



ICESR2013

BOOK OF PROCEEDINGS

International Conference on Environmental Studies and Research

July 1-4, 2013

Federal College of Education(Technical),
Umunze-Anambra State-Nigeria

Edited by

Jacinta A. Opara



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Editorial Remark

I have the pleasure to furnish you herewith the Proceedings which herein contains a collection of the papers presented at *International Conference on Environmental Studies and Research* (ICESR2013) organized by African Society for Scientific Research and African Association for Teaching and Learning in cooperation with several partners and collaborating journals in the international community. The conference was held July 1-4, 2013 at Federal College of Education (Technical), Umuze-Nigeria

The ICESR series is an academic activity for interested scholars, scientists, technologists, policy makers, corporate bodies and graduate students. The aim of the conference is to diffuse research findings and create a conducive environment for scholars to debate and exchange ideas that lead to development in social, political, cultural and economic spheres of the global community.

Following the call for papers by the International Scientific Commission, papers we received more than 100 proposals from 25 different countries from all continents. As a commitment to the vision and mission of academic excellence and integrity, each paper was anonymously reviewed by two members of the editorial sub-committee of the Commission. This book of proceedings contains a selection of the papers presented at the conference.

We wish to express our sincere thanks to the Governing Council, Management and Senate of the Federal College of Education(Technical), Umuze-Nigeria for providing the venue and facilities for the conference and for being committed to towards ensuring the success of the conference by setting up a high powered Adhoc Local Organising Committee led by Associate Professor Dr Ugochukwu P.N. Amadi. We thank the staff and students of the institution for their cooperation and support for the project. We express our profound gratitude to all and sundry especially our Special Guests, delegates, reviewers, the media, the Nigerian foreign missions and all the cooperating partners for their contributions in promoting this noble academic event.

Please read on!!!

Jacinta A. Opara, PhD

Convenor, International Conference on Environmental Studies and Research (ICESR2013)
Visiting Associate Professor, Universidad Azteca, Chalco-Mexico

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Programme of Event (Draft)

Monday 1st July

08:00 – 09:30	Registration
09:30 – 11:45	Welcome Ceremony
11:45 – 14:30	Special Sessions
14:30 – 14:45	Lunch Break
14:45 – 16:45	Special Sessions
16:45 – 17:15	Coffee Break
17:15 – 18:00	Plenary Sessions
20:30---10:30	Welcome Dinner

Tuesday 2nd July

08:30 – 10:00	Special Sessions
10:00 – 10:30	Coffee Break
10:30 – 13:30	Plenary Sessions
13:30 – 14:45	Lunch Break
14:45 – 16:45	Plenary Sessions
16:45 – 17:15	Coffee Break
17:15 – 18:45	Plenary Sessions

Wednesday 3rd July

08:30 – 10:00	Special Sessions
10:00 – 10:30	Coffee Break
10:30 – 13:30	Plenary Sessions
13:30 – 14:45	Lunch Break
14:45 – 16:45	Plenary Sessions
16:45 – 17:15	Coffee Break
17:15 – 18:45	Plenary Sessions

Thursday 4th July

08:30 – 10:00	Special Sessions
10:00 – 10:30	Coffee Break
10:30 – 13:30	Plenary Sessions
13:30 – 14:45	Lunch Break
14:45 – 16:45	Plenary Sessions
16:45 – 17:00	Coffee Break
17:00 – 18:00	Special Sessions/Communiqué
18:00 – 19:00	Closing Sessions

Friday 5th July

Departure

CONTENTS

EFFECTIVE ENVIRONMENTAL MANAGEMENT: A PANACEA FOR SOCIO-ECONOMIC DEVELOPMENT OF DEVELOPING COUNTRIES

Uwakwe Felicia E and Kamalu Nkeiru A.

TOWARDS MITIGATING THE IMPACTS OF CLIMATE CHANGE ON FOOD SECURITY: A GLOBAL PERSPECTIVE

Mansur Bello Dogondaji

GREEN HOUSE GASES, CLIMATE CHANGE AND ENVIRONMENTAL CONSERVATION FOR SUSTAINABLE DEVELOPMENT

Isab, Yinusa

ACHIEVING ENVIRONMENTAL SUSTAINABILITY (MDG7) IN NIGERIA: PROGRESS SO FAR, CHALLENGES AND PROSPECTS

Ademola Adeagbo

GEOMORPHOLOGICAL CHANGES OF THE ROSETTA MOUTH, NILE DELTA COAST, EGYPT DURING 20TH CENTURY

Magdy Torab

WASTE CONTROL STRATEGIES FOR HEALTHY ENVIRONMENT: A CASE STUDY OF FEMALE STUDENTS HOSTELS

Izualor Patience Amuche

THE IMPACT OF ENVIRONMENTAL POLLUTION IN IMO STATE: A CASE STUDY OF OKIGWE LOCAL GOVERNMENT AREA

Adimekwe Stella Chimwe

THE EARTH AS A RESOURCE FOR ART AND CREATIVITY

Okafor, Mercy .A.

INTELLECTUAL PROPERTY AND REMOTE SENSING DATA IN LIGHT OF REALIZATION OF PUBLIC INTEREST

Sara Kaveh

THE EFFECT OF HEALTH SAFETY MANAGEMENT IN NATIONAL DEVELOPMENT

Ikeogu Dennis O.; Joseph O. Uwakwe & Chidolue Ifeyimwa B.

SPATIAL DIMENSION OF DRINKING WATER DEPRIVATION IN URBAN INDIA

Mala Mukherjee

REMOVAL OF HEAVY METALS Fe^{3+} , Mn^{2+} , Zn^{2+} , Pb^{2+} AND Cd^{2+} FROM WASTEWATER BY USING RICE STRAW AS LOW COST ADSORBENT

Nagwa Navar, Mohamed Ebrahim and Eslam Sami

ANALYSIS OF LAND USE/LAND COVER PATTERN ALONG THE RIVER BENUE CHANNEL IN ADAMAWA STATE, NIGERIA

Adefioye Sunday Adewumi

SUSTAINABLE DEVELOPMENT OF BIOENERGY FROM AGRICULTURAL WASTE

Abdeen Mustafa Omer

FLOODS AND RAINSTORMS IMPACTS, RESPONSES AND COPING AMONG HOUSEHOLDS IN ILORIN, KWARA STATE

Olorunfemi, F.B and Raheem, U.A

MODELING FARMERS' DECISIONS ON SOIL NUTRIENTS IN URBAN AGRICULTURE: THE CASE OF CAMEROON

Joel Sotamenou

THE CONTROL OF PIRATE ATTACK ON SUDAN COAST REGION IN SUB-SAHARA AFRICA

Akenara U.C

EVALUATION OF SANITATION PRACTICES IN IBADAN SOUTH

EAST LGAs OF OYO STATE, NIGERIA

Oke, M.O, Atinsola, M.A and Aina, M.

SUSTAINABILITY AS A STRATEGY OF RESPONSIBLE AND COMPETITIVE DEVELOPMENT

José G. Vargas-Hernández

A STUDY ON SOLID WASTE GENERATION AND CHARACTERIZATION IN SOME SELECTED HOSPITALS IN OKIGWE LOCAL GOVERNMENT AREA, IMO STATE

Etusim, P. E., Ijere, A.O., Melariri, P. E., Ogwu, P. A. and Ikonne, U.

MEDICAL GEOGRAPHY IN EGYPT : AS AN INTERDISCIPLINARY SUBFIELD

Mohamed Nour Eldin Ibrahim Elsabawy

KNOWLEDGE, ATTITUDES AND PRACTICES ASSOCIATED WITH WASTE MANAGEMENT IN JOS SOUTH METROPOLIS, PLATEAU STATE

Audu Andrew Jatau

EFFECTIVE ENVIRONMENTAL MANAGEMENT: A PANACEA FOR SOCIO-ECONOMIC DEVELOPMENT OF DEVELOPING COUNTRIES

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ABSTRACT

The science of environmental management is one of the areas of great interest in the present millennium. It deals with the whole concept of the environment, its characteristics, resources, and effective exploitation for the benefit of man. The environment offers unlimited opportunities for socio-economic development through effective exploration and exploitation of the available resources and purposeful utilization of the proceeds in developmental projects. However, in developing countries, environmental management is subject to various limitation and draw-backs. Consequently these countries continues to grapple with the challenges of climate change and its impacts, food security, population explosion, pest infestation, communicablediseases as well as pollution, contamination and environmental sustainability. The overall effects are poverty, low living standard, poor health, inadequate housing, high level of unemployment and under-employment, low agricultural productivity, technological backwardness and poor socio-economic development. Against the above background, it becomes pertinent to carry out an investigation on the essence and methods of effective environmental management, its socio-economic implications and the problems militating effective utilization of environmental resources in developing countries, hence this research. The work is a descriptive survey and the investigation revealed that lack of knowledge and proper planning in environmental issues, lack of executive capacity, technical know-how and political will as well as inadequate funding and socio-cultural inclinations are some of the factors limiting effective environmental management in developing countries. It is therefore recommended that adequate budgetary provisions be made for funding research on environmental management, capacity building and human development.

Keywords: Environmental management, exploitation, natural resources, sustainability, socio-economic development.

INTRODUCTION

The United Nations system did not stipulate any established convention for the designation of developed and developing countries or areas. According to the United Nation's statistics division, the development of any country is measured with statistical indices such as human development, income per capital, life expectancy , the rate of

literacy (education) and the provision of adequate public and health care services. A developing country is a country that is poor, and whose citizens are mostly agricultural workers, but want to become more advanced socially and economically (Wikipedia, 2013). Development can also be perceived in terms of industrial and technological advancement of a country. Based on this perspective, Sullivan and Stephen (2003) viewed a developing country as a less-developed nation with a low living standard, under – developed industrial base and low human development index (HDI) relative to other countries. According to them, these countries have not achieved significant degree of industrialization relative to their populations, human development, effective health care delivery and have in most cases a low per capita income.

Generally, developing countries are characterized by wide spread poverty associated with low income, inadequate housing, poor health, and inadequate or non-existent public health services. Other features as reported by Kintu (2008) include limited or no education, substantial dependence on agricultural produce with low productivity, high and rising levels of unemployment, dualistic economy and technological backwardness. Furthermore, Wikipedia (2013) identified other features as very high population rate, shorter life expectancy of 51 years as compared with 75 years for developed countries, which translates to smaller percentage of the population being available for labour. Consequently, they are barely able to satisfy their basic needs, working long hours and earning little. This is as a result of inadequate job opportunities, skills, tools and machines, and the use of primitive technology, poor organization and limited physical and human capital inputs.

The economy of any country revolves on the environment. Adequate knowledge of the environment, its available and potential resources and the purposeful exploitation and utilization of the proceeds in areas of developmental projects like road construction building of schools and hospitals and the installation of others essential public and social welfare projects can bring rapid transformation of the economy of any country. These potential available in the environment can be harnessed through the establishment of an effective environmental management system which is based on certain principles such as proper understanding of the ecology and accurate documentation of environmental resources, purposeful exploitation and gainful deployment of proceeds, improvement on environmental setting, focus on environmental problems and protection and conservation of resources. In most developing countries, environmental issues are not given adequate and appropriate attention resulting to the under-development of environment–related projects and under-utilization of environmental resources. Effective management of the three categories of environment improves food security, provide substantial income through commercial sale of products as well as provides opportunities for employment and community self-reliance projects. The over all effect would be the attainment of socio-economic growth and sustainable development, in a pristine, healthy, supportive and sustainable environment.

The Nature of the environment

In the simplest form, the environment is reckoned with as the immediate surrounding and outline areas of an individual. However the environment in the wide sense may be conceptualized to comprise the entire globe or earth and the outer space which affects life on earth. The environment consists basically of biotic and abiotic components. The biotic components comprise all life forms which include a wide range of plants, animals and micro-organisms. On the other hand, the abiotic components encompass all the non-living materials which include among others, the soil, water, rocks, organic and inorganic substances. The part of the earth which supports life is known as the biosphere, while

the non-living earth crust is called the lithosphere. The major part of the earth is covered with water and this forms the hydrosphere which houses a wide range of life forms.

The environment is divided into different geographical regions, within which are various ecological zones. Within the zones exist various types of habits, micro-habitats and ecological niches harbouring different types of living things. Man's environment according to Lucas and Gilles (1990) consists of three major components: physical, biological and social. The physical environment refers to the non factor like air, soil, water, minerals and climatic factors which have direct effects on man, his comfort and performance. The physical environment also affects the distribution of organisms like plants that provide man with food, shelter and clothing, animals that compete with him and vectors that produce and transmit diseases. The biological environment on the other hand comprises all living things which are dependent on each another and their physical environment, while the social environment deals with man and his society. In other words, the environment has a profound influence on man, and at the same time, man extensively alters the environment to suit his needs and desires (Lucas and Giles, 1990)

The environment is subject to natural influences such as earthquake, thunderstorms, volcanic eruptions, hurricanes, tornadoes, erosion, flooding as well as climatic factors like sunshine, temperature and humidity. Added to these are all forms of interactions between the biotic and abiotic components and various anthropogenic activities. The environment is therefore not static, but dynamic and these fluctuations usually have severe impacts on the quality of the environment, and the survival of man and other life forms.

THE CONCEPT OF ENVIRONMENTAL MANAGEMENT

Environmental management is one of the areas of great interest in the present millennium. It deals with the whole concept of the environment, its characteristics, exploitation and management to achieve environmental sustainability, security and continuity of life on earth. Environmental management therefore focuses on various habitats, their natural resources including available life forms, the nature of biodiversity in a given area and other non-living environmental resources, and how best all these potentials could be exploited and harnessed for the benefit of man and other life forms. The multiplicity of species of organisms in various environments, and their diverse nature, ecological spread and natural histories form the basis of the modern concept of biodiversity (Iwuala, 2012). The importance of biological diversity to human society, according to United Nations Environment Programme (UNEP, 2010) is hard to over state. It is estimated that 40% of the global economy is based on biological products and processes and besides living things, there are other vital environmental resources of great value to the economy of any state or country (Iwuala, 2012). Environmental management offers mankind the opportunity to maximize the benefits of these resources to achieve sustainability and economic growth.

Environmental management was viewed by Pahl-Most (2006) in terms of resource management and described as a purposeful activity with the goal to maintain and improve the state of environmental resources affected by human activities. He further pointed out that environmental resource management aims at ensuring that ecosystem service are protected and maintained for equitable use by future human generations, and at the same time maintaining ecosystem integrity by taking into consideration ethnical, economic and scientific variables. Furthermore, environmental management takes into consideration all components of the environment, living (biotic) and non-living (abiotic) and also the relationship of the human environment such as social, cultural, economic and bio-physical (Colby, 1991). Commenting on the goals of environmental management, Wikipedia (2012) enumerated the following: reduction and cleaning up all sorts of pollution with the future

goal of zero pollution, emphasis on clean and alternative energy sources that have low carbon emission, sustainable use of water, land and other scarce resources, preservation of existing endangered species and protection of biodiversity. Virtually, all sectors of the economy of any country depend essentially on the environment and its resources. The overall essence of environmental management is therefore to help man explore and exploit the natural and human resources available in the environment and deploy the proceeds effectively for improve living conditions, better longevity and socio-economic development, while at the same time maintain the quality of the environment.

Generally, the environment is saddled with problems which Adeoti (2012) identified as loss of soil fertility, desertification, hazardous wastes in natural media and loss of biodiversity. Other problems to contend with include pollution, climate change, global warming, rise in sea water, population explosion, natural disasters, acid rain and other ecological problems. These problems impact on humans and other life forms and could be taken care of through effective management of the environment.

MANAGEMENT OF VARIOUS TYPES OF ENVIRONMENTS

In Environmental Management, three broad categories of environment are distinguished and these include terrestrial (land) aquatic(water) and aerial (air) environments or habitats. Terrestrial environment constitutes a significant portion of the earth and harbours the entire soil, rocks and the covering vegetation. It also sustains animal settlements and holds substantial mineral and metallic resources. In addition, terrestrial environment supports the establishments of human settlements and urban cities, semi-urban towns and rural communities. The ecological characteristics of terrestrial environment differs from community to community, and from town to town in terms of animal population, nature of vegetation, occurrence of inland water bodies, soil, climate factors and other ecological indices.

In contrast, aquatic environment consists of natural water bodies which generally belong to two broad categories; marine environment and freshwater environment. The marine environment comprises salt water bodies which include the oceans and seas. These are large water bodies with great volume, depth and cover a vast expanse of space. On the other hand, freshwater bodies include rivers, stream, ponds, lakes which are salt-free and sources of portable water. The water bodies are smaller than marine in terms of water depth, volume, circumference and space. The aquatic environments harbour substantial quantity of plant and animal populations and mineral resources.

Aerial environment comprises the entire gaseous atmosphere above the land and water as well as within houses, homes and other enclosures. The aerial environment has a peculiar physical form and is subject to contamination, physical phenomena and physical factors like wind movement, temperature fluctuations, humidity changes, percolation of water, gravity, light and heat transmission and movement of sounds. Like the terrestrial and aquatic environments, aerial environment harbours various life forms

The task of managing specific types of environment is usually guided by the nature and characteristics of such environments. In the management of the three types of environment therefore, we reckon with a wide range of measures, strategies and operations, all designed to understand the nature of such environments, exploit the available resources and maximize the use of the proceeds in development and conservation of the natural environments for future beneficial uses. The methods commonly employed in the management of the different types of environments consists of the following:

Adequate knowledge and proper understanding of the particular environment

This requires indepth knowledge and first hand information about the particular environment under study. Such information as the geographical location, territorial space, physical characteristics, the ecology of the various habitats and niches, plus the animal and plant populations and their distribution patterns are of great importance. Furthermore, the available natural resources, the inter-relationship of the biotic and abiotic components and the prevailing climate, natural and anthropogenic influences should be properly documented. Detailed information on these various indices need to be collated and analyzed for meaningful assessment of the environment.

Environmental planning

Effective planning for management of the environment will require adequate data on household, animal and plant settlements, land utilization, rural and urban planning, delineation of roads and other infrastructure and supervised implementation of environmental layout programmes. The planning should also take account of the available resources, their potential values and possible exploitation for economic benefit. Environmental beautification and estate management may also be considered as part of the initial programme for effective management of the environment.

Effective waste management and disposal

Effective waste management constitutes another important approach to effective management of various environments. This is because all living organisms, as part of their normal life activities generate and exude various forms of wastes on a daily basis. In addition, every activity of man leads to the generation of wastes, some of which are hazardous and cause danger to humans, other life forms and degrade the environment. Accumulation of refuse in the environment leads to the pollution of land, air and water, thereby increasing the likelihood of the spread and transmission of air –borne and water –related diseases (Uwakwe and Iwuala, 2012). For effective waste management and disposal, we require proper knowledge and classification of the different waste types generated, identification of collection centres and the employment of reliable waste collection and disposal strategies. There is also the need to define waste dumping and elimination sites and regular evacuation practices to avoid accumulation. Proper waste management is a step toward sustainable development since waste treatment and disposal occur in such a manner as to render them harmless to humans, other life forms, the economy and the environment (Adewole, 2009).

Active pollution management and control

Active pollution management aims at sanitizing the environment and protecting life and life forms. The emphasis here is on safe elimination and prevention of contamination and damage due to poison chemicals, irradiation agents and other forms of toxic hazards that may feature in the environment. This strategy would attempt to understand, defined and categorize different types of pollution and pollution agents as well as evolve techniques for detection, investigation and handling the various case of pollution available in respective environments.

Effective disease prevention and control

This aspect of environmental management is fundamental to the preservation and prolongation of life. Diseases may result from unhealthy exposure to various microbes, dangerous chemicals, gases, irradiations and dusts. Measures employed would include putting facilities in place for disease documentation, treatment, prevention and surveillance. In addition, efforts should be geared toward the control and destruction of

disease vectors and other harmful agents that may be involved in the dissemination and sustenance of infections.

Effective Pest Management and control

This aspect deals with the regulation of different types of pests that feature in different environments. For example, various forms of household, medical, agricultural, industrial, forestry and wildlife pests as well as cosmopolitan pests found in different habitats and niches of the globe. Pests account for far-reaching losses of life and properties, destruction of agricultural produce, drastic drainage in the economy and destruction of wood work, furniture and various household properties. It is therefore obvious that in managing the environment, pests constitute a factor to be reckoned with. Handling pests involves the development and employment of different methods of pest control and regulation, taking into account the characteristics of the environment under study.

Economic management of land resources

This is a strategic method of managing terrestrial environment. Here all resources on land are taken into account, including human, animals, plant, minerals and other economic resources. Proper utilization of the soil and land resources for agriculture, town and rural development, installation of infrastructure like roads, schools, hospitals and other public utilities constitute parts of the management of land resources. Added to these is the establishment of forestry and wildlife reserves, and other agricultural enterprises like livestock rearing, poultry farming and other forms of animal husbandry. Development of land resources and the exploitation of such resource lead to revenue generation, investment, development of communities and socio-economic growth.

Economic management of water resource

In dealing with the management of water resources, we reckon with such reforms as management of river basins, coastal maintenance and dredging of various water bodies, drainage, irrigation and creation of dams for agricultural, commercial and industrial purposes and maritime uses. Furthermore, fish farming, aquaculture and installation of processing facilities for the exploitation of aquatic organisms like prawn, crabs, fingerlings and other forms of sea food are encouraged as comprehensive management of water resources. Processing and reticulation of water for domestic and industrial uses, and under water exploration and exploitation of mineral resources are also considered as parts of management of water resources. It is the belief that the bulk of animals to provide sustenance for humans may be found in the seas and oceans and countries that are dependent on exploitation of marine and sea food usually have viable economies and adequate nutritional supplies (Uwakwe and Ehujuo, 2012).

Economic management of aerial resources

In this approach of environmental management, the procedures include meteorological studies and monitoring of the atmosphere, planning and regulation of canopies, shades and shelters, establishment and maintenance of airway and air transportation services and socio-economic uses of air space and atmospheric resources. Space control is also considered in town planning for allocation of sites for high-rise buildings, small structures and recreational facilities. Specific tariffs and other charges may be imposed for use of aerial spaces and the revenue generated employed for developmental projects.

Environmental Regulation, Protection and Conservation

Environmental regulation and protection for healthy sustenance of life and life forms focuses on the need for ecological checks and balances to ensure proper protection and conservation of humans and other organisms. To this end, proper environmental laws, edicts and decrees need to be enacted and enforced on citizens to ensure compliances. Such laws include for example public health bye-law on sanitation, vaccination of infants, establishment of markets, arbatoirs, manufacturing units, and laws regulating the handling of pesticides, agro-chemicals and other dangerous chemicals. Similarly, various forms of environmental regulation covering conservation of wildlife, establishment of forest reserves, rural and urban layouts, recreational centres and excavation need to be put in place for effective conservation of environmental aesthetics.

Manpower Training and Development

This aspect of environmental management is concerned with human resources development for effective environmental management services. It requires detailed appraisal of the scope of personnel required for the management of any given environment. As a part of planning in various countries and states, basic education of human population is considered a fundamental right for children and adolescents. This strategy enhances literacy levels and guarantees improved quality of life for the human population. It also calls for periodic training, job orientation and seminars or workshops for both the senior and juniors cadres of staff including the unskilled and semi-skilled personnel needed for field operations in areas of waste management pollution and pest control, agriculture and forestry services, urban and rural maintenance services, water supply, sanitation and various aspects of environmental management services. Furthermore, capacity building programmes should be organized for the expert cadres which include top personnel architects, economists, planners, agricultural and industrial personnels, health personnels, engineers, quantity surveyors, hydro geologists and various other experts that may be needed for the different operations under a strategic environmental management programme.

Public Enlightenment and Health Education

This approach is quite essential to achieve effective environmental management. This is because the general public is entitled to know and appreciate the significance of environmental management programmes which affect them. It become pertinent to involved the wider community in various aspects of environmental management efforts such as measures targeted at waste management and disposal, pollution control, disease prevention and control, mineral exploration and exploitation and development of agricultural practices. This can be achieved through public enlightenment and health education using the electronic media, newspaper, magazines, fliers, gingles. Awareness programmes can also be carried out through Institutions, town unions, market associations and other pressure groups. Through enlightenment the general public would become aware of the various potentials and opportunities offered by the different environments, and work towards exploiting and harnessing them for improved living standards and socio-economic development.

SOCIO-ECONOMIC IMPORTANCE OF EFFECTIVE ENVIRONMENTAL MANAGEMENT

In practice, it is pertinent to note that virtually all sectors of the economy of any country depend essentially on the environment and its available resources and opportunities. Effective management of the different categories of the environment offers great advantages with respect to gainful exploitation of natural and human resources and minimization of environmental loses and spoilage through control of pollution disease contamination wastes and pest infestations. Environmental management aims at achieving environmental

sustainability which according to Iwuala (2012) is the guiding principles for a green economy that focuses on maximizing the use of natural resources in the environment to achieve a healthy, sanitary and supportive environment for man and other life forms. Furthermore, effective management of the environment is the main thrust in the establishment of various groups and organizations which form the framework that helps to achieve environmental goals through consistent policies and control measures for maintaining a healthy and sanitary environment internationally and locally (UNEP, 2010). Such groups include World Health Organization (WHO), United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP), Food and Agricultural Organization (FAO), Environmental Management System (EMS), United Nations Population Council (UNPC) as well as various professional bodies. These organizations have been working in an integrated manner to achieve health care, adequate food supply, population regulation and environmental improvement through flood control, pest management, irrigation activities and other environmental manipulation services to checkmate the impacts of natural disasters in the globe (Iwuala, 2012).

The overall socio-economic importance of environmental management includes among others the following:

- Achievement of environmental sanitation and protection and consequent reduction in the spread and sustenance of diseases, pollution and contamination.
- Establishment of improved health care and social welfare services.
- Development of viable and integrated agricultural practices which guarantee food security and exportation.
- Effective exploitation of minerals and other natural resources including sand, metallic ores, oil and gas.
- Improved literacy level through human development and capacity building.
- Effective use of land, aquatic and air spaces for economic development.
- Establishment of industries and creation of job opportunities.
- Technological development
- Environmental beautification and aesthetics.
- The practice of environmental impact assessment to protect humans and other life forms from adverse effects of developmental projects.
- Achievement of environmental protection, preservation and conservation to prevent wastage, spoilage and extinction of species.
- Increased substantial revenue, improved living conditions and prolonged longevity.
- Attainment of environmental sustainability, sustainable and socio-economic development.

PROBLEMS AND LIMITATIONS OF ENVIRONMENTAL MANAGEMENT IN DEVELOPING COUNTRIES

In most developing countries of the world, environmental management practices suffer various draw-backs which result to deficiency in the level of success achieved in the environmental management issues. Consequently, these countries are saddled with the problem of poverty, unemployment, low standard of living and poor technological and industrial development. The limitations to effective environmental management could be traceable to some fundamental issues which include;

- Limited public enlightenment and involvement in the practice of environmental management.
- Lack of adequate knowledge, understanding and appreciation of the essence of environmental management.
- Lack of executive capacity and technical know-how.
- Lack of political will and commitment in dealing with environmental management challenges.
- Poor funding and inadequate capital involvement in environmental management programs.
- lack of proper planning and projections in dealing with environmental management issues.
- Natural ecology, seasonal factors and climatic fluctuations.
- Cultural belief and inclinations

RECOMMENDATIONS

The knowledge and practice of effective environmental management offer a lot of opportunities for economic development of any country. To be able to harness these opportunities, the following recommendations are made to developing countries;

1. That adequate budgetary provision be made for environmental management studies.
2. That experts in environmental management be employed and sustained for development of programs pertaining to effective handling of environmental issues.
3. That capacity building programmes for human development in areas of environmental management be organized and sustained.
4. That public enlightenment campaign be organized to educate the public on the practice and essence of environmental management, and the consequences of degradation and ineffective management of the environment.

CONCLUSION

Effective environmental management practices provide ways of protecting the environment and harnessing the unlimited resources available in the environment. Developing countries have not been able to effectively explore and exploit the environmental resources due to limited funding, lack of knowledge and the lack of commitment by the government and people in dealing with environmental issues. A progressive and knowledge driven economy may be built on proper understanding of our environment and the purposeful exploitation of the facilities offered by the environment for improved living conditions, better longevity and more productive agricultural and industrial activities. Consequently, the environment becomes sustainable and enhances the achievement of green economy and sustainable development. Effective management of the environment is therefore a panacea for socio-economic development in developing countries.

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TOWARDS MITIGATING THE IMPACTS OF CLIMATE CHANGE ON FOOD SECURITY: A GLOBAL PERSPECTIVE

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Abstract

Until recently, most assessment of the impact of climate change on the food and agriculture sector have focused on the implications for production and global supply of food, with less consideration of other components of the food chain. This paper takes a broader view and explores the multiple effects that global warming and climate change could have on food systems and food security. The paper also explains the concept of climate change and food security. Finally, it suggests strategies for mitigating and adapting to climate change in several key policy domain of importance for food security and the potential impacts of climate change on the four components of food security.

Keywords: Climate Change, Food Security, Adaptation, Mitigation.

Introduction

Food security is the outcome of food system processes all along the food chain. Climate change will affect food security through its impacts on all components of global, national and local food system. Climate change is real, and its first impacts are already being felt. It will first affect the people and food systems that are already vulnerable, but overtime the geographic distribution of risk and vulnerability is likely to shift. Certain livelihood groups need immediate support, but everybody is at risk. Risk exists when there is uncertainty about the future outcomes of ongoing processes or about the occurrence of future events. Adaptation is about reducing and responding to the risks climate change passes to people live and livelihood.

Mitigating climate change however, means reducing green house gas emissions and sequestering or storing carbon in the short term and of even greater importance making development choices that will reduce risk by curbing emissions over the long term. Although the entire food system is as a source of green house emissions, primary production is by far the most important component. Mean global temperatures have been increasing since about 1850, mainly owing to the accumulation of greenhouse gases in the atmosphere. The main causes are the burning of fossil fuels (coal, oil and gas) to meet increasing energy demand, and the spread of intensive agriculture to meet increasing food demand, which is often accompanied by deforestation.

The process of global warming shows no signs of abating and is expected to bring about long-term changes in weather conditions. These changes will have serious impacts on the four dimensions of food security, food availability, food accessibility, food utilization and food system stability.

Food Systems and Food Security

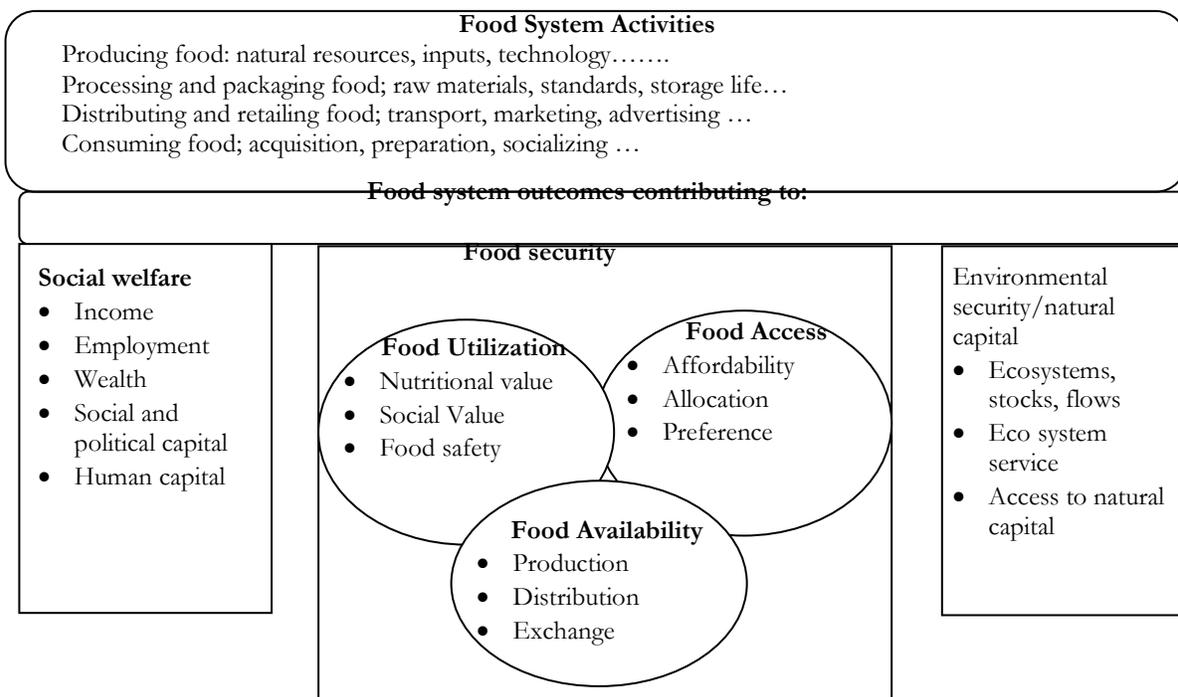
The definition of food security which was adopted at the World Food Summit (WFS) in November 1996, is thus; “food security exists when all people at all times have physical or economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996). To evaluate the potential impacts of climate change on food security, the FAO stated that, “it is not enough to assess the impacts on domestic production in food insecure countries. One also needs to (i) assess climate change impacts on foreign exchange earnings, (ii) determine the availability of food-surplus countries to increase their commercial exports or food aid; and (iii) analyse how the incomes of the poor will be affected by climate change” (FAO, 2003b).

Food system on the other hand constitutes processes along a food chain which need to occur in order to bring about food security and which also determine whether or not food security is achieved. According to Global Environmental change and food systems (GEF, 2007) “Food systems encompass (i) activities related to the production, processing distribution, preparation and consumption of food; and (ii) the outcomes of these activities contributing to food security (food availability, with elements related to production, distribution and exchange; food access, with elements related to affordability, allocation and preference; and food use, with elements related to nutritional value, social value and food safety). The outcomes also contribute to environmental and other securities (e.g income). Interactions between and within biogeophysical and human environments influence both the activities and the outcomes”.

Another study expresses the complexity of food systems and their link to food security as follows: “dynamic interactions between and within the biogeophysical and human environments lead to the production, processing, preparation and consumption of food, resulting in food systems that underpin food security” (Gregory, etal 2005).

The figure below shows the food system activities and food security outcomes.

Table: Food system activities and food security outcomes



Source: GEF 2007

Climate and Climate change

Climate refers to the characteristics conditions of the earth's lower surface atmosphere at a specific location over a long period of time. On the other hand, weather refers to the day-to-day fluctuations in these conditions at the same location. The variables that are commonly used by meteorologists to measure daily weather phenomena are air temperature, precipitation (e.g rain, sleet, snow and hail), atmospheric pressure, humidity, wind, sunshine and cloud cover.

When these weather phenomena are measured systematically at a specific location over several years, a record of observations is accumulated from which averages, ranges, percentages, maximums and minimums for each variable can be computed along with the frequency and duration of more extreme events. The World Meteorological Organization (WMO) requires the calculation of averages for consecutive periods of 30years, such a period is long enough to eliminate year-to-year variations. The averages are used in the study of climate, and as a base with which current additions can be compared (WMO, 1992).

It is important to note that there is no internationally agreed definition of the term "climate change" in the most general sense, this term encompasses all forms of climate inconstancy (i.e any differences from long term statistics of the meteorological elements calculated for different periods but relating to the same area), regardless of their statistical nature or physical causes. Climate changes may result for such factors as changes in solar emission, long – term changes in the earth's orbital elements (eccentricity, obliquity of the ecliptic, precession of the equinoxes) natural internal process of the climate system, or anthropogenic forcing (e.g increasing atmospheric concentrations of CO₂ and other greenhouse gases, WMO 1992). However, the term is often used in a more restricted sense to denote a significant change (i.e a change with important economic, environmental and social effects) in the mean values of a meteorological element (particularly temperature or amount of precipitation) in the course of a certain period, where the means are taken over periods of a decade or longer (WMO, 1992, updated on June 2005). Climate change is also taken as a change in climate that is attributed, directly or indirectly, to human activity, alters the composition of the global atmosphere and is in addition to the natural climate variability observed over comparable periods (IPCC, 1995).

Food Security and Climate change

Food systems exist in the biosphere, along with all other manifestations, of human activity. Some of the significant changes in the biosphere that are expected to result from global warming will occur in the more distant future, as a consequence of changes in average weather conditions. However, the most likely scenarios of climate change indicate that increases in weather variability and the incidence of extreme weather events will be particularly significant now and in the immediate future. The projected increases in mean temperatures and precipitation will not manifest through constant gradual changes, but will instead be experienced as increased frequency, duration and intensity of hot spells and precipitation events. Whereas the annual occurrence of hot days, and maximum temperatures are expected to increase in all parts of the globe, the mean global increase in precipitation is not expected to be uniformly distributed around the world. In general, it is projected that wet regions will become wetter and dry regions drier (FAO, 2008).

Climate change variables influence biophysical factors, such as plants and animal growth, water cycle, biodiversity and nutrient recycling and the ways in which these are managed through agricultural practices and land use for food production. However, climate variables also have an impact on physical/human capital – such as roads, storage and

marketing infrastructure, houses, productive assets, electricity grids and human health which indirectly changes the economic and socio-political factors that govern food access and utilization and can threaten the stability of food systems.

Protecting food security through adaptation to climate change

Adaptation has been defined as “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2000). It involves learning to manage new risks and strengthening resilience in the face of change. Risk management focuses on preparing to deal with shocks. Change management focuses on modifying behaviours over the medium-to-long term to avoid disruptions or declines in global and local food supplies due to changes in temperature and precipitation regimes, and to protect ecosystems through providing environmental services. The followings are the practices for adapting to climate change in the food and agriculture sector:

- (1) Protecting local food supplies, assets and livelihoods against the effects of increasing weather variability and increased frequency and intensity of extreme events through:
 - (a) general risk management;
 - (b) management of risks specific to different ecosystems, marine, coastal, inland water and floodplain, forest, dry land, island, mountain, polar, cultivated;
 - (c) research and dissemination of crop varieties and breeds adapting to changing climatic conditions;
 - (d) introducing three crops to provide food, fodder and energy and enhance cash incomes.
- (2) Avoiding disruptions or declines in global and local food supplies due to changes in temperature and precipitation regimes, through;
 - a. more efficient agricultural water management in general;
 - b. more efficient management of irrigation water on rice paddies;
 - c. improved management of cultivated land;
 - d. improved livestock management;
 - e. use of new, more energy-efficient technologies by agro-industries.
- (3) Protecting ecosystems, through provision of such environmental services as;
 - (a) use of degraded or marginal lands for productive planted forests or other cellulose biomass for alternative fuels.
 - (b) Clean Development Mechanism (CDM) carbon sink tree plantings;
 - (c) Watershed protection
 - (d) Prevention of land degradations
 - (e) Production of coastal areas from cyclones and other coastal hazards
 - (f) Preservation of mangroves and their contributions to coastal fisheries
 - (g) Biodiversity conservation

Potential impact of climate change on the four components of food security availability, accessibility, utilization and stability.

- a) **On Food Availability:** food availability is determined by the physical quantities of food that are produced, stored, processed, distributed and exchanged (Devereux and Maxwell, 2001). Production of food and other agricultural commodities may keep pace with aggregate demand, but there are likely to be significant changes in local cropping patterns and farming practices. There has been a lot of research on the impacts that climate change might have on agricultural production, particularly cultivated crops. 50 percent of total crop production comes from forest and

mountain ecosystems, including all tree crops while crop cultivated on open, arable flat land account for only 13 percent of annual global crop production. Production from both rain fed and irrigated agriculture in dry land ecosystems account for approximately 25 percent and rice produced in coastal ecosystems for about 12 percent (Millennium Ecosystems Assessment, 2005).

The impact of mean temperature increase will be experienced differently, depending on locations (Leff et al, 2004). For example, moderate warming (increases of 1 to 3⁰c in mean temperature) is expected to benefit crop and pasture yields in temperate regions, while in tropical and seasonally dry regions, it is likely to have negative impacts, particularly for cereal crops. Warming of more than 3⁰c is expected to have negative effects on production in all regions (IPCC, 2007). The supply of meat and other livestock products will be influenced by crop production trends, as feed crops account for roughly 25 percent of the world cropland.

For climate variables such as rainfall, soil temperature and radiation, crops have threshold beyond which growth and yield are compromised (Porter and Semenov, 2005). For examples, cereal and fruit trees yields can be damaged by a few days of temperatures above or below a certain threshold (Wheeler et al, 2000). For the 5000 plant species examined in sub-Saharan African study (Levin and Pershing, 2005), it is predicted that 81 to 97 percent of the suitable habitats will decrease in size or shift owing to climate change by 2085, between 25 and 42 percent of the species habitat are expected to be lost all together. The implications of these changes are expected to be particularly great among communities that use the plants as food or medicine.

- b) **Food Accessibility:** Food accessibility is a measure of the ability to secure entitlements, which are defined as the set of resources (including legal, political, economic and social) that an individual requires to obtain access to food (FAO, 2003). Food accessibility involves allocation and affordability. Food is allocated through markets and non-market distribution mechanism. There are factors that determine whether people will have access to sufficient food through market which include income generating capacity, amount of remuneration received for products and goods sold or labour and services rendered, and the ratio of the cost of a minimum daily food basket to the daily income. However, in many countries, the ratio of the cost of a minimum daily food basket to the average daily income is used as a measure of poverty (World Bank Poverty Net 2008). When this ratio fall below a certain threshold it signifies that food is affordable and people are not impoverished; when it exceeds the established threshold, food is not affordable and people are having difficulty obtaining enough to eat. This criterion is an indicator of chronic poverty and food insecurity, owing to reduced food supply and increased prices, to a sudden fall in household income or to both. Climate impacts on income earning opportunities can affect the ability to buy food, and a change in climate or climate extremes may affect the availability of certain food products, which may influence the price (Du toit and Ziervogel, 2004).
- c) **On Food Utilization:** This refers to the use of food and how a person is able to secure essential nutrients from the food consumed. It encompasses the nutritional value of the diet, including its composition and methods of preparation; the social values of foods which dictate what kinds of food should be served and eaten at different times of the year and on different occasion; and the quality and safety of the food supply, which can cause loss of nutrients in the food and the spread of food borne diseases if not of a sufficient standard. Food utilization however consists of

nutritional value and the social and cultural values of food consumed. In the first instance, food insecurity is usually associated with malnutrition, because the diets of people who are unable to satisfy all of their food needs usually contain a high production of staple foods and lack the variety needed to satisfy nutritional requirements. Declines in the availability of wild foods, and limits on small-scale horticultural production due to scarcity of water or labour resulting from climate change could affect nutritional status adversely, in general, however the main impact of climate change on nutrition is likely to be felt indirectly, through its effects on income and capacity to purchase a diversity of food.

The social and cultural values of foods consumed will be affected by the availability and affordability of food. In conditions of chronic food scarcity, households ability to honour social obligations to feed guests even when they have dropped unexpectedly, is likely to breakdown and to be reinforced in locations where the impacts of climate change contribute to increasing incidence of food shortages.

- d) ***On Food System Stability:*** This is determined by the temporal availability of and access to food. In long distance food chains, storage, processing, distribution and marketing process contain in built mechanisms that have protected the global food system from instability in recent times. However, if projected increases in whether variability materialize, they are likely to lead to increases in the frequency and magnitude of food emergencies for which neither the global food system nor affected local food systems are adequately prepared. Food system stability cut across three areas: Stability of supply, stability of access and food emergencies. Many crops have annual cycles and yields fluctuate with climate variability, particularly rainfall and temperature. Maintaining the continuity of food supply when production is seasonal is therefore challenging. Droughts and floods are a particular threat to food stability and could bring about both chronic and transitory food stability. Both are expected to become more frequent, more intense and less predictable as a consequences of climate change.

Stability of Access: As already noted the affordability of foods is determined by the relationship between household income and the cost of a typical food basket. Global food markets may exhibits greater price volatility, jeopardizing the stability of returns to farmers and the access purchased food of both farming and non-farming poor people.

Food Emergencies: Increasing instability of supply, attributable to the consequences of climate change, will most likely lead to increases in the frequency magnitude of food emergencies with which the global food system is ill-equipped to cope. Increasing incidence of drought may force people to migrate from one area to another, giving rise to conflict over access to resources in the receiving area. Resource scarcity can also trigger conflict and could be driven by global environmental change.

Conclusion and Recommendations

It is evidently clear from the foregoing discussion, that the potential impacts of climate change on food security are enormous and is not without great challenges both locally and internationally. To protect local food supplies, assets and livelihood from the effects of increasing whether variability and increased frequency and intensity of extreme events, adaptation measures will need to respond to a variety of risks, many of which are specific to particular ecosystems. The Millennium Ecosystems Assessment Report (2005) evaluated potential climate change impacts for ten ecosystems: urban, marine, coastal, inland water and flood plain, forest, dry land, island, mountain, polar and cultivated. The nature of

the risks and the affected livelihood groups vary considerably from one ecosystem to another, so adaptation and mitigation responses have to be tailored to local conditions and needs. In view of this, the paper recommends the followings:

- a. There should be an enforcement of the Kyoto protocol which sets a legal binding commitment for 39 developed countries to reduce their Green House Gas (GHG) emissions by an average of 5.2 percent, since the targeted period to achieve these emission reductions was between 2008-2012 and up till today it has never been achieved.
- b. The least developed countries (LDCs) should be assisted and have wider access to funds under the Global Environment Facility (GEF) which was established in 1991 as an independent financial organization providing grants to developing countries for projects that benefit the global environment.
- c. There should be appropriate measurement and quantification of the Clean Development Mechanism (CDM) which allows developed nations to achieve part of their emission reduction obligations under the Kyoto protocol through projects in developing countries that affect greenhouse gas emission.
- d. There should be portfolio investors, such as the prototype carbon fund of the World Bank and other large financial institutions, which may wish to spread their projects around the developing world, especially in poorer developing countries where the private sector would not invest.
- e. There should be international development assistance to help poorer developing countries to build national capacity to develop and monitor CDM.

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GREEN HOUSE GASES, CLIMATE CHANGE AND ENVIRONMENTAL CONSERVATION FOR SUSTAINABLE DEVELOPMENT

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Abstract

Climate change is seen as one of the greatest environmental challenges that can alter irreversibly the functioning of the earth's and could produce series of devastating effects on environmental sustainability. This paper examines the concept of the environment and conservation in relation to sustainability. Causes of climate change such as the green house gases, aerosol and land use method were discussed. Some projected impact of climate change on the Earth's environmental stability such as disruption of temperature distribution, precipitation, evapo-transpiration, clouds, air-currents and consequential shifts in the vegetation belts; melting of polar ice-caps, rise in sea level that could adversely affect low-lying areas were mentioned. Adaptation measures to the impacts of climate change were equally discussed.

Keywords: Climate change, Greenhouse Gases, Sustainability, Environment and Impact

INTRODUCTION

Our environment is being continually exploited by man in order to achieve maximum output leading not only to its degradation, but has also destabilized the physical environment. The quest of any Government is to maintain law and order, provision of basic infrastructural requirement and ensuring accelerated socio-economic development among other human needs. Each of these requires enabling social, political and physical environments. Going by scientific predictions on climate change, it has the potential to alter irreversibly the functioning of the earth's climate and to produce a series of devastating effects on environmental sustainability which will be felt worldwide.

Climate change is one of the greatest challenges facing our society today both at the international and local level like Nigeria. The debate or the causes of climate change is over as we now know that the planet is warmed largely due to human activities. In spite of the concerted actions to stem the tide, global warming shall continued to be with us for decades to come. Even with concerted international action now, we are committed to continue global warming for decades to come. For the world to avoid disaster, the international community must work concertedly to reduce green house gas emissions which are the major known causes of global temperature rise and other environmental disasters such as extreme events including heat waves, storms, and floods and more gradual changes in the pattern of the season.

The earth's climate is changing; global temperatures are predicted to continue rising, bringing changes in weather patterns, rising sea levels and increased frequency and intensity of extreme weather events. If the temperature increases by more than 2°C, millions of more people are expected to be at risk of coastal flooding; and 20% of species are estimated to be at increased risk of extinction for a warming of 1.5 – 2.5°C. If temperatures rise above 4°C there are expected significant numbers of extinctions around the globe.

There are so many problems facing the environment which are vast and diverse. Such as global warming, the depletion of the ozone layer in the atmosphere, and destruction of the world's rain forests are just few of such problems that many scientists believe will reach critical proportions in the coming decades. All of these problems will be directly affected by the size of the human population because most of them are caused by human activities. Because of the fact that our environment has to be conserved for sustainable future generations to come we must try to recognize and address these factors that could bring about devastating effect on the environment thereby jeopardizing sustainable development. It is the concern of this paper therefore to capture the causes and impacts of climate change and make appropriate suggestions or recommendations if the future of our environment must be sustained.

CONCEPTUAL CLARIFICATIONS

The Environment

The Environment consist of all the external factors affecting an organism which may include living organisms (biotic factors) or nonliving variables (abiotic factors), such as temperature, rainfall, day length, wind, and ocean currents. The interactions of these factors form an ecosystem. Even minute changes in any one factor in an ecosystem can influence whether or not a particular plant or animal species will be successful in its environment.

Organisms and their environment constantly interact, and both are changed by this interaction. Like all other living creatures, humans have clearly changed their environment, but they have done so generally on a grander scale than have all other species. Some of these human induced changes, such as the destruction of the world's tropical rain forests to create farms or grazing land for cattle, had altered climate patterns thereby causing global warming. In turn, altered climate patterns have changed the way animals and plants are distributed in different ecosystems (Microsoft Encarta, 2009). Scientists study the long-term consequences of human actions on the environment, while environmentalists, professionals in various fields, as well as concerned citizens advocate ways to lessen the impact of human activity on the natural environment

Conservation

Conservation was briefly described by the Microsoft Encarta (2009) as the sustainable use and protection of natural resources that includes plants, animals, mineral deposits, soils, clean water, clean air, and fossil fuels such as coal, petroleum, and natural gas. These resources can easily be influence by influence by climate change if there is no proper use and conservation. Because of what climate change can do to these resources there is the need for conserving them for future generation. This is because our environment is our future.

Conservation conflicts arise when natural-resource shortages develop in the face of steadily increasing demands from a growing human population.

Sustainable development:

This refers to a mode of human development in which resource use are aimed to meet human needs while ensuring the sustainability of natural systems and the environment, so that these needs can be met not only in the present, but also for generations yet unborn . The term 'sustainable development' was used by the Brundtland Commission, which coined what has become the most often-quoted definition of sustainable development: it states that:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United nation, 1987)

This definition contain in it two basic key concepts:

- i. *the concept of **needs**, in particular the essential needs of the world's poor, to which overriding priority should be given; and*
- ii. *the idea of **limitations** imposed by the state of technology and social organization on the environment's ability to meet present and future needs.*

All definitions of sustainable development require that we see the world as a system that connects space; and a system that connects time. This is the reason why the issue of climate change is a global issue because whatever happens in the western world will definitely come to affect the world around us in Africa particularly in Nigeria

Climate change or global warming

From the foregoing introduction, human activities have become a major force in affecting the process of climate change. Climate refers to the average weather conditions of a given geographical area studied over a period of time (usually 35 to 40 years). Parameters such as temperature, rainfall, humidity, wind (Speed and direction), evaporation, e.t.c. are used in expressing weather conditions of a place. It is when noticeable changes occur and are observed in the aforementioned parameters that, experts bring this to the notice of mankind.

Scientists on climate change have reached an overwhelming consensus that climate change is real and caused primarily by human activity. Respected scientific organizations such as the National Academy of Science, the Intergovernmental Panel on Climate Change (IPCC) and World Meteorological Association (WMO) have all identified climate change as an urgent threat caused by humans that must be addressed. The need for urgent action to address climate change is now indisputable due to the impact it has created on the environment. Our intention in this paper is to look at the causes of this climate change and its impact or effect on the sustainability of the environment.

Causes of climate change or Global warming

There are so many factors that could be said to contribute to climate change, but for convenience these factors can be group into Natural and Anthropogenic (human-induced) factors. Since the beginning of the 20th century, scientists have been observing a change in the climate that cannot be attributed to any of the 'natural' influences of the past only. This change in the climate, also known as global warming, has occurred faster than any other climate change recorded by humans is of great interest and of importance to the human population.

Among the natural causes of climate changes are;

A. The green house gases (GHGs)

These are a category of substances, which, under their gaseous state, have a greenhouse effect upon the atmosphere. By preventing infrared radiation to escape the atmosphere and they contribute immensely to the atmospheric temperature rise. These gases include the following.

1. **Water vapour:** The most abundant greenhouse gas (GHG), however because it spends just a short time in the atmosphere, and humans have a very impact on the amount of water in the atmosphere, it is not considered the most important GHG.

- 2. Carbon dioxide (CO₂):** Is a small part of the atmosphere, but one of the most important GHGs. CO₂ is released naturally into the atmosphere through volcanic eruptions and animal respiration but it is also released through human activities such as deforestation and the burning of fossil fuels for energy. CO₂ also spends a long time in the atmosphere increasing its impact. Since the industrial revolution, humans have increased atmospheric CO₂ concentration by 30%.
- 3. Methane (CH₄):** The second most important GHG is produced both naturally and through human activities. The most significant sources of Methane come from the decomposition of organic matter e.g. in landfills and in agriculture. Another large source is from the digestion of ruminants such as cows, goats etc. Methane is a stronger GHG than CO₂ because of its ability to absorb more heat; however it is much less abundant in the atmosphere.
- 4. Nitrous oxide (N₂O):** A very powerful greenhouse gas which is heavily produced in the agricultural sector, specifically in the production and use of organic fertilizers and other agricultural chemicals e.g. herbicides and pesticides. It is also produced when burning fossil fuels. Methane and nitrous oxide are 25 times and 298 times more potent than carbon dioxide respectively in terms of their potential to intensify global warming. (IPCC, 2007).
- 5. Chlorofluorocarbons (CFCs):** These are man-made gases that were produced for industrial use, mainly as refrigerants and air conditioners. They are now regulated under the Montreal Protocol due to their adverse affect on the Ozone Layer.

Since the beginning of the 20th century industrial activity grew 40-fold, and the emissions of greenhouse gases grew 10-fold.

The amount of CO₂ in the air increased from some 280 parts per million by volume (ppmv) at the beginning of the century to 389 ppmv at the end of 2010. The amount of CO₂ varies throughout the year as the result of the annual cycles of photosynthesis and oxidation, illustrated in the graph. Similarly, methane (CH₄) rose from a preindustrial atmospheric concentration of around 700 parts per billion by volume (ppbv) to about 1,789 ppbv by 2007.

The overall warming from 1850 to the end of the 20th century was equivalent to about 2.5 W/m²; CO₂ contributed around 60 per cent of this figure and CH₄ about 25 per cent, with N₂O and halocarbons providing the remainder. This has resulted in Earth's average temperature increasing from 15.5°C to 16.2°C in the last 100 years. The warming effect that would result from a doubling of CO₂ from pre-industrial levels is estimated to be 4 W/m².

B. Aerosols in the Atmosphere

Aerosols are particulates matters that are airborne which absorb, scatter and reflect radiation back into the earth. Clouds, dust and particles that can be traced to eruption due to volcanoes are good examples of natural aerosols. Burning of fossil fuels and burning of farmland used to clear forestland contribute immensely to the presence of aerosols to the atmosphere. Although aerosols are not considered a heat-trapping greenhouse gas, they do affect the transfer of heat energy radiated from Earth to space. The effect of aerosols on climate change is still being debated, but scientists believe that light-colored aerosols have a cooling effect, while dark aerosols like soot contribute to warming (Mastrandrea *et al*; 2008).

Aerosols in the atmosphere affect climate change by scattering and absorbing solar and infrared radiation by changing the microphysical and chemical properties of clouds. The scattering of solar radiation acts to cool the planet, while absorption of solar radiation by aerosols warms the air directly instead of allowing sunlight to be absorbed by the surface of the Earth.

C. Land use change

Another important factor that had been identified by scientist is the way and manners by which the land is put to use.e.g. Cutting down forests to create farmland have led to changes in the amount of sunlight reflected from the ground back into space (the surface albedo). The scale of these changes is estimated to be about one-fifth of the forcing on the global climate due to changes in emissions of greenhouse gases. About half of the land use changes are estimated to have occurred during the industrial era, much of it due to replacement of forests by agricultural cropping and grazing lands over Eurasia and North America. The largest effect of deforestation is estimated to be at high latitudes where the albedo of snow-covered land, previously forested, has increased. This is because snow on trees reflects only about half of the sunlight falling on it, whereas snow-covered open ground reflects about two-thirds.

Other significant changes in the land surface resulting from human activities include tropical deforestation which changes evapotranspiration rates (the amount of water vapour put into the atmosphere through evaporation and transpiration from trees), desertification, which increases surface albedo , and the general effects of agriculture on soil moisture characteristics. All of these processes need to be included in climate models.

Except for climate change studies there are few reliable records of past changes in land use. One way to build up a better picture of the effects of past changes is to combine surface records of changing land use with satellite measurements of the properties of vegetation cover. Such analyses show that forest clearing for agriculture and irrigated farming in arid and semi-arid lands are two major sources of climatically important land cover changes. The two effects tend, however, to cancel out, because irrigated agriculture increases solar energy absorption and the amount of moisture evaporated into the atmosphere, whereas forest clearing decreases these two processes.

Causes of green house gases

There are several greenhouse gases responsible for warming the earth. These has being attributed basically to humans by emitting them in a variety of ways. Most of them come from the combustion of fossil fuels in cars, factories and electricity production. The gas responsible for the most warming is carbon dioxide, also called CO₂. Other contributors include methane released from landfills and agriculture (especially from the digestive systems of grazing animals), nitrous oxide from fertilizers, gases used for refrigeration and industrial processes, and the loss of forests that would otherwise store CO₂.

Impact of climate change on the environment

The projected impact on the Earth's environmental stability and hence changes in global climate would include: disruption of temperature distribution, precipitation, evapotranspiration, clouds, air-currents and consequential shifts in the vegetation belts; melting of polar ice-caps, rise in sea level that could adversely affect low-lying areas and the synergy among these discrete effects. All of these have implication for fresh water resources, agriculture and food supply, natural ecosystems, biodiversity and human health (IPCC, 1996).

Climate change has regional variations capacities for increases and decreases in the amount of rainfall resulting in floods, landslides and droughts, melting of polar ice-caps, thermal expansion, surges and acidification of oceans with resultant oceanfront flooding. The resultant natural disasters such as hurricanes, bush fires, ocean surges and landslides cause economic losses, population displacements, communal crises, forced migrations (promoting ecological refugees), desertification and widespread soil erosion /depletion effects.

Climate change has greatly left its impact on the land and in several ways. Agriculture is extremely vulnerable to climate change. Higher temperatures can reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. Although there will be gains in some crops in some regions of the world, but the overall impacts of climate change on agriculture are expected to be negative, threatening global food security (IFPRI, 2009). Added heat stress, shifting monsoons, and drier soils may reduce yields by as much as a third in the tropics and subtropics, where crops are already near their maximum heat tolerance (UNEP, 2001).

Adaptation measures to the impacts of climate change

Our climate will continue to change. We will have to adapt to warmer average temperatures, higher sea levels, and weather events that are more frequent and many more extreme conditions. The Intergovernmental Panel on Climate Change (IPCC) refers to adaptation practices as actual adjustments, or changes in decision environments, which might ultimately enhance resilience or reduce vulnerability to observed or expected changes in climate. Investment in coastal protection infrastructure to reduce vulnerability to storm surges and anticipated sea-level rise is an example of actual adjustments (e.g. Lagos Bar Beach Protection Scheme). The development of climate risk screening guidelines, which might make downstream development projects more resilient to climate risks, is an example of changes in the environment policy (Muthukumara et al. 2008).

Adaptation to climate risks has been viewed by Muthukumara et al., 2008 to be at three levels:

- (1) Responses to current variability (which also reflect learning from past adaptations to historical climates).
- (2) Observed medium and long-term trends in climate; and
- (3) Anticipatory planning in response to model-based scenarios of long-term climate change.

These measures were further classified into proactive and reactive or ex-post.

Proactive measures include:

- (1) Crop and livelihood diversification
- (2) Seasonal climate forecasting
- (3) community-based disaster risk reduction
- (4) Famine early warning systems
- (5) Water storage
- (6) Insurance

(7) Supplementary irrigation and so on.

Reactive or ex-post measures: include:

- (1) Emergency response
- (2) Disaster recovery and
- (3) Migration.

Recent reviews indicate that the “wait-and see” or reactive approach is often inefficient and could be particularly unsuccessful in addressing irreversible damages, i.e. species extinction or unrecoverable ecosystem damages that may result from climate change.

One other adaptation strategies is keeping our forests standing so that they can provide essential environmental services like acting as carbon sinks, reservoirs of biodiversity, water catchments and regulation of climate and rain patterns. Africa and Nigeria in particular should halt unsustainable agricultural practices like Slash-and-burn, charcoal burning and removal of vegetation. We should reduce emissions from deforestation and forest degradation, because emissions from them is about 20 percent or more than what is contributed by the world transport sector put together” (Maathai, 2009).

Conclusion

Climate change is said to take place when there is any noticeable changes in parameters such as temperature, rainfall, humidity, wind etc. when these changes are observed above a threshold level, experts will say there is climate change. This paper has critically examined the concept of the environment, conservation and sustainable development which are the major connections of this write up. Causes of climate change such as green house gases (GHGs) were discussed. Some projected impacts and adaptations measures of climate change were mentioned.

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ACHIEVING ENVIRONMENTAL SUSTAINABILITY (MDG7) IN NIGERIA: PROGRESS SO FAR, CHALLENGES AND PROSPECTS

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ABSTRACT

The Millennium Development Goal Declaration was adopted by 147 Heads of States in September 2000. The member countries were expected to domesticate the global agenda based on the peculiar situation in each country. This was complied with by Nigeria. The country has taken lots of initiatives towards achieving all the eight goals with varying degrees of achievement. This paper focuses on Goal 7 which is “Ensuring environmental sustainability”. It examines the progress made so far and reveals that the rate of the relevant targets has been slow, especially with respect to achieving environmental sustainability. Various challenges are identified in the course of achieving the goal. These include population explosion, high incidence of poverty, policy inconsistency, among others. The paper also observes some prospects towards achieving the goal. These include some aspects of the policy environment with respect to the relevant sectors, resource availability, among others. Based on all these, the way forward in the course of achieving the goal is discussed. This is discussed in line with the Pressure-State-Response (PRS) model.

Key words: Environmental Sustainability; Millennium Development Goals; Policy Inconsistency; Pressure-State-Response

Introduction

In September 2000 a Millennium Declaration was adopted by 147 Heads of State. Inherent in this was a global agenda of eight Millennium Development Goals (MDGs), one of which is to ensure environmental sustainability, with time bound targets. The inclusion of ensuring environmental sustainability (MDG7) was informed by the recognition of the damage being done to the environment, as captured in the following quotations:

*By avarice and selfishness, and a groveling habit, from which none
of us is free, of regarding the soil as property...the landscape is deformed.’
(Henry David Thoreau (1817-1862)¹
‘Man has been endowed with reason, with the power to create, so that he
can add to what he's been given. But up to now he hasn't been a creator,
only a destroyer. Forests keep disappearing, rivers dry up, wild lifes become
extinct, the climate's ruined and the land grows poorer and uglier every day.’*

¹ Anton Chekhov (1860 - 1904), Russian playwright and short-story writer. Microsoft ® Encarta ®
2008

Anton Chekhov (1860 - 1904)²

In view of the above, the concern for ensuring environmental sustainability is not out of place. Though several measures had been devised in the past, the ineffectiveness of such measures and increasing threat to environmental sustainability led to the global concern which resulted in the Millennium Declaration. As noted by Tibaijuka (2005) the MDGs are people centered, time-bound and measurable. While the goals are universal, each country was expected to set targets considering local priority problems and resource capacity in recognition of individual country's peculiarities. Nigeria cannot but be part of these global campaign and desire to address all the social and economic crises that are devastating the well being of the people and which are targeted by the MDGs.

The situation in Nigeria, especially with respect to the problems addressed by MDG7 is parlous. For instance, UNDP observes that the country's natural resources, some of which constitute the country's national assets, are seriously threatened (www.ng.undp.org/mdgsngprogress.shtml). The state of the components of the environment is as illustrated in Box 1. The Nigerian government is not oblivious of the magnitude of the problem and the need to address the challenges squarely. Thus, in line with global thinking on making life better by striving to attain the goals and targets of MDGs, Nigeria set in motion the machinery for achieving the MDGs by 2015.

A policy Brief by UNDP (www.ng.undp.org/mdgs/policy_brief.pdf) catalogues the various efforts of the government. As stated in the policy brief, two of the steps taken by the government relate to the adoption of MDG-based planning and the commissioning of an MDG Needs Assessment study with the broad objective of providing a solid foundation for policy, budgeting, planning and financing strategy on the MDG. The study was conducted and its findings provided inputs into the policy brief prepared by the UNDP. Further efforts made to address the various challenges facing the country and which are part of the constraints militating against attainment of the MDGs include:

- Economic reforms with the launch, in 2004, of the National Economic Empowerment and development Strategy (NEEDS) at the Federal level; the State Economic Empowerment and Development Strategy (SEEDS) at the State level and the Local Economic Empowerment and Development Strategy (LEEDS) at the local level;
- The envisioning of placing the country among the top 20 leading economies in the world by 2020 leading to the preparation of the Vision 20:2020 document in October 2009 and the preparation of the consequent preparation of the First National Implementation Plan for NV20:2020 (2010-2013);
- The Introduction of the 7-Point Agenda, focusing on:
 - Sustainable growth in the real sector of the economy;
 - Improvement of infrastructure (power, energy and transportation);
 - Agriculture and agro-industry development;
 - Human capital development (education and health)
 - Security, law and order (including electoral reform)
 - Combating corruption; and
 - Conflict resolution through promoting equitable and sustainable regional development (Niger-Delta development)
- Adoption of MDG-related development planning in 2006 to channel investments quickly for meeting the MDGs
- The establishment of the Virtual Poverty Fund (VPF) into which fortuitous gains from the debt relief are pooled and from which MDG activities are financed;

² Ibid:

- Inauguration of the Presidential Committee on the Assessment and Monitoring of the MDGs in Nigeria;
- Introduction of Public Expenditure in NEEDS (OPEN), for tagging and tracking MDG expenditures;
- Establishment of the Office of the Senior Special Assistant to the President on Millennium Development Goals (OSSA-MDGs).

The foregoing is a pointer to the seriousness of the government about the intention to ensure that all the social, economic, physical and environmental challenges set to be addressed by introduction of MDGs are solved with a view to attaining the goals and targets by 2015.

Since the focus of this paper is MDG7, efforts are made to examine the goal and the targets set for the country, how the country has fared in achieving the targets, the prospects for achieving the goal and the targets as well as the challenges and the steps to take to ensure there is remarkable progress.

Environmental Sustainability

It is considered pertinent to examine what environmental sustainability entails. As noted by Harris (2000), the need to achieve environmental sustainability is rooted in the recognition of the fact that the benefits of development have been distributed unevenly and there have been major negative impacts of development on the environment and on the existing social structure. It is recognized that many traditional societies have been devastated by depletion of forests, disruption of water systems, and intensive fisheries while urban centers in many developing countries suffer from extreme pollution and inadequate transportation, water and sewer infrastructure. This negative trend is also captured by Margaret Mead³, as follows:

We are living beyond our means. As a people, we have developed a life-style that is draining the earth of its priceless and irreplaceable resources without regard for the future of our children and people all around the world.'

Margaret Mead (1901 - 1978)

Box 1: The State of the Nigerian Environment

Nigeria's natural resources, some of its most valuable national assets, are still seriously threatened. For example, between 2000 and 2010 the area of forest shrank by a third, from 14.4 per cent to 9.9 per cent of the land area.

Similarly, access to safe water and sanitation is a serious challenge for Nigeria. Little progress was made up to 2005 but improvements since then have brought the proportion of the population accessing safe water to 58.9 per cent and the proportion accessing improved sanitation to 51.6 per cent. The major challenge lies in translating substantial public investments in water into effective access. This requires more involvement by communities to identify local needs, and better planning to deliver holistic and sustainable solutions. In sanitation, efforts are falling short of the target. Rural-urban migration will add to the pressure on sanitation infrastructure throughout the country. It is doubtful that town planning authorities have made adequate preparations for sustainable housing and sanitation.

³ Margaret Mead, U.S. anthropologist. *Redbook*, "The Energy Crisis—Why Our World Will Never Again Be the Same" Microsoft © Encarta © 2008

The fear is that if the trend continues, the achieved benefits of development may be eroded. There may also be a collapse of the ecosystem while the present and future development may be jeopardized. Out of this grievous concern, there was global effort at addressing the problem of conflicts between environment and development goals by formulating a definition of sustainable development which has to do with meeting the needs of the present without compromising the ability of future generations to meet their own needs.

As further elaborated by Harris (2000), there are three aspects of Sustainable Development – economic, environmental and social. The bottom line is that a concept of sustainable development should be concerned with finding solutions to social inequities and environmental damage and at the same time ensuring a sound economic base. Thus, according to Harris, sustainable development approach recognizes that:

- The conservation of natural capital is essential for sustainable economic production and intergenerational equity;
- Again from the point of view of neo-classical economic theory, sustainability has to do with maximization of human welfare which includes food, clothing, housing, transportation, health and education services, etc.;
- From an ecological perspective, both population and total resource demand must be limited in scale, and the integrity of ecosystems and diversity of species must be maintained;
- With respect to social equity, the fulfillment of basic health and educational needs, and participatory democracy are crucial elements of development and are interrelated with environmental sustainability.

From the foregoing, it could be discerned that achieving environmental sustainability (MDG7) requires a holistic and multi - sectoral approach which must also recognize the need for wider participation in terms of policy formulation and design of projects and programmes as well as their implementation and monitoring.

MDG7: Goal and Targets

MDG7 is to ensure environmental sustainability and it is expected to be achieved by meeting three targets – targets 9, 10 and 11 in the overall MDG framework. These targets respectively are: integrating the principles of sustainable development into country policies and programmes; reverse loss of environmental resources; and reduce by half the proportion of people without sustainable access to safe drinking water; and achieve significant improvement in the lives of at least 100 million slum dwellers, by 2020. Each of these three targets has a set of indicators for monitoring progress made towards achieving them. They are as indicated Table 1.

Table 1: MDG7 – Targets and Indicators

Target	Indicator
9. Integrating the principles of sustainable development into country policies and programmes	-proportion of land area covered by forest
	-proportion of gas flared
	-energy use (kg oil equivalent) per \$1GDP

	-carbon dioxide emissions (per capita)
10. Reduce by half the proportion of people without sustainable access to safe drinking water	-proportion of total population with access to safe drinking water (%) -proportion of total population with access to basic sanitation (%)
11. Achieve significant improvement in the lives of at least 100 million slum dwellers	-proportion of people with access to secure tenure (%) -Residential Housing Construction index

Source: Federal Republic of Nigeria (2007): Millennium Development Goals 2006 Report The National Planning Commission, Abuja.

The Progress so far

The level of attainment of targets of MDG7 is as indicated in table 2 as contained in the country's 2010 MDG report (FRN, 2010). The table indicates worsening situation with respect to loss of environmental resources. For instance, the proportion of land area covered by forest which is targeted to be 15% by the year 2015, dropped from 18.9% in 1990 to 14.4 % in 2000. Since then there is paucity of data to update the trend of progress made. However, there have been mounting cases of deforestation, oil spillage, erosion and desertification. All these aggravate loss of environmental resources and threaten attainment of the relevant target.

With respect to the target of halving the proportion of people without sustainable access to safe drinking water and basic sanitation, while the performance of sanitation indicator is a bit better than that of water, the fluctuation in the level of trend of progress of the two indicators is a source of concern. As at 1990, the proportion of population using an improved drinking water source was 54% which increased to 66.25% in 2003 and drastically dropped to 49.1 % in 2007 but increased again to 58.9% in 2009 (figure 1). In essence, the country was able to improve access to improved drinking water source by 4.9 per cent between 1990 and 2009 (a period of 19 years) indicating an annual increase of 0.26%, whereas in three years' time the country is expected to increase access to this source by 18.1% in order to meet the 2015 target of 77% indicating annual increase of about 6%.

With respect to sanitation, the proportion of population with access to improved sanitation was 39% in 1990. This increased steadily to 49.8% in 2003, dropped to 33% between 2005 and 2006, increased to 53.8 per cent in 2008 and dropped to 51.6 per cent in 2009 (figure 2). The country was able to increase access to improved sanitation by 12.6% between 1990 and 2009 (a period of 19 years) indicating an annual increase of less than 1%. In order to meet the target of 70% access by the year 2015 (a period of three years from now), access has to be increased by 18.4% indicating annual increase of about 6%.

With respect to achieving significant improvement in the lives of at least 100 million slum dwellers, the country's 2010 MDG report does not contain level of progress as it does for other targets for MDG 7.

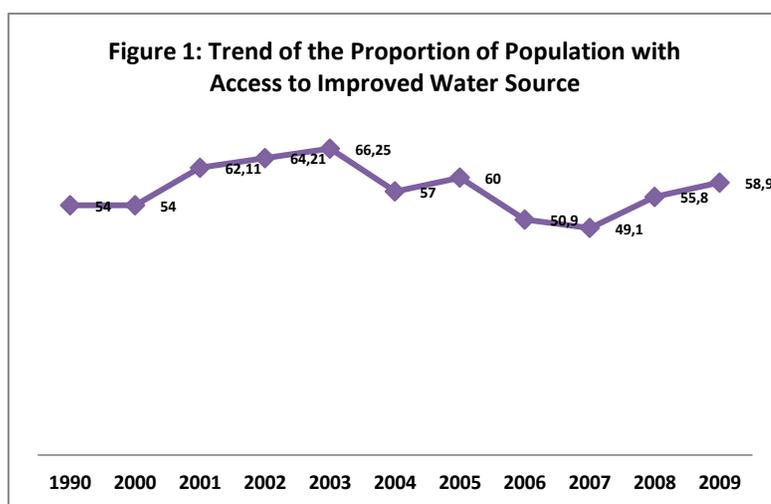
However, the report indicates that one of the country's greatest challenges is providing adequate housing for the growing population. It is further recognized that the country has an estimated deficit of about 16 million housing units, requiring the construction of about 2 million units annually to

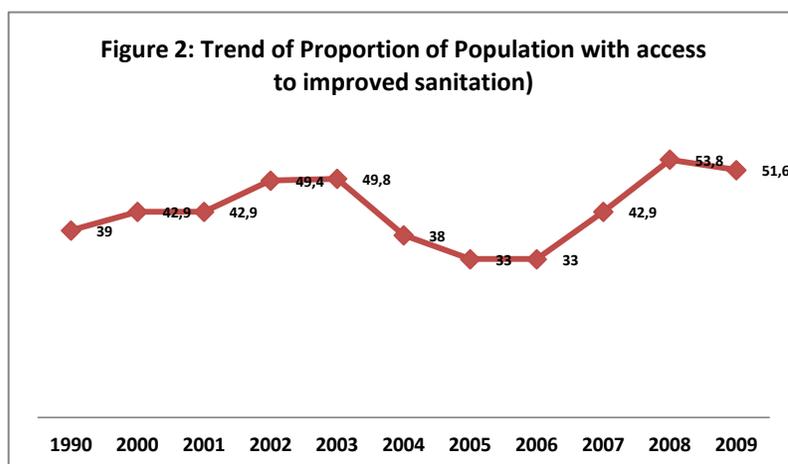
meet the shortfall. The implication is that achieving significant improvement in the lives of at least 100 million slum dwellers by 2015, which is two years from now, becomes difficult if not impossible.

Table 1: Progress in the level of attainment of MDG7- Ensure Environmental Sustainability

Indicator	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Target 7.A- Integrate the principles of sustainable development into country policies and programmes and reverse the environmental resources												
Proportion of land area covered by forest (%)	18.9	14.4	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Target 7.C-Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation												
Proportion of population using an improved drinking water source (%)	54	54	62.11	64.21	66.25	57	60	50.9	49.1	55.8	58.9	n.a
Proportion of population using an improved sanitation	39	42.9	42.9	49.4	49.8	38	33	33	42.9	53.8	51.6	n.a

Source: FRN (2010) Nigeria Millennium Development Goals Report 2010, Office of the Senior Special Assistant to the President on MDGs (OSSAP-MDG), Abuja





Challenges Militating against Achievement of Environmental Sustainability

Definitely there are challenges and limitations in the path towards achieving MDG7. Due to limited space some of them are highlighted as follows

- **Population Explosion:** The country's population is exploding and there is no visible sign of any measure aimed at controlling the upsurge. There is a direct link between environmental resource exhaustion and population pressure. Increasing and uncontrolled population growth will render any well intended policies and programmes aimed at achieving MDG7 ineffective.
- **High Poverty Incidence:** People are getting worse off and the situation is being compounded by collapse of infrastructure. There is also a direct link between poverty and environmental resource depletion, thus with increasing impoverishment of people, achieving MDG7 could be a phantasm.
- **Policy Inconsistency:** There have been cases of policy inconsistency. With respect to economic policies, between 1986 and 2013, the country has experimented with:
 - Structural Adjustment Program
 - National Economic Empowerment and development Strategy (NEED)
 - Vision 20:2020
 - 7-Point Agenda
 - Transformation Agenda

The implementation of these highlighted economic blueprints and strategies has not had significant impact on poverty reduction. With respect to Housing, the 1991 Housing Policy could not achieve its objectives leading to the setting up of a panel in 2001 to review and prepare a new Housing policy. The activities of the committee led to the preparation and printing, in 2006, of Housing Policy and Urban development Policy which were never approved by the Federal Executive Council. It was not until 2012 that a new Housing Policy was approved indicating that there was a policy vacuum in the sector between 2001 and 2012. Within the period, the Federal Ministry of Works and the Federal Ministry of Housing and Urban Development were merged and demerged. This development makes it difficult to address MDG7 target 11 which is 'Achieve significant improvement in the lives of at least 100 million slum dwellers'.

With respect to the energy sector, while there is campaign against forest depletion, kerosene, a popular cooking fuel is made hard to get and very expensive with people resorting to using forest products as cooking fuel, thus negating the objective of the campaign against forest depletions. This again makes it difficult to address MGD7 target 9 (target 7A for Nigeria) which is 'Integrating the principles of sustainable development into country policies and programmes' with particular reference to the proportion of land covered by forest, energy used and carbon dioxide emission.

With respect to water, the Federal Ministry of Water Resources (FMWR) was merged with the Federal Ministry of Agriculture (FMA) with the new nomenclature as Federal Ministry of Agriculture and Water Resources. In 1979 the two Ministries were separated and the FMWR stood on its own. However, in 1984, it was again merged with the Federal Ministry of Agriculture and Rural Development, only for the two Ministries to be separated again in 1989. The Ministry was later merged with the Ministry of Agriculture and it was part of this Ministry until April 2010 when the two Ministries were again separated. This inconsistency, no doubt, is part of the constraints against addressing squarely MDG7 target 10 (target 7C for Nigeria)

- Cross-cutting roles and weak coordination: There are cases where a particular target cuts across two or more ministries. An example is that of the Ministry of Agriculture and Rural Development and the Ministry of Environment when target 9 (target 7a for Nigeria) comes to mind. Another is that of the Ministries of Health, Water resources and Environment for target 10 (target 7C for Nigeria). With respect to target 11 there are the Ministry of Housing and Urban Development, the Urban Development Bank, the Nigerian Building and Road Research Institute. Individual efforts of these ministries and agencies are poorly coordinated.
- The 'Negative' Federal Might: MDG7 like all other goals is about people. It is about the grassroots, it is more of a local concern which should, of course, be initiated at the national level. However all efforts and activities aimed at achieving MDG7 and other goals are more prominently domiciled at the federal level. There is little commitment at the state and local government levels which should be more involved in these activities. The situation, however, is improving at the State level with the introduction of the Conditional Grant Scheme (CGS) which requires beneficiary states must contribute 50 per cent of the total cost of MDG projects for a particular year.
- Low level of awareness at the grassroots level: Level of awareness of MDG7 is low among the local populace. The strength of the campaign for better environmental management practice cannot be compared with that of HIV/AIDS (under MDG6) and Children Immunization (under MDG4) thus downplaying the importance of MDG7. The low level of awareness has restricted the participation of all in the drive towards achieving the goal.

Prospects

In spite of the challenges enumerated above, there are prospects for meeting the MDGs and particularly MDG7. These are discussed as follows.

Policy Environment

With respect to availability of policy documents and guidelines, the situation is impressive. For instance, in the area of environment, there is the National Environmental Sanitation Policy, there is the National Environmental Standards Regulatory and Enforcement Agency (NESREA), and there are Policy Guidelines on Solid Waste Management, among others. What is required is full implementation of the provisions of these policy documents and guidelines and full empowerment of the various MDAs and particularly NESREA. With all this, the problem of forest depletion and poor sanitation could be effectively addressed.

With respect to the Housing sector, now there are approved National Housing Policy and the National Housing Urban Development Policy, though yet to be made public. Furthermore, the Federal Ministry of Lands, Housing and Urban Development, the Federal Housing Authority and the Federal Mortgage Bank of Nigeria (FMBN) are making efforts to increase the housing stock. Examples include: the Mass Housing Initiatives, of the Federal Ministry in collaboration with the State governments and the Federal Capital Territory; the Public-Private Partnership Scheme, an initiative of the Federal Housing Authority; the partnership between the FMBN and the Urban Shelter Limited; among others. There are also the various efforts of the State governments in the area of urban renewal. These are efforts that could transform the housing sector, enhance housing provision and improve the quality of housing in slum areas. What is required again is targeting the real poor who are mainly slum inhabitants.

Resource Availability

The country is blessed with abundant resources. With respect to forestation, the land is enormous and rich in nutrients while there are various forest species to be planted. There is a full-fledged Forest Research Institute of Nigeria (FRIN) which has conducted various researches on forest production, the findings of which could be useful. What is required is the political will to invest in afforestation schemes.

With respect to water, Nigeria has a total water resource estimate of 267.3 billion cubic meters. It has surface water resource estimate of 26.7 billion cubic meters and ground water resources estimate of 51.9 billion cubic meters (FMWR (undated) Water Resources information profile). The water Supply Master Plan prepared in 1995 puts water requirement for the country by 2015 at 16.9 billion cubic meters with irrigation requiring 13.5 billion cubic meters and water supply requiring 3.4 billion cubic meters. This means the country has more than enough water resources to meet the needs of the population if well managed. In 1997, the Federal government through the FMWR commenced the process of reforming the Water resources sector in order to establish effective, efficient, functional and implementable policy, legislation, institutional arrangements and development strategies for Integrated Water Resources Management (IWRM). This is expected to enable the water resources to be developed, utilized and protected to the benefit of all in order to support economic growth, achievement of development goals, equity and the eradication of poverty. What is required is to curb corruption in the implementation of various projects and ensure fairness and equity in the location of water projects.

With respect to sanitation, there are various Development Partners and International NGOs assisting the country in improving the state of sanitation, especially in the rural areas where the problem of poor access to sanitation is endemic. Some of these are the WaterAid Nigeria and the United Nations International Children Fund (UNICEF). There have been developed various Demand-driven sanitation approaches, one of which is the Community Led Total Sanitation (CLTS) which was introduced in 2007 and which as at November 2010 was being implemented in 30 States of the Federation including the FCT. What is required is increased commitment on the part of the State and Local governments.

With respect to the housing sector, in recent times, the private sector appears to be more active in housing and urban development activities. Through their association, the Real Estate Developers' Association (REDAN), which was established in 2001, the private sector has been

THE CONDITIONAL GRANT SCHEME (CGS) CHANNEL

Before the CGS was introduced, the Federal government adopted the idea of channeling the Debt Relief Gains (DRG) solely through the Federal Ministries in 2006. However, the strategy exposed the challenges of delivering services from the federal level. The approach resulted in the exclusion of participating communities in the implementation process. The approach also assumed that the beneficiaries lacked the capacity, knowledge, and expertise to participate in the design and implementation process.

The CGS channel was put in place by the Federal government in order to improve the capacity of sub-national governments to deliver services as well as better coordinate MDG-related programmes across the three tiers of government. The role of the CGS is to channel funds, technical assistance, and best practice from the Federal Government to sub-national governments. Among the objectives is to reduce fiscal constraints that the States and Local Governments face, whilst improving their capacity and demand for effective service delivery.

Objectives of the CGS

As stated in the CGS document, the origins of the CGS were rooted in the desire for a more inclusive and effective approach to public investment and service delivery. The specific objectives include:

- Investing in MDGs at the State and local Government Level to ensure ownership and sustainability
- Empowering State and local Government to carry out their constitutional responsibilities
- Promoting improvements in public service delivery
- Encouraging improvements in public expenditure management
- Strengthening the partnership between the three tiers of government for national planning
- Involving communities in local development and generating feedback on performance.

The water sector is benefiting immensely from the CGS approach. This cuts across all the States of the Federation.

The Way Forward

In an attempt to suggest measures for strengthening efforts at achieving MDG7 it is considered imperative to illustrate how society, through development activities and use of natural resources, exerts pressures on the environment and how information about changes to the state of the environment as well as associated environmental pressures may be conveyed to society, which may then respond individually or collectively with policy, programme, stewardship, or behavioural measures, through the OECD's Pressure-State-Response (PSR) Model(UNDP, 2005) (Fig. 1).

The PSR model indicates three broad components- Pressure from human activities which could be direct or indirect, the State of the environment and natural resources affected by Direct and Indirect pressures through pollution, waste generation and resource use arising from human activities, and Response from economic agents such as administrators, households, enterprises, Sub-national (State and Local) and International

community) based on information received on the state of the environment and natural resources.

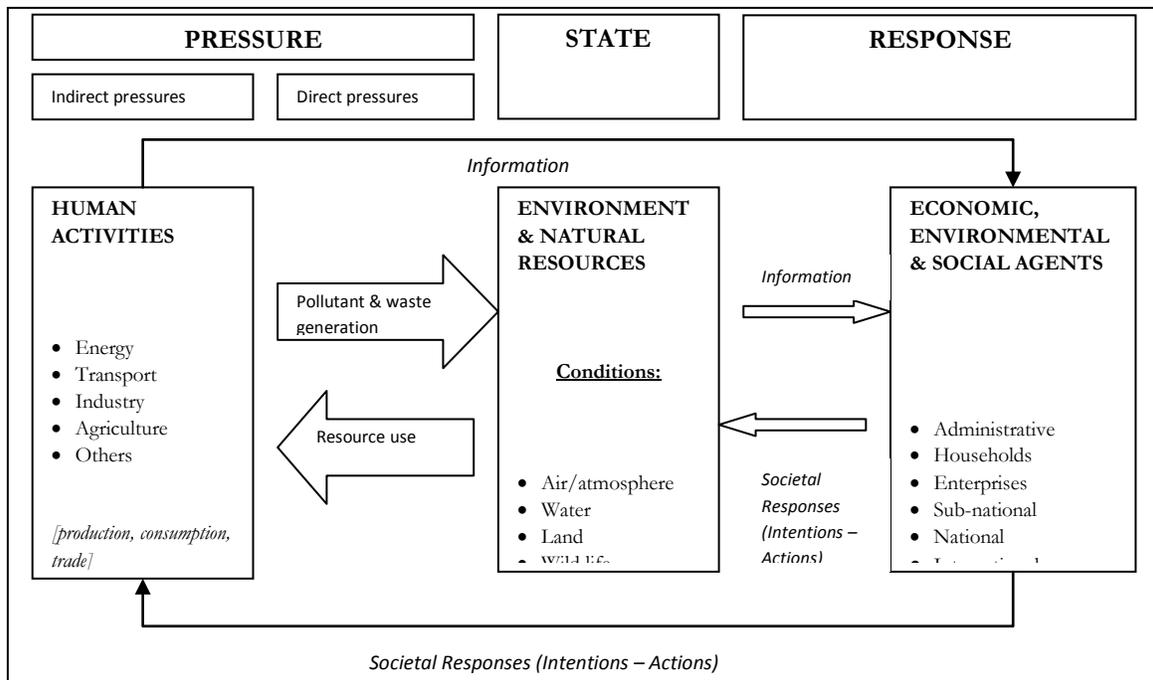


Figure 1: The Pressure – State – Response (PSR)

Source: OECD. 2001. *Environmental Indicators: Towards Sustainable Development* p.134 quoted in UNDP (2005) Monitoring Country Progress towards MDG7: Ensuring Environmental Sustainability, Practice Note, UNDP, March, 2005 p.12.

What can be gleaned from this model is that efforts aimed at addressing MDG7 should not be superficial. With respect to forest depletion, gas flaring, energy use, carbon dioxide emission (Target 9), water utilization and management, sanitary practices (Target 10), housing need and production (target 11), the following should be noted:

- A framework should be put in place that will enhance understanding, monitoring and controlling the operation of all human activities exerting pressures (direct and indirect) on the environment and natural resources;
- There should be a framework for identifying the type of pressures being exerted, the process of exertion, the process through which environmental resources are being utilized and changes in all these over time.
- There is need for putting in place strong machinery for observing and monitoring changes in the condition of the state of the environment and natural resources in general and in particular the relevant components of targets 9 to 11.
- There is need for a powerful data coordinating mechanism which should ensure comprehensive processing and managing of data collected from different agencies dealing with monitoring of changes in the state of the environment. The National Bureau of Statistics (NBS) should be saddled with this responsibility.

- Existing fora for information dissemination such as ministerial briefing, publications by NBS should be strengthened and made accessible to all economic environment and social agents as indicated in figure 1.
- The different roles expected of the various agents should be recognised and facilitation made for each of these agents to be able to play these roles. This is about the need to decentralise MDG7 activities and ascribe roles to different agents up to the household level. This calls for massive awareness and enlightenment campaigns, especially for non-governmental agents.
- With respect to some of the identified challenges there should be aggressive drive towards effective population control, poverty alleviation, infrastructural development, access to affordable energy, among others.
- Since the MDGs are expected to be part of national policies, MDG7 should be incorporated into relevant policy initiatives.

Conclusion

The foregoing is an overview of the importance of MDG7, the progress made so far and the prospects for meeting the goal and the targets and the challenges in the way. Though the time bound for the attainment of the MDGs is just seven years away, all hope is not lost if we are able to right the wrongs in the relevant policy formulation and implementation processes as well as in the areas of project and programme implementation. It must be stressed that we cannot afford to toy with the environment, especially going by the following quotation:

'The environment is man's first right. Without a safe environment, man cannot exist to claim other rights, be they political, social, or economic.'

Ken Saro-Wiwa (1941 - 1995)

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GEOMORPHOLOGICAL CHANGES OF THE ROSETTA MOUTH, NILE DELTA COAST, EGYPT DURING 20TH CENTURY

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Abstract

Most of the world's deltas mouths have become unstable during last century. This is because of the modern climatic changes as well as tectonic subsidence, but in case of The Nile Delta coast there is another effective reason; that is construction of the Aswan Low and High Dams. The construction of these Dams started at the beginning of the last century, and ended in 1970. These Dams have changed the hydraulic regime of the river downstream. One of the major environmental problems of the River Nile was the potential drop in the river channel downstream of the Dam become silt-free water, and coastal erosion in the Nile Delta coast especially in the Rosetta mouth. The Rosetta promontory is one of two young delta lobes formed by Nile Delta branches, historical data and some evidences show that the Delta mouths lobes were growing till the beginning of the 20th Century, but since then it started degrading. The study area is located on the north western coast of the Nile Delta, It has a length from west to east of about 10 km. The major objective of this study is to understand the regional evolution of the Rosetta mouth during the last century as an impact of climatic changes as well as the construction of both Aswan Dams and the major sedimentation processes controlling coastal geomorphology such as north winds of coastal erosion during the period of the study and the tectonic subsidence. Some of the modern changing shoreline positions along Rosetta mouth coast were determined by the following methods: comparing multidates satellite images, aerial photographs and topographic maps, field observation of the study area, renew coast line position by GPS. Samples will be collected for sediments characteristics analysis, and finally analyze the collected data by GIS techniques.

Keywords: Mediterranean Sea, Climate Changes, Sea Level Changes, Geomorphic changes, Nile Delta Coast, Aswan High Dam, Rosetta mouth.

1. Introduction

The Nile Delta connects to the Mediterranean Sea through its two branches surrounding the delta, the Rosetta in the west and the Damietta in the east. Since the beginning of recorded history, sea level has risen so slowly that for most practical purposes, it has been constant. As a result, people and other species have developed coastal areas much more extensively than would have been possible ten thousand years ago, when sea level was rising more rapidly. Whether one is discussing coral atolls, river deltas, barrier islands, or ocean beaches, life is in a delicate balance with the level of the sea. The projected global warming, however, could disrupt

that balance by raising sea level a meter in the next century and perhaps several meters in the next two hundred years.

1.1. The Study area:

The study area of Rosetta coast extends from the west with latitude $30^{\circ} 20'$ to $30^{\circ} 27'$ E, and longitude $31^{\circ} 25'$ to $31^{\circ} 30'$ N covering about 15 Kilometer along the shore (Figure 1&2). The study area represents a sensitive district of erosion along the Nile Delta coast of Egypt.

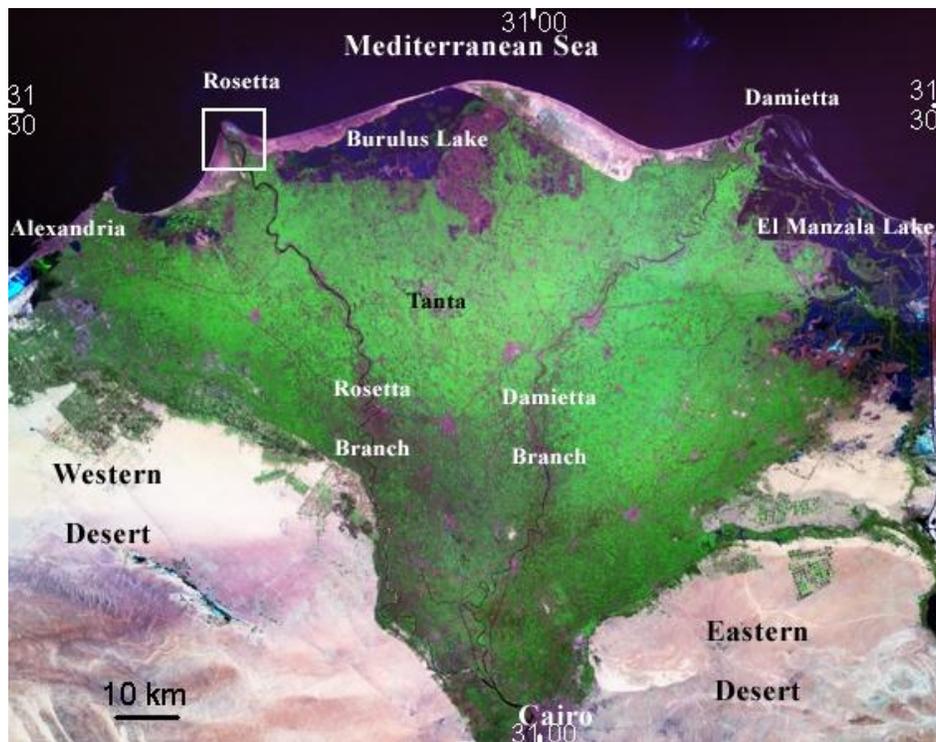


Fig.1: Location of the study area

1.2. Objective:

The major objective of this study is to detect the morphological changes of the Delta coastline and the stability of the Rosetta Promontory shoreline on the Nile Delta during 20th century, over the period from 1925 to 2007.

1.3. Previous work:

The modern geomorphic changes of the Nile Delta coastal zone have been studied specially Rosetta promontory, since the early years of the last century in three phases:

Hume (1925) and D'Arrigo (1936) discussed a general steady shoreline advance during the 18th century.

Comprehensive studies on the geomorphology, geology and dynamic phenomena of this coastal area, such as: Shukri *et al*, (1955); Hilmy (1951); Said (1958); Gorgy (1966); El-

Fishawi *et al.* (1976); Misdorp and Sestini (1976); Toma and Salama (1980); El-Fishawi and El- Askary (1981); El- Askary and Frihy (1984); EL Bouseily and Frihy (1984).

Several publication have been carried out to study shoreline changes along the Nile delta using remotely sensed data, among these phase are: Klemas and Abdel Kader (1982); Inman and Jenkins (1984); Frihy (1988);Elwany *et al.* (1988); Fanos and Khafagy (1989); Ahmed, (1991); Frihy *et al.*, (1990); Stanley and Warne, (1993); Fanos, 1995; El-Raey *et al.* (1995); Yehia, (1998). Recently, Ahmed *et al.*, (2000 a, b; 2001), El Raey (2005), and Torab & Azab, (2006).

2- Materials:

2-1Data used:

1. Topographic maps of the study area scale 1:50,000 published in 1925 and 1945.
2. TM Data (7 bands - Thematic Mapper) in dates (1984, 1987, 1990, 1993)
3. ETM Data (9 bands) in dates (1997, 2002, 2003, 2004)
4. Field surveying of coast line by use GPS every 60 days between March – August, 2007.

2-2 Software used:

- 1- ERDAS Imagine 9.1 package.
- 2-ARC GIS 9 package.

2-3 Methods:

Rapid changes, natural and anthropogenic, across the Rosetta promontory of the Nile delta have been analyzed by undertaking comparisons of satellite image data, in the following dates: 1978, 1983, 1990, 1993 and 1995. These images were utilized in addition to a series of topographic maps; to cover 82-year monitoring period in the following steps:

1. The methods used in this study depend on the main application of both of RS and GIS techniques such as using comparative multi-dated remote sensing images and topographic maps as well as field measurement.
2. The measurement of the geomorphic changes of the coast line between multi-dates images by using unsupervised classification and recoding analysis.

3- Results and Discussion:

Using multidates satellite images and topographic maps as well as field measurement of Rosetta mouth have allowed detecting the shoreline shifts through time especially after construction of both Aswan dams; the old one built in the beginning of last century, the Aswan High Dam started in storing the Nile water and sediments from 1964, and was completed in 1971. From this dates some morphological changes of the Nile delta coast line has been observed, this caused some problems along the Nile delta coastal plane.

A variety of coastal features in the Rosetta mouth coastline have been considered and generally referred to erosion and/or accretion processes. Results of previous works show that erosion of the Rosetta promontory began about 1900 after construction the Aswan Low

Dam, the total eroded area of the western side is 4882 meters and the total eroded distance of the eastern side is 6523 meters between 1900 and 2006 by average 46 and 61.5 m/y (Frihy, 1988, Frihy, et. al., 1990, Fanos, 1995, El Raey, et. al., 1995 and Torab & Azab, 2006).

Coastal variability and natural processes are playing an important role in the delta coastal morphology i.e. waves, currents, sediment deficiency to the promontory, land subsidence or sea level rise, but erosion rate is increased after construction of the High Aswan Dam.

To recognize the effects of construction of The Aswan High Dam, the eroded distance between 1900 & 1964 has been measured; the results show that the eroded distance before construction the Aswan High Dam was 879 and 1282 meters for the western and eastern sides; its average rate about 13.7 and 20 m/yr. The storage of water Nile started on 1964 at Lake Nasser in the front of the High Dam; it increased the erosion rate between 1964-2006 to 95.3 and 124.8 m/yr (tab.1 & Fig.2).

Tab1: Annual rates of erosion on both western and eastern sides of Rosetta mouth (promontory) between 1900 & 2006 (After: Torab & Azab, 2006).

Period		Western Side		Eastern Side	
		Erosion distance (m)	Erosion Rate (m/yr)	Erosion distance (m)	Erosion Rate (m/yr)
Before construction of the Aswan High Dam	1900-1926	243	9.3	396	15.2
	1926-1941	191	12.7	298	19.9
	1941-1964	445	19.3	588	25.6
	1900-1964	879	13.7	1282	20
	Sub Total				
After construction of the Aswan High Dam	1964-1971	826	118	1555	222.1
	1971-1982	2796	254.2	1652	150.2
	1982-1988	381	63.5	826	137.7
	1988-1990	0	0	318	159
	1990-2006	0	0	890	55.6
	1964-2006	4003	95.3	5241	124.8
Sub Total					
Total Period		4882	46	6523	61.5

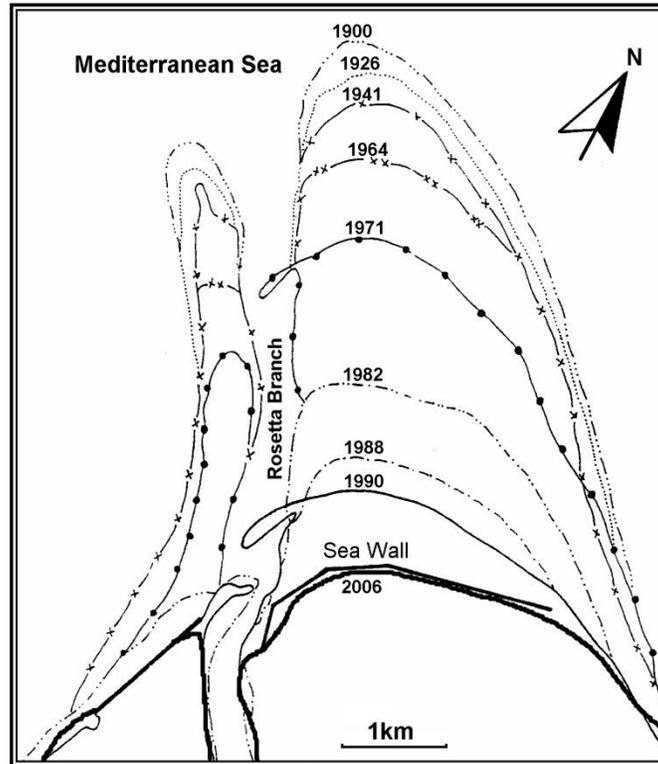


Fig.2: Morphological changes of Rosetta mouth during 20th century
(After: Fanos, 1995)

Comparing morphological changes between 1925 & 2001:

Results of comparing multidates 1925 topographic map and 2001 satellite image as well as GIS analysis (Fig.5), it show that the total eroded distance of the eastern side of Rosetta mouth was 4.07 km; the deposition distance was not more than 850 meters. The total eroded area of western and eastern side was 576 acres and eroded distance was 4.53km. by average erosion rate distance 41.42 m/y and the deposition rate was only 6.83 m/y. The results show that the total eroded distance of the western side is 4.53 km. and the deposition distance is 165 meters only during same period, the annual erosion rate is 59.61 meters, and the total eroded area is 756 acre. From the above we can calculate the total eroded area of the mouth in both sides for about 3904 acres during the study period. (Fig.3,4 &5).

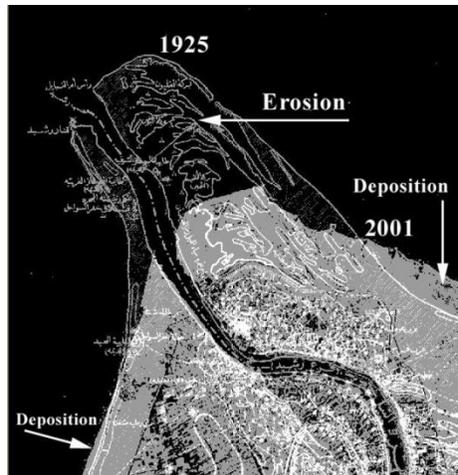


Fig.3: Morphological changes between 1925 & 2001
 (by comparing 1925 topographic map and 2001 Satellite image).

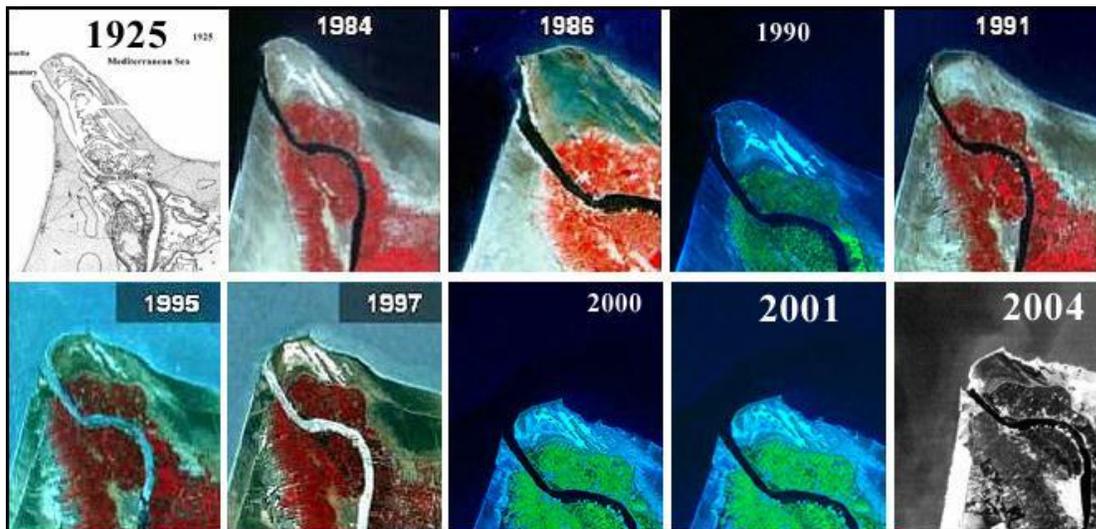


Fig. 4: Shoreline changes of Rosetta mouth using multi-date satellite images
 between 1925 & 2004.

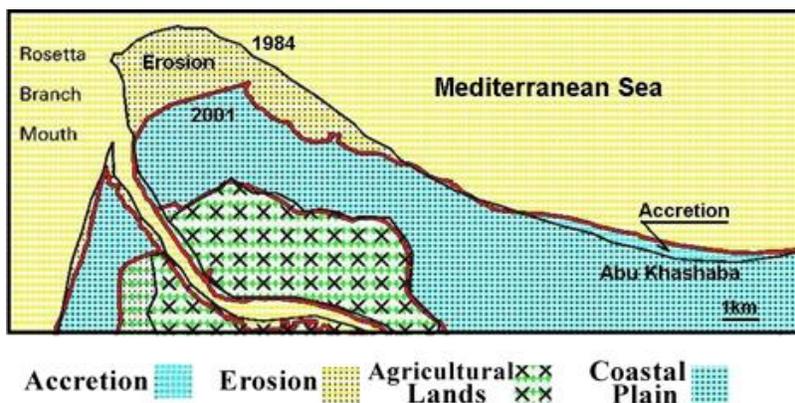


Fig. 5: Morphological and land use changes between 1984 & 2001

(by use RS and GIS technique)

Comparing morphological changes between 1984 & 2001:

The comparison of the analysis of 1984 and that of 2001 satellite images shows that during this period the eastern side is lost 1480.3 meters (about 1337,4 acres) and the western side lost no more than 251meters (about 100,2 acres). During this period about 57, 7 acres in both eastern and western sides were added by deposition (Fig.6).

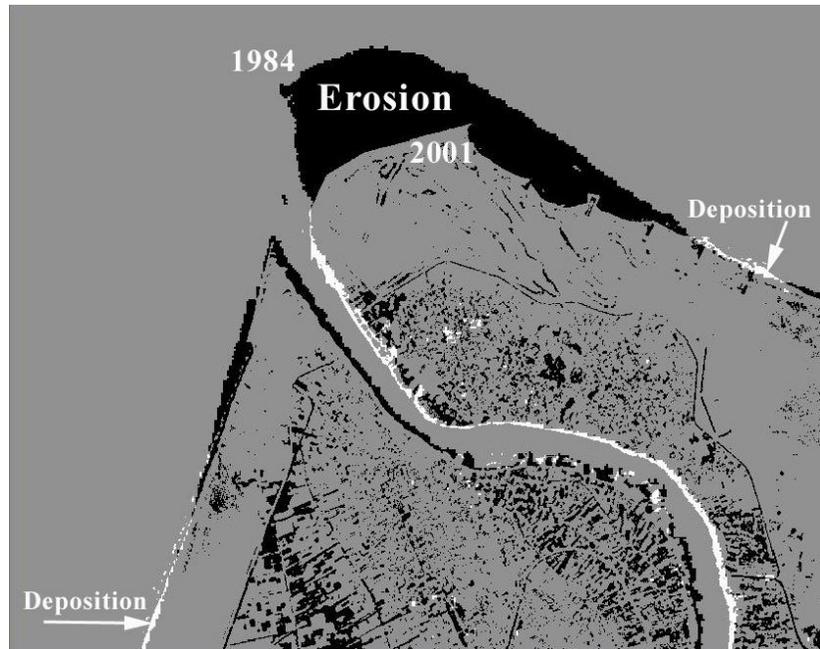


Fig.6: Morphological changes between 1984 & 2001

(by comparing 1984 and 2001 Satellite image).

Comparing morphological changes between 1925, 1984 & 2001:

The comparison of the analysis of 1925 topographic map with that of 1984 and 2001 satellite images shows that the major eroded area has disappeared in the eastern side before 1984, due to alluvial accumulation in the Aswan High Dam Lake, the rate of erosion slowed down after building the sea walls at Rosetta in 1991 but the shift has continued after seawalls construction (Fig.7 & 8).

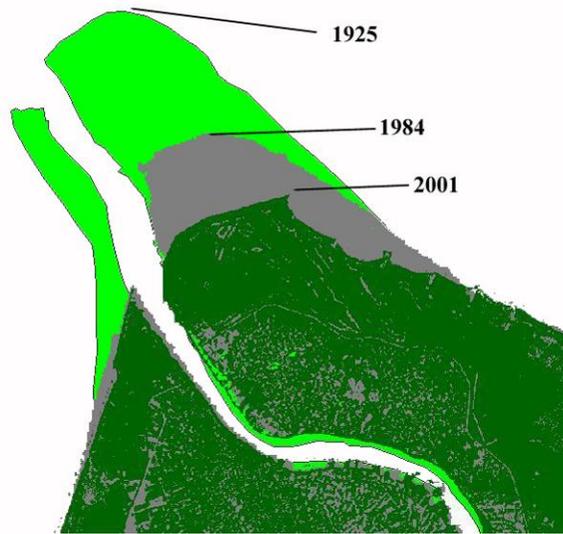


Fig. 7: Morphological changes between 1925, 1984 and 2001 (by comparing 1925 topographic map and 1984, 2001 Satellite images).



Fig. 8: Deposition on the eastern portion of Rosetta mouth

In 1991 some barriers and sea wall have been constructed. These coastal protection barriers and defences follow conventional hard engineering solutions in order to prevent coastal erosion and flooding but in fact they often aggravate the problem further. In the future, all features of coastal protection measures have to be carefully considered, and costs and benefits of different options have to be assessed in order to avoid causing one problem by solving another (Fig. 9 & 10).



Fig.9: Satellite image shows Morphology of Rosetta area on 2005

(Source of image: www.wikimapia.org)



Fig. 10: Detailed coastline changes between November 2006 & August 2007

4. Conclusion:

Shoreline changes have been determined along the Rosetta promontory of the Nile using sequential topographic maps and satellite images acquired in 1925, 1945, 1984, 1986, 1991, 1995,

1997, 2000, 2001, 2003, 2004 and 2005. The following points show major morphological changes has been measured during 20th century:

- The Rosetta mouth has eroded between 1900 & 2006 at an average rate of 38.96 m/yr for the eastern side and 42.8 m/yr for the western side.
- The eroded rate before construction of the Aswan High Dam is (22.25 m/yr for the eastern side and 27.46 m/yr for the western side) as a result of climatic changes as well as construction of Low Aswan Dam.
- But after construction The Aswan High dam the erosion rate is increased to (72.86 m/yr and 74 m/yr) as a result of stopping sediments on the Lake Naser bottom as well as climatic changes.
- The greater loss of the coastal areas is clearly detectable along the western portion of the Rosetta promontory.
- Most effective deposition of the coastal areas extends along the eastern portion of the Rosetta promontory due to the rule of western current of moving coastal sediments.

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WASTE CONTROL STRATEGIES FOR HEALTHY ENVIRONMENT: A CASE STUDY OF FEMALE STUDENTS HOSTELS

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Abstract

The study focused on the proper waste control strategies as a panacea for healthy environment in female student's hostels in Ezeugo and oboli hostel oko. four research question were formulated. Population of the study consisted of Female students living in the hostels. Data were collected with questionnaire. Mean was used to analyze the data collected. The findings revealed the various methods of waste disposal adopted by the Female students living in the hostel such as use of refuse bins, burning, "throwaway" methods etc. Also the reasons for poor waste disposal were identified such as lack of adequate refuse bins, insufficient cleaning equipment and materials, delays in collecting of waste for disposal by the authorities etc. The study further revealed the effects of improper waste disposal on the environment to include air pollution, unsightly environment, breeding places for vectors among others. Finally, possible strategies for improvement were also identified.

INTRODUCTION

Waste in the simplistic term is any thing that is unwanted and discarded, garbage or trash. According to wikipedia free dictionary (2006). waste is unwanted or undersired material left over after the completion of a process. Horn by (2005) also opined that waste is unwanted material or substance that are left after you have used something. It is all substance, which the holder wishes or is required to dispose of in solid, liquid or gaseous form (<http://www.enfo.ie/lefts/fs/.htm>). Any material unused and rejected as worthless or unwanted. (wordnet.princeton.edu/per/.we;wn). Because these materials are no longer valuable or useful. They ought to be properly disposed and should not be dumped any how to litter or menace the environment. environment according to environmental planning/ and protection (EPP) is the world we live in which consist of land, water and air. Charles Davids cited by Anyakoha and Igboeri (1993) upon that environment is one surrounding, including external conditions influencing growth and development of people animal and plants. They further stated that physical environment is where all human beings live and that it provides the resources and process, which makes life possible. hornby defines environment and conditions, circumstances etc that affect the behaviors and development of peoples live. Again, the Encyclopaedia Britannica as cited by Uchebue (2002) noted that environment constitutes both the physical, chemical and biotic factors that acts upon an organism or an ecological community and ultimately determines its forms and survival. Therefore, a clean and healthy environment enhances peoples lives while any damage or deviation from an ideal situation to environment puts the health of its occupants at stake.

Due to substantial growth in students population over the years resulting to increase in the number of students in the hostel as well as the era of "throughway" in which we live, air and

soil pollution have increased to the point where they are surpassing the ecosystem coping capacity. Thus, the indiscriminate dumping of waste around the campus especially in areas surrounding the female hostels has become a serious environmental problem facing the hostel. It is becoming very difficult to have fresh air around the hostels and their environment. It is therefore important to manage the environment for the good Health of the people in the hostel .It was in pursuance to maintaining healthy environment for leaving /learning process that gave rise to the environmental sanitation program which was flagged by the management of the Hostel in may, 2006.

This paper therefore focuses on problem of waste disposal among female students hostels and strategies of improvements.

Purpose of study

The major purpose of this study was to identify the proper waste control strategies for healthy environment in female students hostels in Oko .Specifically, the study identified;

- 1.The various methods of waste disposal, adopted by the female students living inside the Hostel .
2. The reasons for poor waste disposal among the students.
- 3.The effect of improper waste disposal on the environment.
- 4.The possible strategies of improvement.

Research Questions;

The study sought answers to the following research questions.

what are the various methods of waste disposal adopted by female students living inside the hostels ?

What are the reasons for poor waste disposal among the female student by female student in the hostels?

What are the effects of improper waste disposal on the environment?

What are the possible strategies of improvement?

METHODOLOGY

Research Design; The study adopted a survey research design. It sought information from hostel attendants and female students living inside the hostels.

Population ;The study were Ezeugo and obedi in Oko. The population consisted of the hostel attendants and female students living inside the hostels.

Sample and sampling Technique; The sample size of two hundred (200) was made from the population. The sample was drawn from the two female hostels, inside the Hostel Ezeugo and okoli hostel, in each hostel , a total of ninety-five (95) students and five (5) Host el attendants were randomly sampled.

Instrument for Data Collection; The instrument for data collection was structured questionnaire developed based on the objectives of the study. The questionnaire items were

divided into four (4) sections. These were; methods of waste disposal adopted by student, reasons for poor waste disposal, effects of improper waste disposal on the environment and possible strategies for (4) points scale of strongly agree ,agree, disagree and strongly disagree representing 4,3,2 and 1 respectively was used. It was validate by Estate Management experts.

Data collection and Analysis Techniques; A total of two hundred (200) copies of the questionnaire were distributed to the respondents, out of which only one hundred and seventy-five(175) copies were completed and returned. Frequencies and mean were used to analyze the data collected. All items items with mean of 2.50 or above were regarded as agreement while those with mean below 2.50 were regarded as disagreement.

FINDINGS

The following findings were made;

Method of waste disposal adopted by students

Table1;Mean Response on the Method of waste Disposal Adopted by Students

S/N	Methods of Waste Disposal	Means	Remark
1.	Use of refuse bins	3.85	Agreed
2.	Burning	2.73	Agreed
3.	Dumping beside the hostels	2.26	Disagreed
4.	Burning	3.40	Agreed
5.	Use	2.50	Agreed
6.	Throw away method	1.90	Disagreed
7.	Animal feed	2.20	Disagreed

The result in table 1 revealed the method of disposing waste adopted by the respondents .it showed that they agreed with four (4) items in the questionnaire with mean rating between 2.50 to 3.85 while they disagreed with three (3) of the items with mean rating between 1.90 to 2.26.

2. Reasons for poor waste disposal

Table 2 Mean responses on the reasons for poor waste disposal.

S/N	Reasons for poor waste Disposal	Mean	Remark
1	Lack of adequate waste disposal facilities	3.92	Agreed
2.	Ignorance of the importance of clean environment	3.81	Agreed
3.	Ignorance of waste Management Techniques	3.40	Agreed
4	.insufficient ball/hostel attendants	2.62	Agreed
5	Throw away lifestyle attitude of some students	2.75	Agreed

6 Poor drainage system	2.84	Agreed
7 Congestion in the hostel	2.93	Agreed
8 Delay in collection of waste for disposal by the authorities	3.60	Agreed
9 Insufficient hostel attendants /eleaners	2.51	Agreed

Table 2 revealed that all the items recorded means above the criterions level of acceptance. This shows that the respondents agreed with the reasons of poor waste disposal

3 Effects of improper waste disposal

Table 3; Mean responses on the effects of improper waste disposal

S/N	Effect of improper waste disposal	Mean	Remark
1.	Air pollution	3.91	Agreed
2.	Breeding of mosquitoes & other insects	3.17	Agreed
3.	Unsightly environment	2.96	Agreed
4.	Increase in spread of diseases	3.02	Agreed
5.	Flooding of the environment	3.62	Agreed
6.	Aback by rodent and scavengers	3.15	Agreed
7.	Over flowing waste bins	2.95	Agreed

Table 3 showed that all the items in section 3 part of the questionnaire were the effect of improper waste disposal on the environment. This can be seen from their high means rating from 2.95 to 3.91.

Possible strategies for improvement.

Table 4; Mean responses on the proper strategies for improvement.

S/N	Possible Strategies for improvement	Mean	Remark
1.	Provision of adequate waste disposal facilities	3.93	Agreed
2.	Prompt collection & disposal of waste	3.96	Agreed
3.	Students disposing waste at the appropriate place not on the road side	3.92	Agreed
4.	Conducting weekly environment exercise by the students & hostel attendants	3.87	Agreed
5.	Provision of mollers for easily cutting of grasses in the hostels	3.81	Agreed
6.	Organizing environmental education seminar	2.94	Agreed
7.	Inspection of hostels by hostel supervisors	3.05	Agreed

8. Maintaining of manageable students size to avoid overcrowdings 3.43 Agreed
9. Cultivation of flowers and shrubs to improve the surroundings 2.47 Disagreed
10. Provision of proper drainage system 3.56 Agreed
11. Ensuring that septic tanks are properly closed to prevent breeding places for mosquitoes & flies 3.77 Agreed
12. Removal of kiosks and stalls very close to the hostels 3.11 Agreed

From Table 4 above eleven(11) of the items were accepted as strategies for improving waste disposal in the hostel by the respondents with means rating of 2.47 rejected only one (1).

Discussion

Proper waste control strategies are required to maintain clean and healthy environment. Connect (1990) as cited by Anyakoha and Igboeli(1993) ranked a clean and beautiful environment first out of ten basic human needs which include a clean and adequate supply of water, simple clothing, food, healthy care, communication, simple housing, energy requirement, total education etc. According to them, these other basic human needs have direct or indirect bearing to the environment. However, due to the methods of disposing waste by the female students in the hostels sustainable clean and beautiful environment cannot be achieved. The study therefore identified four (4) methods of waste disposal use by the students. These include; use of refuse bin, burning, burying and use of incinerator. The study also indicated eight (8) reasons for poor clean environment and waste disposal facilities, ignorance of the importance of clean environment and waste disposal techniques, congestion in the hostels among other. Again is the increase in students population in the hostels, which influence the rate of waste generation of refuse. They also pointed out that where the increased rate of waste generation is not matched by a rapid and efficient disposal system, problem of waste disposal such as population of air, water and land are bound to occur.

It was also discovered from the study seven (7) effects of improper waste disposal with the greatest effects on air pollution, flooding of environment, unsightly environment, breeding places for mosquitoes and other insects. Abazu (2005) noted that the consequences of indiscriminate disposal of waste could be a problem to public health. She opined that waste disposal in the home create forum for breeding of mosquitoes and flies, which encourage diseases. Like typhoid, dysentery, diarrhea, malaria etc. Citing Kumar(2005), she opined that the survey of health hazards of the human environment suggests the provision of basic sanitation facilities. Furthermore, some possible strategies were identified to improve waste disposal in order to enhance clean and beautiful environment within the hostels surroundings. This is because the ultimate aim of waste control is to minimize waste and thus create a healthy environment achieves healthy or protective family or home. Thus. Anyakoha and (199) emphasized the need for good quality refuse bin and stressed that bins should be properly covered always and kept clean by washing thoroughly each time they are emptied.

The findings therefore indicated that that student disposes waste appropriately and only on places meant for it. Findings also revealed that since waste is disposed promptly, weekly exercise should be mapped out for students and attendants. This is necessary to ensure that all the surroundings are kept neat clean. It was also pointed out that the authorities should provide molaras to enhance cutting of gasses around hostels, carry out

adequate inspection of hostels to ensure that the hostel attendants and cleaners do their work efficiently. The findings also revealed that environment education should be organized through seminars and workshops to create awareness of healthy environment. Supporting this Ania and Salau (1992) as cited by Anyaoha and Igbeli(1993)observed that the better the understanding of the environment the more effectively it can be used and supported. Finally it was revealed that kiosks and stalls surrounding the hostel premises should be removed. This is in line with the findings of Kabuga (2003) where he noted that road side shopping complexes in the metropolitan kano has resulted to the littering of the major roads in the metropolis with waste materias thereby converting the open land land spaces meant for landscaping, gardens, recreational land and playing ground into shopping complexes. This is a similar cse with the hostel environmental in Ezeugo and Obodi, oko. Such spaces occupied by these kiosks and stalls can be converted into receeational parks, gardens as seen in most tertiary institutions. This will help to keep the surroundings neat and beautiful.

CONCLUSION AND RECOMMENDATIONS

From the finding, the respondents adopted certain methods of waste disposal. The study also showed reasons. For poor waste disposal such as lack of adquate waste disposal facilities ignorance of the importance of clean environment etc. a lot of problems were identified as the effects of improper waste disposal. These include air pollusion. Unsightly environment, increase in spread of diseases etc. also some possible strategies for improvement were identified. Based on the findings. The following recommendations were made:

The hostels need large waste bins because of the quality of waste generation to avoid over flowing of waste and therefore making the waste collection site unsightly.

There is need of placing waste bins at various points where they can be easily located in the hostel premises so that refuse such as paper, pure water sachets can be easily disposed of rather than littering them around the premises.

Students, should be given adequate orientation on the importance of maintaing sustainable clean environment through seminars and workshops. This will help to eliminate the danger of indiscriminate littering of the compound that presealty characterizes their lifestyles

4. Environmental education should be included into the general course curriculum to help students have better understanding of the environment and teach them other ways of reducing waste such as refuse, recycling of materials etc.

5. The college should establish a collection frequency for all waste bins to ensure that all waste is removed before it become unsanitary.

6. The college should provide adequate evacuation facilities such as barrows and tippers or trucks to facilitate easy evacuation of waste.

7. the college may where possible enter into retainship operation with waste disposal agency who will take up sweeping, cleaning and disposal of waste within the college premises.

8. creation of dumpsites where decayable waste can be turned into composed manure, plastics sent for recycling and others used as feedstock or raw materials else where, thus helping in wealth creation.

9. open land spaces within the hostel environment should not be converted fro shopping stalls and kiosks but rather can be used for recreational parks and gardens.

10. more flowers and shrubs should be cultivated around the hostels to improve the aesthetic environment.

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THE IMPACT OF ENVIRONMENTAL POLLUTION IN IMO STATE: A CASE STUDY OF OKIGWE LOCAL GOVERNMENT AREA

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ABSTRACT

Environmental pollution is one of the phenomena that have gained international attention. Imo state is not an exception, hence the case of Okigwe local Government Area. This study was borne out of the inquisitiveness to verify the problems associated with the refuse disposal and how they affect the personal and environmental health of inhabitants. Environment concerns have become a major development issue in Nigeria as can be seen in the establishment of the Environmental Protection Agency (EPA) and its equivalent at state levels and in all the local Governments of Imo state. Samples of 1000 people were selected using stratified random sampling. Questionnaire was employed for the data collection. Ten research questions were formulated for the study. The data collection. Using percentages. Findings from the study were discussed. Based on the findings suggestions were made on how to improve on Environmental refuse disposal for good personal and Environmental health. The suggestions were made not only to the Okigwe local Government Area but also to the society, Parents, especially women, students, school and wards of every household

INTRODUCTION

All over the world today, environment pollution is an issue of great concern because of what the environment is to human survival and indeed, the survival of the earth itself. These days, the argument on green house effect is rife everywhere in the world. "If it not green house effect", it is global warming. Both point to the fact that the earth is polluted. Williams (2006:88) affirms that it is well recognized that the environment is one of the health. He however points out that that Nigeria suffers from both primary and secondary environmental problems resulting from underdevelopment and growth in industrialization. As a result, human life and activities are endangered on a daily basis. In view of these threats to the social responsibility Environmental pollution is one of the Phenomenon that has gained international attention including Nigeria and Imo State hence Okigwe local Government Area. News agencies, health. Organizations, federal government's ministries of health have passed information about the menace associated with environmental pollution to the masses.

According to Encyclopedias Britannica (1978) 'pollution has been regarded as a change in the physical, chemical or biological conditions in the environment which harmfully affects the quality of life. The problem of refuse disposal cum environmental pollution as regards the uttering of streets with refuse materials is a crucial problem of the developing countries. Nation (1975) supporting the above statement explained that if sewage or refuse were not properly disposed they could cause serious outbreak disease which could be very harmful to human health. Some studies have shown that accumulation of solid wastes is an aesthetic disaster, if they are burned, they contribute to air pollution and when rain falls percolate through them and pollute ground water supplies.

However, a country whose citizens are suffering from plague of illness, diseases and afflictions has no place in these qualities that contribute to making any country a great

nation. The mismanagement of these wastes can lead to short term risks, environmental degradation, breeding of insects, spontaneous fire outbreak

It has been observed that environmental pollution identifies improper, ineffective and unhygienic disposal of refuse materials as vectors of environmental pollution.

Some studies show that dumping of refuse enables rats, flies and other carriers of dangerous diseases to flourish and research findings have also shown that from each household turn out about a tonne of rubbish a year which comprises of paper, cardboards, waste glass, damaged cars, non-cycling of scrapped cars and their components.

All these represent a source of environmental pollution involving the littering of roads with refuse, dumping of refuse on roads, sides and the conversion of drains. Other parts of the country, human faces are passed in small brushes around people's homes. The experience is the same in high density areas and urban shows where people pass faces into gutters and dump domestic waste products in the streets, blocking both drainage and vehicular passage. In some places where pit latrines are used, they scarcely go with lids. Apart from the stench, which exudes from such latrines, food can easily be contaminated by flies, which have their habitats there. Pollution associated with poor sanitary habits can therefore be said to be a product of underdevelopment. The environment can very well be polluted owing to social misdemeanor when people fail to observe simple public order such as where not to smoke or where not urinate. Smoking in public has been a subject of argument for a long time now.

The most talk about pollution is the industrial pollution which is now a global issue. This has generated a lot of discussions and arguments at various social states especially among the scientists.

While (200) notes that carbon dioxide is what environmental scientists call "a greenhouse gas".

In Imo state, industrial plants and installations emit gasses that pollute the environment. Such pollution is always prominent in the cities where industrial activities are carried out around the clock. In an environment like this, the air and water are often polluted, while noise from industrial machines and equipment create pollution of another sort.

TYPES OF POLLUTION

Environmental pollution can be classified under the following headings; (i) water pollution (ii) land pollution (iii) Air pollution (iv) Noise pollution.

Water pollution is the introduction into ocean waters of chemical, physical or biological material that degrades the qualities of the water. The process ranges from simple addition of dissolved or suspended solids to discharge of the most insidious toxic pollutants (such as pesticides, heavy materials and non degradable bio-accumulative, halogenated, hydrocarbons) which persist and pervade the environment. Much Nigerian water are heavily polluted by human feces and faecal polluted water that causes cholera.

STATEMENT OF PROBLEM

Agricultural and industrial activities have introduced several thousand tons of toxic and hazardous chemicals into the Imo state environment precisely Okigwe local Government Area. Agro-chemicals are largely pesticides which kill or mitigate unwanted plants or animal life. Approximately, 59% of pesticides are used as insecticides, 15% as fungicides, 15% as defoliant and herbicides, 10% as fumigants, 1% as rodenticides [Minckler 1971]. These chemicals are used by farmers to ward off pests for their farms for a healthier crop production and the toxic effect of pesticide poisoning results to headaches, dizziness, nausea, vomiting, respiratory distress and eye burn.

Most of the chemical wastes also led to various environmental problems that have attracted world concern such as acid rain, global warming or the greenhouse effect or the depletion of the earth's ozone layer. Most of these chemicals have either been banned or have been restricted use in developed countries hence the study looked into

the impact of these chemicals on the pollution of the Imo state environment case of Okigwe local Government Area.

SIGNIFICANCE OF THE STUDY

The study of the impact of environmental pollution will make the people of Okigwe, local Government Area especially the women to realize the importance of effective refuse disposal and waste bins and waste control. It will also be significant to people of Okigwe in a way that they will know the proper waste control strategies and how to manage and preserve the environment for the good health of the people. It will also be the people living in commercial and industrial areas of Okigwe. It will also be important so that the people will know the causes and effects of environmental in human health will not be overlooked.

OBJECTIVE OF THE STUDY

The objective of this study was to find out the impact of environmental pollution on the people of Okigwe local Government area of Imo state. To find out the various methods of environmental pollution control and waste disposal adopted by the people of Okigwe LGA. The reasons for management of environmental control and waste disposal among the people. The effects of improper pollution control and waste disposal on the environment and the possible means of controlling the phenomenon.

RESEARCH QUESTIONS

What are the various means of controlling environmental pollution in your Area?

What are the effects / impacts of improper pollution control and waste disposal in your environment?

To what extent is the pollution control agents and disposal Authority effective in Okigwe local Government Area.

What are the popular ways of controlling pollution and refuse disposal in Okigwe local Government Area.

SCOPE OF THE STUDY / LIMITATIONS

The study covered all the people and residents of Okigwe local Government area of Imo state. The work also covered all the twenty one autonomous communities that made up of Okigwe local Government area. The autonomous communities are Ogi, Ezinachi, Umuawaibu, Agbobu, Ihube, Umulolo, Umualumoke, Ndiokorie Orji, Ibinta, Aku, Umuze gery, Ubahu, Amuro, Aro Ogu, Isiokwe, Ugwuaku and Okigwe Urban.

The work is limited to Okigwe local Government Area because of time constraint and financial constraint.

LITERATURE REVIEW

Environmental pollution means guarding all the surrounding condition which influences growth and development [air, water, land, atmosphere and space] against pollution [DERID 2000] Udoudo[2006] observe that in some localities in Nigeria, especially among the riverine communities of the Niger Delta region, one can hardly find modern toilet facilities. In some Land pollution is the degradation of the earth's land surface through misuses of the soil by poor agricultural practices, mineral exploitation, industrial waste dumping and indiscriminate disposal of urine waters.

Air pollution is the accumulation in the atmosphere of substance that in sufficient concentration, endanger human health or produce other measured effects on living matter and other materials. Among the major sources of air pollution are powered heat generation, the burning of solid wastes, industrial processes of air pollutants are carbon monoxide from incomplete combustion engine and others are hydrocarbons, nitrogen oxides, sulphur dioxide and photochemical oxidants.

Noise pollution is a composite of sounds generated by human activities ranging from blasting stereo system to the roar of transport vehicles. The most readily measurable physiological effect of noise pollution is damage of hearing, which may be either temporary or permanent and may cause distraction of normal activities or general annoyance.

Negative impacts of environmental pollution:-

Environmental pollution has threatened human existence in diverse ways. This is because life is dependence on the environment. The negative impacts of pollution in Imo state are grouped as follows:

NEGATIVE SOCIO-ECONOMIC IMPACT:-

The negative impact of pollution, especially from petroleum production activities has been acknowledged, Ugochukwu(2003) notes that:

Since the 1905,s petroleum operations have caused great devastation to the Niger Delta. These have impacted negatively on fishing and farming which are no longer productive enough to the era. In Ogani land food is now imported in an area once known as the food basket.

Oil spills destroy bulk farmlands and crop. They also destroy agnatic life. When a situation like this occurs, economic activities are grossly reduced and good social life hampered. Damage to farm lands and aquatic life by oil spills cannot be overstated.

Negative psychological impact:

Ashton-Jones (1998) sees environmental pollution as capable of derailing the psychological status of the citizens. Some instance of youth restiveness is in some parts of the country.

NEGATIVE PHYSIO-POLITICAL IMPACT:-

The poor toilet facilities, smoking in the public, dumping of refuse around living houses and gas flaring. Acid rain, for example, which is the production of hydrogen chloride and sulphur dioxide which produce oxide in nitrogen in the atmosphere, can fall in solid or liquid form and it can be caused by Excessive gas flaring.

ENVIRONMENTAL IMPACT ASSESSMENT

The purpose of environmental impact assessment (EIA) is to provide decision makers and the public with a systematic, comprehensive and object assessment of environmental consequences of an action. This assessment is to show sufficient adverse environmental effects and to allay public fears over the consequences of such effects based on known methods of handling the effects.

METHODOLOGY

The design of the work is survey design because the researcher approached the study of design in which group of people is studied by collecting data from few people considered to be representative of the entire group. A sample of 1000 people was randomly selected using stratified random sample. The population consists of people from schools (351), markets (265) parents (117), Government workers (233) and Okigwe local Government Secretariat (44). The major instrument used for collecting data was questionnaire from the respondents.

The basic frame work for analysis is found in the questioner. The data collected from the respondents were analyzed using percentages.

DATA ANALYSIS AND RESULTS

The result of the study is presented in tables.

Table 1: Opinion of Respondents on environmental pollution /refuse disposal facilities, Authority effectiveness and authorized sites in Okigwe L.G.A.

Responses	Frequency of yes	Frequency of no	No	opinion
Availability of refuse				
Disposal facility	714(71.4%)	286(28.6%)		-

Refuse material				
Disposed in authorized sites	358(35.8%)	642(64.2%)		-
Women are affective				
In refuse disposal of their homes	467(46.7%)	493(49.3%)		40(40%)
Refuse disposal authority is effective	413(41.3%)	548(54.8%)		39(39%)

From table 1 above, out of 1000 respondents, 714 (71.4%) indented that they have common refuse disposal facilities while 286(28.6%) indicated they have non out of 1000 respondents, 358(35.8%) indicated that was materials are dumped at authorized dumping site while (64.4%) indicated dumping at unauthorized sites. Also 467 (46.7%) indicated that women are effective in waste disposal of their homes while 493 (49.3%) indicated that women are ineffective while 40(40%) indicated no opinion. Out of 1000 respondents, 413 (41.3%) indicated that the waste disposal authority is effective while 548(54.8%) indicated that they are ineffective while 39(3.9%) showed no opinion.

Table 2: most popular method of waste disposal

Response	Frequency	Percentage
Dustbin	487	48.7%
Dumping along street	103	10.3%
Burning	199	19.9%
Disposal at authorized refuse dump	126	12.6%
Other methods	85	8.5%
Total	1000	100.0%

Table 2 shows that out of 1000 respondents, 487 (48.7%) indicated dustbin, 103(10.3%) indicated dumping along the street, 199(19.9%) indicated dumping 126 (12.6%) indicated disposal at authorized dumping sites while 85(8.5%) indicated the refuse generated were buried in the ground.

Table 3: Agencies Responsible for waste disposal and environmental pollution control.

Response	Frequency	Percentage
Local Government Authority	129	12.9%
Refuse contractors	146	14.6%
Tenants	552	55.2%
Others	173	17.3%
Total	1000	100.0%

Table 3 shows that 129 respondents indicated Local Government Authority were the sole agents of environmental waste disposal control, while 146 says contractors and 552 says tenants, while 173 responded indicated other agencies like barrow pusher, kolikoli people.

DISCUSSION

The result of this study indicated that the popular method of refuse disposal used by the respondents includes:-Dustbin, indiscriminate dumping along the streets burning which

cause environmental pollution. Others include burying, indiscriminately inside gutters or close rivers or erosions.

Recommendations

Based on the result of impact of environmental pollution and refuse disposal in Okigwe Government Area, the following recommendations were made:

The authorized contractor should make sure that enough refuse containers each with cover or roof are provided at designated points along the streets.

Each household should keep a clean covered dustbin and stay away from noisy environment.

The Okigwe Local Government health Sector, through her health inspector should undertake routine inspection of the premises to ensure compliance by the dwellers. The council and its agent should ensure that containers are evaluated, Toilets built. They should also embark on proper environment campaign to educate the inhabitant on the dangers and impact of environmental pollution and waste disposal.

Industrialist should be warned against disposal of toxic materials in Okigwe local Area and its environments.

CONCLUSION

This study has identified the problems of environmental pollution and refuse disposal and rightly conclude that the people of Okigwe LGA contribute immensely to the dirty and poor refuse disposal and let all the agencies responsible for pollution control be effective.

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THE EARTH AS A RESOURCE FOR ART AND CREATIVITY

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ABSTRACT

The earth is the greatest resource base for art and creativity. Over the ages, it has provided man with materials used to create and build great monuments, objects, carved images, etc, that have served for utilitarian, religious, socio-economic and aesthetic purposes. From the caredwellings of the early man, the Great Pyramids in Egypt, the Stonehenge, to the skyscrapers in big cities, the earth provided the wood, stone, iron in conjunction with old and new technologies. But man has failed to realize and appreciate the great potentials the earth could and has provided for his sustainable living, art and creativity. The relationship of the earth to the aesthetic and creative mind of man has been relegated to a low level that man has failed to realize that the earth will always generate new ideas and initiatives to solve human problems. In spite of the challenges of the earth's degradation by man's activities, and lack of best practices and resourceful programs to regenerate the earth, the environment still is able to provide resources for art, creativity and sustainable development.

Keywords – Art, Creativity, Nature, Resources, Uli/Nsibidi Designs.

INTRODUCTION

Throughout the evolutionary history of mankind, the earth and nature have had a lot to influence man and impact on his creative mind. The lessons learnt from nature by philosophers, scientists and technologists, have undoubtedly inspired the conception of ideas, symbols and the nature of many inventions.

Man, as the foremost and greatest product from the resources of the earth, is made up of the mineral, vegetable and water elements of the earth. From his environment, man has looked upon his physical body as possessing great power and energy in itself, and also a creative mind to solve his problems. Through the use of the saw, the swinging of an axe, the lifting of the hammer, man has created many life's necessities and nearly all of life's luxuries, all from the resources of the earth.

The ingenuity of man has allowed him to tap his creative energies from his environment and nature. As humans, "we make our own environment by shaping the world around us to suit our needs" (Getlein, 2002;70). But nature as being different from this manufactured, environment has often influence and has been addressed through art. Getlein, (72) maintains that "nature has been more than a subject for art; it has also served as a material for art. As a subject for art, artists have recorded different nature scenes, in different styles, techniques and attitudes. The Impressionist artists tried to capture the momentary scenes in nature through their colourful paintings.

As a material for art, nature has allowed artists to recognize a wide variety of naturalistic forms which they experience and adapt as being in harmony with their feelings and attitudes. The colours in nature – blue sky, green foliage, the red/violet sunsets, the textured barks of trees and stones, birds and other forms of nature, all relate to the appearances of the visible world around us. The most renowned Renaissance artist, Leonardo da Vinci, developed the Renaissance synthesis of art and science in his different drawings. Thus, his artistic endeavours are characterized as investigative and experimental. His drawings reflect his passionate interest in the origins of life (his anatomical drawings of the foetus in the womb), and in discovering scientific explanations for natural phenomena. (Adams, 2001, pp 279-80). Stokstad (1995), saw Leonardo's interest in Mathematics and the natural world. The compiled volumes of his detailed drawings and notes on anatomy, botany, geology, meteorology, architectural designs and mechanics, attest to his ingenuity. For example, from the birds in flight, he designed the first prototype for the building of an aircraft which was eventually adopted by aircraft engineers centuries later.

RESOURCES OF THE EARTH FOR ART

The first action that man took when he transformed from nomadic life to a sheltered life, was to provide himself with shelter. In the caves of Southern France and Northern Spain, we have witnessed the birth of that basic characteristic of self preservation that has made man master of his environment. The human capability for survival made him provide utilitarian objects, though crude, for self preservation from the harsh environment.

Oxford Advanced Learner's Dictionary describes resource as, "a supply of something that a country, an organization or a person has and can use, especially to increase their wealth: the exploitation of minerals and other natural resources...." From the heat and light of the sun, man found power in friction. By this simple process, he was able to originate and produce fire. With fire, he kept himself warm and developed the techniques of pottery.

POTTERY

Nearly every culture that has existed, has practiced the art of pottery (in modern term, ceramics), each with its basic techniques. Pottery involves making objects from clay, a naturally occurring earth substance. (Getlein, 279). Through the basic techniques of pinching, coiling and slabbing, the plastic nature of clay has enabled man form pots, storage jars from clay. Ancient cities in the past were built with clay (as bricks), and contributed in other built up environments. The creative mind of the potter has developed overtime alongside new technologies and techniques, backed by the inspiration from his physical, cultural, historical and religious backgrounds. Wares are now glazed with glazing materials from the earth to produce ground breaking designs in varied shapes and forms. Modern technologies in firing clay has evolved from the primitive techniques of sunbaking clay and open firing to the use of the kiln.

IRON, BRONZE, PRECIOUS STONES AND GEMS

The urge to explore further for materials found in the belly of the earth, has made man to harness many elements in their natural state. The possibilities of new technologies have led man to produce objects for utilitarian and aesthetic purposes. Metals such as iron, aluminum and steel, were melted and used to create other practical objects in unlimited forms. The

mining of iron, bronze, gems – gold, silver, diamonds, etc, have offered man the opportunity to artistically transform them into jewelries that have beautified mankind. The bronze sculptures of Ife and Benin flourished and focused on exquisitely modeled memorial heads which has till date remained sacred to the people in their religious life (Stokstad, p.911).

WOOD CARVINGS

Before man found iron, wood was the most available material found in nature. Wood as a natural resource has been used to form hunting tools, building fire to provide heat, building houses to shelter man from the environment. The oldest surviving art works found in Africa were wood sculptures. The formal inventiveness and expressive power of African sculptures have been sources of inspiration for European artists in their representational artforms (Stokstad, 912). The abstractions inherent in the African sculptures have produced a new generation of art movements and artists in Europe.

ART AND CREATIVITY

Art as a means of self expression, has been explored by many in several ways. It is not only a mark of individual genius, but also an expression of great social, religious and political force. What Genesis is to the biblical account of the fall and redemption of man, early cave art is to the history of his intelligence, imagination and creative power. In this tremendous fact of abstractions, images and symbols, these artist – hunters were able to capture their experiences, and gave meaning to their imaginative concepts of having power over the animals they intend to hunt and kill. Their artistic sophistication notwithstanding, their art gave us an insight into their extraordinary observation and memory, magical and religious implications. Their artworks that have survived, represent ideas which the prehistoric man has objectified.

Art is a vital and persistent aspect of human experience, with a natural impulse to build. Its study teaches about the creative expressions of the past and present, the style, materials and techniques. It is valued by the culture in which it was made, and its significance based on the religious, social, economic and psychological life of the people (Adams, 2001).

Art in its entirety is creativity and concept, associated with an environment – traditional or modern. To Arens (2006), “creativity involves combining two or more previously unconnected objects or ideas into something new. By following it, people can improve their ability to unearth possibilities in human potentials”. To him, the creative process involves a standard procedure used to discover original ideas and reorganize existing concepts in new ways. Everyone needs creativity; from the scientist down to the Business Executive, creativity is needed in their professional practice to open up the channels of observation, imagination and inspiration. For artists, visual creativity is in their domain, being “the most sophisticated form of human communication shaped by the social context in which they find expression” (Stokstad; 24). The visual expressions in specialized areas such as industrial design, architecture, engineering, and artworks that deal with images – painting, sculpture, photography, all fulfill practical purposes of recording, commemorating the past and giving tangible forms to feelings and ideas.

As a human activity, art has been inspired by the simplicity of nature; the harmony of forms, grace of design, regularity and symmetry of petals, methods of unfoldment of flowers, barks of trees, all beautiful in their regularity and texture, yet permitting an almost infinite variations of individual form. Thus, the earth becomes an art gallery, and displayed in it are

the art and crafts of nature, always in motion, constantly changing in size, shape and colour. It is three dimensional art, and must be viewed, just as man-made works are viewed.

Nature has inspired every artist, and each has been led to the discovery of the possibilities of man's mental and creative powers. It is the only power in the universe within the control of man that is wholly and completely unlimited. In its creative mechanism, the mental powers of man is not bound in its physical applications, by time and space, physical limitations and dimensional qualities of matter. It is not bound by the traditions of the past, the possibilities of the present, or the feasibilities of the future.

ART AND SYMBOLISM IN NATURE

In our visual environment today, nature has generated symbols to explain and decipher many abstract concepts. Man thinks in symbols. Symbolism is as prevalent today as it has been to man through the ages. Symbols possess an esoteric language, a secret code, which the viewer must decipher and whose meaning he must unlock. Thus, a symbol is always the outgrowth of a realization, from within or without man's environment.

As a result of thought and reflection on a given theme or concept, a picture or drawing is invented which expresses the figurative image of the concept. In this manner the symbol serves as a hieroglyph expressing the imagined idea. Certain symbols from nature would represent specific concepts and ideas. Colours, birds, animals, are used to define these concepts that are abstract in nature. For example, the Dove signifies Peace and Love; the cross represents Salvation; the scale represents Justice; the Lion represents Power and Strength. Different colours have their own meanings; white communicates Purity and Light; Black absorbs all colours and buries light, thereby symbolizing death, humiliation and mourning; Red is the colour of blood, representing bloodshed, war, guilt and the lower passions; Purple has been a distinguished symbol of Royalty, Dignity and Honour; Green is the colour of plant and growth symbolizing hope and resurrection.

In pre-colonial Igboland, the Uli and Nsibidi designs found precise expression in the hands of the traditional artists. The Igbo women's ingenuity was shown in the manipulation of the primitive brush to produce many of the coloured Uli designs (Basden, 1982). The Uli design was a style employed in a complex system of body design, (personal ornamentation) and mural painting using a vast catalogue of signs, symbols and patterns, to form a distinctive representation of the Igbo universe (Glendora, 1995). Nature colours were used as part of a descriptive approach to nature and environment. Pigments, as the basis of colour, are coloured powders made from organic substances – plant and animal matter, or inorganic substances-minerals and precious stones. Such substances like the local colours of Ufie (red), Odo (yellow), Nzu (white chalk), Nchara (brown) and Uri (indigo) were directly sourced from the earth. The motifs were taken from history, mythology, inspired by nature and everyday living.

The Nsibidi design as a system also originated from the Igbos. It is a system of motifs associated with the Ekpe male secret society, and was used to send messages. Its symbols often stand for social relationships – love, marriage, divorce, powerful emotions, using leaf, tortoise, mirror, spiral lines and other shapes. (National Museum of African Art). Oloidi, art historian and critic, describes Okpu Eze's use of the Nsibidi symbols in "Temple of Power". The artist used the symbols sourced from his culture to bring profound meaning, history and intellectualism, to his sculptural expressions (Okpu Eze, 1992).

Over time, these symbols that were inspired by nature have been explored, refined, classified, simplified and sometimes standardized, to be adopted by a group of people – nations, humanitarian organizations, families and corporate organizations.

CONCLUSION

The earth, nature and environment have been a great resource for art and creativity. Art, unlike nature is a human creation. It is the many ways man expresses himself, communicates and adapts to his environment.

He uses the resources of the earth in different dimensions of living. For as long as man lives, the earth will continue to provide him with tools, materials and inspirations to express himself to the fullest. It is up to man to sustain and preserve the earth and the environment from the numerous negative activities of man. Environmental degradation depletes the natural resource of the earth in so far as the beautiful patterns of nature may one day be erased from the face of the earth. Therefore, the sustainability of the earth becomes man's priority. All the same, nature will always engage our attentions, imagination and intelligence through the experiences we have in response to it.

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INTELLECTUAL PROPERTY AND REMOTE SENSING DATA IN LIGHT OF REALIZATION OF PUBLIC INTEREST

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Abstract

nowadays, without a shadow of doubt, Earth observation by satellites is one of the developing sectors of space activities with the growing involvement in private capital or actors. This leads to the question of how efficient legal rules governing this activity are. Evidently, Copyright law which is a main branch of intellectual property is one of the key fields of law applicable to earth observation activities and is the subject of the present analysis. In this matter, copyright protection crystallized in three methods-databases, maps and images-. This paper discusses whether current international and national regulation of remote sensing activities in EU and US, achieves a true and proper balance between proprietary interests of producers of remote sensing data and information and the needs of the community in accessing that data and information. The paper highlights the balances to be drawn between legal issues of private ownership of data and information and public good interests, hence, in long term, extreme unavailability of data has deteriorate effects on community and realization of their interest as basic requirements of human rights in dissemination of data and information.

Keywords: copyright, spatial data, creativity, remote sensing, creativity, public and private interest,

1-Introduction

As the range of uses of EO data and information products derived from them becomes wider EO activities are becoming more important, despite these developments, the issue of appropriate regulation for data use and distribution has not yet received enough discussion. The paper aims at giving an overview of how copyright law is or can be applied to EO data, what types of data can be protected by copyright, and to what extent. Additionally, based on preamble to the WIPO -Copyright Treaty 1996-society needs to maintain a balance between the rights of authors and the public interest in particular for access to information. In other words, EO activities should be beneficial for the society on the whole, and not just for the private interests and over and above, secure the widest possible flow of data and information as basic requirements of human rights.

2-IPRs and Remote Sensing

The LANDSAT, SPOT which owned by USA, France and respectively have different method for gaining of images from earth. All these remote sensing satellite system gather raw data, technological process to acquire the data is under patent regime because every satellite system uses its own technique. The role of trademark has small importance because the trademark is with the outer body of RS satellites. But when we are using the words like 'SPOT imagery' or 'IRS imageries', in fact, the quality of images the role of trademarks

explore⁴. Copyright comes with the processed data or enriched data resulting from raw data. To assess whether and how copyright can be applied to spatial data first describe copyright principles then define the legal definition of EO data and its method of generation and the characteristics of EO data kinds to see whether they can potentially be protected by copyright.

1-2.copyright principle

Traditionally, according to both norms of international treaties and national law, only the former expression of a work is protected, and not the ideas that underlie it. Reinforcing this principle, the WIPO Copyright Treaty explicitly excluded ideas, processes, method so f operation and data from the scope of copyright protection and originality and creativity is needed to grant copyright protection while in RS its blurred because data collected by a machine and there's no human intervention like creation other literary works⁵.The main issue to bear in mind in this regards is creativity as the critical criteria of copyright protection.

2-2.Definition of Data

As with various other basic concepts, the definition of data and information is blurred, and varies depending on its particular use or application. Not all encyclopedias go so far as to provide definitions for either “data” or “information”⁶. Those that address the subject contain the following definitions: data are “a fact or statistic”, and thus a record of observations; “facts and statistics collected for reference or analysis”, as well as “things known or assumed as facts”. Information is referred to as “facts provided or learned about something or someone”⁷; as well as “knowledge acquired by learning”. Normally, the definitions indicate that “data” and “information” are synonyms⁸. Indeed, even the International Council for Science admits that, although information is defined as “conclusions obtained from ananalysis of data and the results of research”, the distinctionbetween data and information is flexible and changesaccording to the situation⁹.¹⁰

3-2.Methods of EO Data Generation

EO data are generated by satellites and depict the surface of the earth and its natural or man-made objects. The satellite operator sends an order to the satellite, which transmits the coordinates of the place to be sensed. When this geographic area is in the range of the satellite' vision ,EO is done .After this, the satellite sends the acquired data usually as a

4 - Malay Adhikari Legal Regime of Intellectual Property Rights of Spatial Data with Market-driven politics: neoliberal democracy and the public interest. London: Verso; 2001. p. 3.

⁵ - Scientific Data and Information, Report of the CSPR Assessment Panel(December 2004), p. 14, available at /http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/551_DD_FILE_PAA_Data_and_Informa tion.Pdf S, last visited 10.11.2007

6- E.g. Encyclopedia Britannica

7- The Oxford Pocket Dictionary of Current English (Oxford: Oxford University Press, 2007).

8- E.g. the Oxford Pocket Thesaurus of Current English (Oxford: Oxford University Press, 2007).

9- Scientific Data and Information, Report of the CSPR Assessment Panel (December 2004), p. 14, available at /http://www.icsu.org/Gestion/img/ ICSU_DOC_DOWNLOAD/551_DD_FILE_PAA_Data_and_Information. pdfS, last visited 10.11.2007.

¹⁰ - Smith, Lesley; Doldirina, Catherine. « Remote Sensing: A Case for Moving Space Data towards the Public Good». Science Direct, 2008.

binary code to a ground station after this that EO data may be made available to the customer ,archived or further processed¹¹. The process reveals key features of EO data that may influence applicability of copyright protection. It is clear that protection of remote sensing data as such, must be sought in copyright protection ¹².

Firstly, raw EO or “primary data” refers to data “acquired by remote sensors borne by a space object and that are transmitted or delivered to the ground from space by telemetry” these data are generated by an automated process: special satellites sensors record information about the earth and send it to the receiving station so the ground by means of telemetry .Secondly, raw data are a reflection of reality: Thirdly, without any processing, raw EO data are not comprehensible. Processing is required to make raw data usable ¹³often for practical and economic in reasons ,EO data correction, classification and in perpetration involve use of computer algorithms To make corrections some in situ data must bimanually introduced to the computer algorithm¹⁴ “processed data” signifies “the products resulting from the processing of the primary data, needed to make such data usable” and “analyzed information” This term lays down that results from the “interpretation of processed data, inputs of data and knowledge from other sources.” ¹⁵ therefore in this matter processing data plays a key role in this analysis hence, based on requirements of creativity and protection of expression, processed data can acquire protection but raw data that are only reflection of reality place outside of copyright protection¹⁶.

3-Methods of Protection

With geospatial data, that expression can occur as a database, as a map, or as a photograph." But of course private ownership of any of these expressions may be compromised by problems with fixation, a fair use defense or public domain status.

1-3. Protection as a Database

In the United States, a database may receive protection through copyright. A database may be protected in the U.S. Copyright Act through its protection afforded to compilations - that is, works "formed by the collection and assembling of preexisting materials or of data that are selected, coordinated, or arranged in such a way that the resulting work as a whole constitutes an original work of authorship." but the selection, arrangement, and coordination of these materials are protected and not the underlying data themselves. The scope of protection that a database receives was examined by the Supreme Court in *Feist Publications Inc. v. Rural Telephone Servs. Corp* ¹⁷. The Court considered and denied copyright protection to a "white pages" telephone directory. The Court found that because there is only one logical way to arrange a telephone directory, and because the selection was dictated by the subscribers of the telephone service, no there was no minimum creativity, and no originality

11- G.Raber, J .Tullis,J. Jensen, Remote sensing data acquisition and initial processing,EarthObservationMagazineXIV5(2005)Online:
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12- Transforming Remote Sensing Data into Information and Applications, National Academies Press, 2001, online: /http://www.nap. edu/catalog/10257.htmls.

13-UN remote sensing principle.

14 - Leys C. Stadtplanwerk, BGHZ139, NJW3352, 1998

15 - Karten-Grundsubstanz, BGHIZR227/02, GRUR854, 2005

16 - Tyler T. Ochoa, Origins and Meanings of the Public Domain, 28 U. DAYTON L. REv. 215, 228-229 (Symposium 2002) (discussing legislative history of section 301).

17 - The "white pages" of a telephone directory are the pages "in which [individual] subscribers are listed alphabetically." WEBSTER'S, p169

could exist. Therefore, regardless of evidence of wholesale copying, the database could not be protected¹⁸.

2-3. Protection as a Map

Traditionally, a "map" is "a representation, usually on a flat surface, as of the features of an area of the earth or a portion of the heavens, showing them in their respective forms, sizes, and relationships according to some convention of representation"; and maps have been expressly protected in American copyright from the first Copyright Act in 1790." Applying the Feist decision squarely to the definition of "map," because the features of the earth are shown "in their respective forms, sizes, and relationships," it can be deduced that the selection, arrangement, and coordination of a map is far from creative and represents the same degree of originality found in a white pages telephone book. The court addressed the issue of copyright ability of maps in *Mason v. Montgomery Data, Inc.* The court, while qualifying the author's maps as "compilations of facts, 'found them to be original, finding that the author exercised "creativity that far exceeds the required minimum level"¹⁹. In addition, the Mason court protected the maps as "pictorial, graphic, and sculptural works," as specified by the Copyright Act, noting their "inherent pictorial or photographic nature that merits copyright protection. However, as noted above, enhancements are likely entitled to only a "thin" copyright, protecting only against direct copying.

3-3. Protection as Photographs

Another way to address the copyright ability of RS data images is as a photograph. Geospatial imagery providers classify geospatial data images as photography; like maps, photographs are expressly covered as copyrightable subject matter in the American Copyright Act." However, in this matter photograph simply captures a copyrightable fact or qualifies as a work of authorship. It has been argued that because of the mechanical nature of a photograph, this modicum does not exist; the camera merely records the "manual operation. "Of transferring to the plate the visible representation of some existing object. The Supreme Court in *Burrow-Giles Lithographing Co. v. Saroni* dismissed this idea, noting that the photograph came entirely from the plaintiffs own original mental conception and granted protection to it.

1-3-3. Existing Copyright Protection of Photographs

Since the beginning of commercial distribution of images gathered by satellite, distributors have been confronted with the question of how to legally protect their products from unauthorized copying. Several governments, private companies, and international organizations have decided to simply declare that copyright protection applies to their satellite images. However, in most national legislation, as well as in international treaties, works can only be protected under copyright when they are directly created by a human being and when enough intellectual creativity has been introduced into such products. Taking advantage of the technological complexity of producing satellite images and the lack of jurisprudence on the topic, remote sensing satellite owners and data distributors established distribution policies whereby raw data" minimally processed data' and analyzed information' are labeled as copyright "works". In addition, distribution agreements include clauses referring to copyright protection two such copyright declarations were formally challenged in court actions. A German case was brought in the first instance to the State

18 - *Beaudin v. Ben and Jerry's Homemade, Inc.*, 95 F.3d 1, 2 (2d Cir. 1996) (finding cow pattern hat not infringed by other cow pattern hats).

19- Dennis S. Krujala, Copyright in Electronic Maps, 35 JURIMETRICS J. 395, 396 (Summer 1995).

Court of Berlin, which did not grant copyright protection for a satellite remote sensing image. A second case, heard in both a French court of first instance and a court of appeal, did grant copyright for satellite images. Although the arguments in both cases are different, they have a similar center of gravity.

2-3-3.German

"Photographic work or similar work" with protection under the German Copyright Act is required to be created by the direct intervention of a human being and with sufficient intellectual creativity embedded in such." In a legal dispute, the author of "photographic works and similar works" must provide evidence that his intellectual creativity was introduced in the work by selection of the light source, the inclination of the illumination, the time of exposure of the device, object photographed.

Both products, raw data and minimally processed images, are the outcome of automated processes.

To create the Meteosat photograph, a computer assigned color levels to each number of the minimally processed matrixes. According to a pre-programmed scale of tones from black to white, a computer transformed the matrixes into a photographic image. When this photograph arrived in the hands of technicians, it was "enlarged, colored and then again reduced in size", resulting in the photograph in dispute. Additionally, the second part of the German Copyright Act addresses neighboring rights" which protects "simple photographs and similar products". German legislators also granted legal protecttherefore, "simple photographs and similar products" do benefit from copyright protection, but they are protected for a shorter period than the period provided for "photographic works"

Author in the meaning of art. 2 of the German Act, as well as creator of an image in the meaning of art. Of the German Act, can be only a natural person, because only a natural person has the personal and intellectual capability for the creation of a work. As a legal person ESA can neither be author nor creator of an image.

3-3-3.France

M Sat submitted dozens of dark Landsat photographs, in black and white, which served as supporting evidence about the origins of the M Sat color photographs, where the French territory was hardly identifiable. M Sat argued that its employees selected those Landsat photographs corrected them geometrically, set them to create a mosaic, and colored them. After reviewing the satellite photographs, the Court qualified M Sat photographs to be "works of the spirit. The Court reasoned that the assignment of color elements and their harmonization produced specific and original works of a unique nature. The Court reasoned further that the use of complex technology in the transformation and enhancement process; selecting particular colors, contrast and luminosity; as well as softening the colors, introduced personal intellect into the works. The Court was of the opinion that human creativity was involved. Although these court decisions do not create legal precedent in the German and the French legal systems," they do reflect the emerging challenges in applying copyright protection to satellite products. In general, the things that needs to take account is sufficient intellectual creativity in the digital image and By the introduction of digital photographs, in the special case of satellite remote sensing images, judges should not apply the traditional photographic criteria. When they apply the copyright formula, they need to consider the different levels of the digital image processing and apply innovative principles. If judges cannot set new criteria, legislators need to create a new legal formula to protect satellite photographs processing.

4-Approach to Protection of EO Data in Europe

the European union database directive adopted in 1996, the European Union Database Directive (the "Database Directive") acknowledges copyright's role of protecting databases but also creates a sui generis database right (the "database right") for the protection of databases and their content²⁰. This database right extends to all databases representing a collection of "data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means and covers the protection of databases" in any form., To merit protection for the database, the creator of the database must show a substantial investment in obtaining, verifying, or presenting the contents of the database. This investment may be evaluated qualitatively or quantitatively the database creator has various recourses against a party that has misappropriated data. First, he creator can prevent a party from "extracting" substantial amounts of the data from the database or from repeatedly and systemically extracting insubstantial parts of the database extracting" data is the "permanent or temporary transfer of all or a substantial part of the contents of a database to another medium by any means or in any form,,, and may be measured quantitatively or qualitatively.

Second, the creator may prevent a party from "reutilizing" the data in its own product or from repeatedly or systematically reutilizing insubstantial amounts of the data, defining reutilization as "any form of making available to the public all or a substantial part of the contents of a database by the distribution of copies, by renting, by on- line or other forms of transmission."

The Database Directive directly conflicts with U.S. copyright law because it expands intellectual property protection to cover that: facts, and unexpressed facts at that. While the term of protection offered under the Database Directive is short - a mere fifteen years compared with the potential "life plus seventy" offered by the U.S. Copyright Act - the scope of protection is much broader." Furthermore, with the expansive definition of what constitutes an "extraction" or "reutilization" of data, what constitutes an illegal activity under the Database Directive is much less specific than under copyright. Therefore, the European legislators, unlike the US, do not differentiate between raw and processed EO data. Whether such definitional differences have any implications for the application of copyright law to EO data remains to be seen.

5-Problems with Copyright Protection of Geospatial Data

Although it is apparent that copyright protection can serve to protect geospatial these data images, several questions must be answered before concluding that it will in fact protect any unauthorized appropriation of the database, map or photograph.

1-5. Fixation

Regarding the fixation criterion, Art.2 (2) of the Berne Convention leaves to the discretion of the members of the Union to link the availability of the copyright protection to the material fixation of a work. For instance, the US Copyright Act determines that a work is created when it is "fixed in a copy y for the first time" 'Explicit in the Constitutional mandate to Congress regarding intellectual property is the idea that copyright extends to Authors" to protect their "Writings. Implicit in this clause is the notion that it is the physical expression of an idea, rather than the idea itself .in order for a work to be protected by copyright, the work must be "fixed in a tangible medium of expression, now known or later developed, from which [it] can be perceived, reproduced, or otherwise communicated, either directly or

20- Council Directive 96/91EC, 1996 (L 77 1996~03~27) 20 - 28) (of the European Parliament and the Council of 11 March 1996 on the legal protection of databases

with the aid of a machine or device ²¹. The flexibility of this definition has led courts to ensure its liberal application with the expansion of technology into new media. however if an image is intercepted *en route* to the intended receiving apparatus, after the data is gathered but before the image from the data can be created? According to the current standard put forth by the Copyright Act, no change in the protection will occur. Section 101 of the Copyright Act states that "[a] work consisting of sounds, images, or both, that are being transmitted, is 'fixed' ...if a fixation of the work is being made simultaneously with its transmission

2-5.Fair Use

Fair use, a statutory defense to copyright infringement allowing certain uses of copyrighted works, is triggered upon certain protected activities - "criticism, comment, news reporting, teaching, scholarship, or research - so that the private ownership of the intellectual property right will not prevent further expressions if used by a later party for one of these statutorily-defined purposes. Congress set out a four-factor test which a court must consider when determining whether to apply fair use: "the purpose and character of the [secondary] use ...; the nature of the copyrighted work; the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and the effect of the [secondary] use upon the market for or value of the copyrighted work. The factor that implicates mapped geospatial works is the nature of the copyrighted work ²². Generally, works that involve a lesser degree of creativity are generally more susceptible to a defense of fair use against infringement."

3-5.Public Domain

Works authored by the U.S. government, however, do not receive any protection whatsoever. "A government publication is not subject to copyright protection because the work is in the public domain, but if a copyrighted work, such as a geospatial data set, is "authored" by a government contractor and assigned back or licensed to the US government, copyright protection will continue to protect the work and not send it into the public domain. In relation to IP and spatial data, another question is important: whether or not the data were created with public money²³. The rule is different from one country to another. In some European countries, the government claims the copyright of data made by public money but in USA the federal government has no such rights for these data.

1-3-5.Making Balance between Private and Public Interest

Current modes of data and information dissemination should not impede the exchange of ideas, information and knowledge .there is a need to recognize a legitimate claim and interest in accessing data and information as a right. If taken a step further, this could apply to spatial data as well. it then becomes necessary to show that access to RS and EO data and information falls within the public interest therefore whether this notion could applied to use of EO data is assessed below.

2-3-5.Public interest

21- Charles R. McManis, Database Protection in the Digital Information Age, 7 ROGER WILLIAMS U. L. REv. 7, 17 (Fall 2001)

22 - Doldirina, Catherine. « Rightly Balanced Intellectual Property Rights Regime As A Mechanism To Enhance Commercial Earth Observation Activities». Science Direct, 2010

23- john cosgrovemcbride&thomas j. touhey, 9 government contracts: cyclopedic guide to law, administration, procedure, § 52.160[4] 52-199 (2006)

Public interest can be defined as justifying regulatory intervention into private activities in order to limit the exercise of private power, where necessary, to meet the objectives set by the community²⁴.

The literature confirms the problems inherent in defining public interest as a singularly binding legal concept²⁵. One of the factors behind such difficulties is the nature of the specific need (of an individual, a group of individuals, or society as a whole)²⁶ and the ambiguity of the standard of adjudging public interest in terms of its formulation as subjective or objective and/or of general or specific nature. In general terms, it is a right contingent on the balance within the equation, be it public security, public health, public policy, public knowledge, etc.²⁷.

3-3-5. Public good

A further key concept that gives weight to a general right of access can be found within the notion of data and information as a public good. Tax funded RS data (whether raw or processed) are or can be, depending on the level of processing, an information good²⁸. Government-produced information (goods) circulated in digital form may be considered a public good. One of the reasons behind this is that such information goods are an input that supports sustainable development: examples such as a clean environment, health, knowledge, property rights, peace and security demonstrate instances of public good that may well become global public goods in the near future over and above the recognition of the right of access to information can be readily contrasted with that of welfare rights²⁹. However the beneficial character of EO and RS data and information brings it very close to the public good³⁰. Even if the applicability of the public good concept to EO data is to be rejected states should acknowledge their obligation to facilitate access to RS and EO data and information and viewed as an essential facility³¹. The right of access to environmental information is, in certain circumstances, guaranteed by the European Convention on Human Rights and also according to the provisions of the Aarhus Convention³² and the EU Council Directive on the freedom of access to information on the environment, “environmental information” includes “any information in written, visual, aural, electronic or any other material form” relating to the environment. This means it includes RS data and information. Given the methods of legal interpretation available, whether literal, teleological or historical, the legal definitions given to data and information, alongside RS data and information,

²⁴- Selznik P. Focusing organizational research on regulation. In: Noll R, editor. Regulatory policy and the social sciences. Berkeley, CA: University of California Press; 1985

²⁵ - Feintuck M. The “public interest” in regulation. Oxford: Oxford University Press; 2004. p. 179.

²⁶- Bell J. Public interest: policy or principle? In: Brownsword R, editor. Law and the public interest,

Proceedings of the 1992 ALSP conference. Stuttgart: Franz Steiner Verlag; 1993. p. 27.

²⁷- Lasswell HL. In: Bell J, editor. The public interest: proposing principles of content and procedure. Avhuoas: NomosVerlag; 1954. p. 67.

²⁸- Samuelson PA. The pure theory of public expenditure. Review of Economics and Statistics 1954; 36(4):387–9.

²⁹- Clarke AL. Spatial data standards: technical and management issues. In: Proceedings of the AURISA annual conference, 1991.

³⁰-Pearce D. Blueprint 4, capturing global environmental value. London: Earth scan Publications Ltd.; 1995

31- Love J. Pricing government information. Journal of Government Information 1995; 22(5):363–87. 364.

32- Convention on access to information, public participation in decision making and access to justice in environmental matters, 25.06.1998 (1999) 38 ILM 517, article 2(3), hereinafter ‘Aarhus Convention’; and OJ L 41, 14.2.2003, p. 26–32;

logically encompass data. If access is permitted to information, access to data must presumably also fall within the ambit and be permitted as well. Additionally the existence of such a right is especially vital in the information society era that is challenging fundamental channels of (information) distribution³³.

4-3-5. Making Derivative Works As Recognizes Legal Rights

A derivative work, being an author's own creation, is always based on one or more pre-existing works, and may be created through different acts, such as translation, arrangement, reproduction or any other form in which a work may be transformed or adapted. Most of the information products based on the licensed EO data and information will qualify as derivative works³⁴. Therefore, the licensee will be entitled to distribute them as one of the author's economic rights. But if this only happens in theory, the value-adding activities, in which normally any licensee is engaged, become hard to pursue if they are prohibited in practice by restrictive license conditions. Fortunately some example do exist in practice, for instance the data generated by China–Brazil Earth Resources Satellites (CBERS) can be received by the authorized ground stations and there are no restrictions upon their further use and distribution, apart from the recommendation to adhere to the free data distribution policy³⁵.

Conclusion

EO data and information become indispensable for carrying out a lot of activities, and therefore need to be properly protected but it is suitable for processed EO data and analyzed information because copy right protect expression and not the ideas underlay it. A proper balance of the interests of the different players-private companies and community- should be found

Information occupies a central role in modern society and taking the public good components of

data and information into account therefore, it has role in national security, meteorology, disaster management, and environmental protection, sustainable development through recognizing and meeting the right to information as a basic principle of democracy and also over-regulating access to space data may prove counter-productive in the information age.

The trend among most of the satellite remote sensing data distributors is to conclude contracts wherein private persons declare that all satellite products are protected under copyright law, even if some of the products do not qualify for it. This trend includes distribution contracts with end-users that contain clauses referring to "copyright" of satellite products. Such contracts are invalid attempts to establish copyright protection. Consistent contract practice cannot be a substitute for intellectual.Creativity and direct human intervention. However, individuals, companies, and intergovernmental agencies cannot

33- Maxwell C, editor. Global trends that will impact universal access to information resources. Available at <http://www.isoc.org/isoc/UNESCO-paper.shtml>, last visited 10.11.2007.

34 - B. Ryerson, A realistic perspective on earth observation data policy, Canadian Space Summit (2008)

35 - CBERSDataPolicy, November2004, .Online: [/www.obt.inpe.br/cbers/documentos/appl_07_2004.pdf](http://www.obt.inpe.br/cbers/documentos/appl_07_2004.pdf);

CBERS Complementary Protocol on CBERSApplicationSystem, November2004, Online: [/www.obt.inpe.br/cbers/documentos/appl_01_2004.pdf](http://www.obt.inpe.br/cbers/documentos/appl_01_2004.pdf). See also Bacellar, J. CBERS

create an intellectual legal property regime for their products as they wish. States define objects, terms, and conditions for copyright protection. States' legislative and judiciary bodies are the only entities with the authority to decide if an item qualifies for copyright protection.

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THE EFFECT OF HEALTH SAFETY MANAGEMENT IN NATIONAL DEVELOPMENT

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ABSTRACT

The most important resources of any country are its human resources and no nation is stronger than its citizens. Basically, the efficiency, strength and capability of citizens is their freedom from emotional, physical, mental and social illnesses and from accidents or harm. Today, accidents and diseases constitute vital social and personal problems facing our country. Millions of people have lost their lives as a result of accidents (preventable and non-preventable) and millions suffer disabling injuries. It is noteworthy that diseases and accidents cause more death than any other factors. Most of this is due to lack of health and safety education/ management and as such, it is most essential that our youths and adults become familiar with the hazards and diseases of our modern day living and learn how to live safely within their environment. Such quality of health and safety based instruction and training does not result from mere chance, it must be cultivated from a desire to live most and serve best. Direction towards these ends is the purpose of this paper. The goal of health and safety education is to help students and the general public learn about healthy behaviours and safety skills which help to address common health and security issues through education and outreach to support healthy and safe living conditions. It is necessary that safety education be incorporated in health education so that children are taught safety practices early in life in order to enjoy quality health and practice safe.

Introduction

In safety and health, reactive response occurs after an injury or illness and usually has the purpose of minimizing the costs associated with the injury or illness. For example, when people treat illnesses or injury instead of prevent them, they are adopting a reactive approach to health and safety. When management emphasizes a reactive approach to safety and health, it sends a negative message to employees. Reactive programs always cost much more than proactive programs because reactive waits until an injury or illness has occurred. Reactive programs kick in only after an accident has occurred.

Examples of reactive safety programs include:

1. Accountability system that tie discipline to accidents.
2. Accident investigation to fix the blame.

On the other hand, a proactive response to safety and health takes place before the occurrence of an accident or illness. It anticipates and tries to prevent accident. By emphasizing accident prevention, management sends a message of caring to both staff and students. This approach is less expensive in the long term as a result of fewer accidents and injuries. Some examples of proactive safety and health programs include:

1. Hazard analysis to fix the problems
2. Inspection of the system
3. Incentive/ recognition programs that recognize compliance, reporting, suggesting and involvement.
4. Establishment of safety committees and or safety teams. Proactive approach to health and safety involves all activities directed towards the prevention of accident, the measures taken to manage risks, analyze hazards in the environment, prevent sicknesses or diseases and maintain a zero lost workday for staff and zero lost schooldays for students. Proactive approaches to health and safety education is not just meant for the school environment and industries but can benefit the entire community as it concerns maintaining quality life by ensuring protection from risks of life and prevention of diseases by taking proper care of ones life, property and environment by eating food free of germs, drinking clean water, engaging in environmental sanitation in order to obtain a disease and hazard free environment. Health and safety is an important aspect of educational program because it trains people on the acquisition of necessary health habits, safety skills and practices to ensure that the objective of this program is achieved. this course of study should be adopted by schools both primary, secondary and tertiary institutions so that children can learn at their youth age positive behaviours that will carry them throughout their life time and also engage in safe practices which will prevent them from unexpected danger in the home front, at school and any other environment they find themselves.

Health Education& Safety

Health and safety management is a desirable objective which can be achieved through education. The term health education is a social science that is drawn from the biological, environmental, psychological, physical and medical sciences to promote health and prevent diseases, disability and premature death through education driver voluntary behaviour change activities. (Green and Creufer 2005)

Health Education defined as comprising or consciously constructed opportunities for learning involving some form of communication designed to improve health literacy, including improving knowledge and developing life skill which are conducive to individual and community health.

According to world health organization (WHO), Health Education is defined as any combination of leaning experiences designed to help individuals and communities improve their health by increasing their knowledge or influence their health knowledge. The front committee on Health Education and promotion terminology (2011), defined

Health Education as any combination of planned learning experience based on sound theories that provide individuals, groups and communities the opportunity to acquire information and the skills needed to make quality health decisions. Okoye (1999) defined Health Education as the principle by which individuals and groups of people learn to behave in a manner conducive to the maintenance of health. The Encyclopedia of medical concepts defined it as Dowbice et al (1996) provides a broader context of health education in relation to policy, system of environmental changes in the practice of health promotion and related philosophies education that increases the awareness and favourably influences the attitudes and knowledge relating to the improvement of health on a personal or community basis.

From the above definitions, it can be deduced that Health Education is an educational programme designed to get people (individuals, groups and communities) acquainted with issues regarding their health and environment in order to bring about a change in health behaviours and attitudes for the promotion, maintenance and restoration of quality health. This goes to show that the ultimate aim of health education is positive behavioural modification.

Safety on the other hand in the state or condition of being protected against physical, social, spiritual, financial, political, emotional, occupational, psychological, educational or other types or consequences of failure, damage, error, accidents, harm or any other event which could be considered non-desirable. Akwue (2011), defined safety to be the control of recognized hazards to achieve an acceptable level of risk. This can take the form of being protected from the event or from exposure to something that causes health or economical houses. It can include protection of people or possessions.

Ajibola (2008) sees safety as a relative freedom from danger, risks, or threat of harm, injury or loss to personnel and property whether caused deliberately or by accident. Orji (1994) views safety as the ability to manage risks inherent to operations or related to the environment or the commitment to clear identification of risks in relation to production operations, assessing them in terms of quality, quantity and managing them.

Thus, Safety therefore deals with identification or recognition of danger, risks and security threats pertaining to life and property and putting in place appropriate measures to prevent and control them.

Health and safety education's theory and practice base have broadened from focusing on one-to-one and mass media behavioral intervention to encompass responsibility for policies, system and environment that affect population health. In the 21st century, health and safety education became considered as a mature profession given that it has developed a discrete body of knowledge, defined competencies, a certification system for individuals, a code of ethics, a federal classification and recognized accreditation processes in higher education. Health and safety management is generally aligned with the behavioural and social sciences as one of the core dimensions of public health study and practices. Additionally, the fields draw from theories and models from education, health studies, communications, and other diverse areas. The unique combinations of these knowledgeable areas formed the basis for health and safety education competencies.

Similarly, the need for safety education arose as a result of increase in death toll which is due to numerous accidents and hazards in all aspects of human life as well as the environment. Safety education became very popular in the 21st century as awareness of occupational hazards and interest in worker's protection had increased in the public and private sector. Through assessments conducted, it was apparently clear that there was a shortage of qualified industrial health and safety specialists to meet the challenges of worker's health and safety in the economy. The Educational Resource Centers (ERCs) now

called Educational and Research Centers to better reflects their dual roles were established to assist selected institutions to develop and expand existing occupational health and safety training programs and to provide continuing education courses for specialists currently practicing in the specified field. Therefore, Health and Safety education was designed to assist young ones and adults to be able to learn and adopt healthy and safe behaviours, provides guidance on health education and safety assessment, enduring understanding, essential health education skills and safety practices, functional knowledge on safety and health issues, health education skill instruction pedagogy.

Health and Safety education focuses around major areas such as assessing, planning, implementing, managing and evaluating health and safety educational management, its skill practices and interventions. It includes historical and philosophical foundations and development of this professionalism and ethics.

These disciplines embrace both qualitative and quantitative methods, community-based participatory research, health communication and social marketing principles, policy and media advocacy to accomplish program objectives.

Health and Safety educators are stalwarts in fight for social justice and believe that the health and safety of a population should be a priority in any society.

Health and Safety as an integral part of educational system deals with the avoidance of health and property hazards, risks, the promotion of adequate and quality wellbeing of individuals, the control of environmental influences which pose threat to both human and properties. Health and safety educational management begins with people and geared towards improving the living conditions of the people and to develop in them a sense of responsibility for health conditions for themselves as individuals, as members of families and as communities. It involves the appraisal and assessment of health and safety habits, attitudes and skills of the people as they relate to spread and frequency of diseases and hazards around them. It is the family, society and the school that determines the environmental situations which influences health habits and safety attitudes of and individuals, community and society.

Thus, Health and safety educational management as one of the facet of the school health programs and the total school curriculum is integral to “Education for All”. Good health is essential for effective learning as well as safety in maintaining healthy learning environment, free from hazardous influences and education is a powerful tool inculcating in children and adults ways to attain and maintain good health and recognition of health and environmental hazards. Not only does health and safety education have a direct impact on the school pupils but through the pupils’ examples can benefit families, communities and the entire society.

According to UNESCO/UNDP (1995), Topic II, it states that the focus of Health and safety Education is on.

- The important behaviours and condition that promote health and those that put health at risk
- Acquisition of skills needed to practice those positive behaviours and address those risky behaviours and hazardous condition by personally and collectively.

- Imparting knowledge, attitude, beliefs, and values related to those behaviours and conditions.
- Providing learning experiences that allows students to model and practice those skills.

Principles of Health Education

- i. It is a process whereby people learn to improve their personal habits and attitudes to work responsibly for the improvement of health conditions of the family, community and nation.
- ii. It considers the health status of the people which is determined by the economic and social conscience of the country.
- iii. It involves motivation, experience and exchange in conduct and thinking while stimulating active interest. It develops and provides experience for change in people's attitudes, customs and habits in relation to health and every day living.
- iv. Utilize all educational opportunities for health; formal and informal, traditional and alternative, inside and outside school.
- v. Empower students to act for health living and to promote conditions supportive of health.
- vi. Establish a life long learning of health issues.
- vii. It aims to help people make use of their own effects and education to improve their living conditions.
- viii. It makes careful evaluation of the planning, organization and implement of all health education program and activities.
- ix. It is a cooperative activity requiring all categories of health personnel to work together in close team work with families, groups and the community.
- x. It meets the needs, interests and problem of people affected.

Principles of Safety Education

1. Involve young people in real decision making to help them stay safe this includes young people's participations in real decisions about keeping themselves safe in and out of classroom. Activities for young people should include identification of hazards, participating in risk assessment (e.g. assessing whether risks are trivial, tolerable or intolerable) and being part of actions to control or manage risks to themselves and others.
2. Teach safety as part of a comprehensive personal, social and health curriculum – A curriculum helps children and young people learn how to keep themselves healthy and to stay safe. It provides opportunities to learn specific and transferable skills and knowledge in a wide range of circumstances but with attention to feelings, skills, attitudes, values and attributes.
3. Use realistic and relevant setting and resources in Safety Education – Real life data and example (but not those designed simply to shock) help to engage young people and to challenge misconceptions e.g. bully is an acceptable behaviour among children, or accidents just happen where necessary. (Using data in this way is also known as normative approach).
4. Address known risks and protective factor – Risks and protective factors can be anything that is associated with greater or lesser probability of a child or young person

experiencing harm. Risks are not static and can be divided into domains: Individual (e.g. knowledge and skill) school (e.g. Policy) Peer groups (e.g. attitudes).

5. Family (e.g. parental rules) and community (e.g. Crimes). An understanding of risks and protective factors can help those designing and delivering safety education resources to focus on wide aspects of injury prevention and personal safety.

6. Address psychological aspect of safety e.g. confidence, resilience, self esteem and efficacy – psychological risks and protective factors are individual characteristics that may predispose children to injury, or to being a victim of bullying, violence or abuse. Psychological aspects of behaviour operate dynamically with environmental factors, reinforcing the importance of incorporating individual protective factors (such as confidence, resilience, self esteem and self – efficacy) within a whole community approach.

7. Adopt positive approaches which model and reward safe behaviour, within a safe, supportive environment – It is helpful to identify the short and long term benefits of maintaining safe and healthy behaviour that is harmful to health. Children and adults learn from observing and modeling the behaviour of others, including peers and generalize their expectation of positive outcomes across different domains.

8. Work in partnership – Develop links with supporting agencies such as police, fire, rescue, local authorities and educational charities where these add value to work carried out in schools and other setting. Work with parents and members of wider community by seeking their views, providing information, guidance and involving them in developing and implementing solutions and ensures healthy learning surroundings free from environmental hazards.

Health and safety educational management provides educational programs, resources and services to foster students' Organizational Culture that thinks proactively about personal safety and wellbeing at home, at school – during co-curricular activities and how to manage potential risks.

In safety education, there is shared responsibility for the safety of both students and staff. Each person must acknowledge the critical role in ensuring his own safety and that of others. Both students and staff are provided with resources and tools they can use to plan safe events and activities as well as risk management and prevention.

Importance of health and Safety Education

1. Knowledge of health and Safety is vital as it concerns the acquisition of safety skills, habits and health attitudes for the effective functioning of the body, maintenance of healthy environment free from dangers or hazards for the promotion of quality health of the society.

2. It builds students' knowledge, skills and positive attitudes about health and risks needed to be avoided.

5. It motivates students to improve and maintain their health, prevent disease and reduce risky behaviours.

6. Students learn skills they will use to make healthy choices throughout their life time.

7. It results in positive change in behaviour that lower students' risks associated with.

8. Use of alcohol, tobacco and other drugs.

9. Sustenance of injury.

10. Mental and emotional instability.
11. Nutrition.
12. Physical activity.
13. Sexuality and family life etc.

Health and Safety Educational management helps to mitigate risks in any given situation, hence knowledge of health and safety is important in

Helping facilities (schools, hospitals, industries etc) to be competent in delivering proficient and safe care practices while maintaining a protected environment from potential harm in an economy of a given nation.

Studies have shown that students whose behaviours/ attitudes have been modified as a result of health and safety sequel to the instructions and trainings tend to do better in school. Their attendance, grades and performance during assessment were significantly higher than those that have not

Scope of Health and Safety Educational Management

Health and safety educational is a very vast term and has a very wide scope. It is dependent and closely related to many other aspects besides health and safety. Those aspects include housing, economic security, agricultural or industrial prosperity etc. Ordinarily health education includes the following:

1. Food and its importance in the development of human body. It touches all branches of human life namely personal life, school life and community life.
2. Water, air, light, physical exercises, recreation, rest, sleep etc.
3. Abnormal conditions and bad habits. Their adverse effect on the physical and mental health of an individual.
4. Various ailments and diseases. Their causes, ways and means of their prevention and cure.
5. Mental health, sex, hygiene, domestic and community hygiene.
6. Emergency and first aid.
7. Misuse of alcohol, drug and tobacco and harm reduction.
8. Effective stress management.
9. Cultivating and sustaining healthy relationships.
10. Coping with test anxiety, improving time management and sexual health promotion.
11. Safety Education and first aid

Scope of Safety Education

- i. Hazards control.
- ii. Fire protection.
- iii. Ergonomics.
- iv. Process and system safety.
- v. Safety and health management.
- vi. Job hazard analysis.
- vii. Accident investigation and analysis.
- viii. Product safety.

- ix. Construction safety.
- x. Education and training methods.
- xi. Measurement of safety and health.
- xii. Human behaviour.
- xiii. Environmental safety and health regulations and standards.
- xiv. Health and environmental laws etc.
- xv. First aid.

Recommendations

1. Health and safety educational management curriculum should be formulated and implemented in schools so as to develop in students an objective and positive thinking towards health and safety principles and practices.
2. It is evident that people lack proper training in health and safety practices which usually results to fatality; hence it should be adequately looked upon.
3. Workers engage in unsafe and hazardous practices which are due to lack of regular induction and pep talk regarding healthy and safety measures at their work places adequate protective measure should be adhered to.
4. The management staffs need to put in place health and safety committees whose duties are to conduct pep talks, induct workers and students regularly and analyze hazards in the environment and during construction and maintenance of dilapidated school structures this committee should make sure that the contractor make available safety materials such as personal protective equipments (PPEs) for site workers to avoid unnecessary accidents.
5. Management should organize seminars regularly on health and safety and involve both staffs and students so that they can see the need to engage in safe practices and live and maintain quality health in order to be beneficial to both self and the society at large.

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SPATIAL DIMENSION OF DRINKING WATER DEPRIVATION IN URBAN INDIA

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Abstract

Rapid urbanization, unplanned urban growth and inadequacy of basic services and infrastructure are the crucial challenges faced by every Indian city. Inadequate provision of shelter, sanitation, safe drinking water and drainage generate environmental pollution that deteriorates human health. Access to safe and reliable drinking water is one of the basic necessities of human life, thus, this paper examines the experience of India as a lens through which to see the condition of access to potable drinking water in urban areas and spatial variation exists in the delivering of this basic service. Though most of the urban households use tap water as the main source of drinking water but a significant proportion of urban households living in Kerala and Lakshadweep still rely on uncovered well water and in Arunachal Pradesh and Sikkim most of the households get untreated tap water. Drinking water deprivation is highest in the states with low level of urbanization and mainly concentrated in north eastern and eastern states of India. South Indian states, Union Territories and north Indian states and Union Territories perform better in this issue. Lakshadweep is the only Union Territory in south India which record high drinking water deprivation, because most of its urban households still rely on un-covered well water. Spatial variation in the access to safe drinking water generates a new issue and challenge to the urban planners.

Keywords: safe drinking water, spatial variation, Deprivation, Urban Household, Urbanization

Introduction: Rapid urbanisation due to large scale rural to urban migration in search of economic betterment in urban areas poses a major challenge for the city planners and policy makers; extending potable drinking water and proper sanitation services to urban peripheries and slum as well as squatter settlements to reach the poorest of the poor. Unfortunately, unsafe drinking water coupled with lack of basic sanitation snatches many million lives every year in form of cholera, jaundice, dysentery and other infectious diseases. Thus, safe drinking water and sanitation are still a luxury for many of the world's poor people. The picture is quite ridiculous in India where nearly two-thirds of households now have access to phones and LPG for cooking; but less than half the number of households have access to basic toilet facilities and over a third do not have access to safe drinking water. Drinking water is supposed to be one of India's success stories - the government claims it met its Millennium Development Goal on water five years ahead of time, and that its rural drinking water mission has reached every uncovered habitation. Yet Census 2011¹ data reveals that 20% of Indian households have to go more than half a kilometre for drinking water, and that this figure is very high in rural India. Taps (43%) and hand pumps (34%) are the two main

sources of drinking water, followed by wells and bore wells. While taps are the most common source of drinking water for urban India (71%), hand pumps are most common for rural India (44%). Even in New Delhi which is the national capital of India, many households still rely on untreated tap water as the main source of drinking water. Therefore, extension of potable drinking water to all is still a great challenge in India and there is a spatial disparity exists in this issue. Though this paper aims to highlight spatial disparity in the access of safe drinking water in urban India, but it does not mean that we are undermining the problems of the rural India. The only reason is that, the problems of urban India need to be focused separately in the wake of globalisation and economic liberalisation. In a modern Indian city, a city dweller has to pay for water, sanitation, electricity and all other facilities he or she is enjoying, he or she does not have the opportunity to explore river or pond water or to use other water bodies for getting water like his rural counterpart. Congestion, over crowding, space problem and lack of access to adequate housing are the part and parcel of the urban life, therefore, lack of access to safe drinking water not only lead to personal health problems but also stimulate the outbreak of pandemics. Thus, urban problem of the access of safe drinking water and spatial disparity exists in this service should be placed separately.

Literature review: The uniqueness of water to human life makes it a valuable social asset and a common good basic to any human community. Clean water plays an important role in combating epidemics and maintaining personal hygiene (Petrellaⁱⁱ 2001). In developing countries 37 diseases have been identified as the major causes of death and 21 are related to water and sanitation. More than 4 million infants and children die every year in developing countries due to water born diseases (APPENⁱⁱⁱ, 1998) The report prepared by the WHO /UNICEF joint monitoring programme for water supply and sanitation (2005) has clearly defined the concept of safe drinking water and clearly distinguishes the sources of safe and unsafe water. The major sources of potable drinking water includes pipe water into dwelling plots or yards, public tap/ standpipe, tube well, bore well, protected dug well, protected spring and rain water collection. Other sources like unprotected spring dug well, surface water and other sources are treated as unimproved sources of drinking water. The Census of India further bifurcate tap water into two categories i.e. 'tap water from treated source' and 'tap water from untreated source' during its data collection for the 2011 census. Similarly well water is separately canvassed under 'covered well' and 'uncovered well'. Delivery of clean drinking water, removal of waste water and improved sanitation facilities are three of the most basic foundation of human development (UNDP 2006)^{iv}; if people are denied of clean drinking water for domestic purposes, their freedoms are constrained by ill health, poverty and health vulnerability. Unclean water and unhygienic living condition are the main reasons behind child and infant mortality in the developing countries; intestinal worms caused by unsafe drinking water create anaemia and pregnancy related complications. Drinking water is one of the biggest issues in urban India, according to the 2011 Census, the urban population grew to 377 million showing a growth rate of 2.76 per cent per annum during 2001-2011, an increase of 3.3 per cent points during 2001-2011 compared to an increase of 2.1 per cent points during 1991-2001. Clean drinking water is most crucial challenge in Indian cities, but there is state wise variation and its is one of the biggest dimension of urban deprivation. Estimates given by the Planning Commission and the

Census 2001 show that over 20 million households in India do not have affordable and adequate housing facilities with basic services and infrastructure, about 260 million households are living below the Poverty Line and 67 million of them are residing in urban areas. The reported slum population in 607 towns and cities in India is over 40 million. Though the Government of India has launched various programmes like *Valmiki Ambedkar Awas Yojana (VAMBAY)*, *Common Minimum Programme (CMP)* for providing shelter to the BPL families in urban areas, but still a large number of urban poor reside in extremely deplorable condition without potable drinking water and improved sanitation. High level of housing shortage spread over states of Uttar Pradesh, West Bengal, Bihar, Orissa, Maharashtra, Gujarat, Tamilnadu and Andhra Pradesh (*Jabir Hassan Khan et al. 2012*)^v. DFID Report on '*Urban Poverty and Vulnerability in India*' (2001)^{vi} prepared by Loughhead, Mittal and Prof Geof Wood identified four types of vulnerabilities facing by urban poor in India. At least 30 million people in Indian cities reside in non-registered slums and face fear of eviction or housing vulnerability. Personal vulnerability (lack of security, inadequate coverage of pensions, cash benefits, employment etc), health vulnerability (unsanitary living condition which include lack of access to potable drinking water and other basic services) and social vulnerability (individual experiences vulnerability according to age, gender, caste etc in patriarchal society) were the other types of vulnerabilities experienced by urban poor. Thus, deprivation in basic services and necessities is a crucial issue in India. According to D.T. Herbert, 'Deprivation' implies a standard of living or a quality of life below that of the majority in a particular society, to the extent that it involves hardship and inadequate access to resources. Comparisons are made less to an average than to a threshold and all writers upon the subject have emphasised the relative nature of these comparisons and standards (Herbert^{viii}, 1975). Deprivation has many dimensions, among them deprivation in safe drinking water is one of the most crucial indicators of standard of living as well as health vulnerability. Thematic mapping of deprived locales is gaining popularity in the western countries, but in India, it is still in rudimentary form. Therefore, this paper aims to analyse deprivation in safe drinking water in urban India with following objectives:

Objectives:

1. To identify spatial variation in various sources of drinking water in Urban India
2. To identify co-relation between the level of urbanisation and deprivation in safe drinking water
3. To identify regional disparity in drinking water deprivation

Methodology and Data source: Various statistical techniques like composite index, calculation of SD and mean have been employed to identify drinking water related deprivation for every Indian state and through ARG-GIS thematic mapping has been done.

Composite Index: With the help of Z-score method composite index has been constructed and with the help of the average Z-score values ward level deprivation

$$z = \frac{x - \mu}{\sigma} \quad \text{where:}$$

mapping has been done. Formula used for this technique is

μ is the mean of the population; σ is the standard deviation of the population.

The quantity z represents the distance between the raw score and the population mean in units of the standard deviation. Z is negative when the raw score is below the mean, positive when above. In statistics, a **standard score** indicates by how many standard deviations an observation or datum is above or below the mean. It is a dimensionless quantity derived by subtracting the population mean from an individual raw score and then dividing the difference by the population standard deviation.

Administrative map of India has been digitised for this purpose and various thematic maps have been produced by using the Census 2011 data for highlighting state level variation in drinking water deprivation across India.

Discussion: Spatial variation in Different Sources of Drinking Water in urban India:

According to WHO and other international organizations pipe water, tube well, dug well and bore well are considered as the improved sources of drinking water, among them tap water or pipe water is the most important source of drinking water in urban India. Therefore, percentage of urban households having access to tap water is an important indicator of development.

Access to Tap Water (Map Number:1): States like Jammu-Kashmir, Himachal Pradesh, Rajasthan, Chandigarh, Delhi (north Indian states), Maharashtra, Gujarat, Goa in west India, Karnataka, Tamilnadu, Andhra Pradesh, Andaman-Nicobar in south India and Sikkim, Arunachal Pradesh in north east India record more than 80 per cent urban households have access to tap water as the main source of drinking water. Among the major states Bihar and Assam record lowest percentage of urban households having access to tap water. According to the Census 2011 (India) access to tap water does not end drinking water deprivation. Percentage of households having access to treated tap water should be considered as the better indicator.

Access to Treated Tap Water (Map Number: 2): Arunachal Pradesh (37.7%) and Sikkim (22%) record highest number of urban households rely on untreated tap water, though, these two north eastern states record more than 80 per cent urban households have access to safe drinking water. Nagaland and Daman-Diu have more than 20 per cent urban households depended on untreated tap water and Jammu-Kashmir, Gujarat, Chattishgarh record significant proportion of urban households (more than 15 per cent) rely on untreated tap water. Thus, states like Jammu-Kashmir, Sikkim, Arunachal Pradesh etc. though record better picture in terms of access to tap water for urban households as the potable source of drinking water, but many of them get only untreated tap water which can not be used directly as drinking water.

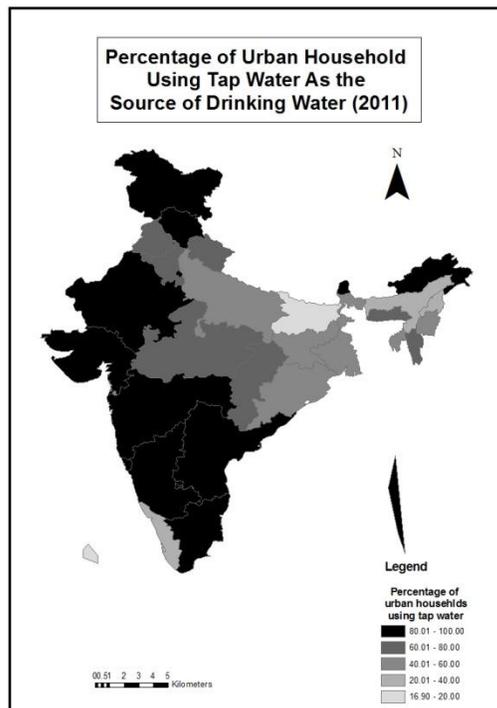
Un-covered Well as the Source of Drinking Water (Map Number 3): Utilization of dug well, bore well, spring, rivers and other water bodies as the source of drinking water depend on geological configuration of an area. In urban areas tap water is the main source of water, but in some states like Kerala, Lakshadweep etc. record that a significant proportion of urban households depend on dug wells for getting drinking water. Covered wells are considered as the improved source of drinking water, but water from the uncovered dug-wells can not be treated as safe drinking water. Kerala (43%) and Lakshadweep (69%) record highest number of urban households rely on uncovered wells. Other states like Assam,

Orissa, Jharkhand and Nagaland record a significant number of urban households depend on uncovered wells.

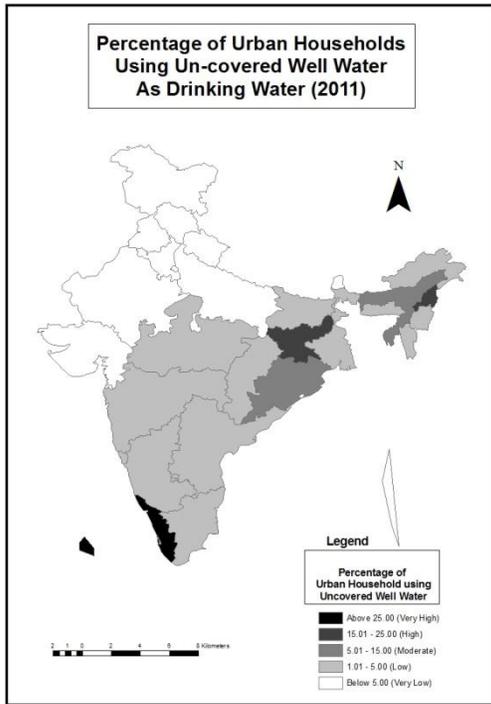
Water Sources Away from the Housing Premises (Map Number: 4): Households having water sources away from the dwelling units (more than 100 metres in urban areas) can be treated as deprived in drinking water. North eastern states like Manipur (32.1%) and Nagaland (22.7%) record highest number of urban households having drinking water sources away from their dwelling units; other states like Jharkhand, Orissa, West Bengal, Madhya Pradesh and north eastern states like Meghalaya, Tripura and Mizoram record significant number of urban households having drinking water sources away from the dwelling units.

Spatial Variation in Access to Different Sources of Drinking Water in India

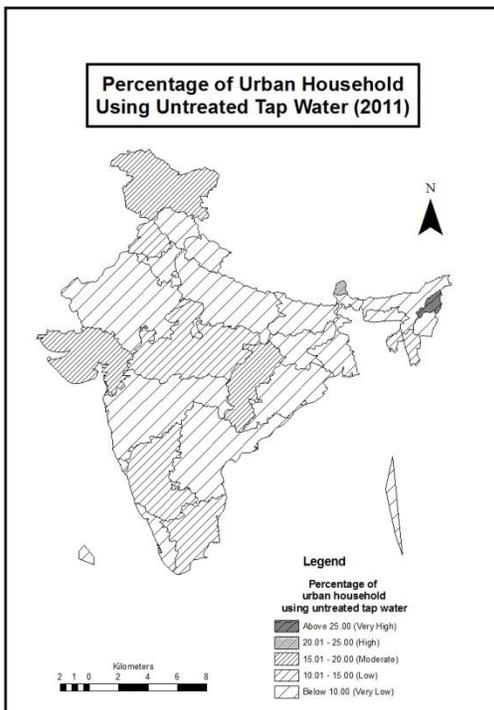
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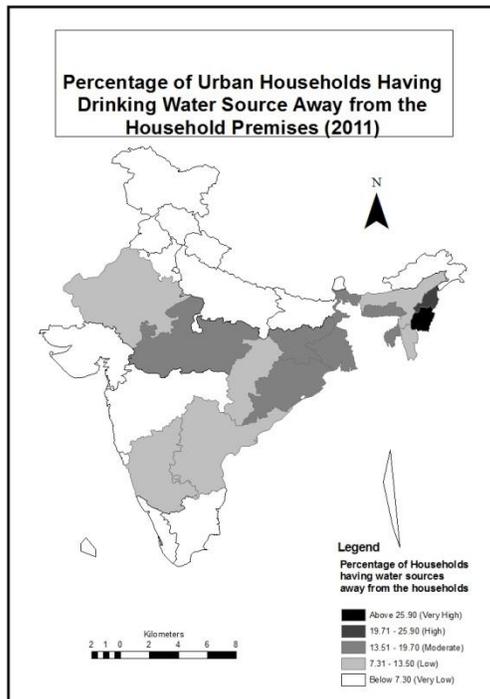
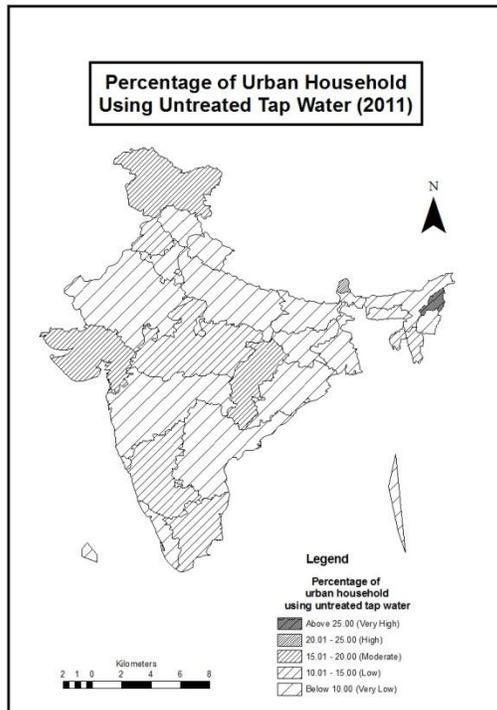
Map Number:2



Map Number:3



Map Number:4



(Source: Maps prepared by the author by using ARC-GIS and data source is Census 2011, India)

Co-Relation between the Level of Urbanisation and Deprivation in Safe Drinking Water: A deprivation index has been calculated with the help of following indicators like: percentage of urban households not having access to tap water, percentage of urban households having drinking water sources away from the dwelling units, percentage of urban

households using un-treated tap water and un-covered well water. A composite index has been calculated by using Z-score method.

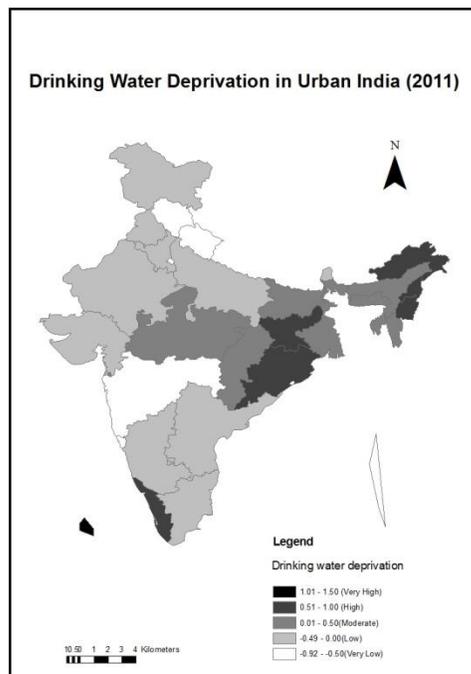
Map number 5 exhibits regional variation in drinking water deprivation. Highest deprivation score is recorded in Lakshadweep, Kerala, Orissa, Jharkhand, Arunachal Pradesh and other north eastern states. West Bengal, Bihar, Madhya Pradesh and Chattishgarh also record moderate deprivation. Least deprivation is recorded in Maharashtra, Delhi, Himachal Pradesh, Punjab and other north Indian states.

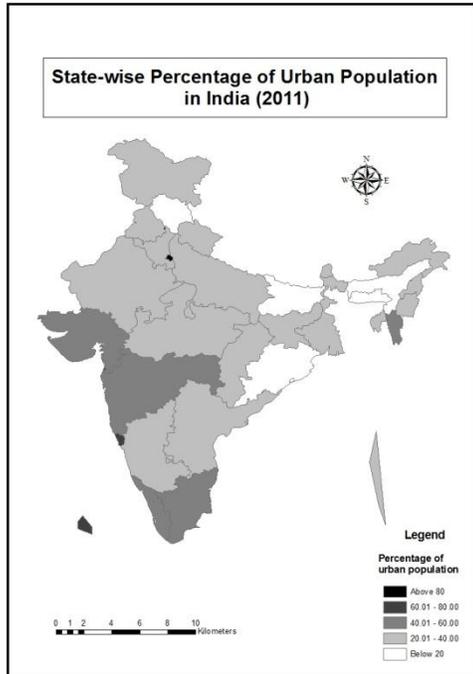
Map number 6 exhibits percentage of urban population in all Indian states. Highest number of urban population is recorded in Delhi, Maharashtra, Gujarat, Goa, Kerala and Tamilnadu. Among them only Kerala record high drinking water deprivations score, because most of the urban population use un-covered well water as the main source of drinking water. Other highly urbanized states perform better in terms of access to drinking water.

North eastern states, some eastern states like Jharkhand, Bihar, Chattishgarh and Madhya Pradesh record high score in the deprivation index, most of them have very low level of urbanization. Only Kerala and Lakshadweep are two exceptional cases where the level of urbanization is quite high but access to safe drinking water is poor, because most of the urban households get drinking water from un-covered wells.

Regional Disparity in Drinking Water Deprivation and Level of urbanization in India (2011)

Map number: 5 and Map Number: 6





(Source: Maps prepared by the author by using ARC-GIS and data source is Census 2011, India)

Findings and Conclusion: Tap water is the most common source of drinking water in urban India, most of the urban households now days get water from taps; but those who get untreated tap water should be considered as deprived in safe drinking water. States like Jammu-Kashmir, Himachal Pradesh, Rajasthan, Chandigarh, Delhi (north Indian states), Maharashtra, Gujarat, Goa in west India, Karnataka, Tamilnadu, Andhra Pradesh, Andaman-Nicobar in south India and Sikkim, Arunachal Pradesh in north east India record more than 80 per cent urban households have access to tap water as the main source of drinking water; but Arunachal Pradesh and Sikkim record that most of the urban households use untreated tap water. Apart from tap water, dug wells and bore wells are still used as the major source of drinking water; but those who use uncovered well water can be considered as deprived of safe drinking water. Kerala and Lakshadweep are the two states where most of the urban households use uncovered wells; apart from these two states north eastern states and eastern states also record that a significant number of urban households use uncovered wells. The drinking water deprivation index shows spatial variation in the access to safe drinking water. Highest deprivation score is recorded in Lakshadweep, Kerala, Orissa, Jharkhand, Arunachal Pradesh and other north eastern states. West Bengal, Bihar, Madhya Pradesh and Chattishgarh also record moderate deprivation.

Therefore spatial variation in drinking water deprivation clearly highlights the face that the north eastern states and eastern states especially Bihar, Orissa, Jharkhand, Chattishgarh and West Bengal need special attention for delivering safe drinking water to every urban household.

REMOVAL OF HEAVY METALS Fe^{3+} , Mn^{2+} , Zn^{2+} , Pb^{2+} AND Cd^{2+} FROM WASTEWATER BY USING RICE STRAW AS LOW COST ADSORBENT

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Abstract

The adsorption of some heavy metals from wastewater by rice straw was investigated. The adsorption capacity was investigated by batch experiments. The effect of weight of rice straw, contact time, initial metal ion concentration and pH on metal ions removal have been studied. The results showed that the removal percentages increased as the weight of sorbent increased, except for iron. The effect of contact time showed that the removal percentages increased as the contact time increased for all metals except for iron the removal was decreased. The effect of pH showed that removal percentages increased as pH increased for all metals. In case of initial concentration changing for metal ions (Mn^{2+} and Cd^{2+}) the removal percentages decreased by increasing initial concentration but for Zn^{2+} it increased by increasing initial concentration until 40 mg/L then decreased. In case of Pb^{2+} the removal efficiency was constant until 40 mg/L then decreased by increasing initial concentration and for Fe^{3+} it was decreased until 60 mg/L then increased. The adsorption data of metal ions have been described by the Freundlich and Langmuir isotherm models. The order of increasing efficiency of metal ions was $\text{Pb(II)} > \text{Cd(II)} > \text{Mn(II)} > \text{Zn(II)} > \text{Fe(III)}$.

Keywords: heavy metals, rice straw, wastewater, low cost adsorbent, Langmuir isotherm model.

Introduction

Heavy metals are often discharged by a number of industries, such as metal plating facilities, mining operations and tanneries, this can lead into the contamination of freshwater and marine environment (Low and Lee, 2000; Bailey, Olin, Bricka and et al., 1999). Heavy metals are not biodegradable, often toxic at a certain concentration, and they tend to accumulate along the food chain, where human being is the last in the link, causing various diseases and disorders (Bailey et al., 1999). Lead and cadmium are deemed the most toxic heavy metals. Their poisoning in humans causes severe damage to the kidney, nervous system, bones and brain (ATSDR, 2007; WHO, 1992). Zinc and copper are essential elements for good health, but like all heavy metals, an excess of the metals can be harmful. For example, Zn excess can cause nausea, vomiting and hematemesis (Yamataka, Pringle, Wyeth, 1998).

There are so many methods available for the removal of metal ions from effluents. The technologies are divided into three categories, biological, chemical and physical.

Chemical methods involved coagulation combined with flotation and filtration, electro flotation, electro kinetic coagulation, conventional oxidation methods by oxidizing agents, irradiation and

electro chemical processes. These chemical technologies are very expensive have disposal problems. Physical methods are membrane filtration and adsorption. Membrane filtration processes are nanofiltration, reverse osmosis, electro dialysis etc. The major disadvantage of this membrane filtration is limited life time before membrane fouling occurs (Yadla, Sridevi and Lakshmi, 2012). Disadvantage of the biological method is requires large area and is constrained by sensitivity toward diurnal variation as well as toxicity of some chemicals and less flexibility in design and operation (Miyaji, Masuda and Suyama, 2010; Ajmal, Rao and Ahmad, 2011). The use of activated carbon and Ion exchange has the advantage of allowing the recovery of metallic ions, but it is expensive and sophisticated. The use of activated carbon and ion exchange resins is not suitable for developing countries due to their high capital and operational costs (Raji and Anirudhan, 1997). This has encouraged research into discovering materials that are both efficient and cheap as a replacement for costly current methods.

Adsorption is one of the most popular methods for the removal of pollutants from effluents since proper design of the adsorption process will produce high quality treated effluents. Adsorption is a separation process in which certain components of the fluid phase are transferred to the surface of the solid adsorbents. Most adsorbents are highly porous materials, and adsorption takes place primarily on the walls of the pores or at the specific sites inside the particle. Separation occurs because differences in molecular weight, shape, or polarity cause some molecules to be held more strongly on the surface than others or because the pores are too small to admit the larger molecules (Yadla, Sridevi and Lakshmi, 2012). In general, an adsorbent can be assumed as “low cost” if it requires little processing, is abundant in nature, or is a by-product or waste material from (Bailey, Olin, Bricka and et al, 1999). Agricultural waste materials have carboxyl, hydroxyl, sulfate, phosphate, and amino groups that can bind metal ions. The adsorption of heavy metals by these materials might be attributed to their proteins, carbohydrates, and phenolic compounds (Bulut and Tez, 2007).

Agricultural waste materials such as polymerized onion skin (Kumar and Dara, 1981), rice husks (Khalid and Ahmad, 1999), some simple and low-cost chemical modifications resulted in increasing the sorption capacity of raw rice husk (RRH) have been studied (Kumar and Bandyopadhyay, 2006). Sawdust (Doris, Zhang, Shukla and et al, 2000; Ajmal, Khan and Ahmad, 1998), wheat bran (Bulut and Baysal, 2006) have been studied to investigate their affectivities in binding heavy metal ions. Papaya wood was evaluated as a new biosorbent of heavy metal ions such as Cu^{2+} , Cd^{2+} and Zn^{2+} (Saeed, Akhter and Iqbal, 2005). Coffee residues binding with clay as adsorbent (hereafter called CC-adsorbent) are utilized for removal of heavy metal ions in solution (Boonamnuyvitaya, Chaiya, Tanthapanichakoon and Jarudilokkul, 2004). Cocoa shells (CS) have been identified as a very efficient natural sorbent to remove Pb^{2+} and other metal ions from acid soil leachates (ASL) (Meunier, Blais and Tyagi, 2004). *Eichhornia Crassipes* (which is an aquatic plant causing many problems in fresh water streams) was used to remove the heavy metal ions from wastewater (Shama, Moustafa and Gad, 2010). Fly ash a waste product from thermal power plants has some adsorption capabilities for Cr (VI) (Grover and Narayanaswamy, 1982). Chitin is second only to cellulose in terms of abundance in nature and is found in the exoskeletons of crabs and other arthropods and in the cell walls of some fungi (Berkeley, 1979; Rorrer et al., 1993). This study depend on using low cost material as rice straw which production annually is about 4.7 ton in Egypt to remove the heavy metal ions having the majority in wastewater.

Experimental and Chemicals

Adsorbent Material

Rice straw was washed several times with de-ionized water to remove all dirt followed by filtration and were dried at 100°C. The cleaned and dried rice straw was oven dried at 500°C for 3 hours without any other further treatment to form what is called Carbonized Rice Straw (CRS).

Chemicals

All chemicals are analytical grade.

1. Sodium hydroxide from POCH.
2. Concentrated nitric acid 63% from POCH.
3. Stock solutions of (Fe^{3+} , Mn^{2+} , Zn^{2+} , Pb^{2+} and Cd^{2+}) ions 1000 mg/L from MERCK.

Determination Of Heavy Metals

The instrument used in determination of heavy metals is the Atomic Absorption Spectrophotometer AAS-Vario 6 – Analytik Jena AG.

The method used for the determination of heavy metals was (3111B Direct Air- Acetylene Flame Method), Standard Method for the Examination of Water and Wastewater 20th Edition. Each element has its own characteristic absorption wavelength; a source lamp composed of that element is used, which is called the Hollow Cathode Lamp. The amount of energy at the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample over a limited concentration range.

Effect Of Contact Time On The Removal Of The Heavy Metal Ions

Single element standard solutions of (Fe^{3+} , Pb^{2+} , Zn^{2+} , Mn^{2+} or Cd^{2+}) which concentration were equal to 100 mg/L, were prepared. To 20 ml of each element solution known weights of CRS were added in 250 ml beakers for a contact time (5, 10, 15, 30, 45, 60, 90, and 120) min. After that the mixtures were filtered and the clear supernatant solutions were analyzed with atomic adsorption spectrophotometer to determine the equilibrium concentrations.

Effect Of Weight of (CRS) On The Removal Of The Heavy Metal Ions

Weights of (0.1, 0.3, 0.5, 0.7, 1, 1.5 and 2) gm CRS were added to 20 ml of each single element standard solution in 250 ml beakers till equilibrium was reached.

After that the mixtures were filtered and the clear supernatant solutions were analyzed with atomic adsorption spectrophotometer to determine the equilibrium concentrations.

Effect Of pH On The Removal of The Heavy Metal Ions

20 ml of prepared standard solutions, which had different pH values (1, 3, 5, 7 and 9) were added with respective optimum conditions of weights of CRS and contact time of each metal in 250 ml beakers. Then were treated and analyzed as previously.

Effect Of Initial Concentration Of Metal Ions On The Removal Percentage

20 ml of prepared standard solutions, which had different concentration ranging from (20, 40, 60, 80, 100) mg/L, were added with respective optimum conditions of weights of CRS and contact time of each metal in 250 ml beakers. Then were treated and analyzed as previously.

Adsorption Isotherm

Adsorption data for adsorbate concentration are most commonly described by adsorption isotherm, such as the Langmuir or Freundlich isotherms. The Langmuir isotherm is valid for monolayer adsorption onto a surface containing a finite number of identical sites. The model assumes uniform

energies of adsorption onto the surface and no transmigration of adsorbate in the plane of the surface. It is represented by the following equation:

$$1/q_e = 1/Q^0 + (1/b Q^0) (1/C)$$

where C is the concentration of solute remaining in solution at equilibrium (mg/L), q_e is the amount of solute adsorbed per unit weight of solid adsorbent equilibrium time (mg/g) and Q^0 and b are Langmuir constants related to the adsorption capacity and energy of adsorption, respectively.

The Freundlich adsorption isotherm was also applied for the adsorption of metal ions. The Freundlich equation is represented as:

$$\text{Log } q_e = \text{Log } K_f + 1/n \text{ Log } C$$

Where K_f is the adsorption capacity and n is the adsorption intensity.

Effect Of Competition Among Metal Ions On The Removal Efficiency

4 ml of each metal ion (100mg/L) solutions were mixed in 250 ml beaker. Addition of 1 gm CRS with contact time 30 and 60 min at pH =1. Then were treated and analyzed as previously.

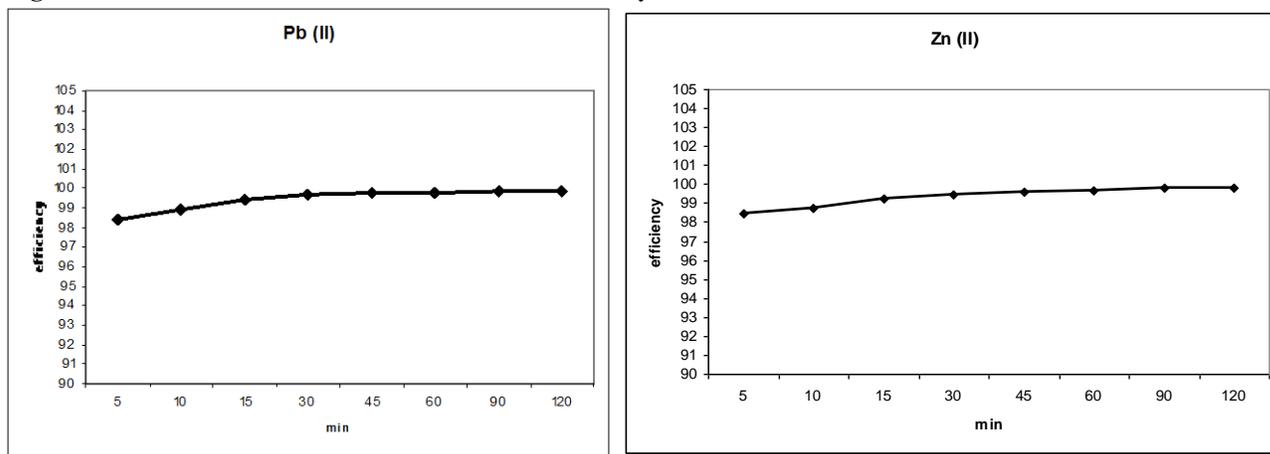
Results And Discussion

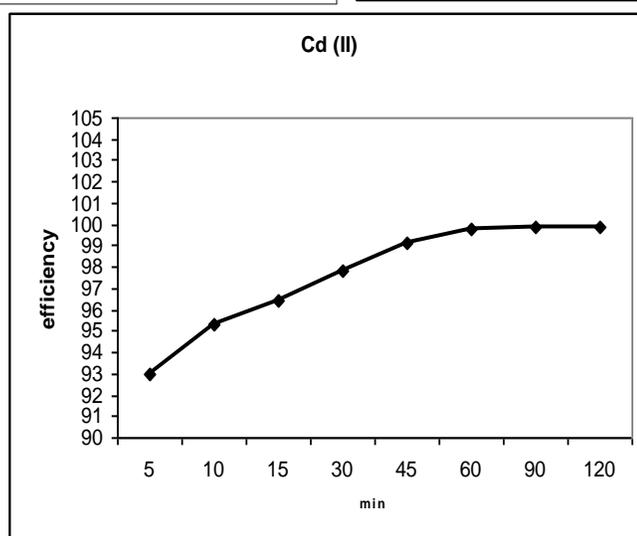
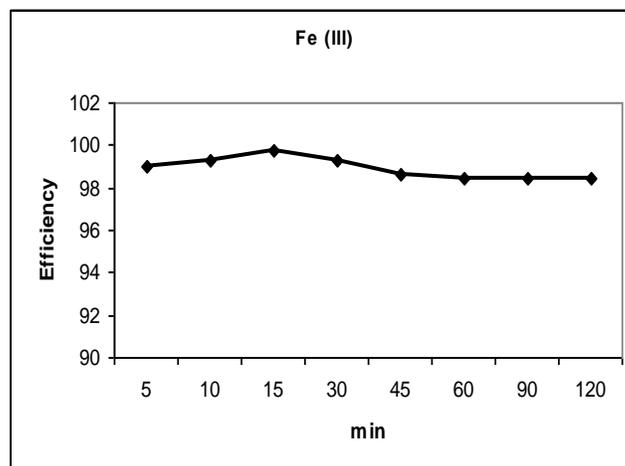
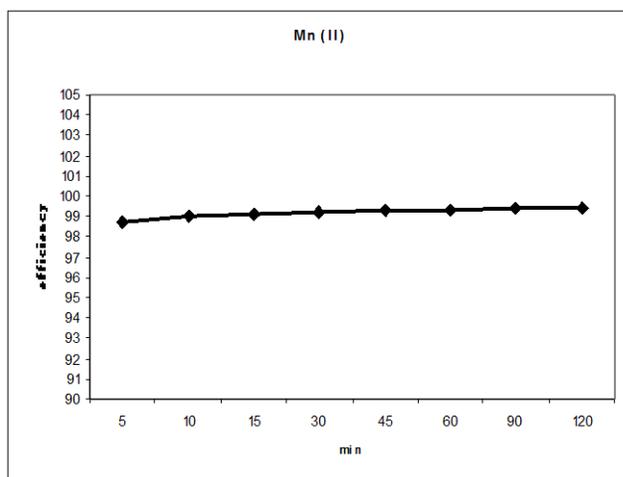
Effect Of Contact Time On The Removal Of The Heavy Metal Ions

The effect of contact time on the removal of heavy metal ion is shown in Fig. 1. The results show that: The removal efficiency of heavy metal ions is increasing by increasing contact time except for Fe^{3+} . The removal efficiency increased rapidly at the beginning of the experiments and then decreased slowly until equilibrium was reached. The maximum equilibrium time was 60 min in case of Zn and Cd ions, then 30 min in case of Mn and the minimum equilibrium time was 15 min in case of Pb and Fe.

Equilibrium times of each metal ion were taken in all coming experiments.

Fig. 1 The effect of contact time on the removal efficiency.

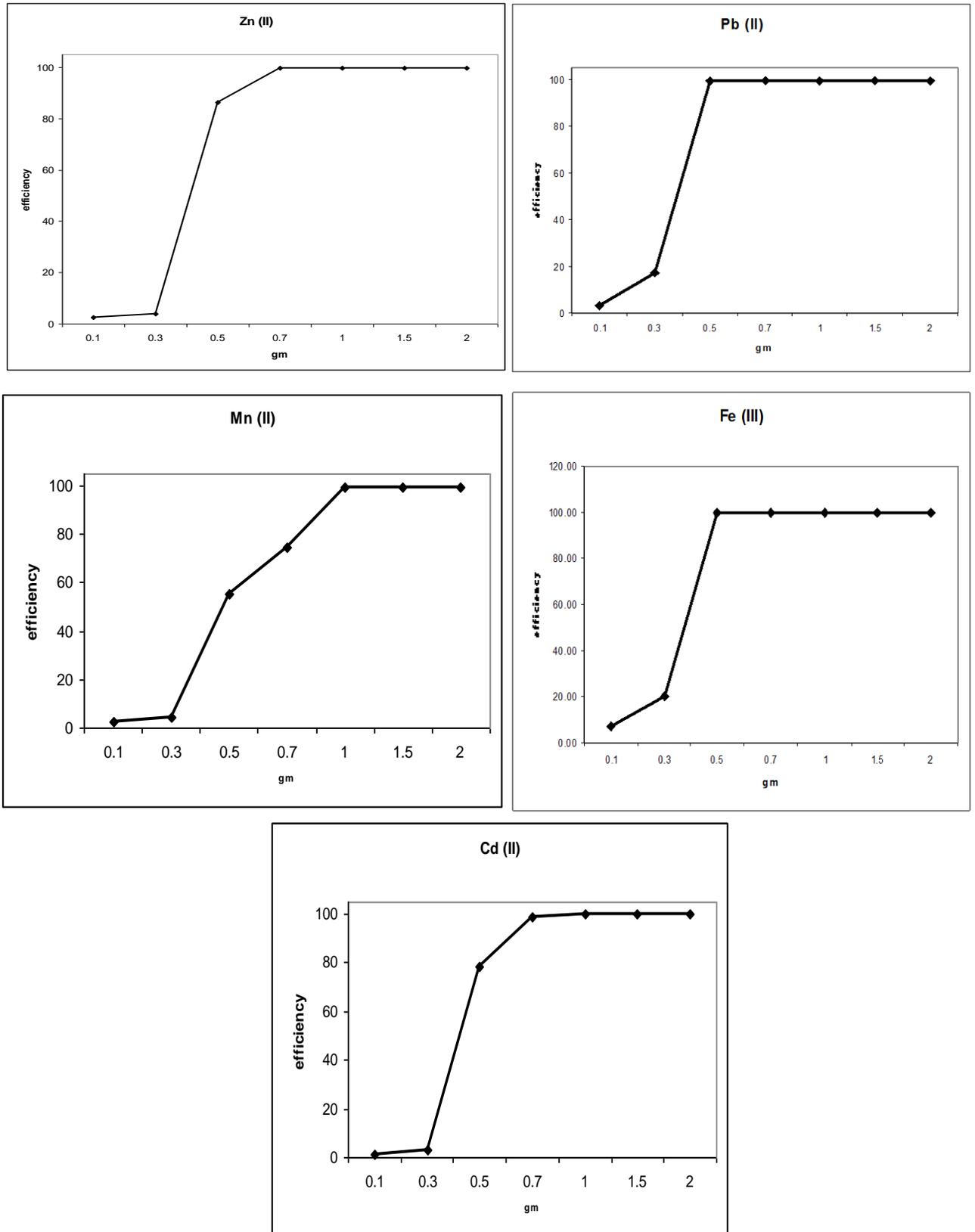




Effect Of Weight Of (CRS) On The Removal Of The Heavy Metal Ions

The effect of weight of CRS on the removal of heavy metal ion is shown in Fig. 2. The results show that: The removal efficiency of heavy metal ions is increasing by increasing weight of CRS expect for Fe^{3+} . The removal efficiency increased quit at the beginning of the experiments, then sharp increase and then further increased did not change the removal percentage significantly. The maximum weight was 1 gm in case of Mn and Cd ions, then 0.7 gm in case of Zn and the minimum weight was 0.5 gm in case of Pb and Fe. This is due to the fact that increasing the adsorbent dose provides a grater surface area or more adsorption sites for the metal ions. The weights of CRS of each metal ion were taken in all experiments.

Fig. 2 The effect of weight of CRS on the removal efficiency.

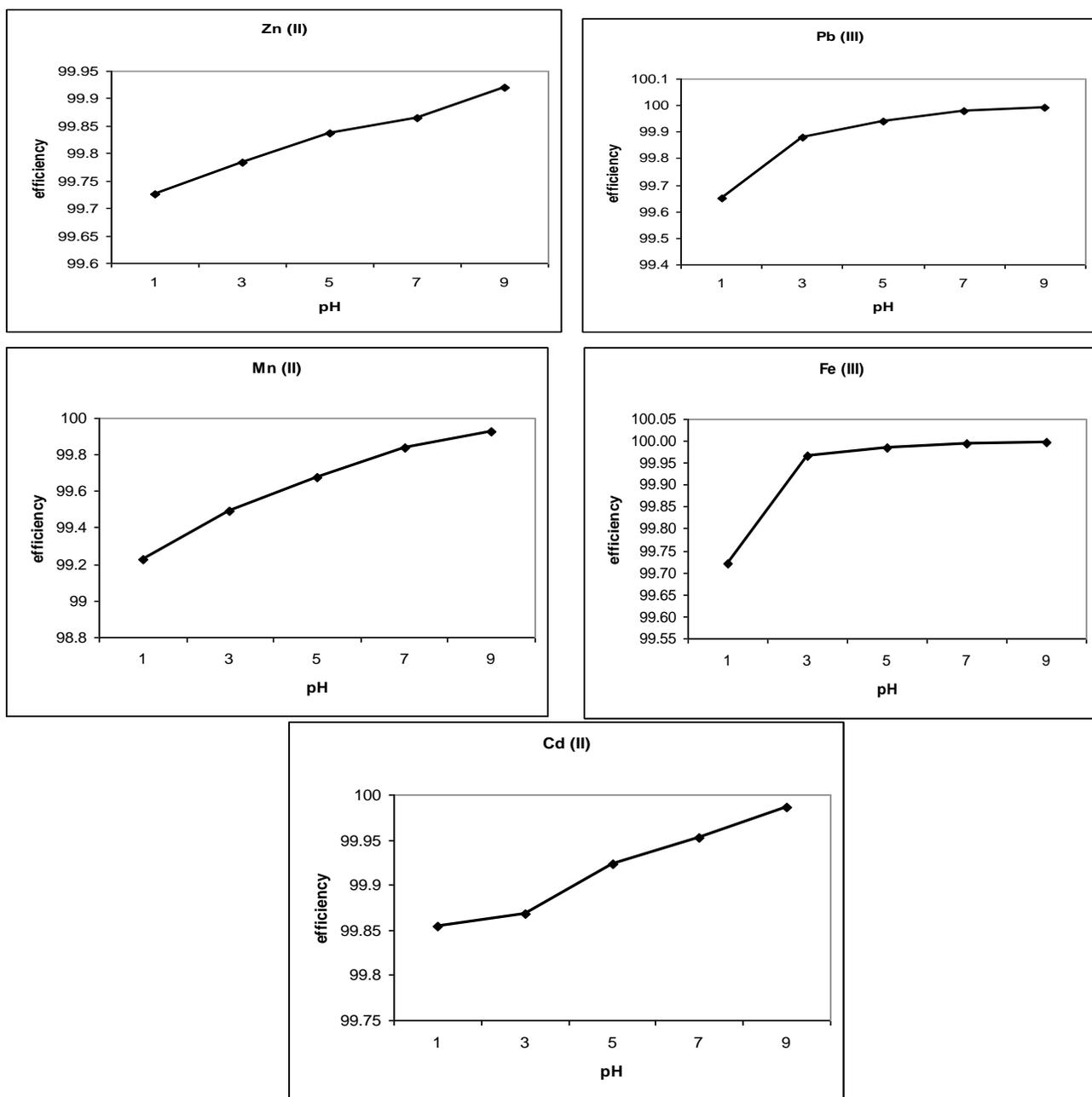


Effect of PH On The Removal Of The Heavy Metal Ions

The pH of the solution has a significant impact on the uptake of heavy metals since it determines the surface charge of the adsorbent and the degree of ionization and speciation of the adsorbate. The effect of pH on the removal of heavy metal ion is shown in Fig. 3. The results show that: The removal efficiency of heavy metal ions is increasing by increasing pH for all ions. Raising pH from 1 to 9 was not effective, since the efficiency was above 99% at pH=1.

For all experiments the pH of metal ion solutions was =1, because if the pH was high, many ions would precipitate out deflecting the purpose of sorption process.

Fig. 3 The effect of ph on the removal efficiency.



Effect Of Initial Concentration Of Metal Ions On The Removal Percentage

The results show that: In case of Mn^{2+} and Cd^{2+} the removal efficiency of heavy metal ions was decreased by increasing initial concentration. In case of Pb^{2+} the removal efficiency was constant until 40 mg/L then decreased by increasing initial concentration. The removal efficiency of Fe^{3+} was decreased until 60 mg/ L then increased. The removal efficiency of Zn^{2+} was increased by increasing initial concentration then decreased for concentration over 40 mg/L.

Adsorption Isotherms

The Langmuir equation:

By plotting $(1/q_e)$ against $(1/C)$ Langmuir constants Q^0 and b can be obtained

The Langmuir linear relation of some metal ions is shown in Fig. 4.

The Freundlich equation:

By plotting $(\log q_e)$ against $(\log C)$ Freundlich constants K_f and n can be obtained.

The Freundlich linear relation of some metal ions is shown in Fig. 5.

Freundlich and Langmuir constants are shown in table (1).

Table (1) Freundlich and Langmuir constants.

Adsorption constants for the adsorption of metal ions on CRS						
Metal ions	Freundlich constants			Langmuir constants		
	n	K_f	R^2	Q^0	b	R^2
Fe^{3+}	1.00	7.79	0.86	58.82	0.137	0.96
Mn^{2+}	1.40	2.31	0.99	3.43	1.46	0.99
Zn^{2+}	1.05	7.17	0.99	55.55	0.14	0.99
Pb^{2+}	3.03	6.06	0.89	4.13	60.53	0.97
Cd^{2+}	2.23	4.18	0.93	2.30	39.52	0.98

Langmuir isotherm fits well with the experimental data. This may be due to homogenous distribution of active sites on CRS, since the Langmuir equation assumes that the surface is homogenous (Wang, Boyjoo and Choueib, 2005).

Fig.4 The Langmuir linear relation of some metal ions.

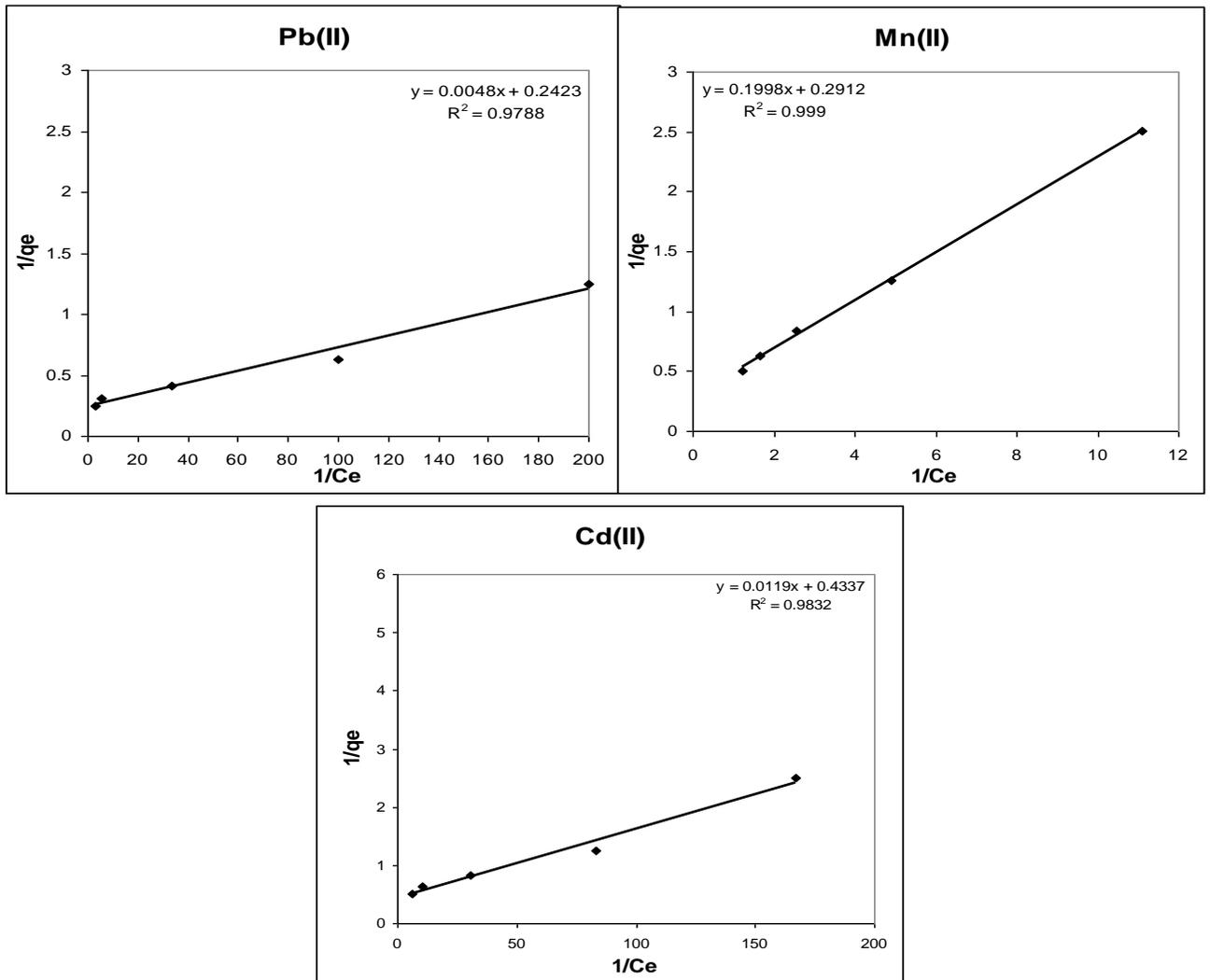
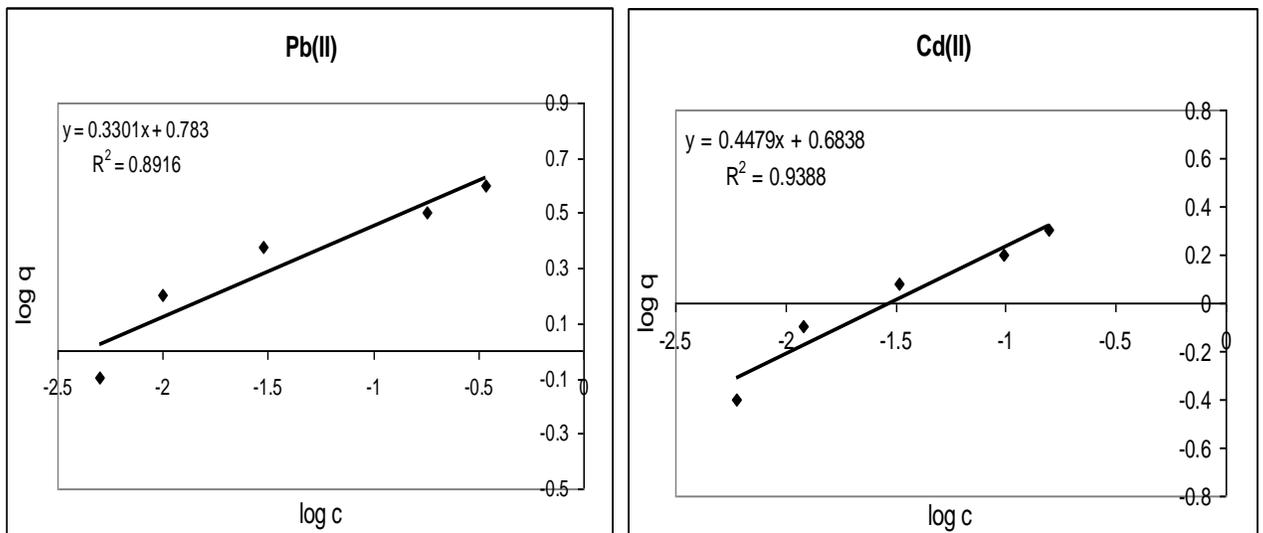
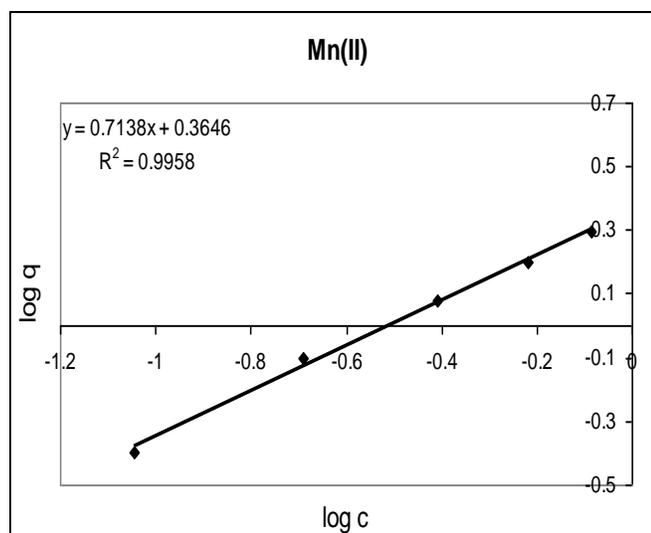


Fig. 5 The Freundlich linear relation of some metal ions.





Competition Among Metal Ions

In wastewaters, the metals of interest are usually found with a number of other metals, so we should test the binding of each metal ion in the presence of other metals. Table 2 shows the percentage of adsorption each ion in the presence of others. The general binding affinity for the metals studied, in order decreasing affinity is Pb(II) > Cd(II) > Mn(II) > Zn(II) > Fe(III). While it is clear that some of the metal ions compete with one another for bark binding sites, it is of interest to note that the binding of Pb (II) is relatively unaffected by other metals (Bulut and Tez, 2007; Gloaguen and Morvan, 1997).

Table (2) the percentage of adsorption of each ion.

Removal efficiency with complex metals %		
Weight of CRS	1 g	1 g
Contact time	30 min	60 min
Fe ³⁺	99.52	99.45
Mn ²⁺	99.83	91.86
Cd ²⁺	99.88	99.94
Zn ²⁺	99.80	94.83
Pb ²⁺	99.90	99.98

Cost Of Adsorbents

The production of rice straw in Egypt is about 4.7 million ton annually. The adsorbent material used in this study is generally available at a relatively cheap rate, 100 L.E. /ton for rice straw. The treatment of 1m³ of wastewater with CRS would cost approximately 31.25 L.E.

Conclusion

The effect of weight of CRS, contact time, pH and initial concentration were studied by batch method and the equilibrium concentration of metal ions was measured by atomic absorption spectrophotometer. It was found that the percentage of removal was increased by increasing weight of adsorbent and contact time expect for Fe^{3+} . Raising pH from 1 to 9 did not increased the percentage too much as it was over 99% at $\text{pH} = 1$. Adsorption of metal ions was fitted with Langmuir isotherm more than Freundlich isotherm. Thus, it could be concluded that CRS is a good low-cost adsorbent for many heavy metal ions from wastewater at low and high pH values with high efficiency.

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ANALYSIS OF LAND USE/LAND COVER PATTERN ALONG THE RIVER BENUE CHANNEL IN ADAMAWA STATE, NIGERIA

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ABSTRACT

Uncontrolled human development without adequate consideration for the environment has led to incessant loss of land cover and natural resources such as water in many parts of the world. Consequently, human and environmental challenges of varying magnitude are rapidly emerging. Interestingly, only few efforts are channelled towards the reclamation of the deteriorating land cover pattern and control of future environmental damages, particularly in the developing countries. This study analyses the land use and land cover pattern along the River Benue channel in Adamawa State, Nigeria between 1988 and 2003. Landsat TM satellite image of 1988, Landsat ETM of 2003, and Shuttle Radar Topographic Mission (SRTM) image of the Upper Benue Catchment area were utilized in the study. The study was carried out with a view of classifying the land use and land cover types in the area; examination of land use and land cover changes between 1988 and 2003; generation of contour and elevation maps for the area; and modelling of the terrain of the area using the Digital Terrain Model (DTM). The Upper Benue catchment area was extracted from the Nigeria catchment map, contour map and DTM were also generated in ArcView 3.2 GIS environment. Supervised classification method was adopted to classify the Landsat imageries into six(6) classes using ILWIS 3.2 academic GIS software. The implication of the spatial pattern of land use and land cover in the area are accelerated socio-economic activities, shortage of food, prevalence of drought conditions, paralyzed inland water transportation, desertification and increase in temperature. The study concluded that there is need for a balance between human development, land use planning, and water resource management. Therefore, recommendations were given to ensure sustainable development in the region.

Keywords: Land use/land cover, River Benue, Digital Terrain Model (DTM), GIS/RS, Landsat, Shuttle Radar Topographic Mission (SRTM).

1 INTRODUCTION

Land is defined as the earth's surface, including both land and water, and the natural resources in their original states. Land use involves both the manner in which the biophysical attributes of the land are manipulated, and the intent underlying that manipulation – the purpose for which the land is used (Turner et al. 1995).

Uncontrolled human activities has led to significant modification of the natural biodiversity in the world over the years. Consequentially, land use and land covers are changed abruptly without adequate consideration for future developments. There is continuous deterioration from the rich biodiversity. The effects of land uses on the environment ranges from minor land cover changes and soil modification to severe desertification, deforestation, erosion, and river encroachment problems. The incessant need for human development via rapid urbanization has led to a wide spread horizontal development especially in the developing countries. As a consequence, river banks are encroached, vegetal covers are removed, soil properties are modified and many micro to macro ecosystem have gone into extinction. Where these changes are not met with complementing planning and management measures, challenges such as water pollution, high risk to disaster (flood), and unstable food production are unavoidable, particularly in the riverine areas.

Nigeria is one of the largest countries in Africa (1,924,000 square km) and it has the 9th largest population size (131, 859, 731) in the World (www.census.gov/cgi-bin/ipc/idbrank.pl). The country lies within the latitudes 4° and 14°N, and longitudes 3° and 15°E. Nigeria shared boundary with Niger, Cameroon, Benin Republic, and the Gulf of Guinea to the north, east, west, and south respectively. The drainage systems in Nigeria consists mainly the Niger-Benue, Chad basins and coastal rivers. The catchment areas in the country are the Niger North, Upper Niger, Upper Benue, Lower Benue, Niger South, Western Littorial, Pasterial Utorial, and the Lake Chad. Water bodies (excluding small reservoirs, ponds, dams, and cultivable wetlands) cover about 149,919square kilometres or 14,991,900hectares of Nigerian land. This constitutes about 15.9% of total land area of the country.

Theoretically, there is no water problem in Nigeria because the availability seems higher than the present use (Eludoyin A. O., Akinbode M. O., and Ediang O. A., 2007). However, the full potential of drainage systems in the country have not been realized. They have been either under-utilized, neglected or abused. The location of the various rivers have been found, to be spatially beneficial to all the sections of the country, studies have noted some problems using the water resources from these apparent sufficient sources. For instance, Nigeria is classified a water – short country, whose water resource is likely to reduce from 2, 506 cubic meters per year in 1995 to 1, 175 in 2025, if not properly managed. According to the Nigeria Demographic and Health Survey in 2003, 35% of urban population does not have access to safe drinking water while 70% of rural population depends mainly on unsafe sources of water such as open wells, rivers, and streams for drinking.

Inadequate land-use planning in areas adjacent to the drainage basin and uncontrolled river encroachment are vital factors adding to the consequences of water challenges and security in the country. The flood plains of the Nigeria river systems are often cultivated without any planning or management practices. Chemicals from the farms are washed into the rivers, hence making them unsuitable for domestic consumptions. The adjacent cultivated soil are loosened thereby causing massive silt-washing into the river system. Wastes were being disposed into the river by the adjoining settlements.

River basin management policies and planning strategies could be used for effective utilization of Nigerian drainage basins for sustainable development. This realization of the importance of adequate water management has probably encouraged the Nigerian government to establish a number of River Basin Development Authorities (RBDAs) (Eludoyin A. O., Akinbode M. O., and Ediang O. A., 2007). The (RBDAs) were charged with the responsibility of a comprehensive water resources (surface and groundwater) development of Nigeria for multipurpose uses.

For a sustainable river basin management policy to be implemented, a corresponding effort must be attained through effective land use planning and management at the adjoining areas around the water channels. Analysis of the land use pattern in the drainage basins using geospatial technology is an approach that would provide reliable information for effective planning and implementation of management policies for both river basins development and land use planning for urban and agricultural development in these areas.

Utilization of satellite imageries and application of Geographic Information Systems (GIS) with its database management, analysis (spatial and non-spatial), modelling and visualization capabilities would ensure the development of frameworks on which both spatial and non-spatial planning could be built upon in the drainage areas. Successful adoption of this approach is suitable and could be applied to six (6) key planning and management areas along the Nigerian drainage basin. These areas include;

1. Land use planning and management around the River channels
2. Water resource management
3. Disaster management (particularly flooding)

4. Inland Fisheries planning
5. Agricultural land use planning (wetland/flood plain cultivation), and
6. Inland water transport planning and management.

Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem, land and water management (Abiodun E. O, Olaleye J. B., Dokai N. A., and Odunaiya A. K., 2011). They provide the medium for the integration of both spatial and non-spatial data. GIS and remote sensing have been widely recognized as an effective tool for planning and decision-making tasks (Martin and Howarth, 1989, Treitz, Howarth and Gong, 1992, Trotter, 1991).

Therefore, this study utilizes the tools of Geographic Information System (GIS) and Remote Sensing in the analysis of the land use pattern along the River Benue channel in Adamawa State, Nigeria.

1.2 AIM

The aim of this study is to analyse the spatial pattern of land use/land cover along the River Benue channel in Adamawa State, Nigeria.

1.3 OBJECTIVES

The specific objectives that this study intends to achieve includes;

1. Identification and classification of land use/land cover types along the river Benue channel using Landsat Enhanced Thematic Mapper (ETM) imagery of 1988 and 2003
2. Examination of changes in land use/land cover in the area
3. Generation of contour and elevation maps for the area using the SRTM satellite image of the Upper Benue catchment area.
4. Modelling the terrain of the area using the Digital Terrain Model

1.4 STUDY AREA

The study area is located in Adamawa state, within the Upper Benue catchment area. Adamawa is a state in the Northeastern part of Nigeria and located within latitude 9°11'N to 9°20'N and longitude 12°23'E (Ishaku, 1995). The state was formed on August 27, 1991 from part of the Gongola state with its capital at Yola. Nicknamed as the "Land of Beauty", Adamawa state has twenty-one local government areas, divided into four administrative divisions namely: Adamawa, Ganye, Mubi and Numan.

Adamawa is one of the largest states of Nigeria and occupies a total area of about 36,917 square kilometres. It is bordered by the states of Borno to the northwest, Gombe to the west and Taraba to the southwest. Its eastern border also forms the national eastern border with the Federal Republic of Cameroon. The Mandara Mountains lie in the northeastern part of the state along the Cameroon border and the Shebshi Mountains rise to Mount Dimlang (2,042 m) in the state's southeastern portion. Adamawa State is largely covered by short-grass savanna and is drained westward by the Benue River and its tributaries, including the Gongola, Taraba and Pai rivers (Maitera O. N., 2011).

Adamawa State is multi-ethnic. The inhabitants of the state belong to, among other tribes, Fulani, Bachama, Mbula, Mumuye, Higi, Chamba, Margi (Marghi), Hausa, Kilba, Gude, Lunguda, Yungur, Kanakuru and Bata tribes. All the tribes in the region except the Hausa traders are primarily engaged in crop farming and livestock herding (cattle, goats, sheep), but fishing is predominant along the riverbanks. Peanuts (groundnuts), cotton, sorghum, millet, rice, and corn (maize) are the main crops (Maitera O. N., 2011). This is reflected by the two predominant vegetation zones in the region - the Sub-Saharan and North Guinea Savannah Zone. The state has networks of roads linking all parts of the country. Figures 1 and 2 shows the location of Adamawa State on the Nigerian Map and the local government areas in the state respectively.

River Benue

Adamawa is one of the five (5) states through which the River Benue passed through. Other states are Taraba, Nassarawa, Benue, and Kogi. River Benue is the longest tributary of River Niger; being about 1,083 km in length. River Benue rises in northern Cameroon as the Bénoué at about 1,340 m and in its first 240 km, it descends more than 600m over many falls and rapids, the rest of its course being largely uninterrupted. During flood periods its waters are linked via the Mayo-Kebbi tributary with the Logone, which flows into Lake Chad. Below the Mayo-Kebbi the river is navigable all year by boats drawing less than 0.75m and by larger boats for more restricted periods (Encyclopedia Britannica, 2004). A considerable volume of imports (particularly petroleum) is transported by river, and cotton and peanuts (groundnuts) are exported in the same way from the Chad region. Between Yola and Makurdi the Benue is joined by the Gongola and it then flows east and south for about 480 km.

1.5 SCOPE OF THE STUDY

The study covers four (4) local government areas in Adamawa state including – Girei, Ifuroro, Yobe North and Yobe South. The study covers an area between lat 9°30'N, long 12°17'E, and lat 9°5'N, long 12°35'E.

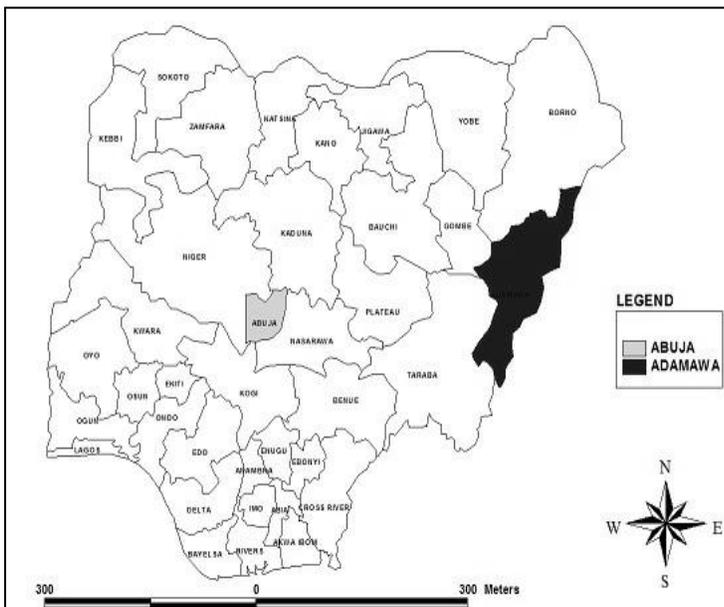


Figure 1: Map of Nigeria Showing Adamawa State

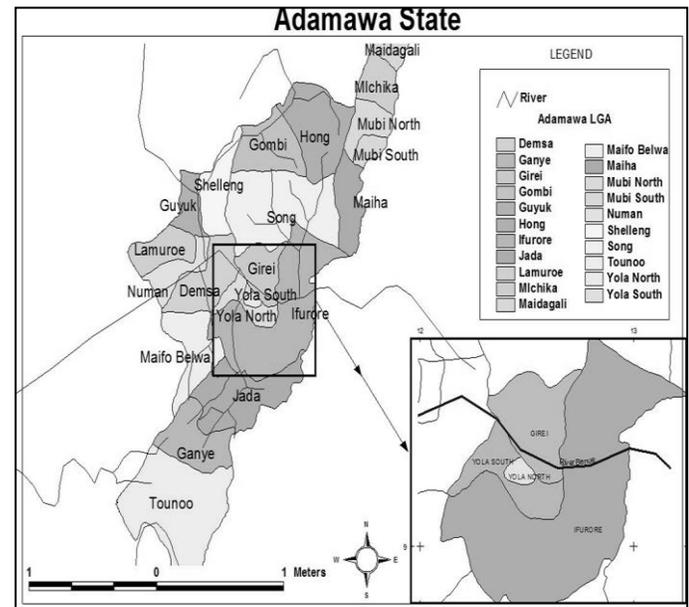


Figure 2: Local Government Areas in Adamawa State

2. LITERATURE REVIEW

Several studies have been carried-out over the years in the analysis of land use/land cover patterns and changes, and assessment of the river basins/channels in Nigeria.

Land Use Analysis

Since the beginning of the 19th Century, vast portions of the earth's surface have been modified, whole ecosystems destroyed, and global biomass altered or eliminated (Fellmann et al 2005). The most important of the land surface changes in many part of the developing country has been that of man activities, especially grazing, farming, bush burning, wood cutting and other activities such as road construction (Baltimore 1987).

The knowledge about land degradation has become increasingly important as the nations plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of important wetlands, river encroachment, and loss of fish and wildlife habitat. Landuse data are needed in the analysis of environmental

processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels especially at this population exploding era (Ikusemoran Mayomi, 2009).

One of the prime prerequisites for land degradation is information on the existing landuse patterns and changes in landuse through time. The knowledge about human impacts on landuses such as agricultural, recreational, as well as information on their changing proportions, is needed by legislatures, state and local Government officers to determine better landuse policy, to identify future development on pressure points and areas, and to implement effective plans for regional development (Ikusemoran Mayomi, 2009).

GIS Application in Land Use Analysis

The ability to forecast land use and land cover change and ultimately to predict the consequence of change will depend on our ability to understand the past, present and future state of land use and land cover change (Oyinloye M. A., Kufoniyi O., 2011). This ability is enabled through the use of multi temporal remote sensing data and or aerial photographs which provides valuable information for natural resources like land, water, forests, urban areas and infrastructure facilities such as road network, river network etc (National Research Council, 2001). Remote Sensing/Geographic Information System (GIS) have been applied to landuse and landcover change analysis, detection and monitoring all over the world. Mattikalli, (1995), applied Remote Sensing and GIS to the land use of the River Glen catchments in England by acquiring data from 1931 to 1989. His work revealed that much of the grassland changed to arable land during the study.

Similarly, Zhi-Yong Yin, et al (2005) used image processing and analysis in a GIS environment to assess spatial change in urban land use patterns and population distribution. The unsupervised classification was used to classify the images into land use classes. Census polygon was constructed into various sets of units using census data in a GIS, and then comparison made with the classified image population in surface areas. In his studies carried out by 2004 in Shaoxing City in China, Zhi-Yong Yin uses satellite imageries for the year 1984, 1997, and 2000. One of the goals of the study was to produce a landuse map of Shaoxing city and its surroundings, the result shows that there are undoubtedly a lot of changes that occurred between 1984 and 1997 when compared with those of 2000, due to the sufficient time gap. From the study, it was observed that residential area development was mainly at the expense of agricultural land use.

River Basin/River Channel Assessment

Both natural processes and anthropogenic interferences influence the quality and quantity of river water. The anthropogenic constitutes one of the major causes of environmental problems that alter the hydrochemistry in our river systems. Rivers are highly heterogeneous at spatial as well as temporal scales. Variation in the quality and quantity of River water is widely studied across the globe (Ishaq S. E., Agada P. O., and Rufus S. A., 2012). Riedel et al. (2000), examined the spatio-temporal variation in trace elements in Patuxent River, Maryland. Gupta and Chakrapani (2005) also studied temporal and spatial variations in water flow and sediment load in Narmada River Basin, India. Temporal and spatial variation of nutrient levels in the Nemunas River (Lithuania and Belarus) has been reported (Sileika A., et al (2006)). Multivariate statistical techniques for the evaluation of spatial and temporal water quality of the Mahanadi River—estuarine system, was reported in India (S. K. Sundaray, et al).

3. METHODOLOGY

The primary data used for this study is the Enhanced Thematic Mapper (+ETM) Landsat Image of Adamawa State, Shuttle Radar Topographic Mission (SRTM) image of the Upper Benue Catchment Areas, Catchment map of Nigeria, and political map of Adamawa

state. The Landsat image uses the Universal Transverse Mercator (UTM) projected coordinate system and WGS84 datum in zone 33. It has a spatial resolution of 28.5metres. ITC ILWIS 3.3, ENVI, and ArcView 3.2 GIS software were utilized for image processing, analysis and presentation.

Analysis

The upper Benue catchment area was extracted from the drainage basin/catchment map of Nigeria in ArcView 3.2 environment. The extraction is in form of digitizing and shape-files creation for the catchment area and the river systems in the area. The administrative map of Adamawa state was overlaid on the created upper Benue catchment map to show the areas covered by the study within Adamawa state and the upper Benue catchment area.

The seven (7) bands of the satellite image for 1988 and 2003 were imported into ENVI environment. An ENVI meta-file was created using all the seven bands of the image. The meta-file enables processing and analysis of all the image bands or selected bands concurrently. A subset (sub-map) of the meta-file was created and exported in Geo Tiff format (.tiff). In ILWIS environment, the sub-mapped imageries were enhanced through filtering and stretching procedures. A supervised classification procedure using selected training samples was adopted and the image was classified into 6 classes namely; vegetation, Water body, sand/dried up water body, rock-outcrop/highland, built up area, and bare land.

The Shuttle Radar Topographic Mission (SRTM) image of the Upper Benue Catchment Areas was used to generate contour and elevation maps for the catchment area. The ENVI 4.5 Overlay/Contour Lines operation was used to generate the contour map for the area in ENVI (.evf) format. The contour map was vectorised and exported as shapefile to ArcView environment. Creating the grid map of the using the elevation data, the resulting map was overlaid on the administrative map of the area. Statistical and graphical methods was used in presenting results for the areal extent of changes in the area and percentage changes in land use pattern. Line and bar charts were used in presentation of the statistical analysis.

4. PRESENTATION OF RESULTS

Identification and Classification of Land Use/Land cover

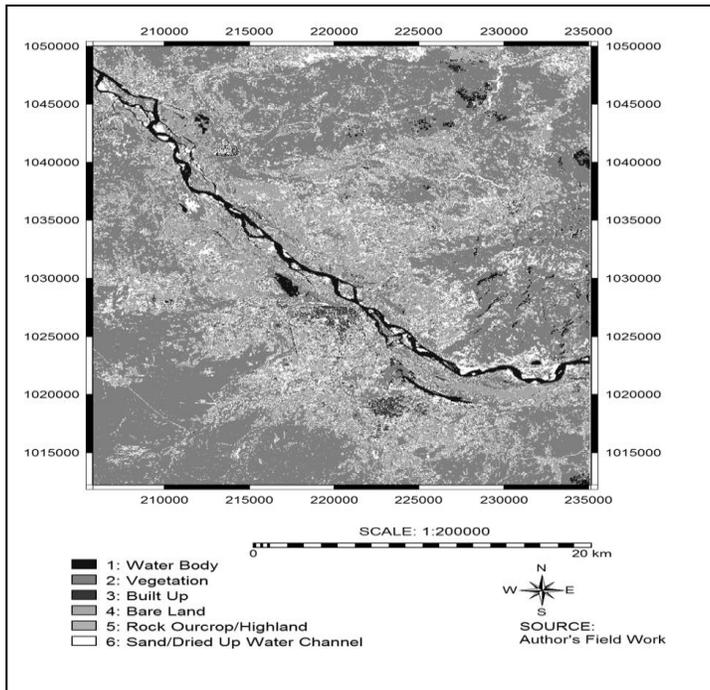


Figure 3: Land use/Land cover Classification of 1988 Landsat ETM Image

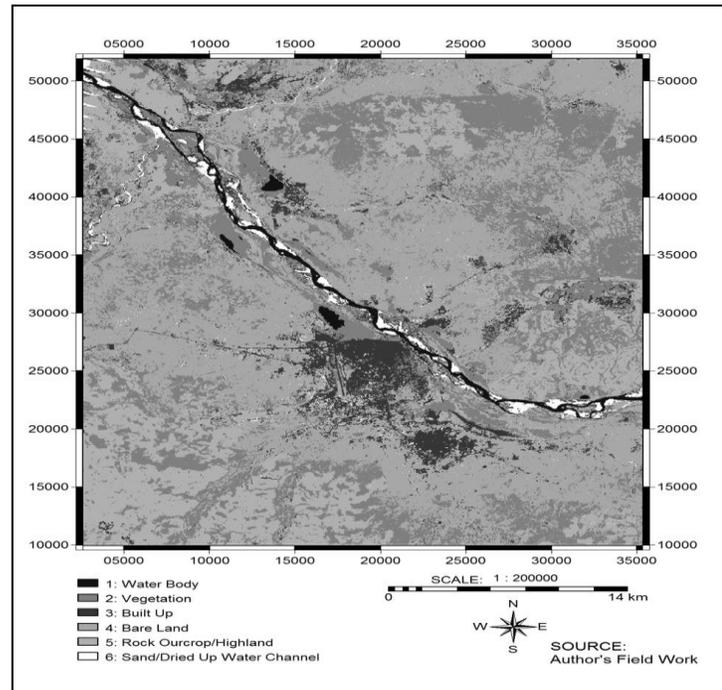


Figure 4: Land use/Land cover Classification of 2003 Landsat ETM Image

Figures 3 and 4 shows the classification result of the landsat ETM image for 1988 and 2003 respectively. Six (6) classes – water body, vegetation, built up, bare land, rock-outcrop and sand/dried up water channel was used in the analysis. The results shows an enormous changes in land cover pattern between 1988 and 2003 in the area. Majority of the large vegetation cover present in the area in 1988 were observed to be absent in 2003. It was also observed that areas that are formally vegetal covered have been replaced by rock-outcrop, highland or bare land. This significantly indicate a large expanse of vegetal cover have been lost between 1988 and 2003 in the area, and the land surface and rocks are exposed, thus resulting in larger area of bare lands and rock outcrops in 2003.

Figures 5 and 6, describes the statistics of the classification showing the spatial pattern and areal extent of in land cover/land use in the area for 1988 and 2003. Figure 5 shows that a total area of 39,896,907 square metres were covered by water body in 1988, 892,876,371sq.mtr by vegetation, 27,168,950 by built up areas, 263,908,959 by bare land, 23,237,660 by rock outcrop/highland, and 13,328,210 by sand/dried up water bodies. Figure 6 reveals that 17,237,700 square metres were covered by water bodies, 423,482,400 by vegetation, 111,807,000 by built up area, 596,305,800 by bare land, 348,200,100 by rock outcrop/highland, and 23,445,000 square metres are covered by sands or are water channels that have dried up.

The changes in land cover/land use between 1988 and 2003 is presented in Table 1. The table shows the total area covered by each features in hectares and their respective proportions (in percentage). The table also reveals the percentage of changes of land cover types that occurs in the area between the given periods. A negative percentage change indicate loss of land cover/land use type. From the table, between 1988 and 2003, 39.66% of water body and 35.66% of vegetal cover were lost in the area. Built up areas increased by 60.99%, bare land by 38.64%, rock-outcrop by 87.49%, and sands/water bodies that have dried up by 27.51%.

Spatial pattern and areal extent of land cover/land use

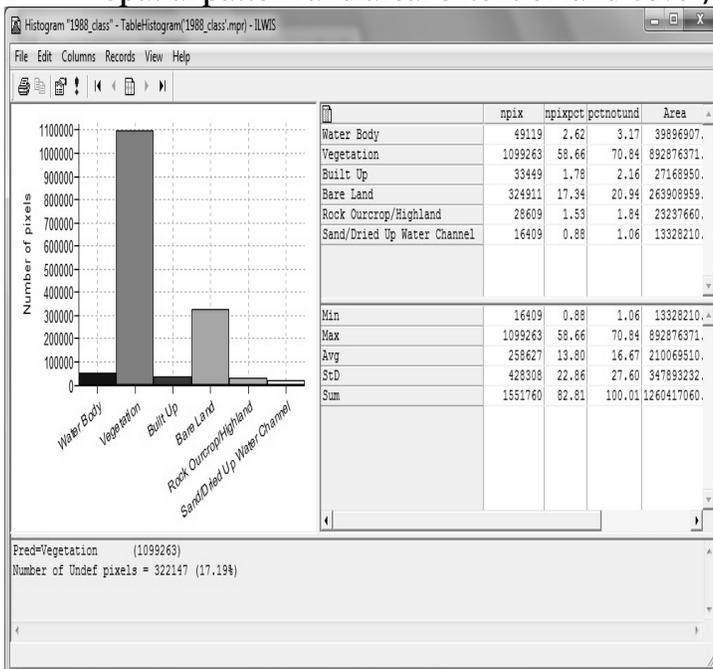


Figure 5: Spatial pattern and areal extent of land cover/land use in 1988

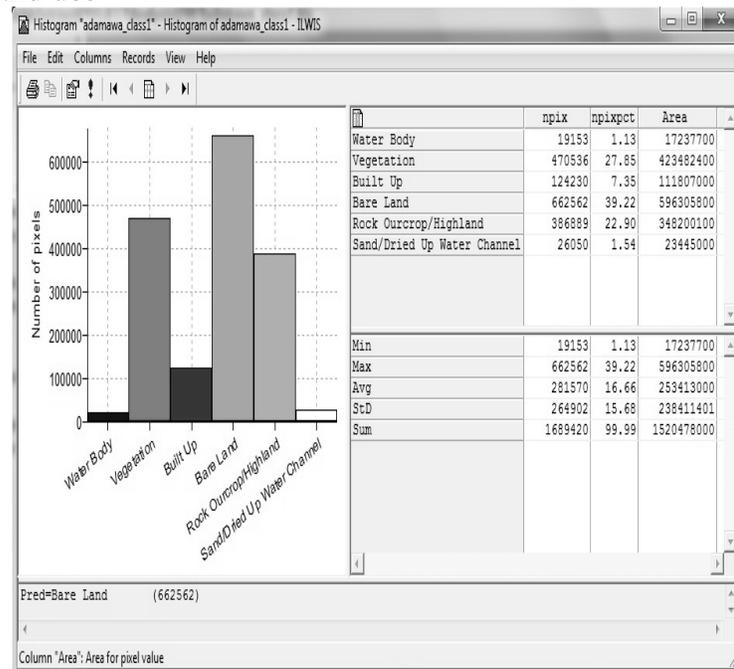


Figure 6: Spatial pattern and areal extent of land cover/land use in 2003

Changes in land cover/land use pattern between 1988 and 2003

FEATURES	TOTAL AREA(Ha)		TOTAL AREA (%)		CHANGE (%)	YEARS
	1988	2003	1988	2003		
Water Body	3,989.69	1,723.77	69.83	30.17	-39.66	15
Vegetation	89,287.64	42,348.24	67.83	32.17	-35.66	15
Built Up	2,716.90	11,180.70	19.55	80.45	60.90	15
Bare Land	26,390.90	59,630.58	30.68	69.32	38.64	15
Rock Outcrop/Highland	2,323.77	34,820.01	6.26	93.74	87.49	15
Sand/Dried Up Water Channel	1,332.82	2,344.50	36.24	63.76	27.51	15

Table 1: Changes in Land cover/land use pattern between 1988 and 2003

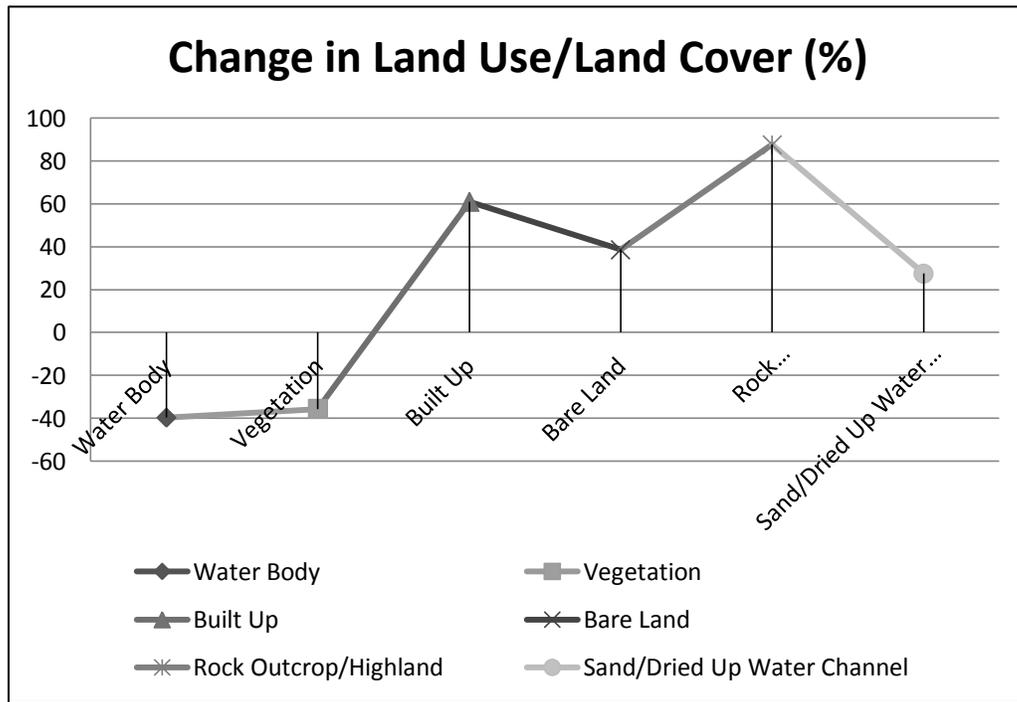


Figure 7: Percentage changes in Land use/Land cover between 1988 and 2003

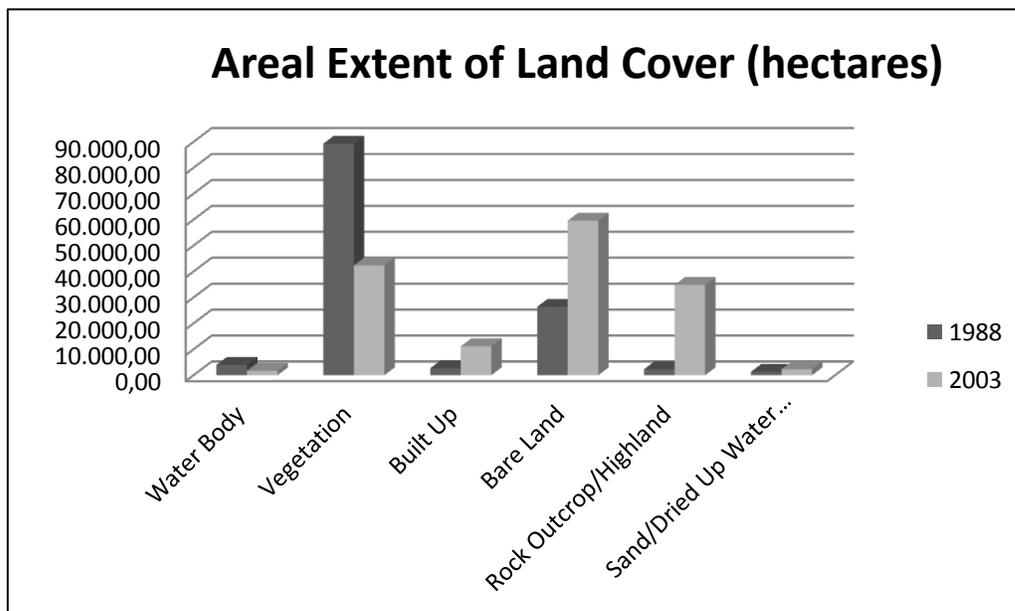


Figure 8: Areal extent of land cover in hectares

Figure 7 indicate that water bodies and vegetal cover has a negative change between 1988 and 2003. That is, large proportion of water bodies and vegetation were lost within the 15years period covered by the study. It was also observed that the areas covered by built up areas and bare land increased, while rock-outcrops/highlands were exposed and large areas that used to be water channels/body dried up.

The areal extent of land cover in the area is illustrated in figure 8. In 1988, the area is covered mostly by vegetation while in 2003, bare lands is the dominant land cover in the area.

Terrain Analysis

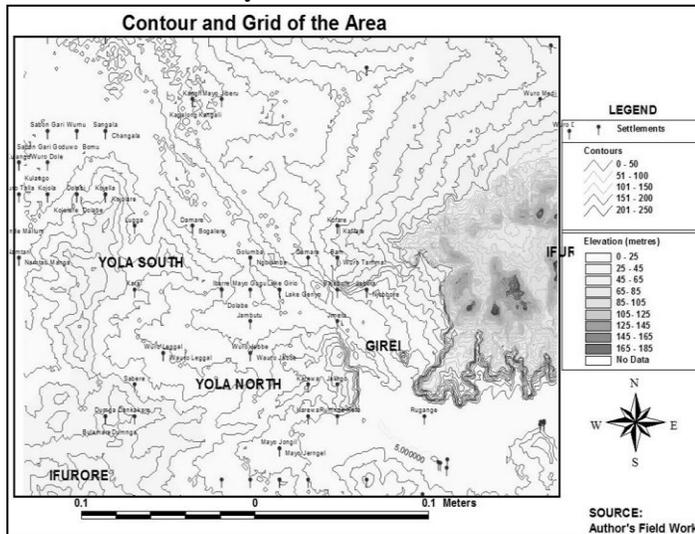


Figure 9: Grid (elevation) and contour map of the area

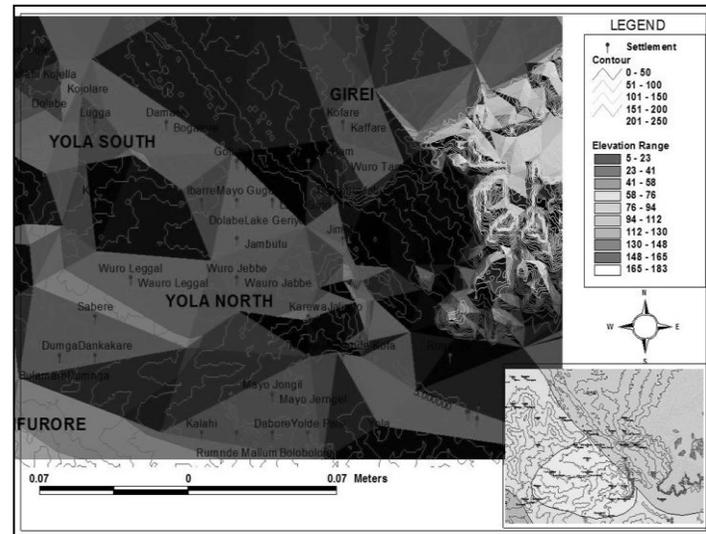


Figure 10: Digital Elevation Model (DEM) of the area

Figures 9 and 10 describe the terrain of the area covered by the study in Adamawa state. Figure 9 presented the contour and Grid (elevation) maps overlaid on the administrative map. The elevation of the area ranges between 0metres to 250metres above the sea level. The highest point in the area is at the eastern part Girei, and southern region of Ifurore local government area. High and wide mountain ranges are concentrated in this area. The elevation of the highest point the area is about 247metres above the sea level. Lowest point is between 5metres to 25metres (Figure 10). These areas are located at the centre of the map, along the River Benue channel.

5. IMPLICATION OF THE SPATIAL PATTERN OF LAND COVER/LAND USE CHANGE IN ADAMAWA STATE

Land use and land cover have changed significantly in the area between 1988 and 2003. This has been attributed to increased human activities in the area. The natural environment have been altered over the 15 years period. Water bodies have reduced in size and volume and some have dried up. Mass of vegetal cover have disappeared while bare land and rocky surfaces were exposed. The noticeable implications of these changes are as follows;

1. Socio-economic activities

The result of the study revealed that there is an on-going urbanization processes in the region due to the observed increase in built up areas by 60.9%. This is an indication of increased in human activities and population in the region. Hence, socio-economic activities have significantly increased in the area between 1988 and 2003, particularly in Yola North and Yola South. Creation of the Adamawa state with

its Capital at Yola in 1991 is a potent factor responsible for the accelerated urbanization observed in the area.

2. Shortage of water and prevalence of drought conditions

Water bodies was observed to have reduced by 39.66% in the region over a period of 15years while sand and water bodies that dried up increased by 27.51%. This is a significant indication of drought in the region. Many part of the region, particularly areas farther away from the Benue channel would not have access to portable and save water for domestic consumption. This would consequentially have effect on the health and productivity level of the inhabitants of the region.

3. Food shortage

The region lies in the Sudan Savannah belt of Nigeria, it depends solely on irrigation agriculture to meet its food needs due to inadequate rainfall. With the rate of vegetation loss cum water bodies reduction in the area, water accessibility for irrigation would be a challenge. As a result of reduction in vegetal cover, land moisture and nutrient contents to support sustainable cultivation would be drained due to persistent exposure of the land surface to heat. Consequentially, there would be shortage of food and increase in prices of food commodities.

4. Desertification

With the observed land use/land cover change in the area, the region has high tendencies and vulnerability towards desertification. A continuous and unchecked reduction in water quantity, loss of vegetal cover, and increasing exposure of the land surface are potent factors responsible to rapid desertification.

5. Increase in temperature

Vegetal cover absorbs solar radiation and recharges the atmosphere, hence it regulates the temperature of an area. Water bodies and soil moisture also absorbs temperature in the same manner. However, with the current trends in land cover pattern and changes in the Adamawa region – exposed land and rock surfaces at the expense of vegetal cover and water bodies, there would be increase in temperature of the area and a consequential potential of an urban heat island. Loss of energy, hence productivity would be an effect of high temperature on the inhabitants of the region if the current land cover change persists.

6. Paralyzed inland water transportation

Reduction in water bodies with large part the river channel filled with sands is an impediment to sustainable water transportation, particularly along the river Benue channel. Overfilled of the river channel with sand and reduction of the water volume to levels where rocks are exposed makes most of the rivers not suitable for navigation. Hence, there would be loss of jobs for the ferry and canoe transporters in the area, and the usual movement of people who depend on transportation by water would be impaired.

6. CONCLUSION

Changes in land cover and land use pattern has received high and persistent attention over the years particularly in developing countries. The need for urban and infrastructural developments in these regions has necessitated rapid modification of the natural environment. The consequences of these modifications, especially where there are no adequate planning and management practices, have become threats to the sustainability of the natural environment. The hinterland have been the major focus of urbanization over the years, however, many emerging big cities have developed around road networks/intercession or along the coast/river channel. The inescapable fact is that, the imminent challenges of human development at the expense of the natural environment persist in all areas where there is no adequate planning and management practices regardless of the location of the area

The consequences of unplanned human development would be severe compared to its intended benefits. Congestion, shortage of food, high cost of living, rapid desertification, drought, increase temperature, and increased crime are some of the adverse effect of unplanned urban development. Arable farmlands and rich biodiversity have been wiped away, water quality and quantity reduced, and soil conditions have deteriorated.

City planners, government agencies, and concerned institutions charged with the responsibilities of urban and environmental planning and management have not been actively involved. Poor educational qualification, inadequate experience, and lack of knowledge of remote sensing and Geo-Information technology are impediments to the productivity of city planners and environmental managers. The inability of planners to forecast and plan beyond the present human needs has been responsible for diverse environmental and human problems arising as a result of developmental processes in many developing countries.

This study utilizes remote sensing and geo-information technology in the analysis of land cover/land use pattern along the River Benue channel in Adamawa state between 1988 and 2003. Land cover/land use has changed dramatically over the past 15 years. Pattern of the changes have been adverse on the natural environment of the area. Hence, there is need for a balance between human development, land use planning, and water resource management to ensure a sustainable development in the region. If the current trends of unplanned urban development at the expense of the natural environment continues, and no active response to the deteriorating pattern of land cover and environmental changes is initiated, the effects would be greater than the intending benefits of the development. However, various measures could be consider in an attempt to reverse the effects of poor land use planning on the environment, to prevent future impacts of unplanned urbanization, and to curtail uncontrolled land cover changes. The following recommendations are therefore suggested;

1. Shelterbelts should be developed in areas with trait of desertification and tree planting should be considered as part of all developmental projects.
2. A stable river channelization and dredging policy should be implemented whereby flow of water in the rivers would be improved by removing sands and rock particles in the channels. This would facilitate inland water transportation system.
3. Adequate planning should be put in place by the government or its agencies for a planned and organized irrigation agriculture system in these regions.
4. Urban planners in implementing various urban development projects should consider projective planning mechanisms. That is, consideration for a long-term effect of any developmental project on both human and the natural environment.
5. Both urban planners and environmental managers should work together in the implementation of developmental policies and execution of projects.

6. Use of remote sensing and geographic information system should be encouraged by urban planners and environmental managers in planning, management, and in making various developmental decisions.

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SUSTAINABLE DEVELOPMENT OF BIOENERGY FROM AGRICULTURAL WASTE

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Abstract

This Article discusses a comprehensive review of biomass energy sources, environment and sustainable development. This includes all the biomass energy technologies, energy efficiency systems, energy conservation scenarios, energy savings and other mitigation measures necessary to reduce emissions. The current literature is reviewed regarding the ecological, social, cultural and economic impacts of biomass technology. This article gives an overview of present and future use of biomass as an industrial feedstock for production of fuels, chemicals and other materials. However, to be truly competitive in an open market situation, higher value products are required. Results suggest that biomass technology must be encouraged, promoted, invested, implemented, and demonstrated, but especially in remote rural areas.

1. INTRODUCTION

This study highlights the energy problem and the possible saving that can be achieved through the use of biomass sources energy. Also, this study clarifies the background of the study, highlights the potential energy saving that could be achieved through use of biomass energy source and describes the objectives, approach and scope of the theme.

The aim of any modern biomass energy systems must be:

- To maximise yields with minimum inputs.
- Utilisation and selection of adequate plant materials and processes.
- Optimum use of land, water, and fertiliser.
- Create an adequate infrastructure and strong R and D base.

There is strong scientific evidence that the average temperature of the earth's surface is rising. This was a result of the increased concentration of carbon dioxide (CO₂), and other greenhouse gases (GHGs) in the atmosphere as released by burning fossil fuels (Robinson, 2007; Omer, 2008). This global warming will eventually lead to substantial changes in the world's climate, which will, in turn, have a major impact on human life and the environment. Energy use can be achieved by minimising the energy demand, by rational energy use, by recovering heat and the use of more green energies. This will lead to fossil fuels emission reduction. This study was a step towards achieving this goal. The adoption of green or sustainable approaches to the way in which society is run is seen as an important strategy in finding a solution to the energy problem. The key factors to reducing and controlling CO₂, which is the major contributor to global warming, are the use of alternative approaches to energy generation and the exploration of how these alternatives are used today and may be used in the future as green energy sources. Even

with modest assumptions about the availability of land, comprehensive fuel-wood farming programmes offer significant energy, economic and environmental benefits. These benefits would be dispersed in rural areas where they are greatly needed and can serve as linkages for further rural economic development. The nations as a whole would benefit from savings in foreign exchange, improved energy security, and socio-economic improvements. With a nine-fold increase in forest – plantation cover, the nation's resource base would be greatly improved. The non-technical issues, which have recently gained attention, include: (1) Environmental and ecological factors, e.g., carbon sequestration, reforestation and revegetation. (2) Renewables as a CO₂ neutral replacement for fossil fuels. (3) Greater recognition of the importance of renewable energy, particularly modern biomass energy carriers, at the policy and planning levels. (4) Greater recognition of the difficulties of gathering good and reliable biomass energy data, and efforts to improve it. (5) Studies on the detrimental health effects of biomass energy particularly from traditional energy users. There is a need for some further development to suit local conditions, to minimise spare holdings, to maximise interchangeability both of engine parts and of the engine application. Emphasis should be placed on full local manufacture (Abdeen, 2008a).

Energy is an essential factor in development since it stimulates, and supports economic growth and development. Fossil fuels, especially oil and natural gas, are finite in extent, and should be regarded as depleting assets, and efforts are oriented to search for new sources of energy. The clamour all over the world for the need to conserve energy and the environment has intensified as traditional energy resources continue to dwindle whilst the environment becomes increasingly degraded. Alternatively energy sources can potentially help fulfill the acute energy demand and sustain economic growth in many regions of the world. Bioenergy is beginning to gain importance in the global fight to prevent climate change. The scope for exploiting organic waste as a source of energy is not limited to direct incineration or burning refuse-derived fuels. Biogas, biofuels and woody biomass are other forms of energy sources that can be derived from organic waste materials. These biomass energy sources have significant potential in the fight against climate change (Abdeen, 2008b).

Conservation of energy and rationing in some form will however have to be practised by most countries, to reduce oil imports and redress balance of payments positions. Meanwhile development and application of nuclear power and some of the traditional solar, wind, biomass and water energy alternatives must be set in hand to supplement what remains of the fossil fuels. The encouragement of greater energy use is an essential component of development. In the short term it requires mechanisms to enable the rapid increase in energy/capita, and in the long term we should be working towards a way of life, which makes use of energy efficiency and without the impairment of the environment or of causing safety problems. Such a programme should as far as possible be based on renewable energy resources (Abdeen, 2008c).

Large-scale, conventional, power plant such as hydropower has an important part to play in development. It does not, however, provide a complete solution. There is an important complementary role for the greater use of small scale, rural based-power

plants. Such plant can be used to assist development since it can be made locally using local resources, enabling a rapid built-up in total equipment to be made without a corresponding and unacceptably large demand on central funds. Renewable resources are particularly suitable for providing the energy for such equipment and its use is also compatible with the long-term aims. In compiling energy consumption data one can categorise usage according to a number of different schemes:

- Traditional sector- industrial, transportation, etc.
- End-use- space heating, process steam, etc.
- Final demand- total energy consumption related to automobiles, to food, etc.
- Energy source- oil, coal, etc.
- Energy form at point of use- electric drive, low temperature heat, etc.

2. BIOENERGY DEVELOPMENT

Bioenergy is energy from the sun stored in materials of biological origin. This includes plant matter and animal waste, known as biomass. Plants store solar energy through photosynthesis in cellulose and lignin, whereas animals store energy as fats. When burned, these sugars break down and release energy exothermically, releasing carbon dioxide (CO₂), heat and steam. The by-products of this reaction can be captured and manipulated to create power, commonly called bioenergy. Biomass is considered renewable because the carbon (C) is taken out of the atmosphere and replenished more quickly than the millions of years required for fossil fuels to form. The use of biofuels to replace fossil fuels contributes to a reduction in the overall release of carbon dioxide into the atmosphere and hence helps to tackle global warming (Abdeen, 2008d).

The biomass energy resources are particularly suited for the provision of rural power supplies and a major advantage is that equipment such as flat plate solar driers, wind machines, etc., can be constructed using local resources and without the high capital cost of more conventional equipment. Further advantage results from the feasibility of local maintenance and the general encouragement such local manufacture gives to the build up of small scale rural based industry. Table 1 lists the energy sources available. Currently the 'non-commercial' fuels wood, crop residues and animal dung are used in large amounts in the rural areas of developing countries, principally for heating and cooking; the method of use is highly inefficient. Table 2 presented some renewable applications. Table 3 lists the most important of energy needs. Table 4 listed methods of energy conversion.

Table 1 Sources of energy (Omer, 2008)

Energy source	Energy carrier	Energy end-use
Vegetation	Fuel-wood	Cooking Water heating

		Building materials Animal fodder preparation
Oil	Kerosene	Lighting Ignition fires
Dry cells	Dry cell batteries	Lighting Small appliances
Muscle power	Animal power	Transport Land preparation for farming Food preparation (threshing)
Muscle power	Human power	Transport Land preparation for farming Food preparation (threshing)

Table 2 Renewable applications (Omer, 2008)

Systems	Applications
Water supply	Rain collection, purification, storage and recycling
Wastes disposal	Anaerobic digestion (CH ₄)
Cooking	Methane
Food	Cultivate the 1 hectare plot and greenhouse for four people
Electrical demands	Wind generator
Space heating	Solar collectors
Water heating	Solar collectors and excess wind energy
Control system	Ultimately hardware
Building fabric	Integration of subsystems to cut costs

Table 3 Energy needs in rural areas (Omer, 2008)

<p>Transport, e.g., small vehicles and boats Agricultural machinery, e.g., two-wheeled tractors Crop processing, e.g., milling Water pumping Small industries, e.g., workshop equipment Electricity generation, e.g., hospitals and schools Domestic, e.g., cooking, heating, lighting</p>
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Table 4 Methods of energy conversion (Omer, 2007)

<p>Muscle power Internal combustion engines Reciprocating</p> <p>Rotating Heat engines Vapour (Rankine) Reciprocating Rotating Gas Stirling (Reciprocating) Gas Brayton (Rotating) Electron gas</p>	<p>Man, animals</p> <p>Petrol- spark ignition Diesel- compression ignition Humphrey water piston Gas turbines</p> <p>Steam engine Steam turbine Steam engine Steam turbine Thermionic, thermoelectric</p>
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Electromagnetic radiation	Photo devices
Hydraulic engines	Wheels, screws, buckets, turbines
Wind engines (wind machines)	Vertical axis, horizontal axis
Electrical/mechanical	Dynamo/alternator, motor

Considerations when selecting power plant include the following:

- Power level- whether continuous or discontinuous.
- Cost- initial cost, total running cost including fuel, maintenance and capital amortised over life.
- Complexity of operation.
- Maintenance and availability of spares.
- Life, and suitability for local manufacture.

The internal combustion engine is a major contributor to rising CO₂ emissions worldwide and some pretty dramatic new thinking is needed if our planet is to counter the effects. With its use increasing in developing world economies, there is something to be said for the argument that the vehicles we use to help keep our inner-city environments free from waste, litter and grime should be at the forefront of developments in low-emissions technology. Materials handled by waste management companies are becoming increasingly valuable. Those responsible for the security of facilities that treat waste or manage scrap will testify to the precautions needed to fight an ongoing battle against unauthorised access by criminals and crucially, to prevent the damage they can cause through theft, vandalism or even arson. Of particular concern is the escalating level of metal theft, driven by various factors including the demand for metal in rapidly developing economies such as India and China (Abdeen, 2008e).

There is a need for greater attention to be devoted to this field in the development of new designs, the dissemination of information and the encouragement of its use. International and government bodies and independent organisations all have a role to play in biomass energy technologies. Environment has no precise limits because it is in fact a part of everything. Indeed, environment is, as anyone probably already knows, not only flowers blossoming or birds singing in the spring, or a lake surrounded by beautiful mountains. It is also human settlements, the places where people live, work, rest, the quality of the food we eat, the noise or silence of the street they live in. environment is not only the fact that our cars consume a good deal of energy and pollute the air, but also, that we often need them to go to work and for holidays. Obviously man uses energy just as plants, bacteria, mushrooms, bees, fish and rats do (Figure 1). Man largely uses solar energy- food, hydropower, wood- and thus participates harmoniously in the natural flow of energy through the environment. But man also uses oil, gas, coal and nuclear power. We always modify our environment with or without this source of energy (Brain, and Mark, 2007). Economic importance of environmental issue is increasing, and new technologies are expected to reduce

pollution derived both from productive processes and products, with costs that are still unknown. This is due to market uncertainty, weak appropriability regime, lack of a dominant design, and difficulties in reconfiguring organisational routines. The degradation of the global environment is one of the most serious energy issues (Abdeen, 2009a).

3. ENERGY USE AND THE ENVIRONMENT

The range of waste treatment technologies that are tailored to produce bioenergy is growing. There are a number of key areas of bioenergy from wastes including (but not limited to) biogas, biofuels and bioheat. When considering using bioenergy, it is important to take into account the overall emission of carbon in the process of electricity production. Energy use is one of several essential components for every country:

- The overall situation and the implications of increased energy use in the future.
- The problem of the provision of power in rural areas, including the consideration of energy resources and energy conversion.

Table 5 Annual GHG emissions from different types of power plants (Robinson, 2007)

Primary source of energy	Emissions (x 10 ³ metric tons CO ₂)		Waste (x 10 ³ metric tons CO ₂)	Area (km ²)
	Atmosphere	Water		
Coal	380	7-41	60-3000	120
Oil	70-160	3-6	Negligible	70-84
Gas	24	1	-	84
Nuclear	6	21	2600	77

Table 6 Energy consumption per person (Robinson, 2007)

Region	Population (millions)	Energy per person (Watt/m ²)
Africa	820	0.54
Asia	3780	2.74
Central America	180	1.44
North America	335	0.34
South America	475	0.52
Western Europe	445	2.24
Eastern Europe	130	2.57
Oceania	35	0.08
Russia	330	0.29

In addition to the drain on resources, such an increase in consumption consequences, together with the increased hazards of pollution and the safety problems associated with a large nuclear fission programmes. It would be equally unacceptable to suggest that the difference in energy between the developed and developing countries and prudent for the developed countries to move towards a way of life which, whilst

maintaining or even increasing quality of life, reduce significantly the energy consumption per capita. Such savings can be achieved in a number of ways:

- Improved efficiency of energy use, for example environmental cost of thermal insulation must be taken into account, energy recovery, and total energy.
- Conservation of energy resources by design for long life and recycling rather than the short life throwaway product and systematic replanning of our way of life, for example in the field of transport.

Energy ratio is defined as the ratio of: Energy content of the food product / Energy input to produce the food (1)

4. COMBINED HEAT AND POWER (CHP)

The atmospheric emissions of fossil fuelled installations are mostly aldehydes ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur oxides (SO_x) and particles (i.e., ash) as well as carbon dioxide. Table 5 shows estimates include not only the releases occurring at the power plant itself but also cover fuel extraction and treatment, as well as the storage of wastes and the area of land required for operation (Table 6). A review of the potential range of recyclables is presented in Table 7.

Combined heat and power (CHP) installations are quite common in greenhouses, which grow high-energy, input crops (e.g., salad vegetables, pot plants, etc.). Scientific assumptions for a short-term energy strategy suggest that the most economically efficient way to replace the thermal plants is to modernise existing power plants to increase their energy efficiency and to improve their environmental performance (Pernille, 1999).

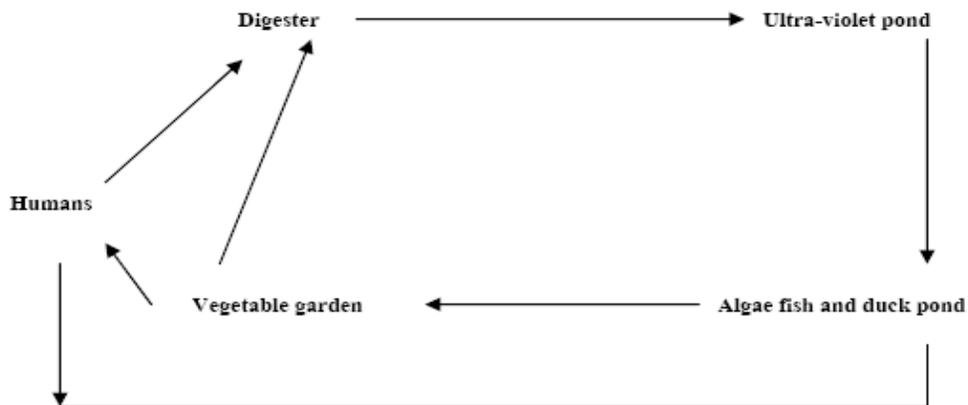


Figure 1 Biomass utilisation cycle concepts (Omer, 2006).

However, utilisation of wind power and the conversion of gas-fired CHP plants to biomass would significantly reduce the dependence on imported fossil fuels. Although a lack of generating capacity is forecast in the long-term, utilisation of the existing renewable energy potential and the huge possibilities for increasing energy efficiency are sufficient to meet future energy demands in the short-term (Pernille, 2004).

A total shift towards a sustainable energy system is a complex and long process, but is one that can be achieved within a period of about 20 years. Implementation will require initial investment, long-term national strategies and action plans. However, the changes will have a number of benefits including: a more stable energy supply than at present and major improvement in the environmental performance of the energy sector, and certain social benefits (Figure 2). A vision that used methodologies and calculations based on computer modelling can be utilised:

- Data from existing governmental programmes.
- Potential renewable energy sources and energy efficiency improvements.
- Assumptions for future economy growth.
- Information from studies and surveys on the recent situation in the energy sector.

The main advantages are related to energy, agriculture and environment problems, are foreseeable both at national level and at worldwide level and can be summarised as follows:

- Reduction of dependence on import of energy and related products.
- Reduction of environmental impact of energy production (greenhouse effect, air pollution, and waste degradation).
- Substitution of food crops and reduction of food surpluses and of related economic burdens, and development of new know-how and production of technological innovation.
- Utilisation of marginal lands and of set aside lands and reduction of related socio-economic and environmental problems (soil erosion, urbanisation, landscape deterioration, etc.).

Table 7 Summary of material recycling practices in the construction sector (Robinson, 2007)

Construction and demolition material	Recycling technology options	Recycling product
Asphalt	Cold recycling: heat generation; Minnesota process; parallel drum process; elongated drum; microwave asphalt recycling system; finfalt; surface regeneration	Recycling asphalt; asphalt aggregate
Brick	Burn to ash, crush into aggregate	Slime burn ash; filling material; hardcore
Concrete	Crush into aggregate	Recycling aggregate; cement replacement; protection of levee; backfilling; filter
Ferrous metal	Melt; reuse directly	Recycled steel scrap
Glass	Reuse directly; grind to powder;	Recycled window unit; glass fibre;

Construction and demolition material	Recycling technology options	Recycling product
	polishing; crush into aggregate; burn to ash	filling material; tile; paving block; asphalt; recycled aggregate; cement replacement; manmade soil
Masonry	Crush into aggregate; heat to 900°C to ash	Thermal insulating concrete; traditional clay
Non-ferrous metal	Melt	Recycled metal
Paper and cardboard	Purification	Recycled paper
Plastic	Convert to powder by cryogenic milling; chipping; crush into aggregate; burn to ash	Panel; recycled plastic; plastic lumber; recycled aggregate; landfill drainage; asphalt; manmade soil
Timber	Reuse directly; cut into aggregate; blast furnace deoxidisation; gasification or pyrolysis; chipping; moulding by pressurising timber chip under steam and water	Whole timber; furniture and kitchen utensils; lightweight recycled aggregate; source of energy; chemical production; wood-based panel; plastic lumber; geofibre; insulation board

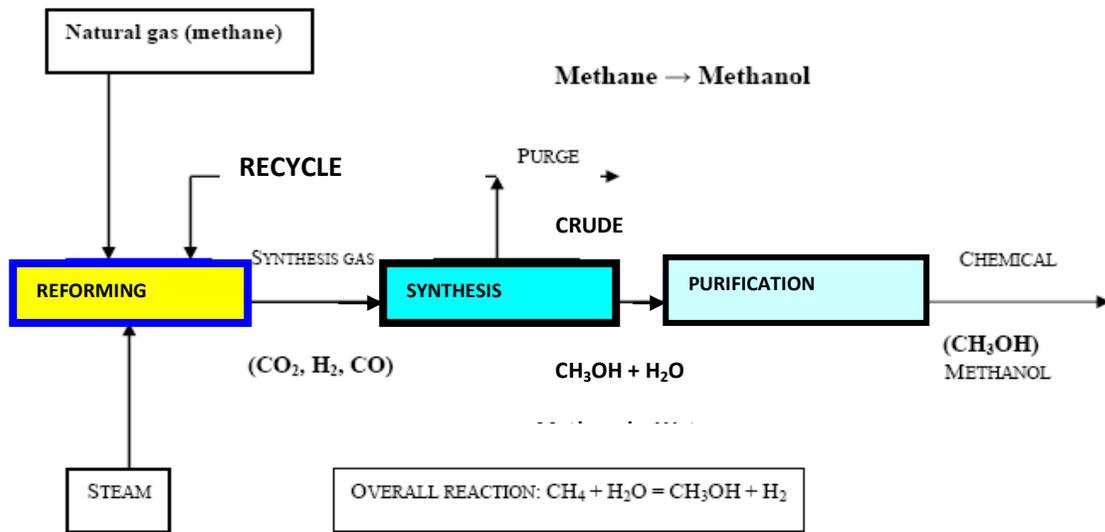


Figure 2 Schematic diagram shows methanol production (Omer, 2006).

In some countries, a wide range of economic incentives and other measures are already helping to protect the environment. These include:

- Taxes and user charges that reflect the costs of using the environment, e.g., pollution taxes and waste disposal charges.
- Subsidies, credits and grants that encourage environmental protection.
- Deposit-refund systems that prevent pollution on resource misuse and promote product reuse or recycling.
- Financial enforcement incentives, e.g., fines for non-compliance with environmental regulations.
- Tradable permits for activities that harm the environment.

District Heating (DH), also known as community heating can be a key factor to achieve energy savings, reduce CO₂ emissions and at the same time provide consumers with a high quality heat supply at a competitive price. DH should generally only be considered for areas where the heat density is sufficiently high to make DH economical. In countries like Denmark DH may today be economical even to new developments with lower density areas due to the high level of taxation on oil and gas fuels combined with the efficient production of DH. To improve the opportunity for DH local councils can adapt the following plan:

- Analyse the options for heat supply during local planning stage.
- In areas where DH is the least cost solution it should be made part of the infrastructure just like for instance water and sewage connecting all existing and new buildings.
- Where possible all public buildings should be connected to DH.
- The government provides low interest loans or funding to minimise conversion costs for its citizens.
- Use other powers, for instance national legislation to ensure the most economical development of the heat supply and enable an obligation to connect buildings to a DH scheme.

Denmark has broadly seen three scales of CHP which where largely implemented in the following chronological order (Pernille, 2004):

- Large scale CHP in cities (>50 MWe).
- Small (5 kWe – 5 MWe) and medium scale (5-50 MWe).
- Industrial and small scale CHP.

Combined heat and power (CHP) installations are quite common in greenhouses, which grow high-energy, input crops (e.g., salad vegetables, pot plants, etc.). Most of the heat is produced by large CHP plants (gas-fired combined cycle plants using natural gas, biomass, waste or biogas). DH is energy efficient because of the way the heat is produced and the required temperature level is an important factor. Buildings can be heated to temperature of 21°C and domestic hot water (DHW) can be supplied with a temperature of 55°C using energy sources that are most efficient when producing low temperature levels (<95°C) for the DH water. Most of these heat sources are CO₂ neutral or emit low levels. Only a few of these sources are available to small individual systems at a reasonably cost, whereas DH schemes because of the plant's size and location can have access to most of the heat sources and at a low cost. Low temperature DH, with return temperatures of around 30-40°C can utilise the following heat sources:

- Efficient use of CHP by extracting heat at low calorific value (CV).
- Efficient use of biomass or gas boilers by condensing heat in economisers (Table 8).
- Efficient utilisation of geothermal energy.

- Direct utilisation of excess low temperature heat from industrial processes.
- Efficient use of large-scale solar heating plants.

Heat tariffs may include a number of components such as: a connection charge, a fixed charge and a variable energy charge. Also, consumers may be incentivised to lower the return temperature. Hence, it is difficult to generalise but the heat practice for any DH company no matter what the ownership structure can be highlighted as follows:

- To develop and maintain a development plan for the connection of new consumers.
- To evaluate the options for least cost production of heat.
- To implement the most competitive solutions by signing agreements with other companies or by implementing own investment projects.
- To monitor all internal costs and with the help of benchmarking, improve the efficiency of the company.
- To maintain a good relationship with the consumer and deliver heat supply services at a sufficient quality.

Installing DH should be pursued to meet the objectives for improving the environment through the improvement of energy efficiency in the heating sector. At the same time DH can serve the consumer with a reasonable quality of heat at the lowest possible cost. The variety of possible solutions combined with the collaboration between individual companies, the district heating association, the suppliers and consultants can, as it has been in Denmark, be the way forward for developing DH in the United Kingdom. Implementation will require initial investment, long-term national strategies and action plans. However, the changes will have a number of benefits including: a more stable energy supply than at present and major improvement in the environmental performance of the energy sector, and certain social benefits (Pernille, 1999).

Table 8 Final energy projections including biomass (Mtoe) (D'Apote, 1998)

Region	1995			
	Biomass	Conventional Energy	Total	Share of Biomass (%)
Africa	205	136	341	60
China	206	649	855	24
East Asia	106	316	422	25
Latin America	73	342	415	18
South Asia	235	188	423	56
Total developing countries	825	1632	2457	34
Other non-OECD * countries	24	1037	1061	2
Total non-OECD* countries	849	2669	3518	24
OECD countries	81	3044	3125	3
World	930	5713	6643	14
Region	2020			

	Biomass	Conventional Energy	Total	Share of Biomass (%)
Africa	371	266	637	59
China	224	1524	1748	13
East Asia	118	813	931	13
Latin America	81	706	787	10
South Asia	276	523	799	35
Total developing countries	1071	3825	4896	22
Other non-OECD *	26	1669	1695	2
Total non-OECD*	1097	5494	6591	17
OECD countries	96	3872	3968	2
World	1193	9365	10558	11

* ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

5. BIOMASS UTILISATION AND DEVELOPMENT OF CONVERSION TECHNOLOGIES

Sustainable energy is energy that, in its production or consumption, has minimal negative impacts on human health and the healthy functioning of vital ecological systems, including the global environment. It is an accepted fact that renewable energy is a sustainable form of energy, which has attracted more attention during recent years. A great amount of renewable energy potential, environmental interest, as well as economic consideration of fossil fuel consumption and high emphasis of sustainable development for the future will be needed. Explanations for the use of inefficient agricultural-environmental policies include: the high cost of information required to measure benefits on a site-specific basis, information asymmetries between government agencies and farm decision makers that result in high implementation costs, distribution effects and political considerations (Wu and Boggess, 1999). Achieving the aim of agric-environment schemes through:

- Sustain the beauty and diversity of the landscape.
- Improve and extend wildlife habitats.
- Conserve archaeological sites and historic features.
- Improve opportunities for countryside enjoyment.
- Restore neglected land or features, and
- Create new habitats and landscapes.

The data required to perform the trade-off analysis simulation can be classified according to the divisions given in Table 9: the overall system or individual plants, and the existing situation or future development. The effective economic utilisations of these resources are shown in Table 10, but their use is hindered by many problems such as those related to harvesting, collection, and transportation, besides the sanitary control regulations. Biomass energy is experiencing a surge in an interest stemming from a combination of factors, e.g., greater recognition of its current role and future potential contribution as a modern fuel, global environmental benefits, its development

and entrepreneurial opportunities, etc. Possible routes of biomass energy development are shown in Table 11.

The key to successful future appears to lie with successful marketing of the treatment by products. There is also potential for using solid residue in the construction industry as a filling agent for concrete. Research suggests that the composition of the residue locks metals within the material, thus preventing their escape and any subsequent negative effect on the environment (Abdeen, 2009b).

The use of biomass through direct combustion has long been, and still is, the most common mode of biomass utilisation as shown in Tables (9-11). Examples for dry (thermo-chemical) conversion processes are charcoal making from wood (slow pyrolysis), gasification of forest and agricultural residues (fast pyrolysis – this is still in demonstration phase), and of course, direct combustion in stoves, furnaces, etc. Wet processes require substantial amount of water to be mixed with the biomass. Biomass technologies include:

- Briquetting.
- Improved stoves.
- Biogas.
- Improved charcoal.
- Carbonisation.
- Gasification.

Table 9 Classifications of data requirements (Omer, 2008)

	Plant data	System data
Existing data	Size Life Cost (fixed and var. O and M) Forced outage Maintenance Efficiency Fuel Emissions	Peak load Load shape Capital costs Fuel costs Depreciation Rate of return Taxes
Future data	All of above, plus Capital costs Construction trajectory Date in service	System lead growth Fuel price growth Fuel import limits Inflation

Table 10 Agricultural residues routes for development (Omer, 2006)

Source	Process	Product	End use
Agricultural residues	Direct	Combustion	Rural poor Urban household
	Processing	Briquettes	Industrial use Industrial use Limited household use

	Processing Carbonisation Fermentation	Carbonisation (small scale) Briquettes Carbonised Biogas	Rural household (self sufficiency) Urban fuel Energy services Household Industry
Agricultural, and animal residues	Direct Briquettes Carbonisation Carbonisation Fermentation	Combustion Direct combustion Carbonised Briquettes Biogas	(Save or less efficiency as wood) (Similar end use devices or improved) Use Briquettes use Use

The increased demand for gas and petroleum, food crops, fish and large sources of vegetative matter mean that the global harvesting of carbon has in turn intensified. It could be said that mankind is mining nearly everything except its waste piles. It is simply a matter of time until the significant carbon stream present in municipal solid waste is fully captured. In the meantime, the waste industry needs to continue on the pathway to increased awareness and better-optimised biowaste resources. Optimisation of waste carbon may require widespread regulatory drivers (including strict limits on the Landfilling of organic materials), public acceptance of the benefits of waste carbon products for soil improvements/crop enhancements and more investment in capital facilities (Abdeen, 2009c). In short, a significant effort will be required in order to capture a greater portion of the carbon stream and put it to beneficial use. From the standpoint of waste practitioners, further research and pilot programmes are necessary before the available carbon in the waste stream can be extracted in sufficient quality and quantities to create the desired end products. Other details need to be ironed out too, including measurement methods, diversion calculations, sequestration values and determination of acceptance contamination thresholds (Abdeen, 2009d).

5.1.1. Briquette

Charcoal stoves are very familiar to African society. As for the stove technology, the present charcoal stove can be used, and can be improved upon for better efficiency. This energy term will be of particular interest to both urban and rural households and all the income groups due to the simplicity, convenience, and lower air polluting characteristics. However, the market price of the fuel together with that of its end-use technology may not enhance its early high market penetration especially in the urban low income and rural households.

Table 11 Effective biomass resource utilisation (Omer, 2007)

Subject	Tools	Constraints
Utilisation and land clearance for agriculture expansion	Stumpage fees Control Extension Conversion	Policy Fuel-wood planning Lack of extension Institutional

	Technology	
Utilisation of agricultural residues	Briquetting Carbonisation Carbonisation and briquetting Fermentation Gasification	Capital Pricing Policy and legislation Social acceptability

Briquetting is the formation of a char (an energy-dense solid fuel source) from otherwise wasted agricultural and forestry residues. One of the disadvantages of wood fuel is that it is bulky with a low energy density and is therefore enquire to transport. Briquette formation allows for a more energy-dense fuel to be delivered, thus reducing the transportation cost and making the resource more competitive. It also adds some uniformity, which makes the fuel more compatible with systems that are sensitive to the specific fuel input (Jeremy, 2005).

5.1.2. Improved Cook Stoves

Traditional wood stoves can be classified into four types: three stone, metal cylindrical shaped, metal tripod and clay type. Another area in which rural energy availability could be secured where woody fuels have become scarce, are the improvements of traditional cookers and ovens to raise the efficiency of fuel saving. Also, by planting fast growing trees to provide a constant fuel supply. The rural development is essential and economically important since it will eventually lead to better standards of living, people's settlement, and self sufficient in the following:

- Food and water supplies.
- Better services in education and health care.
- Good communication modes.

5.1.3. Biogas

Biogas technology can not only provide fuel, but is also important for comprehensive utilisation of biomass forestry, animal husbandry, fishery, agricultural economy, protecting the environment, realising agricultural recycling, as well as improving the sanitary conditions, in rural areas. The introduction of biogas technology on wide scale has implications for macro planning such as the allocation of government investment and effects on the balance of payments. Factors that determine the rate of acceptance of biogas plants, such as credit facilities and technical backup services, are likely to have to be planned as part of general macro-policy, as do the allocation of research and development funds (Hall and Scrase, 1998).

Biogas is a generic term for gases generated from the decomposition of organic material. As the material breaks down, methane (CH₄) is produced as shown in Figure 3. Sources that generate biogas are numerous and varied. These include landfill sites,

wastewater treatment plants and anaerobic digesters. Landfills and wastewater treatment plants emit biogas from decaying waste. To date, the waste industry has focused on controlling these emissions to our environment and in some cases, tapping this potential source of fuel to power gas turbines, thus generating electricity. The primary components of landfill gas are methane (CH₄), carbon dioxide (CO₂), and nitrogen (N₂). The average concentration of methane is ~45%, CO₂ is ~36% and nitrogen is ~18%. Other components in the gas are oxygen (O₂), water vapour and trace amounts of a wide range of non-methane organic compounds (NMOCs).

For hot water and heating, renewables contributions come from biomass power and heat, geothermal direct heat, ground source heat pumps, and rooftop solar hot water and space heating systems. Solar assisted cooling makes a very small but growing contribution. When it comes to the installation of large amounts of PV, the cities have several important factors in common. These factors include:

- A strong local political commitment to the environment and sustainability.
- The presence of municipal departments or offices dedicated to the environment, sustainability or renewable energy.
- Information provision about the possibilities of renewables.
- Obligations that some or all buildings include renewable energy.

5.1.4. Improved Forest and Tree Management

Dry cell batteries are a practical but expensive form of mobile fuel that is used by rural people when moving around at night and for powering radios and other small appliances. The high cost of dry cell batteries is financially constraining for rural households, but their popularity gives a good indication of how valuable a versatile fuel like electricity is in rural area. Dry cell batteries can constitute an environmental hazard unless they are recycled in a proper fashion. Direct burning of fuel-wood and crop residues constitute the main usage of biomass, as is the case with many developing countries. However, the direct burning of biomass in an inefficient manner causes economic loss and adversely affects human health. In order to address the problem of inefficiency, research centres around the world have investigated the viability of converting the resource to a more useful form, namely solid briquettes and fuel gas (Figure 4). Biomass resources play a significant role in energy supply in all developing countries. Biomass resources should be divided into residues or dedicated resources, the latter including firewood and charcoal can also be produced from forest residues (Table 12).

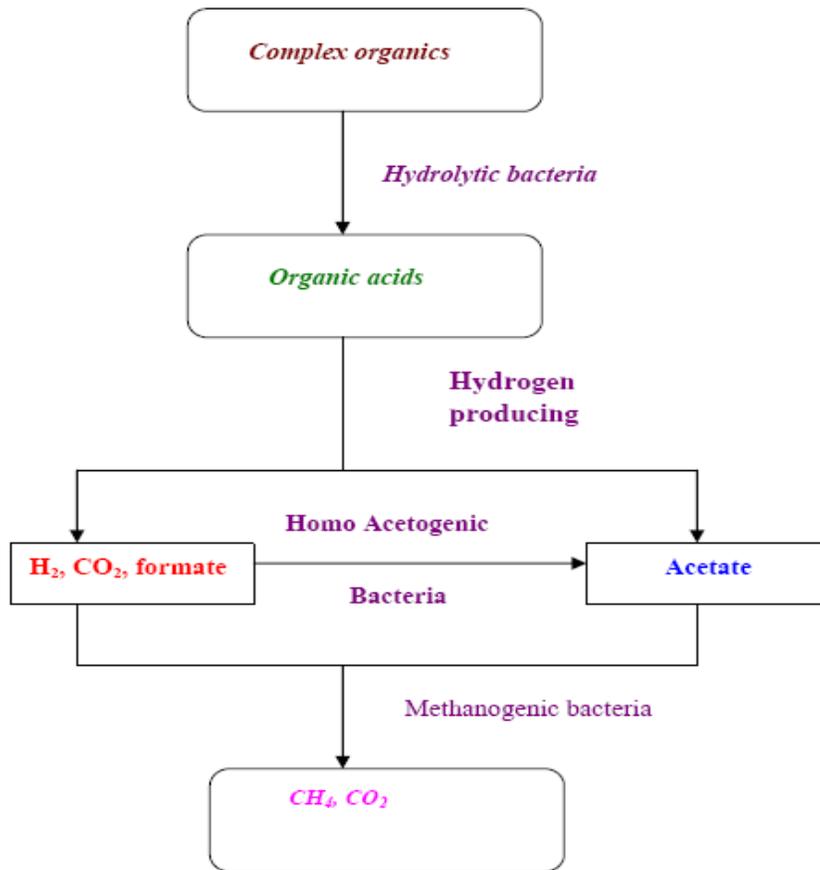


Figure 3 Biogas production process (Omer, 2003).

Implementing measures for energy efficiency increase at the demand side and in the energy transformation sector. It is common practice to dispose of this waste wood in landfill where it slowly degraded and takes up valuable void space. This wood is a good source of energy and is an alternative to energy crops. Agricultural wastes are abundantly available globally and can be converted to energy and useful chemicals by a number of microorganisms. The success of promoting any technology depends on careful planning, management, implementation, training and monitoring. Main features of gasification project are:

- Networking and institutional development/strengthening.
- Promotion and extension.
- Construction of demonstration projects.
- Research and development, and training and monitoring.

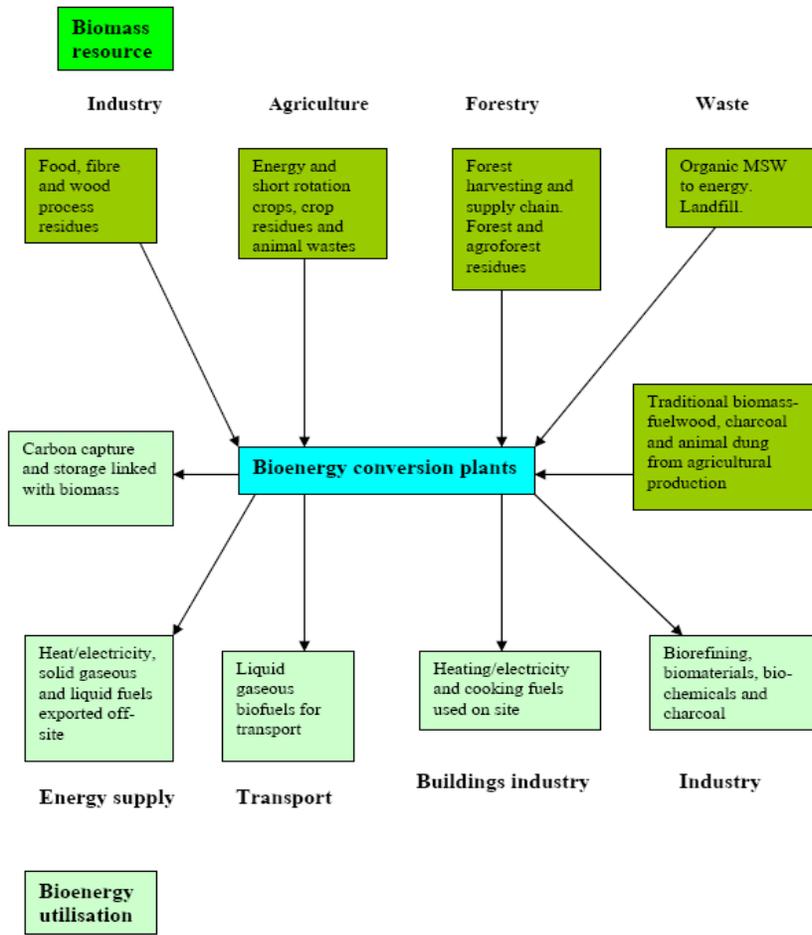


Figure 4 Biomass resources from several sources are converted into a range of products for use by transport, industry and building sectors (Sims, 2007).

5.1.5. Gasification

Gasification is based on the formation of a fuel gas (mostly CO and H₂) by partially oxidising raw solid fuel at high temperatures in the presence of steam or air. The technology can use wood chips, groundnut shells, sugar cane bagasse, and other similar fuels to generate capacities from 3 kW to 100 kW. Three types of gasifier designs have been developed to make use of the diversity of fuel inputs and to meet the requirements of the product gas output (degree of cleanliness, composition, heating value, etc.). The requirements of gas for various purposes, and a comparison between biogas and various commercial fuels in terms of calorific value, and thermal efficiency are presented in Table 13. Sewage sludge is rich in nutrients such as nitrogen and phosphorous. It also contains valuable organic matter, useful for remediation of depleted or eroded soils. This is why untreated sludge has been used for many years as a soil fertiliser and for enhancing the organic matter of soil. A key concern is that treatment of sludge tends to concentrate heavy metals, poorly biodegradable trace organic compounds and potentially pathogenic organisms (viruses, bacteria and the like) present in wastewaters. These materials can pose a serious threat to the environment.

When deposited in soils, heavy metals are passed through the food chain, first entering crops, and then animals that feed on the crops and eventually human beings, to whom they appear to be highly toxic. In addition they also leach from soils, getting into groundwater and further spreading contamination in an uncontrolled manner (Levine, and Hirose, 2005).

Table 12 Biomass residues and current use (Omer, 2007)

Type of residue	Current use
Wood industry waste	Residues available
Vegetable crop residues	Animal feed
Food processing residue	Energy needs
Sorghum, millet, wheat residues	Fodder, and building materials
Groundnut shells	Fodder, brick making, direct fining oil mills
Cotton stalks	Domestic fuel considerable amounts available for short period
Sugar, bagasse, molasses	Fodder, energy need, ethanol production (surplus available)
Manure	Fertiliser, brick making, plastering

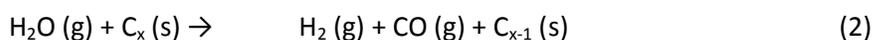
European and American markets aiming to transform various organic wastes (animal farm wastes, industrial and municipal wastes) into two main by-products:

- A solution of humic substances (a liquid oxidate).
- A solid residue.

Agricultural wastes are abundantly available globally and can be converted to energy and useful chemicals by a number of microorganisms. The organic matter was biodegradable to produce biogas and the variation show a normal methanogene bacteria activity and good working biological process as shown in Figures 5-7. The success of promoting any technology depends on careful planning, management, implementation, training and monitoring. Main features of gasification project are:

- Networking and institutional development/strengthening.
- Promotion and extension.
- Construction of demonstration projects.
- Research and development, and training and monitoring.

Biomass is a raw material that has been utilised for a wide variety of tasks since the dawn of civilisation. Important as a supply of fuel in the third world, biomass was also the first raw material in the production of textiles. The gasification of the carbon char with steam can make a large difference to the surface area of the carbon. The corresponding steam gasification reactions are endothermic and demonstrate how the steam reacts with the carbon char (Bacaoui, 1998)



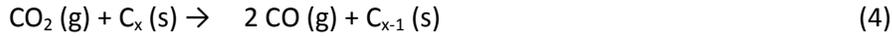
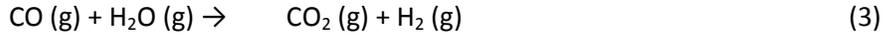


Table 13 Comparison of various fuels (Omer, 2003)

Fuel	Calorific value (kcal)	Burning mode	Thermal efficiency (%)
Electricity, kWh	880	Hot plate	70
Coal gas, kg	4004	Standard burner	60
Biogas, m ³	5373	Standard burner	60
Kerosene, l	9122	Pressure stove	50
Charcoal, kg	6930	Open stove	28
Soft coke, kg	6292	Open stove	28
Firewood, kg	3821	Open stove	17
Cow dung, kg	2092	Open stove	11

The sources to alleviate the energy situation in the world are sufficient to supply all foreseeable needs. Conservation of energy and rationing in some form will however have to be practised by most countries, to reduce oil imports and redress balance of payments positions. Meanwhile development and application of nuclear power and some of the traditional solar, wind and water energy alternatives must be set in hand to supplement what remains of the fossil fuels.

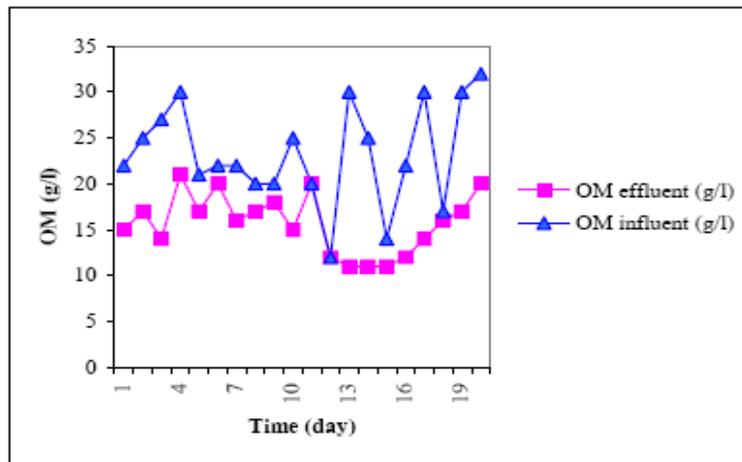


Figure 5 Organic matters before and after treatment in digester (Omer, 2006).

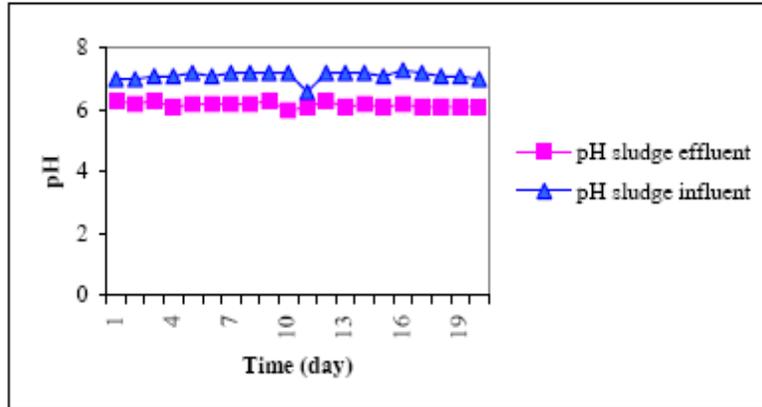


Figure 6 pH sludge before and after treatment in the digester (Omer, 2006).

The encouragement of greater energy use is an essential component of development. In the short term it requires mechanisms to enable the rapid increase in energy/capita, and in the long term we should be working towards a way of life, which makes use of energy efficiency and without the impairment of the environment or of causing safety problems. Such a programme should as far as possible be based on renewable energy resources.

6. BIOHEAT

Bioenergy is a growing source of power that is playing an ever-increasing role in the provision of electricity. The potential contribution of the waste industry to bioenergy is huge and has the ability to account for a source of large amount of total bioenergy production. Woody biomass is usually converted into power through combustion or gasification. Biomass can be specially grown in the case of energy crops. Waste wood makes up a significant proportion of a variety of municipal, commercial and industrial waste streams. It is common practice to dispose of this waste wood in landfill where it slowly degraded and takes up valuable void space. This wood is a good source of energy and is an alternative to energy crops. The biomass directly produced by cultivation can be transformed by different processes into gaseous, liquid or solid fuels (Table 14). The whole process of production of methyl or ethyl esters (biodiesel) is summarised in Figures 8-9.

Table 14 Biomass conversions to energy (Omer, 2006)

Feedstock	Crops	Conversion process	End product
Wood-cellulosic biomass	Short rotation forest (poplar, willow), plant species (sorghum, miscanthus, etc.), fibre-crops (cynara, kenaf, etc.)	Direct combustion Gasification Pyrolysis	Heat Methane Hydrogen Oil
Vegetable oils	Oleaginous crops (rapeseed, soybean, sunflower, etc.)	Direct combustion Esterification	Heat Biodiesel
Sugar/starch	Cereals, root and tuber crops, grape, topinambour, etc.	Fermentation	Ethanol

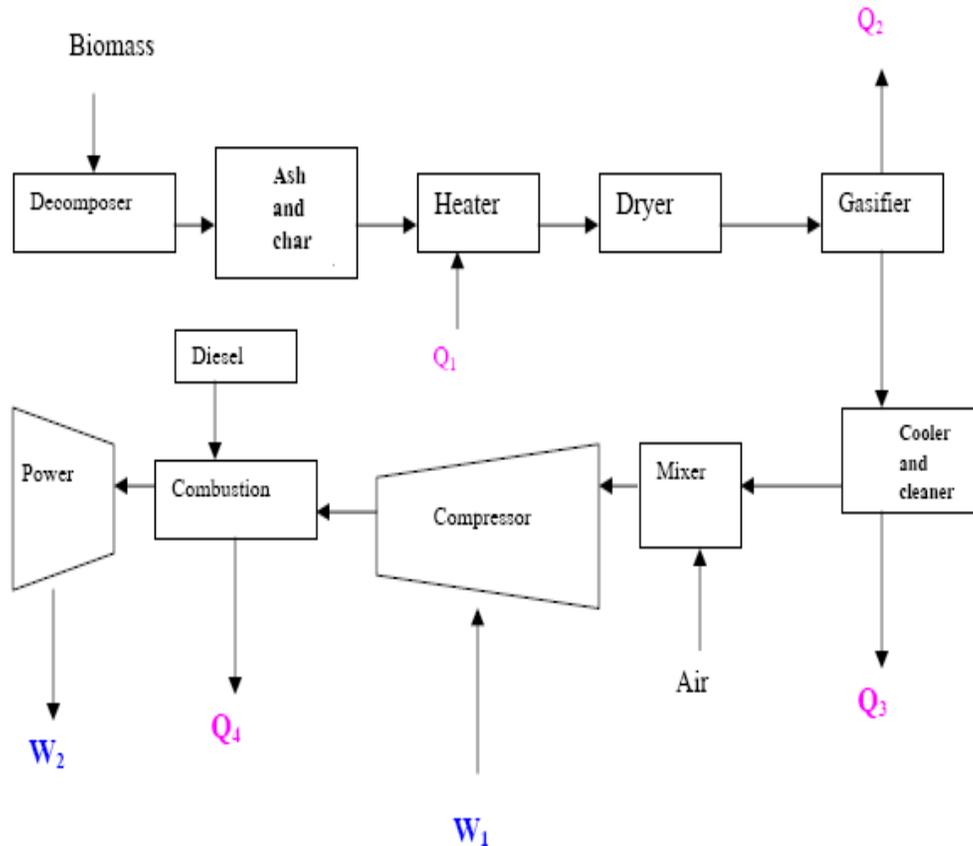


Figure 7 Advanced biomass power with diesel engine (Omer, 2006).

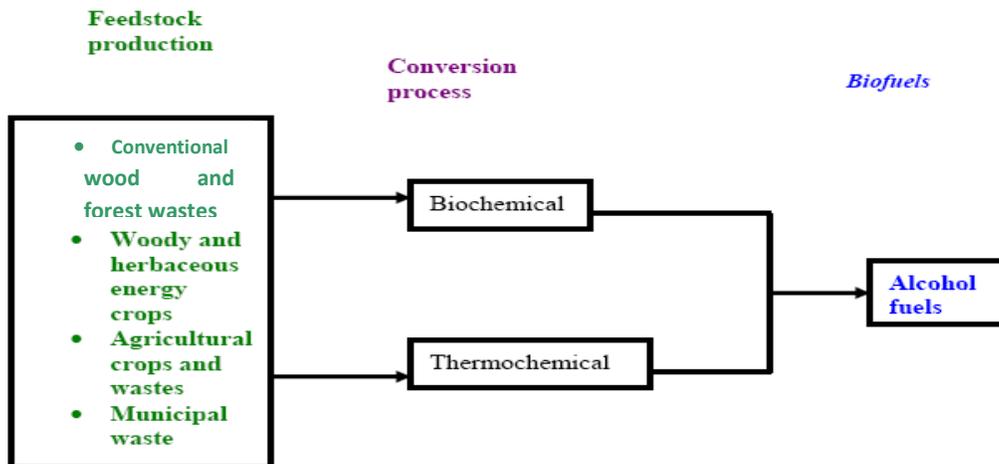


Figure 8 Biofuel pathways for renewable alcohol fuels (Omer, 2006).

6.1 Waste Policy in Context

In terms of solid waste management policy, many NGOs have changed drastically in the past ten years from a mass production and mass consumption society to ‘material-cycle society’. In addition to national legislation, municipalities are legally obliged to develop a plan for handling the municipal solid waste (MSW) generated in administrative areas. Such plans contain:

- Estimates of future waste volume.

- Measures to reduce waste.
- Measures to encourage source separation.
- A framework for solid waste disposal and the construction and management of solid waste management facilities.

Landfilling is in the least referred tier of the hierarchy of waste management options: Waste minimisation, reuse and recycling, incineration with energy recovery, and optimised final disposal. The key elements are as follows: construction impacts, atmospheric emissions, noise, water quality, landscape, visual impacts, socio economics, ecological impacts, traffic, solid waste disposal and cultural heritage (Barton, 2007).

6.2 Energy from Agricultural Biomass

The main advantages are related to energy, agriculture and environment problems, are foreseeable both at regional level and at worldwide level and can be summarised as follows:

- Reduction of dependence on import of energy and related products.

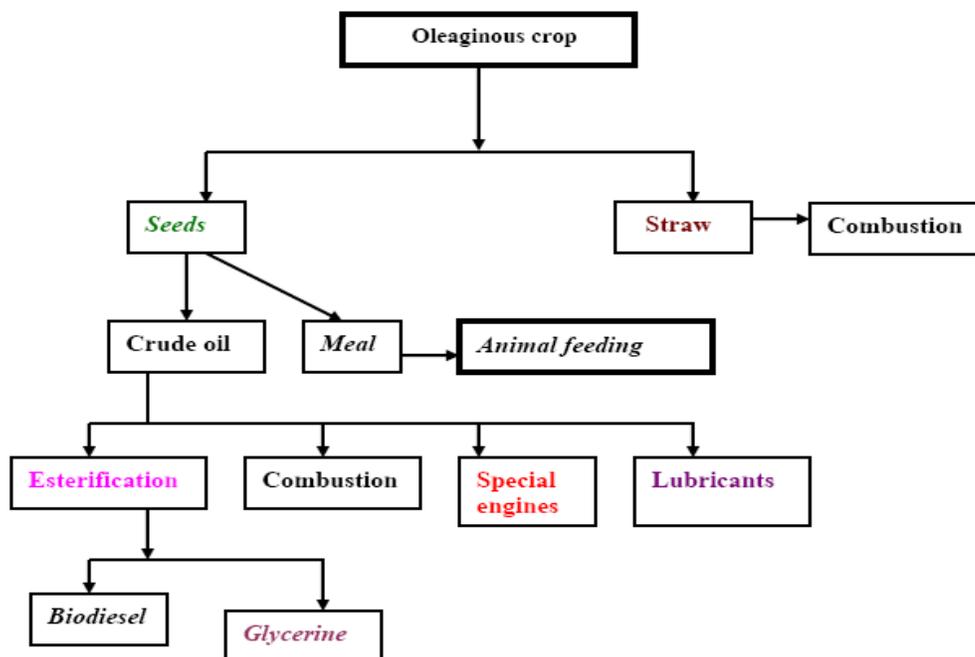


Figure 9 Flow chart of biodiesel production (Omer, 2006).

- Reduction of environmental impact of energy production (greenhouse effect, air pollution, waste degradation).
- Substitution of food crops and reduction of food surpluses and of related economic burdens.
- Utilisation of marginal lands and of set aside lands and reduction of related socio-economic and environmental problems (soil erosion, urbanisation, landscape deterioration, etc.).
- Development of new know-how and production of technological innovation.

A study (Bacaoui, 1998) individuated on the basis of botanical, genetical, physiological, biochemical, agronomical and technological knowledge reported in literature some 150 species potentially exploitable divided as reported in Table 15.

7. ROLE OF CHEMICAL ENGINEERING

Turning to chemical engineering and the experience of the chemical process industry represents a waking up but does not lead to an immediate solution to the problems. The traditional techniques are not very kind to biological products, which are controlled by difficulty and unique physico-chemical properties such as low mechanical, thermal and chemical stabilities. There is the question of selectivity. The fermentation broths resulting from microbial growth contain a bewildering mixture of many compounds closely related to the product of interests. By the standards of the process streams in chemical industry, fermenter is highly impure and extremely dilutes aqueous systems (Table 16).

Table 15 Plant species potentially exploitable for production of agricultural biomass for energy or industrial utilisations (Rossi et al, 1990)

Groups of plants	Number of species
Plants cultivated for food purposes that can be reconverted to new uses	9
Plants cultivated in the past, but not in culture any more	46
Plants cultivated in other world areas	46
Wild species, both indigenous and exotic	47
Total	148
Plant product	Number of species
Biomass	8
Sugars and polysaccharides	38
Cellulose	17
Hydrocarbons	3
Polymeric hydrocarbons	5
Gums and resins	12
Tannins and phenolic compounds	3
Waxes	7
Vegetable oils	38
Total	131

The disadvantages of the fermentation media are as the following: mechanically fragile, temperature sensitive, rapidly deteriorating quality, harmful if escaping into the environment, corrosive (acids, chlorides, etc.), and troublesome (solids, theological, etc.), and expensive. Thus, pilot plants for scale-up work must be flexible. In general, they should contain suitably interconnected equipment for: fermentation, primary separation, cell disruption fractionalises and clarifications, purification by means of high-resolution techniques and concentration and dry. The effects of the chlorofluorocarbons (CFCs) molecule can last for over a century.

Table 16 Typical product concentrations exiting fermenters (Rossi et al, 1990)

Product	Concentration (kg/m ³)
Ethanol	70-120
Organic acids (e.g., citric)	40-100
Vitamin B12	0.02
Interferon	50-70
Single-cell protein	30-50
Antibiotics (e.g., Penicillin G)	10-30
Enzyme protein (e.g., protease)	2-5

7.1 Fluidised Bed Drying

An important consideration for operators of wastewater treatment plants is how to handle the disposal of the residual sludge in a reliable, sustainable, legal and economical way. The benefits of drying sludge can be seen in two main treatment options:

- Use of the dewatered sludge as a fertiliser or in fertiliser blends.
- Incineration with energy recovery.

Use as a fertiliser takes advantage of the high organic content 40%-70% of the dewatered sludge and its high levels of phosphorous and other nutrients. However, there are a number of concerns about this route including:

- The chemical composition of the sludge (e.g., heavy metals, hormones and other pharmaceutical residues).
- Pathogen risk (e.g., SALMOELLA, ESCHERICHIA COLI, prionic proteins, etc.).
- Potential accumulation of heavy metals and other chemicals in the soil.

Sludge can be applied as a fertiliser in three forms: liquid sludge, wet cake blended into compost, and dried granules.

The advantages of energy recovery sludge include:

- The use of dewatered sludge is a 'sink' for pollutants such as heavy metals, toxic organic compounds and pharmaceutical residues. Thus, offering a potential disposal route for these substances provided the combustion plant has adequate flue gas cleaning.
- The potential, under certain circumstances, to utilise the inorganic residue from sludge incineration (incinerator ash), such as in cement or gravel.
- The high calorific value (similar to lignite) of dewatered sludge.
- The use of dewatered sludge as a carbon dioxide neutral substitute for primary fuels such as oil, gas and coal.

7.2 Energy Efficiency

Energy efficiency is the most cost-effective way of cutting carbon dioxide emissions and improvements to households and businesses. It can also have many other additional

social, economic and health benefits, such as warmer and healthier homes, lower fuel bills and company running costs and, indirectly, jobs. Britain wastes 20 per cent of its fossil fuel and electricity use in transportation. This implies that it would be cost-effective to cut £10 billion a year off the collective fuel bill and reduce CO₂ emissions by some 120 million tonnes CO₂. Yet, due to lack of good information and advice on energy saving, along with the capital to finance energy efficiency improvements, this huge potential for reducing energy demand is not being realised. Traditionally, energy utilities have been essentially fuel providers and the industry has pursued profits from increased volume of sales. Institutional and market arrangements have favoured energy consumption rather than conservation. However, energy is at the centre of the sustainable development paradigm as few activities affect the environment as much as the continually increasing use of energy. Most of the used energy depends on finite resources, such as coal, oil, gas and uranium. In addition, more than three quarters of the world's consumption of these fuels is used, often inefficiently, by only one quarter of the world's population. Without even addressing these inequities or the precious, finite nature of these resources, the scale of environmental damage will force the reduction of the usage of these fuels long before they run out.

Throughout the energy generation process there are impacts on the environment on local, national and international levels, from opencast mining and oil exploration to emissions of the potent greenhouse gas carbon dioxide in ever increasing concentration. Recently, the world's leading climate scientists reached an agreement that human activities, such as burning fossil fuels for energy and transport, are causing the world's temperature to rise. The Intergovernmental Panel on Climate Change has concluded that "the balance of evidence suggests a discernible human influence on global climate". It predicts a rate of warming greater than any one seen in the last 10,000 years, in other words, throughout human history. The exact impact of climate change is difficult to predict and will vary regionally. It could, however, include sea level rise, disrupted agriculture and food supplies and the possibility of more freak weather events such as hurricanes and droughts. Indeed, people already are waking up to the financial and social, as well as the environmental, risks of unsustainable energy generation methods that represent the costs of the impacts of climate change, acid rain and oil spills. The insurance industry, for example, concerned about the billion dollar costs of hurricanes and floods, has joined sides with environmentalists to lobby for greenhouse gas emissions reduction. Friends of the earth are campaigning for a more sustainable energy policy, guided by the principal of environmental protection and with the objectives of sound natural resource management and long-term energy security. The key priorities of such an energy policy must be to reduce fossil fuel use, move away from nuclear power, improve the efficiency with which energy is used and increase the amount of energy obtainable from sustainable, renewable sources. Efficient energy use has never been more crucial than it is today, particularly with the prospect of the imminent introduction of the climate change levy (CCL). Establishing an energy use action plan is the essential foundation to the elimination of energy waste. A logical starting point is to carry out an energy audit that enables the assessment of the energy use and determine what actions to take. The actions are best categorised by splitting measures into the following three general groups:

(1) High priority/low cost:

These are normally measures, which require minimal investment and can be implemented quickly. The followings are some examples of such measures:

- Good housekeeping, monitoring energy use and targeting waste-fuel practices.
- Adjusting controls to match requirements.
- Improved greenhouse space utilisation.
- Small capital item time switches, thermostats, etc.
- Carrying out minor maintenance and repairs.
- Staff education and training.
- Ensuring that energy is being purchased through the most suitable tariff or contract arrangements.

(2) Medium priority/medium cost:

Measures, which, although involve little or no design, involve greater expenditure and can take longer to implement. Examples of such measures are listed below:

- New or replacement controls.
- Greenhouse component alteration, e.g., insulation, sealing glass joints, etc.
- Alternative equipment components, e.g., energy efficient lamps in light fittings, etc.

(3) Long term/high cost:

These measures require detailed study and design. They can be best represented by the followings:

- Replacing or upgrading of plant and equipment.
- Fundamental redesign of systems, e.g., CHP installations.

This process can often be a complex experience and therefore the most cost-effective approach is to employ an energy specialist to help.

7.3 Policy Recommendations for a Sustainable Energy Future

Sustainability is regarded as a major consideration for both urban and rural development. People have been exploiting the natural resources with no consideration to the effects, both short-term (environmental) and long-term (resources crunch). It is also felt that knowledge and technology have not been used effectively in utilising energy resources. Energy is the vital input for economic and social development of any country. Its sustainability is an important factor to be considered. The urban areas depend, to a large extent, on commercial energy sources. The rural areas use non-commercial sources like firewood and agricultural wastes. With the present day trends for improving the quality of life and sustenance of mankind, environmental issues are considered highly important. In this context, the term energy loss has no significant technical meaning. Instead, the exergy loss has to be considered, as destruction of exergy is possible. Hence, exergy loss minimisation will help in sustainability. In the process of developing, there are two options to manage energy resources: (1) End use matching/demand side management, which focuses on the utilities. The mode of obtaining this is decided based on economic terms. It is, therefore, a quantitative approach. (2) Supply side management, which focuses on the renewable energy

resource and methods of utilising it. This is decided based on thermodynamic consideration having the resource-user temperature or exergy destruction as the objective criteria. It is, therefore, a qualitative approach. The two options are explained schematically in Figure 10. The exergy-based energy, developed with supply side perspective is shown in Figure 11. The following policy measures had been identified:

- Clear environmental and social objectives for energy market liberalisation, including a commitment to energy efficiency and renewables.
- Economic, institutional and regulatory frameworks, which encourage the transition to total energy services.
- Economic measures to encourage utility investment in energy efficiency (e.g., levies on fuel bills).
- Incentives for demand side management, including grants for low-income households, expert advice and training, standards for appliances and buildings and tax incentives.
- Research and development funding for renewable energy technologies not yet commercially viable.
- Continued institutional support for new renewables (such as standard cost-reflective payments and obligation on utilities to buy).
- Ecological tax reform to internalise external environmental and social costs within energy prices.
- Planning for sensitive development and public acceptability for renewable energy.

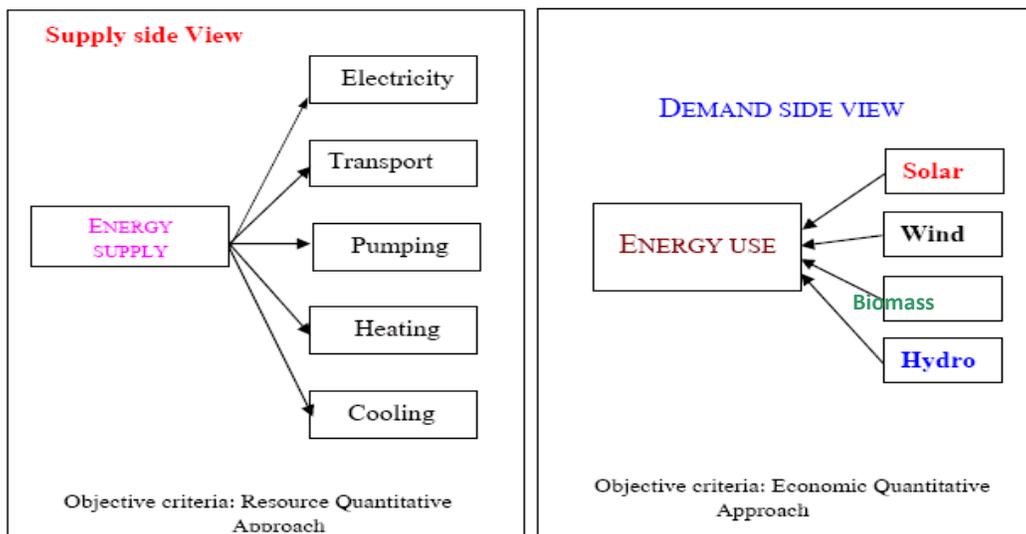


Figure 10 Supply side and demand side management approach for energy (Omer, 2008).

Energy resources are needed for societal development. Their sustainable development requires a supply of energy resources that are sustainably available at a reasonable cost and can cause no negative societal impacts. Energy resources such as fossil fuels are finite and lack sustainability, while renewable energy sources are sustainable over a relatively longer term. Environmental concerns are also a major factor in sustainable

development, as activities, which degrade the environment, are not sustainable. Hence, as much as environmental impact is associated with energy, sustainable development requires the use of energy resources, which cause as little environmental impact as possible. One way to reduce the resource depletion associated with cycling is to reduce the losses that accompany the transfer of exergy to consume resources by increasing the efficiency of exergy transfer between resources, i.e., increasing the fraction of exergy removed from one resource that is transferred to another (Erlich, 1991).

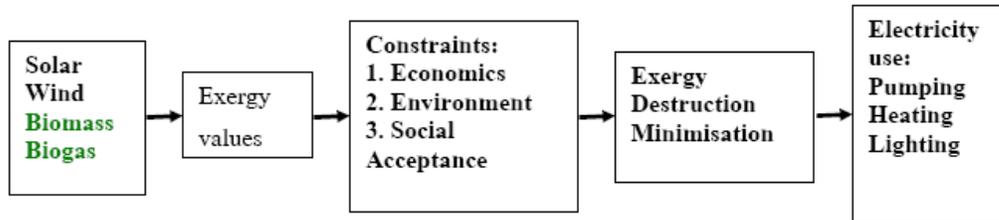


Figure 11 Exergy based optimal energy model (Omer, 2008).

As explained above, exergy efficiency may be thought of as a more accurate measure of energy efficiency that accounts for quantity and quality aspects of energy flows. Improved exergy efficiency leads to reduced exergy losses. Most efficiency improvements produce direct environmental benefits in two ways. First, operating energy input requirements are reduced per unit output, and pollutants generated are correspondingly reduced. Second, consideration of the entire life cycle for energy resources and technologies suggests that improved efficiency reduces environmental impact during most stages of the life cycle. Quite often, the main concept of sustainability, which often inspires local and national authorities to incorporate environmental consideration into setting up energy programmes have different meanings in different contexts though it usually embodies a long-term perspective. Future energy systems will largely be shaped by broad and powerful trends that have their roots in basic human needs. Combined with increasing world population, the need will become more apparent for successful implementation of sustainable development (Aroyeun, 2009).

Heat has a lower exergy, or quality of energy, compared with work. Therefore, heat cannot be converted into work by 100% efficiency. Some examples of the difference between energy and exergy are shown in Table 17.

$$\text{Carnot Quality Factor (CQF)} = (1 - T_o / T_s) \quad (5)$$

$$\text{Exergy} = \text{Energy (transferred)} \times \text{CQF} \quad (6)$$

Where T_o is the environment temperature (K) and T_s is the temperature of the stream (K).

Table 17 Qualities of various energy sources (Omer, 2008)

Source	Energy (J)	Exergy (J)	CQF
Water at 80°C	100	16	0.16
Steam at 120°C	100	24	0.24
Natural gas	100	99	0.99
Electricity/work	100	100	1.00

The terms used in Table 17 have the following meanings:

Various parameters are essential to achieving sustainable development in a society. Some of them are as follows:

- Public awareness.
- Information.
- Environmental education and training.
- Innovative energy strategies.
- Renewable energy sources and cleaner technologies.
- Financing.
- Monitoring and evaluation tools.

Improving access for rural and urban low-income areas in developing countries must be through energy efficiency and renewable energies. Sustainable energy is a prerequisite for development. Energy-based living standards in developing countries, however, are clearly below standards in developed countries. Low levels of access to affordable and environmentally sound energy in both rural and urban low-income areas are therefore a predominant issue in developing countries. In recent years many programmes for development aid or technical assistance have been focusing on improving access to sustainable energy, many of them with impressive results (Omer, 2006).

Apart from success stories, however, experience also shows that positive appraisals of many projects evaporate after completion and vanishing of the implementation expert team. Altogether, the diffusion of sustainable technologies such as energy efficiency and renewable energies for cooking, heating, lighting, electrical appliances and building insulation in developing countries has been slow. Energy efficiency and renewable energy programmes could be more sustainable and pilot studies more effective and pulse releasing if the entire policy and implementation process was considered and redesigned from the outset. New financing and implementation processes are needed which allow reallocating financial resources and thus enabling countries themselves to achieve a sustainable energy infrastructure. The links between the energy policy framework, financing and implementation of renewable energy and energy efficiency projects have to be strengthened and capacity building efforts are required.

8. CONCLUSIONS

Even with modest assumptions about the availability of land, comprehensive fuel-wood farming programmes offer significant energy, economic and environmental benefits. These benefits would be dispersed in rural areas where they are greatly needed and can serve as linkages for further rural economic development. The nations, as a whole would benefit from savings in foreign exchange, improved energy security, and socio-economic improvements. With a nine-fold increase in forest – plantation cover, the nation's resource base would be greatly improved. The international community would benefit from pollution reduction, climate mitigation, and the increased trading opportunities that arise from new income sources. Furthermore, investigating the potential to make use of more and more of its waste. Household waste, vegetable market waste, and waste from the cotton stalks, leather, and pulp; and paper industries can be used to produce useful energy either by direct incineration, gasification, digestion (biogas production), fermentation, or cogeneration. Therefore, effort has to be made to reduce fossil energy use and to promote green energies, particularly in the building sector. Energy use reductions can be achieved by minimising the energy demand, by rational energy use, by recovering heat and the use of more green energies. This study was a step towards achieving that goal. The adoption of green or sustainable approaches to the way in which society is run is seen as an important strategy in finding a solution to the energy problem. The key factors to reducing and controlling CO₂, which is the major contributor to global warming, are the use of alternative approaches to energy generation and the exploration of how these alternatives are used today and may be used in the future as green energy sources. Even with modest assumptions about the availability of land, comprehensive fuel-wood farming programmes offer significant energy, economic and environmental benefits. These benefits would be dispersed in rural areas where they are greatly needed and can serve as linkages for further rural economic development. The nations as a whole would benefit from savings in foreign exchange, improved energy security, and socio-economic improvements. With a nine-fold increase in forest – plantation cover, a nation's resource base would be greatly improved. The international community would benefit from pollution reduction, climate mitigation, and the increased trading opportunities that arise from new income sources.

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FLOODS AND RAINSTORMS IMPACTS, RESPONSES AND COPING AMONG HOUSEHOLDS IN ILORIN, KWARA STATE

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Abstract

Floods and rainstorms affect households each year in Ilorin and contribute to endemic poverty among the poor households in the city. Climate change and anticipated increases in extreme weather events will exacerbate this. This study examines the impacts of flooding and rainstorms in the city and the current responses and coping among the affected households. The social risk management (SRM) and asset-based approaches on which the study is based provide a conceptual framework for understanding the sequential links between risks; human exposure and sensitivity; the impacts of risky events; and risk management (or adaptation) strategies. Both primary and secondary data were used for the study. The secondary data include data from the Kwara State Emergency Management Agency (KSEMA) on flood victims in the State between 2007 and 2009 while the primary data is a structured questionnaire administered to flood and rainstorm victims randomly selected from the KSEMA records. This study brings out the important issue of vulnerability, coping and adaptation to weather induced disasters among the urban poor. A Multiple linear regression model tested shows that the house characteristics and neighbourhood quality contribute significantly to vulnerability to rainstorm and flooding. The study revealed that the indigenous coping mechanisms employed by the poor may become less effective as increasingly fragile livelihood systems struggle to withstand disaster shocks. Strategies to reduce vulnerability should be rooted in vulnerability analysis and greater understanding of both household-level and macro-response options that are available to decrease the poor's exposure to climate risk.

Keywords: Climate change adaptation, Disasters, Flooding, Vulnerability, Poverty.

1. Introduction

Disaster risk and climate change are two threats to human well-being that reinforce each other. Hence, they represent some of the greatest challenges to humankind in this century. Disaster risk is an intrinsic characteristic of human society, arising from the combination of natural and human factors and subject to exacerbation or reduction by human agency. While the adverse impacts of climate change on society may increase disaster risk, disasters themselves erode environmental and social resilience, and thus increase vulnerability to climate change (O'Brien et al, 2008, Gbadegesin et al, 2011). Climate change – and the likely increase in disasters – threatens to block pathways out

of poverty in developing countries especially those in Africa (Lemons and Tompkins, 2008) Any increase in disasters, whether large or small, will threaten development gains and hinder the implementation of the Millennium Development Goals (ISDR, 2008).

In the coming decades, climate change is expected to exacerbate the risks of disasters, not only from more frequent and intense hazard events but also through greater vulnerability to the existing hazards (ISDR, 2008). Approaches toward the management of climate change impacts have to consider the reduction of human vulnerability under changing levels of risk. A key challenge and opportunity therefore lies in building a bridge between current disaster risk management efforts aimed at reducing vulnerabilities to extreme events and efforts to promote climate change adaptation (Olorunfemi, 2008, Few et al. 2006)

The long term horizon of climate change and current scientific uncertainties pose special challenges. Strategies that address challenges recognise that there is no best solution. In this sense, climate change provides new incentives for the need to plan ahead and to anticipate extreme events and trends (Zevenbergen, et al, 2008). Within the context of extreme weather events especially flooding, this means that management strategies must meet the present needs while providing a path of adjustment for the future (Pahl-Wosll, 2006; Ashley et al., 2007; Miller, 2007).

Cities in developing countries are particularly vulnerable to climate change impacts, especially changes in rainfall (Vogel 2000), because of the exposure to extreme weather events and dependence on natural resources (Vogel, 2002). The vulnerability situation, the present and predicted impact of climate change on urban areas is particularly worrisome. According to Satterhwaite et al (2007), the scale of the devastation to urban populations and economies caused by extreme weather events in recent years highlights their vulnerabilities. Worldwide, there has been a rapid growth in the number of people killed or seriously impacted by storms and floods and also in the amount of economic damage caused; a large and growing proportion of these impacts are in urban areas in low- and middle-income nations. For instance, in Nigeria, flooding affected more than three million people in selected urban areas between 1983 and 2009 (EMDAT disaster database). Climate change is likely to have been a factor in much of this, but even if it was not, it is proof of the vulnerability of urban populations to floods and storms whose frequency and intensity climate change is likely to increase in most places.

Henderson (2004) revealed that the level of risk and vulnerability in urban areas of developing countries is attributable to socio-economic stress, aging and inadequate physical infrastructure. Indeed, according to Satterthwaite et al (2007), hundreds of millions of urban dwellers have no all-weather roads, no piped water supplies, no drains and no electricity supplies; they live in poor-quality homes on illegally occupied or sub-

divided land, which inhibits any investment in more resilient buildings and often prevents infrastructure and service provision. A high proportion of this are tenants, with very limited capacities to pay for housing – and their landlords have no incentive to invest in better-quality buildings. Most low-income urban dwellers face serious constraints in any possibility of moving to less dangerous sites, because of their need to be close to income-earning opportunities and because of the lack of alternative, well-located, safer sites. Nigerian urban areas are typical examples of this high level of risk and vulnerability (Olorunfemi, 2008; Olorunfemi and Raheem, 2007).

Successful national economies depend on well-functioning and resilient urban centres. Urgent action is needed now both to address urban centres' current vulnerabilities to extreme weather and to build into expanding urban centres protection from likely future changes (Satterthwaite et al, 2007). For most prosperous and well-governed cities, adaptation to the likely risks from climate change for the next few decades does not appear problematic. This centres on adapting buildings and infrastructure to the increasing risks; working with population groups and settlements most at risk to find solutions that serve them; and good disaster preparedness. But in developing countries, you cannot adapt infrastructure that is not there. The vulnerability of low-income urban dwellers to climate change is often ascribed to their poverty – but it is far more the result of failures or limitations in local government that ensure needed infrastructure is in place.

To date, the challenge of addressing urban floods and reducing urban flood vulnerability has received little attention (Zevenbergen, 2008). This is partly because in the traditional flood management approach, responses to mitigate urban fluvial and coastal flood risks have often been set outside the realm of the urban system (i.e. where confined to the catchment level), but also because responses at the city level were predominantly passive, using robust solutions such as urban defences and increasing the capacity of major culverts. The following major bottlenecks have been identified, which hamper the adoption and effective implementation of flood-risk management in urban planning practices (Sz"oll"osi-nagy & Zevenbergen, 2005):

- (i) Lack of understanding of current and future risks and implications at the city scale.
- (ii) Lack of long-term planning, poorly integrated and comprehensive planning.
- (iii) Inadequate controlling roles of local and regional authorities, and the conservative nature of the building sector.

While examining city development with particular reference to growth of slums and the impacts of climate change on inhabitants of four selected urban poor communities along the coast of Lagos (Makoko, Ilaje, Ijora-Oloye and Marine Beach-Apapa), Adelekan (2009) revealed that flooding is perceived the most important problem among surveyed

communities. From a list of problems encountered in the communities, flooding was ranked as the foremost problem. Other problems mentioned are bad roads, pollution, and infestation by mosquitoes, neighbourhood insecurity, poor power supply, unemployment and prevalence of diseases (Adelekan 2009). The interviewees highlighted several causes for flooding such as overpopulation of the communities, inadequate drainage system, increase in water level of lagoon, overflowing of rivers, blockage of canals due to improper waste disposal, sand filling activities in communities, neglect by government, and supernatural factors (Adelekan 2009).

Extreme weather events especially floods and rainstorms affect households each year in the city of Ilorin affecting the poorest and most vulnerable people in the city and contributing to endemic poverty in most parts of Kwara State. This study, therefore, focuses on the impacts and adaptation to these events city. The specific focus is on the people living in the poor, marginal areas. The study is driven by the underlying assumption that human vulnerability to natural disaster and, particularly, those expected to be amplified by climate change, illustrates the inter-relatedness of governance and environment related issues. Central questions are what generates vulnerabilities and what improves resilience in people's livelihoods, and how can we build on people's own responses, providing a range of institutional support, and promoting resilience and adaptive capacity among vulnerable people in the affected areas. The study supports the emerging view that places adaptation to shocks associated with climate change as a subset of disaster risk reduction.

The paper is divided into six sections. Following this introductory section is the conceptual framework that guided the conduct of the study. The third section provides a description of the study area followed by the methodology of the study in the fourth section. The fifth section, divided into different sub-sections, discusses the findings of the study. The conclusions of the study are presented in the last section.

2 Conceptual Framework

Urban environments are complex - socially, economically and physically. This complexity multiplies the risk which comes from increasing poverty and inequality and failures in governance, high population density, crowded living conditions and the siting of residential areas close to hazardous industry or in places exposed to natural hazard (including the modification of environments which generates new hazard, e.g. through the loss of protective mangroves to urban development, or subsidence following ground water extraction) (Pelling, 2008). This, combined with the cumulative nature of many environmental problems, makes it difficult to identify causal relationships when considering risk and vulnerability (Oelofse, 2002). Urban risk and vulnerability need to be understood in terms of the nature of risk, the causal mechanisms that shape people's response to them and the contingent conditions that provide the context within which

they occur. Many risk problems sit at the interface of the natural and social environment, such as flooding, which occurs as the result of the inadequate provision and maintenance of drainage systems, the location of people on marginal sites, and the physical characteristics of an area (Oelofse, 2002).

This study adopts the framework developed by Heltberg et al, (2008). The framework presents and applies the social risk management and asset-based approaches to the context of climate change. The social risk management (SRM) and asset-based approaches provide a conceptual framework for understanding the sequential links between risks; human exposure and sensitivity; the impacts of risky events; and risk management (or adaptation) strategies. This provides a unifying conceptual framework to examine the characteristics of the risks faced by households; how adaptation responses at multiple levels depend on livelihoods, policies, and institutions; and household vulnerability outcomes. It highlights the importance of a multidimensional and equitable approach to adaptation policy and the need to include higher level (national and international) risk management interventions. This includes social policy and social protection interventions to build resilience at the household level through improved human and physical capital and access to risk management instruments such as safety nets and insurance.

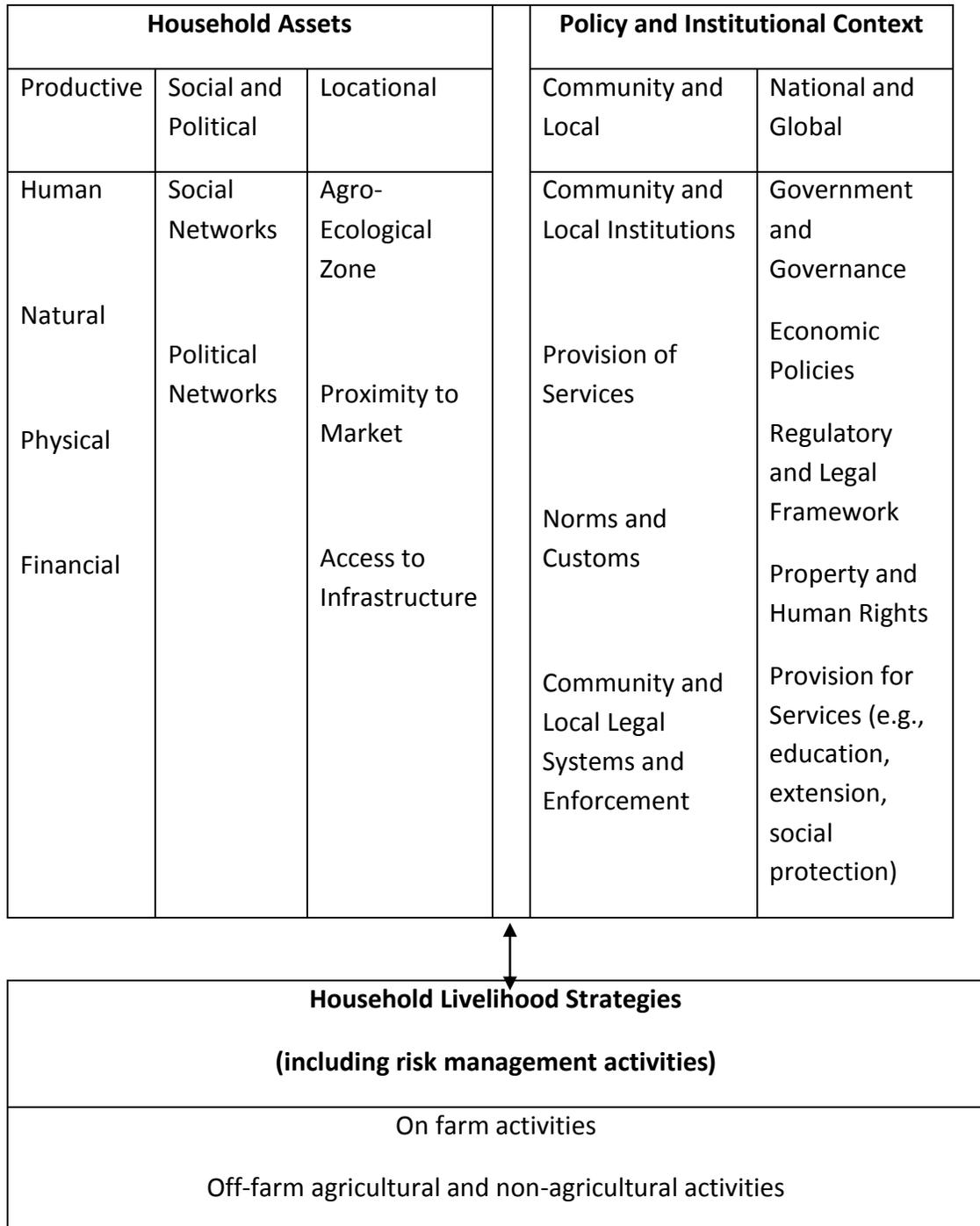
This analytical framework helps focus on the sequential links between climate risks, human vulnerability, and interventions to help manage vulnerability to climate change. The framework is consistent with IPCC (2001) definitions of vulnerability and adaptation and highlights that:

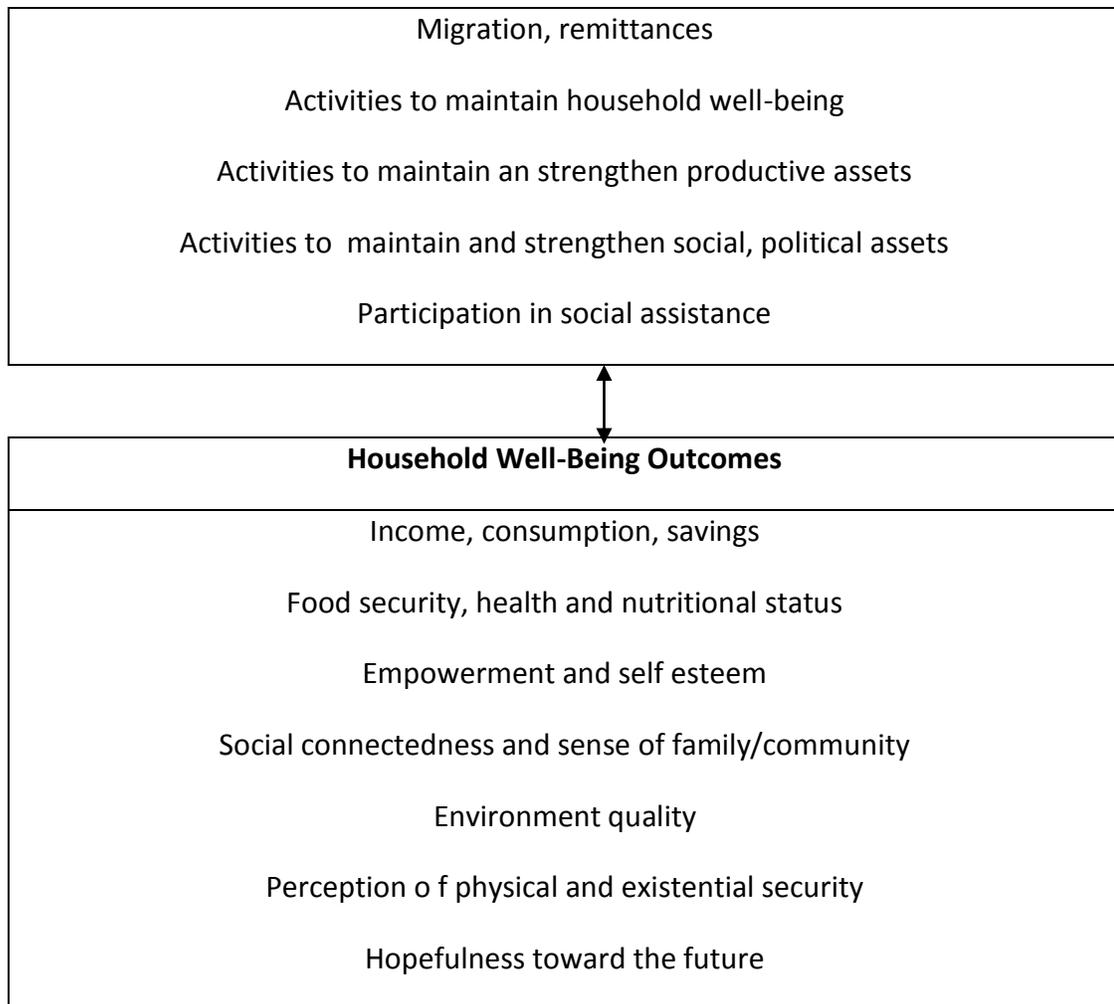
- 1) All households and individuals face risks associated with climate change, but not all are vulnerable. Vulnerability is a function of risks, exposure and sensitivity and adaptive capacity, and depends on the relationship between losses and some benchmark indicator of household well-being (e.g., a poverty line).
- 2) The exposure and sensitivity of household assets and livelihoods to climate change and their adaptive capacity are to a large extent shaped by policies and investments outside of their direct control.
- 3) Risks related to climate change can impact household assets, livelihoods and well-being directly and indirectly, so a multi-dimensional approach to risk management is required.
- 4) Ex-ante management of climate related risks, especially those that lower exposure and sensitivity of assets and livelihoods, can strengthen household assets and increase returns on assets, thereby contributing to improved livelihoods and well-being.
- 5) Climate risk management (or adaptation) has to be multidimensional and span interventions at household, community, national, and (increasingly) international level.
- 6) Institutions and good governance are keys to a multidimensional and multisectoral approach to improved adaptation to climate change.

Thus, household livelihoods and well-being depend on the interface between assets (broadly defined), the policy and institutional context, and risks (Figure 1). Risk affects the expected returns and variance of returns on assets and livelihood strategies, and therefore household well-being and future asset accumulation. Households are poor because they have limited quantity and quality of assets; and their assets have low expected returns and high variance of returns. The combination and flexibility of assets

also matters: Poor and vulnerable households tend to lack key assets and whatever assets they have are not mobile and of poor quality and location. Many poor rural households are also landless and depend on selling their labour, which is typically of low quality in terms of education, skills, and health and nutritional status. Furthermore, because of gender, class, or caste, some individuals and households can have limited access to markets and livelihood opportunities, including migration. This, in turn, limits labour productivity and returns to human assets.

Figure 1: Schematic Presentation of Asset-Based Approach





Source: Heltberg et al, 2008

3 The Study Area

Ilorin, the capital city of Kwara State, Nigeria, is the setting for this study. The city is located on latitude 8° 10'N and longitude 4° 35'E marking a divide between the southern forest Zone and the Northern grassland of Nigeria. The vegetation, in most parts, is guinea savanna interspersed by trees of different species. The dominant streams are Asa, Aluko, Okun, Amule, and Agba. The Asa River is of particular influence on the direction of growth of the city. The situation of the city between the dry North and the wet South of Nigeria gave Ilorin the apt description as the "gate way" between the North and the South of the country" (Adedibu, 1980). The climate is therefore tropical wet and dry characterized by a distinct wet and dry seasons. The mean annual temperature is about 26.80°C with five hours average daily sunshine. The mean annual rainfall is about 125mm. It is important to note that the above locational and physiographic characteristics possess (sometimes significant) implications for human health on one hand and economic and social development on the other.

Ilorin is a typical traditional African city whose urban history predates colonialism in Nigeria. The city therefore falls into the category of third world cities described as reputed for their dualistic internal structure (Mabogunje, 1968). The physical development of Ilorin also translates into significant change in the population of the city. For instance, from 36,300 inhabitants in 1911, Ilorin has a population of about 208,546 in 1963, 532,088 people in 1991 and a projected population of about 765,791 by the year 2006 at the rate of 2.84% annually. The facts of urbanization, development of the modern commercial/industrial economy and the multiplier effects of these factors on natural increase had combined to produce the changes in population described above. Figure 2 is a map of Kwara State showing Ilorin.

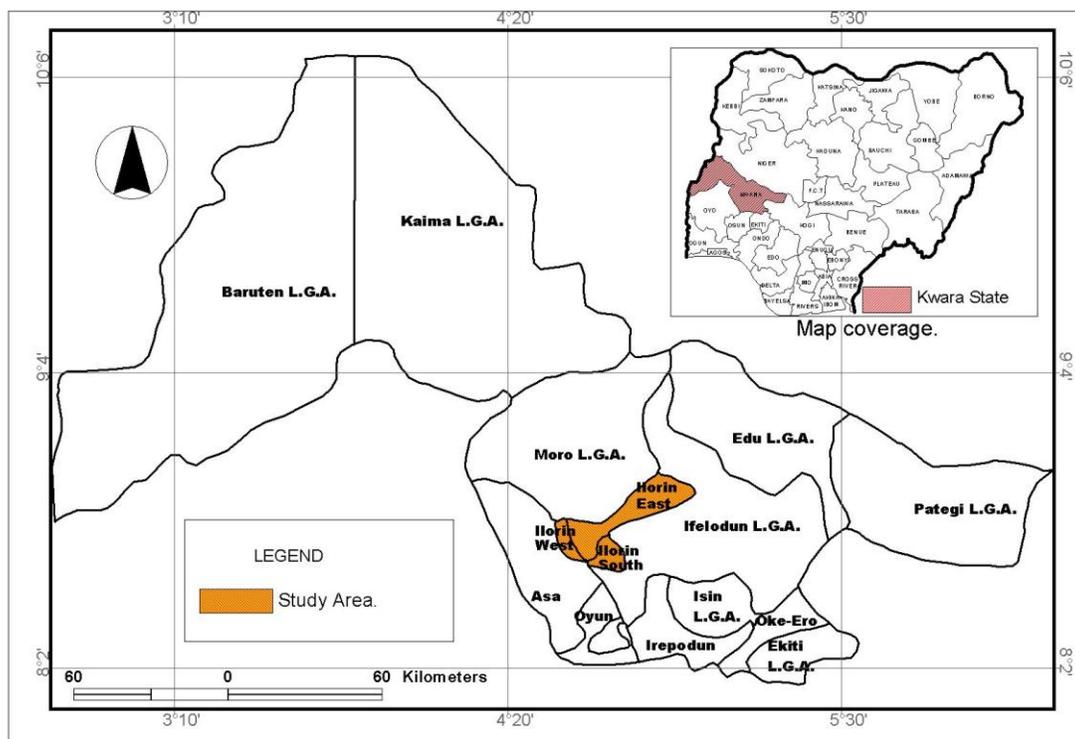


Fig. : Map of Kwara State showing the Study area.

Fig.2: Map of Kwara State showing the Study Area (Inset: Map of Nigeria).

Frequent rainstorms and flooding in Ilorin has made it one of the most vulnerable cities in Nigeria in the recent past. The number of such incidents has been on the increase in the last few years. As shown in Table 1, apart from the fact that the number of incidents have increased, so also has the severity which translates into extensive damage to properties and the livelihoods of the people.

Table 1: Rainstorm and Flooding Incidents in Ilorin, 2002-2007

Year	Rainstorm/Flooding Incidents	Severity*
2002	4	High

2003	2	Moderate
2004	4	Moderate
2005	6	High
2006	6	High
2007	8	High
2008	7	High

* Severity in terms of number of people affected and economic losses

Source: Kwara State Emergency Management Agency's records

4 Data and Methods

In order to study the vulnerability and adaptation of flood victims in Ilorin, the study utilized both primary and secondary data. The secondary data were collected mainly from the National Emergency Management Agency, Kwara State office. The data collected include those on rainstorm and flooding between 2007 and 2009. A record of about 1115 houses was affected by various these incidents during this period. Aside this, data were collected form households that occupied the properties destroyed by rainstorms and floods during the period under review. Thus, a total of 110 households were sampled, representing approximately 10% of the total number of households that were located during the preliminary survey.

A structured questionnaire was administered to them in addition to oral interviews and on the spot assessment of the victims' houses to determine the extent of damage to properties. The questionnaire elicited information on the socio-economic characteristics of the victims, their opinion of government handing of the situation, their coping mechanisms with the disaster incidents as well as their adaptation measures. The questionnaire also elicits information on how the disaster affected their livelihood systems. Furthermore, the victims were asked about their perception of the causes of frequent rainstorms and flooding incidents, and their understanding of climate changes issues. Data were collected on the characteristics of the victims' houses and neighbourhood characteristics.

Ilorin is traditionally divided into 4 socio-cultural and economic areas namely, the estates, inner city, frontier native areas and the suburban. These areas are further subdivided into 20 wards. Using the data obtained from NEMA in respect of the number of buildings affected by rainstorm and flooding, the data was organized according to wards from where a map was used to show the spatial variation in flooding/rainstorm severity among the wards (see Figure 3). Furthermore, a multiple linear regression

model was tested to see the determinants of the vulnerability of houses to rainstorm and flooding. Specifically, the model was designed to see how housing and neighbourhood characteristics determined the impacts of rainstorm and flooding on houses. The dependent variable was represented by the number of houses affected by rainstorm and flooding. The independent variables used for the model were the characteristics of the buildings such as age, materials for the wall and the roof etc (these constitute the house quality). Apart from house characteristics, neighbourhood attributes were also used. The neighbourhood attributes were aggregated into one variable called the neighbourhood quality index. Neighbourhood quality index (NQI) was derived from composite of variables which include presence or absence of tarred roads, drainage, solid waste collection system, green areas, odour, health facilities, and pipe borne water. Where a variable is available it is 1 and otherwise 0.

The model was then formulated as follows:

$$\text{NHD (Y)} = b_1 (\text{HTT}) + b_2 (\text{HCB}) + b_3 (\text{HIR}) + b_4 (\text{DT}) + b_5 (\text{NQI})$$

Where:

Y (NHD)	Number of houses destroyed
X ₁ (HTT)	Number of houses older than 20 years
X ₂ (HCB)	Number of houses constructed with materials other than concrete blocks
X ₃ (HIR)	Number of houses with inferior roofs
X ₄ (DT)	Dwelling type
X ₅ (NQI)	Neighbourhood quality

5 Results and Discussions

5.1 Socio-Economic Characteristics of Respondents

The results of the analyses provided in Table 2 shows that males constituted the highest percentage of respondents (74.6%). This is not surprising considering the fact that most households in the city are male headed due largely to socio-cultural and religious factors. More than two thirds of those interviewed are married (86.4%). Also, more than two thirds are above 36 years of age. Specifically, the largest proportions of the respondents (40%) are above 50 years of age. Again, this is not surprising considering the fact that most of the inhabitants of the core/indigenous areas which are often mostly affected by flooding/rainstorm are old people. With respect to the level of education obtained, 16.4% have no formal education while only 14.6% have tertiary

education. Most of the respondents are artisans (38.2%), 28.2% farmers and another 20% are traders. It is clear from the results that only 9.1% of the respondents are engaged in the formal sector. With respect to the household size, close to 80% of the respondents have more than 4 people in the household.

Table 2: Socio-Economic Characteristics of Respondents

Socio-economic Characteristics		Frequency	Percentage
Sex	Male	82	74.6
	Female	28	25.5
Age	20 and below	-	-
	21-35	28	25.5
	36-50	38	34.6
	Above 50	44	40.0
Marital status	Single	9	8.2
	Married	95	86.4
	Others	6	5.5
Education	No formal education	18	16.4
	Primary	36	32.8
	Secondary	40	36.4
	Tertiary	16	14.6
Occupation	Civil servants	10	9.1
	Farming	31	28.2
	Artisan	42	38.2
	Trading	22	20.0
	Unemployment/retired	5	4.6
Household size	1-3	27	24.6
	4-6	43	39.1
	7-10	28	25.5
	10 and above	12	10.9

Source: Authors' Analysis

5.2 Spatial Pattern of Flooding/Rainstorm incidents in Ilorin

An analysis of the Data obtained from KWEMA office shows that the impacts of the flooding/rainstorm disaster incidents were more in the traditional, core areas of the city going by the number of properties damaged. Figure 3 is a map of Ilorin showing the severity of the disaster incidents between 2002 and 2008.

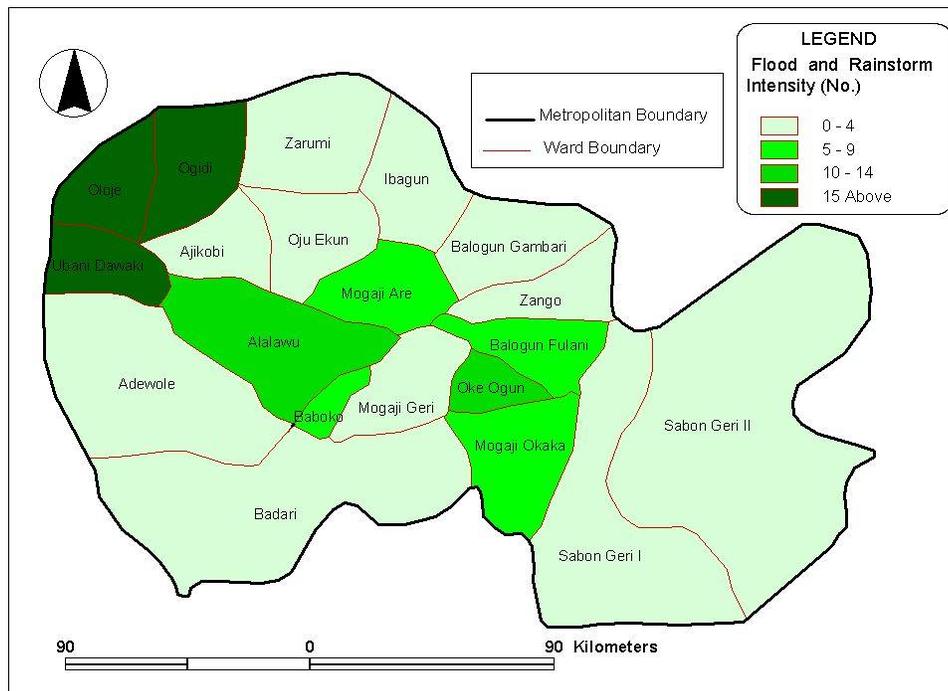


Fig. : Map of Ilorin Metropolis showing the Severity of Flood and Rainstorm intensity.

It should be noted that the traditional, core areas of the city are characterised by high population and the people in these areas are most at risk of all environmental emergencies. This is because basic infrastructures are either not available or old and weak. The houses are also too old or are made of low quality materials. The existing situation has increased the anxiety on the part of the people that future incidents will continue to have higher impacts. The next section which discusses the characteristics of the affected buildings from data collected from the field further confirm the fact that most of the buildings in most parts of the city especially the core, indigenous areas cannot withstands rainstorm or severe flooding whenever they occur.

5.3 Characteristics of affected Buildings

The structure of a building directly affects its resistance to rainstorm and flooding, and the houses are not of very good materials. As shown in Table 3, more than half (60%) of the houses are more than 30 years of age, more than one third (37.3%) constructed with mud bricks. About 64.6% roofed with metal sheets which have turned brownish and fragile over the years. More than two third of the houses have their floor made with earthen floor, out of which about 12.7% are not plastered at all. The houses are mostly

multi family houses (35.5%). The implication of this is that more people are exposed to risks when ever disasters strike in the area, especially the core/indigenous areas. Poor waste collection system leads to drainage blockage. Drainage channels in the modern parts of the city are not open enough to allow free flow of water during heavy rainfall. In the core, indigenous areas, drainage channels are currently non-existent.

Table 3: Characteristics of affected Buildings

Characteristics		Frequency	Percentage
Age of building (years)	1-10	4	3.6
	11-20	12	10.9
	21-30	28	25.5
	31-40	51	46.4
	42 and above	15	13.7
Materials for External wall	Bricks	65	59.2
	Concrete plates	3	2.7
	Mud bricks	41	37.3
	Wood logs	1	0.9
Materials for the roof	Asbestos sheets	10	9.1
	Metal sheets	71	64.6
	Tiles	2	1.8
	Mood thatch	17	15.5
Material for the floor	Tile	12	10.9
	Concrete	18	16.4
	Plastered earthen floor	66	60.1
	Unplastered earthen floor	14	12.7
Type of dwelling	Detached house	10	9.1
	Multi family house	39	35.5
	Separate apartment	7	6.4
	Rooms in a large dwell	36	32.8
	Others	18	16.4

Nature of ownership	Owner occupied	43	39.1
	Family owned	45	40.9
	Rented house	18	16.4
	Others	4	3.6

Source: Authors' Analysis

The result of the multiple linear regression model tested to see the determinants of the vulnerability to rainstorm and flooding shows that the house characteristics and neighbourhood quality contribute significantly to vulnerability to rainstorm and flooding. The 'R' value obtained for the model is 0.65 while the R^2 is 0.43. This result is interpreted to mean that the independent variables contribute 43% to the explanation of the determinants of vulnerability of houses to flooding. Furthermore, the unstandardized regression coefficients shows that HTT (age of building) contributed most to this explanation among the independent variables.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.595	6.058		1.089	.295
	VAR00001 HTT	.251	.863	.091	.291	.775
	VAR00002 HCB	5.927E-02	.494	.029	.120	.906
	VAR00003 HIR	-.592	.793	-.201	-.746	.468
	VAR00004 DT	8.001E-02	.669	.030	.120	.907
	VAR00006 NQ	-6.625	2.408	-.594	-2.751	.016

a. Dependent Variable: VAR00007 NHD

5.4 Impact of Flooding on Livelihood Systems

Flooding and rainstorm, apart from causing destruction to lives and properties often cause significant damage to livelihood systems of the victims. When asked the various ways by which the flooding and rainstorm disasters have eroded their livelihood systems, pauperisation and health problems appear to be the major dimension. For instance, as lamented by some respondents, the incidents generally caused disruption of electricity in some areas for months affecting trading and crops washed away on farms, especially among those in the suburban. It should be noted that when electricity supply is unavailable for some time, it slows down economic activities among the traders and the artisans which, incidentally, constituted the highest proportions of those affected. Furthermore, the disasters are associated with a number of health problems including bodily injuries as well as the attendant psychological trauma. According to one of the victims, "when one's health is affected by disaster incidents, it becomes difficult,

if not impossible, to continue with one’s means of livelihood”. According to him, “this is the singular most worrisome aspect of disaster impact”. The post disaster adjustment would have been easier if relief comes from government and non-governmental organisations on time.

A number of women in the inner city and Frontier Native areas depend on irrigated vegetable farming around the flood plains of Asa, Aluko and Amule- the three dominant streams that flow in most parts of the metropolis. During flood events, vegetable farms are washed away and the land remain flooded for a long time after. Women are rendered unemployed for upwards of three months when they can start all over. To worsen this situation, poor urban women’s economy is not diversified and thus entrenching the regime of poverty.

5.5 Coping mechanisms employed by Victims

Poor communities can be especially vulnerable, in particular those concentrated in high-risk areas. They tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies (see Satterthwaite et al, 2007). The victims were asked how they coped with the immediate impact of the flooding/rainstorm disaster and the adjustment process. The results presented in Table 4 shows that by and large, support from friends and relatives and personal savings accounted for the way large proportion of the victims cope with the immediate impacts of the disaster. Even though government support came for most of them, many of the victims said the support did not come on time and it did not measure any closer to the degree of impacts suffered by the victims. This calls to question the level of disaster response in Nigeria. It is an accepted fact that the agency charged with disaster management in Nigeria (NEMA) is incapable of responding promptly and managing the various disasters that had occurred in Nigeria in recent years. A major problem has been in the areas of funding and lack of modern equipment to respond to disasters in the country. According to some of the victims, many of them did not get relief materials until after six months especially those that had to do with materials to repair or rebuild damaged properties. The coping mechanisms employed by victims as presented in Table 4.

Table 4: Coping Mechanisms employed by Victims

	*Frequency	Percent
Personal savings	29	23.7
Support from friends and relatives	50	41.0
Borrowing from local money lenders	11	9.0

Borrowing from banks	6	4.9
Government donations	26	21.3

*** multiple sources of coping mentioned by respondents**

Source: Authors' Analysis

5.6 Adaptation measures to Rainstorm and Flooding Disasters

Given the existing low level of knowledge of victims about climate change issues, it became difficult to elicit information from them on how to adapt to the problems. Interviews with the victims on adaptations measures they would need or are currently using reveals that two broad measures are required. These are the short term and the long term measures. Immediate, short term measures include improvement in the waste collection system and in the core areas, introduction of waste collection system to avoid drainage blockage. Secondly, drainage channels in the modern parts of the city have to be opened to allow free flow of water during heavy rainfall. But in the core, indigenous areas, drainage channels would have to be constructed because they are currently non-existent.

Furthermore, some of the victims especially those who are traders and artisans have decided not to keep too much of their goods in stock during the raining season to avoid heavy losses. Some also have decided to imbibe banking culture by keeping their money in the banks. There is, however, no mention of insurance among the respondents. It's something that is strange to more than 70% of them.

The long term measures proposed by the victims include reinforcement of the houses in the indigenous areas or complete rebuilding of some of the houses. However, when asked if the victims would be willing to relocate from their present areas especially those in the worse hit areas, many of them said that they have never contemplated such as move. This was especially true among the old.

As easy as some of these adaptation measures may seem, the existing level of poverty may hinder any of such measures. This is why government at the state and local level must come in. government need to put in place measures to reduce the remote factors that exacerbate the intensity and impacts of flooding and rainstorm. Such measures include construction of drainage channels in all parts of the city, improved waste collection system in the city. The government would need to support both the victims and the non victims in reinforcing the existing weak structures in most parts of the city and especially in the indigenous area. But more importantly, there is need for government to enforce building regulations and to improve on city governance.

6 Conclusion

This study brings out the important issue of vulnerability, coping and adaptation to disasters caused by extreme weather events among the urban poor. It examined in some detail the strategies adopted by poor neighbourhoods as disasters impact on their livelihood systems and the sequence of responses which they employ over time as they struggle to cope. The study revealed that the indigenous coping mechanisms employed by the poor may become less effective as increasingly fragile livelihood systems struggle to withstand disaster shocks. Also, many of these long-term trends are rendering indigenous coping strategies less and less effective and thus are increasing the vulnerability of the poor.

It seems increasingly accepted (although not consistently implemented) that disasters shouldn't be dealt with through humanitarian relief interventions alone as revealed in this study. There is some evidence to support the argument that disaster management response in the city, just like in other areas in Nigeria, should shift away from this traditional response approach to focus increasingly on addressing the causes of vulnerability in order to mitigate the effects of disaster. However, the approach tends to address only the visible signs of vulnerability, such as poor access to services, and generally fails to make a deeper analysis based on the maintenance of sustainable livelihoods by vulnerable people.

The result of the study is expected to be useful in designing appropriate institutional interventions capable of transiting victims from being painful victims to developing adaptive capacity to live with recurring floods in Nigeria. Most studies indicate, with sufficient evidence, that climate will continue to change with far reaching implications on the environment and human livelihoods. Strategies to reduce vulnerability should be rooted in vulnerability analysis and greater understanding of both household-level and macro response options that are available to decrease the poor's exposure to climate risk. Increasing the response-capability of Nigeria will require information on seasonal forecast to enable the preparedness to climate variability as well as longer term climate prediction data to ensure that strategies to reduce vulnerability also reflect the underlying longer-term climate trends.

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MODELING FARMERS' DECISIONS ON SOIL NUTRIENTS IN URBAN AGRICULTURE: THE CASE OF CAMEROON

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Abstract

Urbanization and rising food demand in Sub-Saharan Africa pose the problem of land degradation and the resulting decisions adopted by farmers concerning soil fertility. The purpose of this study is to identify the determinants of different soil nutrient options available to urban farmers: no fertilizers at all, compost only, a mix of compost and inorganic fertilizers, and inorganic fertilizers only. To this end a binomial Logit model and an ordered Logit model were tested among 288 farmers in five quarters in the cities Yaoundé and Bafoussam in Cameroon. Results suggest that: 36% of farmers apply either exclusively only compost or compost combined with fertilizers; 23% of farmers use no fertilizers at all; 41% use inorganic fertilizers exclusively. Land property rights, horticulture, chemical input expenditures and ultra short distance between the homestead and the crop field (< 500 m) explain organic fertilization adoption. Thus, the implementation of small composting units disseminated in the lowlands would contribute to recycling the large, organic fraction of municipal solid wastes, and consequently, contribute in improving soil fertility for city supplies.

Keys words: Solid waste, Compost, Inorganic fertilizers, binomial Logit, Ordered Logit

Introduction

Urbanization and rising food demand in Sub-Saharan Africa pose the problem of land degradation and the resulting decisions adopted by farmers concerning soil fertility. The level of urbanization in West Africa increased from 14% in 1930 to 40% in 1990, and is expected to exceed 60% in 2020 (Cour, 2001). At the same time, the agricultural sector provides income to more than half of the West African population (United Nations, 2006 WDR, 2008).

As a result urban agriculture expands as large portions of the African population still earn a living from the agricultural sector although they now live in an urban setting. Moreover, in the next decade there is little evidence that the share of the population earning a living from farming as a primary or a secondary source of income will decline. The agricultural sector provides a substantial share of income for the urban poor a population with limited access to credit and assets, and highly subject to risk and precariousness (Zezza and Tasciotti, 2010).

The rising food demand in Sub-Saharan Africa generates an agricultural intensification process which also affects urban agriculture (Cour, 2001, de Bon et al., 2010). Urban agriculture is in the midst of an intensification process caused by land scarcity, small-farm size, real estate competition and the need of inorganic inputs for high value crops such as horticultural crops

(Gockowski and Ndoumbé, 2004; Parrot et al., 2008).

Distance and population densities positively affect the intensification process through lower transaction and transport costs (Cour, 2001; Zaal, 2002). Moreover, the intensification process embedded with urban agriculture involves millions of people generating a high collection of heterogeneous situations from part time unskilled workers to full time professional farmers.

Among the challenges posed by urban growth and the agricultural sector, incentives will increasingly be required for both improved yields and soil conservation. Land degradation, one of the major risks facing urban agricultural production, is due to the scissor effect of land scarcity due to urban pressure and simultaneously, higher domestic foods demand. Soil amendments among small-scale farmers are affected by the distance from the homestead to the crop field. Tittonell (2007) suggests that distance from the homestead positively affects decreasing crop performance as farmers invest more effort and resources in the more productive and less risky fields. Other studies suggest that distance also positively affects inorganic input use (Nkamleu and Adesina, 2000) and negatively affects domestic waste use (Parrot et al., 2009a).

Diversity of situations is also a major factor characterizing soil inputs among small scale farmers in Africa. Thus, agricultural innovation and technical toolkits, destined for small scale farmers in Africa, need to target socially diverse and spatially heterogeneous farms and farming systems (Larson, 1996; Pender, 2004; Tittonell, 2010; Berkhout et al., 2011). At the same time, innovation and toolkits should also consider, as spatially heterogeneous, the processes of nutrient depletion and soil degradation that limit productivity (Tittonell, 2005).

Distance and diversity of situations are major features for urban agriculture. Urban agriculture is defined by the growing of plants and the raising of animals for food and other uses within and around cities and towns (Veenhuizen, 2006). It is characterized by the diversity of the socio-economic profiles of its actors and their varying income and livelihood strategies, a reflection of the diversity of the labor and capital basis in urban areas (de Bon et al., 2010).

Several constraints are well documented for compost adoption. Its quality per se (heavy metal components and Nitrogen contents) may not meet the requisites for convenient soil amendments resulting in differing real and commercial values (Palm et al., 1997, Folefack, 2009). Compost would therefore require additional ingredients such as poultry manure, all depending on soil characteristics. The composting process may be too laborious and poorly conducted. Transport costs are also a major constraint for disseminating compost material among farmers (Danso et al., 2006). However, a judicious combination of both fertilizers and compost based on their complementary characteristics is an effective way of maintaining soil fertility (Vanlauwe et al., 2002).

Organic fertilizer adoption, such as compost as a complement to inorganic fertilizers, needs to be considered not just for safe and sustainable urban agricultural practices but also for improved municipal waste recycling. Organic fertilizer adoption can contribute to alleviate the burden of public services for municipal solid waste collection in sub-Saharan cities. Several factors act in favor of a renewal of interest for improved compost adoption for sub-Saharan

urban agriculture. First, compost combined with fertilizers provides useful soil nutrients and organic matter which can maintain or improve soil qualities (Palm et al., 1997; Adamtey et al., 2009). Second, standard socioeconomic determinants of adoption factors increasingly act in favour of compost adoption: small-farm size, short distances between homestead and crop field, consumer demand, market access, and positive trends in education among people. Third, municipal solid waste composition in sub-Saharan countries provides between 17 and 80% of organic fraction for composting (Sharholy et al., 2007; Troschinetz and Mihelcic, 2008; Adamtey et al., 2009). Therefore, a compost industry could contribute to recycling significant portions of municipal solid wastes in a context where the municipal waste collection rates in sub-Saharan countries range only between 5 and 40% (Troschinetz and Mihelcic, 2008).

Studies in Cameroon conducted in the 1990s stressed the different pathways of adoption for organic and inorganic fertilizers among farmers and the danger of generalizing the results. At that time extension services and NGOs were widely performing at country level (Nkamleu, 2007). The economic crisis in the 1990s disrupted their activities despite a surge in urban farming (Page, 2002). Other studies in Cameroon underlined the institutional complexity and gap between formal and informal waste management practices at a municipal level (Manga et al., 2008).

The purpose of this study is to focus on the determinants of adoption of compost and the determinants of adoption of different soil nutrient options available to farmers, from no fertilizers at all to only inorganic inputs for soil fertility. The results are expected to suggest institutional recommendations not only in terms of agro-economic research but also in terms of institutional recommendations for municipal waste collection stakeholders.

This paper is organized as follows. Section 2 presents the survey areas in Cameroon, the surveys, and the two adoption models. The binomial Logit model estimates the probability that a farmer adopt compost; the ordered Logit model estimates the probability that a farmer adopt organic fertilizers to a given threshold. Section 3 presents the various input adoption, pathways for soil nutrients among farmers derived from the two models and the variables significant for both models. Section 4 discusses the results and suggests policy recommendations.

1. Methods and models

Cameroon is a developing country in Central Africa with a land area of 475 650 km² and a population of 18.674 million in 2007 (INS, 2008). This country is bordered by Nigeria to the west, Chad to the northeast, the Central African Republic to the east, and Equatorial Guinea, Gabon, and the Republic of the Congo to the south. Cameroon is divided into three major climatic zones, an equatorial zone, a Sudanian zone, and a Sudano-Sahelian zone. Both Yaoundé and Bafoussam are located in the equatorial zone. The equatorial zone extends from 2 to 6° N and is characterized by abundant rainfall (mean 2000 mm/year). The urban population increased from 28.5% of the total population to 52.8% between 1976 and 2003; by 2030, it is expected to reach over 70% of the population (INS, 2004; 2008). Over the same 1976-2007 period, the population density in Cameroon increased from 16.4 inhabitants per km², to 40.7 inhabitants per km² (INS, 2008). The rural sector employs about 60% of the working population (MINADER, 2006). Informal farming accounts for 10% of employment in Cameroon and at least 3% in Yaounde

(INS, 2005).

1.1. Survey methodology

The surveys covered five different quarters in two cities of Cameroon between 2005 and 2009: Yaounde in the Centre province and Bafoussam in the West province. The cities of Yaounde and Bafoussam and their respective quarters cover a high collection of heterogeneous situations for small scale farming. However, their main characteristics are medium to high land pressure due to the urban growth.

Table 1 : Population densities for Bafoussam and Yaounde

		1987		2007	
	Area (km ²)	Population	Density	Population	Density
Mifi division	402	202 193	503	345,891	860
Mfoundi division	297	703 588	2 369	1 481 661	4989
Yaounde	180	578 000 (1985)*	3211	1,801,000 (2010)*	10005
Cameroon	466 050	10 493 655	23	18 674 600	40

* World Urbanization Prospects, the 2009 Revision.

Source: INS (2008)

Table 1 reveals that Yaounde and Bafoussam are both located in relatively high population densities. They are also subject to the lowest poverty rates compared to the rest of the country, i.e., 5.9% and 28.9% respectively, against 40% in the country (INS, 2008).

Yaounde is located in the Central Region of Cameroon over a series of hills and lowland areas (valleys and swamps), at an altitude between 750 and 1200 meters. The city benefits from an equatorial climate, hot and humid, characterized by moderate rainfalls (mean annual rainfall around 1617 mm). There are two wet seasons and two dry seasons, but the mean temperatures vary little with time, around 23.3°C (Mühr, 2007). The population of Yaounde expanded from a hundred thousand inhabitants following its independence in 1960, to up to 1.8 million in 2007 (INS, 2008; Fodouop and Bopda, 2001). Only 30% of all roads are paved which poses serious concerns for efficient municipal waste collection. A total of 60.2 per cent of the population of Yaounde lives in temporary housing.

Bafoussam is located in the West Region of Cameroon at 366 km north-west of Yaounde, the most densely populated region of Cameroon, around 169 hab/km². Bafoussam benefits from a subequatorial climate tempered by its altitude around 1450 meters in highlands ranging from 1500 to 2500 meters. There is a dry and a wet season. The mean annual rainfalls are around 1800 mm/year. The population of the city was around 269,530 according to the 2005 Census.

The data for Yaounde were collected between August and September 2005 in three lowland areas of the city. Lowlands are defined here as areas that are subject to some degree of annual flooding and comprise wetlands, swamps, inland valleys and flood plains. In a city like Yaounde, lowlands are not only a source of nuisance but are also considered as not constructible by the municipality. Therefore, real estate investments do not jeopardize farming activities. There are twelve lowland areas in the city stretched out along the various rivers crossing the city, ranging from downtown to the peri-urban suburbs of the city. According to the National Institute of Statistics in Cameroon, there is no official census available nor any statistical information available for the population living in these areas. The lowland areas were selected according to their location, their general characteristics and the general livelihood profiles of the dwellers. Our statistical unit was the household but information was collected at the individual level for all members of the family. Specific information was collected for each farmer and its crop fields.

The data for Bafoussam were collected after a preliminary survey identified the main horticultural production areas. Two lowlands areas were then selected, Diembou and Njingah quarters, both located in the Bafoussam I subdivision according to the presence of extension service officers, farmers organizations, vegetable and horticultural production. The decisive factor in selecting these areas was the presence of extension services destined to train and assist farmers. Table 2 presents the main characteristics of the five selected lowland areas in Yaounde and Bafoussam.

Table 2 : Main characteristics of the 5 selected lowland areas of Yaounde and Bafoussam

	Yaounde			Bafoussam	
	Nkolondom	Etoug-Ebe	Ekozoa	Diembou	Njingah
Numbers of farmers interviewed	N = 52	N = 43	N = 31	N = 84	N = 78
Location	8 to 9 km from downtown	10 km from downtown	Downtown	4 km from downtown	8 to 9 km from downtown
Cleanliness	Clean	Dirty	Relatively clean	(Relatively clean)	(Relatively clean)
Land pressure	Medium	High (real estate pressure)	High (squatters)	High (real estate pressure)	Medium
Crops	Condiments and vegetables	Staple crops	Flowers and vegetables	Maize, beans, cabbage, coffee	
Farmer's problems	Risk of expropriation, increasing	Seasonal floods in the lowlands,	Marginalization of farmers in building sites	Rare high quality inorganic and seeds inputs, declining soil	

urbanization, lower production	fear of expropriation	for installation of parks	fertility, poor access to market
--------------------------------------	--------------------------	------------------------------	-------------------------------------

Note – All 31 farmers from Ekozoa were interviewed.

Table 2 displays the areas selected in Yaounde and Bafoussam. These areas differ according to their location in the city, their cleanliness related to the pollution level, land pressure due to the urban growth, the agricultural production and the major problems expressed by the farmers. The lowlands of Nkolondom are located between 8 and 9 km away from downtown Yaounde in a more rural environment with much less land pressure from the urban growth. This area can be qualified as a peri-urban area with a part of the crop production used to supply several markets in Yaounde. A paved road makes access to market relatively easy for farmers. The lowlands of Etoug-Ebe are also in Yaounde (10 km away from downtown) but surrounded by slums in a more urban environment with strong real estate pressure and staple crop production. Seasonal floods in the lowlands and fear of expropriation are major problems faced by the population of this area. The lack of paved roads prevents a regular service from the waste collection vehicles. The lowlands of Ekozoa are located in downtown Yaounde. They were mainly used for floriculture by a non-resident population with a great risk of expropriation. In 2006, shortly after the survey, most of the 31 farmers of Ekozoa were expelled by the municipality with no relocation options from the government. Public gardens have since been constructed in this area by the municipality. The sample of the Ekozoa lowland consisted entirely of farmers.

A transect census was conducted along the main river for the two other lowlands. A point was selected upstream, at the beginning of the lowland. From this point, the surveyors walked along the river and transects were selected every 100 meters and 250 meters according to the size of the area surveyed (Etoug-Ebe and Nkolondom, respectively). All households were surveyed on each transect, on both sides of the river. This process was continued until the nearest household was outside the lowland area.

The surveys collected information on socio demographic factors, incomes, savings, as well as agricultural and recycling practices. A total of 126 households were interviewed in Yaounde and 162 in Bafoussam, for a total of 288 households.

1.2. The models

The binomial Logit model and ordered Logit model contributed respectively to value the probability that a farmer uses compost and the probability that a farmer uses the organic fertilizers to a given threshold.

The binomial Logit model

In order to identify the determinants of the compost use in Cameroon, we estimated a binary Logit model. Let Z be the vector of the variables likely to influence the use of compost. The adoption of compost by a farmer can be expressed as a utility function $U_1(Z) = V_1(Z) + e_1$ and their non-adoption expressed as a utility function $U_0(Z) = V_0(Z) + e_0$. V_i and e_i are the

deterministic and random components respectively, Z is the argument. The rational farmer will choose the option which provides the highest satisfaction utility. The probability that it adopts compost is expressed as follows:

$$P(Y=1) = P[U_1 > U_0] = P[V_1(Z) + e_1 > V_0(Z) + e_0] = P[V_1(Z) - V_0(Z) > e_0 - e_1]$$

If, $V_i = \beta_i Z$, we have: $V_1(Z) - V_0(Z) = (\beta_1 - \beta_0) Z$

Therefore, $P(Y=1) = P[\beta Z > e] = F(\beta Z)$ where $\beta = \beta_1 - \beta_0$ is the vector of the parameters to be estimated, where $e = e_0 - e_1$ is the error term.

$F(\beta Z)$ is related to a cumulative distribution. The Logit model assumes that F follows a logistic function.

Under these conditions, the probability that an unspecified farmer adopts compost is given by:

$$P(Y=1) = \frac{\exp(\beta Z)}{1 + \exp(\beta Z)} \tag{1}$$

Consequently, the probability of not using the compost is given by:

$$P(Y=0) = \frac{1}{1 + \exp(\beta Z)} \tag{2}$$

The binomial Logit model was estimated with the method of maximum-likelihood. The Newton - Raphson algorithm was used to approximate $F(\beta Z)$ by a quadratic function from a Taylor series expansion around the unknown value β that maximizes F . Mc Fadden's R^2 estimates the quality of the adjustments.

The ordered Logit model

We consider four distinct groups of households: households which do not use any fertilizers, households which use compost only, households which mix compost with fertilizers, and households which use only inorganic fertilizers. The use of ordered Logit model is justified by the fact that the dependant variable Y_i can be logically ordered. We considered that the level of farm output depends on the chosen fertilization level. In fact, no fertilizer is the choice that is perceived by the farmer as to provide the lowest output, followed by compost, a mix of compost and inorganic fertilizer and finally only inorganic fertilizer which is perceived by the farmer to lead to the highest output.

Despite the fact that the choice of the adoption levels is arbitrary, the four modalities retained match with the perception that the farmers have of the fertilizers. Through this specification of the levels of adoption, we refine the estimation of the determinants of the adoption. Besides, the odds ratios of the explanatory variable will correspond to each interval of adoption. The ordered Logit also helps to predict the probability for each observation to belong to a given interval.

In our ordered Logit model, the modalities of dependant variable Y_i are:

$$\begin{cases} Y_i = 4 \text{ (mineral fertilizer use only)} & \text{if } C_3 < Y_i^* \\ Y_i = 3 \text{ (mix use of compost and mineral fertilizer)} & \text{if } C_2 \leq Y_i^* < C_3 \\ Y_i = 2 \text{ (compost use only)} & \text{if } C_1 \leq Y_i^* < C_2 \\ Y_i = 1 \text{ (no fertilizers use)} & \text{if } Y_i^* < C_1 \end{cases} \quad \forall i = 1, \dots, N$$

where C_1 , C_2 et C_3 are given tresholds of fertilization.

(3)

The fertilization Y_i^* is explain by the equation $Y_i^* = X_i \cdot \beta + u_i$, where X_i is a vector of explanatory variables (the determinants of the fertilization), β the vector of the associated coefficients and u_i a random components according to the logistic law. For every modality j ($j=1, 2, 3$) of Y_i , we supposed that $P_{ij} = \Pr(Y_i > j)$.

$$P_{ij} = 1 - \Pr(Y_i = j) = 1 - \Pr(Y_i^* = C_{j+1}) = 1 - \Pr(u_i = C_{j+1} - X_i \cdot \beta) = \frac{1}{1 + \exp(C_{j+1} - X_i \cdot \beta)} \quad (4)$$

The Ordered Logit model is therefore defined as a system of $j-1$ equations:

$$\ln\left(\frac{P_{ij}}{1 - P_{ij}}\right) = -C_{j+1} + X_i \cdot \beta \quad j = 1, 2 \quad (5)$$

$-C_{j+1}$ is a specific constant. Formulated as follows, the model predicts the probability to be classified in an upper category rather than lower. As in our binomial Logit model, our Ordered Logit Model was estimated with the method of maximum-likelihood.

A total of 13 variables were selected for the models. Labor variables include the age of the farmer (AGE), the gender of the farmer (SEX), the level of instruction or education (EDUC). Capital variables include membership to farmers' cooperatives (COOP), membership to a savings association (SAVE), land property rights (LAND), livestock (LVSTCK), farm size (SIZE).

AGE measures the age of the farmer. With time and age, the farmers accumulate an important personal capital and are more likely to favour innovations. However, studies show that young farmers are more risk takers and in general, they are the first to adopt new technology. They also have the physical strength to transfer bulky organic fertilizer.

Concerning gender issues (SEX), women cannot use organic waste like men due to its bulky nature. Studies also show that women are generally discriminated in term of information and external input access (Dey, 1981). According to Matlon (1994), men are more likely to adopt organic fertilizers than women.

Concerning education (EDUC), several studies show that instructed and educated farmers are

more likely to adopt new technology; generally educated farmers are the early adopters (Kebede et al, 1990; Rahm and Singh, 1988). We hypothesize an interrelationship between the level of instruction, productivity and efficiency in agriculture. Education has a positive influence, therefore, on the probability to use integrated soil nutrients mainly because the educated farmer better understands the agronomic and environmental advantages related to their use.

When a farmer belongs to a farmer's cooperative or a community based organization (COOP), he is in contact with research, development and extension services, and he is more likely to adopt innovations (Adesina et al, 2000; Pender, 2004; Gebremedhin et al., 2009). It is hypothesized that this variable is positively related to integrated soil nutrients adoption.

When a farmer belongs to a savings association or mutual-help association, he can save money and access to informal credit. This membership can improve his capacity to buy chemical fertilizer (Parrot et al., 2008). According to Leonard (1990), the non accessibility to credit limits meaningfully the agricultural innovation adoption.

Concerning property rights (LAND), Otsuka et al. (1990) underline that land property rights have a positive impact on the intensification in agriculture. Farmers with land property rights often consider the negative long-term effect of inorganic fertilizers use. Also, due to the fact that land property rights promotes soil regeneration techniques and pest control alternative such as planting of trees, it is less likely that inorganic fertilizer will be used on permanent land rights compared to temporary land rights.

Concerning livestock (LVSTCK), it is easy to use animal manure and even compost for soil fertility management (Williams et al, 1993). A negative relationship is hypothesized with the inorganic fertilizers.

Concerning farm size, in some circumstances the large cultivated area can be considered like an approximation of wealth. According to many authors, this variable can increase or decrease the adoption of new innovations. For Kebede et al (1990), the size of the farm is the most meaningful variable in the adoption of the inorganic fertilizers in the Region of Shoa in Ethiopia. We cannot assume a priori that adoption of the innovations will be favoured by the large size of the farm. The bulkiness and the dirtying character of the organic fertilizers do not facilitate their use on large areas. In our case, about 70% of the croplands are less than half of a hectare in size, which is understandable in a context of urban agriculture.

Other variables include the distance between the homestead and the crop fields (DIST). Because of the bulkiness and high transportation costs, it is not easy for a farmer to use organic fertilisers on distant fields (Sotamenou et al, 2010). Farmers are more likely to apply them on fields closer to their homestead. According to Parrot et al (2008), this variable is negatively related to the choice of fertilizers.

The production of a crop (CROP) positively affects farmers' decision to use the fertilizers (Nkamleu, 2007), and this is particularly true for high value crops such as horticultural and vegetable productions (Parrot et al., 2008).

The farm income (AGINC): a high level of farm income can decrease or increase the use of integrated soil nutrients. According to Sotamenou et al., (2008), a high level of income is correlated to the use organic fertilizers.

The inorganic fertilizer expenditures (FERTXP) measure the monthly costs of fertilizers. The higher the expenditure for inorganic fertilizers, the lesser use of compost by the farmer (Parrot et al, 2009).

The survey zone (ZONE): the dummy variable ZONE (ZONE = 0 for Bafoussam and 1 for Yaounde) is introduced as the two data sets are merged. The results are expected to show if there are any significant differences based on a geographical comparison.

2. The results

Results revealed that the survey zones Yaounde and Bafoussam do not display any significant statistical differences. Therefore data from these two localities were merged.

2.1. Characteristics of variables considered

Table 3 displays the characteristics of quantitative and qualitative explanatory variables used in our two models.

Table 3: Statistics of quantitative and qualitative explanatory variables

Variables	Modalities	Proportion /	Std. Err. /
		Mean	Std. Dev.
AGE	Age of the farmer	44	13
DEPIM	Budget for chemical fertilizers (FCFA/month)	3050	3657
SEX	0 = Women	32%	0.268
	1 = Men	68%	0.622
LVSTCK	0 = Do not Keeps livestock	54%	0.029
	1 = Keeps livestock	46%	0.029
COOP	0 = Non member of a farmers' cooperatives	61%	0.554
	1 = Member of a farmers' cooperatives	38%	0.332
LAND	0 = Don't have a land property right	22%	0.245
	1 = Have a land property right	78%	0.245
CROP	0 = Cash crop production	15%	0.208
	1 = Food crop production	85%	0.208
SAVE	0 = Non member of a savings association	47%	0.407
	1 = Member of a savings association	53%	0.476
SIZE	1=Farm size less than 500 m ²	35%	0.028
	2=Farm size between 500 and 4500 m ²	36%	0.028
	3=Farm size upper than 4500 m ²	29%	0.026

DIST	1=Distance home-farm less than 500 m	52%	0.466
	2= Distance home-farm between 500 and 1000 m	13%	0.089
	3= Distance home-farm between 1000 and 2000 m	12%	0.080
	4= Distance home-farm upper than 2000 m	23%	0.180
EDUC	0 = None	17%	0.022
	1 = Primary school	39%	0.028
	2= Secondary school	27%	0.026
	3 = Higher school	17%	0.022
AGINC	1= Farm income less than 25000 FCFA	32%	0.027
	2= Farm income between 25000 and 45000 FCFA	35%	0.028
	3 = Farm income 45000 and 100000 FCFA	21%	0.024
	4=Farm income upper to 100 000 FCFA	12%	0.019
ZONE	0 = Bafoussam	56%	0.505
	1 = Yaounde	44%	0.379

According to Table 3, farmers are 44 years old on average and spend around 3050 FCFA every month to purchase chemical fertilisers. Urea and NPK (20-10-10) fertilizer costs are about the same in Yaounde and Bafoussam, about 270 FCFA/kg (13,500 FCFA/50 kg bag) and 320 FCFA/kg respectively (16,000 FCFA/50 kg bag). Extrapolating to a hectare based on the average crop area (4500 m² on average), less than 40,000 FCFA (80 USD) are spent on fertilizers per year. This result is above the 6.50 US\$/ha for all agricultural lands in Cameroon in 2000 but below the 190 USD/ha in some monocrop horticulture areas of Cameroon (Gockowski and Ndoumbé, 2004). Table 3 also reveals that men (68%) are more involved in agriculture than women and 44% of farmers of our total sample are in Yaounde; 83% of them have at least a primary education level. About half of the farmers of our sample keep livestock and 85% of the agricultural productions are essentially food crop. Some farmers (38% of our sample) are members of regrouped within farmer's cooperatives whereas 53% among them are members of a savings association. In spite of land pressure, 78% of the farmers own land property rights. Ultra short distances characterize urban agriculture as more than half of farmers investigated (52%) live close (< 500 meters) to their crop field. Only 12% of the farmers have a farm income higher than 100,000 FCFA per month. 32% of farmers have farm incomes below the poverty rate (which is around 23,500 FCFA per month).

2.2. Binomial Logit model estimation

Table 4 displays the characteristic of dependant variable of our binomial Logit model.

Table 4: Statistics of dependant variable Y_1

Variable	Modalités	Size	Prop.	Std. Err.
Y ₁ =0	No use of compost	155	64%	0,283
Y ₁ =1	Use of compost	87	36%	0,283

Despite difficult supply in quantity and quality for compost inputs, a third of the farmer population adopts compost as an input for soil amendment.

Table 5 displays the results of the Binomial Logit Model estimation using the Maximum Likelihood estimation and odds ratios of the explanatory variables on the dependant variable variables (Y₁). Y₁ is a binomial variable showing the behaviour of a sample of 242 Cameroonian farmers adopting or not compost. The model is statistically valid with a likelihood ratio of 31.57. The model is significant at the 1% level, with an R² equal 0.10. This is rather satisfactory since the percentage of good prediction of the model is 70.25%.

Five relevant variables significantly influence the compost use in the lowlands of Cameroon: membership to a farmer's cooperatives (COOP), land property rights (LAND), food crop production (CROP), the distance between a famer's home and farm (DIST) and the farm income level (AGINC).

The Binomial Logit model estimations reveal that adoption of compost is positively influenced by membership to farmer cooperatives, land property rights, and food crop production. Inversely, it revealed that non adoption is influenced by the distance between a farmer's home and farm and the farm income level.

Table 5: Results of the Binomial Logit model on compost use

Explanatory variables	Compost use
Age of the farmers	0.015 (1.060)
Sex of the farmers	-0.476 (-1.316)
Keeps livestock	-0.435 (-1.318)
Member of a farmer's cooperative	0.807** (2.282)
Land property rights	0.718* (1.811)

Food crop production		0.882*
		(1.667)
Member of a savings association		0.144
		(0.457)
Expenditures for chemical fertilizers		0.025
		(0.148)
Distance home-farm	Between 500 and 1000 m	-0.870*
		(-1.853)
	Between 1000 and 2000 m	-0.010
		(-0.021)
	More than 2000 m	-0.124
		(-0.285)
Level of instruction or education	Primary school	0.397
		(0.853)
	Secondary school	-0.201
		(-0.382)
	Higher school	0.492
		(0.846)
Farm income	Farm income less than 25000 FCFA	-0.933**
		(-2.531)
	Farm income between 25000 and 45000 FCFA	-0.993**
		(-2.165)
	Farm income 45000 and 100000 FCFA	-0.757
		(-1.508)
Farm size	Farm size between 500 and 4500 m ²	-0.441
		(-1.070)
	Farm size more than 4500 m ²	-0.804
		(-1.475)
Yaounde		-0.432

	(-0.878)
Constant	-1.590
	(-0.995)
Number of observations	242
Log-Likelihood	-140.46
chi2	31.573
Adjusted R ²	0.101

Note: *** p<0.01, ** p<0.05, * p<0.1

Membership to a farmer's cooperative is positively significant at the 5% level and has a positive effect on the probability to use compost in Cameroon. This is justified by the fact that within these cooperatives, farmers benefit from the training and advice of specialists (Adesina et al, 2000). The odds ratios show that if the proportion of farmers involved in cooperatives increased by 10%, then the probability of using compost would increase by 18%.

Land property right is significant at the 10% level and has a positive impact on the use of compost. Farmers with permanent land rights often take into account the negative long-term effect of chemical input use on soil fertility. Also, due to the fact that permanent rights give way to using soil regeneration and pest control alternatives such as planting of trees, it is less likely that a chemical fertilizer will be used on permanent land rights compared to temporary land rights (Gillis and al. 1990). The odds ratios show that if the proportion of the farmers who get land property rights increased by 10%, then the probability of using compost would increase by 14%. Still, the relations between land tenure, security, and investments are subject to controversy as they generate causality issues (Brasselle et al., 2002). From another perspective, land tenure and security needs to be compared to real estate investments in an urbanization context, i.e., loss of arable land for agriculture. The relatively high percentage of property rights of land devoted to agriculture reveals better opportunity costs than real estate investments at the time of the study. As stated in the introduction, the other fact which contributes to the persistence and tolerance of farming practices is that lowlands are considered as non constructible by the municipalities.

Food crop production is positive and significant at 10% level. The odds ratios show that if the proportion of the farmers involved in food crop production increased by 10% then probability of using compost would increase by 16%.

Ultra short distances (< 500 meters) affect positively organic adoption. This variable is significant at 10% level. Inversely, the more a farmer lives far from his crop field, the less he uses compost. This result is in agreement with the literature: inorganic input use increases as the distance between homestead and crop fields declines (Adesina et al., 2000; Sotamenou et al, 2010; Parrot et al, 2008). The odds ratio shows that if the proportion of the farmers who lives relatively (> 500 meters) far from their crop fields increased by 10% then probability of using compost would decrease by 16%.

Farm income below 25,000 FCFA and farm income between 25,000 and 45,000 FCFA, are negatively significant at the 5% level on the probability to use compost in Cameroon. This result suggests that the propensity to adopt compost is correlated to income. Odds ratios show that if the probability of becoming a rich farmer increases by 10%, then the probability of using compost would decrease by 19%.

2.3. Ordered Logit model Estimation

Table 6 displays the characteristic of dependant variable Y_1 of our Ordered Logit model.

Table 6: Statistics of dependant variable Y_1

Variable	Modalities	Size	Prop.	Std. Err.
$Y_i=4$	Fertilizers only	99	41%	0,029
$Y_i=3$	Fertilizers and compost combined	51	21%	0,024
$Y_i=2$	Compost only	36	15%	0,020
$Y_i=1$	No fertilizers at all	56	23%	0,024

As Table 6 reveals, there is a diversity of situations among farmers in adopting soil inputs for food crop production ranging from no fertilizers to fertilizers only. Ordered Logit model estimations were already employed for assessing technology adoption (Negatu and Parikh, 1999; Baidu-Forson et al, 1997).

Table 7 displays the results of such models using the Maximum Likelihood estimation on a sample of 242 farmers in Cameroon. The model is statistically valid and significant at the 1% level with a likelihood ratio of 31.57 and with an R^2 equal to 0.10. The estimation of Ordered Logit also shows the odds ratio of the explanatory variables for every modality, i.e., each level of fertilization.

Table 5 : Odds ratios of explanatory variables according to the levels of adoption

Modalities of explanatory Variables	No fertilizers use		Only use of compost		Mix use of compost and inorganic fertilizers		Only use of inorganic fertilizers	
	Dy/dx	$P> z $	Dy/dx	$P> z $	dy/dx	$P> z $	dy/dx	$P> z $
Explanatory variables								
Age of the farmers	0.000	0.288	0.001	0.290	0.001	0.296	-0.003	0.281
Sex of the farmers	0.006	0.722	0.008	0.913	0.013	0.731	-0.028	0.726
Keeps livestock	-0.001	0.913	-0.002	0.913	-0.003	0.913	0.008	0.913
Member of a farmer's cooperative	0.029	0.151	0.037	0.139	0.052	0.118	-0.119	0.113
Land property rights	0.055***	0.001	0.075***	0.001	0.182***	0.003	-	0.000
							0.312***	
Food crop production	0.518***	0.002	0.071***	0.003	0.188***	0.020	-	0.004
							0.312***	
Member of a savings association	-0.010	0.534	-0.013	0.535	-0.020	0.528	0.044	0.528

Expenditures for chemical fertilizers		-0.094***	0.000	-	0.000	-	0.000	0.403***	0.000
				0.120***		0.187***			
Distance home-farm	Between 500 and 1000 m	-0.047***	0.002	-	0.003	-	0.018	0.278***	0.004
				0.065***		0.165***			
	Between 1000 and 2000 m	-0.028	0.147	-0.039	0.172	-0.083	0.286	0.151	0.220
	Upper than 2000 m	-0.003	0.867	-0.004	0.868	-0.007	0.871	0.016	0.869
Level of instruction or education	Primary school	0.036	0.216	0.045	0.203	0.061	0.141	-0.143	0.162
	Secondary school	0.052	0.162	0.061	0.135	0.069	0.040	-0.184*	0.077

	Higher school	0.062	0.236	0.069	0.176	0.058	0.014	-0.189*	0.091

Farm income	Farm income less than 25000 FCFA	-0.033*	0.070	-0.042 *	0.072	-0.074	0.105	0.150*	0.070
	Farm income between 25000 and 45000 FCFA	0.012	0.631	0.015	0.624	0.022	0.580	-0.050	0.606
	Farm income between 45000 and 100000 FCFA	-0.020	0.340	-0.027	0.357	-0.053	0.453	0.101	0.402
Farm size	Farm size between 500 and 4500 m ²	-0.010	0.611	-0.013	0.613	-0.021	0.626	0.045	0.617
	Farm size upper than 4500 m ²	-0.030	0.199	-0.039	0.210	-0.073	0.277	0.143	0.231
Yaounde		-0.039	0.136	-0.050	0.132	-0.081	0.141	0.171	0.120

Six relevant variables significantly influence the use of fertilizers in the lowlands of Cameroon: land property rights (LAND), food crop production (CROP), the inorganic fertilizer expenditures (FERTXP), the distance between a farmer's home and field (DIST), the level of education (EDUC) and the farm income level (AGINC). The key explanatory variables significant at all levels are land property rights, food crop production, chemical fertilizers expenditures, and distance of homestead from the crop field.

Land property rights and food crop production positively influence organic and mixed use of compost with inorganic fertilizers. As expected, distance of homestead from crop field positively influences fertilizer adoption. Beyond 500 meters, inorganic fertilizer adoption becomes significantly more frequent. Education positively influences a mixed use of compost and inorganic fertilizers but negatively influences an exclusive use of inorganic fertilizers. The level of education positively influences the use of mixed compost and inorganic fertilizers and negatively influences the exclusive use of inorganic fertilizers. These results reveal that the lack of land ownership and the need to obtain high returns on investment suggest short term perspectives on the part of the corresponding tenant farmers. Put in perspective these dynamics provide good short term returns as the correlation with farm incomes show. On the other hand, these short term strategies caused by the lack of land tenure security may pose concern for soil conservation. Education becomes here an ambiguous variable depending on the objectives of the farmers optimizing his options either for short term unsustainable practices or long term sustainable practices.

3. Conclusions and recommendations

The aim of this paper was to identify the explanatory variables that influence the use of compost in Cameroon and identify the effects of these variables on each level of fertilization. Binomial and multinomial analyses were conducted on a sample of 288 farmers in the West and Centre Regions of Cameroon.

Compost is adopted by a significant number of farmers (a third of the sample) despite its poor quality and low quantities available. Compost adoption reveals that farmers are sensitized to its potential advantages. On the contrary, about half of the farmers still adopt an exclusive use of fertilizers as the only way of improving yields and farm incomes. Urban agriculture provides economies of scale for soil inputs (higher population densities, large consumer demand, small distances, and small plots).

According to these results, the key variables that can help in the formulation of the policy implications in order to promote organic fertilizers use in Cameroon are: membership to farmer cooperatives, land property rights, food crop production and ultra short distances between homestead and crop fields.

Cooperatives play a key role of sensitizing and training farmers. These cooperatives provide support for farmers in terms of mutual help and common rights defense. They are gaining in importance since the Cameroonian state has suspended the distribution of improved seeds and the extension of on-farm research for farm innovation to the farmer in the midst of the economic crisis of the 1990s. About 40% of farmers visit frequently these cooperatives in Cameroon, but they do not necessarily bring back the answers to their permanent worries about productivity and profitability. Still, farmer cooperatives are a key link to extension programs in order to promote new farm techniques such as composting.

The government should alleviate the conditions to acquire property rights which are often expensive and discourage poor farmers from investing. As opposed to inorganic fertilizers that act quickly on the plants, composts act slowly and contribute to improving the quality of soils by supplying the plant with nutrients. This positive long-term effect of compost encourages farmers with land property rights to apply large quantities of compost and adopt long term perspectives.

A major risk at this point is the opportunity costs between farming and real estate construction caused by urban growth and land pressure. Still it is important to consider that urban agriculture is essentially practised in the lowlands of Cameroon. Urban dwellers squatting these lowlands are vulnerable to expropriation as these areas belong to the national domain and because lowlands are often classified as not constructible for obvious security reasons. In the general framework of city planning, government authorities should clearly define the farming areas without risk of expropriation. Another risk is the prevalence of the informal sector which not only prevails around 40% of the Gross Domestic Product among developing countries but increases over time (Schneider, 2005). The prevalence of the informal sector affects policy implementation.

In fact, a major challenge involving city planners, urban farmers, and private waste collectors, is to find an agreement on waste recycling which would benefit all. The issue would be to insure sustainable food security, poverty alleviation and sustainable waste recycling. As in Dakar,

(Kapepula et al. (2007), the local institutional frameworks constituted by community based organizations, farmer cooperatives and saving associations could contribute efficiently in managing the diversity of situations among farming practices and contribute to training and awareness in collaboration with the extension services, city planners and waste collectors. Public private partnerships could connect small scale compost production units with the waste collection companies which would alleviate the burden on the traditional public sector. Urban agriculture would provide a vast consumer demand for compost material.

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THE CONTROL OF PIRATE ATTACK ON SUDAN COAST REGION IN SUB-SAHARA AFRICA

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ABSTRACT

In this paper, the study of pirate attack on Sudan coast region in Sub-Sahara Africa is welcome. This intrigue is to address the mayhem, illegality and wrong operations of pirate committed on both the offshore and onshore coastal Areas of Sudan. The experimental analysis were collected from various samples from Sudanese government, NGO's, Ecowas security, Wikileaks and Facebook in U.S, Cries from innocent people that have being victimized and other Sub-Sahara Africa between 2008 to 2011. The analysis was conducted on Pentium IV, 160GB Hard disk, 2.5GB RAM and Microsoft Excel package.

KEYWORDS:Pirate, Coast, Sahara, Attack, Sea, Ocean, Sudan, Analysis

1. INTRODUCTION

Within the context of this paper, the menace of pirate attack that has bedeviled the Sub-Sahara Africa is getting out of hand and there is a need to control the impurity ongoing on the coastal region of Sudan. Pirate attack as the imply is the severe attack on people, ships, cargoes, goods and services along the coastal region by unknown gunmen, people or group in order to steal, take hostage, kill, over board and rape. This type of attack is a major constrained that is associated with prompting, signaling, disguising, mapping and strategic smuggling. To control this problem, the Sub- Sahara Africa must be able to come with a lasting solution to tackle these menace sufficiently to allow free flow of people, ships, goods and services and marine product like oil exportation across the coast region. Nevertheless, emphasis in the Literature update has been on the increase to search for a solution to address pirate attacks in Sub-Sahara Africa and in the world, which includes;

Doyle [1] pioneered Africa: Another pirate attack off West Africa. He reported that a number of ships particularly tankers were attacked and hijacked. The pirates have steamed the hijacked ship to a hidden location to off load the cargo- usually oil while Kaufman [2] implemented the myth of ethnic warfare. He reported that the Sudan conflict had nothing to do with ethnicity in the first place.

Further more, Nick [3] developed anti-pirate maritime security solutions. He reported that chemical tankers in MV Biscagha were attacked by Somali pirate. This rescue helicopter came near, and then jumped into the water for rescue by coalition forces while Ignatieffs' [4] pioneered the retrogressive little wars: Honor Forgotten. He reported that the ethnic and bitter mini-wars are evocative but only sporadically illuminating.

Also, Raja and Graham [5] implemented Russia ruinous Chechnya war. They reported that Russian federation blames the Chechnya war on Islamist terrorist while AFP and Reuter [6] pioneered Spanish Navy Thwarts pirate attack in Indian ocean/East Africa. They reported that pirates now received an average of 47 million dollar in ransom for each hijacking and the number of successful hijacking appears to be dropping.

2. PROBLEMS

These sections highlight the problems associated with pirate attack in Sudan coastal seas and oceans and danger they posed to the Sub-Sahara Africa and the environs.

2.1 DUMPING OF TOXIC WASTE IN COASTAL SEAS

Over the years, the Sudanese government has been fighting on toxic waste disposal on the sea and ocean. About 48% of the seas are occupied with abandoned ships and cargoes with poisonous compound, poisonous waste, and polluted liquid and also left over food substance imported from different countries. These toxic wastes finally drip to the seas and oceans, killing the aquatics fishes, animals and plant living in the sea. By so doing, making the sea unfavorable to fishermen. Since such fishermen cannot make anything for their livelihood, they go on sea pirate attack on ships, kidnapping people, good and services and forming different pirate groups and attacks.

2.2 WAR IN SUDAN

More than 10 years ago until 2010 when the war in Sudan finally ceased. The government forces, allied and the people are under lodge ahead. The war which spread all over the country during that period lead to so many death. As the people fled for safety, many of them settled at the sea shore and boarders of the country for the fear of being attack. Unfortunately, after the war they remain there since they are unable to go back to their based, they form pirate groups capturing ship, good and people as a result of incessant starvation and poverty they acquired.

2.3 PORT INSECURITY IN SUDAN

The insecurity problem in the port of Sudan has posed a major treat. The government of Sudan, NGO's and private establishment have lamented on the insecurity treat accommodated on the port. Over 55% of the goods imported and exported in Sudan are smuggled in and out of the country. The port authorities have blamed the nonchalant attitude on the business men and women, Companies and government agencies and also the port workers. As the people and foreigners are not cross checked, they smuggle in hoodlums,

perpetrators and pirate groups who lay a camp station to receive guns and ammunition and create pirate attack along the sea coast.

2.4 UNEMPLOYMENT PROBLEMS IN SUDAN

The rate of unemployment and job cut in the Sub-Sahara Africa especially in the Sudan has tripled from 11% in 2008 to 33% in 2011. Sudan has been rated one of the poorest country in the world. This unemployment sager has added a plus to the pirate attack problem. As the working youth are out of job, they easily look for a way of keeping themselves busy by stealing, smuggling and becoming nuisance in the society. They also form groups that portray habit like raping, smoking Indian hem and capturing of ships with their speed boat on the coastal sea and ocean coming from other countries.

2.5 TERRORIST CAMP IN SUDAN

It was discovered and announced by the U.S wikileak network that Sudan is one country that harbor and train terrorist in Sub-Sahara Africa around the coastal region. These terrorist camps are sponsored by some prominent politicians who pay them ransom to protect their guns and ammunitions imported to the country through the boarders. This act has been lingering for so long and has gone out of hand. As the politician stop sponsoring this group, they form uncontrollable terrorist groups leading to boat crossing, capturing people, demanding for ransom, shooting at will, stealing from one ship to another using their various speed boat. This is an alert that required urgent attention in Sudan.

3. SOLUTION PROPOSED

This section show case the solution that could solve the problem of pirate attack that have bedeviled the people and government of Sudan and all the Sub-Sahara Africa. The solutions when implemented would correct and clean the system in Sudan.

3.1 FORMATION OF ANTI-PIRATE

SQUARD IN SUDAN

Since there are no smokes without a fire, the proposed formation of anti-pirate squad suggested in this paper would combat and bridge the attack of pirate in Sudan. This anti-pirate squad should comprise of SSS (Secret Security Service), trained mobile task force, Air force base (naval), bomb detonator from the military base and surveillance team from the Interpol police. These people should be grouped into a massive squad and mount on the coastal seas and oceans of Sudan with backing from G8 summit, African union and Sudanese government.

3.2 CREATION OF JOB EMPLOYMENT

As was mentioned in section 2.4, the problem of unemployment by the working youth is alarming. When one is unemployed, from a quote "An Idle mind is a devil workshop", brings bad imagination but if the Sudanese government can analyze the growth of the economy and drive towards production by providing jobs for the idle youth and even provide fund for youth who are willing to be self employed, these would curtail the pirate attack at the sea and ocean and bring sanity to the system by so doing, it would make the youth think positively and be creative rather than destructive and pirating. If jobs are created and people are employed and educated, at most 62% of the working youth would be productive and educated on the danger of pirating.

3.3 AIRCRAFT AND HELICOPTER SURVEILLANCE

The operation of aircraft and helicopter surveillance on the coastal region of Sudan should be encouraged by the government and Sub-Saharan Africa. These surveillance methods would require a trained pilot and a sophisticated gun proof aircraft/helicopter to resist gun attack by the pirate because pirates hate to be surveyed. The aircraft should have surveillance cameras that would capture signals, videos, sound and hide out of pirate operations in the region and finally transmit back radio wave signal to the anti-pirate team for immediate cross attack of pirate operation.

3.4 ANTI-TERRORIST LAW IN SUDAN

The illegal sponsoring of terrorist by the politician should stop in Sudan. The enactment of anti-terrorist law should be encouraged by the government where a life jail sentence is pronounced for any captured terrorist persons or group leading to pirate attack on the coastal region and also the politician who sponsor such terrorist groups. These Laws should be monitored, announced on paper, radio, website, television and institutions through out Sudan.

3.5 GOOD GOVERNANCE IN SUDAN

In a country whether, military or civilian government should pose element of good governance. Sudan, which has suffered great lost as a result of bad governance by those in authority to the citizenry, should be brought back to the era of good governance. Every laws and decisions by the government should benefit the masses and the foreigners living in the country. Good governance would control excess spending by the government; it would promote productivity, wipe off poverty and balance the foreign trade. The connection of good governance as a solution to pirate attack in Sudan comes from provision of good laws, governance and decision that would help the masses reverse any bad idea that would make them less important in the society to stop pirate attack at the coastal region.

4 RESULT AND DISCUSSION

This section highlight the result obtained from the sample analysis of pirate attack on ships, unemployment rate, port insecurity and dumping of toxic waste in Sudan coastal region of Sub-Saharan Africa for a period of 4 years.

Table 1. The percentage data's collected from the samples of government, Ecowas security, wikileaks and cries of innocent citizen being attack by pirate on Sudan coastal sea and ocean.

S/N	K(yrs)	AP(%)	UR(%)	PI (%)	DT(%)
1	2008	51	11	60	72
2	2009	47	18	53	30
3	2010	45	25	34	58
4	2011	58	33	40	46

K= YEARS

AP (%) = PIRATE ATTACK ON SHIP

UR (%) = UNEMPLOYMENT RATE

PI (%) = PORT INSECURITY

DT (%) = DUMPING OF TOXIC WASTE

Table1: Represent the comparism analysis gotten from the percentage data samples on pirate attack from Sudan government, wikileaks network, unemployment statistics, port authorities, Ecowas security council (ESC) and the cries of innocent people been victimized by pirates. In 2008 to 2010, there was a reduction of pirate attack on ships from 51% to 45% and then increases to 58% in 2011.

The percentage unemployment rate increases from 11% to 33% in 2008 to 2011 and also the percentage port insecurity decreases form 60% to 34% in 2008 to 2010 and then increases to 40% in 2011 Finally, the percentage dumping of toxic waste drop from 72% to 30 % in 2008 to 2009 and increases to 58% in 2010 then later dropped to 46% in 2011.

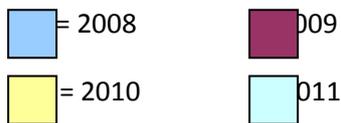
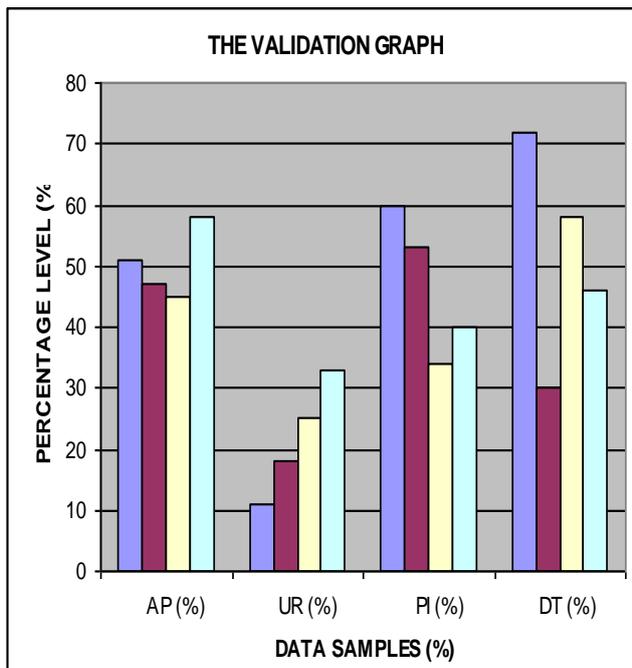


Figure 1. The Validation Graph obtained from the experimental analysis in pirate attack in Sudan coast region.

Figure 1. Showing the validation graph obtained from the data analysis in Sudan coast region on pirate attack. The yellow bar identify the percentage level of AP from 2008 to 2011, the pink bar represent the percentage level of UR from 2008 to 2011, the blue bar showcase the percentage level of PI from 2008 to 2011 and finally, the light brown bar identify the percentage level of DT from 2008 to 2011.

In AP, from 2008 to 2009, there was 4% reduction, from 2009 to 2010, about 2% reduction and finally, from 2010 to 2011, about 13% increase.

In UR, from 2008 to 2009, about 7% increase, from 2009 to 2010, there was 7% increase and finally, from 2010 to 2011, about 8% increase.

In PI, from 2008 to 2009, there was 7% reduction, from 2009 to 2010, about 19% reduction and finally, from 2010 to 2011, about 6% increase.

In DT, from 2008 to 2010, about 42% reduction, from 2009 to 2010, there was 28% increase and finally, from 2010 to 2011, there was 12% increase.

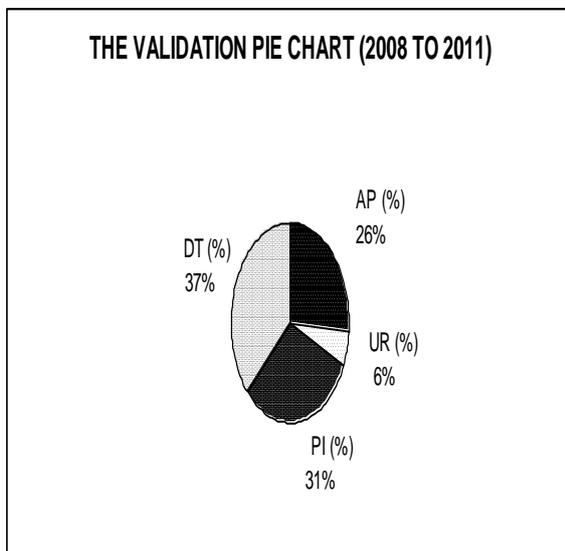


Figure 2. The Validation pie chart obtained from the analysis from 2008 to 2011

Figure 2. Represents the experimental pie chart obtained from the data samples collected from different levels of pirate attack in the Sudan coast region of Sub-Saharan Africa from 2008 to 2011. The DT (%) covered about 37% of the pie chart on the total estimation, the PI (%) covered about 31% on average, and also the AP (%) covered about 26%, while the UR (%) covered about 6% in total.

CONCLUSION

We have analyzed and sampled various problems associated with pirate attacks in the Sudan coast region and proposed a solution that would solve the lingering problem. From our data collection and analysis, we have shown that the solution is robust, efficient, timely, and effective. As the solution is implemented, it would eliminate, eradicate, and stop the menace of pirate attacks in Sudan. In the future, more papers would be presented on; the Bedeviled of Boko Haram insurgency in Nigeria, the pirate attacks at the coast of Guinea and Al'khada penetration in Africa.

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EVALUATION OF SANITATION PRACTICES IN IBADAN SOUTH EAST LGAS OF OYO STATE, NIGERIA

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Abstract

Sanitation is paramount to human life because it contributes to safety from communicable and non-communicable diseases as well as playing important roles in human socio- economic development and sustenance of cultural values. The aim of this paper is to highlight unwholesome practices that are inimical to good sanitation in Nigeria with particular focus on Ibadan South East LGAs of the Metropolis. Survey method was largely used in this study with questionnaire administered on 233 respondents selected from 40 households spatially spread across the LGAs. The analysis shows that domestic liquid and solid wastes constitute environmental hazard in the area. About 69 per cent of the respondents are females which indicate that issue of household sanitation is gender biased, 64 per cent of respondents are married depicting large household size with multiplier effect on quantity of waste generated. Also 28.3 per cent of households pack solid waste in sacks while 24 per cent use waste bins. Also, 17.2 per cent dump and burn solid waste in front of houses while nine per cent dispose of refuse on vacant plots. The astonishing revelation is that 6.9 per cent of them throw waste into flowing streams while 12.9 per cent dump waste into drainage. Adding to these problems is lack of awareness of building code which made sanitary facilities wrongly located. Education through public enlightenment, provision of sanitary facilities and involvement of PPP among other things are advocated to remedying the present sanitation problems in Ibadan city and cities in Nigeria.

1.0 Introduction

Sanitation has been defined by different people and organisations as degree to which clean human environment is maintained. A more comprehensive definition, credited to the United Nations Educational Social and Cultural Organisation (UNESCO), states that sanitation is “Maintaining clean, hygienic circumstances that help to avoid diseases through services such as waste collection and disposal or recycling”. In a similar perspective, the National Water Resources Management Policy (NWRMP) (2003) defines sanitation as dealing with the principles and practices relating to the collection, removal or disposal of human excreta, household waste water and refuse as they impact upon people and the environment. Good sanitation includes appropriate health and hygiene awareness and behaviour, acceptable and affordable as well as sustainable sanitation services. The basic level of environmental sanitation system must satisfy the following criteria: it must be associated with appropriate method for disposing human excreta as well as household waste water and refuse in a manner that is acceptable and affordable to the users; it must also be safe, hygienic, and easily accessible and must not have negative impact on the environment.

The problem of lack of good sanitation varies from place to place but it is more pronounced in the urban centres, especially in developing and under-developed countries. This problem is exacerbated by high population density which results in overcrowding, inadequate planning and poor urban governance (Ayeni, 1981, Agbola and Elijah, 2006, Onibokun and Kumuyi, 2007). The aim of this paper is to highlight some common practices that aggravate the precarious condition of sanitation in urban centres in Nigeria. The paper focuses on Ibadan South East areas in Ibadan Metropolis as a case study.

2.0 The Study Area

Ibadan is located on longitude 7°2' and 7°40'E and latitude 3°35' and 4°10'N, the city was founded in 1829. It was initially occupied by Yoruba immigrants, who sought refuge in the city while fleeing from intertribal wars. It is the largest indigenous city in tropical Africa; and it is the capital of Oyo State, Nigeria. As the crow flies, it is 128 kilometers (km) northeast of Lagos and 345 km southwest of Abuja, the Federal Capital Territory (FCT). The city has grown particularly through the establishment of many institutions, construction of roads and the railway line. One of the institutions in the city is the University of Ibadan, the first university established in Nigeria. The convergence of the major trade routes (through Ijebu /Abeokuta, Lagos and Ilorin/Oyo) in Ibadan, coupled with the establishment of the railway, accelerated the growth of the city. European traders were attracted and granted leasehold to land in Ibadan in 1903. Today, five major roads and a motorway from Lagos radially converge in Ibadan. Most of southwestern Nigeria states (excluding the Lagos area) prefer Ibadan for the procurement of specialised goods and services.

The city has recorded rapid growth, both in land area and population. Developed land increased from only 100 hectares in 1830 to 12.5 square kilometres (km²) in 1931, 30 km² in 1963, 112 km² in 1973, 136 km² in 1981, and 214 km² in 1988. Similarly, in 1856, the population was estimated at 60, 000; by 1890, it had increased to about 200, 000; in 1963, it was 625, 000; and almost 2.4 million at the moment (National Population Commission, 2009). Measured from the General Post Office in the central business district, the city has sprawled out to a radius of 12–15 km along the primary roads. The city's metropolitan region covers about 4, 200 km², with boundaries varying from 17 km in the southwest to about 45 kms in the northeast. It comprises 11 local government areas with five in the inner city and six in the outer areas. This paper focuses on sanitary practices in Ibadan metropolis with special attention to Ibadan South East area where field survey was done.

Ibadan South East Local Government with headquarters at Mapo was among five local government councils/areas carved out of Ibadan Municipal Government (IMG). It comprises 12 political wards (Table 1). It is made up of older residential districts located at the central area of the city. They are occupied largely by the indigenous Ibadan population and the early non-Ibadan Yoruba immigrants. Some of the districts in the area are stated in table 1 below.

The major sources of employment for the residents are mostly retail trade, public administration, service and repair industries, and educational services. The present features of sanitation practices in most parts of Ibadan city are: poorly-managed solid-waste and drainage, poor transportation facilities, inadequate public utilities and social infrastructure, poor housing conditions as well as foul odour. These issues have been compounded by political instability and absence of informed and effective political leadership (CASSAD, 1994).

Table 1: Ward and Residential Areas in Ibadan South East

S/N	Ward	Area code	No of Localities	Residential Areas Name
1	Ward	C ₁	6	Mapo, Oke Dada, Ogunmola, Oja Oba, Oderinlo, Palace,
2	Ward 2	S ₁	6	Oja Oba, Kure, Isale Jebu, Idi Arere, Omiyale, Ita Koto
3	Ward 3	S ₂ A	6	OtunAgbaakin, Kobomoje, Oranyan, Kobiowu, Esuawele, Temidire
4	Ward 4	S ₂ B	3	Kobomoje 2, Odo-Okun, Ogundepo
5	Ward 5	S ₃	5	Labo Eleta, Olukoyi, Ita Ege, Idi Aro, Agbongbon
6	Ward 6	S ₄ A	4	Labo Elekuro, Asanike, Ayedaade, Tafa Adeoye

7	Ward 7	S ₄ B	4	Orita Aperin, Oniyere, Adesola, Tafa Adeoye 2
8	Ward 8	S ₅	3	Odinjo, Eleta, Oyapidan
9	Ward 9	S ₆ A	6	Oke Odo, Kudeti, Olunloyo, Adelabu's House, Adebi Opon, Anirin, Kunfayakun
10	Ward	S ₆ B	5	Oke Oluokun, Oke Ola, Owode, Odo Oba, Sanyo
11	Ward 11	S ₇ A	10	Oke Odo ² , Molete, Idi Arere ² , Kudeti, Yejide, Bode, Odo Oba, Osungbade, Elere, Kerewu, Sanyo ²
12	Ward 12	S ₄ B	6	Felele, Orita Challenge, Olorunsogo Scout Camp, Falana petrol Station and Adelabu Shopping complex

Source: Ibadan South East Local Government, Oyo State.

Review of Literature

This section contains desk research from previous studies and newspaper publications. Most studies reveal that domestic waste contributes greatly to the present unsanitary condition in Ibadan metropolis and it can be categorised into two, namely solid and liquid waste.

3.1 Solid Waste in Ibadan comprises leaves, paper, food waste, tins, glass, and rags (McLaren International Ltd, 1970). This is because Ibadan is located in the heart of a rich agricultural land and has a large old and unplanned section. In a comparative analysis of the composition of solid waste from two acres of Ibadan in 1970, PAI Associates (1983) shows that residential land use accounted for 70.1 per cent of the waste generated, followed by commercial land use (18.8%) and industrial land use (9.7%). Institutional and other land use accounted for 0.7 per cent each. The mean percentage composition of solid waste in Ibadan in 1982 for different parts of the city shows that in the new areas (GRA, Bodija, Mokola and Sango), food remnants, tins and metals constituted the largest proportion of solid waste, whereas in the traditional areas (Agugu, Oja-oba and Oje) leaves and bones, ash dust, and stones constituted the bulk. The composition by weight of the various constituents of solid waste has also changed, with the leaves declining over time and while tins and metals, paper, and bones, ash dust and stones are increasing (Onibokun and Kumuyi, 2006). It is noteworthy that leaf waste particulates are now being replaced by cellophane waste materials. The adoption of new packaging system in the city (e.g. use of nylon bags and drinking of packaged water) is contributing to the huge amount of solid waste found across the city. However, data is not available on the amount of waste currently generated daily by the residents

3.2 Liquid Waste: Liquid waste in Ibadan also contains particles of corroded tins and iron, excreta, oil (red, fat, engine and lubricant), pieces of iron scrap, and other refuse. Outside of large institutions, such as the University College Hospital and State Hospital, Adeoyo, Ibadan has no sewerage. The city's human excreta are disposed off largely by means of septic tanks, pit latrines, and bucket; in some cases, it is wrapped with nylon and thrown into the gutter or stream. The uncontrolled disposal of liquid waste into open gutters, open spaces, and along roads poses serious environmental and health hazards. Bodies of stagnant water produce bad odour, breed mosquitoes, and sometimes obstruct the movement of people and goods. The 1983 study by PAI Associates reveals that 50 per cent of the stagnant pools emitted bad odour, 70 per cent bred mosquitoes, 24 per cent obstructed the movement of people, and 12 per cent bred worms and other germ-breeding pests. Poor practices of liquid-waste disposal are perhaps responsible for water-borne diseases occurring in the city, particularly in the areas constituting Ibadan South East (Plate 1). The unwholesome environment forces the populace to spend appreciable portions of their income and time on improving personal health, adverse consequences for general economic well-being.



Source Fieldwork, 2012.

Plate 1; Liquid waste in an open drainage channel in Idi-Arere, Ibadan.

4.1 Data Source and Collection

The focus of this paper is the analysis of sanitation practices by the residents of Ibadan South East Local Government Area of the metropolis. Primary and secondary data sources were utilised for this paper. The primary data was derived from a survey in which questionnaire was administered on selected resident households in the study area. Secondary data was derived from articles, textbooks and journals as well as documents from the Internet especially for concepts and theoretical issues as well as relevant information on global best sanitary practices.

4.2 Sample Frame and Techniques

Primary data utilised for this study was collected through questionnaire administration in selected localities within the study area. The sample was drawn from 64 localities that constitute Ibadan South East LGAs. The localities were delineated into 40 blocks in which 20 per cent of the total number of localities were selected for the study (Table 2). Stratified sampling technique was adopted and a total of 233 people were contacted with structured questionnaire.

Table 2: Selected Localities in Ibadan South East LGAs

Block Numbers	Selected blocks	Number of localities	Name of Localities
1	3	1	Felele
2	7	1	Scout camp
3	11	1	Sanyo
4	20	1	Kudeti
5	25	3	Odinjo, Eleta, Oyapidan
6	27	1	Oja Oba
7	31	1	Oke Dada
8	39	1	Asanike

Source: Fieldwork, 2012.

4.3 Data Analysis

Descriptive and inferential statistical were used for the data analysis. These include using cross tabulations, charts and frequency distribution to summarise and describe the characteristics of the data as well as variations between different variables in the questionnaire. Chi-square was used for this analysis because the data involved were both in nominal and ordinal scales. Analyses of the amount of income, educational and occupational status as well as sex of respondents are some of the indicators that formed the basis for individual preferences for the quality of sanitation practiced by respondents.

Results and Discussion

5.1.1 Sex and Age Distribution

The result shows that 69.1 per cent of respondents are females while 30.9 per cent are males. It also shown that 41.2 per cent of the respondents are within the age group of 31-40 years while those within the age group of 41-59 years constitute 26.6 per cent and 20.6 per cent are within the age group of 18-30 years (Table 4.1). The large proportion of female respondents indicates that females are more concerned with the issue of sanitation practices than males in the selected areas. This confirms that females play a major role in environmental sanitation in our society; therefore any policy target at improving environmental practices must be take cognisance of this.

Table 3.1: Relationship between Age and Sex of Respondents

Age -Group	Sex		Total
	Male	Female	
18-30 years	19	29	48
C%	26.4	18.0	
R %	39.5	60.4	20.6
31-40yrs	22	74	96
C %	30.6	46.0	
R %	22.9	77.1	41.2
41-59yrs	22	40	62
C %	30.6	24.8	
R %	35.5	64.5	26.6
60-69yrs	9	15	24
C %	12.5	9.3	
R %	37.5	62.5	10.3
70yrs and above	0	3	3
C %	0.0	1.9	
R %	0.0	100.0	1.9
Total	72	161	233
	30.9	69.1	100.0

Source: Fieldwork, 2012.

5.1.2 Marital Status and Age

The result also reveals that 64.3 per cent of the respondents are married and 12.9 per cent are widows. Also, 51.3 per cent of married respondents are within ages of 31-40 years while 28.0 per cent are within 41-59 years and 14.0 per cent are within 18-40 years. Further analysis indicates that there is significant relationship between the age group and marital status (chi-square value of 0.000; $p < 0.05$). This implies that a significant proportion of respondents are married and this has an implication on the household size. Large household size perhaps will have multiplier effect on the amount of waste generated per household in the area (Table 3.2).

Table 3.2 Marital Status and Age Group of Respondents

Marital status	Age					Total
	18-30 yrs	31-40 yrs	41-59 yrs	60-69 yrs	70 yrs +	
Single	24	4	0	0	0	28
C%	50.0	4.2	0.0	0.0	0.0	
Married	21	77	42	10	0	150
C%	43.8	80.2	67.7	41.7	0.0	
Divorced	2	5	6	1	0	14
C%	4.2	5.2	9.7	4.2	0.0	
Widowed	0	7	9	11	3	30
C%	0.0	7.3	14.5	45.8	100.0	
Widower	0	1	2	2	0	5
C%	0.00.0	1.0	3.2	8.3	0.0	
Single parent	1	2	3	0	0	6
C%	2.1	2.1	4.8	0.0	0.0	
Column	48	96	62	24	3	233
Total	20.6	41.2	26.6	10.3	1.3	100.0

Source: Fieldwork, 2012.

5.1.3 Types of Occupation

This study shows that trading (39.1%) is the predominant occupation of the respondents in the study area, followed by artisanal activities (31.8 %). Other occupations of significant proportion are civil service (23.6%) and farming (3.9%). Traders and artisans generate a great deal of solid and liquid waste in the urban setting like the study area. The traders are mostly street vendors and lack the etiquette of disposing waste properly. Dumping waste indiscriminately is a common practice in Ibadan South East LGAs. Also, auto-mechanics, carpenters and other artisans constitute environmental nuisance in this areas. Again, it was observed that some respondents (those in the category of other artisans) engage in cassava-based *gari* and *fufu* processing, palm oil processing, and cloth weaving among others. These categories also generate a lot of solid and liquid waste and the manner in which they dispose the waste is inimical to the environment.

5.1.4 Level of Education, Income and Types of Occupation

The result also indicates that respondents with secondary education constitute 37.3 per cent, those with no education account for 25.6 per cent while those with tertiary education amount to 37.1 per cent. The high proportion of illiterates and low education people in the area impinges on the method and quality of sanitation practices. Education plays an important role in the enlightenment of people not only on personal hygiene but also on good sanitary practices. The level of income is one of the factors that determine where and how people live as well as the quality of sanitation facilities in homes. The result of this investigation indicates that about 40 per cent of the respondents earn between N5, 000 – N15, 000 monthly incomes, and 33.5 per cent have income between N15, 000 -- N25, 000 while 6.9 per cent receive N35, 000 and above. With this and the types of occupation of the residents of these areas, it is evident that they are mostly low-income earners (Table 3.3). Income affects accessibility to health facilities as low-income earners may not be able to afford modern sanitation facilities like flush toilet.

Table 3.3: Monthly Income and Types of Occupation

Monthly Income	Occupational Status					Total
	Farming	Trading	Artisan	Civil Servant	Others	
<N5000	0	7	3	2	0	12
C%	0.0	7.7	4.1	3.6	0.0	
N5001-15000	2	37	40	12	2	93
C%	22.2	40.7	54.1	21.8	50.0	
N15001-25000	3	31	23	21	0	78
C%	33.3	34.1	31.1	38.2	0.0	
N25001-35000	3	14	6	11	0	34
C%	33.3	15.4	8.1	20.0	0.0	
N3500+	1	2	2	9	2	16
C%	11.1	2.2	2.7	16.4	50.0	
Column	9	91	74	55	4	233
Total	3.9	39.1	31.8	23.6	1.7	100.0

Source; Author's Fieldwork, 2011.

5.2.1 Availability of Sanitation Facilities

Reconnaissance study of the Ibadan South East area shows that most of the residential houses are in form of bungalows and storey buildings with face-to-face rooms, and flats. The result of the analysis shows that 84 per cent of the respondents have kitchen, 71.2 per cent have toilet while 87.6 per cent claim to have bathroom in their houses. Also, 68.2 per cent assert that they have open gutter around their houses and 42.9 per cent have waste bin within their premises. However, fewer proportion (15.9 %) do not have kitchen, 28.8 per cent do not have toilet and 12.4 per cent of the respondents do not have bathroom. For 31.8 per cent of the respondents, there is no gutter and 57.1 per cent also stated that there are no waste disposal facilities in their houses (Table 4.1).

The foregoing shows that most of the respondents claimed to have sanitation facilities but physical observation shows that these facilities are in poor condition and cannot promote healthy living. Most bathrooms and kitchens in the areas are made of zinc sheets located at the back of houses, while pit latrine is the commonest toilet facility in these areas. It was discovered that

residents dump their wastes and excreta into available drainage channels in the area especially residents of houses that have no toilet facility (Plate 2). It can be asserted from the result that sanitation practices in the study area are unwholesome. Apart from this, the physical layout of the area was badly planned. Most streets are exposed to bad environmental factors such as bad odour, indiscriminate waste dumps, and stagnant pools of sewage in drainages. This type of environment not only promotes outbreak of diseases but also impairs the health of the residents.

Table 4.1: Availability of Household Sanitation Facilities

Facilities	Kitchen		Toilet		Bathroom		Water Storage Facility		Gutter		Waste Bin	
	No	%	No	%	No	%	No	%	No	%	No	%
Available	196	84.1	166	71.2	204	87.6	233	100.0	159	68.2	100	42.9
Not Available	37	15.9	67	28.8	29	12.4	0.0	0.0	74	31.8	133	57.1
Total	233	100.0	233	100.0	233	100.0	233	100.0	233	100.0	233	100.0

Source: Fieldwork, 2012.



Plate 2: Kitchen and toilet located at the back of a house close to sewage channel in Odinjo, Ibadan.

5.2.2 Method of Solid Waste Disposal

Analysis of method of solid waste disposal in the study area shows that 28.3 per cent of the respondents pack their solid waste in sacks while 24 per cent use waste bins. This practice is common in areas like Felele, Sanyo, and Scout Camp as well as Oja – Oba. Also, 17.2 per cent dump and burn their solid waste in front of their houses while nine per cent dispose of their refuse on vacant plots (open spaces) or inside uncompleted houses in the area. The more astonishing revelation is that 6.9 per cent of the respondents confessed to dumping their solid waste into flowing streams while 12.9 per cent dump waste into drainage channels in their respective areas. These practices do not only constitute environmental hazard but are also capable of provoking natural disaster such as flooding as it happened in parts of the city in 2011 (Plate 3 and figure 1).



Source: Fieldwork, 2012.

Plate 3 Solid waste dumped into drainage channel at Oja Oba Area, Ibadan.

5.2.3 Regularity of Cleaning Household Sanitation Facilities

The analysis on the regularity of cleaning household sanitation facilities reveal that 1.7 per cent of the respondents clean their gutters and waste bins daily, while 9.0 per cent do same weekly. Also, 19.3 per cent carry out cleaning of gutter once in a month while 21.9 per clean their waste bins monthly. This implies that respondents' rate of cleaning household sanitation facilities is very low, further confirming that sanitation practice in the study area is poor and detrimental to clean and healthy environment (Figure 1).

Methods of Collecting and Disposing Solid Waste

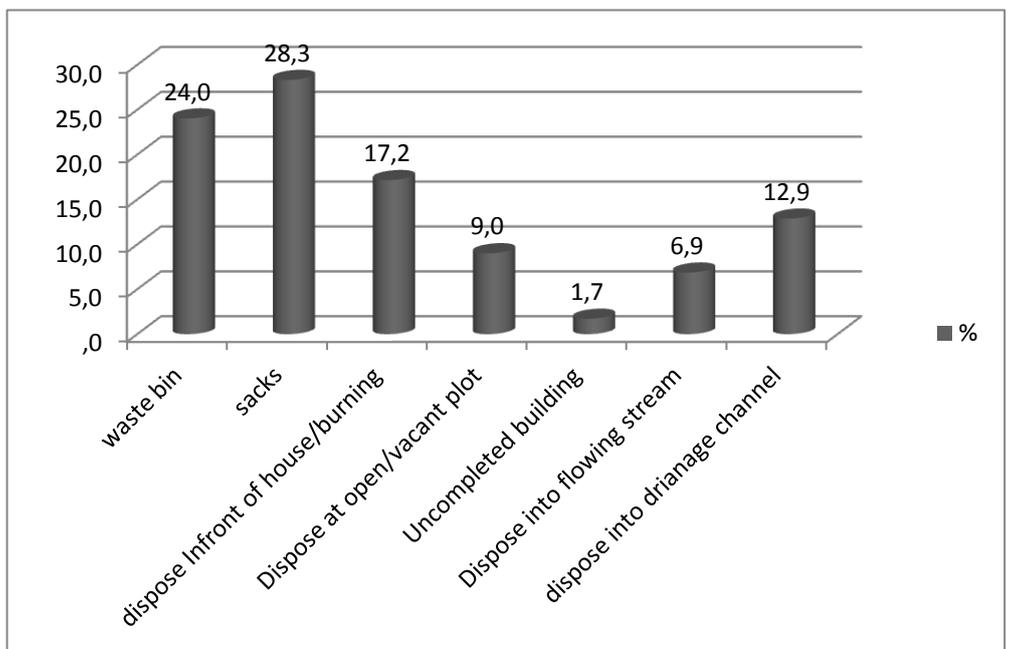


Figure 1. Source: Fieldwork, 2012.

5.2.3 Method of Liquid Waste Disposal

Analysis also shows that inhabitants of Ibadan South East LGAs adopt various methods of disposing liquid waste. About 61 per cent of the respondents discharge their liquid waste into the open gutter, 35 per cent dump their liquid waste outside their houses while six per cent dispose their liquid waste

into available drainage channels in their area. This situation is disgusting in areas like Oja Oba, Idi Arere and Molete as well as Oke Dada.



Plate 4: Liquid waste disposed outside a house in Oke Dada area, Ibadan

It is obvious why most drainage channels are filled and blocked with solid wastes, which restrict the free flow of liquid waste or water which drainage channels are meant for. As a result, these channels emit bad odour and serve as breeding grounds for mosquitoes and flies which are vectors for bacterial infections that cause diseases like cholera and malaria.

5.3.1 Location of Household Sanitation Facilities

This section highlights the location of sanitation facilities within houses as currently practiced by the residents in most parts of the city. The aim is to further highlight practices that are detrimental to healthy environment and that may jeopardise attainment of Millennium Development Goals (MDGs) in health sector by 2020. Result of the analysis shows that 24.5 per cent of toilets are located close to kitchens and 35.6 per cent of bathrooms are close to kitchens. This pattern of location of household facilities is particularly common in tenement houses in the study area where kitchens, toilets and bathrooms are located very close to one another. 5.2 per cent of water storage facilities are placed very close to toilets due to inadequate space, although some respondents claimed to use such water for bathing and washing. 26.6 per cent of waste disposal facilities are located close or inside the kitchens for easy disposal of wastes. 11.6 per cent of gutters are located close to kitchen; this is common in Oja Oba, Oke-Dada, Eleta, Odinjo and Idi-Arere as well as Molete area. Also, 10.7 per cent of the bathrooms are close to water well, these bathrooms are usually made of zinc sheets or wood as illustrated in Plate 5. The location of sanitation facilities in close proximity to one another constitutes an environmental hazard. The implications are bad odour, food contamination, and breeding of mosquitoes, cockroaches and flies all over the place. Underground water pollution as a result of closeness of well to toilets and boreholes close to toilets is a part of the consequences of this badly planned actions (Figure 2).



Plate 5 Bathroom made with zinc sheet and latrine located close to a well in Eleta Area, Ibadan.
Source: Fieldwork, 2012.

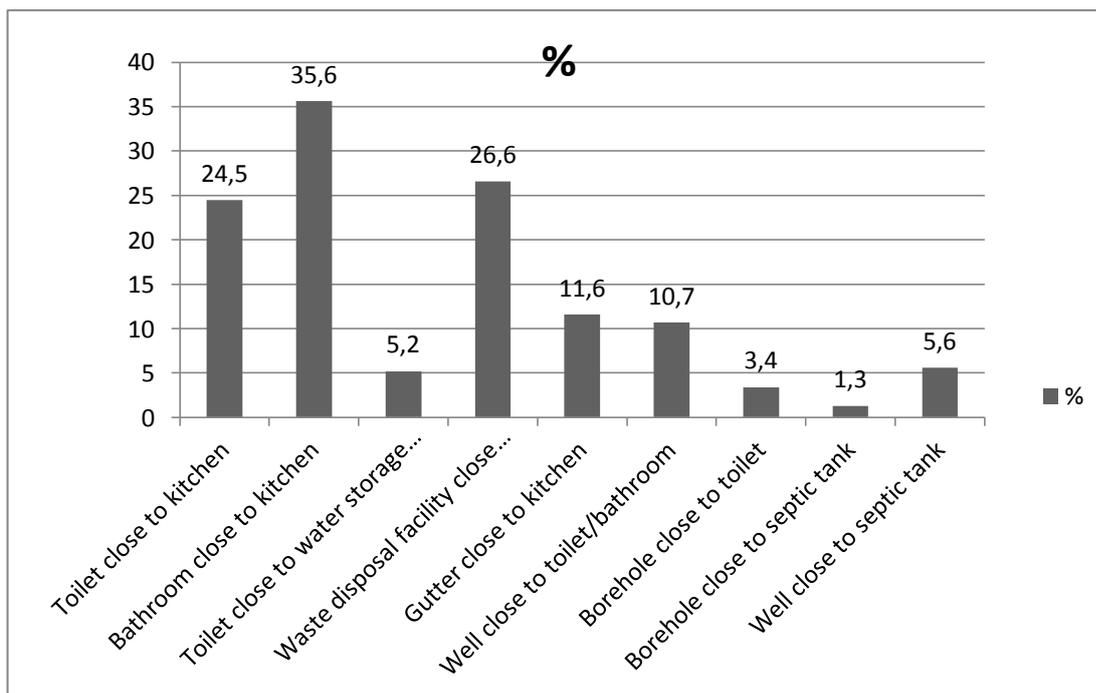


Figure 2: Locations of household sanitation facilities in residential buildings

Source: Fieldwork, 2012.

5.3.2 Perceptions on Location of Sanitation Facilities and Implications for Health

This section utilised Likert scale to ascertain level of agreement of respondents on the location of household sanitation facilities in residential buildings and the implications to health. The responses are examined by comparing the mean (\bar{x}) with the weighted value (X). Responses are categorised into six levels of agreement in order to calculate Respondents Agreement Index (RAI). Nine poser questions (variables) were used to determine the level of agreement on the location of household sanitation facilities. The greater the respondents' satisfactory index compared to the mean, the greater the level of agreement.

From Table 4.2, the level of agreement of respondents on location of toilets close to water storage facilities (5.79) and toilets close to kitchens (5.75) is strong and the weighted mean is greater than mean value ($\bar{x} = 4.98$). This wrong perception of people is responsible for unhygienic location of these facilities and perhaps the cause of environmental problems in the affected areas. It was also discovered that respondents strongly agree that location of well close to toilets /bathrooms (5.45), gutter close to kitchens (5.28) and location of waste-disposal facilities close to kitchens (5.26) may lead to high incidence of water-related health problems such as typhoid fever, dysentery, diarrhoea, and cholera. However, responses on location of well close to septic tank (4.97), borehole close to toilet (3.79) and borehole to septic tank (3.49) recorded decrease in weighted value compared to the mean value. This implies that respondents believe that location of these facilities close one another had no health implications. The calculated RAI variance is (0.70) with a Standard Deviation of (0.84) against a Co-efficient of Variation (16.86). It can be deduced from the result that location of these facilities close to another are detrimental to health of the residents in these areas (Table 4.2 and page 19 for details).

Table 4.2 Perceptions on Location of Household Sanitation Facilities in Residential Building

Level of Agreement	Respondents' opinion						No Respondents	SWV(a)	RAI a/23	x-x	(x-x) ²
	6	5	4	3	2	1					
Toilet close to kitchen	112 2	170	48	0	0	0	233	1340	5.75	0.77	0.59
Bathroom close to kitchen	702	170	256	54	0	0	233	1182	5.07	0.99	0.98
Toilet close to water storage	115 8	165	28	0	0	0	233	1351	5.79	0.81	0.66
Waste disposal close to kitchen	780	215	208	21	2	0	233	1226	5.26	0.28	0.08
Gutter close to kitchen	804	220	168	36	2	0	233	1230	5.28	0.30	0.09
Well close to toilet/bathroom	804	375	80	12	0	0	233	1271	5.45	0.47	0.22
Borehole close to toilet	462	280	52	0	0	87	233	881	3.78	1.20	1.44
Borehole close to septic tank	396	270	40	6	0	101	233	813	3.49	1.49	2.22
Well close to septic tank	762	285	80	3	0	28	233	1158	4.97	-0.01	0.00
Total									44.84		6.28

6--Strongly Agree, 5--Agree, 4--Somewhat Agree, 3--Disagree, 2--Strongly Disagree, 1--No Response.

Source: Fieldwork, 2012.

LIKERT SCALE

Calculation for level of agreement on location of household facilities

RAI = Respondents Agreement Index

SWV = Sum of Weighted Value

NR = No of Respondents

N = Total Number or Variables

$$\frac{\sum (SWV)}{NR} = RAI$$

NR

$$x = \frac{\sum SWV}{N}$$

N

$$\frac{44.84}{9} = 4.98$$

9

$$\text{Variance } (S^2) = \frac{\sum (x-\text{mean})^2}{N} = \frac{6.28}{9} = 0.70$$

N 9

$$\text{Standard Déviation (S.D)} = \sqrt{\text{variance}} = \sqrt{0.70} = 0.84$$

$$\text{Co-efficient of variation} = \frac{S.D}{\text{Mean}} \times 100\% = \frac{0.84}{4.98} \times 100 = 16.86$$

Mean 4.98

Calculation for level of agreement to location of household facilities

RAI = Respondents Agreement Index

SWV = Sum of Weighted Value

NR = No of Respondents

N = Total Number of Variables

$$\frac{\sum (SWV)}{NR} = RAI$$

NR

$$x = \frac{\sum SWV}{N}$$

N

$$\frac{32.26}{7} = 4.61$$

7

$$\text{Variance } (S^2) = \frac{\sum (x-\text{mean})^2}{N} = \frac{0.48}{7} = 0.07$$

N 7

$$\text{Standard Déviation (S.D)} = \sqrt{\text{variance}} = \sqrt{0.07} = 0.26$$

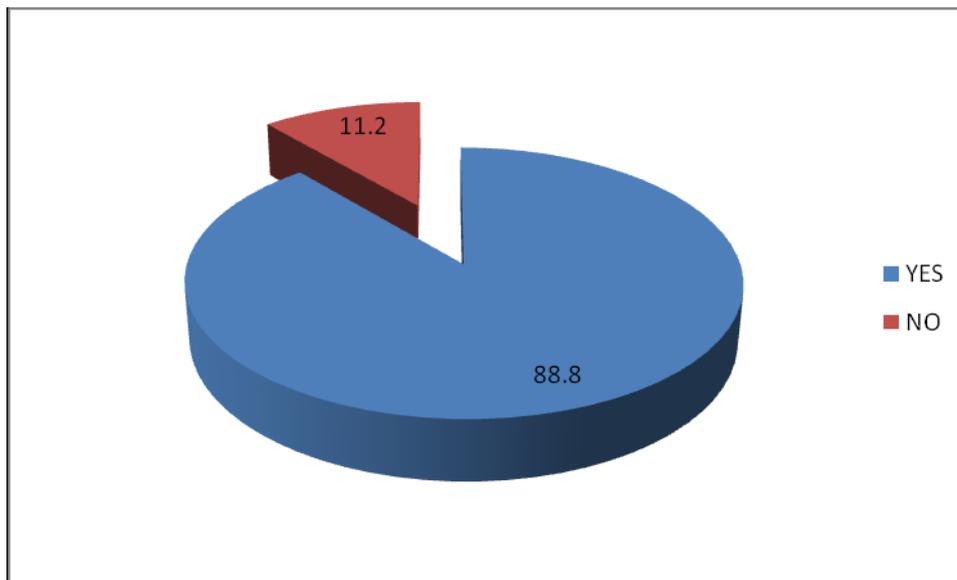
$$\text{Co-efficient of variation} = \frac{S.D}{\text{Mean}} \times 100\% = \frac{0.26}{4.61} \times 100 = 5.64$$

Mean 4.61

5.3.3 Perceptions on Environment-related Diseases

Findings from the study area reveal that there has been high incidence of water-related diseases. In actual fact, 88.8% of the respondents have suffered from one form of water related diseases such as

typhoid, cholera, diarrhea, dysentery, skin rashes and malaria. Another 11.2% stated that they had not suffered from any form of diseases before. The high incidence of water-related diseases can be linked to poor quality of sanitation practices in the area (Figure 3).



Source: Author's Fieldwork, 2012.

Figure 3: Respondents suffered from domestic water-related diseases

4.33 Environment-related Diseases and Rate of Occurrence

Results of analysis as summarised in Table 4.20 reveals that the bulk of the respondents had suffered from water borne disease. Another 0.9 per cent had suffered from diarrhoea weekly, 13.7 per cent monthly, and 18.9 per cent quarterly; in all cases, infants were the most vulnerable. Those that had suffered from typhoid fever constitute 3.4 per cent for quarterly and 42.1per cent yearly. Also, 12 per cent of the respondents had suffered from cholera before and 6.4 per cent suffered from dysentery yearly, while 12 per cent experienced dysentery monthly. Those that suffered from scabies account for 1.3 per cent quarterly and 0.9 per cent yearly while 21.5 per cent experienced skin rashes during dry season when water supply is inadequate. About 4.7 per cent suffered from guinea worm infection in the last one year. Malaria is the most frequent disease in the area. And analysis reveals that 0.9 per cent of the respondents suffered from the disease monthly while 54.5 per cent had it quarterly and 23.6 per cent experienced it yearly. This can be linked to poor environmental condition of the area which refers to mountains of solid wastes, dirty gutters and drainage channels that serve as breeding grounds for mosquitoes and flies.

Table 4.3: Environment-related Diseases and Rate of Occurrence in the Area

Diseases	Rate of Occurrence							
	Weekly		Monthly		Quarterly		Yearly	
	No	%	No	%	No	%	No	%
Water-borne								
Diarrhoea	2	0.9	32	13.7	44	18.9	-	-

Typhoid fever	-	-	-	-	8	3.4	98	42.1
Cholera	-	-	-	-	-	-	28	12.0
Dysentery	-	-	28	12.0	47	20.0	15	6.4
Water washed or water scarce								
Scabies	-	-	-	-	3	1.3	2	0.9
Skin rashes	-	-	9	3.9	32	13.7	50	21.5
Water based								
Schistosomiasis	-	-	-	-	-	-	-	-
Guinea worm	-	-	-	-	-	-	11	4.7
Water-related insect vector								
Dengue	-	-	-	-	-	-	-	-
Malaria	-	-	2	0.9	127	54.5	55	23.6
Trypanosomiasis	-	-	-	-	-	-	-	-

Fieldwork, 2012.

Summary

- 1) Level of awareness on good sanitation practices especially regular cleaning exercise is very low because populace are not concerned with environmental issues and that is why dumping waste indiscriminately is a common practice in the study area.
- 2) The problem of poor maintenance culture on the part of inhabitants as many waste disposal bins and other sanitary facilities have been damaged and not functioning.
- 3) Governments at federal, state and local levels have withdrawn from provision of waste-disposal bins for the populace.
- 4) The manpower, administrative structure and capital required for efficient disposal of refuse are grossly inadequate in the urban centre especially in Ibadan South East Area of the Metropolis.
- 5) Administrative personnel are corrupt and do not act transparently in terms of procurement of waste-disposal bins and other waste disposal facilities as well as no regular payment of salary to staff especially the street sweepers.

Recommendations

- 1) There should be increase in the level of awareness on good sanitation practices and exercise for general populace. Governments should provide public enlightenment and education on proper maintenance culture within our environment.
- 2) Government at different levels must wake up to their responsibilities in terms of providing waste-disposal bins and other sanitation facilities for the people.
- 3) A functional administrative structure must be put in place for efficient disposal of refuse. And building plan must implemented according to approval given by the planning authority.
- 4) Efforts should be put in place for workable solution for solid waste disposal problems through involvement of private partnership programme (PPP).

- 5) Efforts should also be put in place to ensure transparency and accountability among personnel in charge of waste management in Nigeria.

Conclusion

Sanitation is paramount to human life because it contributes to safety from communicable and non-communicable diseases as well as plays important roles in economic development and sustenance of cultural values. As a vital component of individual life, the availability, affordability, management and utilisation of sanitation exerts serious impacts on societal well-being and urban growth. Adequate provision of waste-disposal bins and related facilities should be the focal point of government policies and programmes in order to meet the sanitation demands of the people. In order to achieve this, government policies and programmes on availability of sanitation facilities need to be safeguarded against corruption and mismanagement of funds meant for the project. If the measures stated above are successfully implemented, the problems militating against good sanitation in Ibadan South East Local Government Area and Nigeria in general would be alleviated.

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SUSTAINABILITY AS A STRATEGY OF RESPONSIBLE AND COMPETITIVE DEVELOPMENT

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Abstract

The aim of this paper is to analyze a competitiveness strategy based on sustainability to lead the way to a model of responsible and competitive development. The analysis takes as its starting point the assumption that the maturity of a sustainable business strategy positively affects competitiveness. The used method is the critical analysis. Among other results of this analysis concludes that the current business strategy seeks a system ecologically appropriate, economically viable and socially fair to reach sustainable equilibrium. This strategy based on sustainability must be promoted by the institutions and strengthened by the capabilities and resources that each company counts on to develop advantages to foster the overall development and achieve the maximization of benefits from the tangible and intangible perspectives.

Keywords: Business, competitiveness, development, strategy, sustainability.

Resumen

El objetivo de este artículo es analizar la estrategia de la competitividad en función de la sustentabilidad para dar la pauta a un modelo de desarrollo responsable y competitivo. El análisis tiene como punto de partida el supuesto de que la madurez de una estrategia sustentable en los negocios afecta positivamente a la competitividad. El método empleado es el análisis crítico. Entre otros resultados de este análisis se concluye que la estrategia empresarial actual busca un sistema ecológicamente adecuado, económicamente viable y socialmente justo para llegar al equilibrio sustentable. Esta estrategia basada en la sustentabilidad debe ser impulsado por las instituciones y fortalecido por las capacidades y recursos con los que cuenta cada empresa para desarrollar ventajas que impulsen el desarrollo global y logren la maximización de beneficios desde una perspectiva tangible e intangible.

Palabras clave: Negocios, competitividad, desarrollo, estrategia, sustentabilidad.

1. Introduction

Today's enterprises face a daily challenge to survive by growing material needs, natural resource scarcity and inequalities. Making sustainability a key role as a global strategy may be based on economic prosperity, ecological balance and the common good. Globalization in business has become more complex the panorama, increased competition, access to new markets, development of new technologies have led businesses to focus efforts on building an identity that will strengthen their skills.

According to Porter (1995), these strengths are based on competitive advantage, which exists when there is an equivalence of distinctive competencies of a company, so the customer particular needs allow generating a competitive advantage. Another factor that makes complex business world is the interest of the owners to maximize their profits in the shortest possible time, forgetting prosperity at the expense of society and the environment. Agency theory helps to clarify some aspects related to the problem of the relationship between people, environment and resources, which examines the situations of delegation of authority and decision making and joint interests opposed to individuals that have to be overcome to reduce moral hazard.

The industry in general is embedded in social and environmental spheres. Therefore the companies are concerned to finding a balance that allows the supply and enrichment from the system is of utmost importance. Therefore, it is the responsibility of caring for the environment and society, living in balance to ensure economic sustainability for the future. The challenge for governments is to design rules that enable sustainable development, maximizing the social and economic welfare and environmental care. These rules are based on planned restrictions that structure business integration.

Sustainability is the way to find economic, ecological and social balance, resulting in prosperity and capitalization of new resources. In the theory of resources and capabilities, the notion of competitive sustainability is referred to the equilibrium (Barney, 1994, Barney and Zajac, 1994, Rumelt 1984), which is the way to observe the competition in terms of windfall profits. In an environment like today's highly competitive and globalized, it is necessary to analyze the sustainability bearing in mind that among competitive players there is only one winner and many losers. With a sustainable strategy the short and long term benefits are maximized having greater tangible and intangible profits. Instead the purpose of competitiveness is the economic optimization, leaving aside the social and environmental factors, contrary to what is proposed by the sustainability.

A sustainable strategy ensures the success of organizations and ensures its permanence over time.

2. Background

In the early '70s awareness of the seriousness of the degradation of environmental friendliness manifested itself in the United Nations Conference on Environment in Stockholm in 1972, where it was coined the term sustainable development. The Brundtland Report by the United Nations Organization (1987), proposes the restoration of ecological balance, rebuild what has been damaged by the economic and material progress and build the natural bases that make the development model of industrial society something enduring. Economic development on which the report reflects, analyzes what causes poverty, inequality, injustice and environmental damage. It highlights the common good and ecological health as the absence of both is directly related to environmental degradation of the countries.

The term sustainable development gained acceptance as a result of the United Nations Conference on Environment and Development (1992, 8) which states "Sustainable development

is one that meets the needs of present generations without undermining the ability of future generations to meet theirs". Lezama and Graizabord published in 2010, "The great problems of Mexico," where they explain: Sustainable Development in Mexico departs from the modernization process in the review process and the Institutional transformations. The General Law of Ecological Equilibrium and Environmental Protection records clearly these principles.

The Reform of the Organic Law of Federal Public Administration of 1992 transformed the Secretary of Urban Development and Ecology (SEDUE) in Secretary of Social Development (Sedesol) and created the National Institute of Ecology (INE) and the Federal Environmental Protection Attorney (Profepa) reflecting directly the search for modernization. The National Institute of Ecology (INE) was able to create the regulatory framework, and make the lines to be followed by environmental policy. The Federal Environmental Protection Attorney (Profepa) became responsible for that which was established as a legal and normative principle and that the policy defined as its strategy, objectives, goals and actions, leading to the award of the ecological equilibrium, that it was actually obeyed and fulfilled . These institutional changes taking place in Mexico resulting from the global debate triggered by the Brundtland Report anticipated the Rio Summit.

The signing of the Free Trade Agreement (NAFTA) which entered into force on the first day of 1994, and the addition of Mexico to the Organization for Economic Cooperation and Development (OECD) the same year. Both events brought intense legislative, normative and institutional activity. Environmental standards of various kinds were created with the deliberate purpose of government to be part of the agreement that brought to do commercially to the U.S., Canada and Mexico "(Lezama and Graizabord, 2010, p.47).

3. Definition of the problem

The competitive strategy led to harmful social and environmental that over the years has become economic problems. This is a model in which the competitive survive and the weakest die in failed. From this point, it is proposed a sustainable strategy based on the theories of institutions, resources, industry and corporate social responsibility.

4. Justification

The supporting sustainable strategy based on the fact of having limited natural resources, which before and at the time of exhaustion would cause economic, ecological and social demand for them. Sustainability is an economic development strategy that benefits all three factors increasing satisfaction levels and strengthens the future prospects.

5. Hypothesis

H0. The maturity of a sustainable strategy positively affects business competitiveness, with positive results in the economic, ecological and social development.

6. Objective

To analyze the competitiveness strategy based on sustainability strategy to lead the way to a model of responsible and competitive development.

7. Theoretical frame of reference

The theory based on the industry, resource-based theory and theory of the institutions establish the theoretical frame of reference for government business set up a complex framework based on the studies of Porter (1985), Wernerfelt (1984), Barney (1991) and North (1990). This framework presents the overall picture for business development and its relationship with the environment. The development of society is not unique and exclusive to the institutions, the

business-environment relationship first take an important role in the development of society, reflected in the economy and the standards of quality of life.

Barney (1991) mentions that organizational resources are assets, capabilities, attributes which are controlled by the organization to devise and implement strategies that improve its efficiency and effectiveness. These resources are heterogeneously distributed among the organizations, being valuable, rare, inimitable and not substitutable. From the point of view of resource-based view Wernerfelt (1984) mentions that maintain a competitive advantage built on its resources.

A competitive advantage exists when there is equivalence between distinctive competencies of a firm (Porter, 1985). According to Peng (2006) there are three competitive strategies: differentiation, costs and focus or segmentation. The strategy of differentiation is based on distinguishing between competing firms. The strategy of cost, the company offers lower prices to consumers. The focus is characterized by identifying a market segment in which specialization is the right strategy to capture the niche market.

In the relationship with the environment, the institutions are presented as "humanly planned restrictions that structure human interaction" (North 1990, p.3) represented as rules of the game. It defines dynamic capabilities as "the organization's ability to integrate, build, and reconfigure and align competencies to market changes" (Teece, Pisano and Shuen, 1997, p.521). Organizational capacity and dynamics given by Winter (2003) as a high level capacity which gives the direction of the organization a set of alternatives to achieve valuable results. In turn, he mentions that dynamic capabilities are those organizational capabilities acting to create the conventional capabilities.

The capabilities of the entrepreneur are a fundamental part of strategic development, which will provide sustainable competitive advantages. As it is known (Simon, 1947) there are different capacities in all humans, that can limit maximum utilization of resources according to the bounded rationality. Penrose (1959) states: "A company needs reserves for operation, the displayed subject to a restricted and cumulative development process. It has been suggested that the competitive strategy requires the exploitation of the capabilities, internal and external firm-specific "(Penrose, 1959, p. 94).

Based on this framework it can be established the sustainability strategy as an alternative to responsible and competitive development. The International Union for Conservation of Nature mentioned in the XVIII General Assembly (1990): Sustainable development is a process of economic and social improvement that meets the needs and values of all stakeholders, keeping future options and conserving natural resources "and" Sustainability: a strategy for the care of the planet (International Union for Conservation of Nature, 1990, p.33).

In 2007, mankind consumed resources equivalent to one and a half planet according to the factor of bio-capacity, jeopardizing the provision of resources for future generations. This situation places the sustainability strategy as a solution to the problem in the bud. In collaboration with industry, institutions and society, the implementation of a sustainable strategy is to achieve optimum level which may not be exposed to future generations, as shown below:

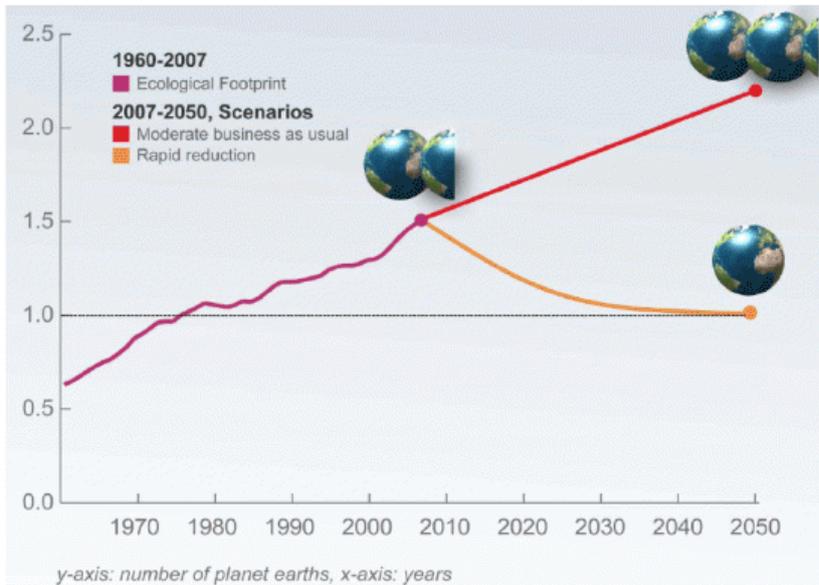
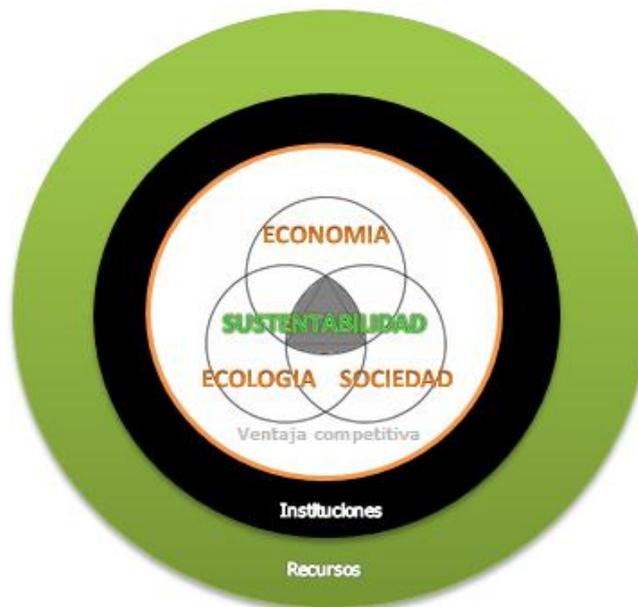


Figure 1: Bio-capacity.

Source: World Wide Fund For Nature (2010),

Making an analysis it can be established the strategy of sustainability as balancing economic, ecological and social interaction with the theories of the resources, institutions and industry, as illustrated in the figure 2 below.



La sustentabilidad como equilibrio económico, ecológico y social en interacción con las teorías económicas de los recursos, las Instituciones y la ventaja competitiva. **Fuente: Elaboración propia.**

Figure 2. Sustainability is balancing economic, social and ecological interactions with economic theories of resources, institutions and comparative advantage.

Source: Own elaboration.

Sustainability suggests a close relationship between business and client entity in which you can be set more than a transaction of mutual benefit of the parties and ensure customer loyalty. The concept of sustainability currently is living with the social responsibility of business organizations that have integrated their strategies voluntarily beyond compliance with laws and regulations of the country, comes from a positive social development through the creation of values and a responsible business conduct.

Sustainability is constituted as an unavoidable necessity for the future survival of the company. Most of today's problems revolve around the wealth, accumulation, inequality, generating new demands for goods, as a synonym for the equilibrium distance, which lie in the ignorance of the subsidiary principle of efficiency social.

8. Competitiveness in terms of sustainability from a perspective of indicators.

The analysis of development indicators helps to assess the factors that make up the function, to give a comparative result between different actors evaluated. To assess the competitiveness are measured product or service variables creating the offering value to the organization compared to competitors, the position of these variables is the level of organizational competitiveness. Among them are the cost, speed, reliability and customer satisfaction. The model of Systemic Competitiveness developed by Esser (1996), provides a framework with a medium to long term vision and dynamic interaction between actors, which should be directed not only to optimize efficiency potential at different system levels, but also in mobilizing social capacities for creativity aimed to develop competitive advantages.

Analyzing the sustainable development indicators show the performance of the industries based on economic, social and environmental factors. The first factor based on economic development is focusing on a framework of quality, environmental audits, introduction of clean technologies and sustainable use of resources. The social factor analyzes the development of employees and their participation in society, creating an atmosphere of wellness based on the values of the company. The last of the evaluation factors of sustainability is the environmental factor which is set to analyze the impact of the company with its environment.

Different organizations have developed different indicators to assess the impact of implemented strategies. Here are some indexes of competitiveness and sustainability:

A. Competitiveness index

Growth Competitiveness Index was introduced by Jeffrey D. Sachs and Andrew Warner and developed with the assistance of John McArthur for the Center for International Development at Harvard. It measures the ability of a national economy to achieve sustainable economic growth in the medium term. Business Competitiveness Index (2003) was created by Michael Porter from the Institute for Strategy and Competitiveness at Harvard Business School. Evaluates the effectiveness with which an economy uses its resource base.

B .Sustainability indexes

Dow Jones Sustainability Indexes (1999) are the first global indexes tracking the financial performance of leading sustainability-driven companies worldwide. ISE-BOVESPA (2005) is a pioneering initiative in Latin America, designed to create an investment environment compatible with the needs of contemporary society for sustainable development and to encourage companies to be ethically responsible. Environmental Sustainability Index Yale University (1995) was developed by Yale University to set the benchmark for the ability of nations to protect the environment. These indicators permit comparison across a number of issues that fall within the following five broad categories: Environmental systems, reducing environmental stress, reduce human vulnerability to environmental stresses, social and institutional capacity to respond to environmental challenges and global management.

It can be noted that the indexes of competitiveness and sustainability are very clear, assess objective factors which are given a weighting. As mentioned earlier, the competitiveness indexes assess primarily economic, while sustainability focus primarily on the environmental factor, worrying at the forefront of the social aspect, to have positive results in the economy.

Then there is the Most Sustainable Global Companies Ranking (2012) published by Corporate Knights that analyses productivity factors of carbon dioxide, diversity leadership, responsibility for payment of tax, it is important to note that in the issue of sustainability, responsible business can make a lot without big investments by having a social, economic and environmental culture, being a good example the Brazilian firm Natura Cosméticos S.A. See Table 1.

Table 1. Ranking of most sustainable global companies 2012.

Company	Rank	CO2 productivity	Leadership diversity	% Tax paid	Country
Novo Nordisk A/s	1	\$68-585	17.65%	80.45%	Denmark
Natura Cosméticos S.A.	2	\$284.661	0.00%	73.90%	Brazil
Statoil Asa	3	\$6,508	40.00%	100.00%	Norway
Novozymes A/s	4	\$4,229	18.75%	91.87%	Denmark
ASML Holding Nv	5	\$70.094	15.38%	80.54%	Netherlands
BG Group Plc	6	\$3, 308	7.14%	99.83%	United Kingdom
Westpac Banking	7	\$152.948	30.00%	100.00%	Australia

Corporation					
Vivendi S. A.	8	\$129.114	33.33%	68.67%	France
Umicore S. A./m.v.	9	\$24,360	20.00%	74.67%	Belgium
Norsk Hydro Asa	10	\$4,520	33.33%	100%	Norway

Source: Corporate Knights, <http://global100.org/index.php>.

The Most Sustainable Global Companies Ranking 2012 it is observed how the firms are evaluated on the ecological role of carbon dioxide, which creates major problems in greenhouse pollution, the social role based on gender diversity and social responsibility in paying taxes. It is a clear example that corporate responsibility is ever-increasing to society, contributing in different ways.

On a macro level Yale University has developed the Environmental Sustainability Index by assessing the environmental systems, reducing stress, reducing human vulnerability, social and institutional capacity and overall management. The results of the evaluation are presented in pentagons. Then it is presented the evaluation of index for Finland, the United States and Mexico which will be analyzed against the global competitiveness index published by the World Economic Forum, which provides competitive factors based on institutions, infrastructure, macroeconomic environment, health and primary education. Higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication and innovation.

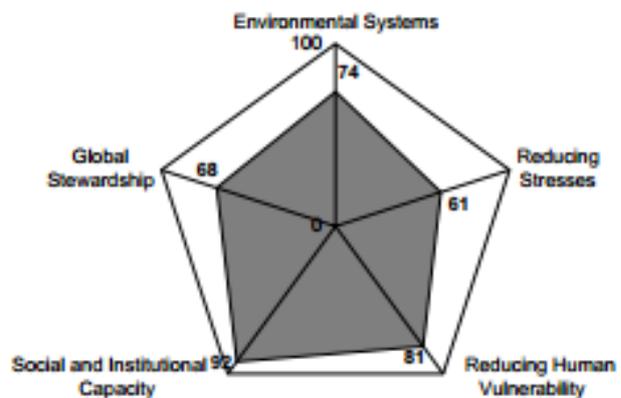
C. Environmental Sustainability Index (Finland)

ESI 2005: Appendix B

Country Profiles

Finland

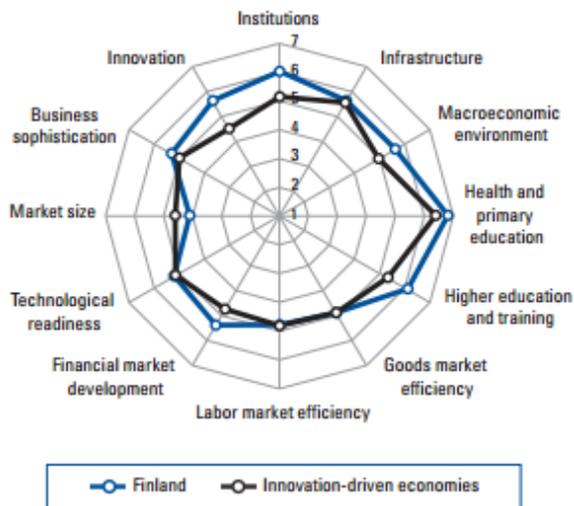
ESI:	75.1
Ranking:	1
GDP/Capita:	\$23,700
Peer group ESI:	55.4
Variable coverage:	75
Missing variables imputed:	1



Source: Environmental Sustainability Index (2005).

http://www.yale.edu/esi/b_countryprofiles.pdf

Global Competitiveness Index (Finland)



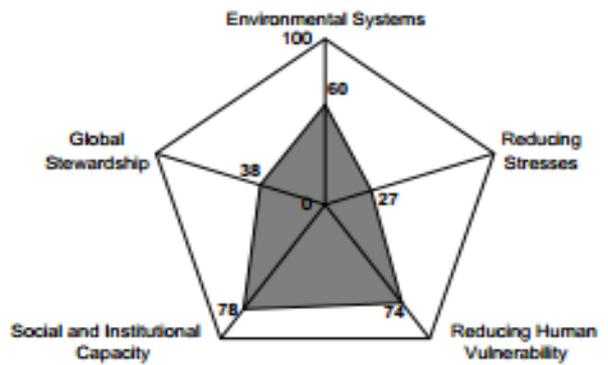
Source: World Economic Forum,

http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf

D. Environmental Sustainability Index (United States)

United States

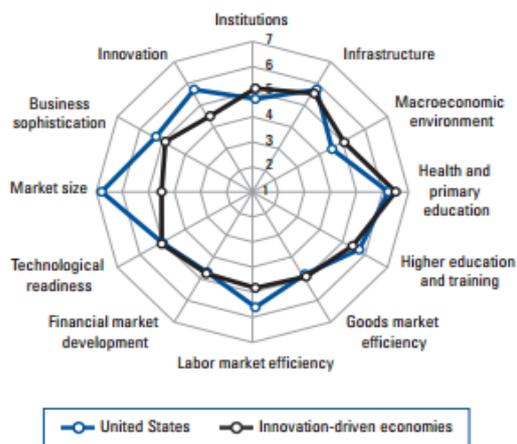
ESI:	53.0
Ranking:	45
GDP/Capita:	\$32,483
Peer group ESI:	55.4
Variable coverage:	73
Missing variables imputed:	0



Sources: Environmental Sustainability Index (2005)

http://www.yale.edu/esi/b_countryprofiles.pdf

Global Competitiveness Index (United States)



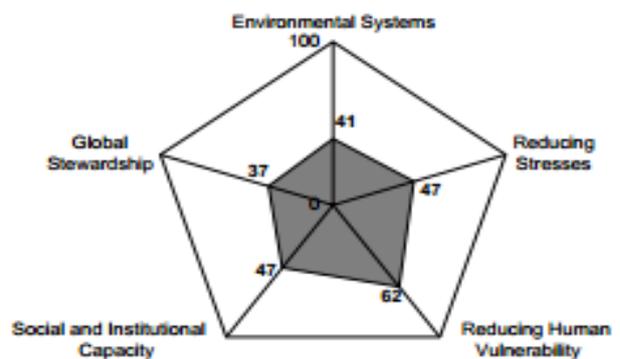
Fuente: World Economic Forum,

http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf

E. Environmental Sustainability Index (México)

Mexico

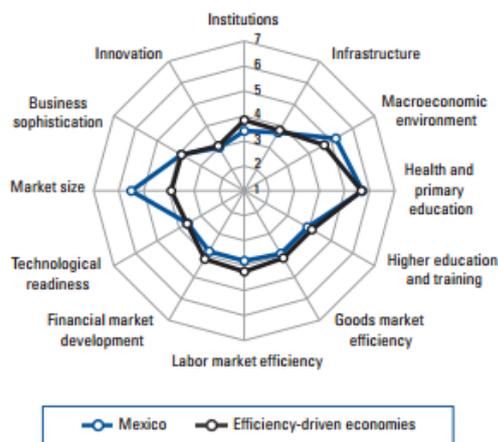
ESI:	46.2
Ranking:	95
GDP/Capita:	\$7,945
Peer group ESI:	52.1
Variable coverage:	74
Missing variables imputed:	1



Source: Environmental Sustainability Index (2005).

http://www.yale.edu/esi/b_countryprofiles.pdf

Global Competitiveness Index (México)



Fuente: World Economic Forum,

http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf

Competitiveness is based on economic variables reflected in indicators such as gross domestic product. A company can deplete forests, pollute the air showing positive competitiveness indicators but not reflecting a sustainable strategy. It can be observed the U.S. case which is among the five most competitive countries and the sustainability index is in the place 45. This reflects the lack of concern for social and environmental factors, which make the difference between sustainability and competitiveness. In contrast, the levels of competitiveness in Finland are among the top ten and sustainability is at number one according to the indicators mentioned above.

Taken at a micro scale by reference to the same factors evaluated, it can be observed that the strategy is sustainable and have positive results in the appearance of responsibility and competitiveness. The most competitive companies have the best economic, social and environmental issues in the long term, ensuring sustainability; this presents a strategy where competitiveness is measured in terms of sustainability.

9. Conclusions

The current business strategy seeks an ecologically appropriate system, economically viable and socially just to reach sustainable equilibrium promoted by the institutions and strengthened the capabilities and resources that each company has to develop advantages that promote the overall and global development, with the results of maximizing benefits from tangible and intangible perspective.

At the end of the analytical study it can be observed that the maturity of a sustainable business strategy positively affects competitiveness, having positive results in the economic, ecological and social. It also is emphasized that the development should not only aim to optimize the system efficiency, but also social and environmental capabilities development and to generate a social, ecological and economic stability.

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A STUDY ON SOLID WASTE GENERATION AND CHARACTERIZATION IN SOME SELECTED HOSPITALS IN OKIGWE LOCAL GOVERNMENT AREA, IMO STATE

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ABSTRACT

This paper reports the result of hospital waste analysis undertaken in some hospitals in Okigwe. This analysis was carried out between August and December 2012. Hospital wastes generated and collected from three different hospitals in Okigwe were categorized into five different classes of hospital waste. A total 95.51kg of waste was collected from the three hospitals; 60.54kg (63.38%) from H1, 18.9kg (19.7%) from H2 and 16.07kg (16.83%) from H3. GHW was the most prominent waste consisting of 64.6kg (67.63%) while the least waste type was RHW 0.09kg (0.09%). SHW, IHW and PHW weighed 11.9kg (12.45%), 16.4kg (17.17%) and 2.45kg (2.56%) respectively. A similar pattern and order of composition was recorded in the three different hospitals. RHW being the least generated waste, followed by PHW, SHW, IHW and finally GHW. A total of 13.2kg of waste was generated per day at the three hospitals; H1 generated the greatest waste per day (7.57kg), H2 generated the least waste per day (2.01kg) H3 generated 3.36kg of the hospital waste per day. H2 produced the greatest Waste/Day/Bed (0.33kg) while H1 produced the least (0.09kg). H3 generated 0.20kg hospital Waste/Day/Bed. This study reveals the absence of modern waste/incineration facilities in all the hospitals and therefore recommends their provision in order to contain the rapid waste generation of the hospitals.

Keywords: solid waste, generation, characterization, storage and composition

INTRODUCTION

As long as there are human activities, definitely waste must be generated (Nwankwo, 2003). A man or woman ceases to generate waste only when he or she is to be disposed off as waste (Adogame, 2009). Wastes may be generated during the extraction of raw materials into intermediate and final products, and other human activities. Residuals recycled or reused at the place of generation are excluded (Diaz, 2006).

Solid waste generation deals with the release of solid materials as a result of several activities of which the materials are of no more value and use to the owner at the time of release. Solid waste generation involves getting rid of waste materials from primary point of generation to any intermediate or final corner which may inconvenience or create discomfort to the normal or healthy living and affects the ecological balance (Okereke, 2006).

Since the beginning, the hospitals are known for the treatment of sick persons but we are unaware about the adverse effects of the garbage and filth generated by them on human and environment. Now, it is a well established fact that there are many adverse and harmful effects to the environment including human beings which are caused by the "Hospital Waste" generated during the patients care. Hospital waste is a potential health hazard to the health care workers, public and flora and fauna of the area (Chandra, 1999).

Hospital generates a variety of different kinds of waste and refuse. Categorizing hospital waste helps staff keep hospitals clean and sanitary so that diseases and infections do not spread. Hospital waste is broken into five general categories, namely; GHW, SHW, IHW, PHW, RHW and each type of refuse is handled with the necessary precautions to help everyone maintain optimal health (Mackenzie and Crownwell, 1998).

METHODS

MOBILIZATION: The medical directors of the selected hospitals were mobilized. The aims of the study and benefits to the establishment were well communicated to them.

ON-SITE STORAGE: Four big dustbins (plastic) were placed at different points in each of the hospitals for gathering of all the hospital waste generated each day.

WASTE COLLECTION: The wastes in the collection points were collected, characterized and weighed.

RESULTS

A total of 95.51kg of waste was generated from the three hospitals; H1 generated the greatest waste of 60.54kg (63.38%) while H2 generated the least hospital waste of 16.07kg (16.83%) and H3 generating 18.9kg (19.7) of the hospital waste. The relative abundance of waste from the three hospitals followed the same pattern of relative composition. The least type of waste was RHW while GHW was the greatest waste. PHW, SHW and IHW recorded 2.45kg, 11.9kg and 16.4kg respectively.

GHW \Rightarrow IHW \Rightarrow SHW \Rightarrow PHW \Rightarrow RHW

A total of 13.21kg of waste was generated per day at the three hospitals. H1 generated the greatest waste per day (7.57kg), H3 generated the least amount of waste (2.01kg) while H2 generated 3.36kg of hospital waste per day.

H2 produced the greatest waste per day per bed (0.33kg) while H1 generated the least waste per day per bed (0.09kg) and H3 generated 0.20kg hospital waste per day per bed.

A total waste of 60.54kg was generated during the period of the study at H1. GHW waste which was the greatest generated hospital waste weighed 40.6kg (67.1%) of the total generated waste, SHW or Sharps weighed 8.2kg making up 13.54% of the total generated waste, IHW weighed 10.2kg of the total waste making up 16.84% of the total generated waste, PHW weighed 1.5kg making up 2.5% of the total waste generated, RHW which was the least generated waste weighed 0.04kg making up 0.1% of the total generated waste. A total of 0.754kg of waste was generated per bed during the study period.

The total hospital waste generated at H2 Okigwe weighed 18.9kg. GHW weighed 12.4kg making up 65.5% of the total generated waste, SHW weighed 2.2kg making up 11.64% of the total generated waste, IHW weighed 3.5kg making up 18.5% of the total generated waste, PHW waste weighed 0.68kg making up 3.6% of the total generated waste, and RHW weighed 0.02kg making up 0.1% of the total generated waste. The GHW constituted the greatest portion of the total hospital waste (12.4KG) generated at H2 while the least waste was constituted by RHW making up just a minute 0.02kg (0.1%) of the total generated waste. A total of 1.89kg of waste was generated per bed during the study period.

The total hospital waste generated during the study at H3 weighed 16.07kg, GHW weighed 11.6kg making up 72.19% of the total generated waste, SHW weighed 1.5kg making up 9.33% of the total generated hospital waste, IHW weighed 2.7kg making up 16.80% of the total generated hospital waste, PHW weighed 0.27kg making up 1.68% of the total generated hospital waste and no RHO was generated during the study therefore RHW made up 0% of the total generated waste. The most predominant waste collected at H3 is the GHW, PHW made up the least generated waste while there was no RHW generated at the hospital during the study. A total of 1.636kg of waste was generated per bed during the period of the study at H3.

TABLE 1: THE COMPOSITION OF WASTE GENERATED FROM SOME SELECTED HOSPITALS IN OKIGWE L.G.A

W.C	H1	H2	H3	T.W
GHW	40.6KG	12.4KG	11.6KG	64.6KG
SHW	8.2KG	2.2KG	1.5KG	11.9KG
IHW	10.2KG	3.5KG	2.7KG	16.4KG
PHW	1.5KG	0.68KG	0.27KG	2.45KG
RHW	0.04KG	0.02KG	-	0.09KG
TW	60.54KG	18.9KG	16.07	95.51
%W	(63.38%)	(19.7%)	(16.83)	(100%)
TW/D	7.57KG	3.36KG	2.01KG	13.21KG
TW/D/B	0.09KG	0.33KG	0.20KG	0.62KG

KEY: WC= Waste Classes H1= General Hospital Okigwe (Government owned) H2= Ivory Clinic Okigwe (private) H3= St. Mary's Hospital Okigwe (private) TW= Total Weight GHW= General Hospital Waste SHW= Sharp Hospital Waste IHW= Infectious Hospital Waste PHW= Pharmaceutical Hospital Waste Radioactive Hospital Waste %w= Percentage Weight TW/D= Total Weight Per Day TW/D/B= Total Waste Per Day Per Bed.

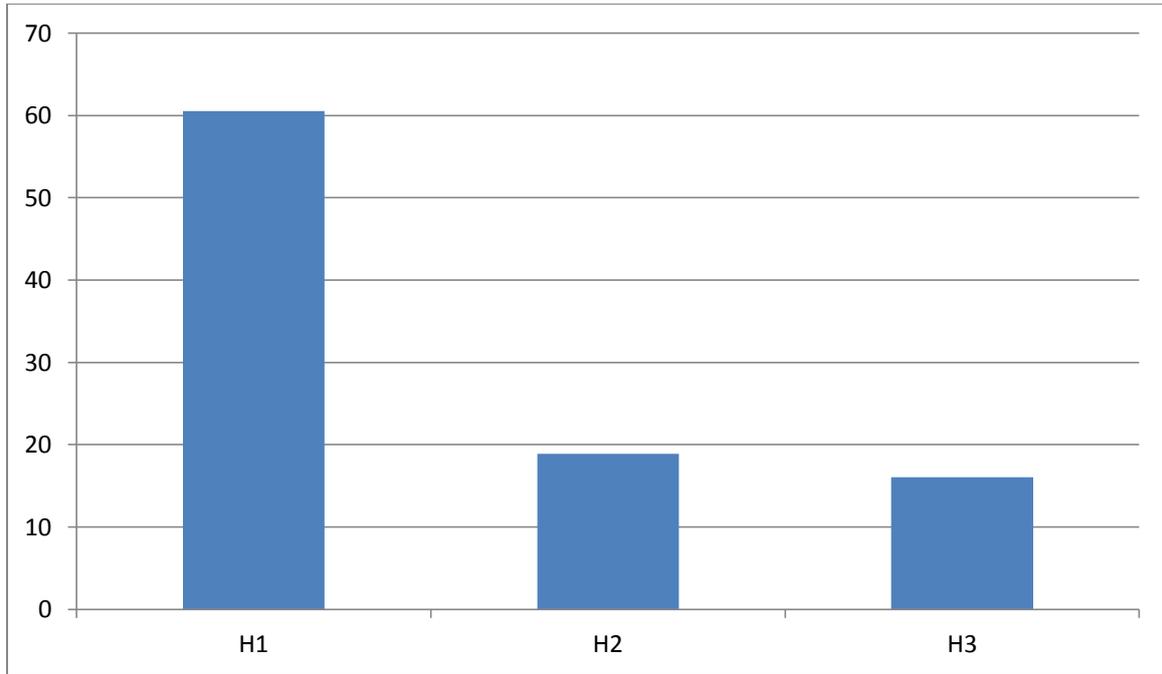


FIG 1: TOTAL WASTE GENERATED AT H1, H2, & H3

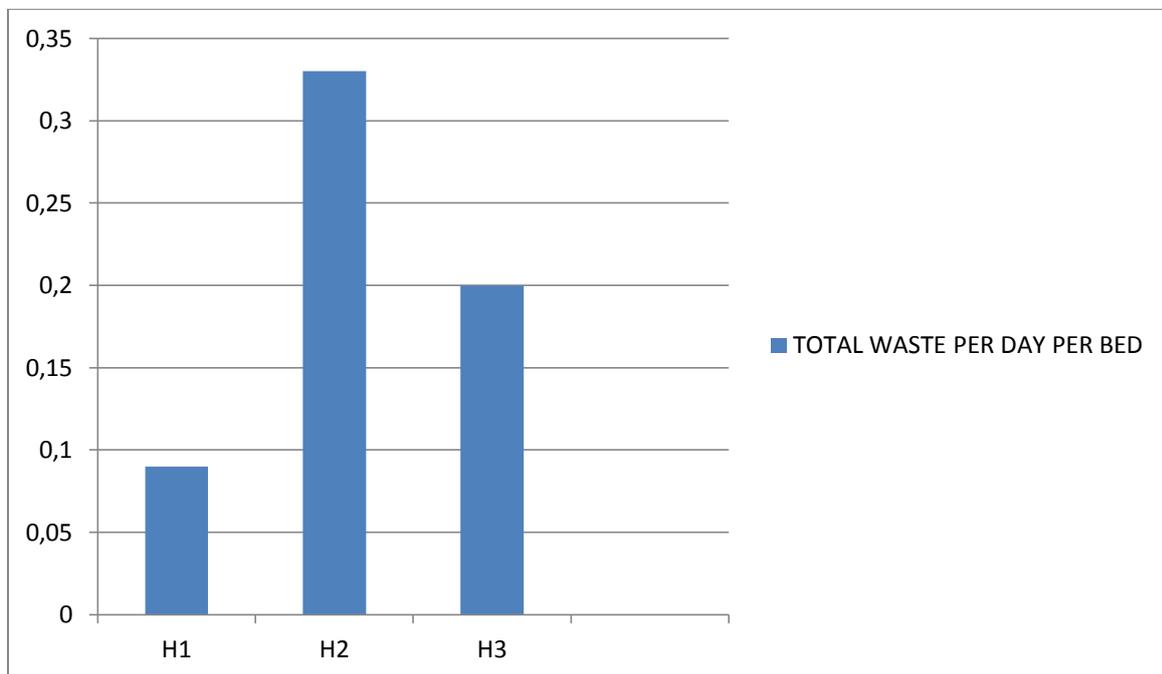


FIG 2: TOTAL WASTE PER DAY PER BED FROM H1, H2 & H3

TABLE 2: COMPOSITION OF HOSPITAL WASTE GENERATED AT H1 OKIGWE

DAYS	GHW	SHW	IHW	PHW	RHW	TWD	BED NO	TW/D/B
1	3.8KG	0.8KG	1.1KG	0.2KG	0.03KG	5.9KG	80	0.073KG
2	4.9KG	1.0KG	1.4KG	0.3KG	-	7.6KG	80	0.095KG
3	4.7KG	1.3KG	1.2KG	0.1KG	-	7.3KG	80	0.091KG

4	5.4KG	0.8KG	1.2KG	0.2KG	-	7.6KG	80	0.095KG
5	4.8KG	1.2KG	1.4KG	0.1KG	-	7.5KG	80	0.093KG
6	5.8KG	1.2KG	1.5KG	0.3KG	0.01KG	8.8KG	80	0.110KG
7	5.6KG	1.1KG	1.3KG	0.1KG	-	8.1KG	80	0.101KG
8	5.6KG	0.8KG	1.1KG	0.2KG	-	7.7KG	80	0.096KG
TOTAL/	40.6KG	8.2KG	10.2KG	1.5KG	0.04KG	60.5KG	80	0.754KG
%W	(67.1%)	(13.54%)	(16.84%)	(2.5%)	(0.1%)	(100%)		

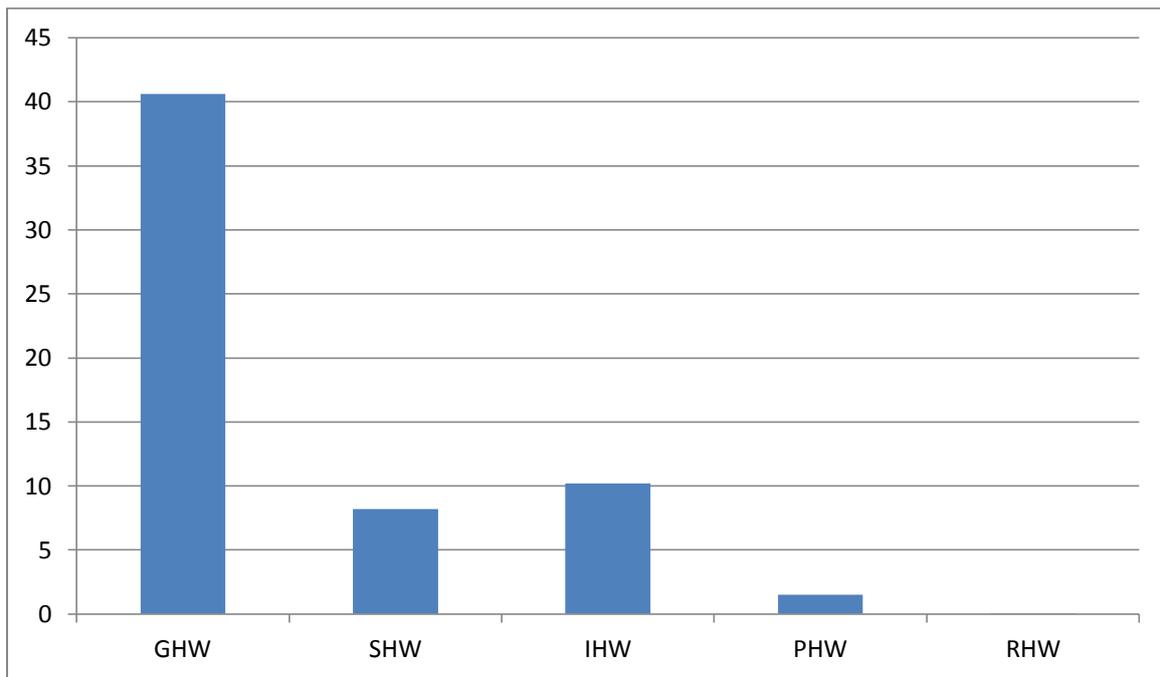


FIG 3: TOTAL WASTE GENERATED AT H1.

TABLE 3: COMPOSITION OF HOSPITAL WASTE GENERATED AT H2 OKIGWE

DAYS	GHW	SHW	IHW	PHW	RHW	TW/D	BED NO	TW/D/B
1	0.4KG	0.1KG	0.3KG	0.05KG	-	0.95KG	10	0.095KG
2	1.8KG	0.3KG	0.4KG	0.05KG	-	2.55KG	10	0.255KG
3	1.7KG	0.4KG	0.5KG	0.4KG	-	3.0KG	10	0.30KG
4	1.6KG	0.3KG	0.6KG	0.02KG	0.01	2.53KG	10	0.253KG
5	1.9KG	0.4KG	0.5KG	0.04KG	0.01	2.85KG	10	0.285KG
6	1.5KG	0.3KG	0.5KG	0.01KG	-	2.31KG	10	0.231KG
7	1.6KG	0.2KG	0.3KG	0.01KG	-	2.11KG	10	0.211KG
8	1.9KG	0.2KG	0.4KG	0.1KG	-	2.6KG	10	0.260KG

TOTAL	12.4KG	2.2KG	3.5KG	0.68KG	0.02KG	18.9KG	10	1.89KG
%W	(65.6%)	(11.6%)	(18.5%)	(3.6%)	(0.1%)	(100%)		

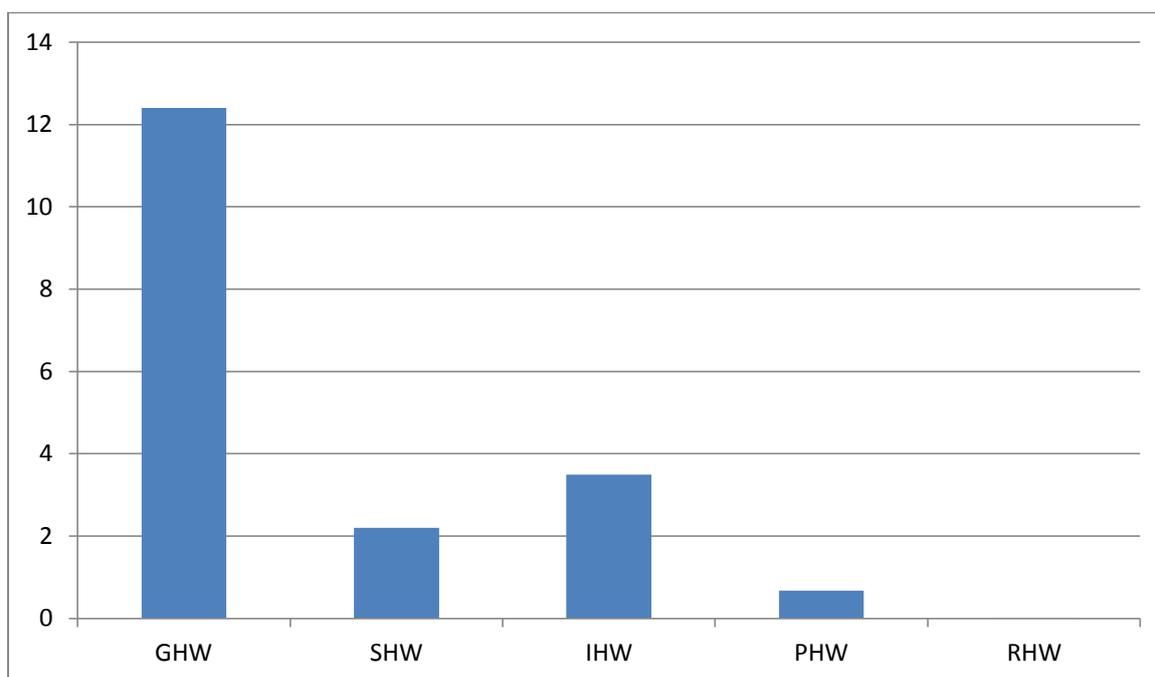


FIG4: TOTAL WASTE GENERATED AT H2.

TABLE 4: COMPOSITION OF HOSPITAL WASTE GENERATED AT H3 OKIGWE

DAYS	GHW	SHW	IHW	PHW	RHW	TW	BED NO	TW/D/B
1	0.3KG	0.1KG	0.2KG	0.04KG	-	0.64KG	10	0.064KG
2	1.7KG	0.2KG	0.3KG	0.04KG	-	2.24KG	10	0.224KG
3	1.6KG	0.3KG	0.4KG	0.03KG	-	2.33KG	10	0.233KG
4	1.5KG	0.2KG	0.5KG	0.01KG	-	2.21KG	10	0.221KG
5	1.8KG	0.3KG	0.4KG	0.03KG	-	2.53KG	10	0.253KG
6	1.4KG	0.2KG	0.2KG	0.01KG	-	1.81KG	10	0.181KG
7	1.5KG	0.1KG	0.3KG	0.1KG	-	2.3KG	10	0.230KG
8	1.8KG	0.1KG	0.3KG	0.1KG	-	2.3KG	10	0.230KG
TOTAL	11.6KG	1.5KG	2.7KG	0.27KG	-	2.3KG	10	1.636KG
%W	(72.19%)	(9.33%)	(16.80%)	(1.68%)		(100%)		

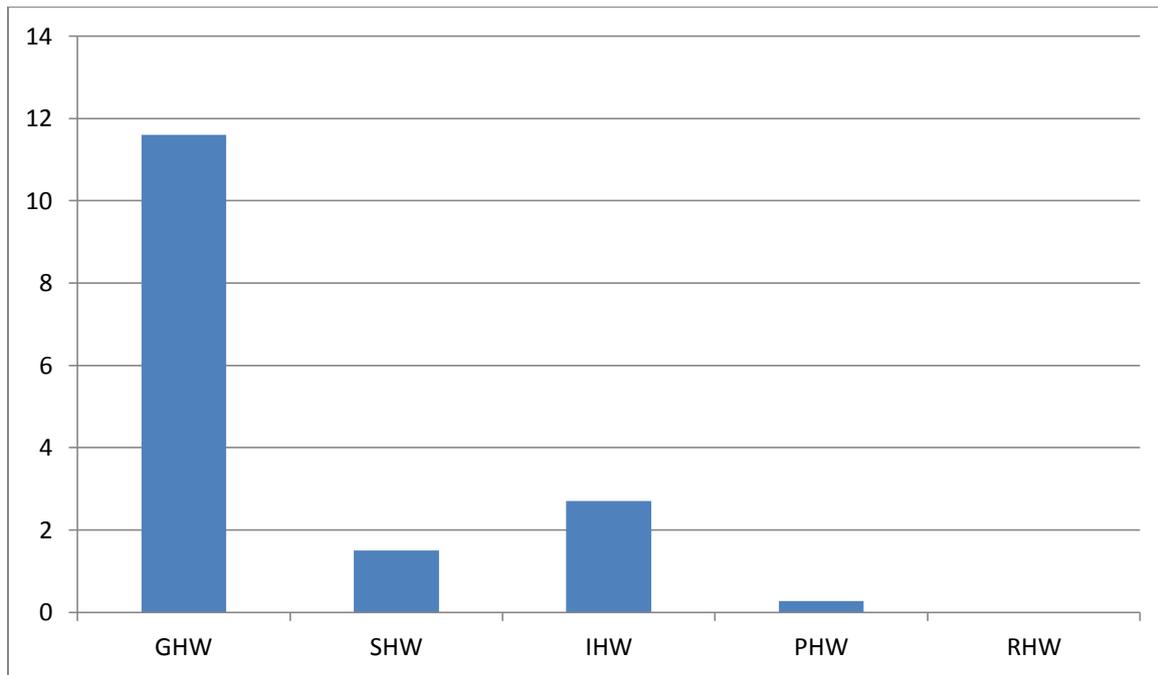


FIG5: TOTAL WASTE GENERATED AT H3.

DISCUSSION

The generation of a total of 95.51kg hospital waste in H1, H2 and H3 is of public health significance. Some of GHW are often burnt and therefore constitute some forms of air pollution around the hospitals. Others like the pathological wastes are infectious and could become veritable sources of infection while some others such as radioactive waste and sharps are hazardous. Health-care activities are a means of protecting health, curing patients and saving lives. But they also generate waste, about 20% of which entails risks of infection, trauma or chemical or radiation exposure (Ogwueleka, 2003).

Although the risk associated with hazardous medical waste and the way and means of managing that waste are relatively well known and described in manuals and other literatures, the treatment and elimination methods advocated require considerable technical and financial resources and a legal framework, which are often lacking (Hayashi, 2006).

In course of this study, it was observed that none of the hospitals studied had incineration capacity or access to other essential Health-Care Waste Management (HCWM) equipment. This observation is similar to the observation of Harhay *et. al.* (2009) who also noted the absence of incineration capacity or access to other essential HCWM among hospitals in Kabul.

Different researchers have produced different statistics on the relative composition of hospital wastes; Basu (2004) in his study noted that infectious materials consist of 15% of hospital waste. This is similar to result of this study (17.35%) and to that of WHO (2011) which recorded infectious hospital waste also to be about 15% of a hospitals waste.

According to Oke (2008) and WHO (2011), just about 1% of hospital's waste is made of sharps; this differs from the result obtained from this study which recorded sharps to have an average of 11.49% of the total hospital waste.

Sarma and Mathur (1998) recorded 3% of hospital's waste to be pharmaceutical. This is similar to the result obtained from this study (2.59%) and to W.H.O (2011) which recorded pharmaceutical waste to be about 3%. Fluke (2006) and WHO (2001) recorded Radioactive Hospital Waste to be less than 1% of a hospital waste. This is higher than the result of this study (0.1%)

Suess *et. al.* (2008) and WHO (2011) noted in their study that General Hospital Waste makes up about 80% of hospital waste. From the result obtained from this study, General Hospital Waste made up an average of 70.26% of the total hospital waste and this is less than Suess *et. al.* and WHO record.

According to Jain and Aggarwal (1998) an ICRC hospital with 100 beds will produce an average of 1.5kg to 3kg of waste per patient per day. From this study, H1 with 80 beds recorded the least waste (0.76kg) per patient per bed, H2 with 10 beds recorded the greatest waste (1.89kg) per patient per bed, while H3 also with 10 beds recorded 1.64kg of waste per patient per bed. Although H1 recorded the greatest waste generated (60.54kg), it also recorded the least waste per bed. This may be because of the non-challant attitude of government workers, poor infrastructure etc. in the place that has discouraged admission cases.

Poor waste management can jeopardize care staff, employees who handle medical waste, patients and their families, and the neighbouring population. In addition, the inappropriate treatment or disposal of that waste can lead to environmental contamination or pollution (Hayward, 2002).

If the overall goal of waste management is to prevent disease transmission from waste products, therefore the emphasis should be placed more on the “management” aspect of the process and not on the “technological fix” which is an expensive diversion rather than an effective solution (Mahmood *et. al.*, 2000).

This study shows the characterization of the hospital waste since the composition must be well known especially by the hospital authorities for decision making and planning.

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MEDICAL GEOGRAPHY IN EGYPT : AS AN INTERDISCIPLINARY SUBFIELD

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Introduction

Medical geography studies geographical factors concerned with cause and effect of health and disease. So its task not to study diseases only, but places affected with such maladies, and not studies health only but Areal differentiations in health Care patterns.

This paper aims to study the importance of medical geography as an interdisciplinary sub-discipline or subfield in Human and Social geography and attempt to follow up, analyze and classify studies of Medical geography in Egypt, since the existence of that branch in the beginning of 1980s to 2010, to observe the development of these studies. This development undoubtedly is necessary because the concept, terrain, and the range of this subfield were not understandable in the beginning of studies. So, many researchers preferred choosing general topics in the first time. Gradually, they have been concentrating, deliberating on subjects related to some diseases which correlate to Egyptian geographical environment. Explicitly, we can decide that the studies of medical geography in Egypt seem to be more general and more comprehensive especially in the period from 1986 until 1996. Thereafter till 2010, studies have dealt with specific topics and new methods and materials of Medical Geography.

Medical Geography as a subfield depending upon many systems, polices and Sciences e.g. medicine, engineering, soil, Geology, Biology, Economy, Politics, History, and psychology. Etc. The main approaches of medical geography depends upon many trends and attitudes, the first approach called “disease diffusion”, which differ from site to site as a cause of climatic factors e.g. temperature, humidity, winds, relief and topography, and other human causes. The second approach “Disease pattern”, includes endemic, epidemic and pandemic diseases in micro and macro scale in the world, and studies spatial and areal differentiations. The third approach “Medical cartography”

devoted to the distribution of diseases and health services, by using GIS and other advanced techniques. Mapping plays a crucial role in the history of medical geography literature, when physicians started to study and draw maps firstly. It was created to show historic outbreaks of diseases like Cholera in Broad Street, London 1835, then global influenza pandemic 1918, and Cholera epidemic in Egypt 1947, for example. The fourth approach "Ethno medicine and medical pluralism" which covers integration between traditional and modern medicine, in this context medical geography concentrates upon spatial variations between rural and urban behavior of the population, The fifth approach "Health care" which deals with planning health systems in different states. So such analysis should be done with the assistance of equations and mathematical methods such as gravity model, neighborhood analysis, and weight mean centers. The Sixth approach "Nutritional geography" which deals with the study of deprivation and hungry places, poverty zones, and through distribution of calories intake between human groups. The seventh approach "Associative relatives" which deals with statistical analysis using advanced indices such as factor analysis, correlation coefficient, standard deviations, analysis of variance and prediction measurements in health care and disease.

Medical Geography is an important field because it aims to provide spatial understanding of health problems and improving health care systems worldwide, this sub-discipline has relatively a modern history though Hippocrates (5th-4th centuries BCE), and Arab physicians (Ibn Seena) investigated such topics which may fall in the area of medical geography. Although medical geography is eminent field of study today, geographers have some barriers to overcome when obtaining data. The problem is associated with recording a disease's locations. Most of underdeveloped countries don't have systematic medical registrations to enable medical geographers actually make a proper geographical analysis.

Medical geography as a science succeeds to put its foot on the geographic departments in Egyptian universities. This subtitle has become a learning subject in undergraduate and postgraduate courses in many universities in Egypt. Despite that has been emerged late in Egypt, compared to developed countries, it has found a good site among other geographic branches in a few years.

This paper may help new descendants in the geography departments, to know more about medical geography studies in Egypt in the past three decades, our problems and may anticipate solving them. Through co-operation between

the geography departments in the Egyptian universities, and another departments of geography in African universities especially in Nigeria we can put strategic plan to covering all of regions according to the site, location and geographic sphere of every university in order to study health problems of population in provinces or states. Moreover, drawing a health map or disease map to each governorate or state, can help the decision maker and policies planners. Through a general strategy of the Ministries of Health and WHO we hope to eradicate serious diseases.

Although this study is interested in the Egyptian geographers studies in the field of medical geography, it can't neglect in the same time the contributions of physicians and scientists in the medical system in this field, which help geographers in their studies and papers.

1- Pre- emerging of medical geography

Physicians and scientists in research centers began to study geographical environment and its relationship with disease diffusion in Egypt before emerging expression of medical geography in Egypt many decades ago by medical geographers. Scientists and physicians help geographers to know more about the relationship between disease and the geographical environment, especially the epidemiologists, tropical medicine physicians and public health doctors.

These centers such as National Research Center, Theodore Bilhars institute, nutrition institute, Tropical medicine center, Cancer institute center, College of medicines, and other centers of research and treatment have many of specific scientific journals interested in disease of geographic environment. Geographers take a benefit of these journals in order to understand the disease pattern, disease diffusion, and the impact of geographical environment on the health and disease. Many of these journals deal with this relationship.

Although most of these papers which published in medical journals in the past fifty years were basically for physicians works and for medical purposes, but some papers were interested in social and geographical environment, when the epidemics and endemic diseases were widespread like Plague, Leprosy, Tuberculosis, Malaria, Trachoma, and other series diseases infected many thousands of Egyptian people. This relationship between geography and medicine reflected on the pattern of papers covered disease ecology, and the environment of these diseases which appeared and disappeared throughout the last century.

In this review, we spotlight only on sample papers related to geographical environment which published in these journals by physicians. One of them published by Ayad, N.A, under the title of "*Short review of the epidemiology of schistosomiasis in Africa, Egypt.*"in the Journal of Bilharsiasis., Vol.1.,1974. Another paper was published in the Egyptian journal of bilharzias in 1975 by Abu-Elhassan under the title of "*Belharsiasis disease in the New Valley and in the reclaimed coastal zone* . In the Journal of tropical medicine and hygiene, vol.31. 1982., Mobarak published his paper under the title of "*The schistosomiasis problem in Egypt*"

Some papers studied the fishermen in the lakes, like the paper which was published in 1978 in the journal of bilharziasis under the title of "*prevalence of schistosomiasis among fishermen of lake Maryut ,Egypt* by Ahmed,M.,Et al , and a recent paper in 2000 by Hammam M.H,and others in the American journal tropical medicine and hygiene 62, under the title of "*The epidemiology of schistosomiasis in Egypt: Qena Governorate*. Some other papers deal with "the effect of the irrigation systems in the prevalence of endemic disease, the Aswan high dam was a topic of one study about the prevalence of bilharzias by Malek,E.A. published in Egyptian Bilharsial journal, vol 8, 1981.

All of these papers did not only study the patient and the effect of irrigation systems in the morbidity level, but also extended to study the environment of intermediate host, as a part of circle of disease. El-Emam M. published his paper 1981 in the Egyptian journal of Bilharzias under the title of "*Environmental study on the snail of Bilharzias in some zones in Arab Republic of Egypt*" Another study for Mousa and Alhassan in 1972 about "*The effect of water temperature on the snail intermediate hosts of Schistosomiasis in Egypt*" published in Med. Assoc. vol.55,1972..Another study of Allam 1981 about "*The effect of environmental factors on the prevalence of pure Schistosoma haematobium infection under basin and perennial irrigation systems in Upper Egypt*" in *Assiut Med Journal* 1981., Abdel Wahab and others published paper in American Journal of tropical medicine & hygiene., vol. 29,1980 under the title of "*Schistosomiasis Mansoni in an Egyptian village in the Nile delta*". ,Abdel-Aty, M.A and others study in 1993 the same species of bilharsia but in Assuit province which situated in middle Egypt. Many papers covered field work studies like Trachoma Disease which spread between school pupils, one of this papers by Habib,M.,and others about '*Prevalence of Trachoma in school children in a village in the Qalyub area of Egypt*'. Another study for Mikhail,B.,and others published in 1989 about "*Impact of Beliefs about eye disease and trachoma in an Egyptian Delta*" in the Bulletin of the High Institute of Public Health, vol.19, .1989..

Physicians studied the change of disease patterns before geographers in Egypt, one of these studies was introduced by Abd Elwahab about "*Changing pattern of Schistosomiasis in Egypt 1935-1979*" in tropical. medicine & hygiene Journal., .On the other hand, physicians involved in study of the geographical and social environment of patient suffering from cancer. Elgazayerli, M.& Aziz published this study in Breast Journal. of cancer.,1963, vol.17, they studied "*The impact of Schistosoma infection on the breast cancer between males*, perhaps this study is seemed as strange, but it is a scientific study. In 1981 Ibrahim studied "*The distribution of cancer in Egypt twelve years experience (1970-1981)*".

All these studies represent a small sample of physicians' studies, which covered stage of **pre medical geography emerging in Egypt** by Egyptian geographers. Before we turn over this review, we must not forget the role of two Egyptian physician scientists in this field, the first one is Abd-Elrahim Omran Professor of Epidemiology, University of North Carolina, and his theory which is known as *Epidemiological transition*. This theory helps to know more about the development of health societies, and it was applied on developing and underdeveloping countries. The second scientist is Yassen abd-Elghaffar Professor of liver diseases, in Cairo University, who realized the true importance of liver diseases problem in Egypt in the last decade of twentieth Century. He was aware of this dangerous disease and he predicted the disease development in the future, as a big health problem in Egypt.

2- The emerging of medical geography in Egypt

Papers and studies of physicians were indeed a green light to geographers to initiate medical geography studies in Egypt. The first article carries the title of medical geography by Egyptian geographer was in 1979, by Abu-Aianah, F. who published his paper under the title of "*some aspects of infant mortality in Alexandria Egypt: A study in Medical Geography*" in the Genus bulletin.

The second study in this field was in 1983, in the geography Department, Minia University. under the title of Kafr Elsheikh Governorate: A study in geography of disease⁽¹⁾.

⁽¹⁾ in the early days of 1980, I was undergraduate student in final year of the university, when I visit some famous old bookstores in Cairo city "Alazbakia wall" I found a book with the title of "*The Ecology of human Disease*" ,the author is Jacques May., in this time I have not read any thing about medical geography, and I haven't any idea about this branch. The surprise that the author of this book dedicated his book to Abd-Elrahim Omran, at this time I did not know about Omran and May any thing. I read some chapters of this book during my serve in the Egyptian Army, when I finished this year in April 1982, I returned back to my college, as a demonstrator in the Geography Department. I joined to pre master degree in September 1982. Professor. Dr Yousry

The progress of studies in the first years of 1980s was slow, because no one had an idea about this new branch. Gradually the studies have been growing up and have become widespread.

3- The development of medical Geography in Egypt

The development of any science, should pass through many stages, like living things, the first is the infancy, then maturity, and then the old , if science is succeeds to develop, it will live and grow, or vice versa.

Medical geography in Egypt as a subfield in geography science is relatively recent if we compare it with some other subfields. We can consider this subfield in the born stage. There are many evidences for that. The first one is the number of researchers in medical geography is still a few. The second one is that the number of studies and papers in medical geography is also little. The third is that the convenience of government and management with the importance of medical geographers in health planning needs support. They need to know that the experts and planners in the developing countries prefer choosing the geographer as a consultant to put health care plans on the geographical bases.

In spite of that, we can say medical geography studies developed in Egypt from 1979 to 2010. This development is not only in the number of studies and papers, but also in the branches, specific topics, and trends. We can divide study of Medical geography to three stages or three decades. The first one started from 1979 to 1989, the number of studies in this period was 7 only, because this branch was born few years ago, and the concepts of study is was not clear to geographers So most of the studies were under the title of medical geography, an applied study in general. There are no papers or studies written in Arabic and the libraries do not contain new journals like Social Science and Medicine, or some specific periodicals related to this branch, in addition to lack of global information systems networks, which were not known at that time. So researchers were suffering from lack of information and data so much. The second stage was from 1989: 1999, the number of studies is grows up to 18 studies. Most of papers and studies take specific subjects, either in the study of

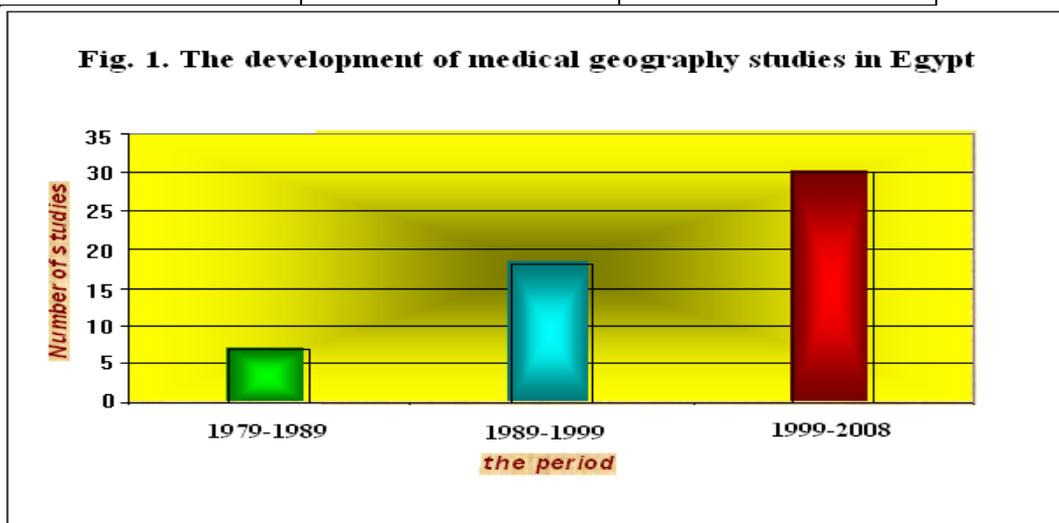
Elgowhary was a chair of Geography Department at that time . He usually chose a paper to every one of graduates to study, I was one of Eleven graduates in the class, when he try to chose my topic, I told him that I had a new topic in the branch of medical geography, "Geography of disease", he was surprised and asked me: "what is the meaning of Medical Geography.?" I responded. Then he accepted immediately, I finished my paper in the end of 1983, and I registered my Master thesis in 1984.

disease pattern or through following methods and new materials of medical geography study, like health services, mapping, and associative relations.

From 1999 to 2008 this number has increased to 30 studies, most of papers and studies are interested in the study of health care and health problems which Egyptian people suffer from. The general trend of papers in that decade studied problems of peoples like liver diseases, Kidney failure, respiratory, cancer, malaria, cardiovascular in Egypt or on the narrow scale .table 1 and figure 1 is show this development.

Table (1) the development of medical geography studies in Egypt

Number of studies 1979 : 1989	Number of studies 1989 : 1999	Number of studies 1999 : 2008
7	18	30



4-Classification of medical Geography studies in Egypt

We can classify the study of medical geography to some criteria as shown:-

4-1- subject of study

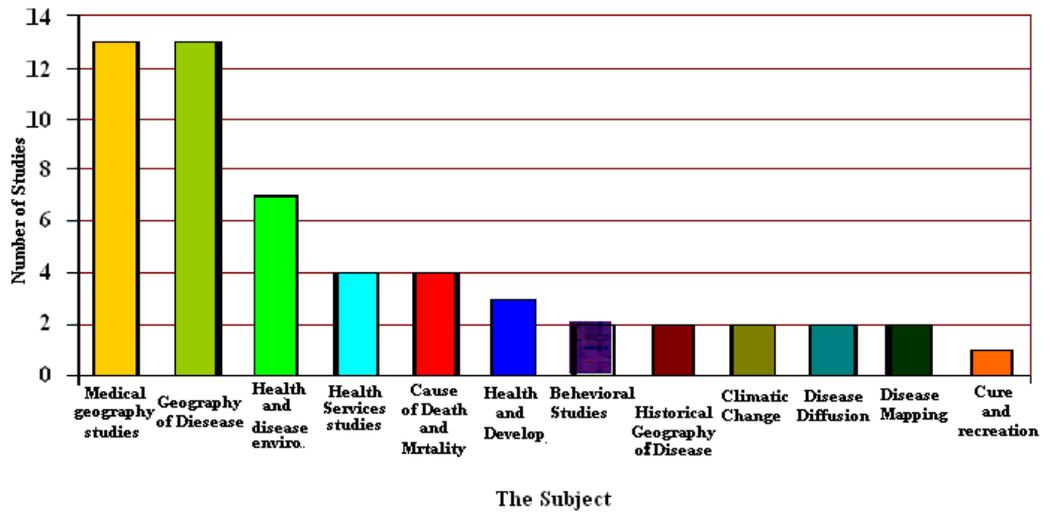
The studies of medical geography in Egypt according to subjects can be divided into some topics as shown in table 2 and figure 2

Table (2) Classification of medical geography studies in Egypt according to subject

Subject	No.	%
Medical geography title topics	13	23.6%
Geography of Disease	13	23.6%
Health and disease environment	7	12.7%
Geographical distribution of health services	4	7.3
Cause of death and mortality	4	7.3
Health and development	3	5.5
Behavioral dimensions	2	3.6
Historical geography of disease	2	3.6
Climatic change	2	3.6
Disease diffusion	2	3.6
Disease mapping	2	3.6
Treatment recreation	1	1.8
total	55	100

The first collection which carries the title of *Medical Geography* is either applied studies in governorates or districts, or through textbooks. The number of these studies is 13 with the percent of 23.6% . These studies is started with the first unpublished M.A thesis discussed in Egypt 1986 in Minia University by Elsabawy, M.N about "*Medical Geography: An applied study in Kafr Elsheikh Governorate*". The second study is an unpublished M.A thesis 1987 in Zagazig University about "*Geography of health in Kuwait country*".The third study is an unpublished M.A thesis 1989 in Zagazig University too about "*Medical Geography for Elsharkiah Governorate*" .The fourth study is an unpublished Ph.D. dissertation in 1993 in Minia University by Elsabawy,M.N. about "*health Problems of population of Minia Governorate :A study in medical Geography*".The fifth study is an unpublished Ph.D. dissertation in 1995 by Elgazairly in Alexandria University with the title of "*Alexandria Governorate: A study in medical geography*" In the same year, Emad Eltemamy introduces his unpublished Ph.D. dissertation about "*Medical geography to Kinia*".

Fig.2. Classification of medical geography studies in Egypt according to subject



The Seventh study is an unpublished M.A thesis in 1995 in Cairo University by Afaf Sayed Mohamed under the title of " *Medical geography for Elkalubia Governorate*". The eighth study is a text book for Elsabawy, M.N., 1996 under the title of "*Medical Geography: techniques and field studies*". The ninth paper is a published in 1997 for Gaber, M.M., under the title of "*medical geography for the Africa continent*". The tenth paper is in 1998 for Mohamed, K.H., about "*new directions in medical geography*". The eleventh unpublished Ph.D. thesis in 2000 for Hoida Ramadan about "*Kafr Eldawar district : A study in medical geography*". The twelfth unpublished M.A. thesis is in 2004 for Sahar Elziny about "*Elmahala Alkobra district : A study in medical geography*". And the last textbook is in the same year for Gaber, M.M. & Faten Elbana, about "*studies in medical geography*".

The second collection correlates with geography of disease, the number of studies in this field is "13" studies, with the percent of 23.6%, the first study is paper for Gaber, M.M., in 1988 about "*Cancer in the Arabian Gulf countries: A study in Medical Geography*". The second paper for the same author is in 1992 about "*Geographical Environment as A Carcinogenesis in some Arab countries: A study in Medical Geography*". The third paper is for Faten Elbana in 1992 about "*geographical dimensions to AIDS Disease in Afrrica continent*". The fourth study is a paper in 1997 by Elgazairly about "*Geographic dimension to bilharsiasis disease in egyptian governorates*". The fifth paper in 1998 is for Mohamed Abdelghany Saudi about "*AIDS in Africa: A study in medical geography*". The sixth study is a textbook for Gaber, M.M., in 1999 about "*Geographical dimensions for Aids Disease: A study in Medical geography*". The seventh study is a paper for Gaber, M.M., about "*geographical analysis for genetic disease in the Arab world*". The eighth study is a paper in 2002 for Elsabawy, M.N., about "*geographical dimensions of malaria and sickle cell Anemia: A study in medical geography*". In the same year, Yara Abdelhamid registered an M.A. thesis in Minia University about "*Cancer disease in upper Egypt: geographical analysis*". The tenth study is a registered M.A. thesis in Minia University 2004 for Zenab Abdelhakem about "*liver Diseases in Egypt: A study in medical geography*". The eleventh is an PH.D registered in Tanta university 2006 for Sahar Elzeny about "*Cancer in Elghrbia governorates: A study in medical geography with GIS Technique*". The twelfth unpublished M.A. thesis is in Minia University 2006 for Mohamed Abdelrazek about "*Kidney failure disease in Suhag governorate: A study in medical Geography*". The last paper in 2006 is for Mohamed Abdu Badr Eldin about "*geographical analysis for liver diseases in Egypt*".

We can see that this category is covering a wide range of study of disease, not only on the range of Egypt level, but also in the Arab world, Africa continent, and the whole world.

The third collection is about Health and disease environment, the number of these studies is 7 with percent 12.7%. The first one is a text book published in 1986 by Abd-Elaziz Torayah Sharaf about "*Environment and human health in medical geography*". Another study is a paper published in 1995 by Nawal hamed about "*Diseases and the environment in Abha and Minia Elkamh: comparative geographical study*". The third study is an M.A thesis registered in Minia University in 2002 by Mohamed Salaheldin about "*Health and Disease in south Sinai Governorate*". The fourth study is a paper published in 2006 by Elsabawy, M.N., about "*unhealthy using roofs: A study in health Ecology*". The fifth study is a paper published in 2007 to the same author about "*Toward health strategy to protect reclamation areas from infectious diseases*". The sixth study is a paper

published in 2007 by the same author, about "*Geographic and health dimensions to labour rural women in the urban markets*". The last study in this classification is a paper published in 2007 by Mohamed Abdelfatah about "*Geographical factors on the disease environment in Kafrelsheikh Governorate*" .

The fourth collection is about, Geographical distribution of health services. The number of these studies is 4 with percent 7.3%. The first study is an unpublished Ph.D. dissertation in 1992 introduced to Ain Shams University by Fathy Bilal about "*Cairo hospitals: a study in geography of services*". The second study is an unpublished M.A thesis in 1995 introduced to Ain Shams University too by Nagat ismael about "*Health services in united Arab Emirates*". The third study is an unpublished Ph.D. dissertation in 1996 by Khalaf Allah Hasan about "*Governmental health services in Assuit Governorate*" :*A study in medical geography*". The last study is an published paper in 2001 by Elgazairly about "*Geographical sphere of Mansura university hospitals*".

The number of papers in fifth collection which is called "Cause of death" is 4 papers and studies only with the percent of 7.3% of all papers and studies. The first one of these papers is the first paper in medical geography by Abu Aiana "*Some aspects of infant mortality in Alexandria Egypt : A study in Medical Geography*" . The second study is an M.A thesis registered in 2004 in Beni suif University by Taghrid Sayed about "*Cause of death in Egypt in the twentieth century: A study in medical geography*". The third study in this group is an M.A thesis registered in 2006 in Minia University by Amro Abdelfatah about "*Cause of death in Minia governorate in the twentieth century: A study in medical geography*". The last study is an unpublished master thesis. In Minia University 2006 for Reda Aly about "Demographic and Epidemiological transition in Beni-suif governorate in twentieth century".

In the same hierarchy "Health and Development", there are three studies in this field. The first one in 1994 is by Faten Elbana, about "*health care and human development in Africa*".The second study to the same author is in 1995 about "*Geographic analysis for some development and settlements projects in Africa: with special reference to effect in health*" . The last study is in 2003 by Gaber, M.M., about "*Geographical, Biological, Cultural determinants to health sustainable in Africa*".

The study of disease diffusion, behavioral dimensions, climatic change, and historical medical geography have the same percentage of 3.6% each category has 2 studies only. The first is a paper published in 1988 by Gaber, M.M., about "*Migration, Mobility and disease diffusion with special reference to the situation in the Arabian Gulf countries: A study in Medical Geography*". Another study is about disease diffusion in 1997 by Elsabawy, M.N., about "*The impact of Roads and routes in the diffusion of diseases: Geographical studies*", the study is conducted within historical perspective. The theory of diffusion is studied by Faten Elbana through "*The diffusion process: theory and practice*" in 2002.

The second topic "Behavioral dimensions in the study of Medical Geography", is studied through some papers and textbooks, one of them is

published in 2004 by ُElsabawy,M.N. about "*Child Abuse: A study in behavioral Geography*". The second paper to the same author about "*Behavioral Dimensions in the study of medical geography: An applied study in tokh Elkhail in village, Minia Province*".

Climate changes too is studied in 2000 by Gaber,M.M., through paper about "*Health Consequences Of "El Nino,*". Another study to the same author also in 2000 is about "*Climate change and its effects on health and development with a special reference to Africa continent*".

Historical geography of disease is the purpose of study through this paper which published in 2007 by Ibrahim Eldusuky about "*geographical dimensions for plague epidemic in Egypt*".

One of studies in disease mapping is an unpublished M.A. thesis in 2003 to Monufia University by Sobhy Abdelmageed, about "*Occupational map diseases in Quisna province: a geographic study*". Another study is a paper published in 2000 by Gaber.M.M., about "*GIS applications and remote sensing in the field of medical geography*".

Another paper about recreation treatment is studied by Fatma Abd Elsamad, under the title of "*Geographical dimensions of recreation treatment in Egypt*". Published as special issue in the Bulletin of Egyptian geographical Society in 2006.

We can see from this view that there are variant studies covered Egypt and some governorates. Clearly we can decide that the studies of medical geography in Egypt seem to be more general and more comprehensive. But there is no strategic plan to study topics related to health problems of every governorate separately, through geography Departments in the universities of Egypt, in order to draw a map of health level on the regional or national scale. Through co-operation between the universities and the ministry of health support or World Health Organization It may be possible to make this step.

4-2: The range of study zones

Medical geography studies in Egypt are covering a wide range from the world scale to a small village in Egypt; "from macro to micro" we can notice through the view of studies and papers in previous pages this variety and multiple locations of study which are covering all spatial levels. Table (3) and figure(3) show the number of studies, there are 7 studies with percent 12,7% covered the world level, and 8 studies to Africa continent with percent 14.6%, the studies of Arab world is 4 only with percent 7.2%. But on the level of Egypt as a whole there are 11 studies with percent 20%, this is the high percent, if we add all these studies we find it 30 studies, with percent 54% in the medical geography study in Egypt covered the world, the Arab world and Egypt. We can say that this is an indicator to generalization in the study of medical geography, and this is a logical result because the study of this branch in the first and second decades from the study of

medical geography in Egypt was still in born and when it reached to maturation stage we see specific studies in micro study. Studies which covered governorates, provinces and rural areas are 16 with percent 29% covered Egyptian governorates, provinces and rural areas, and there are 9 studies with percent 16.4% are not classified into any location, as general studies.

Table (3) Classification of medical geography studies in Egypt according to the region of study

Region of study	No. of studies	%
Studies on the world level	7	12.7%
Studies on the African continent level	8	14.6%
Arab world studies	4	7.2%
Egypt or regions of Egypt studies	11	20%
Egyptian governorates studies	9	16.4%
Provinces or centers studies	5	9.1%
Village level studies	2	2.6%
General studies not related to any site	9	16.4%
Total	55	100

4-3: Susceptible Egyptian Governorates

Studies of medical geography covered a number of Egyptian governorates, except some of them like Canal, Aswan, Matrouh, Giza, North Sinai. Some of studies are on the level of whole governorate and some of them cover parts of this governorates either centers or rural areas. We can notice that two governorates only are on the top of purpose studies, Elminia and Kafr Elshikh have 3 studies, Sharkia governorate is in the second ,with two studies, and every other governorate has one study only . Table(4). Fig.(4)

Fig. (3) Classification of medical geography studies in Egypt according to the region of study

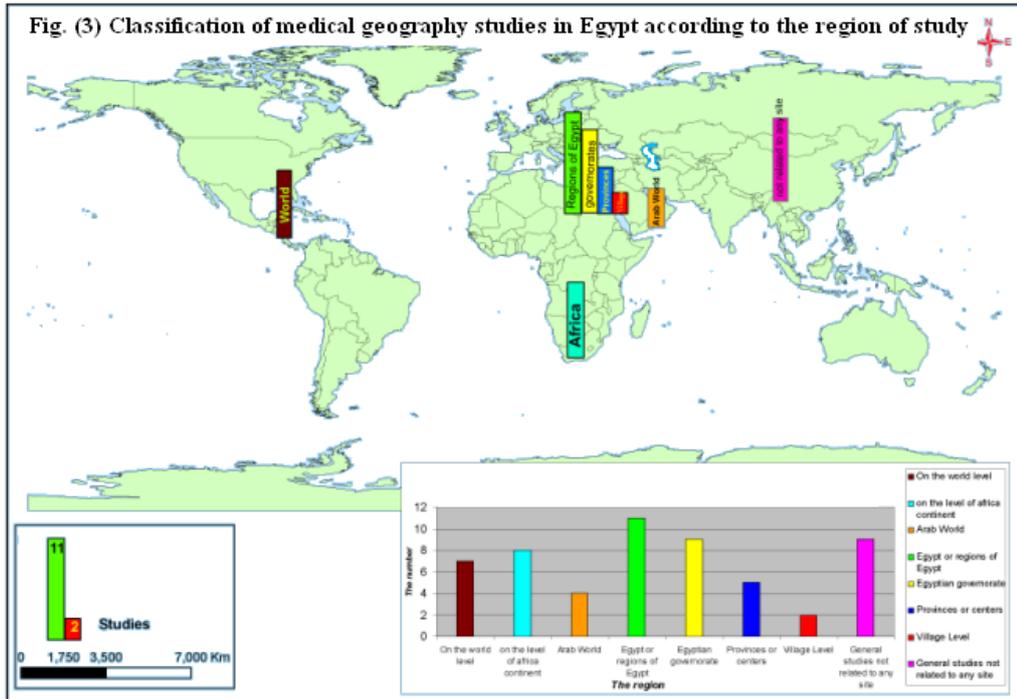


Table (4) Classification of medical geography studies according to number of studies in Egyptian Governorates

<i>Egyptian governorates which studied</i>	On the level governorates	On the level of parts of governorates
Kafr Elshikh Governorate	2	1
Alexandria Governorate	1	
Kalubia Governorate	1	
Sharkia Governorate	1	1
Minia Governorate	2	1
Beni Suif Governorate	1	
Assuit Governorate	1	
Suhag Governorate	1	
Gharbia governorate		1
Behira governorate		1
Dakahlia governorate		1
South Sinai	1	
Total	11	6

4-4: Universities participation in Egypt

The interest in medical geography studies in Egypt started in the geography departments in regional Universities, not in the mother Universities, like Cairo, Ain-shams, and Alexandria. This interest of medical geography studies in Egypt was born in the womb of geography department, Minia University, this department is not only interested in this branch only but also in some new directions of geography like Behavioral Geography, Geography of Crime, and language geography.

Table (5) and Figure (5) show up how Geography department in Minia University is on the top of the Egyptian geography departments in the number of medical geographical theses M.A or PH.D. degrees, the percent of studies in Elminia is 45.5% , from the total number of thesis and dissertations in medical geography, Cairo Alexandria, Zagazig, Tanta, and Ain Shams in the second with 9.1% to each, other universities Beni Suif , and monufia about 4.5% .

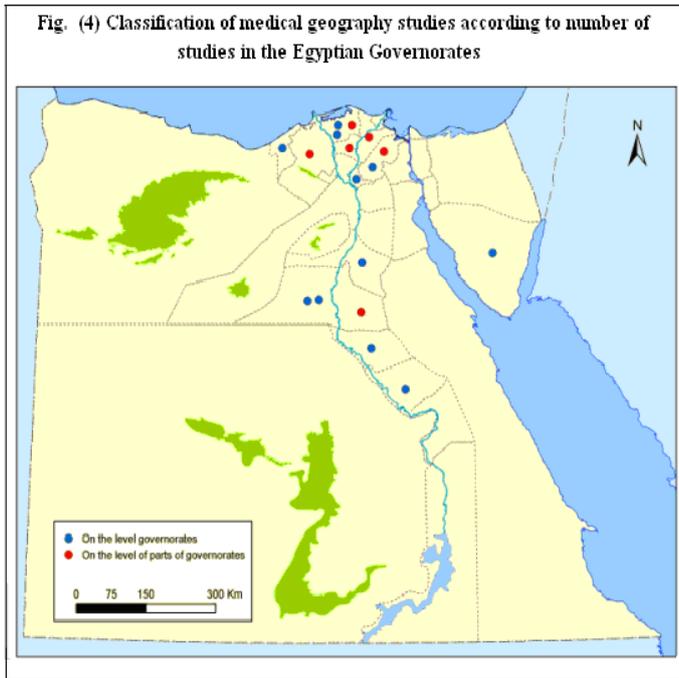
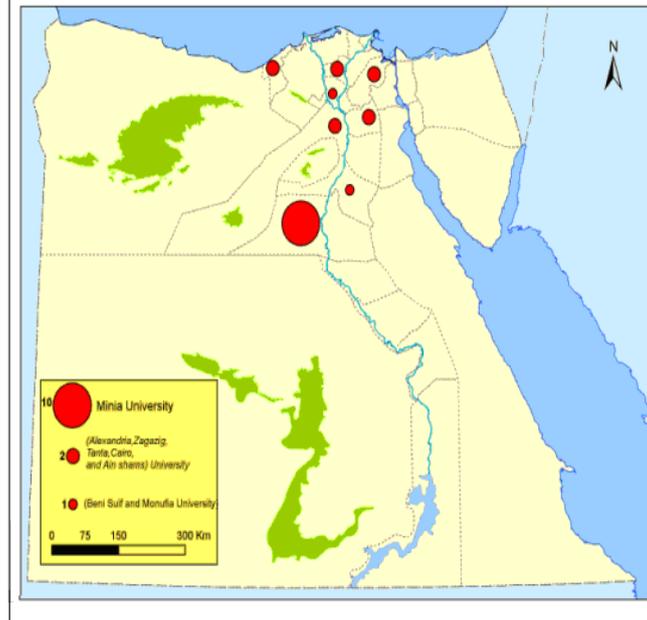


Table (5) Classification of medical geography studies according to Number of studies in the universities

<i>Egyptian Governorates</i>	The number	%
Minia University	10	45.5
Alexandria University	2	9.1
Zagazig University	2	9.1
Tanta University	2	9.1
Cairo University	2	9.1
Ain Shams University	2	10
Beni Suif University	1	4.5
Monufia University	1	4.5
Total	22	100

Fig. (5) Classification of medical geography studies according to Number of studies in the Egyptian universities



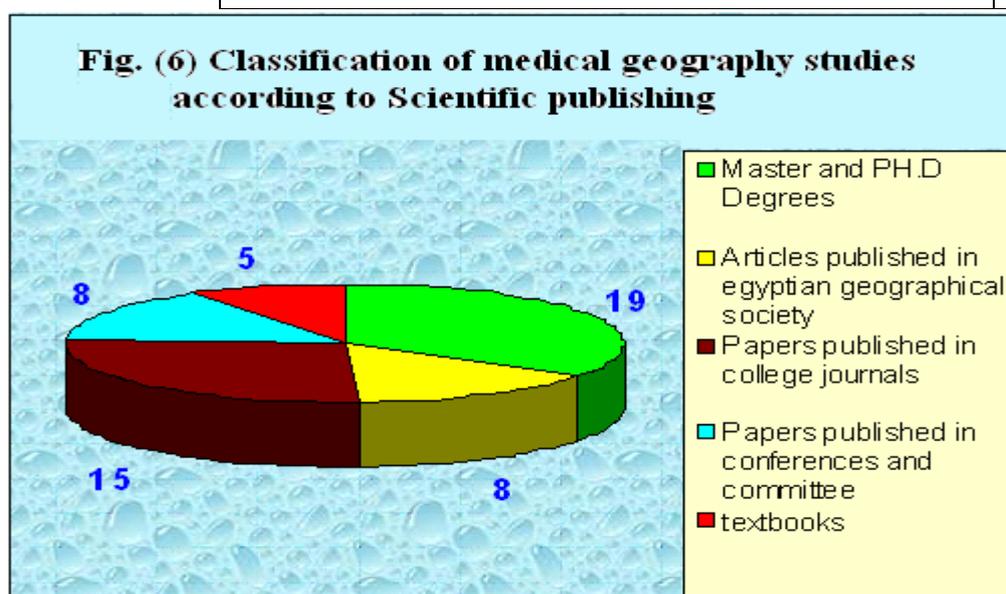
4-5: Publishing type

We can divide all studies in medical geography according to publication to 5 categories as shown in table 6 and figure 6 .

We notice that there are 34.5% from studies in medical geography are M.A. and PH.D. theses, the second is papers and articles which are published in the journals of universities faculties, and in third importance these papers which published in the journal of Egyptian geographic Society, and in the same percent these papers and studies which are shared in the conferences and committees, and then textbooks 9.1%

Table(6) Classification of medical geography studies according to Scientific publishing

Scientific publishing	Number	%
Master and PH.D Degrees	19	34.5
Papers published in the college journals	15	27.3
Articles published in Egyptian geographical society	8	14.5
Papers published in conferences and committee	8	14.5
textbooks	5	9.1
Total	55	100



4-6: Specialists in Medical Geography

All researchers and students are sharing in medical geography papers and studies reached to 28 during 30 years from 1979 -2008. The average of studies or study for each one researcher is 0.51 paper. This is a small number and a small production too. The percentage of researchers who write papers in this field, and not specialized, is 15.3 %,⁽³⁷⁾.

Wherever the number of researchers who wrote in medical geography and they registered or obtained M.A Degree is 12 with the percentage of 20.3 %, the number of researchers who wrote in medical geography and they registered or obtained Ph.D. Degree is 8 with the percentage of 13.6%, but the number of specialists in medical geography is only two, with percentage 3.4%, as shown as table (7) and figure (7)

Table (7) Classification of researchers and Specialists in medical geography

³⁷ - I consider that any researcher who has not obtained or registered M.A. Degree and Ph.D. Degree in Medical Geography is not specialist in Medical Geography

Species of students in medical geography	No.	%
Total of researchers and specialists who wrote in medical G.	28	47.5
Who wrote, not obtained Master or Ph.D. degree in Medical G	9	15.3
students, obtained or registered Master degree in M. Geography	12	20.3
students, obtained or registered Ph.D. degree in M. Geography	8	13.6
Specialists in medical Geography MA+Ph.D	2	3.4
Total	59	100

We can see that the number of specialists in medical geography in Egypt is very insignificant, and the number of all researchers and students is small, although thirty years have passed since the first study appeared in 1979. On the other hand, we can find that some names are repeatedly in this field through the number of studies and papers, these names is 4 only, with percent of 7.2%, they study about 27 papers and studies in this field, with the percentage of 49,1% in total papers, as shown in table (8) and figure (8)

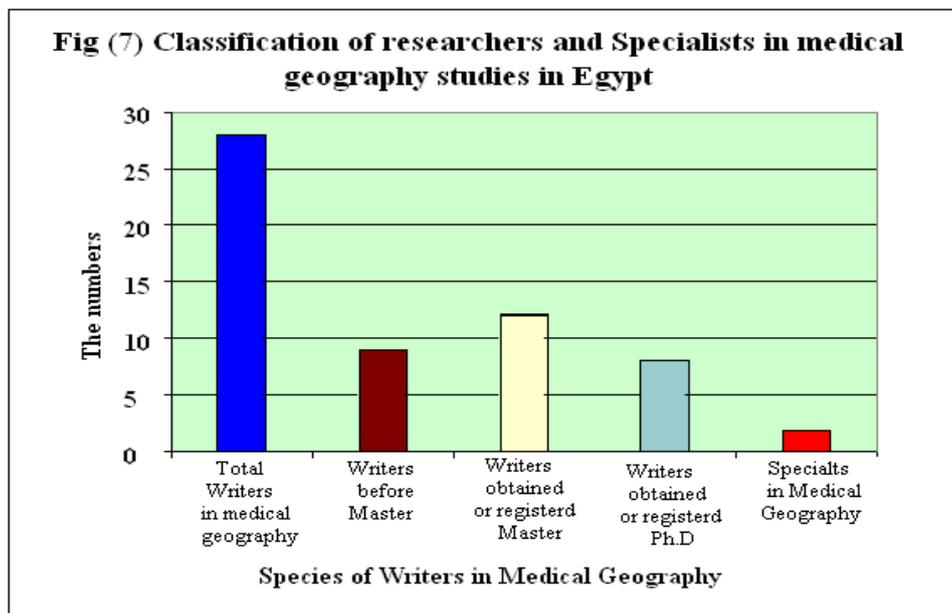
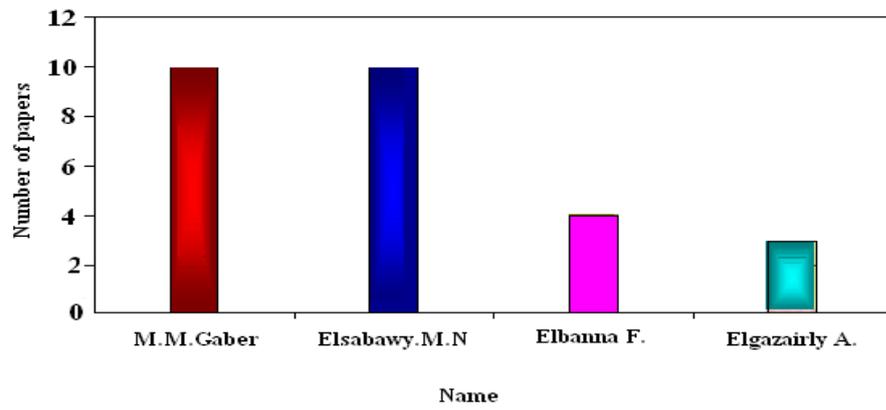


Table (8) Papers which more repeatedly

Names	No.	%
Mohamed Medhat Gaber	10	18.2
Mohamed Nour Eldin Elsabawy	10	18.2
Faten Elbanna	4	7.3
Abd Elhameed Elgazairely	3	5.5

Total	27	49.1
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Fig. (8) Papers numbers of researchers which more repeatedly



Conclusion

Medical geography as an interdisciplinary sub-discipline or subfield in Human and Social geography is important because it aims to provide spatial understanding of health problems and improving health care systems worldwide. It is succeeded to put its foot on the geographic departments in Egyptian universities after became a learning subject in undergraduate and postgraduate courses in many universities in Egypt. Despite that has been emerged late in Egypt, compared to developed countries, it has found a good place among other geographic branches in a few years.

Its depending upon many systems, polices and Sciences e.g. medicine, engineering, soil, Geology, Biology, Economy, Politics, History, and psychology. Etc. The main approaches of medical geography depends upon many trends and attitudes like disease diffusion, disease pattern, health care services, ethno medicine and medical pluralism, nutritional geography, disease mapping, and associative relations.

Medical geography studies in Egypt started by geographers in 1979. We cannot neglect the contributions of physicians and scientists in the medical studies in this field in Egypt before this time, which help geographers in their studies and papers. After this date, geographical studies are developed by geographers but slowly, either in numbers or in the topics nature. Gradually this development becomes necessary, because the concept, terrain, and the range of this subfield were not understandable in the first studies. So Many researchers preferred choosing general topics at first. Gradually, they have been concentrating, deliberating on subjects related to some diseases which refer to Egyptian geographical environment. Explicitly.

This study attempted to follow up, analyze and classify studies of Medical geography in Egypt, since the existence of that branch in the beginning of 1980s to 2010, to observe the development of these studies. We can decide that the studies of medical geography in Egypt seem to be more general and more comprehensive firstly. But in the second and third decade from beginning of study it was more specific and concentrated, the general trend of papers studied problems of peoples like liver diseases, Kidney failure, respiratory, cancer, malaria, cardiovascular in Egypt or on the narrow scale.

There is no strategic plan to study topics related to health problems of every governorate separately, through geography Departments in the universities of Egypt, in order to draw a map of health level on the regional or national scale, may be through co-operation between the universities and the ministry of health support, or World Health Organization It would be possible to make this step. This study suggests finding topics in medical geography in the university, to study health problems in Egypt in geographical view, through co-operation between ministry of health and universities can draw a health or disease map to each governorate. These studies can help decision makers and policies actors through strategic plan to eradicate serious diseases in Egypt.

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KNOWLEDGE, ATTITUDES AND PRACTICES ASSOCIATED WITH WASTE MANAGEMENT IN JOS SOUTH METROPOLIS, PLATEAU STATE.

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Abstract

This study determined the knowledge, attitudes and practices associated with waste management in Jos south metropolis. A cross-sectional survey design was employed for the study. A self developed knowledge, attitudes and practices associated with waste management questionnaire (KAPQ) was the instrument used for data collection. Data collected were analysed using frequency distribution, percentages, means, chi-square and t-test statistics. The findings of the study revealed that respondents with higher level of education (N.C.E/B.Ed) possessed corrected level of knowledge of the impact of improper waste management on health than those with lower level of education (TCII/SSCE). Age 31+ exhibit positive attitudes associated with waste management than age 15-30. Both TCII/SSCE and NCE/B.Ed holders exhibit positive practices associated with waste management. Level of education had statistical significant influence on knowledge of waste management. Age has no statistical significant influence on attitudes associated with waste management. Level of education had statical significant influence on practices associated with waste management. Based on these, the paper proffered suggestions on ways to curtail the problems of waste management.

Key words: Knowledge, Attitudes, Practices, Waste management.

Introduction

Since the beginning, human kind has been generating waste, be it bones and other parts of animals they slaughter for their food or the wood they cut to make their fire. With the progress of civilization, Jatau (2007) noted that the waste generated became complex in nature and difficult to manage to the extent that not only did the air get more and more polluted, with the poor management of both biodegradable and non bio-degradable solid waste. The increase in population and urbanization according to UNEPIETC (1996) were also largely responsible for the increase in solid waste.

The surveys of UNICEF (1999) and Hodges (2001) indicated an overall decline in access to sanitary means of excreta disposal between 1995 and 1999. In a latter year (2000), only 53 per cent of household enjoyed such facilities, roughly the same proportion as in Sub-Saharan African as a whole. Household in the urban areas (75 per cent) in 1999 were in much better situation than those in the rural areas (44 per cent). Access to adequate sanitary facilities deteriorated in all zones.

Amadi and Iwuala (2005) noted that recently, man has drastically altered his immediate environment through his day-to-day activities, in form of pollution, contamination or degradation. Polluted environment contains the multiplication and or development of different stages in the life

cycle of the parasites and pests that pose threats to life. This therefore calls for proper waste management in Nigeria in general and Jos South metropolis in particular.

The term waste is described by Uchegbu (2002) as any garbage, sludge and gaseous and other discharged materials resulting from various community activities. He further added that waste consists of discarded materials resulting from domestic and community activities and from industrial, commercial and agricultural operation. Waste emanating from domestic and community activities requires effective management.

Waste management is defined by Uchegbu (2002) as a planned system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of waste in a sanitary, aesthetically, acceptable and economic manner. The term waste management in this context is conceptualized as the care in manipulation, treatment, use or control of waste in an acceptable, aesthetically and economic manner.

Unfortunately, Nigeria seems to portray lukewarm attitudes towards waste management. No wonder Mobogunje (1999) asserted that the general deplorable and uninspiring characteristics of Nigeria cities continue to fester and appear as if there are no solutions to them. He further added that most of the wastes generated are not removed, and that in spite of the citizens cleaning their immediate environment, the inability of the local government to remove the numerous heaps of refuse all over the streets highlights the very poor level of waste management in Nigerian cities. Filth is thus a pervasive feature of most Nigerian cities and the poor have to survive and contend with this on daily basis due to inefficient urban waste management.

Over the past 20 years, Nigeria according to Uchegbu (2002) has witnessed rapid economic growth. This growth according to him, has given rise to the rising mountains of garbage, which now characterized most of our towns and cities. He further remarked that in the case of refuse, its collection and disposal have become the most glaring problem in Nigeria's urban areas which defied solution by both military and civilian administrators since Nigeria's independence. Discussing further, Uchegbu (2002) contended that the volume of waste generated by Nigeria's populace in cities, towns or villages are directly related to the population density. Lagos is a case in point where two-thirds of its gutters have become free range – part dumping grounds, part peeing and part defecation. This can pose serious public health problems. Explaining further, Falomi (1995) identified two broad categories of Nigeria urban populace on the basis of their waste management attitude, which include:

1. the unconcerned elite who have an out-of-sight, out of mind attitude towards pile of waste, which they drive passed on streets enroute their offices, and
2. the ignorant poor who have an attitude of helpless resignation to living with the filth.

These negative attitudes of waste management undermine health. It is not surprising that UNICEF (1999) and Hodges (2001) studies found that the gaps in access to adequate sanitation remain very high in the rural areas. The study of Hodges (2001) indicated that about one third of rural

households have no toilet facilities at all and as a result make use of the bush and rivers, while the study of UNICEF (1999) on environmental sanitation found that 40 per-cent of households did not have sanitary means of excreta disposal. The study further revealed that 48 per cent of rural dwellers dispose of solid waste in the bush, while 45 per cent used dumping sites. Only 9 per cent used garbage pits and 3 per cent burned their refuse. Many households according to the study (46 per cent) also did not allow their children to use latrines, even if these exist, mainly out of the fear that children may fall into pit (6 per cent) or mess up the latrine (52 per cent). These attitudinal problems underscore the need to accompany the construction of latrines with hygiene education.

Another major waste management problem in the urban areas as Hodges (2001) opined is lack of refuse collection. Waste management authorities collect refuse from households and public containers on a regular basis only in very few urban communities. As a result, most urban households resort to open dumping of refuse, engage private refuse collectors or burn or bury solid waste. He cited Lagos as an example where a survey in 1997 found that 21 per cent of households used dumping grounds, while 52 per cent employed the services of truck pushers to transport their solid waste to refuse skips. In most cities, the mounds of decomposing rubbish provide breeding grounds for rats, flies, and mosquitoes, contributing to unhealthy environment. The poor waste management attitudes and practices may be adduced to poor knowledge of the impact of improper waste management on health.

Sufficient knowledge of the impact of waste management on health may help people to protect themselves from diarrhea, typhoid fever, cholera, hepatitis, malaria and other infections. Adequate knowledge of the negative impact of poor refuse disposal may encourage people to adopt positive waste management practices and positive waste management practices may also promote personal hygiene and the health of the environs.

Despite various programmes by different tiers of government to address the issues of waste management, many Nigerians including the environs of Jos south metropolis seem to possess low level of knowledge, negative waste management attitudes and practices. Regrettably, the poor knowledge, attitudes and practices associated with waste management might have predisposed the environs of Jos south metropolis to the dangers of air born diseases such as whooping cough, asthma, measles, tuberculosis; water borne diseases such as typhoid fever, dysentery, cholera, hepatitis and insect/rodent borne diseases such as malaria, plague and Lassa fever. Diseases associated with poor waste management have caused numerous illnesses and the deaths of many Nigerians in general and Jos south metropolis in particular. This therefore necessitated the present study on knowledge, attitudes and practices associated with waste management in Jos south metropolis

Research Questions

In order to give direction to the study, the following research questions were posed:

1. What is the influence of level of education on the knowledge of the impact of improper waste management on the health of the environs of Jos south metropolis?
2. What is the influence of age on attitudes associated with waste management in Jos south metropolis?
3. What is the influence of level of education on practices associated with waste management in Jos south metropolis?

Hypotheses

In order to guide the study, the following null hypotheses were formulated and tested at .05 level of significance.

1. Level of education has no statistical significant influence on the knowledge of the impact of improper waste management on the health of the environs of Jos metropolis.
2. Age has no statistical significant influence on the attitudes associated with waste management in Jos south metropolis.
3. Level of education has no statistical significant influence on practices associated with waste management in Jos south metropolis.

Methods

In order to achieve the purpose of the study, a cross-sectional survey design was employed. Random sampling technique using balloting without replacement was employed to select 180 households in Jos south metropolis. A total of three hundred and eighty – nine (389) sample was drawn from the 180 randomly selected households in Jos south metropolis.

The instrument for data collection was forty – three item knowledge, attitudes and practices associated with waste management questionnaire (KAPQ). The questionnaire was categorized into four sections. Section A contained two socio-demographic variables of age and level of education. Section B elicited information on knowledge of the impact of improper waste management on health. This section required the respondents to indicate their level of knowledge by responding to True or False statement. Ashur's criterion of determining level of knowledge was employed. In this regard, a proportion less than 20 per cent was considered very low level of knowledge, 21 – 39 per cent low, 40 – 59 per cent average, 60 – 79 per cent high and above 80 per cent very high level of knowledge. Section C contained information on attitudes associated with waste management in Jos south metropolis, which provided four Likert scale of strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD). Section D elicited information on practices associated with waste management, which provided response option of Very Often (VO), Often (O), Not Often (NO) and Never (N). Section C and D were scored using Likert scale of summated rating. The criterion mean of 2.5 was derived by adding all the weighted points and divide them by 4. That is, $4 + 3 + 2 + 1 = \frac{10}{4} = 2.5$.

Thus, a positive response was considered if the mean was equal to or greater than 2.5. Conversely, it was considered negative if the mean score was less than 2.5.

The reliability of the questionnaire was obtained through a split half method which yielded a coefficient of .76. The face validity of the instrument was obtained through the judgment of five experts drawn from Health and Physical Education Department, psychology department and curriculum department of Federal College of Education, Pankshin.

The researcher and two trained research assistants visited 180 households in Jos metropolis and administered the questionnaire. The procedure for the completion of the questionnaire was explained to the respondents in the households selected for the study. Therefore, the completed copies of the questionnaire were collected on the spot. The data generated for the study were analysed using percentages and means to answer the research questions. While, Chi-square and t-test statistics were employed to test the hypotheses at .05 level of significance.

Results

The findings of the study are presented below according to research questions and hypotheses posed.

Table 1
Level of Knowledge of Impact of Improper Waste Management on Health According to Level of Education

S/N	Items	Level of Education							
		TCII/SSCE n = 207				NCE/B.Ed n = 182			
		Correct		Incorrect		Correct		Incorrect	
f	%	f	%	f	%	f	%		
1	Dirty environment breeds flies which precipitates the occurrence of dysentery and diarrhea	119	57.48	88	42.51	124	68.13	58	31.86
2	Flies cause the occurrence of intestinal worms	109	52.65	98	47.34	120	65.93	62	34.06
3	Improper management of waste pollute the sources of water and cause hyphoid fever, cholera and dysentery	118	57.00	89	42.99	124	68.13	58	31.86
4	Improper waste management precipitates the occurrence of air pollution thereby causing respiratory diseases	104	50.24	103	49.75	118	64.83	64	35.16
5	Improper managed waste attracts rodents such as rats and mites, which transmit diseases such as plaque and Lassa fever	106	51.20	101	48.72	134	73.62	48	26.37
6	Improper waste management attracts the multiplication of microorganisms, fungi, bacteria viruses which affects human health	123	59.42	84	40.57	129	70.87	53	29.12
7	Co-disposal of industrial waste with municipal waste exposes people to chemical and radioactive hazard	95	45.89	112	54.10	121	66.48	61	33.51
8	Improper managed waste when washed into sources of water causes hepatitis	99	47.82	108	52.17	98	53.84	84	46.15
9	Direct dumping of untreated waste into rivers, seas and lakes results in accumulation of toxic substances in food chain through the plant and animal that	92	44.44	115	55.55	128	70.32	54	29.67

feed on it.
Grand %

51.79

48.18

66.90

33.08

Table 1 reveals that NCE/B.Ed holders possessed correct level of knowledge than TCII/SSCE holders that: improper waste management attracts the multiplication of microorganisms, fungi, bacteria and viruses which affects human health (NCE/B.Ed holders 70.87% > TCII/SSCE holders 59.42%) and direct dumping of untreated waste into rivers, seas and lakes results in accumulation of toxic substances in food chain through the plant and animal that feed on it (NCE/B.Ed holders 70.32% > TCII/SSCE holders 44.44%). Similarly, the table indicates that NCE/B.Ed holders possessed correct level of knowledge than TCII/SSCE holders that: improper managed waste attracts rodents such as rats and mites which transmit diseases such as plaque and Lassa fever (NCE/B.Ed holders 73.62% > TCII/SSCE holders 51.20%), improper management of waste pollutes the sources of water and cause typhoid fever, cholera and dysentery (NCE/B.Ed holders 68.13% > TCII/SSCE holders 57.00%), dirty environment breeds flies which precipitates the occurrence of dysentery and diarrhea (NCE/B.Ed holders 66.48% > TCII/SSCE holders 45.89%). The overall results show that NCE/B.Ed holders possessed higher and correct level of knowledge than TCII/SSCE holders (NCE/B.Ed holders 66.90 > TCII/SSCE holders 51.79%).

Table 2

Attitudes Associated with Waste Management According to Age

S/NO	Items	Age	
		Age 15 – 30 n = 203 mean (\bar{x})	Age 31+ n = 186 mean (\bar{x})
10	Dumping refuse in a specific open place	3.01	2.98
11	Dumping refuse in any open place	1.97	1.92
12	Dumping refuse on the main road	2.23	3.09
13	Dumping refuse at the backyard	2.38	2.25
14	Dumping refuse in depots	2.64	2.5
15	Dumping my household refuse in cartons	2.01	1.85
16	Dumping refuse in open dumps	2.44	3.0
17	Dumping household refuse in metal containers	2.09	2.36
18	Burying household refuse under the ground	2.91	2.86
19	Burning household refuse with fire	2.98	2.85
20	Dumping household wastes in nearby rivers	2.09	2.36
	Grand Mean	2.43	2.54

Table 2 shows that age 15-30 exhibit positive attitudes of waste management than age 31+ by: dumping refuse in specific open places (age 15-30 = $3.0\bar{x}$ > age 31+ \bar{x} = 2.98), dumping refuse in refuse depots (age 15 - 30 \bar{x} = 2.91 > age 31+ \bar{x} = 2.86) and burning household refuse with fire (age 15-30 \bar{x} = 2.98 > age 31+ \bar{x} = 2.85). On the other hand, the table reveals that age 31+ exhibit positive attitudes of waste management than age 15-30 by: avoiding dumping refuse on the main roads (age 31+ \bar{x} = 3.09 > age 15 - 30 \bar{x} = 2.23) and dumping refuse on open dumps (age 31+ \bar{x} = 3.0 > age 15 - 30 \bar{x} = 2.44). The overall grand means indicate that age 31+ exhibit positive attitudes of waste management slightly than age 15 – 30 (age 31+ \bar{x} = 2.54 > age 15 – 30 \bar{x} = 2.43).

Table 3

Practices Associated with Waste Management According to Level of Education

S/NO	Items	Age 15 – 30	Age 31+
		n = 203	n = 186
		mean (\bar{x})	mean (\bar{x})
21	Dumping refuse in open drains/gutters	3.12	3.13
22	Dumping household waste on refuse heap on the street	2.69	2.94
23	Dumping household waste in market places	2.89	3.30
24	Dumping household waste on the heaps of mountains of garbage on high ways	2.33	2.96
25	Defecating on streets	2.50	2.64
26	Defecating in open place (free range system)	2.64	2.73
27	Dumping babies excreta on streets	3.24	2.64
28	Dumping waste in rivers	3.27	2.66
29	Dumping animal excreta on heap of refuse	2.77	2.80
30	Dumping animals faeces in open farms to serve as manure	2.96	3.26
31	Dumping agricultural waste on the farms	2.73	3.13
Grand Mean		2.83	2.92

Table 3 indicates that the practices of waste management according to level of education were: avoiding dumping refuse in open drains (TCII/SSCE \bar{x} = 3.12 < NCE/B.Ed \bar{x} = 3.13), avoiding dumping household waste on refuse heap on the street (NCE/B.Ed \bar{x} = 2.94 > TCII/SSCE \bar{x} = 2.69), avoiding dumping household waste in market places (NCE/B.Ed \bar{x} = 3.30 > TCII/SSCE \bar{x} = 2.89), dumping animals faeces in open farms to serve as manure (NCE/B.Ed \bar{x} = 3.26 > TCII/SSCE \bar{x} = 2.96), dumping agricultural waste on farms (NCE/B/Ed \bar{x} = 3.13 > TCII/SSCE \bar{x} = 2.73), dumping babies excreta on streets (TCII/SSCE \bar{x} = 3.24 > NCE/B.Ed \bar{x} = 2.66). The overall grand means reveal that NCE/B.Ed holders exhibit positive practices of waste management slightly higher than TCII/SSCE holders (NCE/B.Ed \bar{x} = 2.92 > TCII/SSCE \bar{x} = 2.83).

Table 4

Summary of Chi-square Verifying the Influence of Level of Education on Knowledge of Waste Management

Variable	Cal. x^2	Tab. x^2	Level of significance	Df	Decision
Level of Education	15.79	3.84	.05	1	Rejected

Table 4 shows that the calculated chi-square value is more than the table chi-square (cal. x^2 = 15.79 > tab. x^2 = 3.84, $p < .05$). Since the calculated chi-square value is more than the table chi-square value, the null hypothesis of no significant difference was rejected. This implies that level of education had statistical significant influence on waste management.

Table 5

Summary of t-test Difference in the Influence of Age on Attitudes Associated with Waste Management

Group	No.	\bar{x}	SD	Df	Level of Education	t-cal	t-tab	Decision
Age 15-30	203	2.43	.43					
Age 31+	186	2.54	.41	378	.05	0.77	1.96	Accepted

Results in table 5 show that the calculated t-test value of 0.77 at 387 degrees of freedom is less than the t-table value of 1.96 at .05 level of significance ($t\text{-cal} = 0.77 < t\text{-tab} = 1.96$ $p < .05$). The null hypothesis of no significant difference in the influence of age on attitudes associated with waste management is accepted. This implies that there was no statistical significant difference in the influence of age on attitudes associated with waste management.

Table 6
Summary of t-test Difference in the Influence of Level of Education on Practices Associated with Waste Management

Group	No.	\bar{x}	SD	Df	Level of Education	t-cal	t-tab	Decision
NCE/B.Ed	182	2.92	.16					
TCII/SSCE	207	2.83	.37	387	.05	3.78	1.96	Rejected

Results in table 6 reveal that the calculated t-value of 3.78 at 387 degrees of freedom is greater than the t-table value of 1.96 at .05 level of significance ($t\text{-cal} = 3.78 > t\text{-tab} = 1.96$, $p > .05$). Therefore, the null hypotheses of no significant difference in the influence of level of education on practices associated with waste management is rejected. This implies that there was statistically significant difference on the influence of level of education on practices associated with waste management.

Discussion

The overall results in table 1 revealed that NCE/B.Ed holders possessed correct level of knowledge of the impact of improper waste management than TCII/SSCE holders. This finding is not surprising because it is expected that level of education should have influence on knowledge of the impact of improper waste management. This finding corroborates that of Samuel (2006) who found that primary six school pupils possessed higher knowledge of refuse and sewage disposal than the pupils in the lower classes. Most of the respondents in the higher primary school level according to the study of Samuel demonstrated higher level of knowledge that pests and vectors can breed diseases when there is stagnant water in the environment; drainage blockage, inappropriate refuse disposal and lack of personal hygiene than the pupils at the lower class levels. Further more, the study revealed that most of the pupils in primary six knew the pests and vectors which affect health than the pupils in the lower classes.

Results in table 2 showed that age 15 – 30 exhibit positive attitudes of waste management of dumping refuse in specific open places, dumping refuse in refuse depot, burying household refuse under the ground and burning household refuse with fire. This is not surprising because the Government of Nigeria over the years has emphasized the need to cultivate positive attitudes towards waste management to all age groups. However, despite the emphasis on proper waste management, Nigerians seem to exhibit negative waste management attitudes. This finding negates that of Hodges (2001) who found that one – third of rural households had no toilets facilities at all and as a result made

use of the bush and rivers. The finding further disagrees with that of UNICEF (1999) who found that 40 per cent of household resorted to the attitudes of open field defecation and that 56 per cent of rural household did not have sanitary means of excreta disposal. Similarly, the study of Hodges (2001) found that 48 per cent of rural dwellers dispose of solid waste in the bush, while 45 per cent used dumping sites. Only 9 per cent used garbage pits to dump their refuse. Many households (46 per cent) did not allow their children to use latrines, even if these exist, mainly out of fear that children may fall into the pit (60 per cent) or mess the latrine (52 per cent). These attitudinal problems associated with waste management underscore the need to accompany the construction of latrines with hygiene education.

Overall results in table 3 revealed that NCE/B.Ed holders exhibit positive practices associated with waste management than TCII/SSCE holders. This finding is not surprising because the level of one's education more often than not, influences practices associated with waste management. The finding corresponds with the view of Hodges (2001) who asserted that as a result of waste management Authority's failures to collect refuse from household on regular basis, most urban households resorted to the practices of open dumping of refuse and engaging private refuse collectors or burn or bury solid waste. His study further found that 21 per cent of household develop the practices of dumping waste on the ground, while 52 per cent employed the services of truck pushers to transport their solid waste to the refuse skips. In most cities where practices associated with waste management are poor, the mound of decomposing rubbish provides breeding grounds for rats, flies and mosquitoes contributing to the unhealthy living environment.

This finding negates that of Hodges (2001) who found that the proportion of the urban population with no toilet of any kind rose from 8 – 12 per cent and 25 per cent of the urban population in Nigeria did not have any sanitary means of excreta disposal. These figures are especially alarming as they imply that large number of people develop the practice of urinating and defecating in open places, which poses serious health implications in densely populated urban settlements. The finding also disagrees with that of Stoveland and Bassey (2000) who found that refuse collection was almost non-existent in small towns, with only 41 per cent of household enjoying such a service, and about two thirds of households resorted to the practices of open dumping of solid waste, with the risks such method entail for health and the environment. This situation was made worse by the fact that only 14 per cent of small towns in Nigeria have organized public waste disposal sites. Over 63 per cent of households perceived environmental and health problem with the current refuse disposal methods they were practicing.

The results in table 4 indicated that the calculated chi-square value is more than the table chi-square value. This implies that level of education has statistical significant influence on the knowledge of the impact of improper waste management on health. This finding corresponds with the finding of Samuel (2006) who found that level of education had statistical significant influence on the knowledge of environmental sanitation.

Table 5 revealed that the calculated t-test value is less than the table t-value. This implies that age has no statistical significant influence on attitudes associated with waste management. This finding is surprising because one expected that age 31+ would exhibit positive attitudes associated with waste management than age 15 – 30.

The results in table 6 revealed that the t-test value is more than the table t-value. This implies that level of education has statistical significant influence on practices associated with waste management. The finding is not surprising and therefore expected because those with higher level of education were expected to exhibit more positive waste management practices than those with lower level of education.

Conclusion and Recommendations

Based on the findings of the study, it was concluded that most respondents with higher level of education (NCE/B.Ed) possessed correct level of knowledge of the impact of improper waste management on health than those with lower level of education (TCII/SSCE). Age 31+ exhibited positive attitudes associated with waste management than age 15 – 30. Both TCII/SSCE and NCE/B.Ed holders exhibit positive practices associated with waste management. Level of education had statistical significant influence on knowledge associated with waste management. Age has no statistical significant influence on attitudes associated with waste management. Level of education had statistical significant influence on practices associated with waste management.

Based on the findings of the study, the following recommendations were proffered:

1. Federal, States and Local Governments should promulgate and enforced policies on waste management.
2. Knowledge on waste management should be promoted. Those with lower level of education should be the focus group. This can be achieved through organizing workshops, seminars and conferences on waste management by environmental sanitation authorities and public health educators.
3. The Federal and Non-governmental organizations should sponsor people to undertake community based projects on knowledge, attitudes and practices associated with waste management. This will help to create awareness as well as alter the negative attitudes and practices related to waste management.

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