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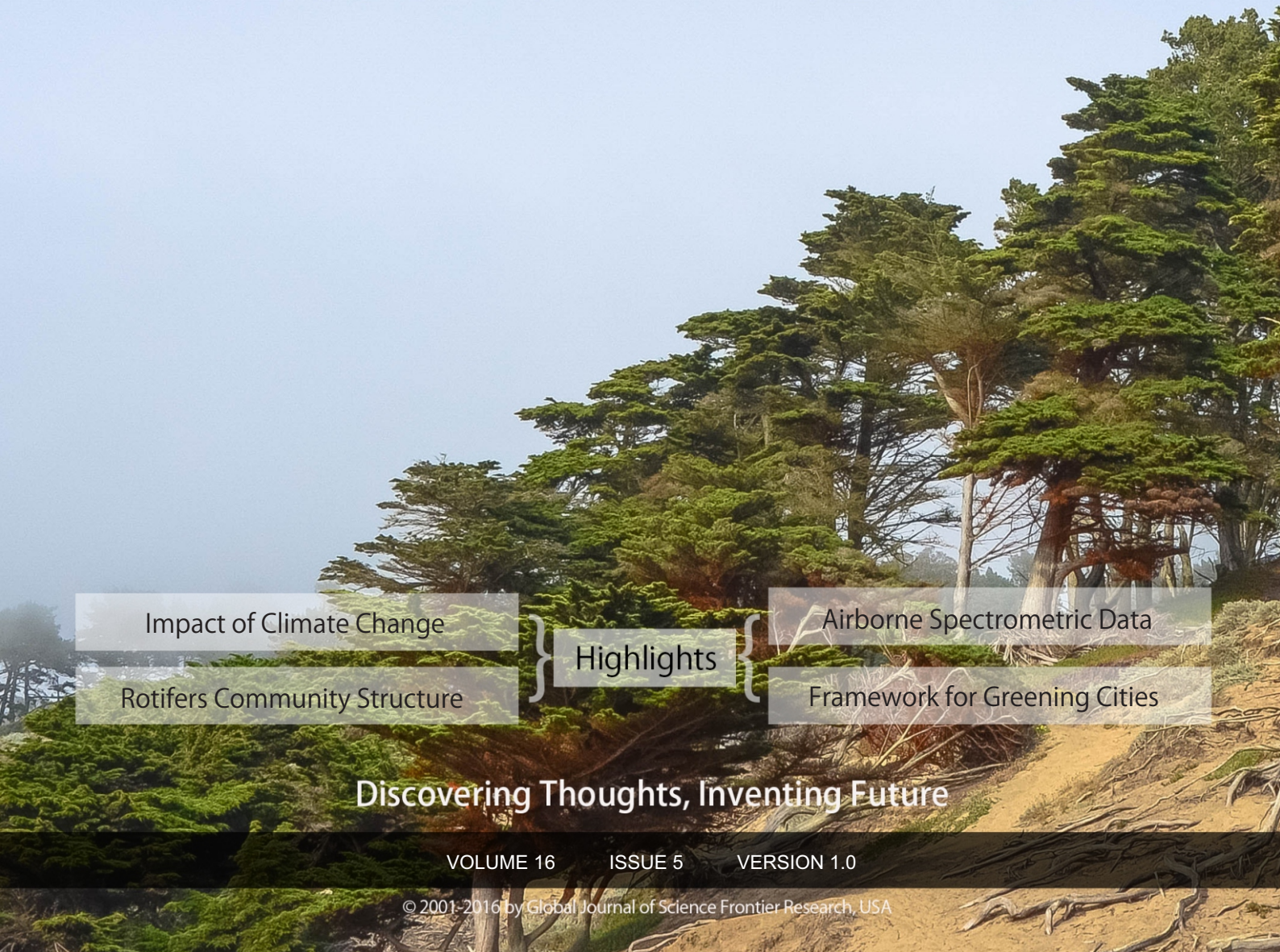

Impact of Climate Change

Rotifers Community Structure

Highlights

Airborne Spectrometric Data

Framework for Greening Cities

Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 5 VERSION 1.0

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An Ecological Framework for Greening Cities

By Priya Pradeep Joshi, Akanksha Sharma, Vishal Patil, Hegde GT, Sujata Upgupta, Indu K Murthy & N. H. Ravindranath

Centre for Sustainable Technologies

Abstract- An ecologically planned greening strategy in an urban landscape helps provide a healthy and wholesome environment for its citizens and, at the same time, promotes biodiversity, offers ecosystem services, raises awareness about environmental conservation, protects the city's environment (from pollution), and ameliorates climate locally. Designing a greening strategy compatible to local physico-climatic conditions requires consideration and integration of a number of complex factors. The current paper aims to develop a comprehensive framework for a greening strategy based on the principals of ecology. This paper also focuses on deriving benefits from the green cover in the landscape through maximizing the flow of ecosystem services. The outcome of such an ecologically designed greening strategy will be in the form of a customized green plan right from a neighbourhood scale to a community and finally a city scale.

Keywords: *urban greening, ecology, greening strategy, greening implementation models, framework.*

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An Ecological Framework for Greening Cities

Priya Pradeep Joshi [α], Akanksha Sharma [σ], Vishal Patil [ρ], Hegde GT [ω], Sujata Upgupta [¥], Indu K Murthy[§] & N. H. Ravindranath [χ]

Abstract- **An ecologically planned greening strategy in an urban landscape helps provide a healthy and wholesome environment for its citizens and, at the same time, promotes biodiversity, offers ecosystem services, raises awareness about environmental conservation, protects the city's environment (from pollution), and ameliorates climate locally. Designing a greening strategy compatible to local physico-climatic conditions requires consideration and integration of a number of complex factors. The current paper aims to develop a comprehensive framework for a greening strategy based on the principals of ecology. This paper also focuses on deriving benefits from the green cover in the landscape through maximizing the flow of ecosystem services. The outcome of such an ecologically designed greening strategy will be in the form of a customized green plan right from a neighbourhood scale to a community and finally a city scale.**

Keywords: urban greening, ecology, greening strategy, greening implementation models, framework.

I. Introduction

An eminent scientist, E.O Wilson coined the term '*Biophillia*' which essentially means an intrinsic emotional need of human beings to connect with nature (Benfield 2014). What this signifies is, being in close contact with nature results in a natural burst of energy, happiness and mental peace in an individual. Until recently, urban greening was thought to achieve only the purpose of aesthetics and provision of recreational opportunities to the residents. With climate change becoming a reality, the side effects of unplanned urbanization, such as increased temperature and heat island effect, are further pronounced (Ziska, Gebhard et al. 2003). Planned Urban Greening has the potential to act as an active adaptation strategy to combat climate change.

Michelle de Roo (Roo, Kuypers et al. 2011) highlights how greening in the form of street trees, green roofs, walls, parks and gardens, contributes to moderating the impacts of the urban heat island effect. Mitigation of urban heat islands can potentially reduce a country's energy use in air conditioning by 20% and save over $10B per year in energy use (Akbari, Pomerantz et al. 2001). Small scale parks have the potential of achieving more cooling as compared to a single large park. Studies show that a coverage of 25% greenery can reduce the concentration of particulate matter in the air by 10% (Steward, 2002 from (Cavanagh, Zawar-Reza et al. 2009)). Thus, greening, if properly planned in cities, has the potential to positively impact the varied side-effects attributed to urbanization.

Urban greenery is also found to have the potential to promote biodiversity (Roo, Kuypers et al. 2011). The diverse human activities in cities creates and maintains a variety of unique habitats ranging from fairly natural ones to highly modified ones, which sometimes may contain endangered species (Niemelä 1999). Having ecological corridors which connect green spaces throughout the city could raise the value of the urban ecological system (Hiemstra J.A. et al. 2008). City-wide parks can further enhance urban biodiversity by providing habitats for birds, insects and small mammals.

Greener environments are found to encourage people to spend more time outdoors, which in turn increases the rates of social interaction, and thereby the happiness index of a city (Mass et al. 2006). A green network through ecological corridors can also provide safe routes for pedestrians and cyclists. Small scale parks in the form of pocket parks and community parks in different zones ranging from residential, institutional, corporate, commercial to educational areas can provide a much-needed break from one's daily hectic schedule, which can rejuvenate a person's mind and body. Mental health is found to improve with exposure to greenery due to reduction of depression and stress; exposure to greenery can also increase employee productivity and result in employees taking up fewer sick days (Tzoulas, Korpela et al. 2007, Dop 2014). Green spaces at a small scale also serve as active and passive recreational spaces which give citizens the option to maintain physical fitness, thus further improving the health and quality of living of the society.

Thus, to harness the full potential of green cover in a city, a thorough background research on factors such as biodiversity, climate, soil type, habitation, etc., in and around the proposed site is necessary. The greening process, rather than being limited to the setting up of parks and amenities, should be a process of adaptation that helps mitigate and counter the loss of natural landscapes resulting from urbanization. Greening, if well planned, can influence an urban landscape right from a city level to community and down to an individual's mental and physical wellbeing. Integrating greening strategies right from the nascent

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phase of a new city is critical for maintaining the sustainability of the city.

This paper aims to synthesize a framework for a greening strategy based on principles of ecology and sustainability.

II. Materials and Methods

The framework was developed for Naya Raipur – an upcoming capital for the state of Chhattisgarh, India. However, the basic principles and steps could be adapted and/or adopted for implementation elsewhere.

The greening plan for a city considers many complex interlinked factors such as identification of different zones of the city (residential, institutional, etc.) and the area to be dedicated in each zone for different greening models (parks, water bodies, etc.). Due consideration also needs to be given to the present land-use type, soil quality, native flora and the quantum and distribution of rainfall. The needs and expectations of stakeholders must also be accounted for. Special attention should be given to unique land uses such as botanical garden and eco-park as predefined in the city plan. Considering these factors, an approach has been developed and the same is presented in Figure 1 and the steps are discussed in this section.

Steps 1 & 2: Assessment of current and proposed land use pattern along with stratification of zones.

The first step in designing a greening strategy is to develop an understanding of the current and proposed land use pattern. This step involves assessment of area under different land use categories proposed for development in a city. A city could have several zones, sub zones and sectors.

Step 3: Development of baseline

Prior to designing a greening strategy, it is necessary to develop a baseline scenario to capture the current status of the landscape. To develop the baseline scenario, existing data on the biophysical characteristics of the region from literature and from the Forest Department will have to be collected. Additionally, field studies need to be carried out to assess the status of land categories and resources. The baseline scenario includes current land-use patterns with area under different land-use categories, a map of the land-use pattern, plant diversity in different land categories, bird diversity, and biomass and carbon stock estimations using standard ecological methods. These baseline data serve as a benchmark for future comparison, to help assess the impact of the proposed and implemented developmental activities.

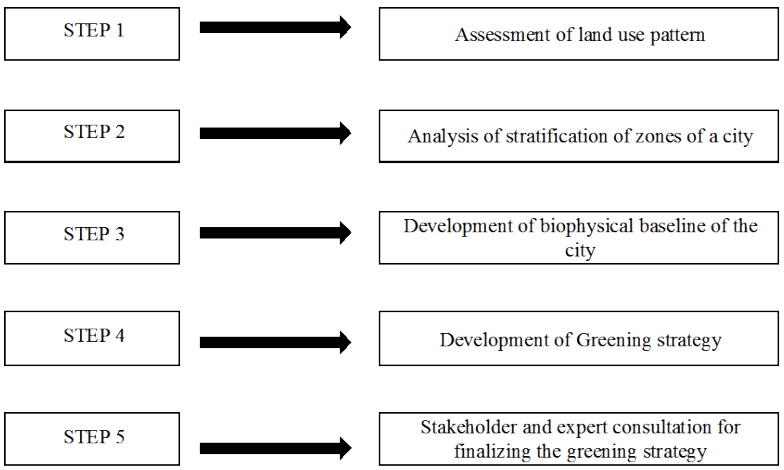

Figure 1: Broad approach for development of a greening strategy

Step 4: Development of greening strategy

The main element of greening strategy is the development of a Greening Implementation Model (GIM), customized for different zones of a city, keeping in mind specific needs and objectives of a zone. This study defines GIM as "A module prepared for meeting a set of primary and secondary objectives, keeping in mind the features of the urban areas such as residential areas, market places, educational institutions and so on." The GIM has been developed considering the primary and secondary objectives of a zone and provides information on the objectives, components of the model, area of implementation, benefits, scientific rationale and an illustration.

Step 5: Stakeholder and expert consultation for selection and finalization of the GIM and species choice

This step involves consultation of various stakeholders, including local village representatives, forest department officials, local school teachers, nursery professionals, NGOs, academicians and local/national level forestry and horticulture experts.

III. Results And Discussion

Here, the principles adopted for development of a greening strategy, the criteria adopted for development of GIM, the species choice, and the development of some unique implementation models is discussed.

a) Principles for greening Naya Raipur

Green spaces in a city should be designed to act as versatile spaces that can be adapted for future needs. Generosity in provision of space for greening is important as it bolsters mental health and physical activity levels while also providing a range of 'free' ecosystem services. The main goal of greening is to provide a healthy and wholesome environment for its citizens and, at the same time, promote biodiversity, offer ecosystem services, raise awareness of environmental conservation, protect the city's environment, and ameliorate climate locally. Such greening efforts also need to consider future climate and try to build in a certain amount of adaptability in the green cover to climate change through species selection and diversity.

The key principles adopted to design the greening strategy of Naya Raipur are:

- Mitigate the adverse effects of urbanization to enhance the quality of life in the city by providing physiological, sociological, economic and aesthetic benefits
- Improve health and propagate activities which promote physical well-being as well as help in stress relief and relaxation
- Reduce atmospheric, noise, water and soil pollution
- Promote conservation of flora and fauna (trees, birds, butterflies etc.)
- Provide opportunities for tourism
- Create awareness about conservation of flora and fauna and co-existence with nature
- Regulate the microclimate and help in temperature moderation
- Enhance ecosystem services like water conservation, prevention of soil erosion, etc.

b) Greening objectives

The main zones in a city are residential, recreational, industrial, and commercial, which could be further sub-divided into sub-zones. For example, the residential zone could be classified as 'higher-income residential area' and 'economically weaker sections residential area' sub-zones (Table 1). The characteristic features of the zones and sub-zones would therefore determine the objectives of greening, which are further classified here as primary and secondary features. The rationale for this categorization is that a zone can have several sub-zones or components and in them, a hierarchy of objectives is to be addressed. However, for selection of models and tree species, it is necessary to focus on the key objectives for a given sub-zone. Table 2 presents the primary and secondary objectives of different zones planned for a city.

Table 1: Illustration of features, primary and secondary objectives for key zones of a city

Zones	Sub Zone	Features and components of zones	
		Main	*Secondary*
Residential	High income areas	Individual bungalows, apartments, intra-sectoral roads	Schools, playgrounds, temples, small market complexes, club houses
	Economically weaker areas	Small row houses, apartment blocks, intra –sectoral roads	Schools, playgrounds, parks, community centre, temples, weekly markets
Public/ semi-public spaces	Educational	School and college campuses, university campus, research institution campus	Small parks, playgrounds, sports centres, hostel complexes, gardens, parking spaces, intra-sectoral roads/ avenues
	Medical	Hospitals, Medical, college campus, health centres	Recovery centres, old-age homes, gardens, waterfronts, parking spaces, intra-sectoral roads
	Official: Government	Government Office complex, independent offices, corporate offices,	Post offices, secretariat buildings, police stations, pocket parks, gardens, parking spaces
Transport	City arterial roads	Wide roads (width 60–100 m)	Roundabouts, local bus stations, multiple lanes, large road dividers (high pollution
			areas)
	Intra-sectoral roads	Roads of medium width, lanes and by-lanes	Bus stops, road dividers, footpaths
	Parking areas	Parking areas	Open spaces High pollution
		(where organized recreational/ leisure activities	Sports fields, open lawns, badminton courts, cricket/

Recreational (including parks)	Active	happen), Sports complex, playgrounds,	football grounds, exhibition grounds, community centres
	Passive	Medium sized city wide parks, walking/ jogging paths(utilized for non-organized recreation and relaxation)	Large urban forests, waterfronts, sit outs, natural forests and Plantations, etc.
	Dedicated parks (eco-parks, botanical gardens)	Large dedicated or theme parks / gardens	Large areas dedicated to specific themes

The primary objective largely determines the selection of tree species. These objectives include promotion of aesthetics, growing of fruits, etc. to supplement children's nutrition, recreation, biodiversity conservation, education and awareness, health, pollution abatement, and provision of shade. The criteria for developing a GIM and the species-mix are based on the features of the zone (e.g., breadth of roads and pollution levels) and the primary and secondary objectives of greening.

Table 2: Objectives of greening of different zones and sub zones of a city

Zones	Sub Zone	Objectives of Greening	
		Main	*Secondary*
Residential	High income areas	Aesthetic: Promoting flowering trees for beauty, recreation and relaxation	Promoting shade, habitat for birds, nutrition and carbon sequestration
	Economically weaker areas	Nutrition: Promotion of nutrition among communities	Promoting shade and flowering trees
Public/ semi-public spaces	Educational	Education & awareness: Promoting education and awareness related to biodiversity and promoting nutrition	Promoting outdoor recreation & relaxation in form open green spaces, positively influencing health & indirectly carbon sequestration
	Medical	Health: Promoting good health in the form of green cover, providing beauty, clean air, noise free environment and ample oxygen for inhabitants	Generating awareness on nutritional value of trees, and improving biodiversity and indirectly enhancing beauty and carbon sequestration
	Official: Government	Aesthetic: Promoting flowering trees for beauty, recreation and relaxation from the daily work schedule	Promoting plant and bird biodiversity conservation and awareness, carbon sequestration
Transport	City arterial roads	Pollution abatement: Reducing pollution and dust levels by introducing trees with pollution absorption characteristics	Improving aesthetics by promoting flowering trees for beauty, shade and biodiversity and carbon sequestration
	Intra-sectoral roads	Pollution abatement: Reducing pollution and dust level	Improving aesthetics by promoting flowering trees, biodiversity conservation and carbon sequestration
	Parking areas	Shade, pollution abatement: Reducing pollution and dust levels Shade trees to protect vehicles from heat	Improving aesthetics by promoting flowering trees for beauty, biodiversity conservation and carbon sequestration
Recreational (including parks)	Active	Recreation & health: Provision of activities to promote health, fitness, physical strength and stamina	Promoting social, educational and cultural activities and programmes
	Passive	Biodiversity conservation: Promoting shade, tree and bird biodiversity	Promotion of relaxation and mental peace, education and awareness on biodiversity, carbon sequestration
	Dedicated parks (eco-parks, botanical gardens)	Education & biodiversity conservation: Promoting trees to represent various ecological features, educational, conservation values	Promotion of relaxation and mental peace and awareness on biodiversity, carbon sequestration

c) Greening Implementation Models for various zones

Each zone has sub zones and each sub zone consists of a number of components which determine its greening strategy. For example, the higher-income residential area sub zone may include parks, bungalows parking spaces, etc. and the economically-weaker sections residential area sub zone may include apartment complexes, market places, pocket parks, etc. Each of these components will have a different objective for greening, depending on its unique features as discussed in the previous section. This will in turn determine the greening model to be adopted, and the choice of species. Figure 2 presents a list of Greening Implementation Models as well as some Unique Greening Implementation Models.

Greening Implementation Models

1. Pocket Park
2. Neighborhood Parks
3. City Arterial Roads
4. Intra-sectoral Roads
5. Urban Villages
6. Small Educational Campuses
7. Large Education Campus
8. Community spaces
9. Sports Complex
10. Large Office Complexes
11. Smaller Offices
12. Religious Complex
13. Markets & Shopping Complexes
14. Weekly Markets
15. Parking Areas
16. Large Medical Campus
17. Small Medical Campus
18. Recreational Water Bodies
19. Boundaries

Unique Greening Implementation Models

1. Eco – park 2. Botanical Garden 3. Green Belt

Figure 2: Greening Implementation models and Unique Models Conceived for Greening

Each planned sector in the city consists of a number of components like broad roads, narrow roads, logistics hub, hospital and schools. Table 3 provides an illustration of the application of GIMs in different sectors, and includes components of each zone as well as the Greening Implementation Model.

Table 3: Illustration of zones, sub zones and corresponding greening implementation models

Zone	Greening Models recommended for each zone and sub-zones		
Residential	Higher income	1. Pocket park	6. Intra-sectoral roads
		2. Neighbourhood park	7. Parking spaces
		3. Small playground	8. Institutions (educational/ health)
		4. Religious complex	9. Community spaces
		5. Market and shopping complex	
	Economically weaker section	1. Pocket park	5. Intra-sectoral roads
		2. Neighbourhood park	6. Institutions (educational/ health)
		3. Religious complex	7. Community spaces
		4. Weekly market places	
Public places	Educational	1. Educational complex	5. Sports complex
		2. Playgrounds	6. Intra-sectoral roads
		3. Community spaces	7. Small medical campus
		4. Boundaries	
	Medical	1. Small/ Large medical campus	4. Religious complex
		2. Pocket park	5. Intra-sectoral roads
		3. Boundaries	6. Parking spaces
	Official	1. Boundaries	4. Large and small office complexes
		2. Pocket parks	5. Intra-sectoral Roads
Transport	City Arterial	City arterial roads (60 m and 100 m)	
	Intra – sectoral	Intra-sectoral roads (24/18/12 m models)	
	Parking areas	Parking spaces	

d) Species choice for Greening Implementation Models

Each GIM has a mix of species which is quite exhaustive. The species selected are suited to the soils and the climatic conditions of the region, partial to indigenous species. However, under urban forestry programmes, the goal is also to have a large diversity of tree species for enhancing biodiversity, education and awareness and for aesthetics. Therefore, species from other regions could also be included. Figure 3 provides an illustration using intra-sectoral roads as an example.

The selection of tree species for different GIMs was determined by the following factors:

- Utility of the species to meet the objectives of the zone
- Nativity of the tree species with a focus largely on local or native species; however, exotic species from outside the region or even country are included for some models
- Evergreen or deciduous nature of the tree species: focus is largely on evergreen tree species, to

provide shade and greenery during different seasons of year

- Form of the tree: height (tall, medium or short) and crown spread (narrow cylindrical or broad round)
- Suitability to the soil and rainfall: poor growing condition pertaining to soil and moisture availability can be mitigated to a large extent by adopting a suitable package of practices that provides for use of fertile soil and farm yard manure, along with provision for watering of plants during dry period
- Ease of raising nurseries: this is considered while suggesting, particularly primary species for each model
- Perennial tree and shrub species: the focus is largely on perennial tree and shrub species, to minimise planting and maintenance activities

Objectives: To provide aesthetic appeal as well as shade to city lanes and by-lanes. To combat pollution and to facilitate dust and particulate matter reduction along with temperature moderation. To promote overall greening of the city along with carbon sequestration.

Components	**Areas of implementation:**
Medium to tall trees with high to medium canopy Dividers if present would be dominated by bushy and flowering shrubs.	Intra-sectoral roads: 24 m wide Intra-sectoral roads: 18 m wide Intra-sectoral roads: 12 m wide

Benefits:

Pollution and dust reduction	Beauty and aesthetic value	Shade provision
Temperature moderation	Biodiversity Facilitating	rainwater harvesting
Increasing road safety	Carbon sequestration	

Scientific rationale: Trees in general play a central role in enhancing a roadway's liveability (Dumbaugh and Gattis 2005). Judicious placement of not only large trees but also grasses, climbing ivy and other plants along the roads can reduce the concentration of NO2 at street level by as much as 40% and that of PM by 60% along with resulting temperature differentials of 5–15 °C (Burden 2008; Pugh et al. 2012). Roadside trees facilitate rainwater percolation and reduce run-off rates by 30%. Comparison of treeless streets with treed streets show reductions in run-of-the-road crashes and overall crash severity (Ewing 2003); apart from this, speed differentials of 5–24 km/h are noted in treed streets as compared to those without trees, thus proving that street trees promote road safety.

Species Choice

Primary species	**Secondary species**	
1. *Cassia fistula*	*Pterocarpus marsupium*	*Erythrina suberosa*
2. *Pterospermum acerifolium*	*Jacaranda mimosifolia*	*Moringa oleifera*
3. *Pongamia pinnata:*	*Muntingia calabura*	*Soymida febrifuga*
4. *Thespesia populnea*	Malpighia emarginata	*Solanum grandiflorum*
5. *Morus alba, M. nigra*	*Stereospermum chelonoides*	*Azadirachta indica*
6. *Diospyros melanoxylon*	*Toona ciliata*	

Figure 3: Illustration of a GIM: Intra-Sectoral Roads

e) Unique Greening Implementation Models

The botanical garden, eco-park (ecological park) and green belt models are considered as unique zones, each with a large dedicated area that can be used for conservation, recreation and educational purposes. The presence of such parks in urban areas helps people realize the importance of biodiversity and nature. Further, the green belt will help protect a city from high velocity winds and livestock intrusion from neighbouring areas. Such areas not only provide diverse recreation and educational opportunities but are likely to attain additional conservation significance under impending climate change.

i. Botanical Garden Model

Botanical gardens provide an opportunity to inform the public on taxonomy, biodiversity inventory, conservation biology, restoration ecology, and ethno-botany, with the main purpose of scientific research, conservation education and awareness-creation among people (BGCI 2009). Components of a botanical garden have been developed keeping in mind the following goals of; (i) recreation, (ii) education, (iii) conservation, and (iv) research. Figure 4 presents different components of a botanical garden.

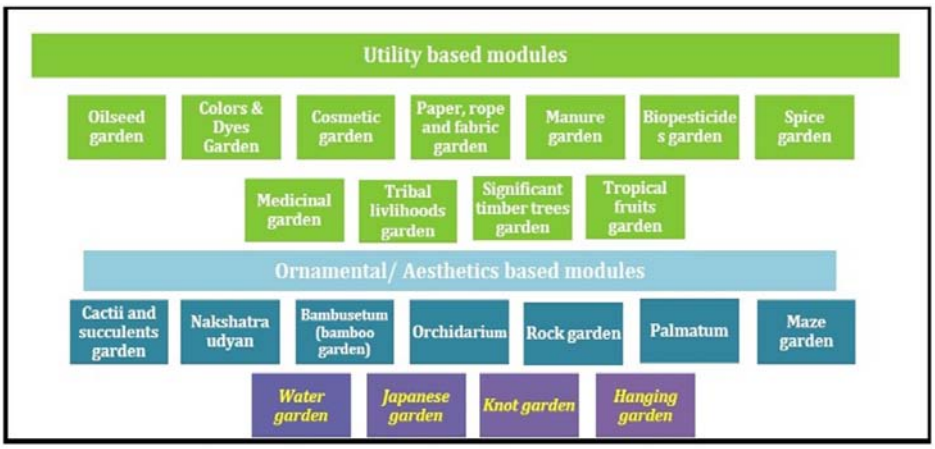

Figure 4: Botanical garden module

A large number of tree species, both native and exotic, are included along with themed gardens. Other components include a plant museum - housing information on plant species around the world, a seed bank centre, a research and development centre, and an education and training centre, etc. A number of tree species and perennial shrubs are identified and recommended for each module.

ii. *The eco-park model*

The concept of an eco-park (or an ecological park) is aimed at developing a demonstration area exhibiting local as well as national forest (ecosystem) types with the purpose of promoting conservation, education and recreation. The main purpose is to develop appreciation of the diversity of forest types by creating awareness and promote conservation of native forest ecosystems. Several modules are proposed under the eco-park model. Under each module, a set of dominant or key species characterizing the module is included. An eco-park could be designed to meet the following objectives:

- Demonstrate the diversity of forest types of a region
- Showcase endangered flora from the region and create awareness
- Encourage research on native forest types of a region
- Generate opportunities for education and training relating to biodiversity conservation.

iii. *Green belt module*

The main purpose of the green belt is to improve urban ecological conditions by purifying the atmospheric environment by abating pollution, regulating local microclimate, protecting local water resources, restoring degenerated ecosystems, enhancing urban biodiversity (Binford and Buchenau 1993; Bolund and Hunhammar 1999) and meeting the fodder, fuelwood and non-timber product needs of rural communities residing in the neigbouring areas. The strategy adopted for the green belt has been developed considering the following principles:

- Make available a substantial chunk of green area readily accessible to city dwellers for recreation, and to enhance the aesthetics of the city, apart from other ecological benefits.
- Regenerate a part of the green belt with high-density plantations of fast-growing species, and the remaining area with silvo-pasture species, to generate fodder for cattle for communities residing in rural areas adjoining the city.
- Ensure that the green belt acts as a buffer to the entire city, protecting it from high velocity winds and livestock intrusion, along with moderating the microclimate of the region.

IV. Conclusions

The framework for the greening strategy presented in this paper represents how consideration from an ecological, social and educational perspective redefines the concept of a smart city to being ecologically, and climatically smart. Customization of greenery to address local concerns and facilitate the flow of ecosystem services like the provision of nutrients and fodder, along with regulatory services such as climate amelioration, further enhances the performance of a green system. The framework inculcates the significance of conservation not only in the very wiring of the city, but also in its habitants, through its focus on research and awareness. Knitting a green grid to embrace neighborhoods, communities, villages and public spaces breathes vitality into the animate as well as inanimate entities, transforming cities that are traditionally concrete jungles to a living and breathing city.

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Bioremediation Potentials of Some Indigenous Micro-organisms Isolated from Auto Mechanic Workshops on Irrigation Water used in Lokoja Kogi State of Nigeria

By Ekpa, Emmanuel, Adaji, Andrew Usman, Udofa, Daraobong & Opaluwa, Queen
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Abstract- Three (3) indigenous bacteria species (Bacillus spp, Acinectobacterspp and Moraxella spp) previously isolated from contaminated soil of some auto mechanic workshops were used for bioremediation studies on some irrigation water used at Sarkin-nomaFadama farms located in LokojaKogi State, Nigeria. This was done in order to investigate their bioremediation potentials using a simple pour plate method. The physicochemical parameters and heavy metal analysis (using AAS iCE 3000) of the irrigation water were performed before and after inoculation of the isolated organisms. Nitrate and phosphate concentration were found to be 10.56mg/L and 12.63mg/L prior to inoculation while iron and zinc were 0.9569mg/L and 0.2245mg/L respectively.

Keywords: *bioremediation, heavy metals, physic- chemical parameters, bacillus spp, acinecto-bacterspp and moraxella spp, AAS, spectrometer 3000.*

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Keywords: bioremediation, heavy metals, physico-chemical parameters, bacillus spp, acinecto- bacterspp and moraxella spp, AAS, spectrometer 3000.

I. Introduction

Heavy metals are one of the most persistent pollutants in water. Unlike other pollutants, they are difficult to degrade, but can accumulate throughout the food chain, producing potential human health risks and ecological disturbances. Their presence in water is due to discharges from residential dwellings, groundwater infiltration and industrial discharges [1]. The discharge of wastewater containing high concentrations of heavy metals to receiving water bodies has serious adverse environmental effects. Their occurrence and accumulation in the environment is a result of direct or indirect human activities, such as rapid industrialization, urbanization and anthropogenic sources [2]. The major sources of heavy metals in water are corrosion of galvanized pipes, erosion of natural deposits, discharge from metal refineries, runoff from waste batteries and paints. Another important source of heavy metal is the production of phosphate fertilizers where part of the heavy metal ends up in the soil after the fertilizer is applied on farm lands and the rest of the heavy metals end up in surface waters when waste from fertilizer production is dumped by production companies [3]. The susceptibility to heavy metals can vary greatly between aquatic organisms. Animals eating or drinking heavy metals sometimes get high blood pressure, liver disease and nerve or brain damage. Heavy metals are also gotten from the seepage, from natural oil reservoirs, domestic waste including runoff from road surfaces. In plants it decreases seed germination, plant growth, decreases enzyme activity, inhibits photosynthesis, reproductive process, water uptake, and reduces chlorophyll production.

Exploitation and poor management of natural resources resulting in environmental pollution is due to incessant quest of man for a better standard of living. Environmental issues such as climate change, land degradation, air and water pollution have become a major concern all over the world today. In Nigeria, environmental pollution through indiscriminate disposal of domestic, agricultural and industrial wastes without considering health and environmental implication is alarming [5]. Heavy metal pollution is one of the most important environmental problems today. Modern industry is, to a large degree responsible for contamination of the environment. The Industrial wastes contain various types of toxic chemicals. Among toxic substances reaching hazardous levels are heavy metals. Increasing environmental pollution by heavy metals results from their increasing utilization in industrial processes. Heavy metals are dangerous because they tend to bioaccumlate. Irrigation is the artificial application of water to the land or soil. It is used to assist in growing of agricultural crops, maintenance of landscapes, and vegetation and in suppressing weed growth in grain fields and preventing soil consolation.

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Biological treatment is an innovative technology available for heavy metal polluted waste water. However, the water is being polluted by activities such as agricultural waste and other industrial effluents which affect the growth and function of plants, animals and even humans. Treating these pollutants therefore becomes imperative. This could be done by the use of microorganisms to degrade toxic chemicals into less toxic or non-toxic materials by natural biological process popularly referred to as bioremediation [6].

Since microorganisms have developed survival strategies in heavy metal polluted habitats, their different microbial detoxifying mechanisms such as bioaccumulation, biotransformation, biomineralization or biosorption can be applied either ex situ or in situ to design economical bioremediation processes. In this current work, studies were carried out to examine the levels of some heavy metals, inorganic ions (nitrates and phosphates) contamination in the irrigation water used at Fadama farms located in Lokoja metropolis of Kogi State with a view to finding the bioremediating potentials of some bacteria isolated from automechanic contaminated soil on the water.

II. Materials and Methods [7]

a) Sample collection site

Sarkin-Noma Fadama farm the study area is geographically located between longitude 7°50′ and latitude 6°45′ North. It is bounded by the river Niger to the east and Sarkin-Noma village to the west in North-Western Lokoja, North- Central geo-political zone of the Federal Republic of Nigeria.

b) Collection of water sample

The water was collected from four points (3m apart) on the sample site by using sterilized plastic containers to stir and then dipped into the river. For isolation of bacteria, 10g of randomly pooled soil samples from some auto mechanic workshops was taken and serially diluted with 90 ml of distilled water and 1 ml each of the mixed sample was spread on plates of about-to jelled nutrient agar and incubated at 37°C for 24 hrs. Bacterial isolates were picked up and purified by repeated streaking on nutrient agar. Isolated bacterial strains were identified based on the morphological, cultural and biochemical characteristics (this part was done in the pilot phase of this work and has been reported elsewhere).

c) Measurement of Physicochemical parameters

i. *Dissolved oxygen (DO)*

Dissolved oxygen content in water sample was determined in mg/L by using Winkler method.300ml glass BOD stopper bottle was carefully brim filled with water sample. Immediately 2ml of manganoussulphate was added to the BOD bottle by inserting the calibrated pipette just below the surface of the liquid. 2ml of alkali-iodide-azide was then added in the same manner. The bottle was stoppered with care to ensure no air was introduced and mixed by inverting several times. 2ml of concentrated Sulphuric acid was added via a pipette held just above the surface of the sample. It was inverted several times to dissolve flocks. The burette was rinsed with sodium thiosulphate and then filled with same solution. 20ml of the solution was the measured out from the bottle and transferred to a conical flask. Titration was done against sodium thiosulphate using starch as indicator (3-4 drops). End point of the titration was the first disappearance of the blue color to colorless.

Calculation

$$DO = \frac{V_1 \times N \times 1000}{V_2}$$

Where; V_1 =volume of sodium thiosulphate
V_2 = volume of sample
N = normality of sodium thiosulphate
Converting to mg/l multiply by 1000

ii. *Biochemical oxygen demand (BOD)*

Biochemical oxygen demand in water sample was determined in mg/L. The BOD measurement of water sample was the difference of oxygen concentration in the sample before and after incubation in the dark. Incubation was made at 20°C in BOD incubator for five day. Freshly collected water sample was diluted to about 100 times only to get measurable amount of oxygen after five days of incubation. This was filled into four BOD bottles. Initial oxygen concentration was determined immediately in two of the bottles. Remaining two bottles were incubated in BOD incubator at 20°C for five days, and then oxygen concentration was again determined.

Calculation:
BOD mg/L = DI - D2
Where: DI = initial oxygen value.
D2= oxygen value after 5 days incubation.

iii. *Chemical oxygen demand (COD)*

Chemical oxygen demand was determined by the method of Pescod [8]. It is a measure of oxygen consumed by strong oxidizing agent (Potassium dichromate) during oxidation of organic matter. Into two COD vials 2.5ml of the sample was added and into the third vial meant for blank distilled water was added. To the 3 COD vials 1.5ml of potassium dichromate reagent –digestion solution was added. Sulphuric acid reagent of 3.5ml-catalyst solution was added. COD vials became hot. Tubes were capped slowly and the COD digester switched on and the temperature fixed at 150°C and heated for 2 hours. The digester automatically switch off and the vials removed and allowed to cool to room temperature. Burette was filled with ferrous ammonium sulphate solution, adjusted to zero. The

content of the blank vial was transferred into a conical flask, few drops of ferroin indicator was added which resulted in a bluish green color. It was afterwards titrated with the ferrous ammonium sulphate in the burette. End point of titration was the appearance of reddish brown color. This was also carried out on the water sample.

Calculation:

$$COD = \frac{(A-B) \times N \times 8 \times 1000}{V}$$

Where: A = volume of ferrous ammonium sulphate for blank
B = volume of ferrous ammonium sulphate for sample
N = normality of ferrous ammonium sulphate
V = volume of sample taken.
To convert the sample size from ml to l multiply by 1000

iv. *pH*

The water sample of about 25ml was transferred into a beaker and swirled continuously for uniform mixture, afterwards the electrode of the calibrated pH meter was then immersed into the sample and the pH recorded when the meter reading was stable.

v. *Electrical Conductivity (EC)*

The EC meter was turned on and the probe calibrated using a standard solution of known conductivity. The probe was thoroughly rinsed before and after calibration using deionized water and carefully blots dried using cotton wool. Water sample was transferred into a beaker and the probe submerged into the sample. The EC was recorded when the EC reading on the meter became stable Monica (2014).

vi. *Phosphate*

The method described by Rima[9] was employed.

a. *Preparation of Calibration Curve*

Standard stock solution of phosphorus of 100 mg/dm^3 was prepared by dissolving 0.11g of KH_2PO_4 in distilled water and diluting to 250 cm^3 in a volumetric flask (Stock Solution A). 10 cm^3 of this solution was accurately transferred to a 250 cm^3 volumetric flask and made up to volume with distilled water (Stock solution B). Stock solution B was used to prepare standards of approximately 0.20, 0.40, 0.60, 0.80 and 1.0 mg P/dm^3, that is, 5, 10, 15, 20 and 25 cm^3 portions was pipette respectively to separate labeled 100 cm^3 volumetric flasks. Then 50 cm^3 of distilled water was placed into a 100 cm^3 flask as a blank solution, then all the analytical solutions were organized for color development. Solutions were not made up to the mark yet

b. *Analysis of Water Sample*

Duplicate 25.0 cm^3 portions of the sample with a dilution factor of 10 was pipetted into two separate 100 cm^3 volumetric flask, then the color was developed as outlined below.

c. *Color Development*

Distilled water was added to all the analytical solutions (standards and samples) so that each flask contained roughly 50 cm^3 of solution. Starting with standard 1, 13 cm^3 of combined reagent was added using a 25 cm^3 measuring cylinder (Note 1) mixed thoroughly and made up to the mark with distilled water. All the solutions were treated similarly and then allowed to stand for 30 minutes for color development. The absorbance of the standards was measured in order of increasing concentration followed by that of the sample solutions, using water as blank.

vii. *Nitrate*

The UV-spectrophotometric method was used for the determination of nitrate content of water sample.

Preparation of reagent A

5 g of salicylic acid was dissolved in 96% Sulphuric acidandfilled up to 100 ml with 96% Sulphuric acid.

Preparation of reagent B

40 g of NaOH was dissolved in deionized water andfilled up to 500 ml with deionized water

Preparation of standard solution

0.0680 g of sodium nitrate was dissolved in deionized water and made up to 100 ml with deionized water (concentration of sodium nitrate is 8.0 mM). The standard solution was diluted with deionized water in a range of: 0; 0.1; 0.2; 0.5; 1.0; 2.0; 4.0 and 6.0 mM nitrate.0.8 ml of reagent 1 was added to 0.2 ml standard or sample and mixed properly. It was left for 20 minutes at room temperature. 19 ml of reagent 2 was added slowly and mixed properly.

It was allowed to cool to room temperature with a yellow color which was stable for 48hours. The absorption was measured at 410 nm with a spectrophotometer.

d) Heavy Metal Analysis of Water Sample

The estimation of heavy metals was done using Computer Controlled Atomic Absorption Spectrometer (AAS iCE 3000). Firstly, 1 ml of the sample was taken and digested with 10ml of nitric acid and after complete digestion the volume was made up to 100ml with deionized water in a volumetric flask, filtered and stored in a polypropylene container. The samples were then analyzed with computer Controlled Atomic Absorption Spectrophotometer.

e) Bioremediation studies using the isolated indigenous microorganisms

About 20 cfu/mlof the individual isolated strains of microorganism were inoculated into 500ml of the irrigation water in a sterilized plastic container and left in the incubator for a week. Physicochemical parameters and heavy metal analysis were carried out on the inoculated water sample to determine the differences

before and after the introduction of the organisms. Heavy metal and physicochemical analysis were then carried out to study the bioremediation potential of the bacteria.

III. Results

Table 1: Physicochemical Analysis of Water Sample (before and after innoculation)

Parameters	(before innoculation)	(after innoculation)
pH	6.89	7.02
Conductivity (μscm)	207	165
BOD (mg/L)	12.62	11.40
COD (mg/L)	2.35	2.05
DO (mg/L)	8.98	8.32
Phosphate (mg/L)	12.63	2.61
Nitrate (mg/L)	10.56	2.53

Table 2: Heavy Metal Analysis of Irrigation Water before and after Innoculation

Heavy Metals	Concentration (mg/L) (before innoculation)	Concentration (mg/L) (after innoculation)	
Cadmium (Cd)	ND	ND	ND
Zinc (Zn)	0.2245	0.0174	92
Lead (Pb)	0.0294	0.0227	30
Iron (Fe)	0.9569	0.1694	82

Key: ND = Not Detected

Table 3: Biochemical Characterization of isolated bacteria

S/N	Gram staining	Catalase	Indole	Citrate utilization	Oxidase	Sugar utilization	Identified bacteria
1	- Cocci	+	-	+	-	+	*Acinectobacterspp*
2	- Bacilli	+	-	+	-	+	*Bacillus spp*
3	- Bacilli	+	-	+	+	+	*Moraxella spp*

IV. Discussion

The results represented in Tables 1 and 2 shows the effect of adding the isolated microorganisms in the irrigation water. In Table 1, all the values except for pH are above the normal range for normal water suggesting that the source of this water which might be due to some industrial discharges and other human activities may have contributed to the pollution observed. According to Pescod (1992), irrigation water is not supposed to have a higher than normal nitrate content because of its toxicity to the final consumers of the irrigated crops. In Table 2 (before inoculation), it was observed that iron had a higher value (0.9569mg/L) above the standard for normal water of 0.3mg/L [10] probably because of the geology of Lokoja town which is rich in iron ore deposits as evidenced by the number of iron ore mining sites scattered across Kogi State. Since water bodies could be due to the runoff of surface waters to the rivers, the possibility of iron at higher concentrations in this irrigation water is not far-fetched. The other heavy metals (Cd and Cr) observed before the inoculation show less significance which might be due to their rare occurrence in most environments. After the bioremediation test was carried out (inoculation with the isolated microbes) there was a significant reduction in the values of all the determined parameters. This is simply a reflection of the bioremediating potentials of the isolated organisms (*Moraxella spp, Bacillus spp,* and *Acinectobacterspp*) which have been implicated in different bioremediation studies [11]. Some of the values of physicochemical parameters like DO, BOD, and COD do support the growth of this microbes. Hence, their high rate of metabolism which eventually enhances their degradation capacities. Phosphate and nitrates are also good sources of nutrients for microorganisms generally, but this work shows that at elevated concentrations (above 5mg/L and 10mg/L respectively) as shown in table 1, they could become toxic to the crops and eventually their final consumers [11]. However, the ability of this isolated microorganisms to reduce the phosphate and nitrate contents as seen in Tables 2 shows that theypossess some bioremediation potentials. The reduction in nitrate and phosphate could also be due to their suitability as sources of nitrogen and phosphorous for the organisms. The role of *Acinectobacter* for example in nitrogen cycle could have also contributed to the observed reduction in the nitrate content of the pre and post inoculated water used (tables 1). Bacillus generally is a good degrader of most environmental pollutants. When the percentage reduction (bioremediation values) were computed, it was shown that zinc was reduced by 92% followed by iron 82% while lead was lowest by 30%. In most bioremediating organisms, and also because of the geological nature of the Niger River, it is possible that

zinc was highly metabolized due to its role as essential micronutrients for these organisms and for its redox potentials. Iron closely followed Zinc probably because of its chelating properties and its predominance in the Lokoja terrain [12]. The perceived low values for lead could be due to the fact that lead and other metals such as silver and aluminum are non-essential and potentially toxic to most soil and aquatic microorganisms. Within the scope of this study, potentials exist in the utilization of these indigenous microorganisms to bioremediate some toxic heavy metals and non-metallic ions that might be present in irrigation water and thereby ensure a sustainable safety in the consumption of irrigated crops.

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Impact of Agroforestry Systems on Ecological and Socio-Economic Systems: A Review

By Indu K Murthy, Subhajit Dutta, Vinisha Varghese, Priya P. Joshi & Poornima Kumar

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Abstract- Agroforestry systems are deliberately designed and managed to maximize positive interactions between tree and non-tree components and encompass a wide range of practices. The fundamental idea behind the practice of AF is that trees are an essential part of natural ecosystems, and their presence in agricultural systems provides a range of benefits to the soil, other plant species and overall biodiversity. They are also increasingly recognized as a tool for mitigating climate change and also aid in adaptation of farming communities. Significant research has been carried out over the years at a range of spatial scales and the impacts of agroforestry systems researched and reported in literature. In this paper, the impacts of AF systems on various aspects such as ecology and environment, aesthetics and culture, social and economic status of farmers practicing AF and finally, climate change mitigation and adaptation is discussed, based on a review of papers over a temporal and spatial scale.

Keywords: *agroforestry, impact, biodiversity, soil fertility, climate change mitigation and adaptation.*

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Keywords: agroforestry, impact, biodiversity, soil fertility, climate change mitigation and adaptation.

I. Introduction

Agroforestry (AF) can be defined as "a collective name for land-use systems in which woody perennials (trees, shrubs, etc.) are grown in association with herbaceous plants (crops, pastures) or livestock, in a spatial arrangement, a rotation, or both; there are usually both ecological and economic interactions between the trees and other components of the system" (Lundgren, 1982). In simple terms, it consists of raising tree species and agricultural crops on the same piece of land, resulting in unique ecological interactions and maximized economic returns (Young, 2002).

These systems are deliberately designed and managed to maximize positive interactions between tree and non-tree components and encompass a wide range of practices like contour farming, intercropping, established shelterbelts, riparian zones/buffer strips, etc. The fundamental idea behind the practice of AF is that trees are an essential part of natural ecosystems, and their presence in agricultural systems provides a range of benefits to the soil, other plant species and overall biodiversity. With threats that smallholder farmers in the developing world face with predicted impacts of climate variability and change, the scope of AF systems to reduce vulnerability and adapt to the conditions of a warmer, drier, more unpredictable climate is now being recognized (McCabe, 2013). AF systems are also being increasingly recognized as a tool for mitigating climate change by reducing the overall volume of greenhouse gases in the atmosphere and profiting the economically weaker sections from emerging carbon markets.

Significant research on the types of AF systems, their impacts on the environment, social and economic aspects has been carried out over the years at a range of spatial scales, right from local to regional and global scale. In this paper, the impacts of AF systems on various aspects such as ecology and environment, aesthetics and culture, social and economic status of farmers practicing AF and finally, climate change mitigation and adaptation is discussed, based on a review of papers over the temporal and spatial scale.

II. Methodology

Many of the research and review papers of the last 35 years, published in peer reviewed journals during the period 1981 to 2016, were analysed by the authors. These papers have been listed in the reference section, and range from "Consumption and supply of wood and bamboo in Bangladesh" by Douglas, 1981 to "Variation in pollinator density and impacts of large cardamom (*Amomum subulatum* Roxb.) crop yield in Sikkim, Himalaya, India" by Gaira et al. 2016. The papers have been reviewed for the varied impacts reported on implementation of AF systems in different parts of the world. The review not only summarizes the positive impacts, but also some of the negative impacts that have been reported by the papers.

III. Results and Discussion

In this section the positive and negative impacts of AF are summarized, based on impacts reported by

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various studies across the world. The positive impacts reported across the many papers include impacts on biodiversity – both flora and fauna, soil fertility, air quality, reliance on fossil fuels and fuelwood, aesthetics, culture and finally climate change mitigation and adaptation. In Section 3.1.2., the negative impacts of AF systems on biodiversity, water table, nutrients and related aspects, as reported by various studies is discussed.

a) Positive impacts of agroforestry

i. *Biodiversity*

The United Nations Convention on Biological Diversity defines 'biodiversity' as "the variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems." From the 1990s, AF had also begun to be identified as an integrated land-use which enhances biodiversity while simultaneously reducing habitat loss (Noble, 1998).

Flora conservation: Agroforestry contributes to landscape conservation of biodiversity by extending natural habitats, creating corridors between habitat remnants, buffers to existing reserves, and landscape heterogeneity in multi-functional landscapes (Bichier et al., 2000; WAC, 2006; Bhagwat et al., 2008; Nath and Vetaas, 2015). AF in the Western Ghats and the Satoyama landscapes in Japan are excellent examples of this (Kumar and Takeuchi, 2009). Additionally, trees (including native, endangered (Sujatha et al., 2011), medicinal (Rao et al., 2004) or fuelwood species (Kumar, 2006)) grown in these systems reduce the pressure on formally protected reserves (Bhagwat et al., 2008).

Agroforestry systems can help combat species loss outside formal conservation zones. One study (WAC, 2006) conducted in Eastern and Western Africa showed that AF systems usually contain more than half of the tree species that are found in nearby primary forests. Nath et al. (2015), report higher tree species richness in some AF systems of the Nepalese Himalayas than in nearby natural forests. Dawson et al (2013), reviewed evidences for circa situm conservation in the case of smallholder AF. According to Bhagwat et al., 2008, many AF systems (Table 1) have been shown to be important to maintain heterogeneity at the habitat and landscape scales even amidst competition for land.

Table 1: Animal and plant taxa represented in tropical agroforestry systems and the richness and similarity in species composition in relation to neighbouring forest reserves

Taxa reported	Number of examples	Agroforestry systems* represented	Richness compared to forest % (mean)	Similarity with forest % (mean)
Bats	3	Bn, Co	139	61
Birds	12	As, Bn, Cf, Co, Ft, Jr, Mf	92	52
Herptiles	1	As	62	34
Insects	19	Bn, Co, Cc, Cf, Jr	86	49
Macrofungi	1	Cf	89	61
Mammals (excluding bats)	3	As, Bn, Co	93	65
Plants (lower)	5	Co, Jr	112	42
Plants (herbaceous)	5	Co, Cc, Cf, Hg	64	25
Trees		Bn, Bz, Ca, Co, Cc, Cf, Ft, Hg, Jr, Rt	64	39

Source: Bhagwat et al., 2008

**Agroforestry systems: As-allspice, Bn-, Bz-benzoin, Ca-cardamom, Cc-cocoa-coffee, Cf-coffee, Co- cocoa, Ft-farm trees, Hg-home gardens, Jr-jungle rubber, Mf-mixed fruit orchard, Rt-rattan.*

Schroth (2004), identified and discussed three roles of AF in biodiversity conservation on a landscape scale: "the provision of supplementary, secondary habitat for species that tolerate a certain level of disturbance; the reduction of rates of conversion of natural habitat in certain cases; and the creation of a more benign and permeable 'matrix' between habitat remnants compared with less tree-dominated land uses, which may support the integrity of these remnants and the conservation of their populations. These systems are often like small fragments of forests integrating several species in a single system consisting of a structurally complex canopy (unlike monocrop systems), capable of providing ecosystem services similar to forests. However, the extent of these services is highly variable.

Birds: McDermott et al (2014) surveyed two common AF systems, shade-coffee plantations and silvopastures, in the Colombian Andes and observed that flock activity increased with increasing canopy cover and tree density in both systems. Buck et al (2004) reviewed 12 studies that found AF systems to provide habitats for diverse populations of birds, highlighting the habitat value of shade-grown coffee and cocoa systems in Southeast Asia and Central America. Bird richness has been reported to increase in coffee plantations with increased floristic and structural diversity. This includes habitat

characteristics such as canopy cover, canopy depth, canopy height, coffee plant density, tree species richness, tree density, and management intensity (Gordon et al., 2005; Philpott et al., 2007; Philpott and Bichier 2012). Ahmed and Dey (2014), studied the Rosekandy Tea Estate situated in Barjalenga in the Cachar district of Assam. They documented 88 bird species belonging to 38 families, and 48 in the tea plantation alone and concluded that the edges of the tea plantations which transitioned from shrubs to forest vegetation greatly contributed in maintaining a high diversity of animal species while also enabling their movement.

Small mammals: Small mammals play an important role in tropical ecosystems. From the handful of studies that have been published on small mammal communities in coffee AF, researchers have found that the species richness rivals or surpasses that of native forests (Cruz-Lara et al., 2004; Husband et al., 2009; Molur and Singh, 2009; Caudill et al., 2013). Cruz-Lara et al (2004), recorded 10 species of small mammals in coffee AF compared to eight species in a nearby forest in a study conducted in Mexico. Two studies in separate areas in Costa Rica reported 11 and eight small mammal species in coffee AF with 14 and 10 species in the adjacent forest remnants (Husband et al., 2009; Caudill, 2013, respectively). Molur and Singh (2009), found nine small mammal species in the coffee AF and five species in the remnant forest habitats in a small mammal study in Kodagu (Karnataka, India). Caudill et al (2013), assessed the mammal diversity within coffee AF systems in Kodagu, Karnataka, India and investigated the impacts of the non-native shade tree species - Grevillea robusta on 11 mammal species. Their abundance and richness were found to increase with increase in tree species richness, herbaceous ground cover and proximity to forest areas.

Insects and arthropods: Harvey and Villalobos (2007) compared the abundance and species richness of dung beetles and terrestrial mammals across several land use systems in the BriBri and Cabecar indigenous reserves in Talamanca, Costa Rica. Rahman et al (2012) sampled soil invertebrates in the Nilgiris, a human-dominated biosphere reserve amidst 15 land-use practices including managed AF systems. With 21 ant species, AF systems had the highest diversity of ants followed by forest ecosystems (12 species). Pollinator abundance (bumblebees and honeybees) was shown to positively correlate with the number of flowers in a Himalayan AF system with cardamom (Amomum subulatum Roxb.) and also increase the yield of the target crop (Gaira et al., 2016).

Agroforestry has also been shown to be beneficial to insects that feed on crop pests, thereby reducing the use of pesticides (Murthy et al., 2013). Variations in tree-crop combination and spatial arrangements (Jose, 2009), vegetation diversity, tree density and canopy height (Philpott et al., 2007), nearness to forests and abundant food resources (Harvey and Villalobos, 2007) such as hosts, prey and nectar are some of the factors reported to have positive impacts on insect diversity. These studies demonstrate the arthropod conservation potential of heterogenic AF systems that do not destroy or drastically alter microhabitats and microclimatic conditions.

ii. *Soil fertility*

Agroforestry is shown to be an efficient land management method in order to enhance soil quality and to conserve water resources (Kumar, 2006; Murthy et al., 2013; Nair, 2004). A study (Sharma et al., 2009) at the Central Research Institute for Dryland Agriculture, Hyderabad, India, revealed that physicochemical properties such as soil pH and organic carbon were significantly influenced by different land-use systems. The tree shade can reduce evapotranspiration from understory plants resulting in a likely increase in soil water content compared to open pastures (Joffre and Rambal, 1993). The incorporation of trees and crops that are able to biologically enhance soil nutrients like nitrogen is fairly common in tropical AF systems. Even non-N-fixing trees release organic matter, recycle nutrients and thereby, significantly enhance all the properties of the soil (Jose, 2009).

Gupta et al (2009) carried out research in a poplar (*Populus deltoides* Bartr.) based AF plantation with wheat (*Triticum aestivum*) during winters, and green gram (*Vigna radiata*) during summers at farms in Central Punjab, India. They observed that the average soil organic carbon increased from 0.36% in monocrop to 0.66% in AF soils (2.9–4.8 Mg ha-1 higher), and this was found to increase with tree age. Studies of soil enrichment services through litter fall from Ficus trees (*Ficus benghalensis*) in rainfed AF systems in Karnataka showed that approximately 20% of the required phosphorus, 77% of required nitrogen and 67% of required potassium could be delivered from the Ficus litter (Dhanya et al., 2013). Saha et al (2010), studied the effects of five multi-purpose tree species (MPTs) on soil in AF farms located in the north-eastern Himalayan region in India and found that all soil hydro-physical characteristics were greatly improved.

Agroforestry systems have also been proven to be able to reclaim polluted land and mitigate soil salinization and acidification (Murthy et al., 2013). Eco-restoration and sustenance of soil resources through AF is also one of the most viable options to manage land and soil resources (Dhyani and Chauhan, 1995). Rockwood et al (2004), documented AF systems in phytoremediation through short rotation woody crops (SRWCs) that can remediate contaminated soil and groundwater across Europe and America. Of the various tree-agronomic crop systems, it is the riparian systems

and windbreaks that have the greatest potential for dendro-remediation. This could involve planting SRWCs for reclamation and restoration of disturbed land (e.g. mined surfaces, contaminated sites, degraded land, landfills, etc.) to improve soil properties, control invasive species, and even provide a transition to natives (Rockwood et al., 2004). Tassin et al (2012), have studied how farmers in highland Madagascar, the island of Re´union, the Bateke plateau near Kinshasa, Congo, and the Palani Hills of southern India have improved fallows by using invasive woody legumes (Acacia sp.) which were 'negative' plant invasions converted into productive AF systems.

Agroforestry is believed to increase the soil organic carbon (SOC) through litter fall (Young, 1989; Aldeen et al., 2013; Murthy, et al., 2013) and rhizospheric effects (Saha et al., 2010), increase land productivity (Noble, 1998; Saha et al., 2010), check soil erosion (Guevara-Escobar et al., 2002; Schultz et al., 2004), conserve moisture in the soil (Morgan, 1995; Nair, 2004), and diversify the farm income (Seobi et al., 2005). Similar observations have been reported by Young et al (1987); Reicosky and Forcella (1998); and Saikh, Varadachari, and Ghosh (1998).

iii. *Improved air quality*

Features prevalent in AF, such as windbreaks and shelterbelts, benefit air quality and aid in reducing pollution in multiple ways. They safeguard buildings and roadways from drifting snow in colder countries. They also reduce wind chills, protect crops, provide additional habitats for wildlife, remove atmospheric carbon dioxide and improve oxygen circulation, reduce wind velocity and with it, erosion and particulate matter in the air, reduce noise pollution and livestock odour. Of late, shelterbelts have gained popularity as a means to mitigate livestock odour (Tyndall and Colletti, 2007). They filter airstreams of particulates and remove odour-causing aerosols.

Another time-tested benefit of AF is its provision of clean water. Agriculture has numerous effects on water systems, changing water chemistry through eutrophication, modifying the food web, pesticide pollution, increasing sediment load from erosion and so forth (Moss, 2008). In particular, riparian buffers can be immensely beneficial to reducing pollution. Conventional agricultural systems involve a significant amount of fertilizer runoff from agricultural fields, as less than half of the applied nitrogen and phosphorous fertilizer is taken up by crops. The rest is washed away in the form of surface runoff, or leached into subsurface water supplies (Cassman, 1999).

Agroforestry has been shown to reduce non-point source pollution from agricultural land in five key ways (Dosskey, 2001), namely: (i) reducing surface runoff from fields; (ii) filtering surface runoff; (iii) filtering groundwater runoff; (iv) reducing bank erosion, and (v) filtering stream water. AF vegetative buffers have been shown to reduce non-point source pollution from row crop agriculture (Udawatta et al. 2002; Anderson et al. 2009). Trees with deep roots provide a safety net of sorts by recycling excess nutrients back into the system and improving nutrient use efficiency (van Noordwijk et al. 1996).

iv. *Reduced reliance on fossil fuels and forests for fuelwood*

In a time of mounting concern about the long-term availability of oil, AF systems have the potential to reduce reliance on fossil fuel consumption in a number of ways. For instance, AF plantations have the potential to provide fuelwood (Smith, 2010), which could reduce reliance on fossil fuels significantly. A study of the impact of community AF on households in Bangladesh by Chakraborty et al. (2015), also showed that AF was an important source of fuelwood, which reduced household expenditure on conventional fossil fuels. Similarly, Bugayong (2003) discovered that AF significantly reduced the reliance of communities on nearby forests for fuelwood. Also, AF systems, through production of renewable energy, coppice systems or as a by-product of timber production, can reduce the use of fossil fuels for heating and cooking. Furthermore, internal nutrient cycling and enhanced pest and disease control can reduce the need for oil-based agrochemicals. Localized production of multiple outputs can avoid the need for long-distance transportation of goods and therefore reduce fuel use.

v. *Aesthetics and Culture*

Traditional AF systems such as orchards, parkland and wood pastures are valued for their visual appeal. Integrating trees into landscapes can increase the attractiveness of the landscape (McAdam et al., 2009). Franco et al (2003) note that there is a need to consider the values that society places on non-market aspects such as beauty. This tends to maximize the efficiency of resource allocation in a landscape management setup.

Cultural aspects of traditional AF systems, particularly in temperate regions, are often overlooked, despite long histories of woodland and orchard grazing, alpine wooded pastures, pannage, the dehesa and parklands (McAdam et al., 2009). Lifestyles such as nomadism, transhumance (seasonal movement of people with their livestock) and traditional techniques such as pollarding and hedge-laying are integrated within such systems. The symbolic and cultural perceptions of these landscapes are shaped by local practices, laws and customs (Ispikoudis and Sioliou, 2004). While only remnants of these traditional landscapes exist today, the significance and value of these cultural landscapes have been recognized at the international level by UNESCO.

In India, as in other countries with indigenous cultures such as Brazil, Bangladesh, etc., traditional AF systems have been in place for generations. In Rajasthan, fodder and grain crops have long been intercropped with Prosopis cineraria. Prosopis guards against crop failure by acting as the primary source of fodder during such times. Its leaves and seeds are stored in anticipation of lean periods. Its wood is used to make charcoal and fuelwood, as well as agricultural tools (Paroda and Muthana, 1981). A study in the West district of Tripura found an interesting difference in the participation of women from different sociocultural groups, which it attributed to belief systems and traditions. In the study, women's participation in tribal and non-tribal communities practicing AF was compared. It was found that the latter participated more in marketing activities than the former, who were more involved in production, management and harvesting (Jaba et al., 2015). In the flood-prone, fertile alluvial soils of Bangladesh, multi-storey plants, shrubs, bamboos, palms and other trees that can withstand flooding are grown together (Douglas, 1981). AF thus has a huge potential to conserve traditional knowledge and practices that have existed for centuries.

vi. *Economic and social benefits of agroforestry*

A very important marker of the social benefits of a system such as AF is its effect on the conditions of the more vulnerable sections of society, in particular, women, children and marginalized groups. A study conducted over a decade in the Banswara district in Rajasthan and Dahod district in Gujarat in semi-arid western India where wadi AF was introduced found that AF had numerous benefits to the condition of women in the study group. The study determined that institutional arrangements were necessary for the continued inclusive upliftment of the marginalized sections of these societies (Bose, 2015). Chakraborty et al., (2015) compared the socio-economic conditions of farmers who adopted AF and those who did not in Manirampur and Baghepura of Jessore district in Bangladesh and report that farmers practicing AF better off than those not practicing AF, both socially and economically. Bugayong (2003) in a study in the Philippines, show that nearly 80% of participants report medium to high income change as a result of AF. Similarly, a study of AF implementation in the Attappady block of Kerala, in the Nilgiri biosphere Reserve, reported significant improvements in the socio-economics, food and livelihood security of those involved (Kumar, 2006).

Saha et al. (2010) rightly argue that the economic and social benefits of AF are vital in ultimately determining whether a farmer will consider it a viable alternative to conventional 'modern' agricultural practices. Agroforestry systems are an investments of sorts – planting timber species such as teak (*Tectona grandis*) or Silver Oak (*Grevillea robusta*) may not generate many benefits in the initial stages, but do so significantly when they are logged two decades later (Dagar et al. 2014). AF has the potential to provide multiple harvests in a year, thus evening out both labour as well as income through the year. This leads to increased financial resilience and reduced vulnerability to crop failure, which is all too common a phenomenon with single-cropping or monoculture practices (Kumar, 2006; Murthy et al. 2013). The NRCAF (2007) estimated that there was potential for employment under improved AF systems, amounting to 943 million person-days annually from 25.4 million ha (Table 2).

Table 2: Employment generation potential of agroforestry in India and rates of return from investment in agroforestry system

Agroforestry System	Area (million/ha)	Additional employment (persons/ha/year)	Total employment (million/days)	Ratio of rate of investment (%/year)
Silviculture	1.8	30	53.3	126
Agrisilviculture (irrigated)	2.3	40	91.3	150
Agrisilviculture (rainfed)	1.3	30	38.0	157
Agrihorticulture (irrigated)	1.5	50	76.1	129
Agrihorticulture (rainfed)	0.5	40	20.3	131
Silvipasture	5.6	30	167.4	89
Tree borne oilseeds	12.4	40	497.1	38
Total	**25.4**	--	**943.4**	**117**

Source: NRCAF 2007

The productivity of the land increases as well, since AF often improves soil properties. This further improves the earning potential of the farmer (Murthy et al. 2013). In addition to higher yield potentials of AF, product diversification increases the potential for economic profits by providing annual and periodic revenues from multiple outputs throughout the rotation and reducing the risks associated with farming single commodities (Benjamin et al. 2000).

Bhattacharya and Mishra (2003) conducted a study to understand the potential, costs and benefits of agrihorticulture systems in north eastern India. According to this study, agrihorticultural systems with Psidium spp. yielded a net return 2.96 times greater

than similar systems without trees. Similarly, Singh and Pandey (2011) report that in traditional systems of AF that used Acacia species with Oryza species, the benefit to cost ratio was found to be 21.47. Jaba et al., 2015 conducted a study in Tripura West district and analysed the sources of income of tribal and non-tribal communities. Their findings demonstrate that earnings from tree crops (through AF) were significant at INR 24,075 in tribal communities. Compared with exclusive forestry land use, AF practices are able to recoup initial costs more quickly due to the income generated from the agricultural component (Rodríguez et al. 2009; Grado, Hovermale and Louis, 2001), and studies have shown increased profitability of silvo-arable (Yates et al. 2007; Benjamin et al. 2000) and silvopastoral (Benavides, Douglas and Osoro, 2009; Brownlow, Dorward and Carruthers, 2005) systems compared to agricultural monoculture systems.

vii. *Climate change mitigation-adaptation*

Globally, climate change is the prevalent environmental and developmental challenge endangering natural resources and humanity. The AFOLU (Agriculture, Forestry and Other Land Use) sector accounts for about a quarter (~10–12 GtCO2-eq/year) of net anthropogenic GHG emissions, mainly from deforestation, agricultural emissions from soil, nutrient and livestock management (IPCC, 2014). Climate mitigation efforts in land use sectors like agriculture and forestry, especially in the developing countries, can play a significant role in the global efforts to address climate change. The potential of AF as a management practice which increases aboveground and belowground carbon stocks to mitigate greenhouse gas emissions is highlighted progressively in contemporary research. The principle behind it rests in the fact that trees have the capability of sequestering a relatively large quantity of carbon for longer periods, as compared to other vegetation. Harvesting followed by long term locking, fossil fuel substitution, and soil carbon also contribute to enhanced carbon sequestration (Sharma, et al, 2015). The total carbon storage capacity of an AF system depends on the growth and nature of the tree species, and varies from region to region (Newaj and Dhyani, 2008).

Increased growth and assimilation rates of intercropped tree components in AF have higher carbon storage capacity than mono-cropping systems. This may be attributed to the additional carbon pool in the trees, along with litter fall and fine root turnover, which result in increased soil carbon pools (Chauhan et al., 2010). Pandey (2007) highlight that AF for carbon sequestration is additionally attractive as the need for slash-and-burn or shifting cultivation is significantly reduced, due to intensive use of the land for agricultural production. Further, unsustainable harvest of wood products from natural forests is considerably reduced as a result of their continued supply from AF systems.

The average carbon storage potential of Indian AF is estimated to be 25 tC/ha over 96 million ha (Sathaye and Ravindranath, 1998). However, this potential is dependent on the ecosystem, species, growth rate and management involved (Pandey, 2007). FSI (2013) reports that AF systems in India store about 279 MtC (Table 3); the East Deccan zone is estimated to store a whopping 53 MtC in its AF systems while the west coast and South Deccan regions store almost 33 and 23 MtC, respectively. In the agroecosystems of Indo-Gangetic Plains, about 69% of soil carbon in the soil profile is confined to the upper 40 cm soil layer where carbon stock ranges from 8.5 to 15.2 tC/ha, while the agricultural soils contain 12.4 to 22.6 tC/ha of organic carbon in the top 1 m soil depth (Singh et al., 2011).

Table 3: Physiographic zone-wise growing and carbon stock estimate under agroforestry

Physiographic zone	Geographical area (sq. km)	Carbon stock in million tonnes
Western Himalayas	329,255	15.47
Eastern Himalayas	74,618	2.98
North East	133,990	9.51
Northern plains	295,780	22.66
Eastern Plains	223,339	19.86
Western Plains	319,098	10.42
Central Highlands	373,675	22.85
North Deccan	355,988	14.91
East Deccan	336,289	53.30
South Deccan	292,416	23.74
Western Ghats	72,381	22.57
Eastern Ghats	191,698	9.64
West Coast	121,242	33.33
East Coast	167,494	18.60
Total	**3,287,263**	**279.83**

Source: FSI, 2013

On a species system scale, Koul et al. (2011) reported that soil organic carbon was found to be the highest (17.69 t/ha) in natural forest of *Shorea robusta* followed by pure plantations of *Terminalia arjuna* (13.29 t/ha). Agri-horticulture AF systems (12.14 t/ha), pure plantations of *Dalbergia sissoo* (10.66 t/ha) and tea (*Camellia* spp.) gardens (10.45 t/ha) were also found to have significant carbon sequestration potential. Poplar-based AF systems have also been adopted extensively for carbon farming (Chauhan et al., 2010). This short rotation AF crop has been reported to sequester around 8 MgC/ha/yr. Poplar can be considered a major carbon assimilator, as it locks up carbon in its wood products for longer periods. Thus, traditional agricultural systems intermixed with poplar provide the best land use option for increased carbon sequestration.

Studies in Khammam district, Andhra Pradesh, on technical potential for afforestation on cultivable wastelands, fallow, and marginal croplands with Eucalyptus clonal plantations found baseline carbon stock to be 45.3 tC/ha, mainly in soils (Sudha et al., 2007). Although most AF systems sequester a lot of carbon, home gardens are argued to be particularly effective. This is due to the fact that they can provide fuelwood to alleviate the pressure on natural forests, as well as biofuel-products which may reduce the need for fossil fuel burning (Kumar, 2006). Nair et al. (2009) estimated that tropical home gardens have particularly high carbon sequestration potential (16-36 Mg/ha/year). Tropical home gardens of Kerala, exhibit an average aboveground standing stock of 16 to 36 Mg/ha; small home gardens are often found to have higher carbon stocks on per unit area basis, compared to large- and medium-sized ones (Murthy, 2013; Sahoo, et al, 2007).

Negash and Starr (2015) presented and evaluated the biomass carbon and soil organic stocks in three indigenous AF systems (Enset - Ensete ventricosum, Musaceae, Enset-Coffee and Fruit-Coffee) practiced on the Rift Valley escarpment of Ethiopia. The total biomass carbon stocks of the small holdings in their study were within the range reported for AF systems globally (12–228 Mt/ha).

Integration of climate change mitigation and adaptation strategies to promote sustainable development and moderate the ensuing impacts of climate change is being advocated in the recent times and AF is one among these strategies. It provides a particular example of an innovative practice which represents synergy between mitigation and adaptation options, alongside providing multitudes of socio-economic and ecological benefits (Ekpo and Asuquo, 2012). It is designed to enhance productivity in a way that contributes to climate change mitigation through enhanced carbon sequestration. It can also strengthen the ability to adapt to adverse impacts of changing climatic conditions (IPCC, 2001; Ekpo and Asuquo, 2012; Verchot et al. 2007; Roy et al. 2011).

Matocha et al. (2012) highlight nine key interventions which have the potential for obtaining synergies between adaptation and mitigation in AF systems. Income diversification is highlighted to be one of the most effective of these interventions. Tree and forest products provide multiple raw materials, thus increasing options available for income. This reduces the vulnerability of resource-poor farmers to climate and market shocks (adaptation), while increasing landscape carbon stocks (mitigation). The range of benefits accrued can further be enhanced through the incorporation of trees with either crops or silvo-pastoral lands, or even the introduction of livestock into mixed land uses. Charles et al. (2013) conducted a study in Tanzania and concluded that products from AF practices improved the resilience of smallholder farmers against the impact of climate changes. In particular, they improved farm production (food, fodder, timber, fuelwood and manure), ecosystem services (soil

improvement, climate amelioration, wind break, erosion control, and disease and pest control) and household income.

Apart from benefits to the immediate micro environment in which AF systems thrive, the surrounding ecosystems and their components also incur some benefits. AF systems act as corridors connecting fragmented forest lands and facilitate the movement of wildlife through a landscape that may otherwise be too hostile. This role of AF in providing corridors that allow movement of species through landscapes will increase in importance under predicted climate change scenarios, by allowing species to adapt their distributions in response to the shifting climate (Manning et al., 2009).

Thus, combining adaptation with mitigation has been recognized as a necessity in developing countries, particularly in the AFOLU sector. In reality, there is no dissociation between crop production and other ecosystem services from land use (Mbow et al. 2014). AF systems help farmers adapt to changing socio-economic and climatic conditions (McNeely and Schroth, 2006). In order to optimize AF for adaptation and mitigation to climate change, there is a need for more integrated management to increase benefits and reduce negative impacts on climate (Table 4).

Table 4: Examples of positive or negative implications of agroforestry practices for adaptation or mitigation to climate change (adapted from Mbow et al. 2014)

		Mitigation	
		Positive	Negative
Adaptation	*Positive*	Soil carbon sequestration, improved water holding capacities, use of manure instead, mixed AF for commercial products, income diversification with trees, reduced nitrogen fertilizer, fire management.	Dependence on biomass energy, overuse of ecosystem services, Increased use of mineral fertilizers, Poor management of nitrogen and manure, over extraction of non-timber products, timber extraction.
	Negative	Integral protection of forest reserves, limited rights to AF trees, Forest Plantation excluding harvest.	Use of forest fires for pastoral and land management, tree exclusion in farming lands.

Thus, AF systems have the ability to enhance the resilience of a system for coping with the adverse impacts of climate change, and provide a unique opportunity to combine the twin objectives of climate change adaptation and mitigation.

b) Negative impacts of agroforestry

Although there are numerous benefits to establishing an AF system, there are also certain trade-offs. Three aspects of Leakey's (1996) definition, used very frequently, are important for the value of AF. Firstly, AF involves deliberate integration of trees with farms and landscapes, which may have direct and indirect effects on farm and landscape biodiversity. Secondly, there are trade-offs and complementarities between the social, economic, ecological and biodiversity benefits of AF compared to other land use systems. Finally, while some AF practices in certain circumstances contribute greatly to diversification and sustainability, there are other circumstances where they contribute very little.

Increased shade in AF systems reduces yield by reducing the amount of direct light, which is usually the limiting resource in northern temperate regions (Benavides, Douglas, and Osoro, 2009; Chirko et al., 1996; Reynolds et al., 2007; Smith, 2010). Similarly, competition for water is likely to limit productivity in semiarid regions such as the Mediterranean, although it is difficult to quantify it separately from nutrients and other requirements (Chirko et al., 1996; Reynolds et al., 2007). Competition for water, sunlight and nutrients may affect grain yield and total biomass of agricultural crops but the magnitude depends on the species used in the AF system (Singh et al., 2013). This 'weedy' nature of AF trees also makes cultivation more tedious and labor-intensive (Tassin et al., 2012). A common problem is that the positive effects for some tree species are accrued over a longer period of time while the negative effects such as competition for resources are immediately apparent (Nair, 2004). Soini (2004) reported that AF systems have created an inhospitable habitat for most bird species in Kilimanjaro, Tanzania, owing to very high levels of interference from the human population.

There are also a few studies that discuss and highlight the major constraints with respect to implementation of AF (Devaranavadgi, 2010). Garcia et al (2010) considered challenges to the strategies proposed by Harvey et al (2007), in coffee AF landscapes in South India and drew insights from the ground realities in Kodagu District (Karnataka). For example, multipurpose AF trees on farms that aimed to serve as alternative sources of fuelwood were often not accessible to the poor. The landless population (tribal groups, migrants, labourers, etc.) neither had legal access to fuelwood from state-controlled forests nor from private lands. Another example was that the forest patches were a source of "nuisance" to nearby plantations as they attracted elephants and other wildlife that destroyed plantation crops.

It must also be recognized that AF has potential to threaten native biodiversity. The introduction and

colonization of invasive alien tree species can replace valuable indigenous species which are comparatively less aggressive. Domination of local pastures and altering catchment hydrology are landscape level examples of the consequences (Tassin et al., 2012). Ultimately, however, Tassin et al (2012), argue that given the properties (resilience, fast growth, etc.) of AF tree species that lead to their selection in the first place, acceptability becomes a broader social and political debate.

IV. Conclusions

It is evident from the review that AF systems by and large across the world have several positive impacts and have a two-way relationship with livelihood and biodiversity in multi-functional landscapes. They help maintain and contribute to tree and animal diversity and also help improve livelihoods through increased flow of products that could generate income. However, it is important to note that the impacts of agroforestry are dependent on varied factors and even those that have been reported have been at different scales, for different systems and for different regions. Further, the impacts of agroforestry systems would be very specific and would also depend on management practices adopted by individual farmers. It is also pertinent to note that the impacts reported are standalone cases and many have no systematic control or reference plots for comparison. However, AF is one of the key strategies that will help design multifunctional landscapes that can deliver multiple ecosystem services. But, AF is not a stand-alone conservation measure, additional measures to minimize disturbance from a rising human population are required, thus making AF an integral part of a mosaic of strategies. Given the potential of AF to contribute positively towards climate change mitigation as well as adaptation synergistically, it is gaining importance as a land-based mitigation option and as a reliable coping strategy or adaptation measure, particularly in regions with large rainfed agriculture dependent farming communities. This is because of the potential of agroforestry to generate income during agriculture lean or agriculture failure periods. Countries such as India have formulated targeted agroforestry policy in addition to including it as one of the key mitigation and adaptation measures in the National Action Plan on Climate Change. Finally, there also remains a future prospect of carbon trading and payments through implementation of payment for environmental services and REDD+ programs which could serve as added incentive to local communities to promote AF systems.

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The use of Airborne Spectrometric Data in Geological Mapping and Uranium Exploration at Qena-Quseir Shear Zone Area, Eastern Desert, Egypt

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Strictly as per the compliance and regulations of :

The use of Airborne Spectrometric Data in Geological Mapping and Uranium Exploration at Qena-Quseir Shear Zone Area, Eastern Desert, Egypt

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Abstract- Qena-Quseir shear zone area is located at the central part of the Eastern Desert covering area of about 9460 Km^2. This area is mainly covered by basement rocks however there are parts covered by sedimentary rocks ranging in age from Upper Cretaceous to Quaternary. In this research, airborne gamma-ray spectrometric data is used to refinement of the mapped surface geology depending on the radioelements content between lithological assemblages. The gamma-ray data is also used for studying the distribution of the radioactive elements and determination of anomalous zones of uranium. The data were collected by Aeroservice department, Western geophysical company of America along flight lines oriented in a NE-SW direction with 1.5 Km line spacing and along tie lines oriented in NW-SE direction with 10 Km line spacing. Radioelements maps shows three levels of concentrations. The high level is related to younger granite, Duwi formation and some parts of Dokhan volcanics whereas the lowest level is related to metavolcanics. Radioelements ratio map shows that the high level is compatible with Duwi formation, Younger granite and some parts of Dokhan volcanics. The radioelement composite image map display that the light zones is correlated with younger granite, Duwi formation and parts of Dokhan volcanics. Normality and Chi-Square ($\chi 2$) tests were applied to construct the interpreted radiometric lithologic unit (IRLU) map depending on the total count radiometric survey data. After applying normality and Chi-Square ($\chi 2$) tests, it is found that twenty-five rock units have normal distribution and eight rock units don't have. The rock units which is found to obey non-normal distribution are divided into two subunits. In this study, significant locations of eU anomalies are defined on the basis of calculation of probabilities, where their data differ significantly from the mean background, as defined by the data themselves, and at certain levels of probabilities these differences were computed. The high anomalous values are considered as the values equalling or exceeding at least two standard deviations from the calculated arithmetic mean values (X+2S) for eU, eU/eTh and eU/K measurements, for a single point in each rock unit. Fifteen groups of statistically significant (anomalous) points can be distinguished on urnium point anomaly map. Anomalies are concentrated in areas covered by Duwi formation, Younger granite and some parts of Dokhan volcanics.

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I. Introduction

The area of study (Fig.1) is located at the central part of the Eastern Desert of Egypt (covering an area of 9460 Km^2). This area is mainly covered by basement rocks however there are parts covered by sedimentary rocks ranging in age from Upper Cretaceous to Quaternary.

Gamma-ray spectrometry usually used as one of good tools in geological mapping especially in areas of high terrain complex. The conventional approach to the acquisition and processing of airborne gamma-ray spectrometric data is to monitor three relatively broad spectral windows. These three elements named as potassium (K), equivalent uranium (eU) and equivalent thorium (eTh) windows have energy of 1.46 MeV, 1.76 MeV and 2.62 MeV respectively (IAEA, 2003). They are used for the measurement of K, U and Th.

The present study deals essentially with the analysis and interpretation of aerial spectral radiometric and magnetic survey data acquired over the study area. The data interpretation would be supplemented by the consideration of all available previous geological, geochemical and geophysical information in this area. In brief, the proposed study has two main objectives; the refinement of the mapped surface geology and determination of uranium anomalous zones.

II. Geological Background

Based on the geologic map of Egypt (Elramly, 1972), Stern and Hedge, 1985, identified three distinct basement domains in the Eastern Desert; these are the North, Central, and South Eastern Deserts. These areas were divided by two fault zones, and are abbreviated NED, CED, and SED. The present study area located at the transfer zone between NED and CED (Qena-Quseir shear zone). There is a much higher concentration of granitic rocks in the NED and SED than in the CED. The CED exposes, by far, the greatest concentration of rocks with strong oceanic affinities, such as ophiolites and Banded Iron Formation (BIF) (Sultan et al., 1988). The area is covered at the western side by sedimentary rocks ranging in age from upper Cretaceous to Quaternary (Fig. 2).

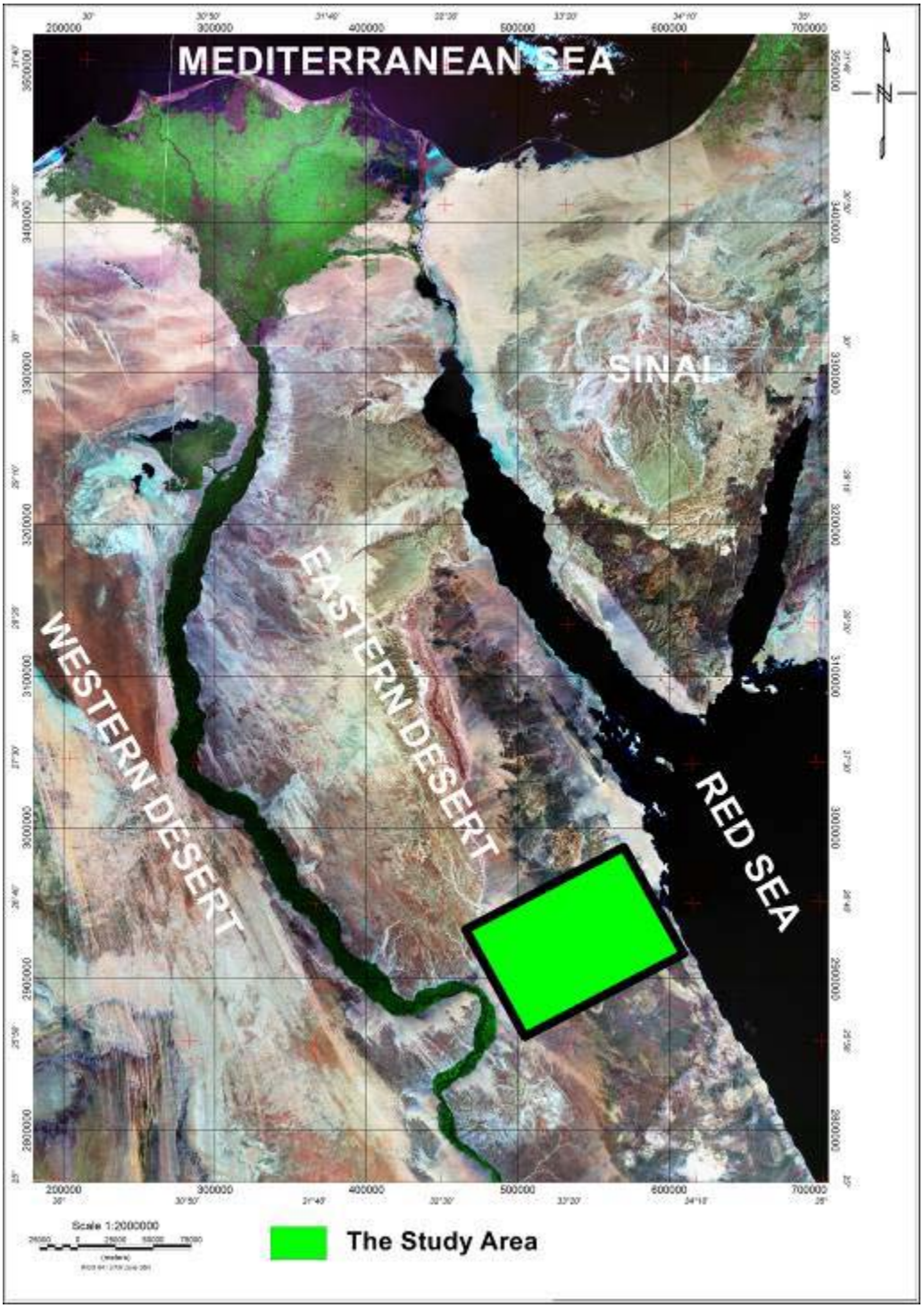


Figure (1): Satellite image showing location of the present study area

The rock units exposed in the study area could be arranged into four main groups; from older to younger units (Schandelmeier et al., 1983 & 1987; Greiling et al., 1988):

1- Pre-Pan-African rocks (gneisses and migmatites).
2- Pan-African ophiolites and island-arc assemblage (serpentinites, metagabbros, metavolcanics and metavolcaniclastics).
3- Cordilleran-stage associations (different types of granites).
4- Quaternary sediments.

The Eastern Desert of Egypt lies within the fold and thrust belt of the Pan-African continental margin orogeny (El- Gaby, 1983). It consists of relatively thin and imprecated thrust sheets overlying an attenuated Early Proterozoic continental margin.

Greiling, 1988 believe that the Pan African belt was created by compression from an easterly direction, while Shackleton et al. 1980, Ries et al. 1983, and Habeib et al. 1985) consider that the direction of tectonic transport was towards the NNW.

According to the constructed structural map (Conoco and EGPC, 1987), the fracture lineaments including faults have four main trend sets; NW - SE, NE – SW, ENE – WSW and E-W.

In the interior of the African–Nubian Shield, steep vertical movements are accepted and for the Precambrian rocks and the Phanerozoic rocks. These faults are often regenerated with quite steep graben borders intersecting the uplift in the Miocene age, in connection with the variations and oscillations in the vertical pattern of faulted areas on the plunges of old massifs, (Schurmann, 1974).

The orientation of the Late Paleozoic to Mesozoic large-scale undulations indicates that the reason for the SE–NW compression in the rotation tendency of Africa start in Carboniferous and culminate in Tertiary regions of Africa separated from Asia (Schurmann, 1974).

Being of epi-Hercynian age, they are generally filled with Triassic and Jurassic series. They are often thick, containing such volcanics such as andesite, basalt, and related tuff. Unlike the aulacogens of ancient platforms, scientists have suggested calling these depressions taphrogenes. The second stage in the young platforms is characterized by the generation of gentle uplifts, similar to shields, and by extensive and long-developing depressions looking like synclines and pericratonic down-warps of ancient platforms. The depressions were initiated in the Jurassic time and then developed during the Cretaceous, Paleogene, and Neogene times; some of them are subsiding at present.

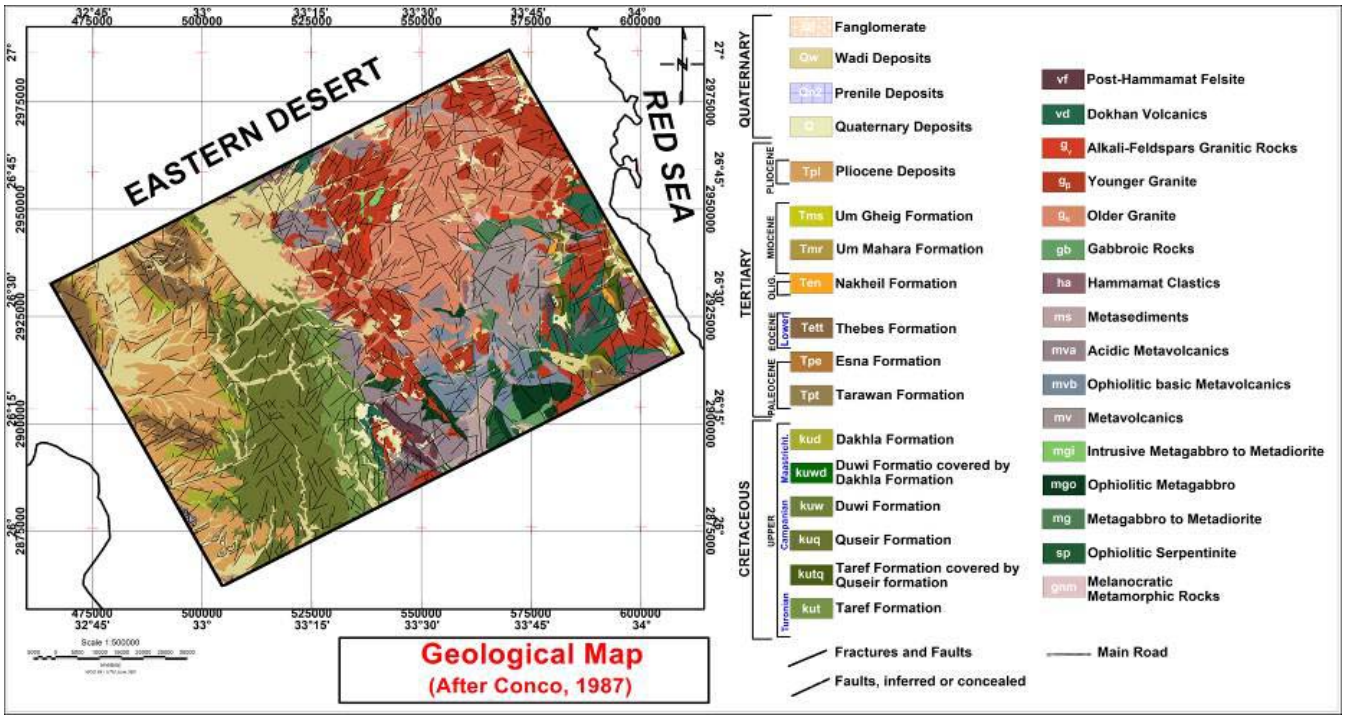


Figure (2): Geologic Map of Qena-Quseir Shear Zone Area, Central Eastern Desert, Egypt, (After Conco, 1987)

III. Aerospectrometric Data

In 17th December, 1984, Aero-Service Division, Western Geophysical Company of America conducted spectral gamma-ray survey covering an area of 9460 km^2 over Qena-Quseir shear zone area, Central Eastern Desert, Egypt (Fig. 1). The data were acquired along flight-lines oriented in NE-SW direction using 1.5 Km line spacing and along tie-lines oriented in NW-SE direction using 10000 m line spacing. Nominal flying elevation was 120m above ground surface (Aeroservice Report, 1984) (Fig. 3).

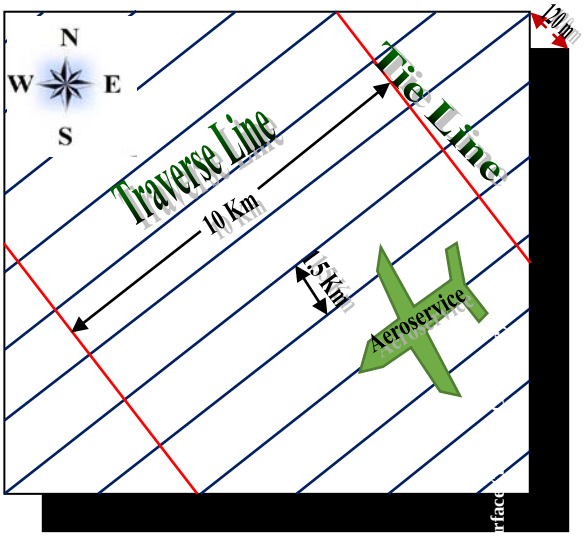


Figure (3): Flight Path Specifications of the Study Area (After Aeroservice, 1984)

The Aero-Service aircraft, registration number N80DS, twin-engine Cessna-Titan, type 404 was used for the data acquisition. A 35 mm path-recovery camera was used to record the ground track of the aircraft. High-sensitivity 256-channel (12 keV/channel) gamma-ray spectrometer system was used in measurement. The detectors system comprises primary (downward-looking) detector for measuring the terrestrial gamma radiation and secondary (or upward-looking) detector for measuring the atmospheric radon. The primary detector include three detector packages, each package consists of four crystals of high-resolution sodium iodide, thallium-activated (NaI "Tl") detectors of individual dimension 4x4x16 inches (256 cubic inches = 4195.088 cc = 4.195 litres). The four crystals in each package were put in intimate contact of dimension 16x16x4 inches (1024 cubic inches = 16780.35 cc = 16.78 litres). The total volume of the primary detector is 3072 cubic inches (50341.06 cc = 50.341 litres). The secondary or the upper-looking detector consists of two crystals of sodium iodide thallium-activated (NaI "Tl") detectors of the same dimension. The total volume of the secondary detector is 512 cubic inches (8390.176 cc = 8.39 litres). Each detection package is enclosed in a heated and thermally stabilized container to assure system spectral stability (Aero-Service Report, 1984).

A variety of analogue outputs from the data acquisition system (CODAS) developed by Aero-Service, 1984, may be software-selected by the system operator. For this type of survey, normal outputs were, total count (0.6-3.0 MeV), potassium (^{40}K) (1.37-1.57 MeV), uranium (^{214}Bi) (1.67-1.87 MeV), thorium (^{208}Tl) (2.41-2.82 MeV), and radar altimeter (100 feet/inch, i.e., 12 m/cm).

IV. Interpretation

a) Radioelements Maps Descriptions

The investigation of the four radioelements maps (TC, K, eU, eTh) (Figs. 4, 5, 6&7) shows that, these maps reflect three levels of radiometric concentrations. The first low radiometric level is less than 5 μR/h for total count, less than 0.4 % for potassium, less than 1.4 ppm for equivalent uranium and less than 2.4 ppm for equivalent thorium. This level is well compatible with metavolcanics, metagabbro and small parts of metasediments.

The second intermediate radiometric concentration level ranges from 5 to 11 μR/h for total count, from 0.4 to 1.4 % for potassium, from 1.4 to 2.7 ppm for equivalent uranium and from 2.4 to 5.5 ppm for equivalent thorium. This level is related to the sedimentary cover at the western part of the study area, some parts of older granite and small spots of metavolcanics.

The third high radiometric concentration level ranges from 11 to more than 25 μR/h for total count, from 1.4 to more than 3 % for potassium, from 2.7 to more than 8 ppm for equivalent uranium and from 5.5 to more than 15 ppm for equivalent thorium. This level is well-matched with younger granite, Duwi formation, parts of Dokhan volcanics and dispersed spots of older granite.

Careful examination of eU/eTh and eU/K ratio maps (Figs. 8&9) shows that, the distribution of eU/eTh and eU/K values are variable and spread over most geologic units, in the form of dispersed anomalies scattered in intermediate eU/eTh and eU/K background. The lowest values (less than 0.35 for eU/eTh and less than 1.2 for eU/K) are related to metavolcanics, metasediments and parts of younger granite. Meanwhile the highest values (more than 2.2 for eU/eTh and more than 17 for eU/K) are compatible with Duwi formation, Thebes formation, Dakhla formation and small parts of younger granite. Increasing of eU/eTh and eU/K values over the sedimentary rocks may be related to the uranium leaching process since it is mobile and leachable.

Different rock types have different characteristic concentrations of radioelements, potassium, uranium and thorium. Therefore, concentrations calculated from gamma -ray spectrometric data can be used to identify zones of consistent lithology and contacts between constraining lithologies (Duval, 1983).

It was noticed that, the highest light zones are clearly correlated with younger granitic rocks and some parts of Dokhan volcanics. Meanwhile, the poorly eU, eTh and K concentrations (black area in Fig. 10) covers metavolcanics, metasediments and metagabbro.

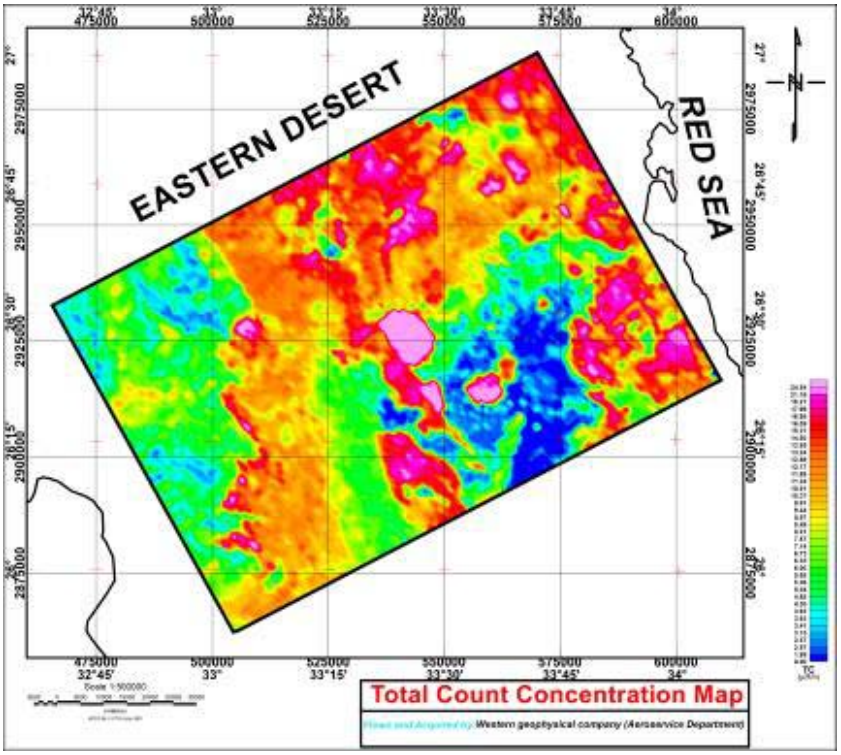


Figure (4): Filled Colour Contour Map of the Total Count Radiometric Data of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt

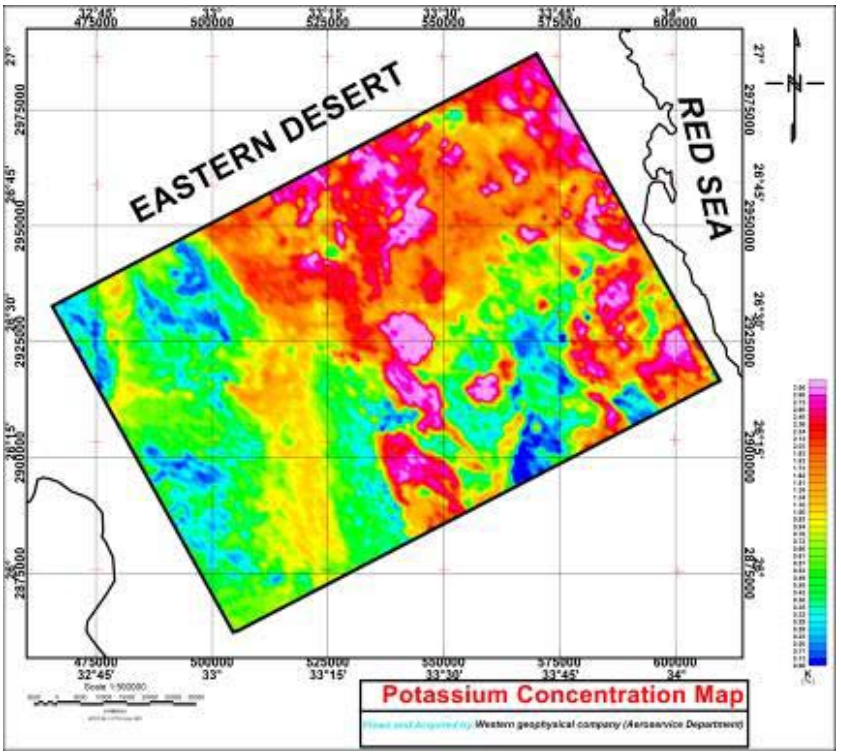


Figure (5): Filled Colour Contour Map of the Potassium Concentration of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt

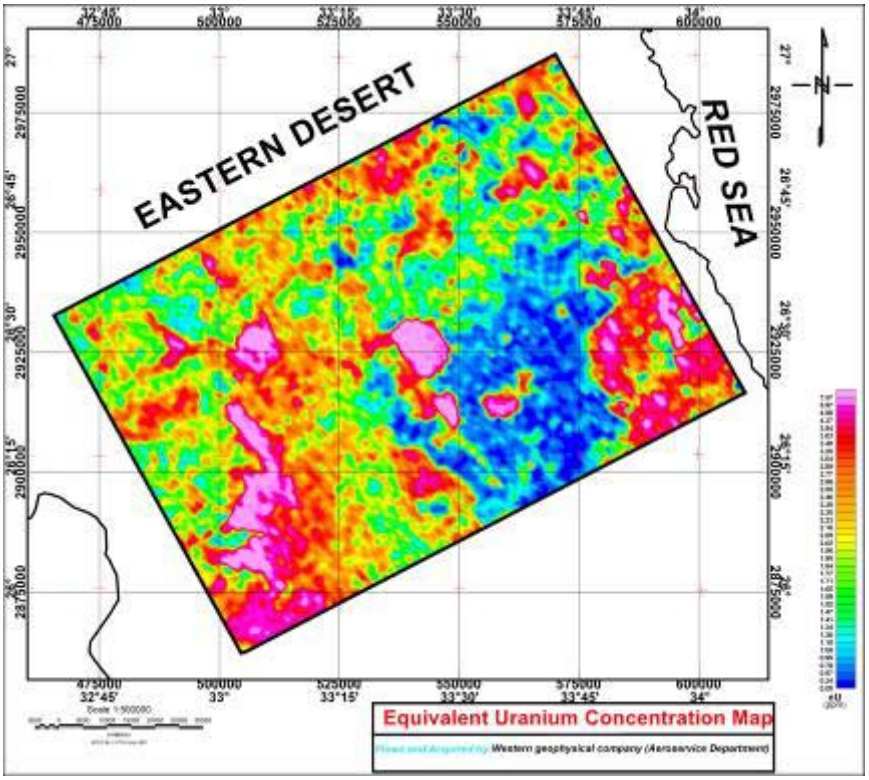


Figure (6): Filled Colour Contour Map of the Equivalent Uranium Concentration of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt.

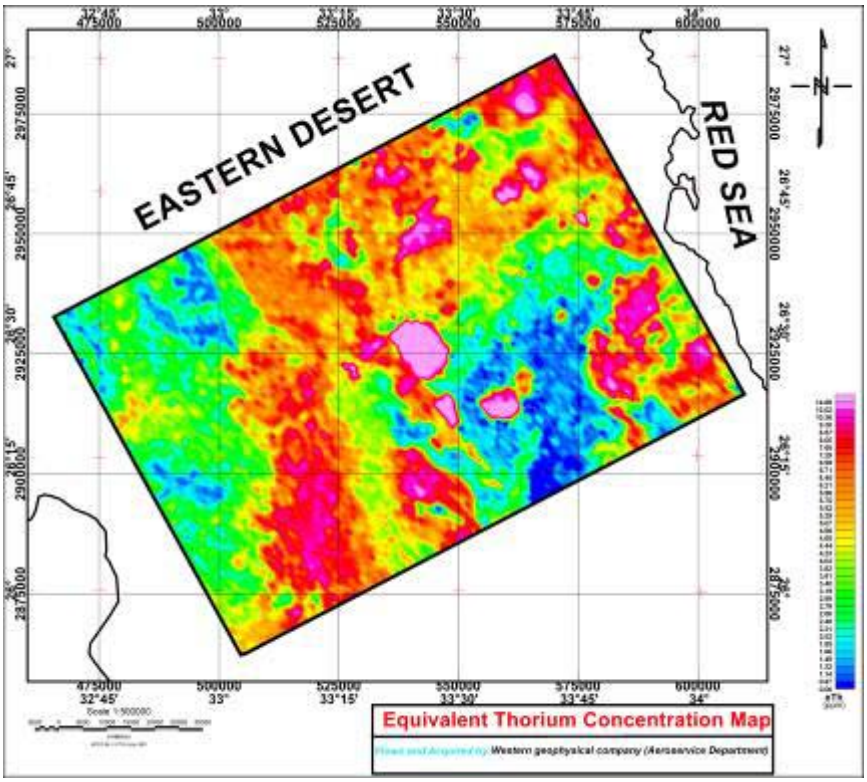


Figure (7): Filled Colour Contour Map of the Equivalent Thorium Concentration of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt.

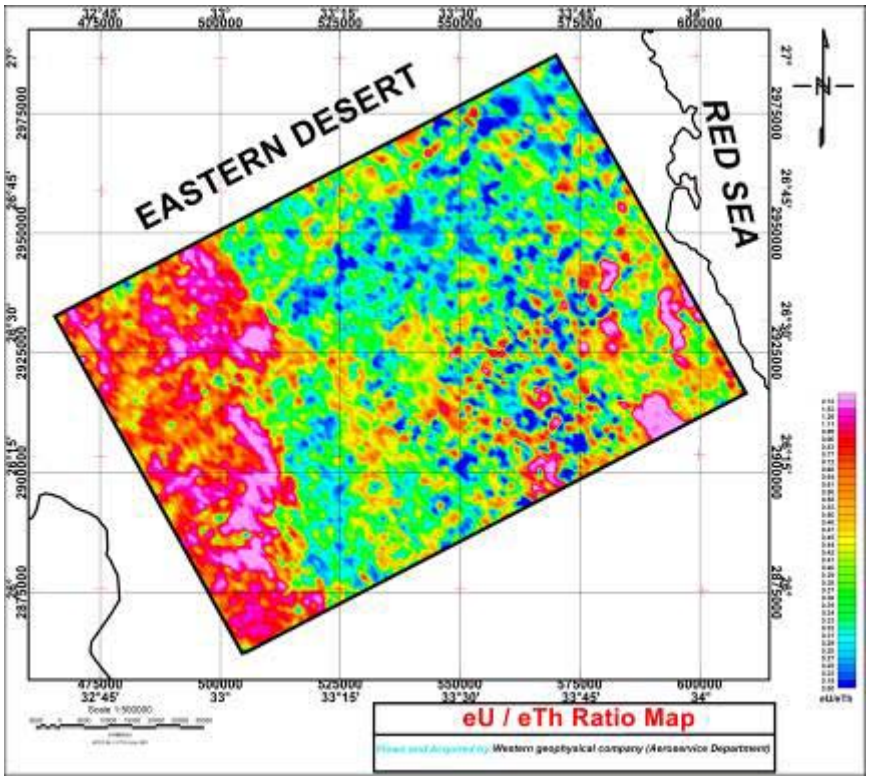


Figure (8): Filled Colour Contour Map of the Two-Radioelements (eU/eTh) Ratio of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt.

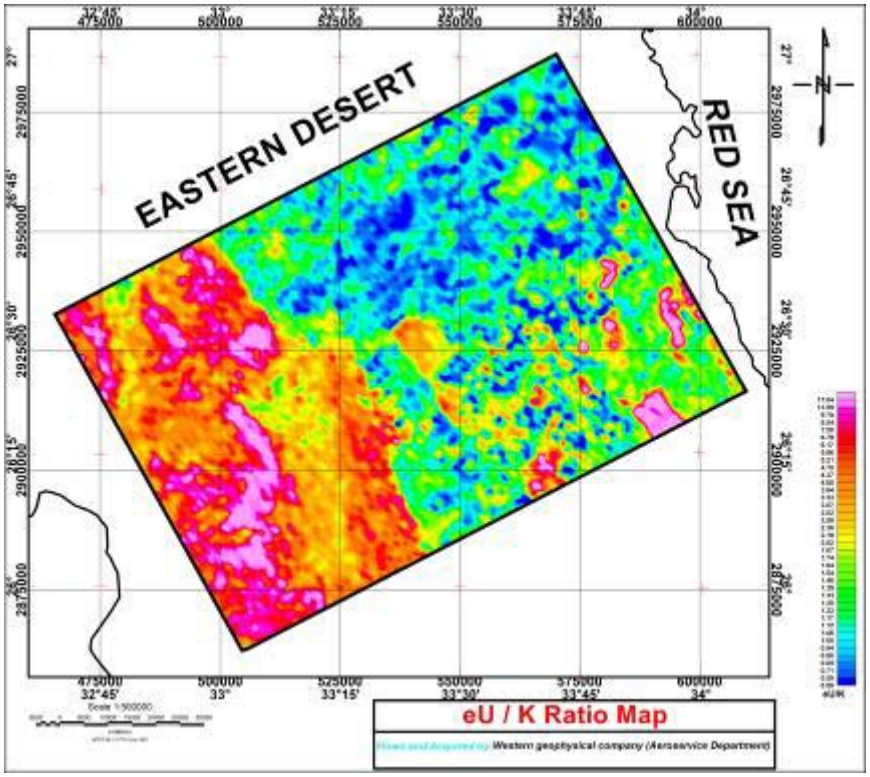


Figure (9): Filled Colour Contour Map of the Two-Radioelements (eU/eTh) Ratio of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt

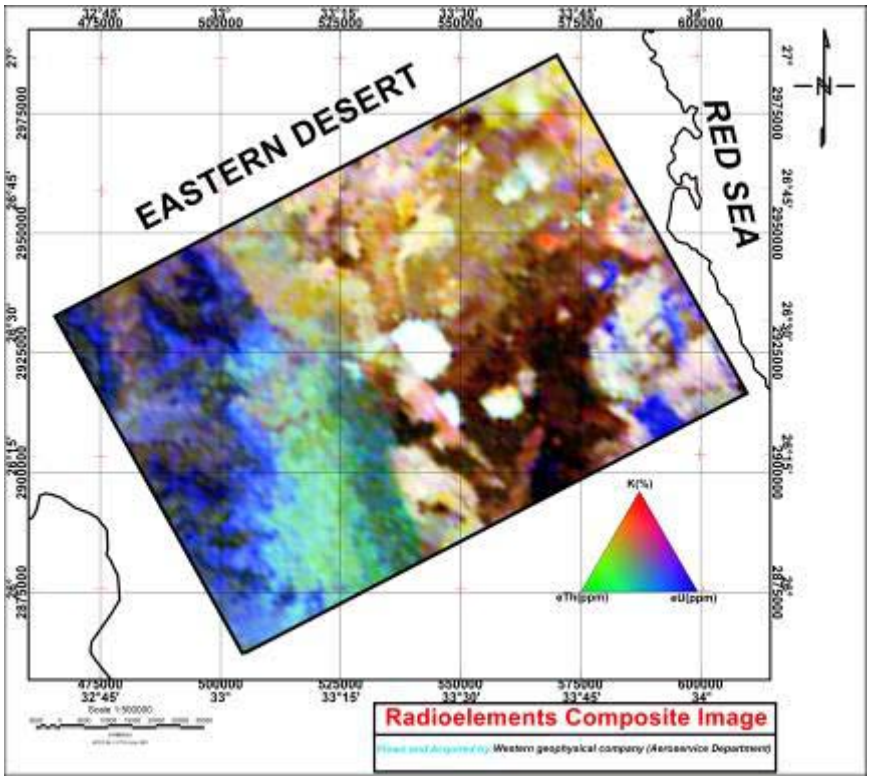


Figure (10): False Colour Radioelements Composite Image of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt.

b) Interpreted Radiometric Lithologic Unit (IRLU) Map

The construction of interpreted radiometric lithologic unit map can be achieved by applying the normality test and calculating the Chi-Square ($\chi 2$) test depending on total count values. The chi-square ($\chi 2$) test is carried out to test the degree of goodness of fit between the normal (theoretical) curve and the observed one. This test is used to measure the normality of the distribution by applying the following formula:

$$\chi^2 = \sum_{i=1}^{i=k} (f_i - F_i)^2 \Big/ F_i$$

where:

χ^2 = chi-square value,

k = total number of class intervals,

f_i = actual number of observations in the i^{th} category, and

F_i=theoretical frequency in the i^{th} category.

The area is covered by thirty three rock units of sedimentary rocks and basement complex, as given in the geologic map (Fig. 2). The univariate statistical analysis was carried out to obtain the arithmetic mean (X) and standard deviation (S) for each individual rock unit. The chi-square ($\chi 2$) test is applied to check the distribution of the variables, whether it is normal or non-normal. This was done by comparing the observed frequencies of the distribution with the theoretical normal curve having the same mean, standard deviation and total number of samples. After application of normality and chi square tests for every unit spectrometric data, it is found that there are twenty five rock units have normal histograms and eight don't have. The histograms of normal and non-normal rock units are represented in figures (11) and (12) respectively. The results of Chi-Square Test is tabulated in table (1). The rock units which is found to obey non-normal distribution are divided into two subunits as follow:

1- Melanocratic metamorphic rocks is divided statistically into two subunits, low total count subunit (gnm1) and high total count subunit (gnm2). The low total count subunit (gnm1) has a normal curve at category (k=7) and the high total count subunit (gnm2) has one at category number (k=8).
2- Metagabbro to metadiorite rocks is divided statistically into two subunits, low total count subunit (mg1) and high total count subunit (mg2). The low total count subunit (mg1) has a normal curve at category (k=11) and the high total count subunit (mg2) has one at category number (k=9).
3- Ohiolitic Metagabbro rocks is divided statistically into two subunits, low total count subunit (mgo1) and high total count subunit (mgo2). The low total count subunit (mgo1) has a normal curve at category (k=12) and the high total count subunit (mgo2) has one at category number (k=10).
4- Gabbroic rocks is divided statistically into two subunits, low total count subunit (gb1) and high total count subunit (gb2). The low total count

subunit (gb1) has a normal curve at category (k=10) and the high total count subunit (gb2) has one at category number (k=8).

5- Younger granite rocks is divided statistically into two subunits, low total count subunit (gβ1) and high total count subunit (gβ2). The low total count subunit ($g_{\beta}1$) has a normal curve at category (k=15) and the high total count subunit ($g_{\beta}2$) has one at category number (k=11).
6- Dakhla Formation is divided statistically into two subunits, low total count subunit (Kud1) and high total count subunit (Kud2). The low total count subunit (Kud1) has a normal curve at category (k=12) and the high total count subunit (Kud2) has one at category number (k=10).
7- Esna Formation is divided statistically into two subunits, low total count subunit (Tpe1) and high total count subunit (Tpe2). The low total count subunit (Tpe1) has a normal curve at category (k=10) and the high total count subunit (Tpe2) has one at category number (k=7).
8- Fanglomerate is divided statistically into two subunits, low total count subunit (Qf1) and high total count subunit (Qf2). The low total count subunit (Qf1) has a normal curve at category (k=11) and the high total count subunit (Qf2) has one at category number (k=11).

After the calculating of Chi-Square values of the non-normal rock units and dividing theses rock units into two subunits according to total count concentration, another Chi-Square test is also performed to the subunits to check if it obey normal or non-normal distribution. The results of the Chi-Square test of these subunits (Table 2) showed that these subunits are following normal distribution. Therefore, the normal units and normal subunits was used to construct the interpreted radiometric lithologic unit (IRLU) map (Fig. 13).

c) Location of Uraniferous Leads

The main target of aerial prospection using gamma ray spectrometric survey data is the delineation of expected boundaries of potential uraniferous areas, in which the varying rock units are enriched in uranium (Saunders & Potts 1976). The most important parameters, which can be measured, are relative concentrations of uranium to thorium and uranium to potassium, taken in conjunction with uranium measurements.

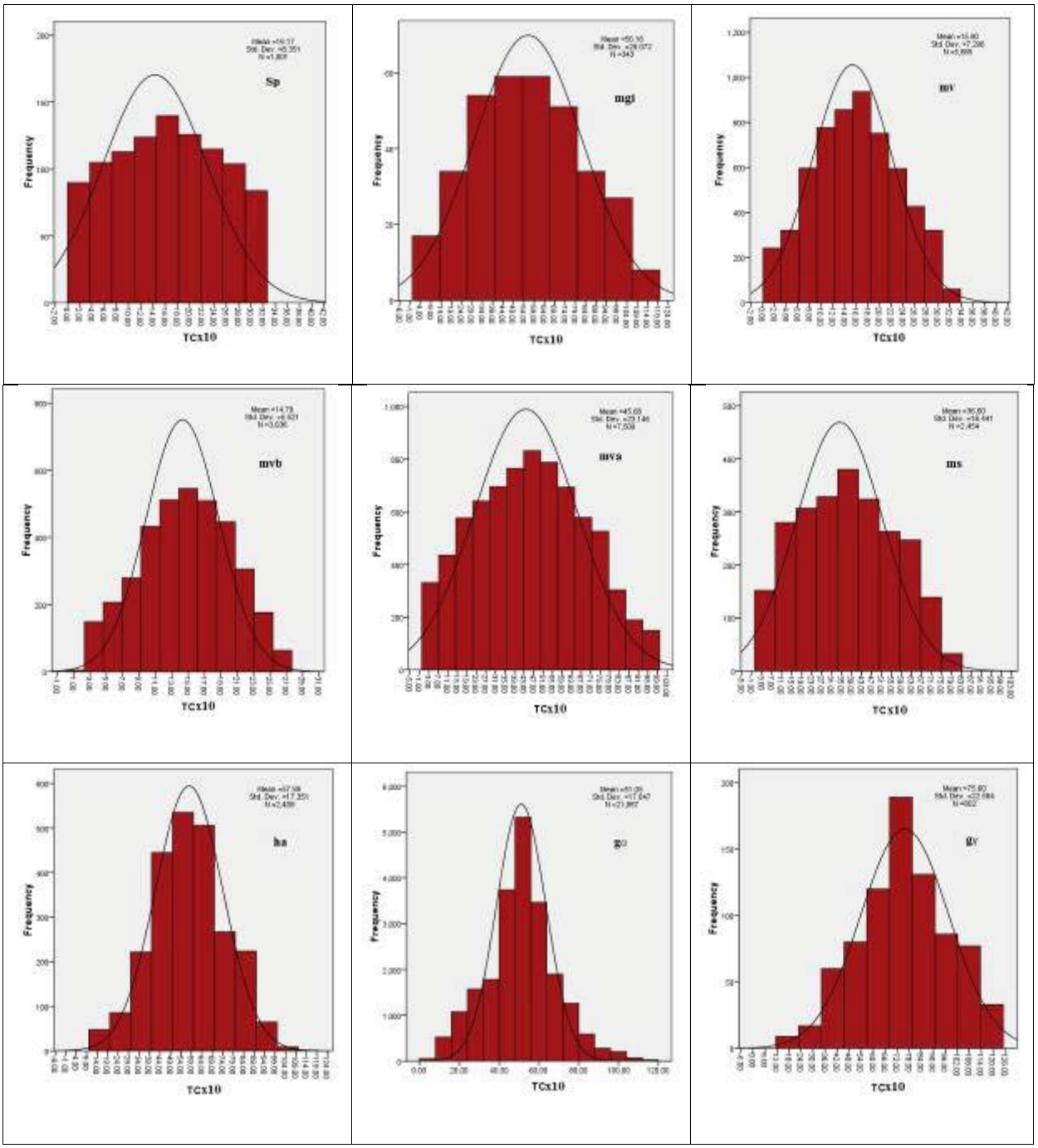
In this study, significant locations of eU anomalies are defined on the basis of calculation of probabilities, where their data differ significantly from the mean background, as defined by the data themselves, and at certain levels of probabilities these differences were computed. The high anomalous values are considered as the values equalling or exceeding at least two standard deviations from the calculated arithmetic mean values (X+2S) for eU, eU/eTh and eU/K measurements, for a single point in each rock unit. This acceptable technique was chosen for distinguishing between the normal and abnormal measurements, which could be anomalous values according to Saunders & Potts (1978) technique for calculating the significant factor of each radio-spectrometric variable in each rock unit. Calculations of arithmetic mean (X), standard deviation (S) and the values of (X+2S) for eU, eU/eTh and eU/K of each rock unit are summarized in tables (3, 4 & 5). Figure (14) shows the interpreted uranium point anomaly map of the study area, which possesses values exceeding X+2S for eU, eU/K and eU/eTh variables. Fifteen groups of statistically significant (anomalous) points can be distinguished on this map (Fig. 14). Anomalous locations are summarized in Table (6). The majority of uranium anomalous zones are related to younger granite, Duwi formation and parts of Dokhan volcanics.

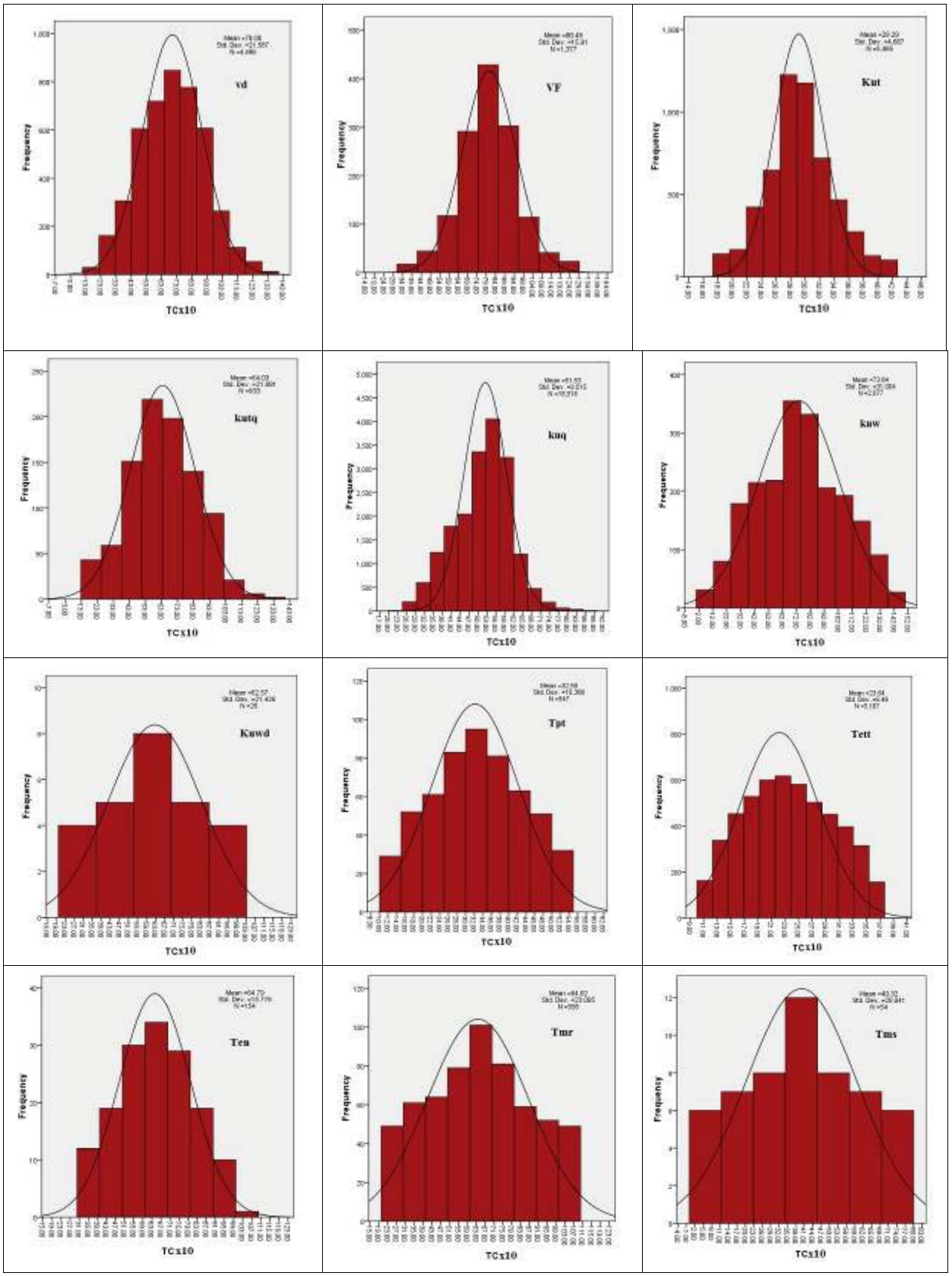
V. Concolusion

Qualitative Interpretation of all radiospectrometric maps prove that the highest values are related to younger granite, Duwi formation and parts of Dokhan volcanics.

After application of normality and chi square tests for every unit spectrometric data, it is found that there are twenty five rock units have normal histograms and eight don't have. The rock units which is found to obey non-normal distribution are divided into two subunits. Another Chi-Square test is also performed to the subunits to check if it obey normal or non-normal distribution. The results of the Chi-Square test of these subunits showed that these subunits are following normal distribution. Therefore, the normal units and normal subunits was used to construct the interpreted radiometric lithologic unit (IRLU) map.

Significant locations of eU anomalies are defined on the basis of calculation of probabilities, where their data differ significantly from the mean background, as defined by the data themselves, and at certain levels of probabilities these differences were computed. Fifteen groups of statistically significant (anomalous) points can be distinguished on IRLU map. The majority of uranium anomalous zones are related to younger granite, Duwi formation and parts of Dokhan volcanics.





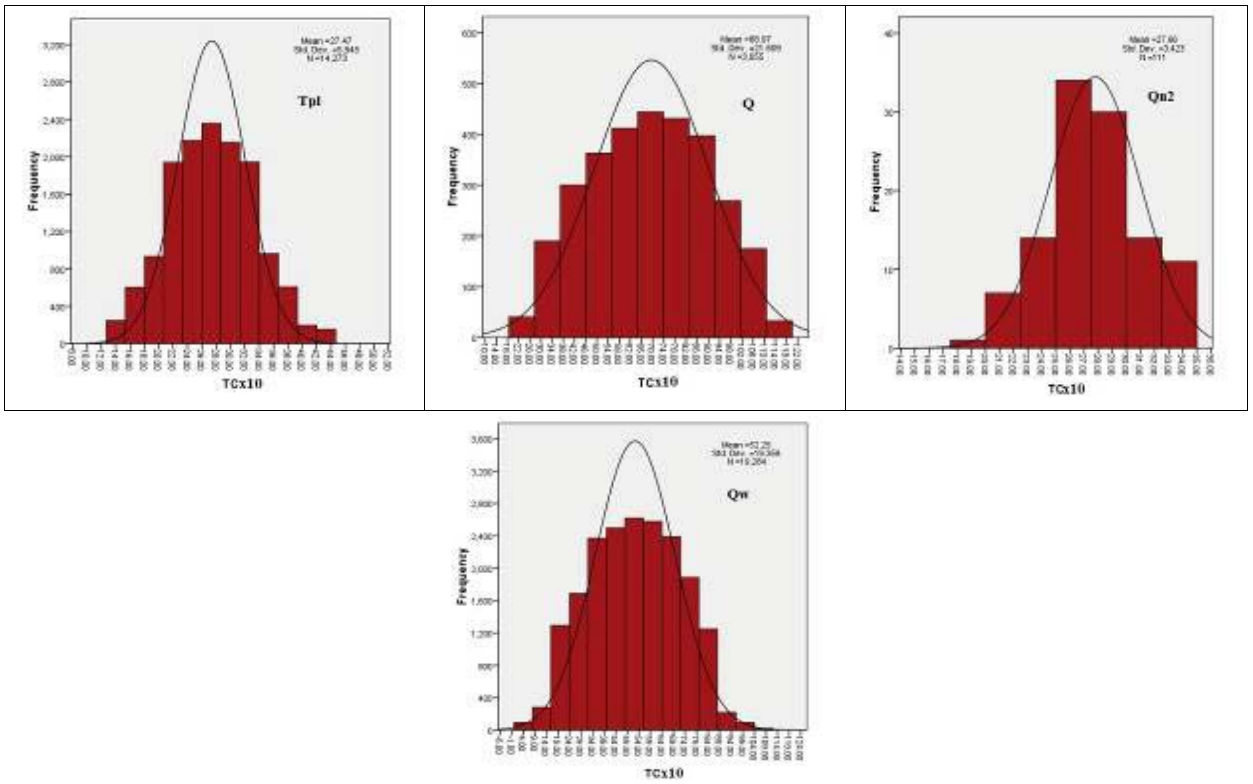
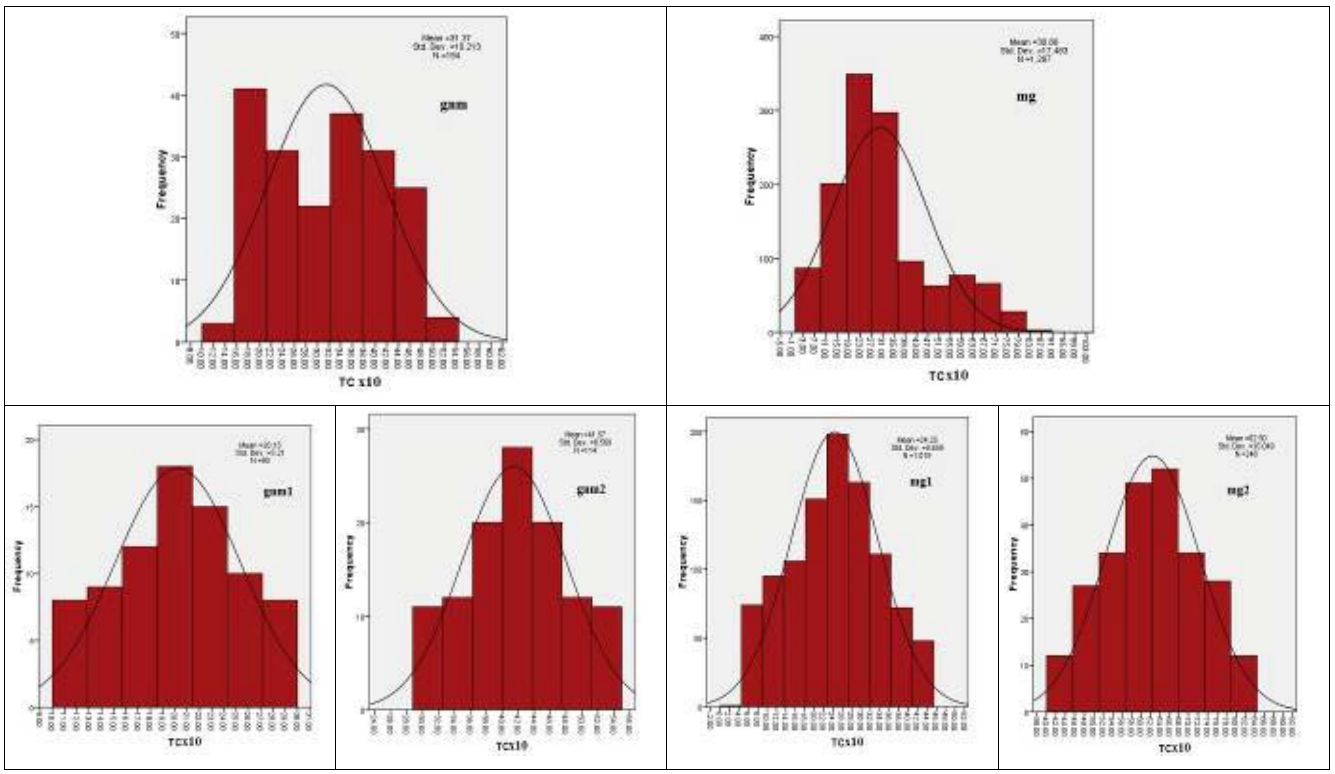
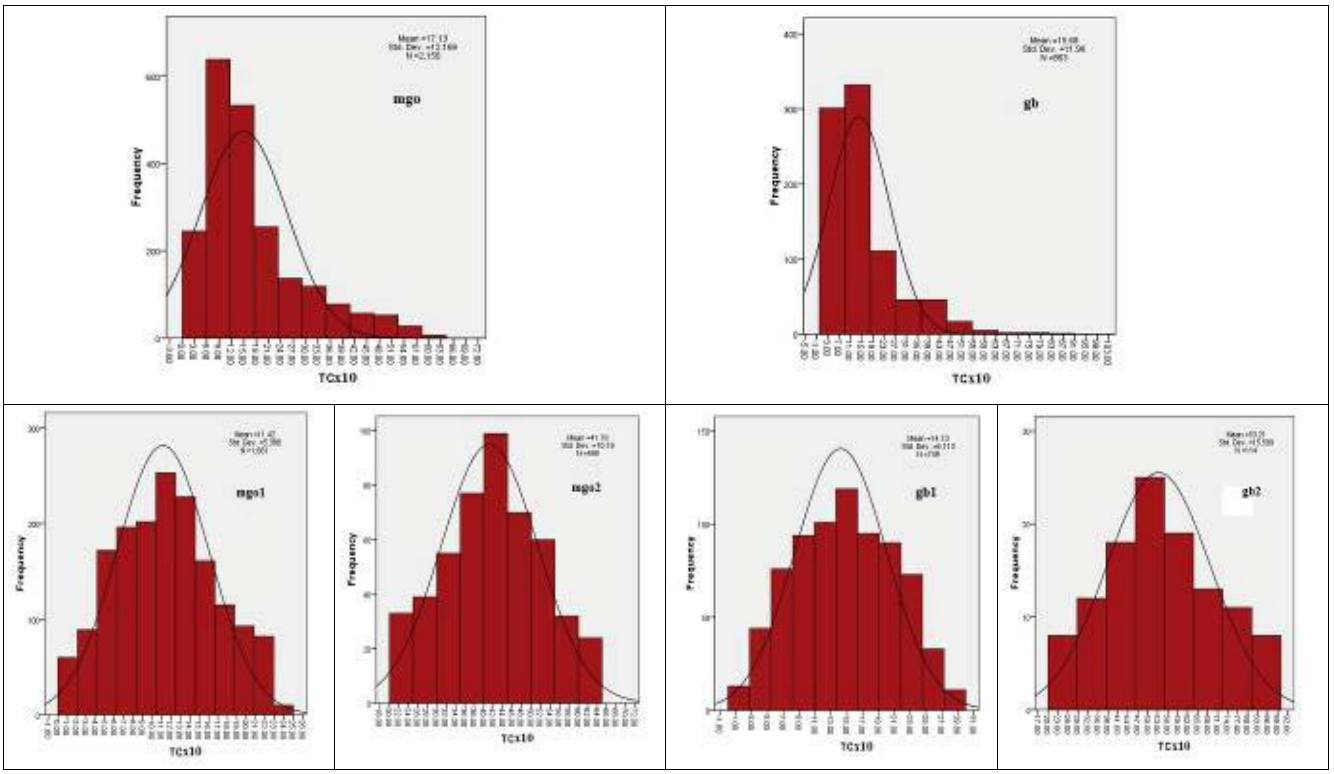
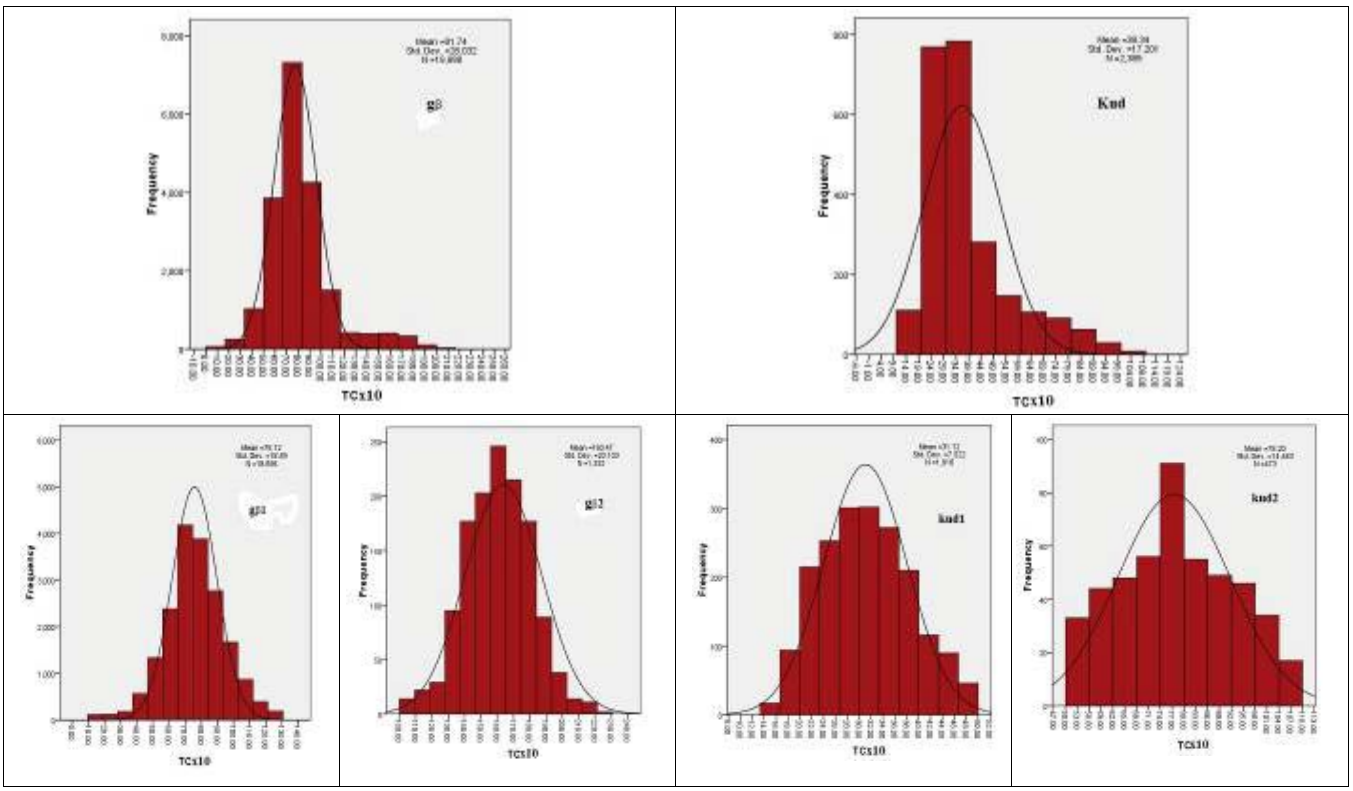


Figure (11): Frequency Distribution Histograms of Aerial Total Count Concentrations with Their Fitted Theoretical Curves of Normal Rock Units







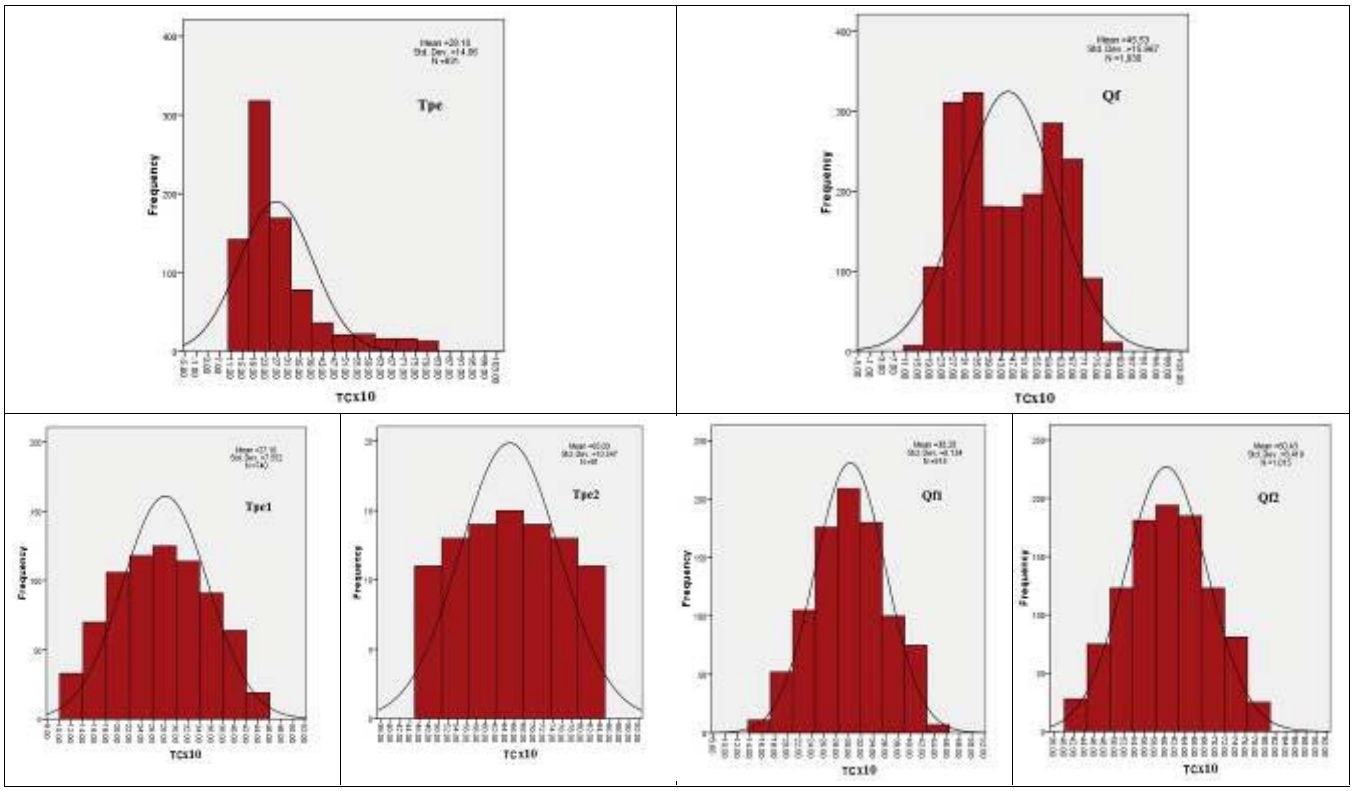


Figure (12): Frequency Distribution Histograms of Aerial Total Count Concentrations with Their Fitted Theoretical Curves of Non-Normal Rock Units and Its Subunits

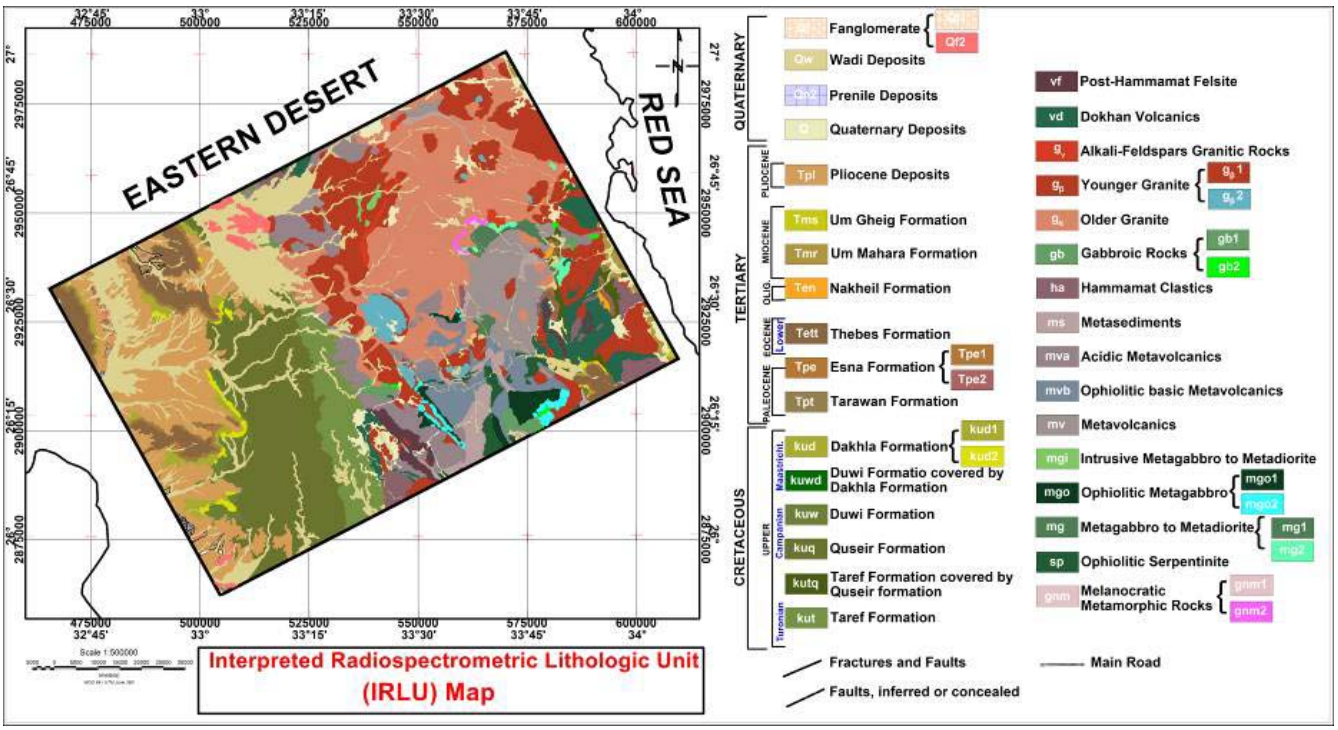


Figure (13): Interpreted Spectral Radiometric Lithological Unit (IRLU) Map of Qena-Quseir Shear Zone area, Central Eastern Desert, Egypt

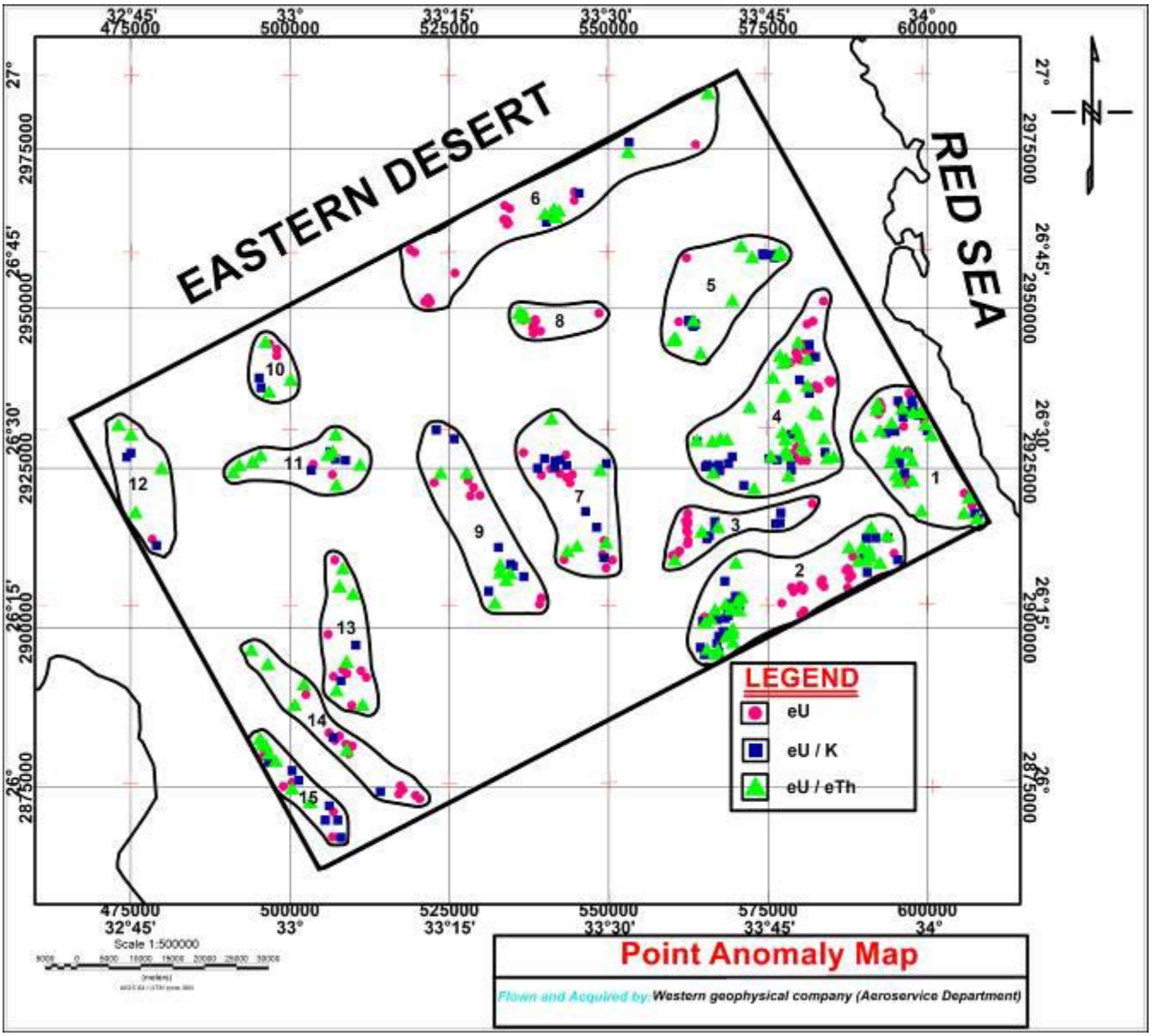


Figure (14): Uranium Point Anomaly Map of Qena-Quseir Shear Zone Area, Central Eastern Desert, Egypt

Table (1): Summary of the results of χ^2-test of the TC measurements of All Rock Units of Qena-Quseir Shear Zone Area, Central Eastern Desert, Egypt

No.	Rock Units	Theoritical Chi Value	Calculated Chi Value	K	Normality
1	gα	24.68	23.952	15	Normal
2	gβ	24.68	27.64	15	Not Normal
3	gb	19.68	22.01	11	Not Normal
4	gγ	19.68	18.67	11	Normal
5	gnm	16.92	19.51	9	Not Normal
6	ha	21.03	21.61	12	Normal
7	Kud	21.03	23.94	12	Not Normal
8	Kuq	24.68	28.76	15	Normal

9	Kut	22.36	21.98	13	Normal
10	Kutq	19.68	19.52	11	Normal
11	Kuw	21.03	21.5	12	Normal
12	Kuwd	12.22	12.08	6	Normal
13	mg	19.68	22.98	11	Not Normal
14	mgi	16.92	15.99	9	Normal
15	mgo	21.03	24.21	12	Not Normal
16	ms	21.03	21.52	12	Normal
17	mv	22.36	22.03	13	Normal
18	mva	23.68	24	14	Normal
19	mvb	22.36	22.05	13	Normal
20	Q	22.36	22.52	13	Normal
21	Qf	21.03	24.55	12	Not Normal
22	Qn2	15.05	14.74	8	Normal
23	Qw	24.68	24.59	15	Normal
24	Sp	19.68	19.23	11	Normal
25	Ten	15.05	14.52	8	Normal
26	Tett	22.36	22.05	13	Normal
27	Tmr	20.48	20.05	10	Normal
28	Tms	13.23	13.08	7	Normal
29	Tpe	19.68	24.06	11	Not Normal
30	Tpl	24.68	24.72	15	Normal
31	Tpt	20.48	20.91	10	Normal
32	Vd	22.36	22.52	13	Normal
33	Vf	19.68	19.73	11	Normal

Table (2): Summary of the results of χ^2-test of the TC measurements of Non-Normal Rock Units and Its Subunits of Qena-Quseir Shear Zone Area, Central Eastern Desert, Egypt

No.	Rock Units	SubUnits	Theoritical Chi	Calculated Chi	K	Normality
1	gnm	gnm1	13.23	13.12	7	Normal
		gnm2	15.05	14.81	8	Normal
2	mg	mg1	19.68	19.47	11	Normal
		mg2	16.92	16.78	9	Normal
3	mgo	mgo1	21.03	20.94	12	Normal
		mgo2	20.48	20.31	10	Normal
4	gb	gb1	20.48	20.27	10	Normal
		gb2	15.05	14.89	8	Normal
5	gβ	gβ1	24.68	24.09	15	Normal
		gβ2	19.68	19.51	11	Normal
6	Kud	Kud1	21.03	20.87	12	Normal
		Kud2	20.48	20.36	10	Normal
7	Tpe	Tpe1	20.48	20.25	10	Normal
		Tpe2	13.23	13.15	7	Normal
8	Qf	Qf1	19.68	19.55	11	Normal
		Qf2	19.68	19.43	11	Normal

Table (3): Statistical Analysis of the (eU) Content in the Different Lithologic Units

Data	L.U	Range		Mean(X)	S.D (S)	X+1S	X+2S	X+3S
		Mini.	Maxi.					
eU (ppm)	gnm	0.09	2.56	1.08	0.44	1.52	1.96	2.4
	sp	0	7.03	0.75	0.91	1.66	2.57	3.48
	mg	0.04	3.6	1	0.67	1.67	2.34	3.01
	mgo	0	4.03	0.77	0.58	1.35	1.93	2.51
	mgi	0.2	3.33	1.33	0.78	2.11	2.89	3.67
	mv	0	5.29	0.77	0.56	1.33	1.89	2.45
	mvb	0	6.78	0.64	0.49	1.13	1.62	2.11
	mva	0	7.88	1.45	0.96	2.41	3.37	4.33
	ms	0	6.11	1.15	0.78	1.93	2.71	3.49
	ha	0.18	12.24	2.38	0.99	3.37	4.36	5.35
	gb	0.04	2.07	0.68	0.43	1.11	1.54	1.97
	gα	0	16.02	1.66	0.92	2.58	3.5	4.42
	gβ	0	18.83	3.03	2.09	5.12	7.21	9.3
	gγ	0	4.92	2.23	0.96	3.19	4.15	5.11
	vd	0.27	8.54	2.75	0.99	3.74	4.73	5.72
	vf	0.78	8.17	2.93	0.98	3.91	4.89	5.87
	kut	0.53	4.91	1.97	0.48	2.45	2.93	3.41
	kutq	0.33	19.07	6.21	3.64	9.85	13.49	17.13
	kuq	0.76	18.15	3.19	1.53	4.72	6.25	7.78
	kuw	1.44	25.98	9.02	4.45	13.47	17.92	22.37
	kuwd	1.22	9.93	5.46	2.68	8.14	10.82	13.5
	kud	0.96	20.91	4.34	2.97	7.31	10.28	13.25
	Tpt	0.82	7.11	2.56	1.14	3.7	4.84	5.98
	Tpe	0.28	17.01	3.01	2.11	5.12	7.23	9.34
	Tett	0.74	12.94	2.13	1.22	3.35	4.57	5.79
	Ten	1.99	5.76	3.39	0.92	4.31	5.23	6.15
	Tmr	0.42	13	3.67	2.06	5.73	7.79	9.85
	Tms	0.13	3.72	1.52	1	2.52	3.52	4.52
	Tpl	0.44	17.4	2.42	1.3	3.72	5.02	6.32
	Q	0.14	13.32	3.09	1.64	4.73	6.37	8.01
	Qn2	1.75	2.66	2.11	0.17	2.28	2.45	2.62
	Qw	0	16.1	2.4	1.35	3.75	5.1	6.45
	Qf	0.84	5.8	2.42	0.72	3.14	3.86	4.58

Table (4): Statistical Analysis of the (eU / eTh) Content in the Different Lithologic Units

Data	L.U	Range		Mean(X)	S.D (S)	X+1S	X+2S	X+3S
		Mini.	Maxi.					
	gnm	0.05	0.56	0.35	0.1	0.45	0.55	0.65
	sp	0	5.05	0.68	0.55	1.23	1.78	2.33
	mg	0.02	1.43	0.35	0.14	0.49	0.63	0.77
	mgo	0	4.08	0.48	0.42	0.9	1.32	1.74
	mgi	0.06	0.62	0.27	0.11	0.38	0.49	0.6
	mv	0	7.56	0.4	0.27	0.67	0.94	1.21
	mvb	0	12.28	0.46	0.41	0.87	1.28	1.69
	mva	0	36.8	0.38	0.44	0.82	1.26	1.7
	ms	0	4.57	0.49	0.36	0.85	1.21	1.57

eU / eTh	ha	0.1	3.77	0.44	0.26	0.7	0.96	1.22
	gb	0.03	2.93	0.47	0.28	0.75	1.03	1.31
	gα	0	2.08	0.34	0.12	0.46	0.58	0.7
	gβ	0	3.27	0.37	0.12	0.49	0.61	0.73
	gγ	0	1.13	0.31	0.12	0.43	0.55	0.67
	vd	0.12	2.75	0.43	0.14	0.57	0.71	0.85
	vf	0.16	0.88	0.38	0.09	0.47	0.56	0.65
	kut	0.17	0.92	0.43	0.09	0.52	0.61	0.7
	kutq	0.23	6.86	1.63	1.31	2.94	4.25	5.56
	kuq	0.14	4.4	0.49	0.34	0.83	1.17	1.51
	kuw	0.31	6.88	2.13	1.05	3.18	4.23	5.28
	kuwd	0.39	2.13	1.04	0.52	1.56	2.08	2.6
	kud	0.27	6.21	1.46	0.81	2.27	3.08	3.89
	Tpt	0.32	4.13	1.2	0.51	1.71	2.22	2.73
	Tpe	0.16	6.02	1.39	0.77	2.16	2.93	3.7
	Tett	0.27	6.51	1.3	0.78	2.08	2.86	3.64
	Ten	0.32	3.25	0.78	0.57	1.35	1.92	2.49
	Tmr	0.06	6.03	0.95	0.87	1.82	2.69	3.56
	Tms	0.13	0.78	0.48	0.13	0.61	0.74	0.87
	Tpl	0.12	4.16	0.8	0.36	1.16	1.52	1.88
	Q	0.02	3.7	0.48	0.32	0.8	1.12	1.44
	Qn2	0.53	0.89	0.67	0.08	0.75	0.83	0.91
	Qw	0	4.96	0.54	0.36	0.9	1.26	1.62
	Qf	0.16	1.98	0.58	0.29	0.87	1.16	1.45

Table (5): Statistical Analysis of the (eU / K) Content in the Different Lithologic Units

Data	L.U	Range		Mean(X)	S.D (S)	X+1S	X+2S	X+3S
		Mini.	Maxi.					
eU / K	gnm	0.22	2.14	1.19	0.38	1.57	1.95	2.33
	sp	0	19.12	3.43	3.08	6.51	9.59	12.67
	mg	0.06	5.94	1.16	0.63	1.79	2.42	3.05
	mgo	0	20.15	1.9	2.07	3.97	6.04	8.11
	mgi	0.15	1.81	0.79	0.35	1.14	1.49	1.84
	mv	0	10.98	1.38	0.92	2.3	3.22	4.14
	mvb	0	16.83	1.78	1.41	3.19	4.6	6.01
	mva	0	8.85	1.35	0.78	2.13	2.91	3.69
	ms	0	37.2	1.59	1.52	3.11	4.63	6.15
	ha	0.28	22.11	1.64	1.43	3.07	4.5	5.93
	gb	0.06	11.61	2.12	1.55	3.67	5.22	6.77
	gα	0	13.37	1.04	0.47	1.51	1.98	2.45
	gβ	0	6.64	1.22	0.67	1.89	2.56	3.23
	gγ	0	3.91	0.86	0.43	1.29	1.72	2.15
	vd	0.47	18.55	1.44	0.7	2.14	2.84	3.54
	vf	0.49	3.12	1.19	0.35	1.54	1.89	2.24
	kut	0.48	49.97	4.62	2.12	6.74	8.86	10.98
	kutq	0.73	52.82	9.83	10.11	19.94	30.05	40.16
	kuq	0.52	36.97	4.43	3.28	7.71	10.99	14.27
	kuw	1.53	58.75	18.07	9.2	27.27	36.47	45.67

	kuwd	1.27	7.51	3.45	1.66	5.11	6.77	8.43
	kud	1.53	58.75	12.2	7.32	19.52	26.84	34.16
	Tpt	2.02	40.62	9.41	5.58	14.99	20.57	26.15
	Tpe	0.3	36.81	9.73	5.97	15.7	21.67	27.64
	Tett	1.22	47.09	8.79	5.87	14.66	20.53	26.4
	Ten	1.12	24.03	3.45	3.98	7.43	11.41	15.39
	Tmr	0.16	33.82	3.94	4.88	8.82	13.7	18.58
	Tms	1.03	2.66	1.69	0.45	2.14	2.59	3.04
	Tpl	0.55	47.44	5.89	3.55	9.44	12.99	16.54
	Q	0.06	18.99	1.86	1.65	3.51	5.16	6.81
	Qn2	3.51	7.18	4.92	0.79	5.71	6.5	7.29
	Qw	0	33.12	3.03	3.34	6.37	9.71	13.05
	Qf	0.67	24.55	3.4	2.75	6.15	8.9	11.65

Table (6): Anomalous Locations at Qena-Quseir Shear Zone Area, Central Eastern Desert, Egypt

No	UTM of anomaly Center		Trend	Anomaly Result From	Rock Types	Rocks Location
	X	Y				
1	598414	2925427	NW-SE	eU, eU/K, eU/eTh	gβ-Vd-ha-Kuwd-Kutq-Tmr-Tett-Q	East G. Umm Zarabit
2	579925	2906524	ENE-WSW	eU, eU/K, eU/eTh	gβ-Vd-ha-Kuw-Kutq-mgo-gb-ms	South G. Halham
3	570405	2916596	ENE-WSW	eU, eU/K, eU/eTh	gβ-Vd-mv-mvb-gb-ms-sp	NE G. Umm El-Abas
4	576338	2933567	NE-SW	eU, eU/K, eU/eTh	gβ-gα-Vd-mg-ms-mv-Vf-Tett-Tpt	NE G. Abu-Aqarib
5	566128	2953436	ENE-WSW	eU, eU/K, eU/eTh	gβ-gα-mgi-mg-gnm-Q	NW G. Nuqara
6	539843	2967164	ENE-WSW	eU, eU/K, eU/eTh	gβ-gα-mv-mva-Vd-ha-ms-Q	G. Fatira
7	545362	2919977	N-S	eU, eU/K, eU/eTh	gβ-gα-ms-mvb-mva-gb	West G. Semna
8	542051	2947572	E-W	eU, eU/eTh	gβ-gα-mgi-Q-Kut-Kuq	G. Abu-Shihat
9	529357	2915286	NNW-SSE	eU, eU/K, eU/eTh	gα-mva-Vd-Q	West G. Missikat El-Gukh
10	497623	2940121	N-S	eU, eU/K, eU/eTh	Tpl-Qw-Kud-Tett-Ten-Tmr	G. Abu-Had
11	501762	2925496	E-W	eU, eU/K, eU/eTh	Tpl-Kuw-Kud-Tett-Ten-Tmr-Kuq	North G. Qreiya
12	476375	2922460	N-S	eU/K, eU/eTh	Tpl-Tpt-Tpe-Ten-Tmr-Kud-Qf-Qn2	NW W. El-Qreiya
13	508661	2898177	N-S	eU, eU/K, eU/eTh	Kuw-Kuq-Kud-Qw-Ten-Tmr	West W. El-Atwani
14	507557	2882724	NW-SE	eU, eU/K, eU/eTh	Tpl-Tpe-Ten-Tett-Kuw-Kud-Kuq	West W. Abu-Tenadib
15	502038	2874169	NW-SE	eU, eU/K, eU/eTh	Qw-Qf-Qn2-Tpl-Kuw	West W. Abu-Tenadib

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Rotifera Abundance and Species Diversity in Al-Kufa River, Iraq

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Abstract- The present study was carried out on AL-Kufa River in the middle of Iraq to study the biodiversity of rotifera by investigating some of biodiversity index values. The samples were collected monthly, from March 2012 till February 2013, at four selected stations on the river; the first is located in Al-Kifil City, the second in Al- Kufa City, the third in AbuSkhar City and the fourth after Al- Mushkab City. About 92 Taxa of rotifera was identified. The rotifera density recorded ranged from 425 to 17925 Ind./m^3, the high values were in Spring and Autumn, while the lowest values were recorded in Summer and Winter. The results of the relative abundance index showed that *Keratella cochlearis, K. valga, Euchlanis delatata* were more abundant in the Kufa River. Also the results of constancy index showed 9 taxa belonged to rotifera which were considered "Constant" at all stations. The other taxonomic units ranged between emergency and additive according to its presence in the study stations.

GJSFR-H Classification: *FOR Code: 050199*

Strictly as per the compliance and regulations of :

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Muhanned R. Nashaat [α], Khalid A. Rasheed [σ] & Hussein A. Hassan [ρ]

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The values of the species richness index of rotifera varied from 3.42 to18.26 with the greatest values in April ,while lower values in September and June. The Shanon-Weiner index of rotifera ranged from 1.85 to 3.78 bits/Ind., with the highest values in April 2012 and September 2012, while lower values in June 2012 and January 2013. The uniformity index of rotifera varied from 0.01 to 0.9,these high values indicate that there is no ecological stresses on zooplankton in the study area.

I. Introduction

The rotifera play an important role in the freshwater ecosystem as optional feeders on phytoplankton and planctonic bacteria, which considered as predators (Aronovich and Spektova, 1974), most rotifera feed on algae or minutes that less than 20μ in length, but some types can engulf the cells with a total length of 48μ (Erdugan and Guher, 2005). Research has shown a clear interest in studying the rotifera, Mohammed (1986) studying the presence of rotifera in the Euphrates River and found that they are dominant quantitatively and qualitatively, especially the species belonging to the genera *Brachionus* and *Keratella* and *Polyarthra*. Al-Saboonchi *et al.* (1986) identified in their study on the marshes of Iraq's, 32 species of zooplankton were belogated to the 19 species of rotifera, 7 species of copepoda and 6 species of cladocera, the study pointed out that the highest growth of zooplankton occurs at the end of the Spring, and less growth in the Summer, while the rotifera characterized as dominant group, also had considered *Lecane* the most dominant of the rest of the rotifera . Saadallah (1998) showed in his study the impact of Hamrin impoundment on the Diyala River and identified 88 taxonomic units in five locations, the rotifera was the dominant group in that study, and the *K.quadrata, Keratella cochalaris, Polyarthra dolicoptera*, recorded a higher percentage of the total population density of the zooplankton community. Al-Lami (2000) studied the presence of zooplankton in the Tigris and Atham rivers, 38 taxonomic units were recorded with highly occupied of rotifera, while the genus *Brachionus* and *Keratella* recorded the largest number of species.

Kufa River is of great important sources of water in a wide agriculture area, drinking water, different human uses and as a source of fisheries. Due to the lack of studies on the biological diversity of this river, the current study was conducted, which aimed to recognize the quantity and quality of rotifera stationed in Kufa River and the biodiversity of rotifera within the study area by applying some biological indicators index.

II. Materials and Methods

a) Study area

Euphrates River originates from southeastern Turkey and estimated about 2290 Km in length (Al-Masoudi, 2000) it passing inside Iraqi territory for a distance of 1159 Km without any tributary, then extends 150 Km south of Ramadi Province, where Al-Hindia Dam. Then divided into two major branches, the Al-Hindiah River and Al- Hilla River, then the river being from Al-Hindia Dam at a distance of 180km even Al- Kfel district then divided after about 1Km to Al-Abasya and Kufa Rivers. The length of Kufa River within the province of Najaf, about 75.2 Km and discharge is controlled through Kufa Dam.

Four stations were selected for water sample collection. The first station in Al-Kfel City about 1Km. The second station is located after the departure of the river from Al- Kufa City about 2Km, it away approximately 22Km from the first station, the third station is located within an agricultural area in the Gurf Al-Sakhar City and lies about 20Km away from the second station. Fourth station is located at the exit of the river from the Meshkab City about 10Km, its about 20Km away from the third station (Figure 1).

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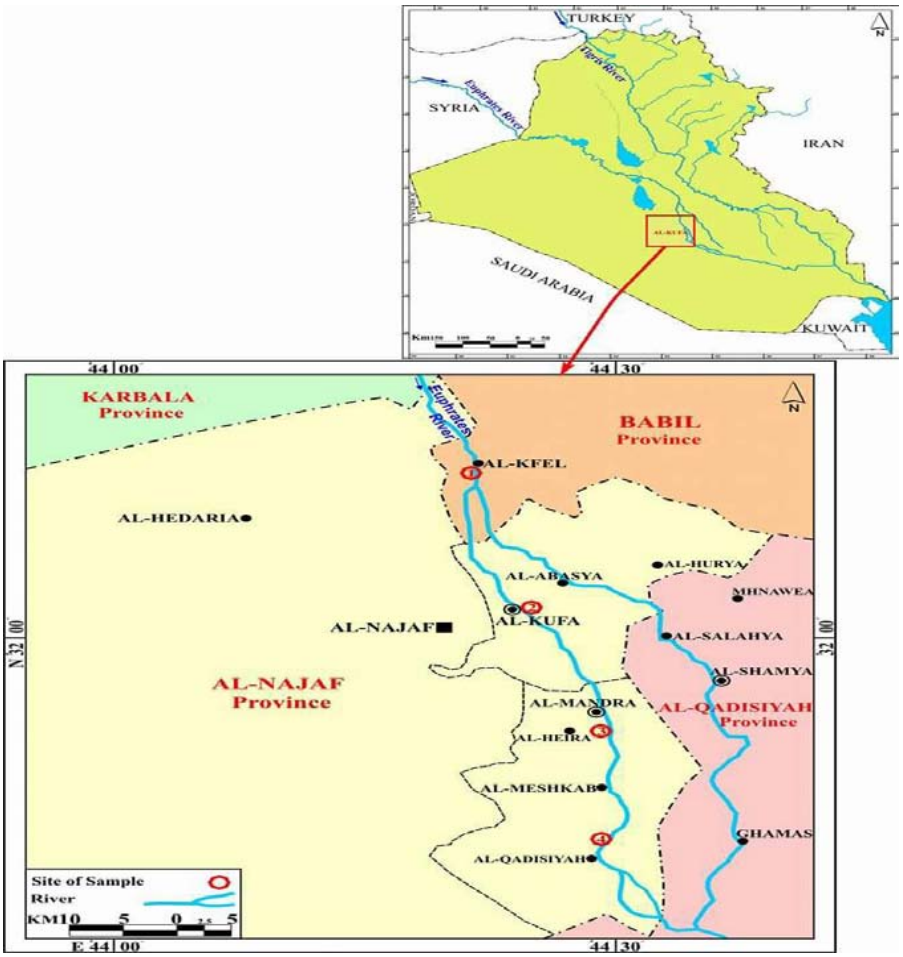

Figure (1): Map showing the study stations in Kufa River

For the purpose of this study 40 liters of water passage through plankton net type (Hydro-bios) with opening diameter 55μ. Samples were concentrated to 10ml and was keeping in bottles after addition of 4% formalin. The sample identfied and counted using a compound microscope depending on (Edmondson, 1959; Pennak, 1978; Pontin, 1978), the results expressed as individual/m^3. Environmental indicators were accounted for as follows: (1) Relative abundance index (Ra): according to the formula contained in Omori & Ikeda (1984). (2) Constancy index (S): the existence and frequency of each type of account according to the formula contained in Serafim *et al*.(2003). (3) Species richness index (D): calculated monthly according to the formula set out in Sklar(1985). (4) Shannon-Wiener index of diversity (H): monthly calculated from this value used the Shannon-Weiner equation as stated in Floder & Sommer (1999). Results expressed as bits/individual. The bit is equal one piece of information, the values less than 1 bit, means have low diversity, while more of 3 bits means high diversity. (5) Species uniformity index (E): this index is computed according to the formula contained in Neves *et al*. (2003),the values greater than 0.5 as equal or homogeneous in appearance (Proto-Neto, 2003).

III. Results and Discussion

The rotifera varied in its density in Kufa River depending on the different of months and study station. Station 1 recorded a higher density of rotifera in October 2012 with 17.925 Ind./m^3, while the lowest density was 425 Ind./m^3 during July 2012 at station 2 (Figure 2).

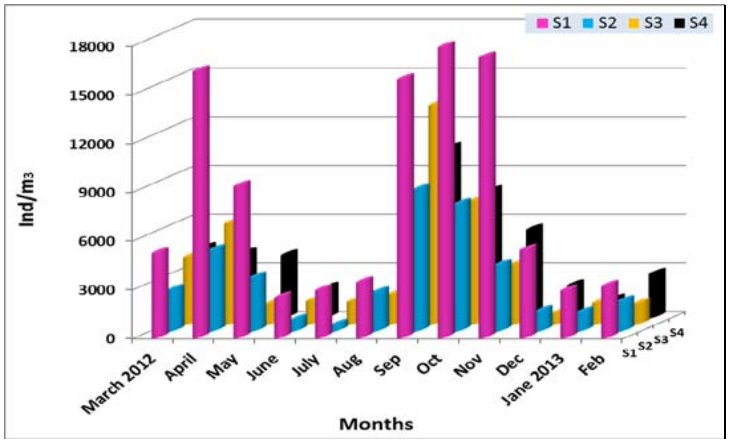

Figure (2): Total density of rotifera (Ind./m^3) in the study stations of Kufa River from March 2012 until February 2013

The high recording densities of rotifera occurred during Autumn season, especially in October, which may be related with the appropriate conditions such as:- temperature, high level of disolved oxygen and the availability of food, such as:- bacteria or phytoplankton or detritus (Dhanpathi, 2000). This result was agree with Mangalo and Akbar (1986) and Sabri *et al.* (1993) that considered the temperature and dissolved oxygen are the main factors that led to increasing the intensity of rotifera during Autumn season. The low values of rotifera density were recorded in the Summer season, which may go back to higher water temperatures, or a lack of dissolved oxygen, generally, the rotifera live with higher oxygen (Sladecek, 1983). Station 2 recorded the lowest population density of rotifera, the reason may be due to the occurrence of the station in the area receive a lot of human waste and the accompanying rise in the proportion of organic pollutants that lead to depletion of dissolved oxygen when organic pollutants degradation (Ahmad *et al*., 2011).

The relative abundance index of rotifera set out in the table (1), the proportion of the species displayed for each station in the study period, as follows: *Euchlanis delatata* recorded the highest percentage compared to the total density of other species at station 1 (12%), followed by the *Keratella valga* (10%), followed by *K. cochlearis* with (5%). *K. cochlearis* recorded the highest percentage compared to the total density of other species in station 2 (15%), followed by the *K.valga* that recorded 14%, followed by *Brachionus calyciflorus calyciflorus* 5%, while station 3 recorded the *K .valga* with the highest percentage compared to the total density of other species in this station reached to 14%, followed by *K. cochlearis* 13%, followed by *B. calyciflorus calyciflorus* 4%. Station 4 has recorded the *K. cochlearis* with highest percentage compared to the total density of other species (13%), followed by *K.valga* (11%) and *E. delatata* followed with 8% (Figure 3).

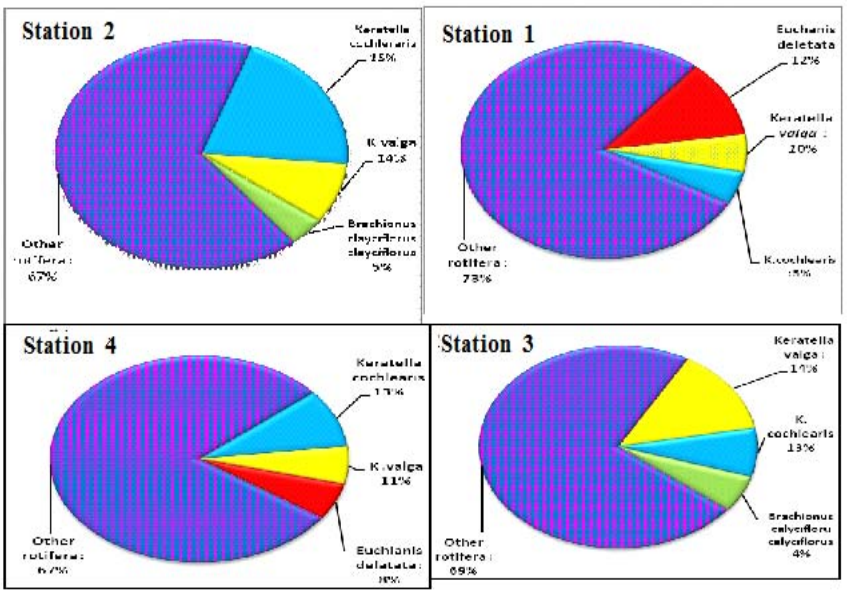

Figure (3): The relative abundance index of dominant rotifera in the study area from March 2012 to February 2013

The lack recording of relative abundance index values of the dominant species of rotifera, which failed to reach to the percentage of abundant species or prevalent as the relative abundance index, provides proof that the Kufa River has non-exposed to any type of environmental pressures during the study period, which may provide suitable for the dominant rotifera species to environment resistance (Ahmad *et al.*, 2011), Neves *et al.* (2003) shows that dominant one species or a few species in Lake Atalaia in Brazil due to the presence of high quantities of organic waste. Proto- Neto (2003) refer in his study on Ovia River in Nigeria, that the presence of many species in large numbers for any group gives evidence of a cleaner environment.

According to the constansy index these species: *Brachionus angularis*, *B. calyciflorus, Euchlanis delatata, Flinia longiseta, Keratella cochlearis, K. valga, Lepadella ovalis, Monostyla bulla, M. closterocerca* can be considered as the most frequent and so it is a constant species in Kufa river, according to this guide as it existed in 50% or more of the total samples in this study.

Nine constant taxa are unequally distributed in the study stations of Kufa River, with numbers 9,4,5,5 taxonomic unit at stations 1,2,3 and 4, respectively. Which formed 85%,41%,59% and 66% of total taxonomic units, respectively. Station 1 recorded more containment of constant species, while station 2 is less, reason for this is the fact that station 1 more environmentally stable than the rest of the stations, as observed through a high total density and diversity of this station, while station 2 was opposite of that. The species with hight frequency appearance often is that recorded with high densities in this study, may be dau to the widespread species in warm water with organic contamination (Hofman, 1998) or perhaps, species that have a wide range to withstand environmental conditions (Kulkarni and Surwase, 2013). The presence of large numbers with high frequency in the current study is compatible with (Porto-Neto, 2003) when he described the clean environment, which that contains a large number of species and high-frequency, especially species that are unbearable to the pollution. Sterner (2002) noted that the existence of the species belonging to the genera *Euchlanis*, *Filinia*, *Mytilinia* and *Monostyla* directory to clean environment.

Table (1): Taxonomic units of rotifera in Kufa River and relative abundance index (Ra Index) Constansy index (S Index). Represent R = Rare species (less than 10%), La = Less abundant species (10-40%), A = Abundant species (40-70%), D = Dominant species (greater than 70%) A = Accidental species (1%-25%), Ac= Accessory species (25% - 50%), C = Constant species (greater than 50%)

	Relative abundance Index				Constansy Index			
Station / Rotifera Taxa	1	2	3	4	1	2	3	4
Anuraeopsis fissa	R	-	R	R	Ac	-	Ac	A
Aspelta bidentata	R	-	-	-	Ac	-	-	-
Asplanchna priodonta	R	-	-	-	Ac	-	-	-
Brachionus angularis	R	R	R	R	C	C	C	C
B. bidentatus	R	R	R	R	Ac	Ac	Ac	Ac
B.calyciflorus amphiceros (long spine)	R	-	R	R	Ac	-	Ac	Ac
B.calyciflorus amphiceros (short spine)	R	R	R	R	Ac	Ac	Ac	Ac
B.calyciflorus calyciflorus	R	R	R	R	C	C	C	Ac
B. falcatus	R	R	R	R	Ac	A	Ac	A
B. haranansis	R	R	R	R	A	A		A
B. quadridentaths	R	R	R	R	Ac	A	Ac	A
B. rubens	R	R	R	R	Ac	A	Ac	A
B . urceolaris	R	R	R	R	Ac	Ac	Ac	Ac
B. zahniseri	-	R	-	-	-	A	-	-
Brachionus sp.	R	-	R	-	A	-	A	-
Cephalodella auriculata	R	R	R	R	Ac	Ac	Ac	Ac
C .intuta	-	-	R	-	-	-	A	-
C .mucronata	-	-	-	R	-	-	-	A
C . forficul	R	-	R	-	A	-	Ac	-
C. gibba	R	R	R	R	Ac	Ac	Ac	A
C. intilloides	R	-	-	-	Ac	-	-	-
Cephalodella sp.	R	-	-	-	A	-	-	-

Colurella adriatica	R	R	R	R	Ac	Ac	Ac	Ac
Colurella sp.	-	R	-	-	-	A	-	-
Dipluchlanis propatula	R	R	R	R	Ac	Ac	Ac	A
Euchlanis delatata	La	R	R	R	C	Ac	Ac	C
Flinia longiseta	R	R	R	R	C	Ac	C	A
F. opliensis	R	R	R	R	Ac	Ac	Ac	Ac
Hexarthra mira	R	R	R	R	Ac	A	Ac	A
Keratella cochlearis	R	La	La	La	C	Ac	A	C
K. hiemalis	R	R	R	-	Ac	A	A	-
K .paloda	-	R	-	-	-	A	-	-
K. quadrata (long spine)	R	R	R	R	Ac	A	A	A
K. quadrata (short spine)	R	R	-	R	Ac	A	-	A
K. valga	La	La	La	La	C	C	C	C
Keratella sp.	R	-	R	-	A	-	A	-
Lecane depress	R	-	-	-	Ac	-	-	-
L. elasma	R	R	R	R	A	A	A	A
L. hegurensis	R	R	R	R	A	Ac	Ac	A
L. luna	R	R	R	R	Ac	Ac	Ac	A
L .plosenensis	-	R	-	-	-	A	-	-
L . nana	R	-	R	-	A	-	A	-
L. ohionsis	R	-	R	R	Ac	-	A	A
L.rhombioes	R	-	-	-	Ac	-	-	-
Lecane sp.	R	-	-	R	A	-	-	A
Lepadella depresa	R	-	-	-	A	-	-	-
L. ovalis	R	R	R	R	C	Ac	Ac	Ac
L. salpina	R	-	-	-	Ac	-	-	-
L . patella	R	-	R	-	Ac	-	A	-
Lepadella sp .	R	-	-	-	A	-	-	-
Lophcaris salpina	R	-	R	R	A	-	A	A
Macrochaetus subqudratus	R	-	R	R	Ac	-	A	A
Manfredium eudactylotum	R	-	R	R	Ac	-	A	A
Monostyla bulla	R	R	R	R	C	C	C	C
M. closterocerca	R	R	R	R	C	Ac	Ac	Ac
M. lunaris	R	R	R	R	Ac	A	Ac	A
M. quadridentata	R	R	R	-	A	A	A	-
M. Stenroosi	-	-	-	R	-	-	-	A
M. thalera	-	R	R	R	-	A	Ac	A
M. thienemanni	R	-	-	-	A	-	-	-
Monostyla sp.	R	R	R	R	Ac	A	Ac	A
Monomata grandis	-	-	R	-	-	-	A	-
Mytilina mucronata	R	-	R	R	Ac	-	A	A
Notholca acuminate	R	-	-	R	Ac	-	-	Ac
N. squamula	R	-	R	R	Ac	-	A	A
Philodina roseola	R	-	R	R	Ac	-	A	A
Philodinavus paradoxus	R	-	R	-	A	-	A	-
Platyias patulus	R	R	R	R	A	Ac	A	A
P. quadricornis	R	-	R	R	Ac	-	A	A
P. polyacanthus	R	-	-	-	A	-	-	-
Polyarthra dolicoptera	R	-	R	R	A	-	A	A
P . vulgaris	R	R	R	R	A	A	A	A
Polyarthra sp.	R	-	-	-	A	-	-	A
Pomopholyx complanata	R	-	R	R	A	-	A	A
P . sulcata	R	-	-	-	A	-	-	-
Rotaria neplunia	R	R	R	R	A	Ac	A	Ac
Scardium longicaudum	R	-	R	-	A	-	A	-
Synchaete oblonga	R	R	R	R	A	A	A	Ac
Synchaete sp.	R	R	R	R	A	A	Ac	A
Pedipartia gracilis	R	-	-	-	A	-	-	-
Testudinella patina	R	R	R	R	Ac	-	A	A
Trichocerca bicristata	R	R	R	R	A	Ac	Ac	A

T . capucina	R	-	R	-	Ac	-	A	-
T . cylindrical	R	-	R	R	Ac	-	A	A
T. longiseta	R	-	-	-	Ac	-	-	-
T . insignis	-	R	-	-	-	A	-	-
T. porcellus	R	R	R	R	Ac	A	A	A
Trichocerca sp.	R	-	-	-	Ac	-	-	-
Trichotria tetractis	R	R	R	R	A	Ac	A	Ac
Tripleuchlionis plicata	R	-	-	-	A	-	-	-
Other Rotifera	R	R	R	R	Ac	A	Ac	Ac

Ninety two taxonomic units of rotifera were identified in this study. The differences and changes in the number of taxonomic units of the current study compared with the previous studies may be return to several reasons, including:- the dominant nature of environmental conditions in the area, as well as, the nature distribution of phytoplankton and the size of the aperture size of plankton net, which may be control the quantity and quality of zooplankton collected (Ajeel *et al.*,2008).

Station 1 recorded the highest value for species richness index of rotifera in April 2012 and amounted to 18.26, while the lowest values (3.42) have been recorded during July 2012 at station 2 (Fig. 4).

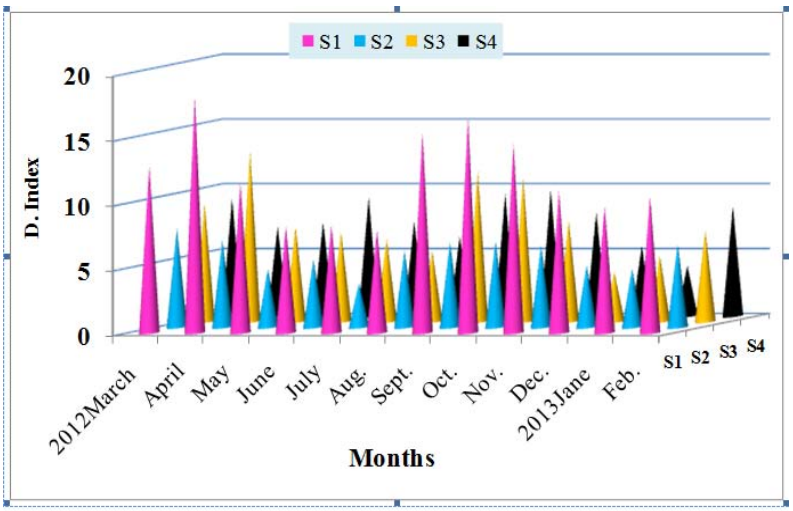

Figure (4): Monthly variations of species richness index (D) of rotifera in the stations of Kufa River from March 2012 to February 2013

Species richness index of taxonomic units abundance was a better indication of the change in the ecosystem. The increase in abundance of taxonomic units associated with an increased of bio-health community and the habitats (Barbour *et al.*, 1999).

The rotifera was the most important groups of zooplankton because of their largest numbers in the aquatic ecosystem, in addition to being vital credible evidence to assess the physical processes (Aquino *et al.*, 2008). This group showed quantity and numerically abundant in all stations, it was found 92 taxonomic units belonging to 32 genera, this which is higher than recorded in many local studies such as the study of Al-Lami *et al.*(1999) which recorded 58 species, while Ibrahim (2005) record 70 species in the Dagharah Rivers and Diwaniyah and Rabee (2007) record 34 species.

The reasons for increasing the species number of rotifera in freshwater ecosystem dating may be related to the lacking of interaction of rotifera with different trophic levels. Some species, such as *Keratella cochlearis* possibly live in a high-nutrition environments, as well as with a low level of nutrition (Ferraz *et al.*, 2009), in addition to their small size and parthenogenesis reproduction and the short periods of their growth (Ozbayl and Altındag, 2009). Also, their ability to adapt to living in low oxygen content (Jappesen *et al.*, 2002). While Jose and Sanalkumar (2012) explained the increasing number of rotifera attributed to the lack of food specialization, parthenogenesis reproduction and high fertility of it.

The genus *Brachionus* showed higher diverse than the rest, As recorded 11 species with varying degrees in all the stations, followed by genus *Lecane* with 8 species and genus *Monostyla* with 7 species and genus *Trichocerca* and *Keratella* with 6 species for each one, this corresponds with what referred to Okogwu (2010) that species belonging to the family of Brachionidae and Lecanidae numerically dominant in environments at higher temperatures and increased content of dissolved oxygen. While the following genus appeared with one species only, *Anuraeopsis, Aspelta, Asplanchna, Lophcaris, Mytilina, Rotaria, Philodinavus,*

Testudinella, Trichotria, Philodina, Pedipartia, Tripleuchlionis, Monomata, Macrochaetus and Manfredium.

The results also showed that some species may be frequented to appear in abundance in all study stations, including *Brachionus angularis*, *B. calyciflorus, Cephalodella auriculata, Colurella adriatica, Euchlanis delatata, Keratella cochlearis, K. valga, Lecane elasma, L. luna, Lepadella ovalis, Monostyla bulla and Polyarthra vulgaris*. While some species appeared only in one station, such as *Aspelta bidentata, Asplanchna priodonta*, which was appearing at station 1 and species *Brachionus zahniseri* appeared at station 2 and *Monostyla stenroosi* appeared at the station 4.

By comparing the current results with local and global studies, Al-Namrawi (2010) have recorded values to the species richness index of rotifera ranged from 2.2-1.56 in the TharThar Canal. Nashaat (2010) record values ranged from 1.23-6.174 on the Tigris River, also on the Tigris River Al-Mashhadani (2012) record a value ranged from 2.53-8.84. Ghazi and Ali (2012) recorded a value for rotifera in the Shatt Al-Arab ranged from 8.47-6.39.

Globally Aquino *et al.* (2008) record value to the species richness index of rotifera in Lake Paoay in the Philippines ranged from 2.5-2, Sleem and Hassan (2010) recorded in the Nile River, values ranged from 4.2 to 8.1.

Station 1 recorded the highest value of Shannon Weiner index for the biodiversity of rotifera through April 2012 and amounted to 3.78 bits/Ind., while the lowest value 1.85 bits/Ind. during July 2012 at the station 2 (Fig. 5).

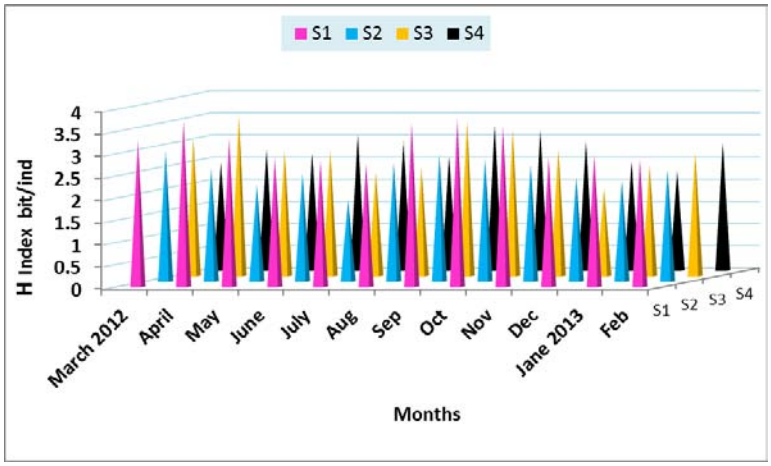

Figure (5): Monthly variations of the Shannon-Wiener diversity index(H) bits/Ind. for rotifera at four stations in Kufa River during March 2012 until February 2013

The diversity of rotifera depends mainly on the water temperature and available food that the diversity is gradually increasing in the Spring to the Summer at rising of water temperature and increasing in the density of phytoplankton, which is the source of food for rotifera and decrease diversity at the end of Autumn, when the water becomes colder (Erdugan and Guher, 2005). According to the values of Shannon- Weiner index in the current study Kufa River has highly biodiversity where exceeded more than 1 bits/Ind. and Kufa River water can be considered at this moment as moderate organic pollution,where the values more than 3 bits/ Ind.= Clean condition, values 3-1 bits/ Ind.= Moderately polluted, while values less than 1 bit/ Ind.=Heavily polluted (Goel, 2008).

By comparing the recorded values of diversity in this study with some local studies, Al-Lami *et al.*(2000) has recorded values from 2-2.2 bits/ Ind.in the Tigris River and TharThar Arm, as Al-Namrawi (2002) recorded values ranged from 0.56-2.8bit/ Ind. in the Euphrates River, while Ibrahim (2005) gives values of diversity ranged from 1.92-2.36 bits/ Ind. in the Diwaniyah and Dagharah Rivers, Al-Namrawi (2005) recorded values from 0.9-1.88 bits/ Ind. in the Tigris River and 0.7-2.4 bits/Ind. in the Euphrates River, also Shekha (2008) recorded values of diversity from 0.69-1.77bits/Ind. in the Great Zab River.

Globally Flinn *et al*. (2005) record a value ranged from 0.75-1.02 bits/Ind. in the Mississippi River in the United States, Okogwu (2010) record values in the Lake Ehoma in Nigeria ranged from 0.68-1.28 bits/Ind., Jafari *et al.* (2011) recorded values ranged from 1.21-2.48bits/Ind. in Haraz River in Iran.

Station 1 recorded the highest value of the species uniformity index of rotifera in April 2012 reached 0.99, while in July 2012 it was recorded values about 0.01 at station 2 (Fig. 6). The highest values of this index in the study stations indicate that the species was homogeneous in appearance because of the absence of any stress or environmental pressure thus providing a favorable environment for the stability of rotifer fauna. While the low-lying values for this index (few species of high density), which is a sign of the presence of environmental pressure and this is agree with what

referred to Green (1993), which is what happened in the stations 2 and 3, when that the decline in species uniformity index value of species may be due to the organic content with decline of dissolved oxygen concentrations and incressed of BOD_5 value. Thadeus and Lekinson (2010) recorded values from 0.99-0.993 in Tropical Jungle River in Nigeria also Ezekiel *et al.* (2011) recorded values ranged from 0.87 - 0.978 in Maceio Sombreiro River in Nigeria and is little like to the record in this study.

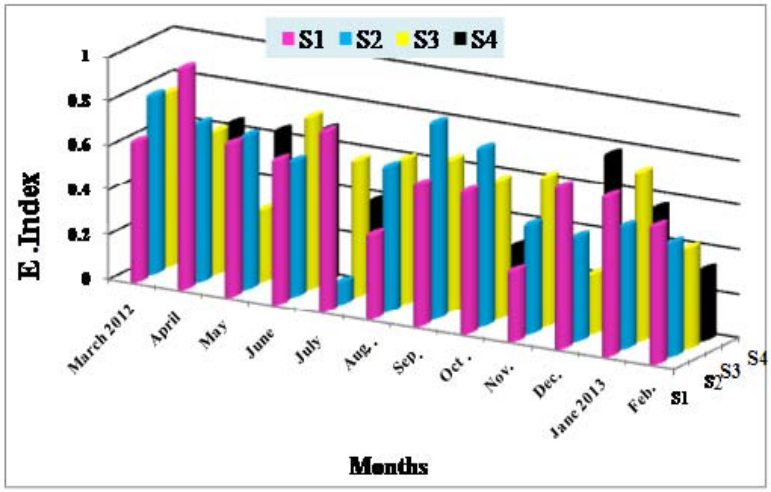

Figure (6): Monthly variations of species uniformity index (E) of rotifera in the Kufa River during the March 2012 until February 2013

Locally Ibrahim (2005) recorded values for this index in the Diwaniyah and Dagharah Rivers ranged from 1.45-1.62, also Rabee (2007) recorded values ranged from 0.41-0.99 in the Euphrates River, Nashaat (2010) recorded values ranged from 0.7-0.99 in Tigris River, Al-Namrawi (2010) recorded values ranged from 0.87-0.67 in the TharThar Canal and from 0.88-0.91 in the Euphrates River, Al-Hilfi (2011) recorded values ranging from 0.000108-0.725 in the Tigris River.

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Impact of Climate Change on Global Agriculture: Impact Map

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Summary- Our main focus in this article is to evaluate individually, that is to say, at the level of every country, the impact of climate change on agriculture. The objectif at this level is to set a new world map of the impact of climate change on global agriculture. Our analysis is mainly concerned with impulse response functions as this instrument enables us to synthesize the essential information contained in the dynamics of the estimated VAR system and ECM. Impulse response functions, enabled us to determine the nature of the effects of different shocks on different variables and being based on this instrument one could distinguish 4 large country families on a new global map by type of climate impact.

Keywords: *climate change, agriculture, world impact, VAR, MCE, IRF, map.*

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I. Introduction

The uncontrolled growth in greenhouse gas emissions is warming the planet, with the consequences of melting glaciers, increased precipitation, more frequent extreme weather events, and shifting seasons. The acceleration of climate change, combined with the growth in population and income globally, threatens food security everywhere.

Agriculture is extremely sensitive to climate change. Higher temperatures reduce yields of desirable crops while causing a proliferation of weeds and pests. The change in precipitation patterns increase the likelihood of poor harvests on the Short-term and a long term decline in production. Although some regions of the world can register an improvement of some of their crops, climate change will generally have negative impacts on agriculture and will threaten food security globally.

Bearing this in mind, in this article we seek to evaluate individually, that is to say, by country, the impact of climate change on agriculture. The goal at this level is to see how agriculture in each country of the world will be affected by climate change? And in which direction will it evolve ?

The answer to these questions will be developed in four sections: The first section will be devoted to a review of the empirical literature, the second section will be devoted to the derivation of the model to estimate and presentation of data to operate. At the third section is the exposure of the actual methodology and empirical analysis to be developed and the fourth section will be reserved for d'estimations results, the key recommendations and the presentation of the impact world map.

II. Literature Review

To study climate change, economists (mainly economists working in the IPCC) often refer to the study of change in the climate state. This is to say the change in the state of climate that can be measured by using either a:

- Statistical tools such as tests, calculating averages, variances, …
- Observing, for a long period, typically decades or more, changes in the properties of the climate itself.

Regarding the study of climate change impacts on agriculture, theorists are not unanimous as to the nature of these effects and some others and are a minority, saw a positive impact; others, wich from the majority, rather see negative impacts. However the impact on agriculture is rather based on the physiological characteristics of the region suffering the climate change and in production cultures.

The climate change impact studies on agriculture had covered the globe: Africa, Europe, Asia, America and Australia. Many authors have highlighted the effects of climate change:

In a study of econometric time series, VA Alexandrov and G. Hoogenboom (2000) studied Bulgaria during the last decade of the twentieth c., the impact of climate variability. These authors confirmed the theories developed above; they claim that they alone, natural climate variations can not explain the drop in agricultural production, other anthropogenic factors contribute to explaining the variability of this production.

Monirul and Mirza (2002) calculated the increased risk of crop losses in Bangladesh following the increase in the frequency of flooding. they concluded that agriculture in Bangladesh is vulnerable to climate change, particularly to flooding due to heavy rainfall and / or cyclones.

The overall results advanced by these authors conceal an enormous variability depending on whether the area is in Africa or Latin America. Furthermore Peter G. Jonesa and Philip K. Thornton (2003) recommend an emergency assessment of climate change at the household level, so that the poor and vulnerable people

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dependent on agriculture can be targeted appropriately in activities research and development.

Rashid Hassan (2010) in a study on the impact of climate change on African agriculture could demonstrate a close relationship between these two variables; He demonstrated particularly how climate change has shaped African agriculture in the past and how it will lead in the future, an impact on African agricultural economies; the author relies on the awareness of African farmers to draw effective adaptation strategies.

For Shilong, P. et al, (2010) China with 7% of arable land is required to feed about a quarter of the world population (22%); Yet despite its explosive economic growth the past decade, the Chinese economy remains vulnerable to climate change including global warming that will impact the Chinese water resources for agriculture and therefore will compact its ability to feed its population.

Nkulumo Zinyengere et al (2014) have evaluated the impact of climate change on agriculture in southern Africa, their study examined how climate change may affect different food crops in specific locations in the region. Corn and sorghum in the Mohale Hoek in Lesotho and Swaziland Big Bend. corn and peanuts in Lilongwe, Malawi).

The study confirmed that the impact of climate change on crop yields in southern Africa vary according to places and cultures. Despite various uncertainties associated with these evaluations, the results showed that crop yields are expected to decrease at Big Bend (corn (-20%), sorghum (-16%)) and Lilongwe (maize (- 5%) l groundnut (-33%)). However, crop yields in Hoek Mohale, located in a high altitude area historically prone to yield losses of cold-related crops are expected to increase (maize (+ 8%) and sorghum (+ 51%)).

III. Methodology and Data

a) Model specification

[Y] production is based on three factors of production: land or natural resources [T] which, in the rest of the article, is assimilated to the performance of agriculture, capital [K] and work [L] [F] means the technology used in the combination of production factors and [u] is a term that takes into account factors overlooked in empirical studies or econometric model.

$$Y=F(X1, X2,\ldots.. Xi) = F (T, K, L) (u) \quad (1)$$

Relation (1) is a non-monetary relationship since binds a Y output volume to input [X1, X2, ..., Xi] volume regardless of prices or production costs.
The total differential expression (1) gives us :

$$dY = \frac{\partial F}{\partial T}dT + \frac{\partial F}{\partial K}dK + \frac{\partial F}{\partial L}dL \Leftrightarrow dY = F_T dT + F_K dK + F_L Dl \quad (2)$$

$$\frac{dY}{Y} = e(Y,T)\frac{dT}{T} + e(Y,K)\frac{dK}{K} + e(Y,L)\frac{dL}{L} \quad (3)$$

$$Y = e^h T^\theta K^\alpha L^\beta \quad (4)$$

- *h* refers to the integration constant,
- $\alpha = e(Y, K)$,
- $\beta = e(Y, L)$,
- $\theta = e(Y,T)$ represent the partial elasticities of output with respect to each factor,
- e^h corresponds to a scalar technology [scale factor productivity index or size factor].

Being inspired by the work of Richard SJ Tol (2005), Long. C et al (2010), Dell. M et al (2008), Nelson. G C et al (2014) and Lecocq. F Shalizi. Z (2007) can be rewritten as the integration constant [s] so that it integrates climate change :

$$h = \delta CC \text{ Where}$$

- δ is an indicator that measures the direct effect of climate change on agriculture and economic growth.
- CC is an indicator of climate change

$$\Rightarrow e^h = e^{\delta CC} \Rightarrow Y_t = F(K_t, L_t, T_t) = e^{\delta CC} K_t^\alpha L_t^\beta A_t^\theta \quad (5)$$

Where A = T (Agriculture In is the product of the earth T)

$$\theta = \mu_0 + \mu_1 CC$$

- μ_0 is an indicator that measures the contribution of the agricultural sector to the production in the absence of climate change. $\mu_0 \succ 0$: Improved agricultural productivity is expected to positively affect production.
- μ_1 is an indicator that measures the indirect effect of climate change on the production CC. $\mu_1 <0$: A climate change reduces agricultural output which in turn slows growth.

$$\Rightarrow Y_t = e^{\delta CC} K_t^\alpha L_t^\beta A_t^\theta = e^{\delta CC} K_t^\alpha L_t^\beta A_t^{\mu_0 + \mu_1 CC} \quad (7)$$

To calculate the Y growth rate as a function of growth rate K, L and A, we use the following property (8) :

$$g_Y = \frac{\dot{Y}}{Y} = \frac{\partial \ln f(t)}{\partial t} \quad (8)$$

$$\ln Y = \delta CC + \alpha \ln K_t + \beta \ln L_t + \theta \ln A_t \quad (9)$$

$$\Leftrightarrow \frac{\Delta Y_t}{Y_t} = \alpha \frac{\Delta K_t}{K_t} + \beta \frac{\Delta L_t}{L_t} + \mu_0 \frac{\Delta A_t}{A_t} + \mu_1 \frac{\Delta A_t}{A_t} CC \quad (10)$$

The specification (10) estimates the contribution of agriculture to the growth process by highlighting the role of climate change. In the following section, we will present the empirical analysis and results.

To study the impact of climate change on agriculture, we used equation (10), an equation that describes the relationship between climate change, agriculture and GDP.

The evaluation of the effect of a climate shock on dynamic long and short term, will be via a MCE type of modeling (model error correction) or VAR (Vector Autoregressive). The interaction between climate change (CC) agricultural output (A) and GDP (Y) can be analyzed through the following multivariate model:

$$[Y_t = A_t + CC_t]$$

Where :
Y: the Gross Domestic Product,
A = agricultural output,
CC = climate change indicator

b) Data

The data to use in the empirical analysis concerning 157 countries of the world and are extracted from the database of the World Bank, these data are annual and cover the period which runs from 1980 to 2013.

- Production [Y] is assimilated to GDP. GDP is defined by the World Bank as "the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of products.
- Climate change [CC] is measured by carbon dioxide emissions (CO2).
- Agricultural output [A] is the ratio between the share of the value added of agriculture in GDP and the total area of arable land.

IV. Empirical Analysis

For each country, the objective is to position and know its impulse response function following a climate shock. Knowing the impulse response model assumes estimating a VAR model or ECM; To do this we will need analysis in terms of Co-integration analysis is applicable only on stationary series. Thus the empirical analysis in this article will follow the following five steps:

1. Testing the stationarity of the series.
2. Determing the number of optimal delay
3. Analyzing the relationship of cointegration.
4. Estimating ECM or a VAR model.
5. Analyzing the impulse response function,

a) Tests of stationarity

Models used as a basis for the construction of the Dickey-Fuller Increases (ADF) are three in number and they are based on the assumption | Φ1 | <1, the OLS estimation of the three models:

Model 1 : $\Delta x_t = \rho x_{t-1} - \sum_{j=2}^{p} \Phi_1 \Delta x_{t-j+1} + \varepsilon_t$

Model 2 : $\Delta x_t = \rho x_{t-1} - \sum_{j=2}^{p} \Phi_1 \Delta x_{t-j+1} + c + \varepsilon_t$

Model 3 : $\Delta x_t = \rho x_{t-1} - \sum_{j=2}^{p} \Phi_1 \Delta x_{t-j+1} + c + bt + \varepsilon_t$

With $\varepsilon_t \rightarrow$ i.i.d

The decision rule is such that:

- if $t^{cal} < t^{tab}$, we reject H0 (H0: the existence of a unit root), the series is stationary in level.
- Si $t^{cal} > t^{tab}$, we accept H0 (H0: the existence of a unit root), the series is not stationary in levels. It is integrated of order 1: I (1) or higher order 1.

b) Number of lags

The number of lags to consider in a VAR or ECM model is the number h that minimizes the following functions:

$$AIC(\rho) = \ln\left[\det\left|\sum_e\right|\right] + \frac{2k^2\rho}{n}$$

Where :
- Σ_e is the estimate of the covariance matrix of the residuals with the VAR (h) or ECM (h)
- ρ the order of process
- k the number of variables in the system
- n the number of observation

c) Cointegration Test

Two series x_t and y_t are called cointegrated if both conditions are verified :

- They are assigned a stochastic trend similar integration d
- A linear combination of these series makes it possible to bring a series of lower integration order.

whether : $x_t \rightarrow I(d)$, $y_t \rightarrow I(d)$

such as $\alpha_1 x_t + \alpha_2 y_t \rightarrow I(d-b)$ with $d \geq b > 0$

We note : x_t, $y_t \rightarrow CI(d,b)$ where $[\alpha_1 \alpha_2]$ is the vector of cointegration.

In the general case with k variables, we have:

$$x_{1,t} \rightarrow I(d) \ , \ x_{2,t} \rightarrow I(d)$$

…….. we note $X_t = [x_1, x_2, \ldots, x_{k,t}]$

$$x_{k,t} \rightarrow I(d)$$

If there is a cointegration vector $\alpha = [\alpha_1, \alpha_2, \ldots, \alpha_k]$ de dimension (k,1) such as $\alpha x_t \rightarrow I(d\text{-}b)$, then the k variables are cointegrated and the vector is Cointegration α. We note que $X_t \rightarrow CI\ (d,b)$ avec b > 0.

d) Error Correction Model

ECM combine two categories of variables, non-stationary variables expressed in levels, which are interpreted as determinants of the long-period equilibrium and stationary variables.

Either the model below :

$$y_t = b + \alpha x_t + \varepsilon_t$$

And considering the long-term relationship $y_t = b + \alpha x_t$. We admit that there is a long-term relationship between the variables x_t and y_t that are integrated of ordre 1 with the cointegrating linear combination.

$y_t - b - \alpha x_t = ED \neq 0$ that is stationary with ED = error disequilibrium

The coefficients b and a are long-term parameters.

If xt and yt are in balance, ED should be zero. Otherwise, ED is either positive or negative. That is why we talk about error disequilibrium.

Supposing that y_t follows an autoregressive process distributed delays of ordre (1.1) and written :

$$yt \sim AD \qquad (1,1)$$

$$y_t = k + \alpha x_t + \beta x_{t-1} + \gamma y_{t-1} + \varepsilon_t \qquad (1)$$

K = constant and $0 < \gamma < 1$

Parameterization (1) provides a dynamic representation called ECM

$$y_t - y_{t-1} = k + \alpha x_t + \beta x_{t-1} + (\gamma\text{-}1) y_{t-1}$$

$$\Delta y_t = k + \alpha x_t - \alpha x_{t-1} + \alpha x_{t-1} + \beta x_{t-1} + (\gamma\text{-}1) y_{t-1}$$

$$= \alpha \Delta x_t + (\gamma\text{-}1)[y_{t-1} + \frac{\alpha + \beta}{\gamma - 1} x_{t-1} + \frac{k}{\gamma - 1}]$$

By reducing the expression $(\gamma\text{-}1)$ à $(1\text{-}\gamma)$ we get:

$$= \alpha \Delta x_t - (1\text{-}\gamma)[y_{t-1} - \frac{\alpha + \beta}{\gamma - 1} x_{t-1} - \frac{k}{\gamma - 1}]$$

$$= \alpha \Delta x_t - (1\text{-}\gamma)[y_{t-1} - AX_{t-1} - c] \qquad (2)$$

We posing $\frac{\alpha + \beta}{\gamma - 1} = A$ et $\frac{k}{\gamma - 1} = c$

Equality is called Model 2 has Error Correction (ECM).

α is the short-term impact of Δx_t on Δy_t; $(1\text{-}\gamma)$ is the magnitude of the adjustment

Δy_t imbalance observed in relation to the period spent between x_t and y_t. Since $0 < \gamma < 1$ shows that $0 < (1\text{-}\gamma) < 1$.

Returning to the equilibrium relationship of long period:

$y_t = b + \alpha x_t \rightarrow y_{t-1} - b + \alpha x_{t-1} = ED = 0$ which is the error of imbalance.

If ED = 0, this means that x_t and y_t are in equilibrium. Otherwise, ED> ED 0 or <0. These are the deviations which make us talk about error disequilibrium.

For the calculations, we use the lagging indicator:

$y_{t-1} - b - \alpha x_{t-1} = ED\ (-1)$ ED called a delayed period. ED Comparison (-1) to the equation (150), this means that A = α and c = b so that the classic formula ECM becomes :

$$\Delta y_t = \alpha \Delta x_t - (1\text{-}\gamma) ED(-1) = ECM$$

e) AutoRegressive Vector

The VAR is a combination of simultaneous equation models and autoregressive process. They were introduced by Christopher Sims (1980) from a critique based on the analysis of macroeconomic models.

The process $y_t = A + By_{t-1} + U_t$ is a autoregressive vector order 1: it is, it has only one delay and two endogenous variables. This is a simplification of reality; Indeed the modeling of some macroeconomic phenomena, the economist can use several variables and to introduce more than five delays depending on the degree of precision.

To take into account this aspect, I resume the system with n variables and p lags. In other words, we generalize as follows:

$$I \begin{cases} y_{1t} = \alpha_0 + \alpha_{1t} y_{1t-1} + \ldots + \alpha_{1p} y_{1t-p} + \ldots + \beta_{1p} y_{2t-p} + \ldots + \phi_{1t} y_{nt-1} + \phi_{1p} y_{nt-p} + \mu_{1t} \\ y_{2t} = \beta_0 + \alpha_{2t} y_{1t-1} + \ldots + \alpha_{2p} y_{1t-p} + \ldots + \beta_{2p} y_{2t-p} + \ldots + \phi_{2t} y_{nt-1} + \phi_{2p} y_{nt-p} + \mu_{2t} \\ \vdots \\ y_{nt} = \theta_0 + \alpha_{nt} y_{nt-1} + \ldots + \alpha_{np} y_{nt-p} + \ldots + \beta_{np} y_{2t-p} + \ldots + \phi_{nt} y_{nt-1} + \phi_{np} y_{nt-p} + \mu_{nt} \end{cases}$$

We posing $y_t = (y_{1t}, y_{2t}, \ldots, y_{nt})$

$$A = (\alpha_0, \ldots, \beta_0, \ldots, \theta_0)$$

$$y_{t-1} = (y_{1t-1}, y_{2t-1}, \cdots, y_{nt-1})$$

$$y_{t-2} = (y_{1t-2}, y_{2t-2}, \cdots, y_{nt-2})$$

$$\ldots.$$

$$y_{t-p} = (y_{1t-p}, y_{2t-p}, \cdots, y_{nt-p})$$

$$U_t = (\mu_{1t}, \mu_{2t}, \cdots, \mu_{nt}) \text{ et}$$

$$B_1 = \begin{bmatrix} \alpha_{11} & \beta_{11} & \cdots & \delta_{11} \\ \alpha_{21} & \beta_{21} & \cdots & \delta_{21} \\ \cdots & \cdots & \cdots & \cdots \\ \alpha_{n1} & \beta_{n1} & \cdots & \delta_{n1} \end{bmatrix}, \ldots, B_p = \begin{bmatrix} \alpha_{1p} & p & \cdots & \delta_{1p} \\ \alpha_{2p} & \beta_{2p} & \cdots & \delta_{2p} \\ \cdots & \cdots & \cdots & \cdots \\ \alpha_{np} & \beta_{np} & \cdots & \delta_{np} \end{bmatrix}$$

The system *I* can write:

$$y_t = A + B_1 y_{t-1} + B_2 y_{t-2} + \ldots + B_p y_{t-p} + U_t$$

This system is the general presentation of an autoregressive vector (with n variables and p lags).

V. Simulations and Results

a) Simulations

The impact of climate change on agriculture study is measured by applying a pulse function rethinks.

i. *The impulse response function*

In general, the analysis of a shock is to measure the impact of changes Due Action (innovation, shock pulse) on variables. For example from the estimated model for Tunisia:

$$Y = 0.853651 * Y_{t-1} - 0.042458 * A_{t-1} + 0.216834 * CC_{t-1} + 0.848176 + e_{1t}$$

$$A = -0.756745 * Y_{t-1} + 0.252199 * A_{t-1} + 1.451919 * CC_{t-1} - 5{,}604848 + e_{1t}$$

$$CC = 0.354766 * Y_{t-1} + 0.089684 * A_{t-1} + 0.462537 * CC_{t-1} - 1.882922 + e_{2t}$$

A change at a given time of e_{1t} has an immediate consequence on Y_t then A_{t+1} CC_{t+1} for example if there is a shock in t E1T to 1, we have the following impact:

a period t : $\begin{bmatrix} \Delta Y_t \\ \Delta A_t \\ \Delta CC_t \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$

a period t+1 :

$$\begin{bmatrix} \Delta Y_{t+1} \\ \Delta A_{t+1} \\ \Delta CC_{t+1} \end{bmatrix} = \begin{bmatrix} 0.853651 & -0.042458 & 0.216834 \\ -0.756745 & 0.252199 & 1.451919 \\ 0.354766 & 0.089684 & 0.462537 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 0.853651 \\ -0.756745 \\ 0.354766 \end{bmatrix}$$

a period t +2 :

$$\begin{bmatrix} \Delta Y_{t+2} \\ \Delta A_{t+2} \\ \Delta CC_{t+2} \end{bmatrix} = \begin{bmatrix} 0.853651 & -0.042458 & 0.216834 \\ -0.756745 & 0.252199 & 1.451919 \\ 0.354766 & 0.089684 & 0.462537 \end{bmatrix} \begin{bmatrix} 0.853651 \\ -0.756745 \\ 0.354766 \end{bmatrix} = \begin{bmatrix} 0,837791 \\ -0,321754 \\ 0,399070 \end{bmatrix}$$

Etc.…

The various calculated values make up the impulse response function.

b) Results

i. *The new world map*

We present in this section the different model results and MCE VAR specified in previous sections. Our analysis is mainly concerned with impulse response functions, as this instrument allows to synthesize the essential information contained in the dynamics of the estimated VAR system and MCE.

The estimation results enabled us to draw up an impact map of climate change on agriculture in the world (Figure 1). This map shows that climate change will affect different countries of the world. This allowed us to distinguish 4 large country families distributed in the magnitude of the impact:

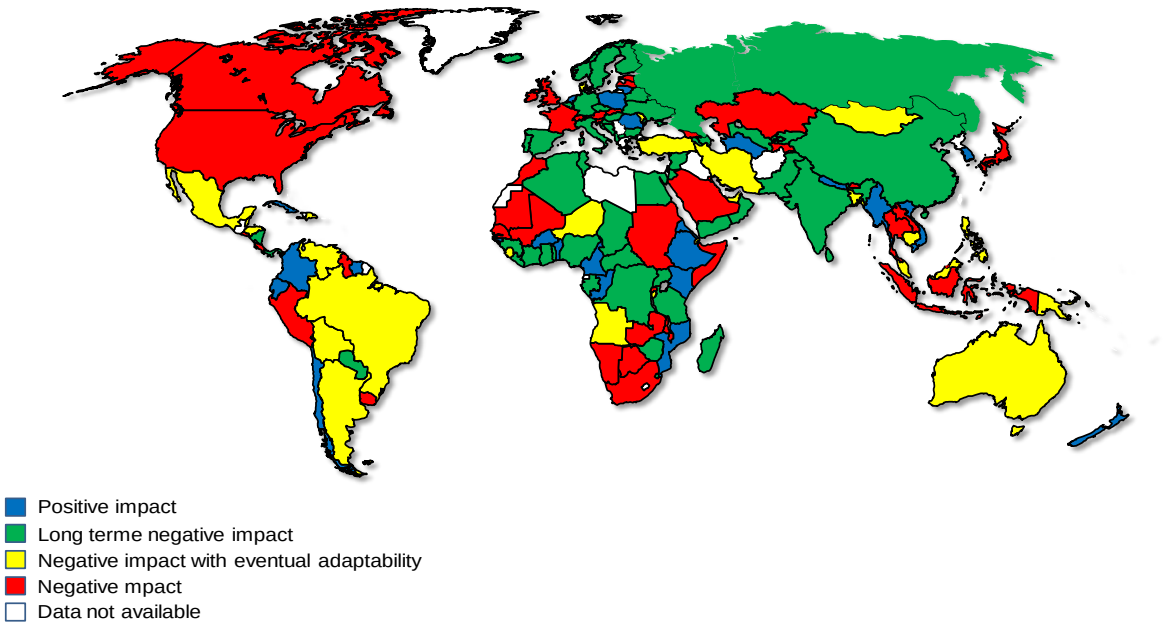
1. Countries whose agriculture is positively affected by climate change: agriculture in this country category will benefit from the CO2 fertilization effect and yield of many crops will increase. since these countries are not major emitters of greenhouse gases, climate extremes will be smaller in terms of impact.
2. Countries that will suffer long-term negative impacts: agriculture in many countries in this category may benefit from climate change and the CO2 fertilization effect at least in the short term. However, most of the regions in Africa, Europe and Asia are expected to save up to 5% of the losses, even with strong CO2 fertilization. These losses increase to 30% if CO2 fertilization effects are omitted. In fact, without CO2 fertilization all regions are expected to experience a loss of productivity due to climate change.
3. Countries that are equipped with a resilience: its countries have great agricultural potential so they can adapt even on the long term. Ingenuity and innovation will be critical in the years ahead in order to produce more food sustainably on less land available. The adaptation includes proven practical techniques such as improved water management, improved pasture, integrated crop-livestock management, crop rotation, conservation agriculture and innovative practices, for example insurance against risk, more resistant food crops and better weather forecasts.
4. Countries negatively affected by climate change: Estimates suggest that the continued rise in CO2 concentrations and the excess in threshold limit will significantly increase global food production losses and cancel the fertilizing effect of CO2 by the end of the century. A change in concentrations of CO2 permanently and negatively affect the climate and increasing the frequency and severity of extreme weather events such as drought, floods, precipitation, cyclones and storms.

Degradation of natural resources is liable to hinder the increase of agricultural productivity and could tarnish the optimistic assessments of the prospects for meeting the growing global demand for food at acceptable environmental cost.

According to the impact map (Figure 1) and the graph of CO2 emissions (Figure 2) shows a correlation between the impact type and amount of carbon dioxide emitted, the more issues more GHG impacts will be more severe. The amount of carbon dioxide in the atmosphere has increased by about 35% since the industrial era and we know that this increase is due to man, mainly from burning fossil fuels. Thus, humankind has dramatically altered the chemical composition of the atmosphere of the planet, with important consequences for the climate.

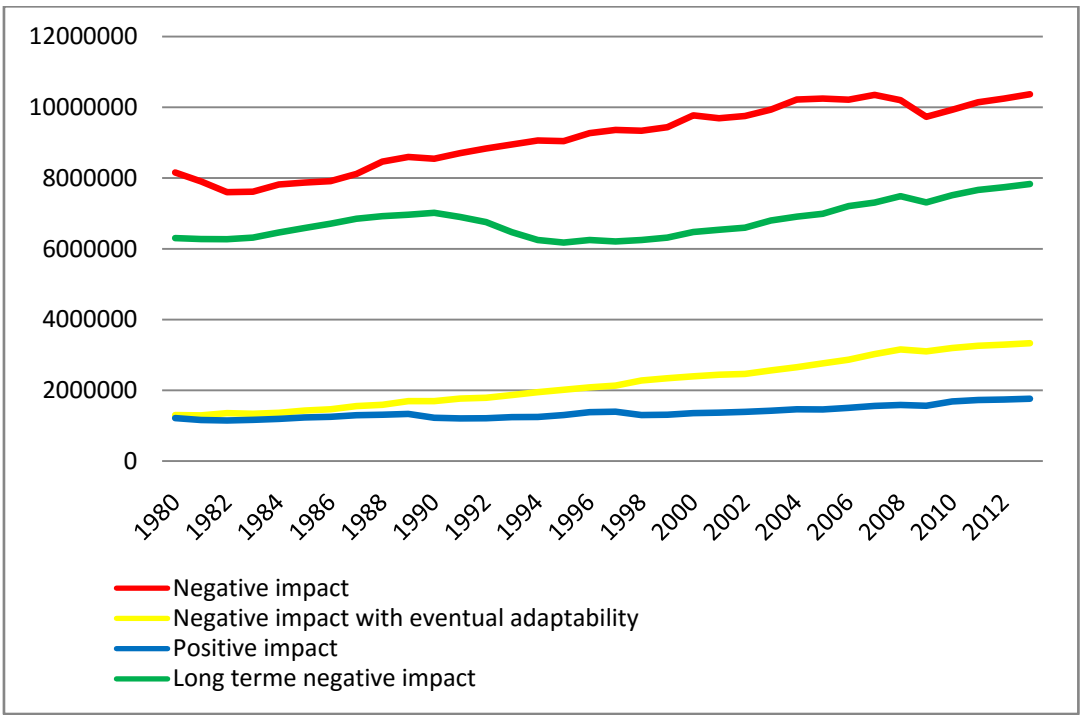
Poor countries and developing countries are generally the most affected by climate change even though they are not large emitters of GHGs, however major global economic and agricultural powers like the US, Canada, Australia, japan or the countries of the European union are not secure and they will experience negative impacts on their agriculture which may destabilize the global market for food products and lead to a future food crisis.

The results of our work supports the overall results made by various studies such as William Cline (2007), Gunter Fisher et al (2005) and the IPCC (the Intergovernmental Panel on Climate Change) (2007, 2014). Climate change has a negative global impact on agriculture.



Source: A.Ghazouani

Figure 1: Impact of climate change on agriculture in the world



Source : A. Ghazouani / WBI

Figure 2: CO2 emission by country group and type of climate impact

Agriculture is extremely vulnerable to climate change. Higher temperatures reduce yields of desirable crops while encouraging the emergence and proliferation of pests and weeds. Changes in precipitation patterns increase the likelihood of poor harvests in the short term and long term production declines.

Although there are gains in some crops in some regions of the world, the overall impacts of climate change on agriculture should be negative, threatening global food security. In developing countries, climate change will cause yield declines for the most important crops. In Asia, Africa and South America. Even developed countries will be particularly affected.

The populations of the developing world, who are already vulnerable to food insecurity, are likely to be the most affected. In 2005, almost half of the economically active population in developing countries or 2.5 billion people, depend on agriculture for their livelihood. Today, 75% of the world's poor live in rural areas.

VI. Conclusion

This paper proposes a model to highlight the impacts of climate change on global agriculture. The empirical results show that:

- Climate change affects in different ways global agriculture, but generally these impacts are negative and are more important for countries to emit more CO2. Further analysis of the impulse response functions for 37 countries shows that climate change is affecting negatively and permanently agricultural output and 77 countries will suffer the same long-term impacts. However, climate change will have positive impacts on agriculture from 20 countries and 23 countries will adapt.
- At the end of our analysis we can say that given the global climate situation and the results that have been reached, it is obvious that steps to be taken in emergency especially for countries affected negatively. And generally for any country in the world even the beneficiaries of favorable weather conditions since if several countries are not major emitters of CO2 they are affected by gas concentrations of greenhouse gases emitted from other countries.
- As it is expected that global GHG concentrations will increase. the world will even be more affected by the emissions and must be other cultural methods cannot be considered to make agricultural lands be more introductive.
- If we cannot quickly adapt and adopt adaptation strategies and to let the pressure that will exert climate change on global agriculture will inevitably lead to a global food crisis, the poorer countries and essentially developing countries will be the most affected and the most severely affected, the crises of 2008 and 2010 are only the beginning in a series of farming setbacks to come.

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Studies of Rotifers Community Structure in Al-Shamiah River-Hilla/Iraq

By Khalid A. Rasheed, Muhanned R. Nashaat & Saad K. Ala Allah
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GJSFR-H Classification: *FOR Code: 049999*

Strictly as per the compliance and regulations of :

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I. Introduction

The rotifers were an important plankton in feeding the young fish in fish hatcheries. And have a vital role in the food chain in the aquatic environment, and to study its presence in the important water bodies in estimating the abundance of food in the water and the validity of the investmewnt (Al-Lami *et al.*, 2002).

The importance of studying the diversity of ecological communities for any population to identify the nature of interlocking and complex relationships between different species in these communities, reflecting the role of these species in the ecosystem, in addition to the results of these studies it can be a good indicator of the stability of the ecosystem and the nature of the change in the various biotic and abiotic environmental factors that increase or decrease the biodiversity during different periods of time or in different regions could be adopted indicator of the changing nature of environmental factors (Thompson *et al*., 2004).

The study of qualitative and quantitative composition and biodiversity of the rotifera in Al-Shamiah River/Hilla City is the goal that brought the current study as an important component of the food chain in the aquatic environment.

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II. Materials and Methods

River Al-Shamiah is considered as the major surface water source in the this district and one of the main sources of irrigation, which classified within the water contained a large area, It is a land that depends on irrigated ends of the Hilla River (Al-Waaeli, 2005). This river enters the territory of Al- Diwaniya from the northwest, heading to the south. Along of 80Km and discharge capacity of 180 m^3/s (Al-Ebadi,2011).

Four stations were selected to collect samples of the Al-Shamiah River. The first station was located at the beginning of the entry of the river city. While the second was located about 15 Km from the first station. The third station away from the second to 18 Km. Fourth station was located about 20 Km from a third station (Figure 1).

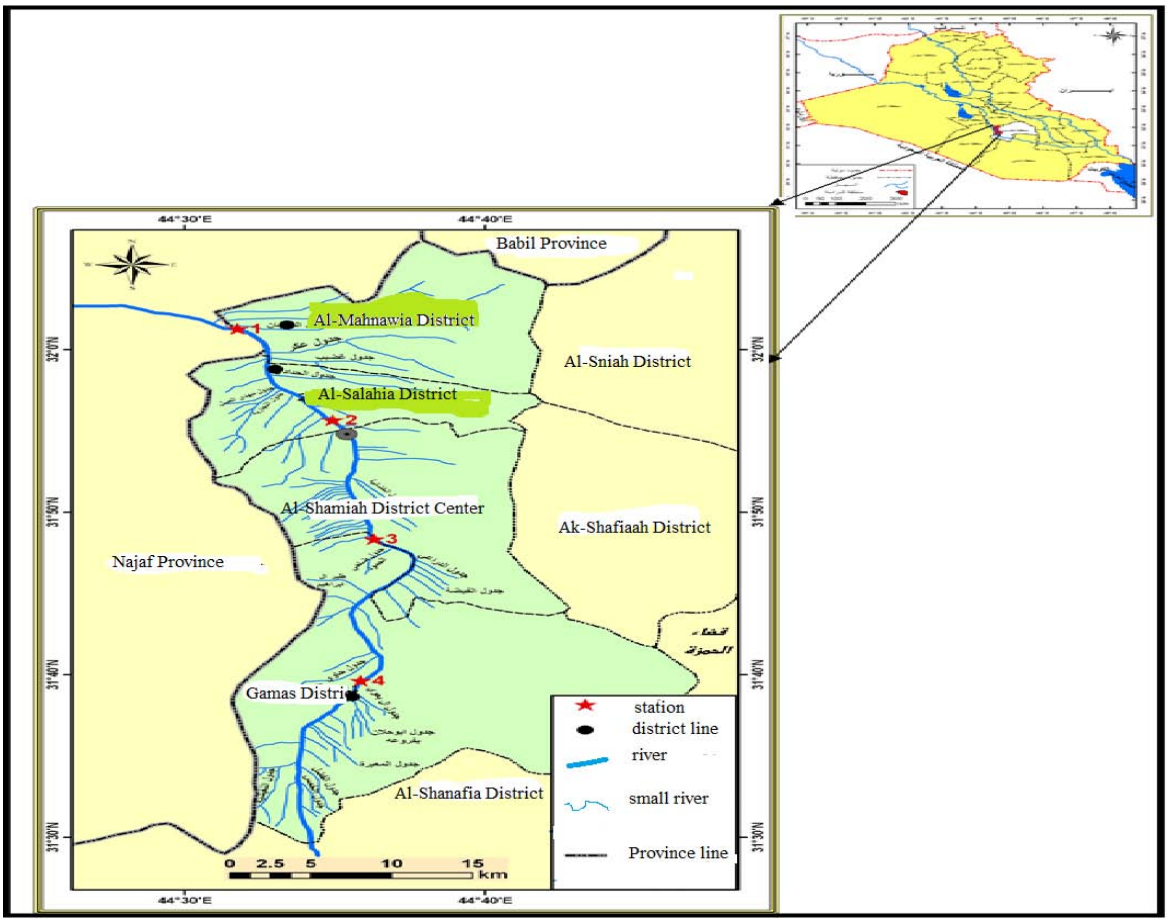

Figure 1: The study stations on the Al-Shamiah River/Iraq

For the purpose of studying the biodiversity of rotifera, it has been passed of 40 liters of water in the zooplankton net type (Hydro-bios) diameter openings pore about 55 microns. Samples are concentrated to 10 ml were diagnosed all respondents and counted using a compound microscope type Olympus depending on Edmondson (1959) Pennak (1978), Pontin (1978) and expressed the results of an Individual/m^3 (m^3 /Ind.).

Environmental indicators were accounted as follows: (1) Relative abundance index (Ra): According to the formula contained in the Omori & Ikeda (1984). (2) Constancy index (S): Was the presence and frequency of each type of account according to the formula contained in the Serafim *et al*. (2003). (3) Species richness index (D): Calculated monthly according to the formula contained in Sklar (1985). (4) Shannon Wiener index of diversity (H): Monthly calculated from this value used the Shannon Weiner equation as stated in Floder & Sommer (1999). Results expressed as bits/individual. The bit is equal to one piece of information), and values less than 1 bit, means have low diversity, while more of 3 bits means high diversity. (5) Species uniformity index (E): This index is calculated according to the formula contained in the Neves *et al*. (2003) considered as values greater than 0.5 as equal or homogeneous in appearance (Proto-Neto, 2003).

III. Results and Discussion

The difference in the densities of zooplankton may be due to several factors, including the physical and chemical properties of water , food, competition, predation and parasitism (Herzig, 1987). The density of rotifer ranged in Al-Shamiah River between lower density reached 175 Ind./m^3 in January 2013 at the station 3, and the highest density 27,650 Ind./m^3 at the station 1 in September 2012 (Figure 2).

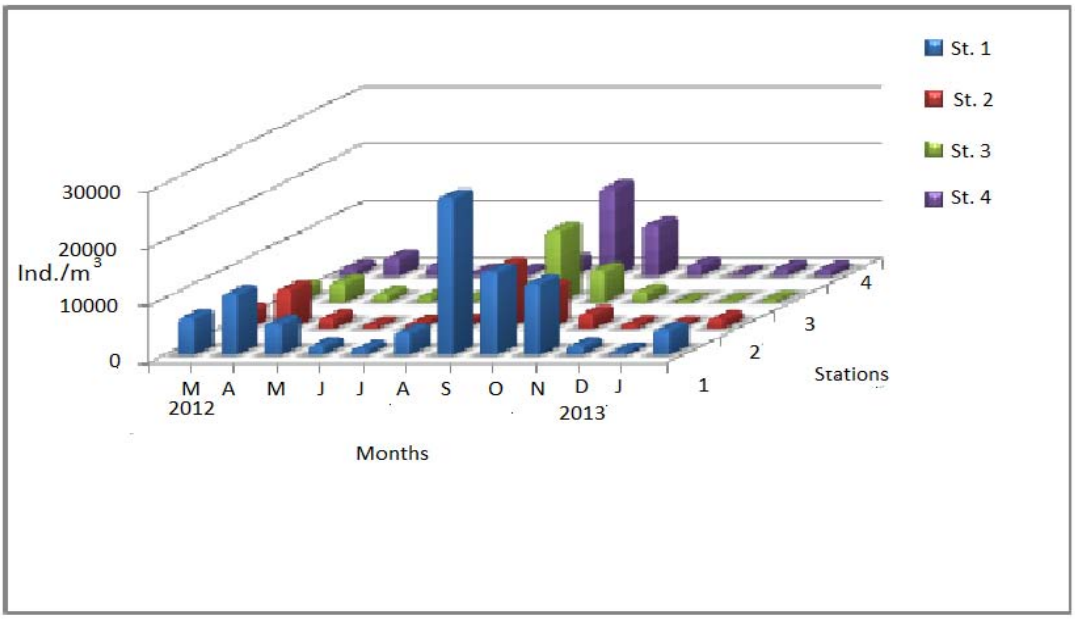

Figure 2: Total density of rotifera (Ind./m^3) in A-Shamiah Rive from March 2012 until February 2013

It showed that the relative abundance index (Table 1 and Figure 3) that the species *Keratella valga* scored the highest percentage compared with the total density of other species and recorded 12% in the first station, 21% in station 3, 14% in the station 3, 9% in station 4.

Table (1): Taxonomic units of rotifera in Al-Shamiah River, Relative abundance index (Ra Index) and Constancy index (S Index). Represent R = rare species (less than 10%), La = less abundant species (10-40%), A = species are abundant (40-70%), D = Dominant species (greater than 70%) A = Accessory species (1%-25%), Ac= Accidental species (25% - 50%), C = Constant species (greater than 50%)

	Ra Index				S Index			
Station / Taxa	1	2	3	4	1	2	3	4
Anuraeopsis fissa	R	R	-	-	A	A	-	Ac
Aspelta bidentata	R	-	-	-	A	-	-	-
Asplanchna priodonta	R	-	-	-	Ac	-	-	-
Brachionus angularis	-	-	-	-	C	Ac	Ac	Ac
B.bidentatus	-	-	-	-	A	-	-	A
B.calyciflorus amphiceros (long. spine)	R	R	-	R	A	-	-	A
B.calyciflorus amphiceros (short. spine)	R	-	-	-	Ac	Ac	Ac	C
B.calyciflorus calyciflorus	R	-	-	-	C	Ac	Ac	Ac
B. falcatus	R	R	R	R	Ac	Ac	Ac	A
B. haranansis	R	-	-	R	Ac	Ac	A	A
B. quadridentatus	R	-	-	R	Ac	A	A	A
B. rubens	R	R	R	R	A	-	A	A
B. urceolaris	R	R	R	R	C	Ac	Ac	Ac
B. zahniscri	R	R	R	R	-	A	-	-
Cephalodella auriculata	R	R	R	R	Ac	A	A	A
C . forficul	R	R	R	R	A	-	A	-
C . intuta	R	-	R	R	-	-	A	A
C. gibba	R	R	R	R	C	Ac	Ac	Ac
C .mucronata	-	R	-	-	-	-	-	A
C. Intilloides	R	R	R	R	A	A	-	-
Cephalodella sp.	R	-	R	-	A	-	-	-
Colurella adriatica	-	-	R	R	C	Ac	Ac	Ac

Station / Taxa	Ra Index				S Index			
	1	2	3	4	1	2	3	4
Colurella sp.	R	R	R	R	-	A	-	-
Dipluchlanis propatula	-	-	-	R	A	A	A	A
Euchlanis delatata	R	R	-	-	C	Ac	Ac	Ac
Filinia longiseta	R	-	-	-	A	A	-	A
F. opliensis	R	R	R	R	Ac	A	-	A
Hexarthra mira	-	R	-	-	A	A	-	A
Keratella cochlearis	R	R	R	R	C	Ac	C	Ac
K. hiemalis	R	R	R	R	Ac	A	A	-
K .palodsa	R	R	-	R	-	A	-	-
K. quadrata (long. spine)	R	R	-	R	A	A	A	A
K. quadrata (short. spine)	R	R	-	R	A	A	-	A
K. valga	R	R	R	R	C	C	Ac	C
Lecane depressa	R	R	R	-	A	-	-	-
L. elasma	-	R	-	-	A	A	A	A
L. hegurensis	R	R	R	R	Ac	A	Ac	Ac
L. latisema	R	R	-	R	-	A	-	-
L. luna	La	La	La	R	C	Ac	Ac	C
L .plosnensis	R	-	-	-	-	A	-	-
L.nana	R	R	R	R	A	-	A	-
L. ohionsis	R	R	R	R	A	-	A	A
L. rhombides	-	R	-	-	A	-	-	-
Lecane sp.	R	R	R	R	A	-	-	-
Lepadella depresa	-	R	-	-	A	-	-	-
L. ovalis	R	-	R	-	Ac	Ac	Ac	A
L. salpina	R	-	R	R	A	A	-	-
L . patella	R	-	-	-	A	-	A	-
Lophocaris salpina	R	-	-	-	A	-	A	A
Macrochaetus subqudratus	R	-	-	-	A	A	-	-
Manfredium eudactylotum	R	R	R	R	A	-	-	-
Monostyla bulla	R	R	-	-	C	Ac	Ac	Ac
M. closterocerca	R	-	R	-	Ac	Ac	Ac	A
M. lunaris	R	-	R	R	Ac	Ac	Ac	Ac
M. quadridentata	R	R	-	-	Ac	A	A	A
M. thalera	R	-	-	-	-	A	A	A
M. stenroosi	R	R	R	R	A	-	-	-
M. thienemanni.	R	R	R	R	A	-	-	-
Monostyla sp.	R	R	R	R	Ac	Ac	Ac	Ac
Monomata grandis	R	R	R	R	-	-	A	-
Mytilina mucronata	-	R	R	R	Ac	A	-	A
Notholca acuminate	R	-	-	-	A	-	-	A
N. squamula	R	-	-	-	A	A	-	A
Philodina roseola	R	R	R	R	A	-	A	A
Philodinavus paradoxus	-	-	R	-	A	A	A	-
Platyias patulus	R	R	-	R	A	A	A	A
P. quadricornis	R	-	-	R	A	A	A	A
P. polyacanthus	R	R	-	R	A	-	-	-
Polyarthra dolicoptera	R	-	R	R	Ac	-	A	A
P. vulgaris	R	R	R	-	Ac	Ac	A	Ac
Pomopholyx complanata	R	R	R	R	Ac	A	A	A

Taxa \ Station	Ra Index				S Index			
	1	2	3	4	1	2	3	4
P . sulcata	R	R	R	R	A	-	-	-
Rotaria neplunia	R	-	-	-	Ac	Ac	Ac	Ac
Scardium longicaudum	R	-	R	R	A	-	-	-
Synchaeta oblonga	R	R	R	R	C	A	A	Ac
Synchaeta sp.	R	R	R	R	Ac	Ac	Ac	Ac
Pedipartia gracilis	R	-	-	-	A	-	-	-
Testudinella patina	R	R	R	R	Ac	A	-	A
Trichocerca bicristata	R	-	-	-	Ac	Ac	Ac	Ac
T .capucina	R	R	R	R	A	-	A	-
T . cylindrica	R	R	R	R	A	-	A	A
T. insignis	R	-	-	-	-	A	-	-
T. longiseta	R	R	-	R	A	-	-	-
T. porcellus	R	R	R	R	A	A	A	Ac
T. smilis	R	-	R	-	-	-	A	-
Trichocerca sp.	R	-	R	R	-	A	-	-
Trichotria tetractis	-	R	-	-	Ac	Ac	Ac	Ac
Other Rotifera	R	-	-	-	C	C	Ac	Ac

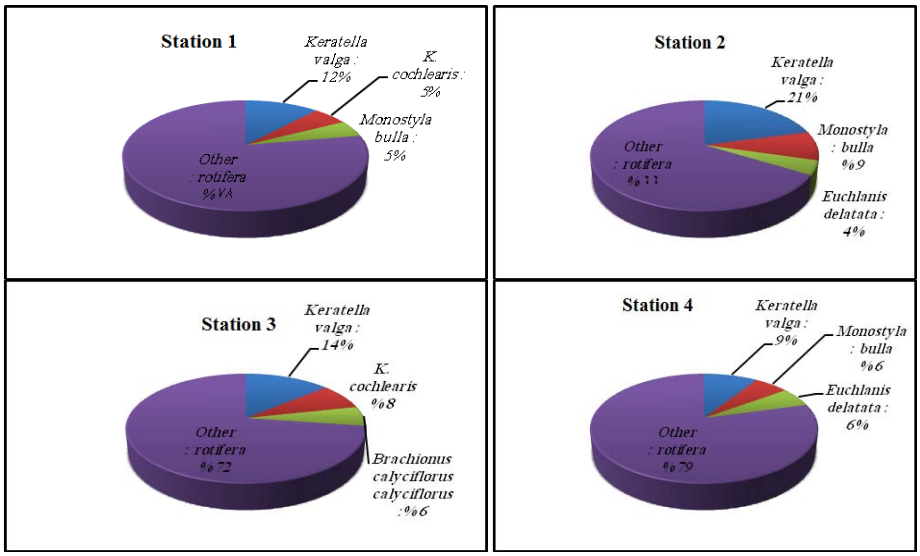

Figure (3): The relative abundance of dominant rotifers in Al-Shamiah River (March 2012 - February 2013)

The density of rotifera is affected directly and indirectly heavily by microscopic algae and other organisms, particularly bacteria, small minutes of organic matter due to its their feeding habits on algal cells, bacteria and small rotifera as well as organic debris (Ghazi and Ahmed, 2008).

The highest density recorded of rotifera was at station 1 in the Autumn season and this may be due to increasing the density of phytoplankton as the abundance daitomite in the rives, which lead to an increase in the density of rotifer because of the food relations, as well as environmental conditions of the rivers that are suitable for both (Sharma *et al.*, 2010). While the lowest densities were in the station 3 and this may be due to the discharge of waste from household into the river directed, and the accompanying rise in turbidity at this station (Noueir, 2001), in addition to the eutrophication and predation by fish and other invertebrates (Al-Shamma`a *et al*., 2011). As a seasonal variation, Winter record is a less dense group of rotifer especially in January, and this may be due to the low density of algae as well as, lower temperatures in this season (Honggang *et al*., 2012).

Recording disapear of the relative abundance index value for of the dominant species of rotifers which has not been able to reach the percentage of abundant

species or dominant depending on the relative abundance index gives evidence of the lack of environmental pressures in the river during the study period, which may result in an area appropriate for the bloom of certain species of resistance to these pressures and to achieve dommint on the other species (Rajagopal *et al.*, 2010).

Constansy index shows the extent of the stability of each species in the environment and a frequncy appearance. The endurance measurements and the availability of the species in the environment reflects the relative sensitivity to environmental disturbances, which may include a number of resistant species or non-resistance (sensitive to pollution), and note changes in taxonomic units, which show how the safety of any ecosystem (Barbour *et al.*, 1995).

Table (1) shows the most frequent and appearance species in the study stations like *Brachionus angularis, B.calyciflorus* (short spine), *B.calyciflorus calyciflorus*, *B.urceolaris*, *Cephalodella gibba*, *Colurella adriatica*, *Euchlanis delatata*, *Keratella cochlearis*, *K.valga*, *Monostyla bulla*, *Lecane luna* and *Synchaeta oblonga* which is constant species in Al-Shamiah River water, according to the constancy index, as it existed in more than 50% of the total samples in this study.

The results also show that the station 1 is the most-owned constant species whereas station 3 contened least one, the reason for this is that the station 1 is more stable ecologically from other stations through increase of total density and diversity of this station (Al-Saadi, 2013). Sterner (2002) shows that the presence of the species belongate of the genera *Monostyla, Mytilinia,Filinia* and *Euchlanis* indicate to the clean environment. As evidence of that kind of environment that is not absolute, as a matter of the taxonomic additive unit may turn out to provide a constant of the appropriate conditions (Hofmann, 1987).

The values of species richness index of rotifera species ranged in Al-Shamiah River between the lowest value 0 at the station 3 in December 2012, and the highest value 13.05 at the station 1 in September 2012 (Figure 4).

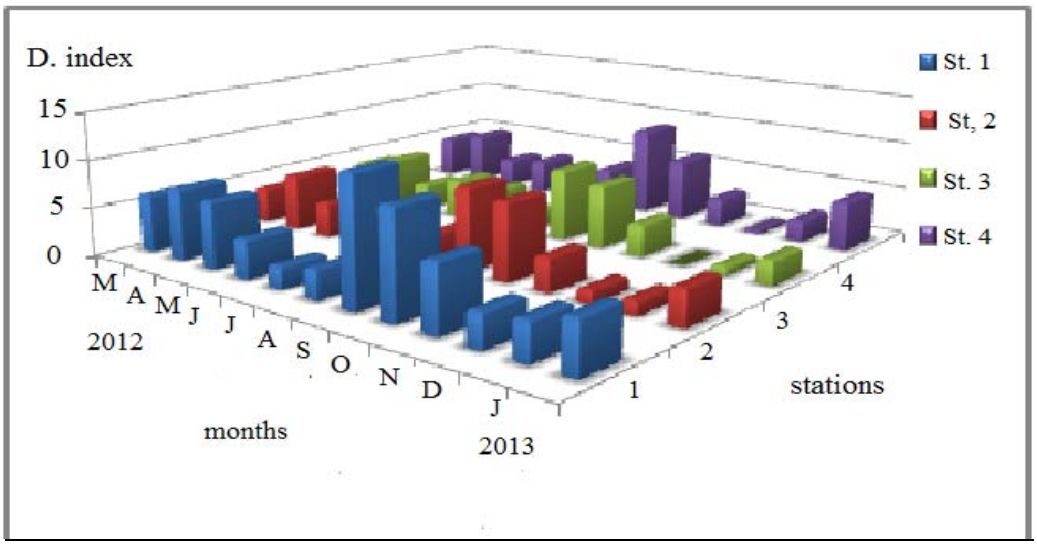

Figure (4): Monthly variations of the values of species abundance index (D) of rotifera (March 2012- February 2013)

The results showed a high index value for the species richness in the Spring and Autumn and this may be due to the increase primary productivity in these two seasons (Van Dijk and Van Zanten, 1995). And the number of rotifera differ in one water body for several years may be due to variation in the properties of the water, bottom and the abundance of nutrients (Al-Lami *et al.*, 2001).

The Shannon-Wiener index of diversity was the most biodiversity indicators commonly used, ranging from 0-5 and, when the value of this indicator is higher than 3 means that the composition of habitat is stable, and less than 1, it indicates a defect in the ecosystem caused by pollution (Turkmen and Kazanci, 2010). The values of Shannon-Wiener index of rotifera ranged between the lowest value 0-bit /Ind. at the station 3 in December 2012, and the highest value, 3.58 bits/ Ind. at the station 1 in September 2012 (Figure 5).

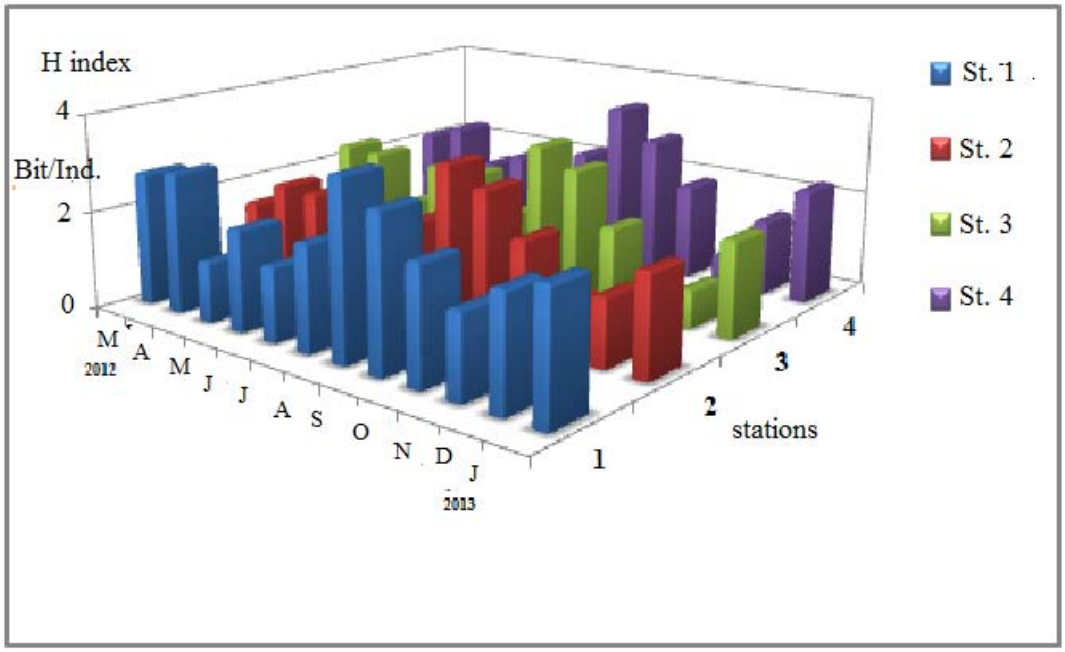

Figure (5): Monthly variations values of Shanon-Weiner diversity index (H) for rotifera in Al-Shamiah River from March(2012-February 2013)

The species uniformity index for rotifera ranged in Al-Shamiah River between the lower value was 0 at the station 3 in December 2012, and the highest value 0.94 at the station 3 in February 2013 (Figure 6).

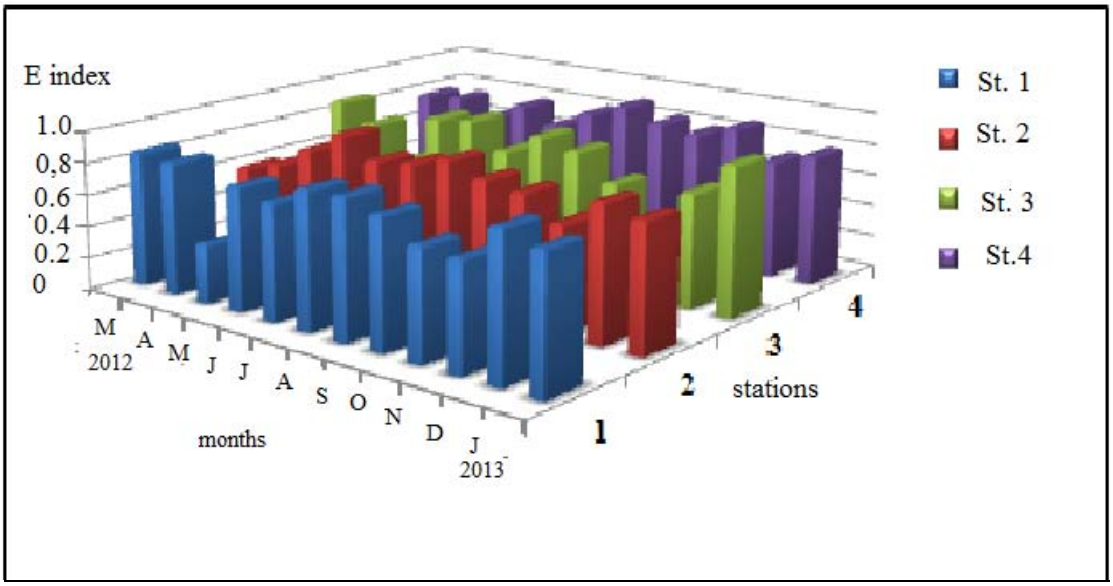

Figure (6): Monthly variations of the species uniformity index values for rotifera in Al-Shamiah River from March 2012-February 2013

The results showed presence of high values of Shannon-Wiener diversity index in the station 1 and 2, this may be due to favorable environmental conditions at these two stations because whenever the environmental conditions more stable and consistent increase diversity in the river (Trout-Haney, 2006). It's considered that the diversity of rotifera in Al-Shamiah River is good for this index.

The presence and diversity of aquatic plants lead to the formation of different environmental habitats, which is not homogeneous and is habitat by different zooplankton communities, while the recorded Shannon-Wiener index values at the station 3 may be due to the discharge of wastewater into the river, which caused pollution directly (Salman and Nassar, 2012). As well as the cause of the low Shannon-Wiener index values in the

station 3 may be due to an increase turbidity and total suspended solids at this station were considered as the reason of the lack of biodiversity (Neves *et al*. 2003). Also the increase in water transparency leads to increase in the diversity of zooplankton.

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All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

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Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

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Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

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Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

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9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

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15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

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The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

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The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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