T	7.80 % (11)	6.99 % (10)	13.26 % (13)	35.78 % (34)	66.66 % (20)	0 % (0)	0 % (0)	2 % (2)	0 % (0)
14.If we knew all about a person's heredity we could predict his success in the world.	F	15.60 % (22)	6.29 % (9)	8.16 % (8)	16.84 % (16)	20 % (6)	4.81 % (4)	4.25 % (4)	5 % (5)	0 % (0)
15.On the average the strongest men are the weakest mentally.	F	12.76 % (18)	21.67 % (31)	10.20 % (10)	11.57 % (11)	20 % (6)	0 % (0)	0 % (0)	1 % (1)	0 % (0)
16.Homely women are born with more intelligence than beautiful women.	F	4,96 % (7)	8.39 % (12)	3.06 % (3)	5.26 % (5)	3.33 % (1)	0 % (0)	0 % (0)	2 % (2)	0 % (0)
17.Intelligence plays a larger role in human happiness than does emotion.	F	39.00 % (55)	35.66 % (51)	11.22 % (11)	23.15 % (22)	26.66 % (8)	6.02 % (5)	0 % (0)	3 % (3)	6.66 % (2)
18.Certain lines on a person's hand are indicative of his future.	F	14.18 % (20)	4.19 % (6)	8.16 % (8)	24.21 % (23)	30 % (9)	3.61 % (3)	0 % (0)	2 % (2)	0 % (0)
19.People with long fingers are likely to be artistic.	F	33.33 % (47)	20.27 % (29)	14.28 % (14)	43.15 % (41)	33.33 % (10)	0 % (0)	0 % (0)	2 % (2)	0 % (0)
20.All of man's actions are determined by his desire to seek pleasure and avoid pain.	F	36.87 % (52)	23.77 % (34)	27.55 % (27)	75.78 % (72)	63.33 % (19)	4.81 % (4)	2.12 % (2)	3 % (3)	10 % (3)

An independent samples T-test was conducted to compare the scores on each question for current and past psychology students. The current results from the Greek students, compared to the Houssiadas study [7], reveal an impressive decline in belief for statements about occult sciences $t(176) = 8.095$, $p < .001$ (Q1 astrology), $t(176) = 4.034$, $p < .001$ (Q18 palmistry), non-scientific views concerning heredity: $t(176) = 5.737$, $p < .001$ (Q10 Lamarckism), $t(176) = 1.625$, $p < .001$ (Q12 genetic profile and equality) and $t(176) = 2.566$, $p < .001$ (Q14 genetics). Statistical differences were found for views against evolutionary biology: $t(176) = 6.919$, $p < .001$ (Q3), $t(176) = 4.380$, $p < .001$ (Q4 Darwinism), $t(176) = 5.267$, $p < .001$ (Q5 animal instincts) and $t(176) = 1.625$, $p < .001$ (Q12). There were also less current distorted views on intelligence $t(176) = 7.397$, $p < .001$ (Q11) and $t(176) = 3.255$, $p < .001$ (Q17), old ideas-stereotypes concerning the relationship between physical and psychological characteristics: $t(176) = 3.278$, $p < .001$ (Q15), $t(176) = 2.135$, $p < .001$ (Q16) and $t(176) = 7.894$, $p < .001$ (Q19), women stereotypes $t(176) = 6.763$, $p < .001$ (Q13) and other ideas-scientifically proven as wrong-from the field of psychology: $t(176) = 11.545$, $p < .001$ (Q6), $t(176) = 4.973$, $p < .001$ (Q8), $t(176) = 2.931$, $p < .001$ (Q9) and $t(176) = 13.597$, $p < .001$ (Q20). There were no significant differences for scores of past students ($M = .316$, $SD = .1758$) and current students [$M = .241$, $SD = .1542$, $t(176) = .300$, $p = 5.49$)] for Q2 and similarly old students ($M = .2368$, $SD = .44268$) and students of today [$M = .228$, $SD = .4226$, $t(176) = 7.799$, $p = .292$)] did not show statistically significant differences in their responses on Q7.

Similarly, past and current high school teachers demonstrate differences in all items of the questionnaire ($p < .001$), except for Q7 [$t(58) = 3.333$, $p = .273$]. Current psychology and medicine students do not differentiate in any item of the questionnaire, showing the same disbelief in different forms of superstitions. Finally, high school students do not believe in any sort of superstitions, which is also the case for young university students (regardless of academic discipline).

4 DISCUSSION-CONCLUSIONS

Although there are no current studies about superstitions and the nature and origin of strange beliefs regarding human nature in the Greek population, two initial Greek studies [7], [8] showed surprisingly similar (and even stronger persistence on wrong beliefs about human nature) in comparison with the latest British study [6].

In contrast with the previous data, the current results show a radical change in the way that young adults and their teachers perceive human nature. The fact that medical students reject unscientific beliefs in the same way as the psychology students and slightly younger high school students, shows the general change on these issues not only in society as a whole, but especially in educational settings before and during university studies. The only possible disadvantage is the prevalence of female participants in the sample (an essential element in order to have comparable data with the Houssiadas' 1989 and 1991 studies) is the fact that we cannot impose these findings on the general population by examining mainly university educated individuals (students and teachers).

Teachers' views as explored through additional semi-structured interviews indicate the factors that they consider to better explain the change as time passes on superstitious beliefs. The majority of current women high school teachers (26/30) believe that there are three reasons for this spectacular change: 1) foremost, the primary school teachers' and high school teachers' active efforts to talk to their classes about wrong and out of date superstitions, 2) new school books, which clearly imply critical thinking and subsequent disbelief on superstitions, and 3) the passive contact with ideas of disbelief that students of all ages have through mass media exposure. According to them the current low (nearly 0% of disbelief in superstitions in high school and university students alike) could continue to exist if society as a whole could maintain the influence that these three factors have on students' thought from an early age.

According to semi-structured interview findings, students of all three groups seem to have similar views with the teachers'. For which factor they considered that shaped the most their beliefs, the majority of participants indicated their primary-high school teachers' and parents' behavior (in the form of extra curricular activities and in class discussions on these issues) and not the broader social changes and scientific progress.

These data can be interpreted as the result of advancement of the educational process in Greece. The wider significance these data might carry and the meaning of the present findings for other countries is that various educational theories and corresponding practices were explicitly used, during the past two decades, by teachers and parents alike, in order to achieve the attainment and the goals of the system. Although the main aim of the educational process is not only changing or minimizing everyday superstitious beliefs, it seems that teachers' efforts have succeeded in this. The teachers' views of the present sample (as explored in short semi-structured interviews) indicate that they are aware of different educational theories and practices, which they consciously and unconsciously use (as does the majority of their colleagues) in order to achieve one of their main goals; the diffusion of new scientific ideas.

The fact that almost all of the participants in this study showed a clear disbelief in strange ideas concerning the human nature implies the end of erroneous superstitions, which could also be explained on the basis of radical social changes, scientific advances, and educational reforms. Given that a plethora of factors influence the students of today in Greece, the best explanation for this spectacular drop in superstitious beliefs is that they seem to receive more official systematic information about the above questions through the educational system (mainly teachers and books). Although the sample consisted mainly by women, the finding that the new generation of students and teachers have ceased to believe in anachronistic non-scientific ideas, may depict the wider change in the modern Greek society towards human nature. Future research should focus on the ideas that less educated individuals and/or young students and their teachers have about superstitions not only in Greece, but also in other countries. This comparative data may shed light to the factors that contribute to possible cross-cultural changes.

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Changes in total and extractable macroelements of grains of sorghum cultivars grown under different levels of micronutrients

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ABSTRACT: The grains of four sorghum cultivars (Tabat, Tetrom, WadAhmed and Gadambellia) were grown in a sandy clay soil with a pH 7.2 for two consecutive seasons under different levels (0, 2, 4, and 8 gm/5kg soil) of micronutrients fertilizer and a constant level of macronutrients (6 gm/5kg soil). After addition of the fertilizers and water to the soil, the pH dropped to 5.7. Macroelements (Ca, P, Mg, K and Na) content and extractability (bioavailability) of the harvested grains were investigated. The content of macro-elements of the grains harvested during both growing seasons was significantly ($p \leq 0.05$) increased with increase in micronutrients dose. However, the grains harvested during the second season for all cultivars had significantly ($p \leq 0.05$) higher amount of macroelements than that harvested during the first season. Calcium content of the cultivar Tabat and sodium content of the cultivar Tetron were increased by more than 100% as a maximum values during the second season. Macroelements extractability (bioavailability) was increased with micronutrients fertilization with very few exceptions. The maximum value of extractability recorded was 92.88% for Mg extracted from the grains of Tabat cultivars grown under 8 gm/5kg soil micronutrients. The results revealed that micronutrients fertilization of sorghum cultivars is an ideal method in improving macroelements contents. Moreover, the pH (5.7) is the suitable value for the acquisition of micronutrients by the plant.

KEYWORDS: Sorghum, grains, micronutrients, macroelements, extractability.

1 INTRODUCTION

Sorghum nutritional quality is dictated mainly by its chemical composition and one of the constraints on the utilization of sorghum grain as food or feed is the occurrence of anti-nutritional factors [1]. Cereal crops are inherently very low in grain Zn and Fe concentrations, and growing them on potentially Zn- and Fe-deficient soils further reduces Fe and Zn concentrations in grain [2]. It is evident that the nutritional importance of a given food/feed stuff depends not only on nutrient composition of raw foodstuff but also on the amount utilised [3].

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In the Sudan, sorghum comes first in volume of cereals produced and is the staple food for people in rural areas, particularly the low-income groups as food or sometimes processed to produce alcoholic or soft beverages or as feed for livestock [4]. Many soil factors such as pH, temperature, and moisture affect the availability of micronutrients to crop plants. The effects of these factors vary considerably from one micronutrient to another as well as in their relative degree of effectiveness [5]. Some of the adverse effects of micronutrient deficiency-induced stress in plants include low crop yield and quality. Plant factors such as root and root hair morphology (length, density, surface area), root-induced changes (secretion of H^+, OH^-, $HCO3^-$), root exudation of organic acids (citric, malic, tartaric, oxalic, phenolic), sugars, and non-proteinogenic amino acids (phytosiderophores), secretion of enzymes (phosphatases), plant demand, plant species/cultivars, and microbial associations (enhanced CO_2 production, rhizobia, mycorrhizae, rhizobacteria) have profound influences on plant ability to absorb and utilize micronutrients from soil [6].

Soil pH influences solubility, concentration in soil solution, ionic form, and mobility of micronutrients in soil, and consequently acquisition of these elements by plants [7, 5]. As a rule, the availability of B, Cu, Fe, Mn, and Zn usually decreases, and Mo increases as soil pH increases. The availability of most micronutrients tends to decrease at low temperatures and moisture contents because of reduced root activity and low rates of dissolution and diffusion of nutrients. The deficiency of essential micronutrients induces abnormal pigmentation, size, and shape of plant tissues, reduces leaf photosynthetic rates, and leads to various detrimental conditions [8]. Iron deficiency occurs not because of Fe scarcity in soil but because of various soil and plant factors that affect Fe availability to inhibit its absorption or impair its metabolic use [9].

Different approaches have been tried: germination [10], addition of malt [1], fermentation [11], addition of malt followed by fermentation [12], radiation [13] and conventional breeding [14] to improve minerals content and extractability of millet and sorghum seeds. Moreover, previous research focused only on the effect of micronutrients fertilization on yield. Therefore, in this study, we would like to investigate the effect of micronutrients fertilization on total and extractable macroelements of grains of four sorghum cultivars grown under controlled conditions during two consecutive seasons.

2 MATERIALS AND METHODS

2.1 MATERIALS

Grains of four sorghum (*Sorghum biocolor* L. Monech) cultivars (Tabat, Tetron, Wad Ahmed and Gadamblia) were obtained from the Department of Agronomy, Faculty of Agriculture, University of Khartoum, Shambat, Sudan. The grains were grown in pots under compound micronutrients (14% water soluble Mo + 0.3% water soluble Mn + 0.3% water soluble B + 1.2% FeS + 0.02% Cu_2SO_4 + 0.02% $ZnSO_4$ + 0.004% $(NH_4)_6[Mo_7O_{24}].4H_2O$) and compound macronutrients ($N\text{-}P_2O_5\text{-}K_2O$) fertilizers for two consecutive seasons (2010 and 2011). The experimental site lies at the Demonstration Farm of the Faculty of Agriculture, University of Khartoum, Shambat (latitude 15˚40'N and longitude 32˚32'E). The soil was sandy clay (82% sand and 18% clay) with pH of 7.2 and temperature between 20 and 25 ^oC. Four doses (0, 2, 4 and 8 g/5kg soil) of micronutrients were applied to each pot. Beside micronutrients, all treatments received compound macronutrients ($N\text{-}P_2O_5\text{-}K_2O$) at a constant dose (6 g/5kg soil). The pH of the soil dropped to 5.7 after addition of fertilizers and water to the soil. Each experiment was arranged in a factorial design with four replicates. At the end of each season, the grains were collected, sun dried, cleaned from dirt and broken grains and then ground to pass a 0.15 mm screen and stored at 4 ^oC.

2.2 TOTAL MINERALS DETERMINATION

Minerals were extracted from the samples by the dry ashing method described by Chapman and Pratt [15]. About 2.0 gm of sample was acid-digested with diacid mixture (HNO_3:$HClO_4$, 5:1, v/v) in a digestion chamber. The digested samples were dissolved in double-distilled water and filtered (Whatman No. 42). The filtrate was made to 50 ml with double-distilled water and was used for determination of total calcium, phosphorus and iron. Elements were determined by atomic absorption spectrophotometer (Perkin-Elmer 2380). Calcium was determined by a titration method. Phosphorus was determined spectrophotometrically using molybdovanadate method.

2.3 EXTRACTABILITY OF MINERALS (IN VITRO BIOAVAILABILITY)

Minerals in the samples were extracted by the method described by Chauhan and Mahjan [16]. About 1.0 gm of the sample was shaken with 10 mL of 0.03 M HCl for 3 h at 37 ^oC and then filtered. The clear extract obtained was oven-dried at 100 ^oC and then acid-digested. The amount of extractable minerals was determined by the methods described above. HCl extractability (%) was determined as follows:

$$\text{Mineral extractability (\%)} = \frac{\text{Mineral extractable in 0:03NHCl (mg/100g)}}{\text{Total minerals (mg/100g)}} X100$$

2.4 STATISTICAL ANALYSIS

Each determination was carried out on three separate samples and analyzed in triplicate on dry weight basis; the figures were then averaged. Data were assessed by the analysis of variance [17]. Comparisons of means for treatments were made using Duncan's multiple range tests. Significance was accepted at $P \geq 0.05$.

3 RESULTS AND DISCUSSION

Figure 1 shows total and extractable Ca of grains of four sorghum cultivars (Tabat, Tetron, WadAhmed and Gadambalia) grown under different levels of micronutrients (0, 2, 4 and 8 g/5kg soil) and a constant dose (6 gm/5kg soil) of compound macronutrients for two consecutive growing seasons. Calcium content of the grains (Fig. 1a) before fertilization was 3.77, 11.01, 10.83 and 14.07 mg/100gm for the cultivars Tabat, Tetron, WadAhmed and Gadambalia, respectively during the first growing season while during the second growing season it was 4.50, 12.29, 12.63 and 14.12 mg/100gm for the cultivars, respectively. For all cultivars, Ca content of the grains harvested during the first growing season was increased with increase in fertilizer dose. However, the percent increase in Ca content was higher during the second growing season. During the first growing season, the maximum rate of increment in Ca content was 28, 92, 43 and 8% at a fertilizer dose of 8 gm/5kg soil for the cultivars Tabat, Tetron, WadAhmed and Gadambalia, respectively, while during the second growing season it was increased by 169, 66, 25 and 6% for the cultivars, respectively. Ca extractability (Fig. 1b) was also improved with micronutrients level and reached maximum value when the grains were fertilized by 8 gm/5kg soil. The grains of Tabat cultivar recorded higher value of extractable Ca (70.15%) followed by the cultivar Tetron (58.39%) during the second season.

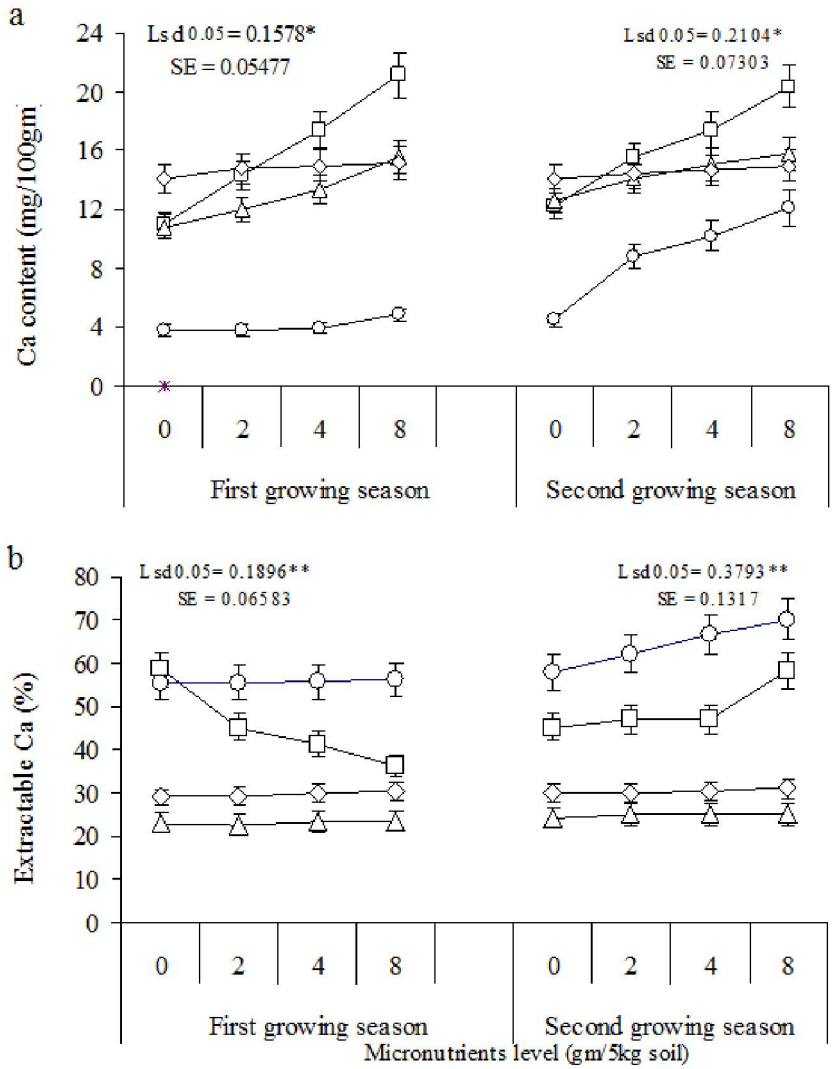

Fig. 1. Total (a) and extractable (%) Ca of grain sorghum cultivars (○, Tabat; □, Tetron; Δ, WadAhmed; ◊, Gadambalia) grown under different levels of micronutrients fertilization.

However, Ca extractability of the cultivar Tetron was significantly (P ≥ 0.05) decreased for the grains harvested during the first growing season. The results revealed that the cultivars Tabat highly respond to micronutrients fertilization with respect to total and extractable Ca. As shown in Figure 2, P content and extractability of the grains was increased significantly (P ≥ 0.05) with micronutrients dose especially for the grains harvested during the second growing season. During the first growing season, phosphorus content (Fig. 2a) of the grains before fertilization was 128.11, 327.00, 329.81 and 330.00 mg/100gm for the cultivars Tabat, Tetron, WadAhmed and Gadambalia, respectively while during the second growing season it was 180.17, 330.05, 330.45 and 330.04 mg/100gm for the cultivars, respectively. The cultivar WadAhmed recorded higher percent increase in P (36%) followed by Tetron (13%) during the first growing season. However, during the second growing season Tabat recorded higher percent increase (92%) followed by WadAhmed (38%) when the plants grown under 8 gm/5kg soil. The rate of increment in P was significantly (P ≥ 0.05) higher during the second growing season for all cultivars compared to the first growing season. P extractability (Fig. 2b) was fluctuated for grains harvested during the first season but for those harvested during the second season was significantly (P ≥ 0.05) increased from 23.33 to 55.31% for the cultivar Tabat and from 35.55 to 43.25% for the cultivar Tetron.

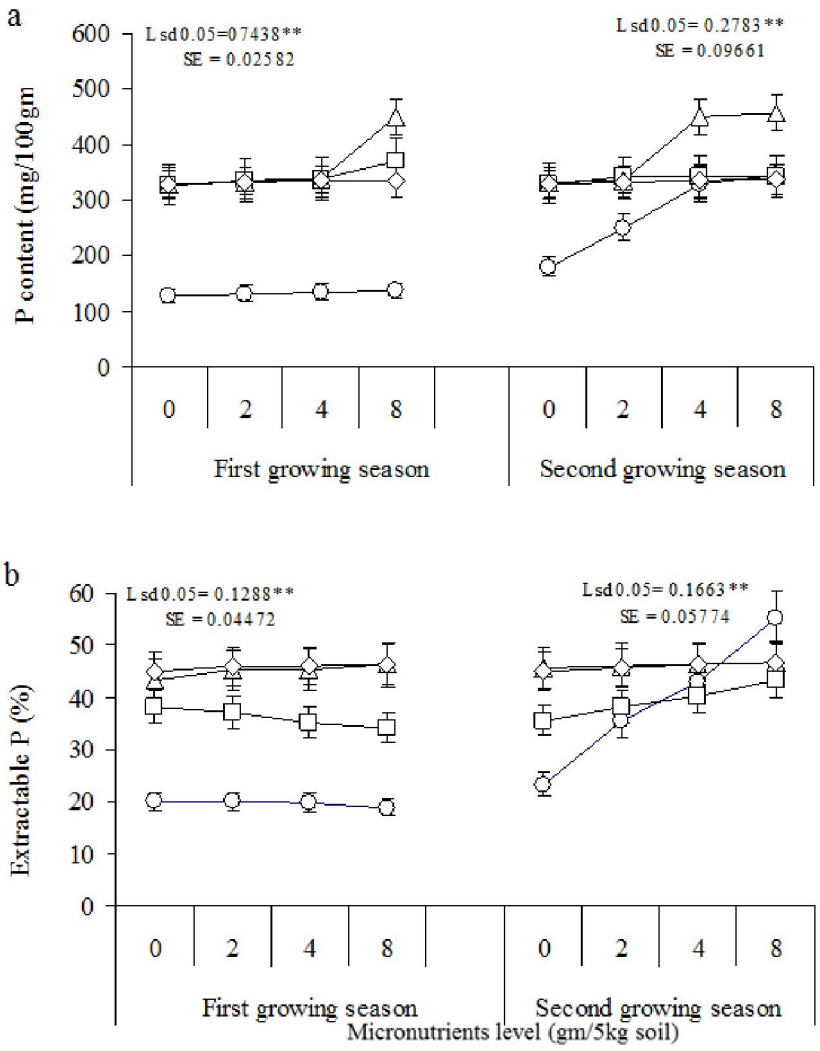

Fig. 2. Total (a) and extractable (%) P of grain sorghum cultivars (○, Tabat; □, Tetron; Δ, WadAhmed; ◊, Gadambalia) grown under different levels of micronutrients fertilization.

Magnesium content of the grains was increased significantly (P ≥ 0.05) with micronutrients dose especially for the grains harvested during the second growing season (Figure 3). Magnesium content (Fig. 3a) of the grains before fertilization was 65.17, 62.06, 52.53 and 50.00 mg/100g for the cultivars Tabat, Tetron, WadAhmed and Gadambalia, respectively during the first growing season while during the second growing season it was 67.6, 62.47, 54.87 and 50.05 mg/100gm for the cultivars, respectively. Fertilization of the plant with 8 gm/5kg soil during both growing season significantly (P ≥ 0.05) increased Mg content with a maximum rate of increment obtained for the grains harvested during the second season and the grains of Tabat cultivar recoded higher value (38%) followed by the grains of Gadambalia cultivar (16%). The rate of increment in Mg was significantly (P ≥ 0.05) higher in grains harvested during the second growing season for the cultivars Tabat and Gadambalia compared to the first growing season. Magnesium extractability (Fig. 3b) significantly (P ≥ 0.05) increased with fertilizer dose and reached maximum values when the grains were fertilized by 8 gm/5kg soil. For the grains harvested during the first season, Tetron (71.40%) and Gadambalia (62.81%) recorded higher values of extractability compared to other cultivars. However, during the second growing season the grains of the cultivars Tabat (92.88%) and Tetron (65.10%) recorded higher extractability values.

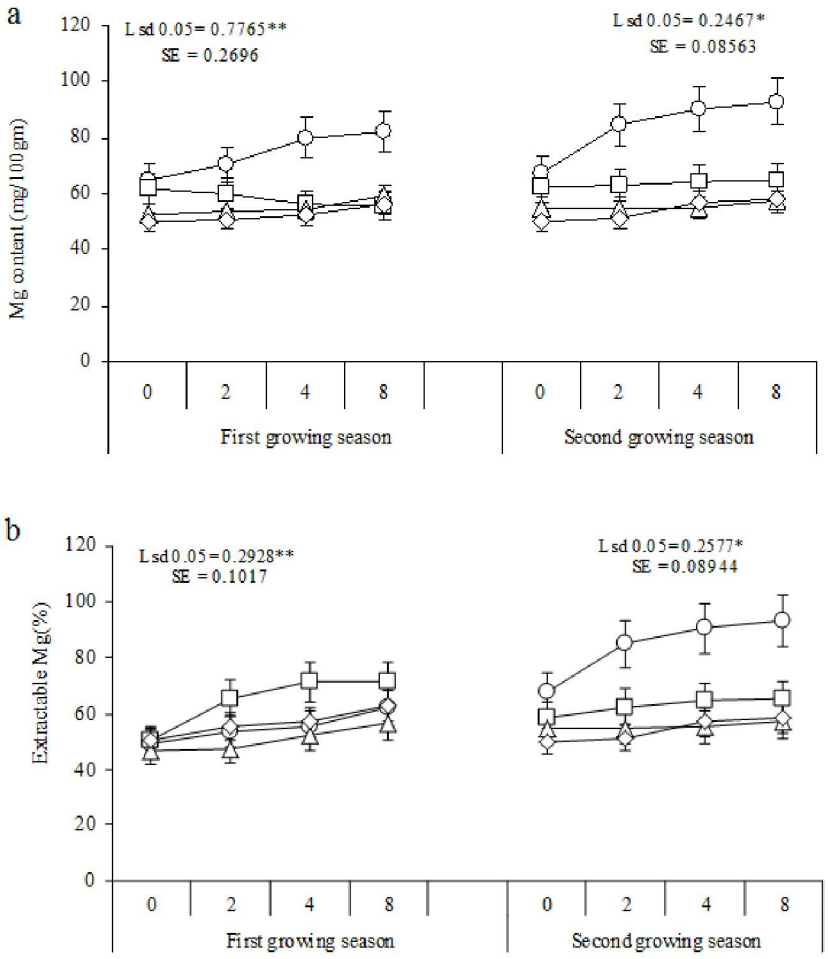

Fig. 3. Total (a) and extractable (%) Mg of grain sorghum cultivars (○, Tabat; □, Tetron; Δ, WadAhmed; ◊, Gadambalia) grown under different levels of micronutrients fertilization.

As shown in Figure 4, potassium content of the grains before fertilization was 440.18, 380.00, 380.00 and 419.53 mg/100gm for the cultivars Tabat, Tetron, WadAhmed and Gadambalia, respectively during the first growing season while during the second growing season it was 482.34, 391.14, 385.00 and 420.02 mg/100gm for the cultivars, respectively. Fertilization of the plant with 8 gm/5kg soil during the first growing season significantly ($P \geq 0.05$) increased K content with a maximum rate of increment observed for the cultivar Tetron (29%) followed by the cultivar WadAhmed (19%). The rate of increment in K content was significantly ($P \geq 0.05$) higher during the second growing season compared to the first growing season with a maximum rate of increase observed for the cultivar Tetron (36%) followed by the cultivar Tabat (34%). Potassium extractability (Fig. 4b) varied between cultivars and fertilizer dose with a maximum value of 57.16% obtained for the grains of the cultivar Gadambalia during the first growing season but for grains harvested during the second season Tabat recorded higher value (70.57%) followed by Gadambalia which recorded 61.12% of K extractability.

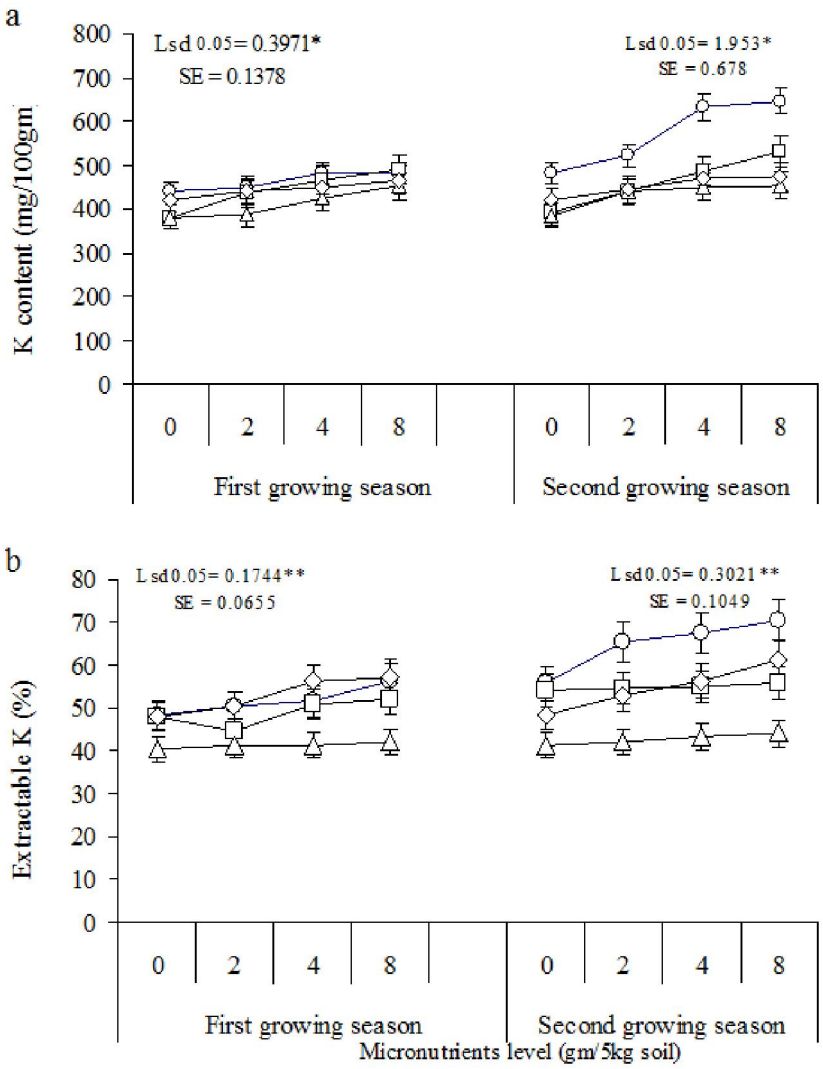

Fig. 4. Total (a) and extractable (%) K of grain sorghum cultivars (○, Tabat; □, Tetron; Δ, WadAhmed; ◊, Gadambalia) grown under different levels of micronutrients fertilization.

Sodium content of the grains before fertilization was 7.76, 8.80, 10.34 and 18.30 mg/100gm for the cultivars Tabat, Tetron, WadAhmed and Gadambalia, respectively during the first growing season while during the second growing season it was 7.93, 9.59, 10.29 and 22.60 mg/100gm for the cultivars, respectively (Fig. 5a). Fertilization of the plant with 8 gm/5kg soil during the first growing season significantly ($P \geq 0.05$) increased Na content with a maximum rate of increment observed for the cultivar Tetron (153%) followed by the cultivar WadAhmed (75%). The rate of increment in Na was significantly ($P \geq 0.05$) higher during the second growing season with a maximum rate of increase observed for the cultivar Tetron (163%) followed by WadAhmed (81%). Sodium extractability (Fig. 5b) was significantly ($P \geq 0.05$) affected by micronutrients fertilization and it increased during both seasons. The grains of the cultivar Tetron harvested during the first season recorded higher extractability (78.27%) compared to other cultivars while the grains of the cultivar Gadambalia harvested during the second season were observed to record higher value (81.14%) of Na extractability.

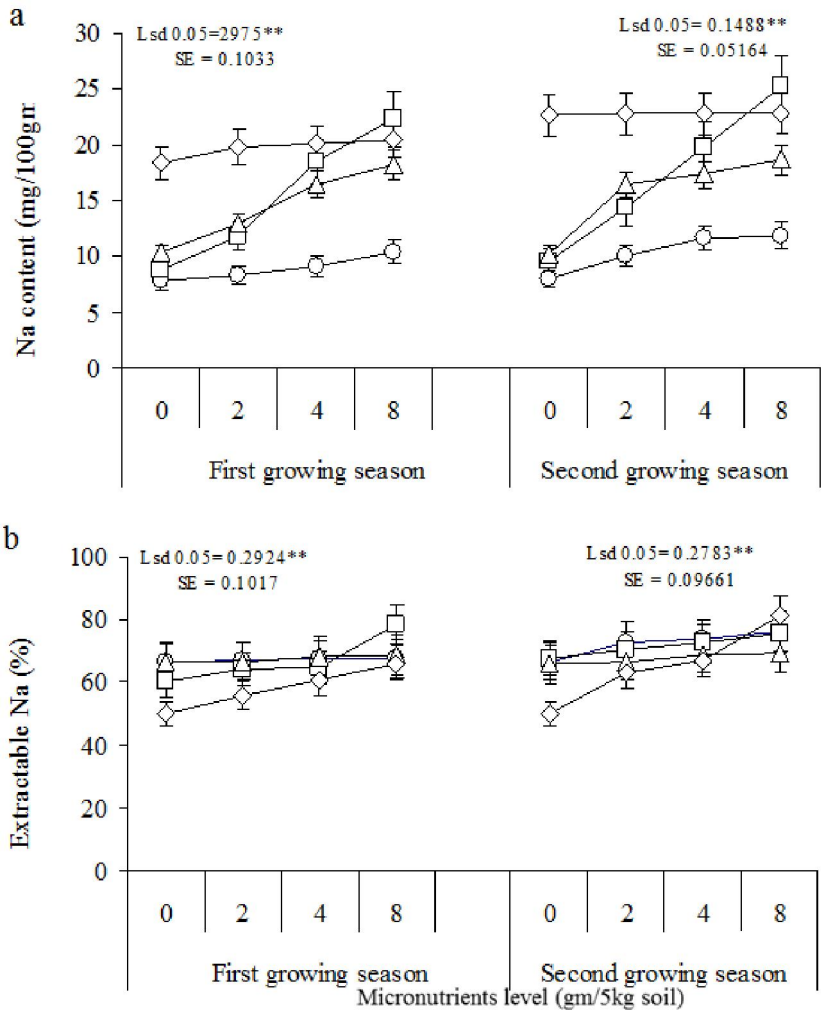

Fig. 5. Total (a) and extractable (%) Na of grain sorghum cultivars (○, Tabat; □, Tetron; Δ, WadAhmed; ◊, Gadambalia) grown under different levels of micronutrients fertilization.

The results obtained for macroelements content and extractability of sorghum grains indicated that micronutrients fertilization is an effective method in improving macroelements of sorghum grain. Moreover, the increment in macroelements content was accompanied by a significant ($P \geq 0.05$) increase in macroelements extractability. The results obtained showed that all cultivars highly respond to micronutrients application especially during the second growing season. However, the degree of response varied between the cultivars. The differences among plant cultivars have been attributed to genetics, physiological/biochemical mechanisms, responses to climate variables, tolerance to pest and diseases, and responses to agronomic management practices. Genetic variations in plant acquisition of micronutrients have been reviewed [18]. The development of cultivars effective in the acquisition and use of micronutrients and with the desired agronomic characteristics is vital for improving yields and achieving genotypic adaptation to diversified environmental conditions and increased resistance to pests [19]. It has been reported that the application of micronutrient-enriched NPK fertilizers provides a double benefit: increasing grain yield and improving the nutritional quality of the harvested grains, since micronutrient-enriched NPK fertilizers also increase the concentration of micronutrients in grain [20]. There are significant differences between crop cultivars in the efficiency with which they absorb and utilize micronutrients, and these differences may be one valuable tool for increasing food quality on some tropical soils. The absorption and utilization of most elements by plants are strongly influenced by factors other than elemental concentration in the soil solution such as soil pH, organic matter, CEC and interactions with other nutrients. Although it has been reported that macro- and micro-nutrients interact with each other forming complexes and reduced the acquisition of such minerals [6]. In the present study we optimize the conditions that reduced the accessibility of the minerals as indicated by increase in both total and extractable macroelements.

4 CONCLUSIONS

The observations about macroelements content and extractability in the studied samples tend to suggest that the application of micronutrient-enriched NPK fertilizers improved the nutritional quality by improving the content and extractability of macroelements of sorghum grains since micronutrient-enriched NPK fertilizers also increase the concentration of micronutrients in grain. Moreover, micronutrients fertilization when compared with chemicals or heat treatment as means to improve the nutritional quality emerges as an attractive and healthy alternative.

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Internal Marketing Policy of Cocoa in Ghana: Farmers' Incentives and Challenges

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ABSTRACT: The study was conducted to analyze farmers' incentives and challenges in the internal marketing policy of cocoa in Ghana by using two administrative districts (Nkawie and Dunkwa) of the Ghana COCOBOD. A random sample of 171 respondents was drawn from across the two cocoa producing districts and the data analyzed using frequency tables and the Kendall's coefficient of concordance. Most cocoa Farmers were found to be land secured because they either owned their lands (73%) or practiced the abunu (21.1%) system of land tenure. Farmers mean age and farming experience were estimated as 52 and 17 years respectively; an indication of an ageing farming population and highly experienced cocoa farmers. Most farmers (87%) believed that the internal marketing policy of cocoa has provided non-pricing incentives for them to increase their cocoa production in Ghana. Prompt payment was found by 79% of farmers to be the most important incentive derived from the policy. This was followed by easy access to credit, and employments at the communities as the Licensed Buying Companies (LBCs) compete among themselves at the farm-gate. However, farmers were mostly challenged by the way the LBCs adjust weighing scales at the farm gate to the disadvantage of farmers. It is therefore recommended that, the competition in the internal marketing should stay as the Ghana Standards Board strengthens their monitoring role of ensuring that weighing scales are not adjusted to the detriment of farmers.

KEYWORDS: Internal Marketing, Cocoa, Policy, Farmer incentives, competitiveness.

1 BACKGROUND

Cocoa is the main export crop in Ghana; accounting for over 80% of all incomes earned from the Agricultural sector as foreign exchange [1]. It is the second foreign exchange earner after gold since 1994 [2]. Currently, Ghana is second to Cote d'Ivoire in the world's cocoa production and produces the best quality.

In 1993, government finally yielded to the World Bank's recommendation of introducing the participation of other privately Licensed Buying Companies (LBCs) into the internal marketing of cocoa to compete with the Produce Buying Company (PBC) which used to be the only buyer of cocoa at the farm-gate since 1977 [3]. Initially four companies were admitted and licensed in 1992/93 cropping season; this has risen to 26 in 2010/11cropping season [4]. The growing number of companies in the purchasing of cocoa at the farm-gate is a major aspect of the current internal marketing policy of cocoa.

In service marketing, the concept of internal marketing refers to the promotion of a firm's products to its employees [5]. Employees and jobs are considered as customers and internal products respectively; therefore, the firm must endeavor to design these products to meet the needs of the customers [6], [7], [5]. This is because by satisfying the needs of the internal customers, organizations should be in a better position to deliver the quality desired to satisfy the external customer. By this concept, employees are seen as the most important customers of any organization as they link the firm to its external customers. Also, external customers may not distinguish between the employees and the firm. However, the Internal marketing of cocoa all over the world, offers a paradigm shift to this concept.

The Internal marketing of cocoa in cocoa-producing countries involves: local purchasing of cocoa beans from producers' farm gates, grading, sealing, and evacuation to the depots in the country or to warehouses at the ports awaiting sales to

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overseas buyers, or to fulfill forward committed sales or the requirement of a local processing plant [8]. The internal marketing policy of a producing country depends on factors such as the manner of cultivation, governments' attitude to free enterprise, the relative share of cocoa earnings in the economy, and the colonial business practices before independence.

The case of Ghana's internal marketing of cocoa is the totality of all those activities involving licensed buyers, that ensures that cocoa beans from the farm-gate reaches the state monopsony and the sole exporter of cocoa (COCOBOD). This process involves various actors including purchasing clerks, agents, and traders who deal with the Licensed Buying Companies (LBCs) [9].

The current system of marketing cocoa internally in Ghana has introduced fierce competition among the 26 Licensed Buying Companies at the farm gate level (LBCs) [4], [10]. The negative effect of such a competition on the quality and output of cocoa beans has been recorded in countries such as Cote d'Ivoire, Cameroun and Nigeria [11]; however, in Ghana, apart from some minimal level of deterioration in the area of quality of dry cocoa beans [9], the current internal marketing policy, seems to be influencing farmers to increase their cocoa output. The question then is what incentives do farmers derive from this internal marketing competition which influences them to increase cocoa output? The introduction of any policy comes with incentives as well as new challenges to the target beneficiary. What challenges are faced by these farmers in selling their cocoa at the farm-gate? This study therefore seeks to evaluate farmers' incentives and challenges in the internal marketing of cocoa in Ghana.

2 MATERIALS AND METHODS

The study was conducted in two selected cocoa producing districts Dunkwa and Nkawie) in Ghana. An initial reconnaissance study using interviews was qualitatively conducted with some key informants in the two districts with the help of the Agricultural extension agents. The results aided in the development of a well structured questionnaire which was pre-tested on ten cocoa farmers outside the study area; after which changes were made in the questionnaire.

Two cocoa districts (Dunkwa and Nkawie) were purposively selected after which fifteen cocoa villages were selected across the districts in the ratio of 2:1 respectively. At the village level, twelve farmers were selected for interview to constitute a total sample of 180 cocoa farmers.

Enumerators were trained to conduct the survey after which the data was entered using the statistical package for the social scientist software (SPSS). The analysis was done following data cleaning, where nine respondents were excluded from the analysis due to high non-response rate. The analysis on the cocoa farmers was therefore based on the sample size of 171 comprising of 57 from Nkawie and 114 from Dunkwa.

2.1 THE STUDY AREA

Ghana COCOBOD has its own cocoa administrative districts which are different from the political regions and districts in Ghana. The study therefore covered two cocoa districts (Nkawie and Dunkwa) in two cocoa regions; with Nkawie representing Ashanti and Dunkwa representing Western South regions respectively. There are 15 and 12 cocoa districts in Ashanti and Western South regions respectively. Each of the two cocoa districts is made up of three political districts. Nkawie cocoa district comprises: Atwima Nwabiagya, Atwima Mponua and Ahafo-Ano South districts of Ghana's political Administration. Dunkwa cocoa district is made up of Upper Denkyira East, Upper Denkyira West and Twifo Lower Hemang Denkyira districts of the political administration of Ghana.

Nkawie Cocoa district lies between latitudes 6^0 22" and 6^0 50" North and; Longitudes 1^0 40" and 2^0 27" West. Similarly, the Dunkwa cocoa district is situated between latitudes 5^0 30" and 6^0 15" N and longitudes 2^0 10" and 2^0 30" W.

The Nkawie district is bordered in the north by Tepa and Offinso cocoa districts; in the east by Antoakrom district; in the south by Duako district and in the west by Sankore cocoa district. Similarly, the Dunkwa district is bordered in the north by Antoakrom, Obuasi and Bekwai cocoa districts respectively. In the east, it is bordered by, Sefwi Bekwai, Wasa Akropong, and Tarkwa districts, respectively. In the South east, it is bordered by Fumso and Foso cocoa district. The two study areas are indicated in the map of Sothern Ghana with the administrative cocoa regions of COCOBOD in Figure 1.

Fig. 1. Map of Southern Ghana indicating Cocoa regions and the Study Area

2.2 ANALYTICAL FRAMEWORK

Marketing challenges facing farmers were first identified with key informants and then presented to respondents for ranking in order of importance in an ascending order. The mean rankings were then taken. The Kendall's coefficient of concordance (W) was used to test for the level of agreements in the rankings giving by the respondents.

The formula for the Kendall's Coefficient of Concordance (W) is given as:

$$W=12S/p^2\,(n^3-n)-pT \quad (1)$$

Where:

W= Kendall's coefficient concordance; n= the number of respondents;

P= the number of constraints; S= sum of squares statistic; and

T= correlation factor for tied ranks.

$$S = \sum_{t=1}^{n}(R_i - R)^2 \quad (2)$$

Where:

R_i= row sums of ranks; R = the mean of R_i.

The correlation factor for tied ranks (T) is

$$T = \sum_{t=1}^{m}(t^3k - t^k) \quad (3)$$

Where: t_k= the number of ranks in each k of m groups of ties.

Hypothesis and Significant test for W

The null (H_0) and the alternative (H_1) hypotheses are stated as follows:

H_0: there is no agreement among the rankings of challenges, versus

H_1: there is agreement among the rankings of challenges.

The Kendall's coefficient of Concordance (W) may be tested for significance using Chi-square statistic (X^2) computed as:

$$X^2 = p(n\text{-}1)W \quad (4)$$

Where:

N= sample size; p= number of constraints; and W = Kendall's coefficient of concordance.

The decision rule is if chi-square calculated > chi-square critical, then the null hypothesis is rejected in favour of the alternate hypothesis [12], [13], [14], [15].

3 RESULTS AND DISCUSSION

3.1 SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

The results indicated that cocoa production is not the preserve of any particular gender but for both sexes.

Table 1. Socio-economic Characteristics of Respondents

Characteristics	Frequency	Percentage (%)
Gender		
Male	110	64.3
Female	61	35.7
Land Ownership		
Owners	124	72.5
Abunu	36	21.1
Abusa	8	4.7
Both owner and Abunu	3	1.8
Marital Status		
Married	162	94.7
Single	3	1.8
Divorced	1	0.6
Widowed	5	2.9

The study showed that males constituted over 60% of cocoa farmers sampled from the two districts. This is an indication of a male domination, probably due to the labour intensive nature of the cocoa sector (Table 1). Most farmers (over 70%) owned their cocoa farms; about 20% practiced the abunu system of sharecropping with less than 5% going for abusa system of sharecropping. However, 1.8% owned their farms and practiced abunu simultaneously; probably, to ensure the benefit of diversification. In the abunu system, 50% of the produce goes to the landlord with the farmer retaining the rest. This is because the farmer mostly clears a virgin forest taking charge of the crop till it starts bearing fruit. Prior to maturity, the farmer uses the other food intercrops like plantains to maintain the farm. The abunu farmers may eventually become land owners. Contrarily, this cannot be said of the abusa farmers; since they are mostly brought on board after the establishment of the cocoa farm therefore, they can be hired and fired at anytime. Abusa tenancy may arise after tenants are made to use the land for their food crops and in return plant cocoa for the landlord. In this case, the farmer shares the produce with the landlord in the ratio of 1:2. On the whole, majority of the farmers sampled are land secured, because they owned land or practiced abunu which makes them potential landlords. This is very important due to the long-term nature of cocoa production. Majority (94.7%) of the respondents were married; an indication of socially responsible farmers.

Table 2. Farmers' Age, Years in Farming, and Household size of respondents

	Min	Max	Mean	Standard dev
Age	20	95	52.2	13.8
Years in farming	5	60	17.1	11.3
Yrs in education	0	25	7.7	4.4
Household size	1	20	7.1	3.7

Farmers' age ranged from 20 to 95 with a mean age of 52.2 years (Table 2). This gives an indication of an ageing farming population and poses a threat to sustainability of cocoa production. It confirms the observations of other researchers [16], [17], [3] that cocoa production was more appealing to the aged than the youth. On the other hand the 17.1 mean years of farming cocoa implies that, farmers had adequate experience in cocoa production. This corroborated well with study conducted on plantain [17] where they had the average experience to be about 14 years. The mean year of formal education was 7.7; ranging from 0 to 25 with a standard deviation of 4.4. Again, the mean years of formal education of the cocoa farmers agrees with that of plantain farmers [17]. The respondents had a mean household size of about 7; an indication of a larger family size in a predominantly rural community.

3.2 FARMERS PERSPECTIVE

Table 3. Farmers' perspective of the Internal Marketing Competition and their Communities

Farmers response to internal Competition	Frequency	Percentage (%)
Increased production	149	87.1
Decreased production	4	2.3
Same production	18	10.5
Total	171	100

Source: Field Survey, February, 2011

Most farmers (about 87%) were of the opinion that the competition generated by the Licensed Buying Companies (LBC's) in the internal marketing of cocoa, has encouraged them to increase cocoa production in their communities (Table 3). Only 2.3% believed that the LBC have discouraged them in their cocoa production.

Table 4. Farmers Incentives in the Internal competition

Incentives	Frequency	Percentage (%)
prompt payment	123	79.9
Credit	27	17.5
Employment	4	2.6
Total	154	100

Source: Field Survey, February, 2011

Describing how they have been encouraged by the LBC's to increase their production; over 79% of the farmers said they can now be sure of prompt payment for their produce while, 17.5% said getting credit for production was now easier; about 2.5% believed it was a way of solving the unemployment problem in the communities (Table 4). This is because some community members were offered jobs as Purchasing Clerks by the LBC which has a multiplier effect on the entire community. It also means that the competition in the internal marketing of Cocoa provides non-price incentives to farmers as the Licensed Buying Companies compete among themselves.

The issue of prompt payment seems to be the most important farmers' incentive of the current policy. When the Produce Buying Company was the sole buyer of cocoa, farmers alleged that monies meant for cocoa purchases, were sometimes channeled into other businesses by District Managers and purchasing clerks of the societies. However, with the opening up of the system for competition, the issue no longer existed. It was observed that LBCs who delay payments unduly or refuses credit do so at the expense of their market share.

3.3 CHALLENGES

Table 5. Marketing challenges of farmers in the sale of cocoa

Challenges	Mean rank	Rank
Adjusted scales	1.13	1
Inadequate credit	2.81	2
Delayed payment	2.89	3
Break in season	3.16	4
N	94	
Kendall's W[a]	0.731	
Chi-square	206.04****	

*** = significant at 1% Chi-Square tabulated = 11.35 at 1%*
Source: Field data, February, 2011.

Four main challenges were generally identified by the cocoa farmers across the districts (Table 5). Scale adjustment by the Purchasing Clerks obtained the least mean rank and was therefore the most challenging constraint to the farmers; this observation was made during the field survey. Also, some farmers complained that the normal farm-gate weight of 64kg was not being strictly adhered to as some Purchasing Clerks go beyond the stipulated weight.

The second most limiting challenge was inadequate credit given by the Purchasing Clerks. Usually, credits are given to farmers when they are about to harvest the cocoa. This is to help them meet the costs they incur during harvesting; making it a short-term loan which farmers take an average of five weeks to re-pay. Credit is not given to cover the whole production process.

Delay in the payment of the cocoa purchased was the third most important problem confronting the farmers. Although farmers confirmed that the situation has improved with the competition in the internal marketing. The farmers believed that there could be improvement as farmers would always prefer prompt payment for their produce.

The fourth challenging problem was the annual seasonal break in the cocoa cropping season, since it received the highest mean ranking. This enables the other players in the cocoa sector to take stock and account for their stewardship. Unfortunately, it was seen by farmers as a set back since Purchasing Clerks take advantage of them and sometimes pay them a little lower than the official price. This is because, the new varieties of cocoa bear fruit all year round; secondly the seasonal breaks usually coincides with the beginning of the educational calendar where farmers incur a lot of expenses in the

education of their wards. It was clear that cocoa prices are normally reviewed upwards; farmers who sell their cocoa to the private agents during the seasonal break seem to be on the losing side.

Kendall's coefficient of concordance showed significant level of agreement (W = 0.731; P $\leq$ 0.001) among the rankings of the challenges by farmers on the internal marketing of cocoa (Table 5). This finding suggests that there was 73% agreement among the rankings of the farmers.

4 CONCLUSION

The study confirmed that the current internal marketing policy of cocoa in Ghana provides non-pricing incentives such as prompt payment, credit and employment to the cocoa farmers as the LBCs compete among themselves at the farm-gate. The most important constraint by farmers at the farm-gate was the adjustment of weighing scales by the agents of the LBCs. There is the need for the Ghana standards Board to monitor the weighing scales of the LBCs. Also, the competition should be maintained at the farm gate.

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Radio-sensibility of pearl millet (*Pennisetum glaucum (L.) R. Br.*) and cowpea (*Vigna unguiculata (L.) Walp.*) seeds germination and seedling growth

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ABSTRACT: Millet and cowpea crops are important for food security, poverty alleviation and malnutrition in the arid Sahel. The two crops generally grow together and have the advantage of supporting poor climatic conditions such as drought and low use of inputs which characterize agriculture in the world's least developed countries. Recent climate change raised up the dryness phenomenon and the traditional species cycle of production is no longer adapted to the reduced length of the wet seasons. New early and drought tolerant varieties are needed to ensure a steady supply of food in the driest regions on the planet. As it was done in numerous species, the mutation induced breeding can help to develop new crop varieties in pearl millet and cowpea. This method is carried out in Niger, in the Laboratory of Plant Breeding and Biotechnology to find out varieties of pearl millet and cowpea, more drought and high temperatures tolerant. This work examines the sensitivity of these two species to gamma radiation, as a first prerequisite step, for crop improving using mutation induction technique. The LD50 was found to be 669,3 Gy for millet crop and respectively 176,6 and 209,4 Gy for TN578 and IT90K 372-1-2 cowpea varieties.

KEYWORDS: Pearl millet, cowpea, seeds irradiation, food security, Niger.

1 INTRODUCTION

Millet and cowpea are important crops in Niger. Millet is the staple food of the majority of the Niger population, the cowpea is a source of cash for farmers especially women. These two crops are usually grown in association and have the advantage of producing where other species would have perished. In millet as in cowpea grain productivity is related to the length of the cycle. The most productive varieties are those that have the longest cycle. Recent climate changes result in shortening the duration of the wet season in the Sahel region, making increasingly unsuitable varieties with long vegetative cycle. The need to create new varieties combining productivity and precocity is an obligatory passage for the achievement of the Millennium Development Goals in nutrition and human health in the Sahel component. Conventional breeding has a relatively high cost for closed secondary interest crops like millet and cowpea. It takes 10 to 15 years of experimentation to lead to new varieties. Selection by induced mutation techniques, though it remains uncertain, has the advantage of saving time and ease of implementation. This technique is carried out in Niger, in the Biotechnology and Crop Improvement Laboratory, to increase pearl millet and cowpea crops drought tolerance. This work is a first step, studying the radio-sensitivity of the two species, to determine lethal dosage (LD_{50}) of gamma ray irradiation. It would, then, be used for irradiating and mutation induction breeding.

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2 MATERIAL AND METHODS

2.1 SEEDS IRRADIATION

Seeds of two varieties of cowpea (TN578 and IT90K-372-1-2) and one variety of pearl millet (HKP) coming from the Biotechnology and Crop Improvement Laboratory of National Radio-Isotopes Institute were used in this experiment. Gamma ray irradiation took place in the Radiation Technology Center of Ghana Atomic Energy Commission (GAEC), in Accra in November 2012, using Cobalt-60 source. Dry seeds were split in 8 samples (of sixty five grams), each corresponding to one of the seven irradiation treatments 0 (Control), 100, 200, 300, 400, 500, 600 and 700 Gy. All irradiation was done with a rate of 258,8 Gy/h, determined during a preliminary irradiation. After irradiation, seeds were sown, half *in vitro* in Petri dishes, and half in soil in the green house.

2.2 *IN VITRO* GERMINATION TEST

In vitro germination test was done in Petri dish of 90 mm diameter with cotton wetted with 10 ml of distilled water for pearl millet and 20 mm for cowpea. Each Petri dish received 10 seeds and there were 10 Petri dishes by treatment for pearl millet and one for cowpea. Incubation took place in dark, in a growth room at ambient temperature of 25 to 36°C. The percent of germination was recorded three days after sowing (DAS).

2.3 *IN* SOIL GERMINATION AND SEEDLING GROWTH

In soil test took place in a green house, on a germination tray for the pearl millet and in PVC pot for the cowpea. The soil used is a mixture of local topsoil and sawdust in a radio of 2:1 (v/v). Seeds were sown in a small hole of 2 to 4 cm deep after profusely watering, in a complete randomized experiment replicate 48 times for pearl millet and 10 times for cowpea. Spacing was 5 cm from plant to plant in millet and in pot of 10 cm diameter for cowpea. The experiment was irrigated at suitable intervals in such a manner that the crop did not experience with water stress. The data regarding the seedling emergence and plant height were recorded 7 days after sowing. In the result presentation, the seeds controls (with no radiation) were considered as reference (100%) of normal growth.

3 RESULTS AND DISCUSSION

3.1 SEEDS GERMINATION AND SEEDLING LIFTING UP

Data on the effects of different doses of gamma ray on seeds germination were summarized in Table 1. The two species responded differentially to various gamma radiation doses. For millet crop, the average rate of germination obtained *in vitro* is 98,9% and 104,6% in pot, with no significant difference between treatments, *in vitro* so as in soil, however the lower germination value is for the highest radiation dose. On figure 1, we can easily notice no difference between treatments. Germination is not negatively affected by gamma radiation even at high doses. This result is similar to some previous results [1]. Working on *Lepidium sativum* L. with dosages varying between 0 and 800 Gy, they found that gamma radiation affect significantly all observed important traits except germination percentage. It was concluded that the germination percentage is not a good indicator of radio-sensitivity in pearl millet. In soil test, the germination ability seems to be stimulated by all irradiation doses. Only the latest higher dose of 700 Gy showed inhibitory effect. This result was reported by several authors [2], [3]. In pearl millet, effective radiation doses are higher than 600 Gy, whereas previous results worked exclusively on doses under this value [4], [5]. This result should be considered and radiation doses above 700 Gy should be prospected in pearl millet.

Table 1. In vitro and in soil germination rate of pearl millet and cowpea as affected by radiation doses

Date	CTL	100	200	300	400	500	600	700	Average	STDEV
Pearl millet *in vitro*	100	101,0	100,0	99	100,0	94,9	98,0	99,0	**98,9**	**1,8**
Pearl Millet in soil	100	107,3	104,9	107,3	109,8	102,5	109,8	94,1	**104,6**	**4,8**
Cowpea *in vitro*										
TN578	100	100	100	100	100	80	70	60	**88,8**	**16,4**
V2	100	90	90	90	90	70	60	50	**80,0**	**17,7**
Cowpea *in soil*										
TN 578	100	80	140	20	20	60	20	20	**57,8**	**45,9**
V2	100	112,5	75	25	25	25	25	12,5	**50,0**	**39,5**

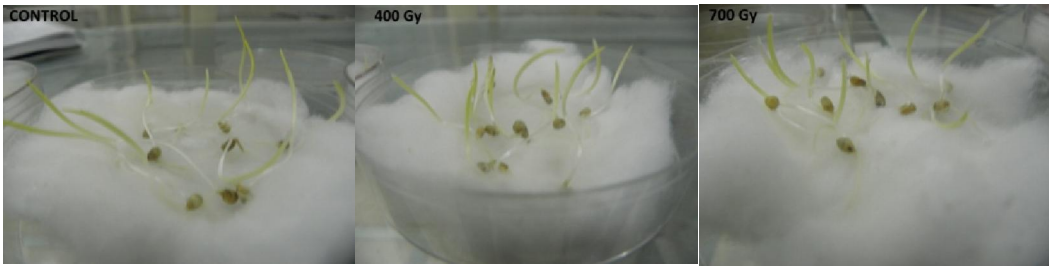

Fig. 1. in vitro Pearl millet (Pennisetum glaucum (L.) R. Br.) germination, three days after incubation, as affected by the dose of seeds' Radiation between 0 to 700 Gy

Instead, cowpea showed mean values of germination rate ranged from 50,0% to 88,8%, with great differences tests and between varieties. In *in vitro* test, inhibitory effects began at higher radiation dose (> 500 Gy), whereas in soil, it started from 300 Gy. The germination rate showed regular decrease with increase in radiation dose. In *in vitro* test, from 100 to 400 Gy, there was no significant effect of radiation. The germination rate began to fall down at 500 Gy, to attend 60% and 50% for TN578 and IT90K respectively at highest dose. In soil test, the inhibitory effect began at 300 Gy and decreased progressively to attend 20% and 12,5% for the highest dose, respectively for TN578 and IT90K varieties (see Figure 2).

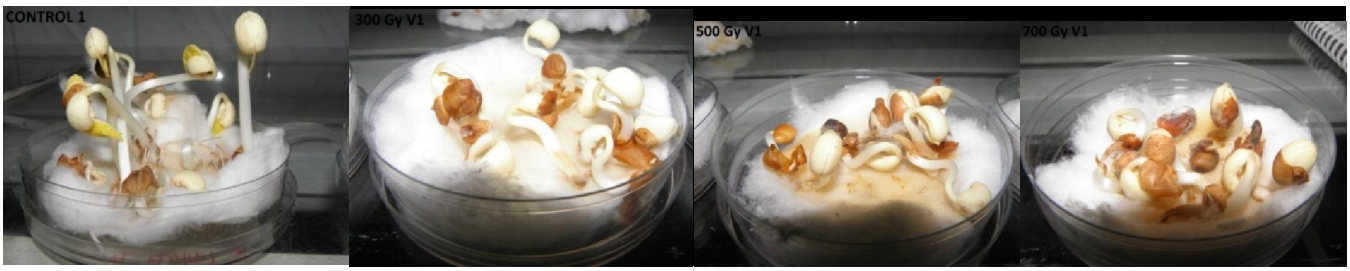

Fig. 2. in vitro cowpea (Vigna unguiculata (L.) Walp.) germination, three days after incubation, as affected by the dose of seeds' Radiation between 0 to 700 Gy

The difference between *in vitro* and *in* soil test indicate that the inhibitory effect affects more the epicotyls and hypocotyls growth (reducing seedling lifting up) than the germination rate.

3.2 SEEDLING GROWTH

Data on the effect of different doses of gamma ray on seedling growth are graphically illustrated in Fig 5 to 8. Lower doses of 200 Gy did not reduce the seedling significantly seedling growth. Higher doses exerted inhibitory effects on seedling growth of both millet and cowpea (Figures 3 and 4). Radiation effect was recorded with higher doses above 300 Gy in pearl millet (Fig 5) and above 200 Gy in cowpea (Fig 7). This response is in great agreement with earlier research findings [4], [6], [7], [5], [8]. This decline in stem height was obtained even in the case of massive inflows of mineral fertilizers [9]. In pearl

millet, plant height decrease progressively, with radiation dose, from 100% of the control, to 40% at the highest dose (700 Gy). In cowpea, the height drop is sharper, from 200 to 300 Gy and plant growth is almost zero beyond 300 Gy. No significant difference was recorded between the two varieties of cowpea.

Fig. 3. Pearl millet (Pennisetum glaucum (L.) R. Br.) seedling growth in pot, in green house, three days after sowing, as affected by the dose of seeds' Radiation between 0 to 700 Gy.

Fig. 4. Cowpea (Vigna unguiculata (L.) Walp.) Seedling growth in pot, in green house, three days after sowing, as affected by the dose of seeds' Radiation between 0 to 700 Gy.

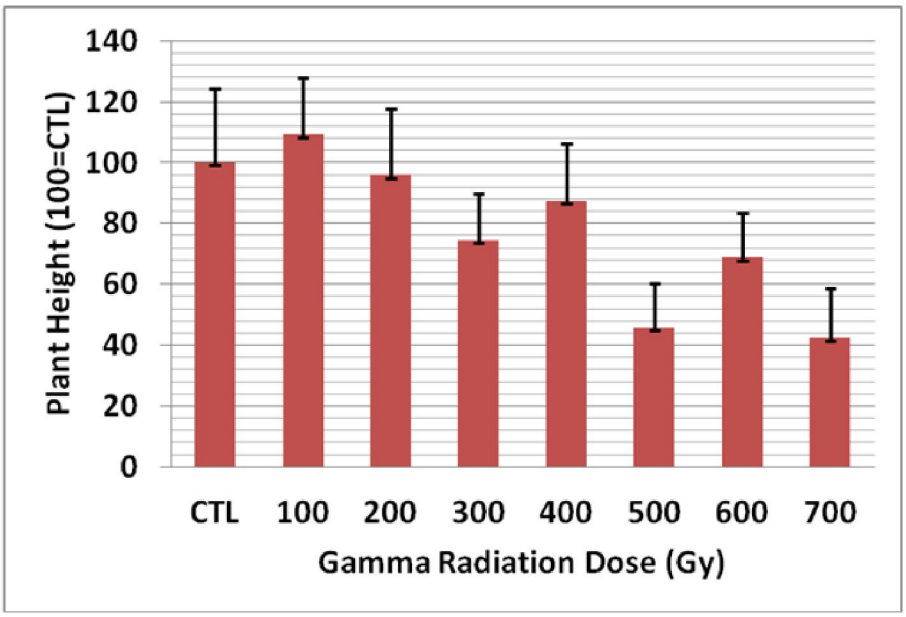

Fig. 5. Pearl Millet (variety HKP) height as affected by gamma radiation dose, 7 days after sowing

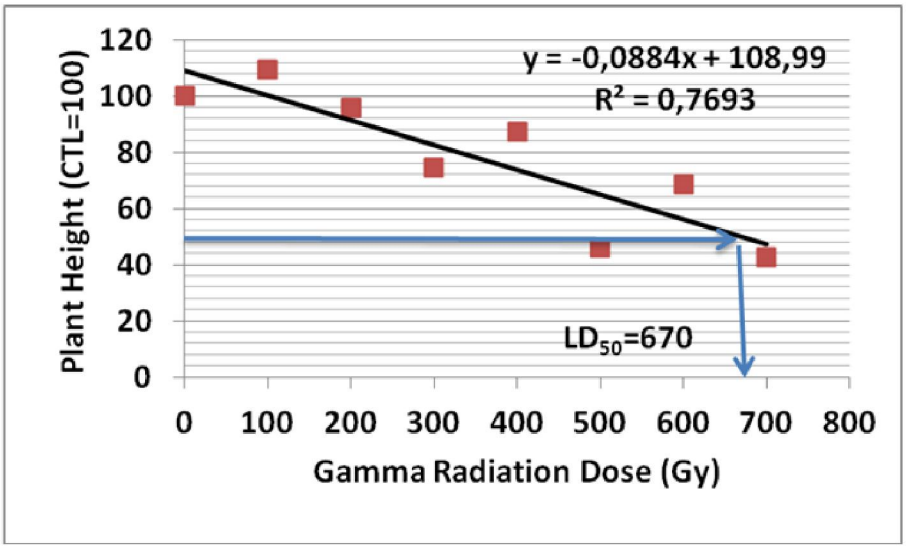

Fig. 6. Pearl Millet (variety HKP) height as affected by gamma radiation dose, 7 days after sowing. LD_{50} determination

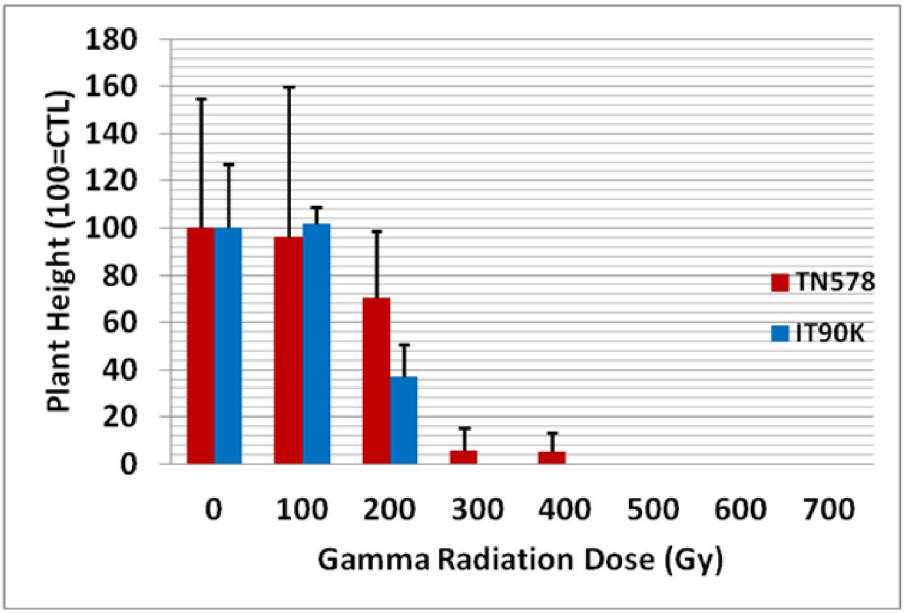

Fig. 7. Cowpea height as affected by gamma radiation dose, 7 days after sowing. Varieties TN578 and IT90K

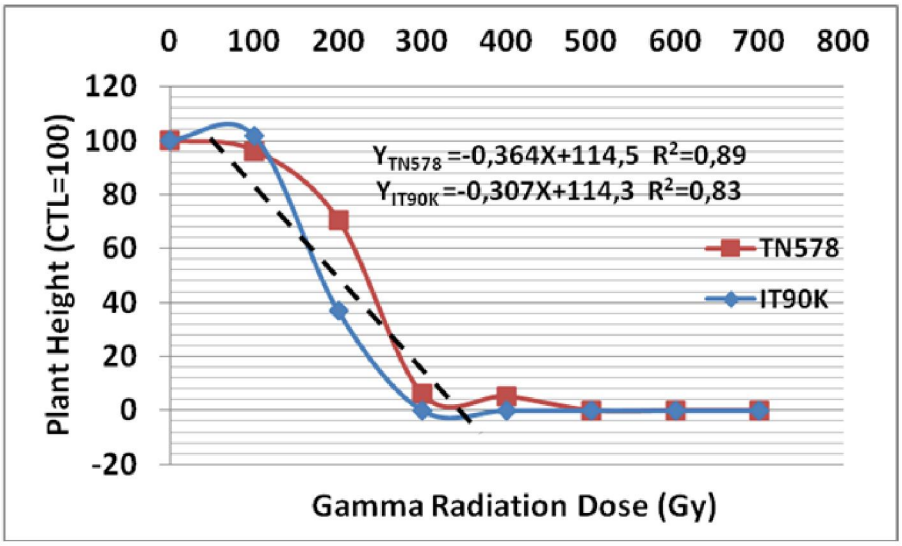

Fig. 8. Cowpea height as affected by gamma radiation dose, 7 days after sowing. Varieties TN578 and IT90K. LD_{50}determination

3.3 LETHAL DOSE OF 50% GROWTH INHIBITION DETERMINATION (LD_{50})

The results above permit to consider the seedling height as a good indicator of the biological effect of the gamma rays on seeds and seedling growth of pearl millet and cowpea. The data were used to calculate the Lethal Dose for 50% growth inhibition. The radiation doses showed negative correlation with seedling growth (Fig 6 and 8). As expressed in the equations below, regression analysis revealed that the decrease for unit increase in dose was 0,088 in pearl millet, 0,307 in cowpea TN578 and 0,364 in cowpea IT90K, with regression coefficients varying from 0,77 to 0,89.

$$Y_{MIL} = -0{,}088\,X + 108{,}9 \qquad R^2=0{,}77$$
$$Y_{TN578} = -0{,}307\,X + 114{,}3 \qquad R^2 = 0{,}83$$
$$Y_{IT90K} = -0{,}364\,X + 114{,}3 \qquad R^2=0{,}89$$

Where:

Y is the relative growth in percent

X is the radiation dose in Gray

The LD_{50} is the gamma ray dose expected to produce enough genetic modification to lead to new mutant viable lines. Using the above formula, the LD_{50} is the X value calculated with Y equal to 50. Obtained values were presented in Table 2 : 669,3 Gy for millet; 209,4 Gy for cowpea TN578 and 176,6 Gy for cowpea IT90K. Recently, some authors [5], working on plant mortality as observed indicator, found LD_{50} values varying from 599 to 731 Gy for pearl millet. Even the observed indicators were different, the LD_{50} values obtained were similar for the two experimentations, with different varieties of pearl millet. Anggia [10] working with large game of dosage (0-2000 Gy) on corn, found LD_{50} mean values ranged from 220 to 615 Gy depending on the variety. Instead, LD_{50} is variable between cowpea varieties and was to be determined before working on each new variety of this species.

Table 2. Calculated LD50 for pearl millet and Cowpea in Niger

Crop	LD_{50} (Gy)
Pearl Millet	
HKP	669,3
Cowpea	
TN578	209,4
IT90K	176,6

4 CONCLUSION

The pattern of seedling growth response of pearl millet and cowpea seeds to gamma ray irradiation has been successfully determined. In addition, LD_{50} relative to plant eight of the tested varieties was found to 669 Gy for millet and ranged from 176 to 209 Gy for cowpea. The stimulation positive effects observed in pearl millet, for all tested doses, suggested to further irradiate this specie with gamma radiation dosages above 700 Gy. In the other hand, our results showed that pearl millet is more tolerant than cowpea to gamma ray radiation.

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Evaluating salt Concentration and Exiting Sewage Electrical Directing of Isfahan Oil Refinery Company for Application in Green Environment

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ABSTRACT: Irrigation water quality has significant importance in dry region that have high temperature and low humidity. Mechanical properties and physical properties are stability, porous, soil structure and hydraulic directing relative to exchange ion in irrigation. We can control problem due to pollution in environment level and water resources and can increase products performance. Eatable vegetable are in border with respect to consumption process and should be evaluate because of gathering different elements such as heavy metal like sorb, calcium, corm, Niche, Mercury, Arsenic, cobalt. Model output is depending on application method and reuse method of effluent. Also filterable effluent volume, weather situation, cost and investment level and each value are other effective factors. Recommendation are filtration, Earth filter and soon. We can attribute part of filter to irrigation system trend. Also we can avoid of effluent mix apply or effluent alternative application. Najafi (2002) shows that subsurface drop irrigation filtration application has meaningful effect on complementary treatment and effluent pollution load decrease. Capra & Semicolon (2004) present best mods for drop irrigation filtration. The reaction is done until third equation if there are not sulfate-reducing bacteria. Sulfide ions produced strongly affect to anodize and catholic reactions. In this article we are evaluating salt concentration and exiting sewage electrical directing of Isfahan Oil Refinery Company for application in green environment.

KEYWORDS: Industrial Sewage, Sodium Absorption Ratio, Filtration, Exploitation, Environment.

1 INTRODUCTION

EXPLOITATION OF SEWAGE

Sewage origin around large cities are industrial and human-being water in industrial regions Industrial sewage divided to refinery industries, petrochemical industries, food industries, chemical industries, metal industries. Also sewage of other agricultural and activities such as veterinary and slaughter house have high pollution, that should manage properly. Extraction of urban sewage drainage is rich of food elements. That is useful for alkaline soil. Treatment level selection suggested for use of sewage quality correction. In this level we present different levels for use of sewage in agriculture. These levels are first treatment that includes physical treatment, second fast treatment such as active sledge, dropper filter and airing lagan. Slow treatment instead of fast treatment suggested base on situation for earth treatment that is for desert earths. In certain situation we can present higher level of treatment such as reverse osmosis. That is naturally with higher cost and technology. We should present Exploitation method base on treatment sewage quality. Exploitation method include kinds of vegetation, its frequency, hydraulic load level in surface with respect unit with respect to organic load in sewage, cleaning level with respect to mineral level and special ions and fresh water. For compensate dropping oil product quality.

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2 EFFECTIVE FACTORS IN IRRIGATION WATER EVALUATE

Irrigation water quality has significant importance in dry region that have high temperature and low humidity. Mechanical properties and physical properties are stability, porous, soil structure and hydraulic directing relative to exchange ion in irrigation. So we should several factors while we comfort with exploitation of sewage. Also we should attention to stratifying environmental command. Other issue relate to agriculture is solution material effects on vegetable grow. solution salts increase osmosis pressure of soil water and this increase lead to plant energy consumption increase. So we have more respiration and finally decrease their performance. Vegetable are sensitive to active salt in soil water that are effective on osmosis potential. Some ions are useful for vegetation in low concentration [9].

But are toxic in high concentration that can be toxic indirectly with effect on food material absorption and directly by involvement in metabolism A-salt concentration: salts concentration is one of the main parameters for recognizing agricultural water. solution salts in water is relate to soil salt and base on this grow plant affect by performance and quality of products. B-Electrical directing: We use of electrical directing for showing ions in water. Electrical direct is relate to anions and actions of chemical material resolution and is relate to all salts. Electrical direct is in 25˚c and is adjustable with other situation. Ewer shows water electrical direct and Eco is soil saturation extraction electricity and its electrical unit is ds/m and shows salt constituent in irrigation water and Relationship of salt conversion to electrical direct, several researches conducts about salt effects on plant grow [2]. FAO divided plant resistant relatives to saline to 4 categories such as: resistive, semi resistive, sensitive and semi-sensitive. C-Sodium absorption ratio: sodium is unique action because have effects on soil. Exchange sodium can change soil physical-chemical properties and structure. Exchange sodium tend to soil distribution and can decrease water and soil penetration speed. Also this particle distribution can make one shield layer on soil surface and prevent of seeding. Irrigation water considered as one source for increasing soil solution and evaluated for this. Table 1 shows salinity problems and sodium in soil and plant. certain parameter for determining irrigation eater effect on soil exchange sodium increase is sodium absorption ratio parameter or sirs that define as below [1]:

Equation 1:

SAR=Na/√ (ca+mg)/2

In these equation ions concentration is based on meq/l

In addition we could determine irrigation water SAR value. Also we can obtain Exchangeable sodium percent (ESP) in one balance soil with irrigation water [3].

Equation 2:

ESP=y/tlf/if%5 SAR adj

In farm situation ESP value is more than Evaluate value, because in farm situation, salt concentration increase by steam. and SAR value predicted of sodium ion effect equation, Although SAR value change after entering water to soil, But capon concentration change after water to soil in relation to carbonate and B-carbonate onion in irrigation water and Co_2pressure in soil air. Ewer and scat (1989) present SAR for solve this problem that calculates according to equation 3.

Equation 3

SAR adj=SAR in [it (8.4-phc)]

SAR adj=Modified sodium absorption ratio

SAR iw=irrigation sodium absorption ratio

PHC=Calculate from this equation

In equation 3 8.4-phc values consider as saturation index (SI) [5].

This parameter is important in drip irrigation direct situation. And if this value is positive it present carbonates calcium penetration [8].

Table 1. Corrosion of Various Sulfides

Corrosion of Iron Sulfide	Percent Sulfur
1	46
0/3	44
0/2	44
0/12	37
0/07	37

3 US. EPA STANDARD

American environmental organizations present direction for use of affluent. In these direction feces coliform is less than 200 MPN/100ML, BoD5<30 mg/f, TSS<30 mg/I and Acidity between 6to 9 recommended, But in situation that use of affluent in green environment we recommend secondary filter, filtration and qualitative index are rigorous. And they recommend muddy less than NTU2 and clore less than 1 mg/l bus on BOD5<10 mg/I, FC<0, MPN/100mI. It's possible that city center indusustral & agricultural section affluent contain bacterial elements such as coliform and other bacteria and viruses. In addition mineral and organic elements lead to be more toxic elements in affluent. Although, they don't report one global standard for acceptable effluent quality for irrigation, but organizations such as (WHO), world bank, Nations organization environment, and present some biologic parameter for use of affluent. This parameter show that parameter is acceptable for irrigation and filter style. Standards are absent for heavy metal in irrigation water that is based on global business by passcode in 1992 (e.g. [2], [6], [7], [8], [11]).

Iron-Oxidizing Bacteria: These bacteria are usually found in fresh water and salt water occasionally. These bacteria are aerobic and enabling to grow in environment that amount of oxygen is 5/0ppm. They produce large amounts of sludge mass. Iron bacteria, use the iron soluble salts for their growing and deposited unsalable iron compounds as secondary products of metabolism, the reaction is as follows**:**

$$4FeCO_3 + O_2 + 6H_2O \rightarrow 4Fe(OH)_3 + 4CO_2 + 81000calori$$

These reactions produce more energy and ultimately created a lot of ferric hydroxide which cause to bulk deposition, reduce heat transfer and corrosion such as smallpox. They often find in iron water pipes or wells if these resources are water of cooling tower; they entered to cooling system and can cause a lot of problems. These bacteria are heterotrophic, meaning that they required energy provide from organic sources such as alcohols and organic acids (e.g. [15], [19], [28], [38], [41]).

Pseudomonas type hydrocarbons as an energy source are used. They can because problems include: the electrochemical cell, clogging of pipes and pumps, clogging of injection wells and oil and filter clogging. These bacteria are able to live in salt water. Only one type of bacteria that can grow in aerobic systems, whereas some anaerobic systems can also provide growth and proliferation, which are being Facultative, under of the bulk deposition that produces by Construction sediment bacteria, due to not reach oxygen break the aerobic bacteria. This is a good food source for anaerobic bacteria that reduce sulfate. If there are chloride and bacterial oxidant iron such as gallinsela in system together, they produce FeCl3 ferric chloride is a strong acid that occur frequently will accelerate metal corrosion. Aerobic baggily Bacteria produce sediment. Bacteria and other organisms that are correct shield compared with baggily Bacteria make less sediment. Sheathed bacteria growth that leads to the deposition of high sticky to the surface, especially occurs in the heat transfer and suspended matter in water, such as mud, sand, gravel, soil and corrosion products on the network interconnected with the sediment and make the sediment is more bulky. The experiments show that small part of the weight of sediment is microbial organic matter. It should be noted that almost 90 percent of the volume of sediment is the biological material (e.g. [14], [19], [27], [28], [29]).

Acid Bacteria Causing: Two major types of acid-producing bacteria are: aerobic sulfur bacteria capable to oxidize sulfur and sulfate into vitriol (sulfuric acid) and another type of bacteria which are able to produce organic acids.

Corrosion of Organic Acids: The process of metabolism produces the anaerobic bacterial of organic acids such as lactic acid. Except of bacteria, some fungi effect of your metabolism produce organic acids such as acetic acid and formic acid. The acid in the presence or absence of oxygen leave negative effects on metal corrosion and material. High temperature and humidity conditions that are produced by fungi cause to corrosion electronics in stores. Table 2 shows the severity of soft iron corrosion is caused by organic acids under massive microorganisms 5mm thickness (e.g. [21], [26], [37], [38], [39]).

Table 2. The Severity of Soft Iron Corrosion Is Caused by Organic Acids under Massive Microorganisms 5mm Thickness

(mm/yr) Pitting Corrosion Rate	(mdd) Weight Reduction	Acid
2	730	Formic
0/8	140	Acetic
0/7	130	Propionic
0/6	100	Butyric
1/2	225	Citric
1	190	Lactic

Sulfate-Reducing Bacteria: The most common bacteria involved in the biological corrosion are sulfate reducing bacteria (SRB). Usually these bacteria are abundant in the environment in soil and water. In general, the sulfate reducing bacteria called which are able to regenerate inorganic sulfate to sulfide. These bacteria are anaerobic and in the environment that there is no oxygen able to grow and multiply. Of course, there are other species aerobic bacteria and anaerobic that able to regenerate sulfur compounds to sulfide and the importance of bacterial sulfate reduction (mineral) desulfurize kens bacteria from caste idem family. These bacteria are able to consume hydrogen and some other organic material and reducing sulfate ions to sodium sulfite gain energy needed for their growth. Sulfide ion induced adverse effects on steel corrosion. The presence of these bacteria is characterized by the deposition of iron sulfides. Sulfide compounds produced by the bacteria are deposited on surfaces compared to steel; the situation is more cathodes and accelerated corrosion to the steel (e.g. [11], [16], [24], [35], [40]). Some anaerobic bacteria each of them have different types able to feed organic materials such as private choline and lactate and grow on their even in situations that is no ambient sulfate ions in the environment. the main role of sulfate-reducing bacteria give electron from organic and inorganic substances present in the environment (oxidized to them) and deliveries to sulfate as the final receiver of electrons (reducing them). Several mechanisms have been suggested for the corrosion of sulfate-reducing bacteria witch the most important mechanism of formation of cathode depolarization and galvanic couple iron sulfide with Fe. In mechanism polarization of iron corrosion is considered to be a thin layer of hydrogen on the surface that it is polarized. SRB bacteria removing hydrogen cathode by hydrogenated enzymes from itself that are able to spend it for regenerate sulfate ions and thus cathode region are depolarized that lead to increase metal corrosion. For example, the corrosion of steel, the following reactions have been reported:

Anodic reaction 1) $4Fe \rightarrow 4Fe^{+2} + 8e^{-}$

Water Analysis 2) $8H_2O \rightarrow 8H^{+} + 8OH^{-}$

Cathode reaction 3) $8H^{+} + 8e^{-} \rightarrow 8H^{0}$

Cathode depolarization 4) $SO_4^{-2} + 8H \rightarrow S^{-2} + 4H_2O$

Corrosion product 5) $Fe^{+2} + S^{-2} \rightarrow FeS$

Corrosion product 6) $3Fe^{+2} + 6\ OH^{-} \rightarrow 3Fe\ (OH)_2$

Final reaction 7) $4Fe + SO_4^{-2} + 4H_2O \rightarrow 3Fe\ (OH)_2 + FeS + 2OH^{-}$

The reaction is done until third equation if there are not sulfate-reducing bacteria. Sulfide ions produced strongly affect to anodic and catholic reactions. Some investigators have proposed another mechanism is the formation of iron sulfide with iron galvanic couple. In the mechanism composed thin layer of iron sulfide by sulfate-reducing bacteria absorb hydrogen cathodic.in thin layer sulfide acts as the cathode and with steel form a galvanic couple and cathode dipolarization function is performed by sulfate-reducing bacteria is done on the sulfide layer and thus increases the corrosion of steel (e.g. [22], [34], [36], [17], [39]).

4 CONCLUSION

EFFECTIVE FACTOR ON ONE EXPLOITATION MODEL:

Input data: one of the main input data is effluent qualitative properties before reuse in irrigation. These properties divided to 3 chemical, physical and biologic groups. Chemical factors contain Ec, SAR, PH, and COD. Nitrate, Nitrite, phosphate, sulfur phenol, saner concentration and biologic properties contain BOD5, coliform, feces coliform, No mated, Bacterizes and physical properties such as Do, TSS, turbidity, organic matter and color. But factors value are variable depend on effluent origin. And because this we can change input parameters effluent origin Weather situation is one of the main input in recommended model Temperature is effective on BOD3 value, Microorganisms in effluent and some of organic

matter and mineral matter such as nitrate. Temperature, day brightness hours, relative's humidity and wind blow are important because of effect on evaporation and sweat. Also blowing speed is important for irrigation method select in reuse situation of effluent. Also Geographical with and altitude of sea level, effective rain level and irrigation time are necessary for input data to calculate vegetable water need. Soil texture is effective on application situation (e.g. [12], [13], [23], [22], [25]).

Physical features such as soil structure and soil texture are more while in decreasing effluent earth filter, pollution indexes are high penetrability is effective on waste water due to Hydro intensity and application. Plant vegetable divided in to raw vegetable, industrial vegetable and not-useful vegetable. Eatable vegetable are in border with respect to consumption process and should be evaluate because of gathering different elements such as heavy metal like sorb, calcium, corm, Niche, Mercury, Arsenic, cobalt. Another parameter is vegetable persistent border to effluent chemical parameter that are salinity, sodium penetration ratio, chloride, sodium, and beer. Also we should pay attention to some of vegetable sickness on the other hand some of vegetables which have important role in absorb pollution elements and are effective in polluted soil filter. Surface method such as basin irrigation and border irrigation lead to prevalence microbial pollution for water distribution, but we should less use of them because of farm worker direct contact and we should use of high level of filtering. But among surface methods furrow irrigation with wide jibe, better, we recommend surface methods such as basin and border if this be in dry and semi-dry regions and we should manage in vegetable plant and irrigation method if we use of furrow irrigation. But raining irrigation is not acceptable in low chemical and microbial quality until it has high cost of microbial and chemical filtering. that are not cost effective. Crop irrigation method is the best method for use of affluent in agriculture, especially then they use subsurface drop irrigation. In this method microbial pollution decrease by effluent injection in soil subsurface. And we should install wide dripper that reach to soil surface temperature we can calculate wide model base on this relation and Philip relation is one of the simple equations (e.g. [4], [10], [20], [30], [41]).

Model output: Present recommendation for effluent modify deform use. This recommendation is depending on application method and reuse method of effluent. Also filterable effluent volume, weather situation, cost and investment level, and each value are other effective factors. Recommendation are filtration, Earth filter and soon. We can attribute part of filter to irrigation system trend. Also we can avoid of effluent mix apply or effluent alternative application. Najafi shows that subsurface drop irrigation filtration application has meaningful effect on complementary treatment and effluent pollution load decrease. Capra & Semicolon (2004) present best mods for drop irrigation filtration (e.g. [19], [29], [31], [32], [33]).

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A New Generalized Regression Artificial Neural Networks Approach for Diagnosing Heart Disease

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ABSTRACT: Artificial Neural Networks (ANNs) play an important role in the field of medical science in solving health problems and diagnosing diseases both in critical illnesses and in common diseases. Since it is important to diagnose accurately the people' disease condition, therefore for the precisely diagnosing those condition, we must use appropriate methods that to minimize the errors in diagnosis. So, using an appropriate method to diagnose heart disease and to prevent complications of the disease is an important step toward patients' improvement. Therefore, in this paper the presence or the absence of heart disease of the four datasets using Generalized Regression Neural Networks (GRNN) will be discussed. Each of the four datasets contains of 14 features that they are used to diagnose heart disease with GRNN. In this paper, GRNN have been implemented in MATLAB environment. The aim is maximizing the precision of measurement in accurately diagnosing heart disease in the process of training and testing. By comparing the results of each dataset, we found the best accuracy in the training phase that is equal to 100% which belongs to Switzerland and Long Beach VA datasets, and the best accuracy in the testing phase belongs to the Cleveland dataset that is equal to 96.6667%.

KEYWORDS: Generalized Regression Neural Network (GRNN), heart disease, datasets, training accuracy, test accuracy.

1 INTRODUCTION

Nowadays, heart diseases are the most common in the industrialized and the developing countries followed by the high mortality and morbidity. The heart is a muscle which pumps blood from the lungs to the lower part of the body around the body. If blood circulation in the body be inefficient, another organism like brain suffers from this problem. If the heart stops working, death can occur in minutes. Life is totally dependent on the work of the heart, a number of factors that increase the risk of heart disease include family history, smoking, poor diet, high blood pressure, high blood cholesterol, obesity, physical inactivity, and ... [1]. Factors such as these are used for the analysis of heart disease, In many cases, the diagnosis is generally based on the results of the test, the patient and physician, the diagnosis is a complex task that requires high skills and experience, early diagnosis and intensive medical care of patients with this disease can largely prevents them from sudden death [1], [2]. Different methods have been proposed to solve this problem. One of these methods is ANNs. In recent years, machine learning techniques are widely used in prediction and diagnosis, especially in medical diagnosis, ANNs are 'hot' topics for medical research, particularly in the fields of radiology, urology, cardiology, cancer, etc. One of the major problems is a medical diagnosis because the disease is diagnosed by a physician who requires medical attention and previous experience [3]. Several research groups around the world working on the development of ANNs in medical field. An ANN is used for the purpose of enhancing the precision, accuracy and objectivity in medical diagnose. The purpose of diagnosing a disease by ANN is to achieve a high rate of accuracy and tangibility of medical diagnose in the training and testing of a dataset [3]. It is a technique that attempts to simulate the behavior of the human brain's neurons. This technique has been

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used for several recent years in many cases including the detection and estimation and prediction of the capabilities of ANNs [4]. The most important advantage of using ANNs is that they are used for solving the problems that are too complex for conventional technologies that there is no algorithmic solution or solutions are highly complex. This attributes is widely used in medical fields [5]. ANNs have been successfully used in various areas of medicine like diagnosing systems [6], the analysis of medicine [7], medical images' analysis [8]. Diagnosis of the illness in patients is the most important feature for medical treatment in which ANNs are suitable system for the operation. How to obtain information on individual patients is of crucial importance. The more patients are used in implementing an ANN, the better performance of the ANN will appear [3], [9]. Another advantage of ANNs regarding the diagnosis of diseases is that feature like fatigue, exhaustion, emotional state have no influence on them. Its reason is the implementation of ANNs on computer systems; these cases are vacuous for computer systems. ANNs are able to learn and an ANN can be trained before performing major operation, and use it after training and testing. Learning in ANNs can be done by adjusting the input weights and the act of learning can be done, if weight in the input changes in the case that the desired results happen [10], [11]. There are many relationships between stored data on the computer that at first the designed ANNs must be trained for learning patterns and the relationship among data and extracting hidden information and after those procedures apply those ANNs [12], [13]. ANNs are used in any situation where a relationship between some of the variables considered as input and some of them as output variables (diagnosis) [14]. In this paper, we tried to diagnose heart disease to a degree of accuracy using the GRNN and find maximum optimized answer. Having information (Data's) is one of the critical issues in the use of ANNs. In this paper, we used the 4 dataset named Cleveland, Hungarian, Switzerland and the Long Beach VA with specific examples that the GRNN are trained by these data. GRNN have been implemented in MATLAB environment.

In [15], Researchers diagnosed heart disease with GRNN and Radial Basis Function (RBF) of ANNs which were used from a data set containing 300 samples. In This method features such as high blood pressure, diabetes, hyperthyroidism, chest pain, shortness of breath, smoking, tobacco, alcohol and … are used for patients. In this way the data have been normalized in the range of 0 and 1. After training the data, the results showed that the performance of RBF has been much better than GRNN for the diagnosis of heart disease. We discuss in the second section of the paper about datasets that is used for heart disease diagnose. In the third section of the paper we will discuss GRNN and the proposed method and the results of GRNN training and testing data. As soon as we will deal with the conclusions and future works in fourths section.

2 DATASETS FOR THE DIAGNOSIS OF HEART DISEASE

According to statistics from the World Health Organization, heart disease is the most common cause of death among other diseases [16]. Early diagnosis and intensive medical care of patients with this disease can largely prevents them from sudden death. Healthcare management of heart failure patients is a very complicated and difficult task. It depends on many factors and how to approach life. For example, age, tobacco use, personal fitness, blood pressure, stress, etc. are some of these factors [17.18]. Without a doubt, one of the most important parts of the development of ANNs is selecting the data. Our collected data which are from four hospitals in Cleveland, Hungarian, Switzerland and the Long Beach VA are from 14 features for doing this research. The data can be used for training and testing the GRNN. Table 1 shows all 4 dataset and the number of each dataset has been written in Table 1.

Table 1. Dataset names and the number of each dataset

Dataset	Total
Cleveland	303
Hungarian	294
Switzerland	123
Long Beach VA	200

Each dataset contains of 14 features that they are used to diagnose heart disease with GRNN. Table 2 shows the 14 used features in this paper.

Table 2. The names of used features for diagnosing heart disease, along with the kind of their values

No. of Feature	Feature	Descriptions and Feature values
1	Age	Numerical values
2	Sex	Male=1 Female=0
3	Chest pain type	Typical angina=1 Atypical angina=2 Non-angina pain=3 Asymptomatic=4
4	Resting blood pressure	Numerical values in mm hg
5	Serum cholesterol	Numerical values in mm/dl
6	Fasting blood sugar	Fasting blood sugar > 120 mg/dl (True=1; False=0)
7	Resting electrographic results	Normal=0 Having ST-T wave abnormality=1 Left ventricular hypertrophy=2
8	Maximum heart rate achieved	Numerical values
9	Exercise induced angina	Yes=1 No=0
10	ST depression induced by exercise relative to rest	Numerical values
11	Slope of the peak exercise ST segment	Up sloping=1 Flat=2 Down sloping=3
12	Number of major vessels colored by fluoroscopy	Value = 0-3
13	Defect type	Normal=3 Fixed defect=6 Reversible defect=7
14	Diagnosis of heart disease	Yes=1 No=0

According to Table 2, the first 13 features are used as inputs for GRNN and the feature number 14 called heart disease' diagnosis used as output's feature. It is used as an attribute to clarify persons' healthiness or sickness. As shown in Table 2, the values of the feature number 14 are 0 and 1, 0 means as being healthy and 1 as being patient.

3 PROPOSED MODEL

Generally, the ANNs are parallel processing systems which are used for recognizing complex patterns in the between data. In fact, an ANN is an information processing system consisting of some common features with biological neural networks. Then each ANN consists of a set of neurons with special makeup. The chief part of an ANN composed of neurons and communication links between them. The neurons are interlinked processing elements which interacted coordinately to solve an issue [19]. ANNs are capable of learning. This capability through experience and generalizability in solving new problems is the advantage of this method over other methods [20].

The proposed model in this paper is to diagnose heart disease using GRNN. GRNN is often used in function approximation [21]. In fact, these types of ANNs are a kind of ANNs based on RBF. GRNN are trained and respond quickly. The main advantage of GRNN model is that it is much faster than trained sample back- propagation [21]. GRNN is exactly four layers including an input layer, a layer called the radial basis (a hidden layer), a layer of regression Neurons, and an output layer [22]. Neurons of radial basis layer (hidden layer) recognized as instructional centers for data. The hidden layer transfer function is non-linear function radbas (Gaussian). The number of neurons in this layer is equal to the number of training data. In GRNN, regression layer must be exactly one neuron more than the output layer. Regression layer composed of linear units (linear neurons). The output layer transfer function is purlin linear function. Formula (1) is a predicted output by GRNN.

$$y_i = \frac{\sum_{i=1}^{n} h_i w_{ij}}{\sum_{i=1}^{n} h_i} \quad (1)$$

There are two sections in the regression layer. One section is the sum of the denominator unit and the other is the sum of the fraction unit. According to formula (1), the upper part is the sum of the fraction unit and lower part is the sum of denominator in the regression layer. Output layer divides the obtained value of the sum of the fraction on the sum of the denominator unit. W_{ij} is the output corresponding aim (purpose) with training of the input vector X_i and the output j. h_i is the output of each neuron in hidden layer in the form of formula (2) that it is in the form of nonlinear transfer function in Gaussian.

$$h_i = \exp\left(\frac{-D_i^2}{2(spread)^2}\right) \quad (2)$$

According to formula (2), spread is a Constant value to increase the accuracy of training and testing and it is used for neurons in hidden layer. D_i^2 is squared distance between the input vector X and the training vectors u in formula (3).

$$D_i^2 = u_i(x-u_i)^T(x-u_i) \quad (3)$$

According to formula (3), X is the input vector and u_i is the center of the hidden ith neuron.

Since the range of variation of the reviewed data is very high, and also the nature of transfer function using ANNs often need to have their input in limited scope, these functions are usually flat in small and large in quantities, and their sequences are less sensitive to changes in input values.Thus, their normalization value is often used instead of data values. Employing methods to put input data in a limited range is called normal values which are one of the pre-processing methods. Other advantage of putting inputs in a limited range is to inhibit the excessive growth of the weight. This limitation reduces the convergence time in ANN and minimizes achievable error. In other words, entering data in raw form reduces the speed and accuracy of the ANN, to prevent this, the data must be normalized before training [23], [24]. Different methods were tested to normalize the data, finally using formula (4) the data were normalized in the range [-1, 0] to increase the training performance.

$$In = \frac{In - Max_{In}}{Max_{In} - Min_{In}} \quad (4)$$

Input data in GRNN are classified into two training and testing categories. We have chosen randomly 90% of all the data as training data. After that GRNN was trained by the data, they find their final weights, so that the GRNN gives the least error for the training of data. The rest of the data that are 10%, after that the GRNN was trained by the training data to achieve the minimum error, this 10% of the data that have not a role in the training given as input to the GRNN, the GRNN response and the desired response is compared and in this way the trained GRNN is measured. If GRNN that are tested in a time period, answer correctly the training is over, otherwise; GRNN training begins again. When at the final step the program got out of the training and on all inputs produced the right outputs, in this case, it is clear that the weights of GRNN are adjusted properly, so from now on we will use these values to diagnose the action.

We considered 4 datasets in this paper. The number of data in GRNN for training is 90%, and for testing is 10% which they are classified as follows in Table 3.

Table 3. The number of training and testing of data in each datasets in GRNN

Datasets	Total	Number of training samples	Number of tested samples
Cleveland	303	273	30
Hungarian	294	265	29
Switzerland	123	111	12
Long Beach VA	200	180	20

According to the given description, (Fig. 1.) shows the used architecture on GRNN to diagnose heart disease.

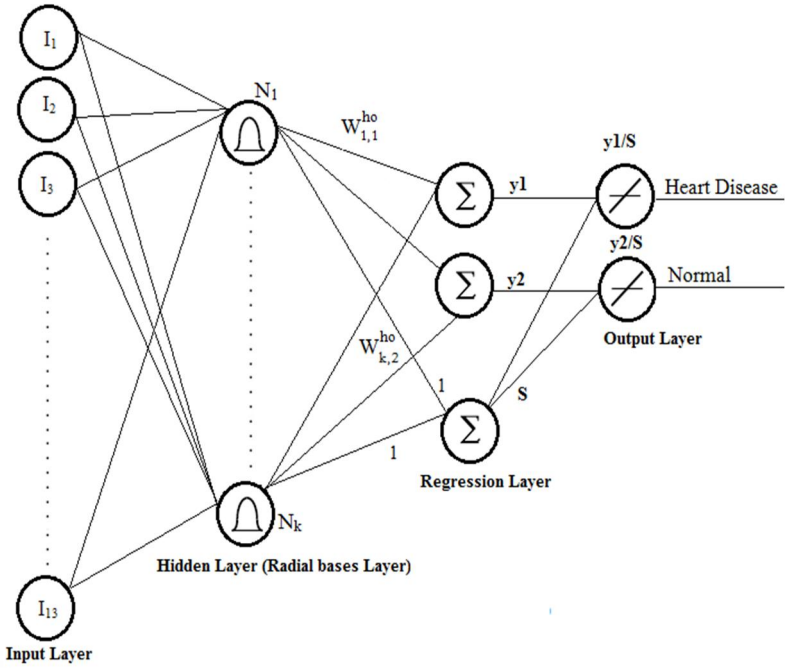

Fig. 1. Proposed scheme for GRNN to diagnose heart disease

According to (Fig. 1.), GRNN has an input layer, a hidden layer, a regression layer and an output layer. The Number of neurons in the input layer is equal to the first 13 features in Table 2 (I_1 to I_{13}), the number of hidden layer neurons is equal to N_k (N_1 to N_k) which is equal to the number of training data. The number of neurons in the regression layer is equal to 3. Because the number of neurons in this layer is a unit more than the neurons of the output layer, so the incoming weights of the third neuron in the regression layer is always equal to 1. y1 and y2, individually are the sum of the fractional of the regression layer based formula (1). Also S is the sum of the denominator of the regression layer based formula (1). And the number of output layer neurons is the number of defined classes containing 2 neurons that is the existence of disease (1) and the lack of it (0).

The construction of the implementation of newgrnn function is [25] that this function is used to construct GRNN. Also, the spread value has been set 0.3 in GRNN. Determination of such value is basically experimental that the amount of training and testing accuracy increases based on the value. We showed the accuracy rate of training, testing, and the points (actual data) that diagnosed properly by GRNN for the diagnosis of heart disease for all four dataset based on to the proposed GRNN scheme and used functions in GRNN.

Fig. 2 and Fig. 3, show the rate of training' accuracy, testing, the points (actual data) that diagnosed properly for heart disease diagnose by GRNN for Hungarian dataset.

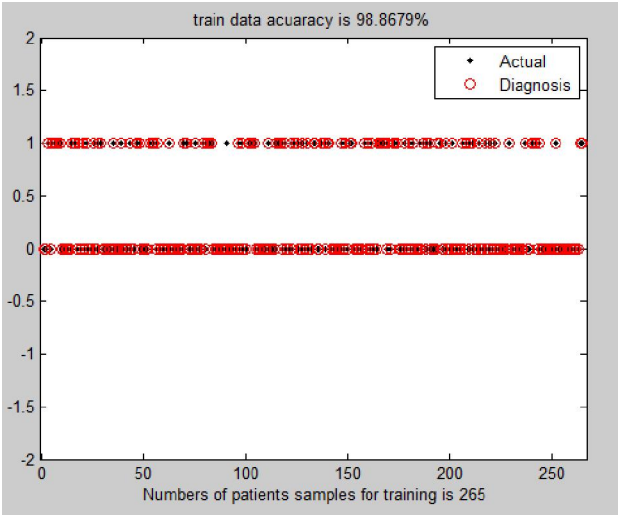

Fig. 2. The rate of accuracy of training in Hungarian dataset

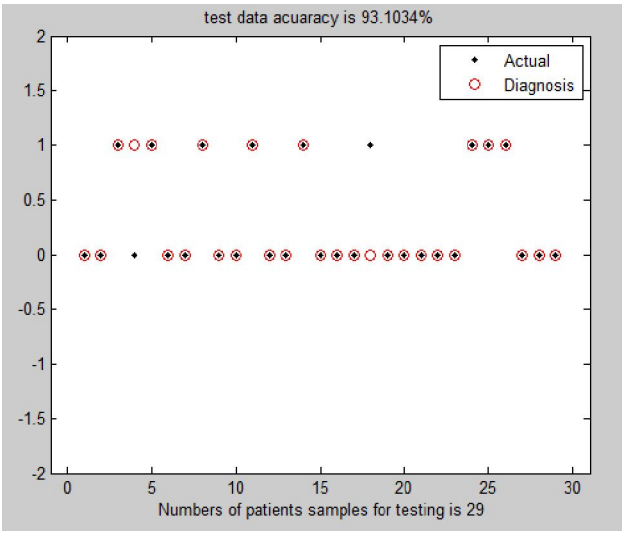

Fig. 3. The rate of accuracy of test in Hungarian dataset

According to Fig. 2 and Fig. 3 as we can see the training and testing rate of accuracy are 98.8679% and 93.1034%, respectively.

The horizontal axis (in Fig. 2, sets of training data and in Fig. 3 set of test data) and the vertical axis (0 and 1 points) are the black points (actual data) and red points (diagnostic data). The black points include the values of 0 (non-disease) and 1 (disease) which they are covered by red points. The red points are the output of GRNN in training and testing stage. This cover indicates the correct diagnose of the data (0 and 1 points) by the output of the GRNN in training phase in Fig. 2 and testing in Fig. 3. The procedures are the same for all datasets in testing and training.

Fig.s 4 and 5 show the rate of training' accuracy, testing, the points (actual data) that diagnosed properly for heart disease diagnose by GRNN for Cleveland dataset.

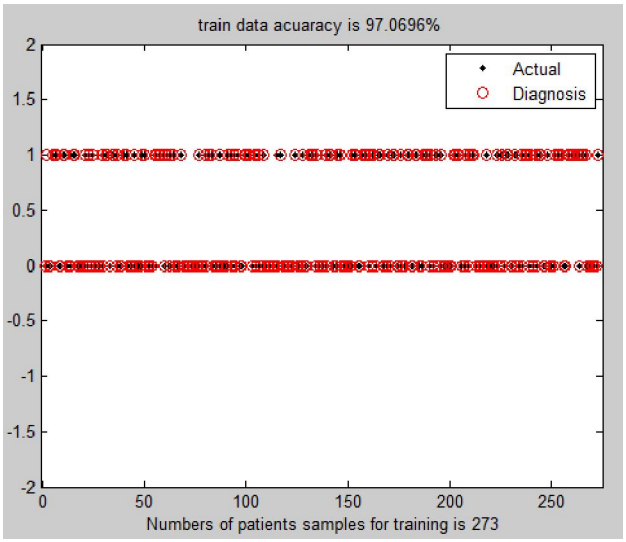

Fig. 4. The rate of accuracy of training in Cleveland dataset

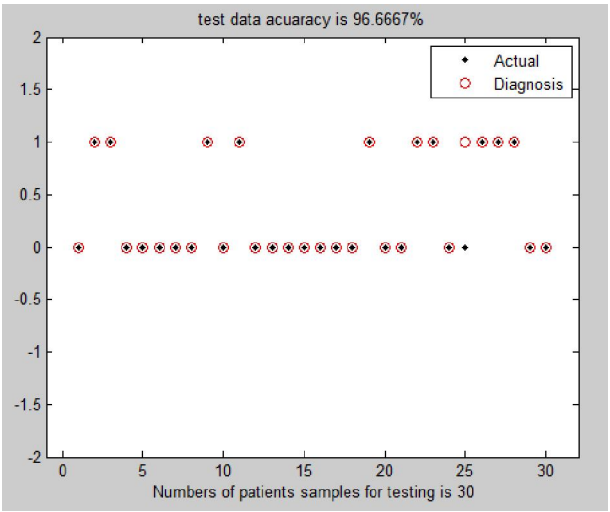

Fig. 5. The rate of accuracy of test in Cleveland dataset

According to Fig. 4 and fig.5 we can see that the training and testing accuracy rate are 97.0696% and 96.6667%, respectively.

Fig. 6 and Fig.7 show the rate of training' accuracy, testing, the points (actual data) that diagnosed properly for heart disease diagnose by GRNN for Switzerland dataset.

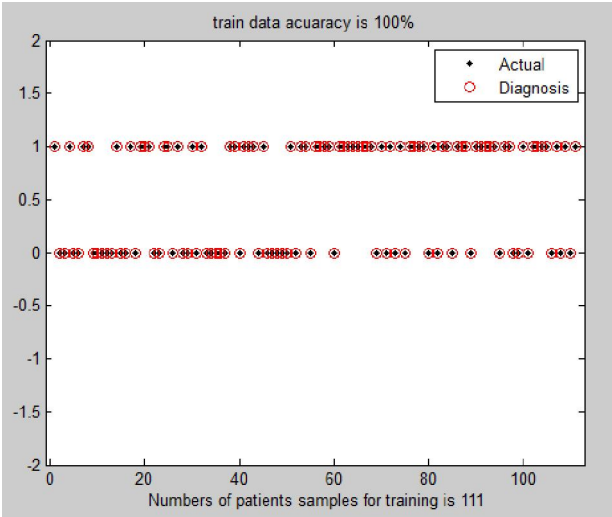

Fig. 6. The rate of accuracy of training in Switzerland dataset

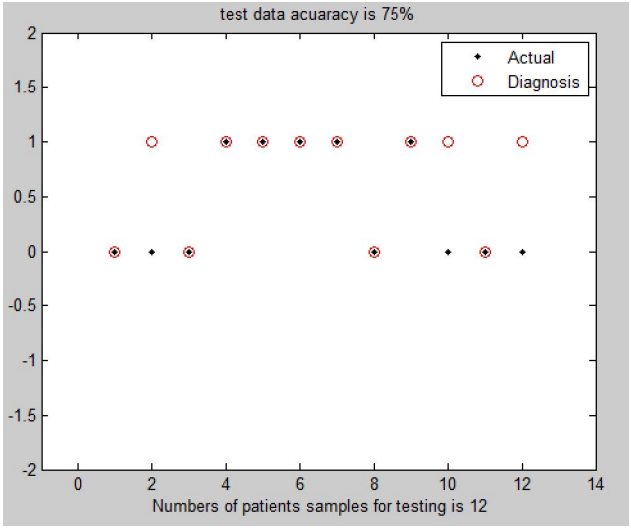

Fig. 7. The rate of accuracy of test in Switzerland dataset

According to Fig. 6 and Fig.7 we can see that the training and testing accuracy are 100% and 75%, respectively. Fig. 8 and Fig. 9, show the rate of training' accuracy, testing, the points (actual data) that diagnosed properly for heart disease diagnose by GRNN for Long Beach VA dataset.

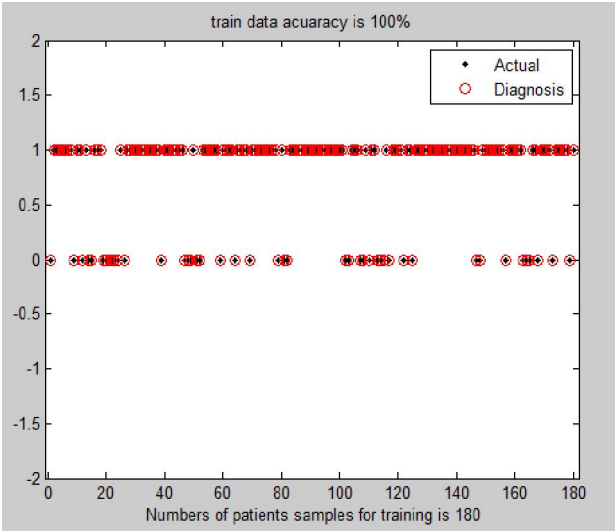

Fig. 8. The rate of accuracy of training in Long Beach VA dataset

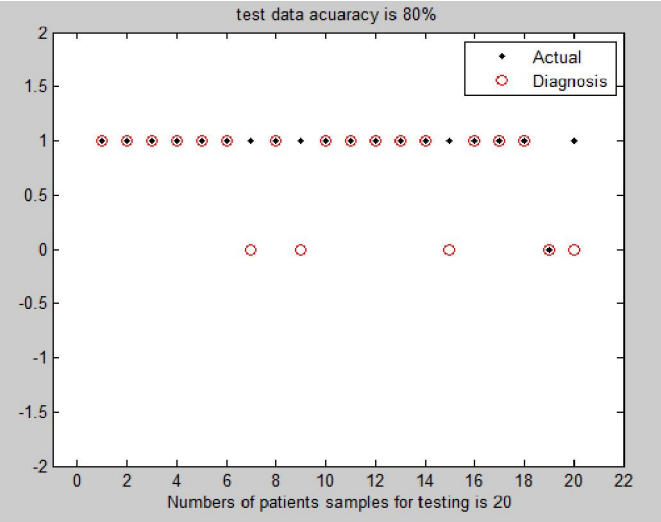

Fig. 9. The rate of accuracy of test in Long Beach VA dataset

According to Fig. 8 and Fig. 9 we can see that the training and testing accuracy are 100% and 80%, respectively. Comparing the accuracy of training and testing of any datasets, we can say that Switzerland and Long Beach VA datasets have the best diagnose accuracy on the training phase, which is equal to 100%, even including the smallest samples of patients. In other words, they have been able to diagnose all the training data. But the best accuracy in the testing phase belongs to Cleveland dataset which is equal to 96.6667%.

4 CONCLUSION AND FUTURE WORKS

In this paper, we tried to use the GRNN to provide a method for heart disease diagnose. So that we can reduce human error in diagnosing of heart disease using GRNN to solve significantly one of the problems i.e. the heart disease diagnose as the first step. Then, as a result of using this way the patient can prevent the so-called disease and maintain his/her health. We used 4 datasets with the same features and different samples for the work using MATLAB environment to implement GRNN. The GRNN consists of four layers, an input layer, a layer called radial basis (a hidden layer), a layer of regression Neurons, and an output layer. We used non-linear transfer function of radbas (Gaussian) for the hidden layer and a linear function purelin for regression layer and output layer. After the normalization of the data, we divided the data into training and testing data that 90% of total data were for training and 10% for testing. As a result, the training and testing of each dataset was determined that the best accuracy in the training phase belongs to Switzerland and Long Beach VA datasets that is equal to 100%, and the best accuracy in the testing phase belongs to Cleveland dataset that is equal to 96.6667%. GRNN

can take advantage of this new model to replace the traditional methods for detecting heart disease associated with human cited errors. It reduces the human cost that is a major contribution in the field of medical science. What we can do in the future is that other models ANNs such as multilayer perceptron of ANNs, probabilistic neural networks and RBF of ANNs can be also used in training and testing phase to achieve better diagnose accuracy, then each of these models can be compared with each other, especially with GRNN to see which one has better diagnose accuracy.

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