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Editorial Note

Journal of Geography and Development is a bi-annual publication. In line with the philosophy of the Department of Geography, Benue State University Makurdi, the Journal was launched to provide an avenue for scholars in Geography and other related fields to publish their research results and engage in the exchange of information on conceptual issues, scholarly debate and ideas which will further the course of maximizing the benefits of human behavior while minimizing cost and damages to human environment.

The journal lays emphasis on result of empirical research and conceptual issues in the different aspects of Geography and spatially related aspect of the environment. There is also a section for School Geography, which is devoted to the improvement of research methods and the teaching of Geography. Articles in this area are also welcomed. As more and more scholars seek to apply the knowledge of Geography to real life issues for the purpose of improving human life, we hope that this journal will continue to be an avenue for such publications.

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THE VIABILITY OF ALTERNATIVE SOURCES OF ENERGY IN NIGERIA

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Abstract

A rising awareness for sustainable energy is being spurred by the anxieties over energy security and the adverse environmental and social effects of the exploitation of fossil fuels which are fast depleting and non-renewable. Presently, the energy situation in Nigeria indicates a looming crisis whereby the energy demands especially in the cities are overwhelming the ability to meet the needs. This has greatly slowed down the pace of national productivity and stunted socio-economic and physical development. This paper reviews the viability of eco-friendly and sustainable alternatives to the conventional energy resource utilization which is being plagued with inconsistency and technical setbacks with a view to creating "Energy Efficient" cities in Nigeria.

Key words: Energy, Energy Efficiency, Renewable energy, alternative energy, Fossil fuels

1.0 Introduction

Currently, the Nigerian energy crisis has continued to frustrate the socio economic activities of the country and this has brought untold hardship on the people. At the moment, despite being attributed to having the lowest electricity per capita consumption in Africa (Abiodun, 2014) and one of the lowest in the world (Nwofe, 2014). The electricity supply in Nigeria does not meet national demand with 81 percent of the national population (approximately 130 million Nigerians) generating electricity through alternative sources to compensate for the irregular power supply (Abiodun 2014). Even despite the privatization of the Power Holding Company of Nigeria (PHCN) in 2013, Nigeria's electricity generation capacity has dropped from the peak generation level of about 4,517.6 megawatts

(MW) as recorded in December 2012 to about 3,670 MW in January, 2014. In the same vein Nwofe (2014) pointed out that the electricity generation forecast was 12,800MW hour per hour (MWH/H), while the actual electricity delivered into the national grid was 3,585.32 MWH/H. However when the estimated annual economic growth rate of between 7 percent and 13 percent and the urbanization rate of 3.8 percent was factored in, Nigeria's electricity demand was projected to grow from 15,730 megawatts (MW) in 2014 to 41,133 MW and 88,282MW by 2015 and the end of the year 2020 respectively (Abiodun, 2014). These figures show a huge disparity of expected demand and actual generation.

The increasing dependence on alternative sources of energy to generate electricity and other end uses has brought its own share of adverse impacts on both urban and rural areas such as pollution on the environment, imbalance in the ecosystem, human health concerns and climatic changes on a global level.

2.0 The Impact of Non-Renewable Sources of Energy on the Environment

Up to date, fossil fuels (which are non-renewable) have been the main source of energy, meeting three-quarters of total world energy needs (Sesan, 2008). However, there has continued to be increasing anxieties about the security of energy supplies which have led to a global exploration for alternative energy sources.

In Nigeria, the dependence on fuel-wood for domestic purposes has led to deforestation and attendant degradation of the environment and worsening desertification (Babanyara & Saleh, 2010). Domestic fuel prices have gone up several times with associated rise in transport fares and prices of goods and services. Industrial capacity utilization plummeted from 78.7% in 1977 to 30.1% in 1987 before resurgence to 53.3% in 2007 and 53% in 2010 (Bamikole, 2012). The erratic nature of public electric power distribution and supply has led to the dependence of private generators, driven by fossil fuels as alternative sources of electricity. The use of these fuels and their deposits has its impact on the environment, such as air pollution, noise pollution, global warming, short, medium and long term health implications such as asthma, lung disorders, hearing impairment and cancer.

Other alternative energy sources, including solar, wind and wave are largely underdeveloped in the country. Sustainability is a key factor influencing the long term viability of any energy resource and it comes as no surprise that it is at the

forefront of the global campaign to abandon the use of fossil fuels (Sesan, 2008). In Nigeria the major energy-consuming activities in the households include cooking, lighting, and use of electrical appliances, accounting for 91%, 6%, and 3% respectively (Energy Commission of Nigeria, 2005). Despite the contribution of electricity to the total gross domestic product, it is evident that Nigeria is faced with the low capacity of the electricity subsector to efficiently meet the demand for electricity which is having a detrimental impact on economic growth.

The paper attempts to explore lasting and sustainable approaches towards addressing the energy situation in the country with the intention of creating "Energy Efficient" cities in Nigeria. This shall be achieved through; a review of the concept of energy and its sources, energy efficiency, an outline of investment in energy resources in Nigeria and the need to explore other sources of energy. This would set a path for the way forward for efficient and sustainable end user energy generation and consumption.

3.0 The Perception of Energy and its sources

Energy has been defined as the ability to do work. Other variations to this are the capacity of a body or system to do work or a supply or source of electrical, mechanical, or other form of power (Microsoft Encarta, 2008), a source of power such as fuel used for doing machines, providing heat etc, solar, nuclear energy (Hornby, 2000). Energy within the context of power generation is primarily derived from renewable and non-renewable sources. The renewable sources are those that can be replaced over shorter time by natural processes or are inexhaustible. Non-renewable sources are those that are in limited supply and cannot be replaced or can be replaced but only over extremely long periods of time. Sesan (2008), states that renewable sources produce 'energy flows which are replenished at the same rate as they are used'. Regardless of the definition, the concept remains the same: renewable energy sources, in contrast to fossil fuels which are non-renewable, are environmentally friendly. They are abundant, self-replenishing, infinite, and consequently considered world-wide as the way of the future. Examples of non-renewable sources of energy include fossil fuels (coal, oil and mineral gas) and mineral deposits such as iron ore and gold ore, while the sun in its inexhaustible nature is a good example of a renewable source of solar energy. Other sources

include wind energy, biomass, hydro (water) and geothermal energy (Sesan, 2008).

End use energies include those energies used by the end consumer such as electricity, heating oil, refined gas, long distance heat, petrol and diesel. Useful energies comprise forms of energy that are used during final application, e.g. radiated thermal heat in a room, process heat, light, compressed air and kinetic energy (Irrek and Thomas, 2008). Energy is an essential ingredient for socio-economic growth of all nations. While it exists in various forms like chemical, mechanical, electrical, thermal, light etc, the objective of the whole energy system is to provide energy service in the industrial, transport, household and services sectors of the economy thereby making it the 'oil' that lubricates the engine of growth of national economies (Sambo, 2009). Umar (2004) points out that energy cannot be affordable unless its production and availability are sustainable and the more accessible it is, the higher the consumption by human beings.

Onakoya, Onakoya, Jimi-Salami and Odedairo, (2013) also posit that energy is widely regarded as a propelling force behind any economic activity and indeed industrial production. Therefore, high grade energy resources will amplify the impact of technology and create tremendous economic growth. High grade resources can act as facilitator of technology while low grade resources can dampen the forcefulness of new technology. Sesan (2008) also emphasizes that energy is an important contributing feature in the development of any country or region, and as such is fundamental to the fulfillment of basic individual and community needs such as lighting, transportation, provision of water, food, health and education. With these services serving as indices by which a nation's progress and development are measured, it then follows that energy is a major determinant of every country's economic and social development.

3.1 Energy- Efficiency and Energy Efficient Cities

Jollands, Kenihan and Wescott (2008) perceive energy efficiency as a change to a particular use that results in a net benefit per unit of energy consumed. In a similar vein, Oyedepo (2012) captures energy efficiency to be improvement in practices and products that reduce the energy necessary to provide services while its products essentially help to do more work with less energy. He also shares a similar opinion with the World Energy Council (2004) which refers to energy efficiency

improvements as a reduction in the energy used for a given energy service (heating, lighting, etc.) or level of activity. In this sense, energy efficiency can be thought of as a resource – often considered as an important, cost-effective supply option. Some advantages of energy efficiency include the efficient exploitation of natural resources, the reduction in air pollution levels and lower spending by consumers on energy-related expenditure. Longer term benefits include reduced energy consumption, local environmental enhancement and overall economic development (Oyedepo, 2010).

Energy-efficient cities are predominantly driven by renewable energy that is sustainably managed with minimal negative impact on the environment while also enhancing socio-economic and physical development. While cities like Reykjavik (in Iceland), Vancouver (Canada), Copenhagen (Denmark), Oslo (Norway) and London (England) successfully top the list of the most energy efficient cities in the world (Gleich, 2014), the United Nations Environment Programme (UNEP) is establishing projects in several cities like Kuyasa in South Africa, Gwangju (Korea), Bogota (Columbia) and Curitiba (Brazil) to address sustainable cities which address energy efficiency (UNEP, 2012).

3.2 Energy Conversion and Power Generation

Energy in its raw form (be it from a renewable or non-renewable source) in most cases requires some form of process of conversion into a specific form to be channeled towards a specific use. Power generation can be described as the process of converting energy from an available source to end-use energy such as electrical energy in a form that is suitable for distribution, consumption and storage. Examples of such energy utilization/ conversion for generation of power include solar thermal conversion and solar-electric (photovoltaic) conversion (Oji, Idusuyi, Aliu, Petinrin, Odejobi and Adetunji, 2012). Other examples include hydroelectric power generated from water, and nuclear power derived from the reaction of nuclear elements.

3.3 Outline of Investment in Energy Resources in Nigeria

Nigeria has been identified with energy resources such as petroleum, natural gas, coal, nuclear and tar sand. Others include solar, wind, biomass and hydro. The

development and exploitation of such energy resources however have been tilted to favour hydro, petroleum and natural gas.

The agricultural sector dominated the economy in the 60's, contributing about 70% to it. However a decade later the discovery of oil shifted the dominance of economy from agriculture to oil. The exploitation of the Nigerian energy resources began with coal in 1916. There are nearly three billion tonnes of indicated reserves in seventeen identified coal fields and over 600 million tonnes of proven reserves in Nigeria (Anaekwe, 2010). The Nigerian civil war brought about the abandonment of many coal mines and coal production never fully recovered. This is evident by coal production levels becoming erratic as both the resuscitation and maintenance of imported mining equipment proved troublesome (Godwin, 1980; Onakoya et al). This resulted in the significant drop in coal production levels from 50% in 1960 to less than 1% in 1990. This decline in coal production was hastened by the discovery of crude oil in commercial quantities in Otuabagi/ Otuogadi, Oloibiri district in Bayelsa state by Shell Darcy on 15th January, 1956. Between 1970 and 1980, petroleum products were cheap and readily available as premium motor spirit, (PMS) otherwise known as petrol and assumed the role of main source of energy in Nigeria. As a result, all other energy sources were neglected (Onakoya, et al, 2013).

3.4 The need to explore other sources of energy and power supply

The need to explore other sources of energy and power supply in Nigeria can be justified by the impact of the current systems on the urban environment, which can be viewed from three angles; (i) characteristic nature of energy systems in developing countries (ii) The source of the energy and (iii) Challenges of power generation and supply in Nigeria.

i. The Characteristic Nature of Energy Systems in Developing Countries

Energy systems in most developing countries like Nigeria possess similar traits as can be seen on table 1. These characteristics form a strong argument for transition to more efficient and sustainable energy systems.

TABLE 1: Characteristics of Energy Systems in Developing Countries

Characteristics	Implications for modeling energy systems and sustainable energy transitions
Non-technical losses in electricity sectors	Meter data does not reflect city consumption.
Under-pricing of electricity tariffs (below long term marginal costs of production)	Base load stations may not have predictable availability due to poor maintenance. Low financial viability of utilities makes financing of new infrastructure difficult. This may affect reliability of assumptions in demand forecasting.
Informal economy and markets	Many unregulated transactions that are difficult to capture – data difficulties. Such markets also often tend to work –sub-optimally in terms of information and transaction costs, meaning that neoclassical assumptions of rational choice may not hold true.
Existence of many poor quality and/or second hand end-user technologies (appliances, cars etc) with poor efficiency	In the absence of survey data, the assumption of data from other markets may be highly inaccurate.
Built environment – informal Housing	Impacts on thermal properties of buildings.
Poverty and inequality	A very wide range of income driven consumer behaviours may exist, requiring extensive disaggregation to achieve a structurally sound model.
Households without access to safe and modern energy services	Difficulties in tracking energy use and large suppressed demand. Also large focus on transitioning consumers to safe and modern energy services. However such energy transitions often cannot be explained with optimizing and rational choice theory (e.g responding to prices). In reality such transitions are much more complex and often require specific policy interventions.
'Suppressed demand'	Basing analysis on consumption data only reflects 'satisfied demand'. Extrapolating consumption patterns into the future might therefore be problematic.
High reliance on biomass and traditional fuels	Difficulty in acquiring reliable data about consumption, efficiencies, technologies etc. Point of use combustion with poor quality or no appliances has significant impacts on local air pollution.
Urban form and low densities – many cities have 'urban sprawl'	Implications for the transport demand sector. The viability of certain public transport investments is affected by population densities. High cost of expanding electricity distribution infrastructure. Lower density single family dwellings generally have poorer thermal performance than high density dwellings.
Own generation through diesel and gasoline generators to compensate for unreliable supply.	Difficult to track and assess fuel consumption which confounds both residential energy demand estimates and the calibration of transport demand.

Source: Adopted from Bhattacharyya & Timilsina (2010)

I. Sources of Electrical Energy in Nigeria

The Power Holding Company of Nigeria (PHCN) accounts for about 98% of the total electric power generation (CBN, 2000) and relies on hydro and thermal power. However electricity is also a consumer of fuel and energy such as natural gas, fuel and diesel oil. The importance of these sources of energy for fuel for generating electricity has been decreasing in recent years. Hydropower has been growing in importance instead, and the advantage is that it is relatively cheaper. All the power distribution substations are spatially interlinked by a transmission network (the National grid). The entire electricity generated nationwide is pooled into the National Control Centre, Oshogbo, from where electricity is distributed to all parts of Nigeria (Oyedepo 2012).

iii. Challenges of Power Generation and Supply in Nigeria

The impact of the distribution and utilization of electricity over time has brought its own set of challenges which are peculiar to Nigeria. These are discussed as follows:

Huge Energy losses - The Power Holding Corporation of Nigeria has over the years suffered huge energy losses as a result of the lack of proactive/ preventive and routine maintenance of its facilities. This also includes consistent major breakdowns which are a resultant effect of the constant use of outdated and heavily overloaded equipment. Consistent machine breakdowns, low gas pressure and low water pressure also create operational/technical problems culminating in inadequate generation.

Poor Coordination between Institutions - There is a poor overall system planning and overloading of PHCN equipment due to the poor or near lack of coordination between town planning authorities and PHCN.

Financial Inadequacies - Finance is a key factor in terms of effective running of the sector; however, the organization is poorly funded and in most cases budgetary provision is far inadequate and release of funds to PHCN is unduly delayed. The billing and collection system has been found to be highly inefficient. Reluctance of consumers to pay energy bills has led to both private and public consumers being highly indebted to the PHCN.

Vandalization - Constant vandalization and theft of PHCN equipment has also become a normal occurrence all over the country (Oyedepo, 2012).

Under-utilization of Existing Electricity Plants - There is a gross under-utilization of Electricity plants in Nigeria, and Emeka (2010) attributes this challenge to:

i. Scarcity of relevant manpower for adequate maintenance and general consumer indiscipline.
ii. Lack of essential spare parts for maintenance of plants
iii. Absence of local manufacturing capabilities
iv. Lack of systematic studies of distribution networks to reduce the extraordinary losses that usually accompany haphazard system expansion and inability to convert gas flares to a source of electricity.

The fact cannot be overemphasized that electricity consumption is positively related to economic growth and as such the level of consumption directly affects growth such that the impacts are far-reaching with respect to socio-economic activities and consequentially the living standards of the people. However, the afore-mentioned challenges have rendered public electricity supply in Nigeria unreliable and inefficient with a significantly increasing trend of utilization over the past years.

As a result of the static nature of utilization in the industrial sector, many companies have resorted to making provision for their own power- generating sets as sources of electricity, leading to huge transfer costs on their products and services. In its totality, power generation in the country has been pitiable and incomparable to what has been obtained in smaller African countries (Oyedepo, 2012).

The Way Forward for Efficient and Sustainable Power Generation and Consumption

One cannot over-stress the fact that Nigeria is presently operating at a low and unsustainable rate of energy provision and use when considering the rate of population growth and user demand, nor can the negative consequences on the environment, economy, health and domestic sector amongst others be exaggerated. This situation however can be addressed to a national and globally acceptable

standard of efficiency if intelligent and informed choices are made by decision/ policy makers in partnership with the private sector and all stakeholders involved.

i. Diversification and Decentralization of Primary Energy Sources

Diversification as an approach involves exploring alternative sources of energy and channeling them for effective usage and to take pressure off the conventional energy source. While various primary sources of energy are listed in table 2 along with the environmental implication of the type of waste generated from them, a Cost Benefit Analysis can be used to extract a viable option or a hybrid of viable options to compliment the already existing energy source. This should attract extensive research that could generate a model or models for effective exploration, generation and distribution to end users. Kaduna state for example, recently signed an agreement with the United Kingdom to invest in and acquire the latest technology in Solar Power. The next step for the state is to send an assessment team to countries like Tanzania and Kenya and draw lessons from the success rate of the models applied in those areas.

TABLE 2; Environmental Wastes from Generating Plants

Primary Energy Sources	Environmental Wastes	Remarks
Gas turbine plant	Nitrogen oxides (NO_x) carbon monoxide (CO_X), sulphur oxides (SO_X), lubricants etc.	Dangerous to humans, plants and animals and need sophisticated technology to control
Diesel engine	Nitrogen oxides (NO_x) carbon monoxide (CO_X), sulphur oxides (SO_X), polycyclic aromatic hydrocarbons (PAHs), particulate matter.	Dangerous to humans, plants and animals and need sophisticated technology to control
Solar energy plant	Silicon tetrachloride, Cadmium, Selenium, Sulphur hexafluoride, potent greenhouse gas.	Impacts negligible and waste easily disposed of.
Biogas plant	Greenhouse gas, solid wastes	Impacts negligible and solid waste used as agricultural manure
Small hydropower plant	Water spill from flood	Impacts negligible and easily controlled
Nuclear	Radiation of various forms and degrees	Dangerous with non-easily disposed waste whenever accident occurs

Source: Akinboro, Adejumobi and Makinde (2012)

ii. Reinforcing Public Responsiveness

The level of public awareness in the area of need for investment and consumption of renewable energy products has to be re-emphasized. The public also needs to be gradually deprogrammed from a culture of wasteful utilization of energy to more prudent consumption practices and this can be gradually imparted into the mindset of the public through continuous public awareness and environmental consciousness.

iii. Good Urban Governance and Management

Good urban governance would set an enabling environment for effective investment in renewable energy products and the subsequent management of the resources, as this would exhibit a high level of transparency in governance, accountability, security and proactive measures towards addressing challenges that present themselves through informed policy decisions and implementation of such policies while ensuring that all the actors are carried along in the decision making and implementation process. This would steadily bring the country to a state of compliance with global best practices in tackling the rising challenges in the energy sector and maintain sustainable development as well.

iv. Establishment and Funding of Energy Research Institutions

Setting up Energy institutes with both local and international funding and support from donor agencies would further advance cutting edge technological innovations, and committed research in developing and enhancing the value of energy exploration and distribution.

v. Cohesive Interrelationship between Energy and Planning Institutions

A very essential element to the success of Service provision/distribution is the level of coordination displayed between the power distribution agencies and planning agencies in the country. That way, information gathered can be shared between the agencies and infrastructures can be rationally planned and set up in functionally strategic locations for effective generation and efficient distribution. A combination of ideas between the institutions cannot only boost the security of power installations and monitor end user behaviour better but also generate ground-

Conclusion

Various resources and sources of energy can be effectively utilized to meet the ever-increasing energy demands in the country. Their benefits are extensive, considering wide ranges of applications both within and outside the urban environment. Exploration of other alternative in our cities and the country as a whole depends on the ability to identify the existing challenges and future implications faced by our current energy system and the ability to map out a workable set of plans and strategies incorporating alternative renewable energy technology with a view to creating energy-efficient cities that can sustain the system and still boost productivity for national growth.

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AN ANALYSIS OF THE TEMPORAL NATURE OF URBAN ACTIVITIES IN ILORIN, NIGERIA

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Abstract

This paper analyses the temporal pattern of activities of the people in Ilorin especially the length of time spent on each activity. Data were collected from 500 residents of Ilorin, each of whom completed a time budget diary over one week. Descriptive statistics and analysis of variance were used to summarize the data while stepwise regression analysis was used to determine the factors responsible for the spatial fixity of respondents' activities. The result shows that the activities were fixed in time and three variables: age, income and occupation were the major determinants of the time spent on the activities. The study also shows clearly that the temporal structure of activity in Ilorin is different from what obtains in Western cities where there is flexibility in the usage of time.

Keywords: Urban Activities, Temporal Fixity, Ilorin

Introduction

The study of the interaction between population, activities and times is a complex one with many dimensions. These dimensions include the location, timing, duration, sequence and type of activities and or trips. These characteristics of space-time behaviour have made the simultaneous analysis of its many dimensions imperative (Kwan, 2002, 2003). Although geographers view places in a two-dimensional way: space and time or spatio-temporal, they often tend to ignore the time element. Previous researches have either focused on spatial dimensions (Main, 1982) or have completely ignored time element as if it is not important. This paper, thus, discusses the temporal nature of activities, that is, the degree of spatial fixity of each activity and its implication on urban infrastructural planning.

The approach of integrating individual spatial behaviour overtime was pioneered by Hãggertrand (1969). He used a simple diagram to illustrate his concept of space-time dimensions (Figure 1) Hãggertrand postulated the geographers' two-dimensional space on the surface of the earth or on the surface of a map. A line on this surface indicated movement in space but not in time. He suggested a third dimension to signify time.

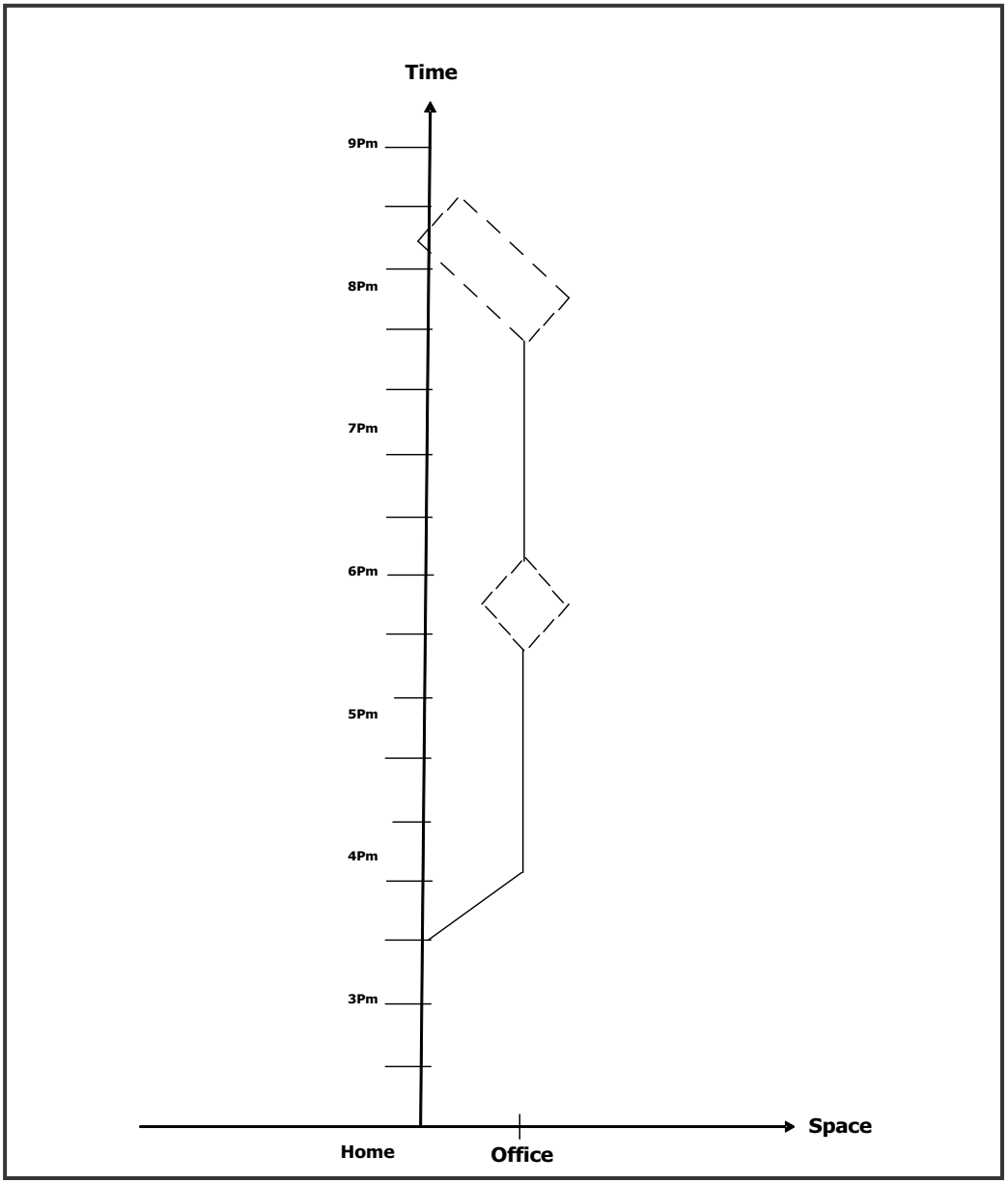

Fig.1: Man's daily space-time dimensions
Source:*Adapted from Haggerstrand (1969).*

Figure1 represents a very simple working day. Solid lines represent the path of all obligatory activities and dotted lines the prism or feasible regions of movement in periods for which there are no fixed activities. The worker is assumed to be effectively fixed at home until 7:30am to 8:00am where he can conveniently sleep and take breakfast. He must then take a direct route to work, where he is obliged to stay until lunchtime. During the lunch hour he has a certain amount of freedom; he must be back in the office exactly an hour. From 2pm until about 5pm he is again expected to stay at work. But after 5pm he has no need to be home until 7pm for supper. In this period, 5-7pm, he can stay on at work or he can go somewhere near or stop off on the way back for a drink or visit. The main feature implicit in this model of daily behaviour is the idea that certain activities are fixed in both space and time.

METHODOLOGY

Source of Data

The Activity Network Approach (ANA) was adopted for this study. ANA is a micro-behavioural, inductive approach that makes 'predictions about the whole from disaggregate data of the behaviour of individuals using Time Budget Diary (TBD). TBD questionnaire focuses on the socio-economic attributes of the individual, types of activities, location of activities, beginning and end time of activities, number of participants in each activity, extent to which each activity was arranged and whether an individual could have done:

- anything else at the time of this activity,
- this activity at any other time,
- this activity elsewhere, and whether,
- been anywhere else at the time of his activity is taking place.

Sampling Procedure

The 20 electoral wards in Ilorin formed the spatial framework for primary data collection. The use of these wards was based on the fact that it makes it easier to obtain data on population. The sample size was 500 literate individuals. This number was proportionally distributed among the 20 wards based on their 1991 population projected to 2006, using 3.5 percent annual growth rate. Number of

respondents interviewed from each ward was randomly selected. This sample is considered adequate for the study of this nature because of the complexity of completing the questionnaire, the time and cost involved in administering the questionnaire, monitoring the respondents, and more importantly, because researches involving Time Budget Diary do not normally accommodate large samples (Timmermanns, 2000; Kwan, 2005). Each respondent was issued seven copies of the TBD questionnaire, one for each day of the week. Research assistants monitored the respondents at home and work places.

Method of Data analysis

The following methods were use to analyse the data: (i) descriptive statistics and tables to summarise the data; (ii) Stepwise regression analysis to determine the temporal fixity of the respondents.

THE STUDY AREA

When the present city of Ilorin was founded is not very clear. Indeed, little is known about its pre-jihad political development. Ilorin is today the capital of Kwara State. It is located on latitude 80.30N and Longitude 40.35'E. It lies on the southern fringes of the savanna region and north of the forest zone. Ilorin is located in the Guinea savanna grassland belt of middle belt region of Nigeria. The main river in Ilorin is the Asa which flows in the south-north direction. It divides Ilorin into two parts: a western part representing the core or indigenous area and the eastern part where the Government Reservation Area (GRA) is located (Oloru, 1998).

Ilorin has experienced a rapid growth in its population over the years. The first population census in 1911 put the population of Ilorin at 36,343 while the 1953 population census put the town's population at 40,994. The 1963 and 1991 censuses recorded the population of the town as 208,546 and 532,088 respectively. The projected population of Ilorin in 2005 when this research was carried out was 748,150 based on an assumed annual growth of 3.5 percent.

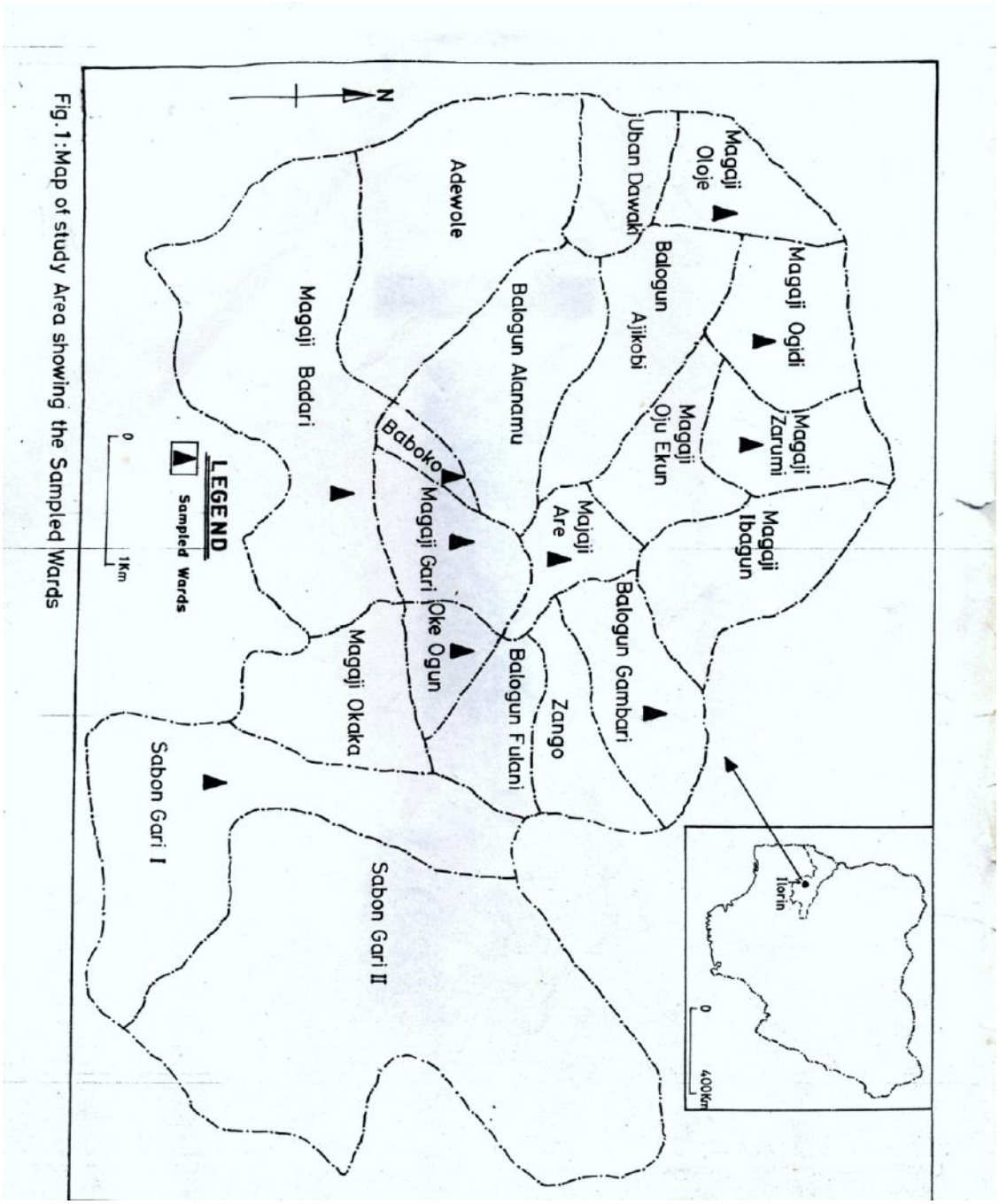

Fig. 1:Map of study Area showing the Sampled Wards

TEMPORAL FIXITY OF ACTIVITIES

To establish the temporal nature (fixity) of activities, respondents were asked whether they could have done anything else at the time they did a particular activity. The number of respondents that answered this question was 296. The result shows that 280 (94.6%) respondents said they could not do anything else at the time

TABLE 1: Temporal Fixity and Activity Location

Activity type	Could you have done anything else at this time?					
	Yes	%	No	%	Total	%
Home based	14	4.72	112	37.8	126	42.57
Office/work place	2	0.68	166	56.08	168	56.76
Outdoor	_	_	2	0.69	2	0.69
Total	**16**	**7.43**	**280**	**91.9**	**296**	**100**

Source: Field work, 2005.

This result, however, varies with different socio-demographic groups:

Gender, Marital Status and Activity Fixity

Among the males, 5.4 per cent could do something else at the time while 94.6 percent indicated that they could not do anything else at the time they were engaged in a particular activity. Among the females none could do something else at the time they were engaged in a particular activity, 47.0 percent had their activity fixed in time.

Among the married respondents 4.1percent can do something else at a time and 45.6 percent had their activities fixed in time. Among the singles, 1.4 percent could do something else and 49.0 percent had their activities fixed in time.

TABLE 2: Gender/Marital Status and Activity Fixity

Could you have done anything else at the time	Gender						Marital Status					
	Male	%	Female	%	Total	%	Married	%	Single		Total	%
Yes	16	5.4	_		16	5.4	12	4.1	4	1.4	16	5.4
No	141	47.6	139	47.0	280	94.6	135	45.6	145	49.0	280	94.6
Total	157	53.0	139	47.0	100	100.0	147	49.7	149	50.3	296	100.0

Source: Field work, 2005.

Religion, Age and Activity Fixity

Among people of different religious and age groups, temporal fixity of activity varies. Table 2 shows that s 4.1 percent Christians and 1.4 percent Muslims could have done something else at the time, while 47.3 percent each among Christians and Muslims respectively could not trade off the times they were performing their activities. Among people of different age groups, 1.5 Percent, 3.1 percent and 6.2 percent of the respondents between ages 18-30 years, 31-45 years and 46-60 years respectively could do something else at the period they were performing activities, while 51.4%, 39.0% and 3.5% among the 3 respective age groups had their activities fixed in time.

TABLE 3: Religion/Age and Activity Fixity

Could you have done anything else at that time	Religio						Age Group							
	Christianity	%	Islam	%	Total	%	18-30	%	31-45	%	46-60	%	Total	%
Yes	12	4.1	4	1.4	16	5.4	4	1.5	4	1.5	8	3.1	16	6.2
No	140	47.3	140	47.3	280	94.6	101	39.0	101	39.0	9	3.5	243	93.8
Total	152	51.4	144	48.6	296	100.0	137	52.9	105	40.3	17	6.6	259	100

Source: Field work, 2005

Education Qualification and Activity Fixity

Furthermore temporal fixity of activity varies among people of different educational qualification. As shown in Table 3, activity fixity varies among respondents with different qualifications. Among respondents with primary education, NCE and other qualifications, they all had their activities fixed in time with 1.4%, 23.6% and 1.4% respondents having their activities fixed in time. Among secondary, polytechnic and university degree holders 1.4%, 0.7% and

3.4% respondents can trade off their activity times while among the same group, 32.1%, 12.5% and 29.1% had their activity fixed in time.

TABLE 4: Educational Qualification and Activity Fixity

Could you have done anything else at the time	EDUCATION QUALIFICATION												Total	%
	Primary		Secondary	%	NCE	%	Poly	%	University	%	Others	%		
Yes			4	1.4			2	0.7	10	3.4			16	5.4
No	4	4	91	30.7	70	23.6	35	11.8	76	25.7	4	1.4	280	94.6
Total	**4**	**1.4**	**95**	**32.1**	**70**	**23.6**	**37**	**12.5**	**86**	**291.**	**4**	**1.4**	**296**	**100.0**

Source: Field Work, 2005

Occupation type and Activity Fixity

Temporal fixity of activity also varies among people with different occupations. Among the artisans/technicians, students and those with other occupations, their activities were fixed in time with 28 (9.6%), 60 (20.6%) and 3 (1.0%) respondents who could not do anything else at the time of performing their activities. Among civil servants, traders and professionals, 3.4%, 1.4% and 0.7% respectively could do some other things else at the time of their normal activities. On the other hand 39.5%, 16.8% and 6.9% among the same group had their activities fixed in time, as shown in Table 5

TABLE 5: Occupation type and Activity Fixity

Could you have done anything else at the time	OCCUPATION												%	Total
	Civil Service	%	Trading/ Business	%	Artisan/ Technician	%	Profe-ssional	%	Students	%	Others	%		
Yes	10	3.4	4	1.4	_	_	2	0.7	_	_	_	_	16	5.5
No	115	39.5	49	16.8	28	9.6	29	6.9	60	20.6	3	1.0	275	94.5
Total	125	43.0	53	18.2	28	9.6	22	7.6	60	20.6	3	1.0	291	100

Source: Field work 2005

Nature of Activity and Activity Fixity

There is also a difference between the nature of activity (i.e. whether an activity is arranged, planned, routine or unplanned) and its temporal fixity

TABLE 6: Nature of Activity and Fixity of Activities

	Could you have done anything else at the time					
Nature of Activity	Yes	%	No	%	Total	%
Arranged	_	_	28	9.5	28	9.5
Planned	_	_	04	1.4	4	1.4
Routine	16	5.4	248	83.8	264	89.2
Total	**16**	**5.4**	**280**	**94.6**	**296**	**100**

Source: Field work, 2005.

From Table 6; it is evident that the nature of activity determines its time fixity. For instance, respondent could not perform “arranged” and “planned” activities at any other time. The entire 9.5% and 1.4% arranged and planned activities could not be done at any other time. While in case of routine activities only 5.4% out of 296 respondents could have done their routine activities at any other time; and the remaining 83.8% had their activities fixed in time.

Location of Activity and Activity Fixity

Finally, temporal fixity of activity also varies with the type of activity, i.e. where the activity is based. In Table 7, 288 (97.3) of the respondents concerned could not have done anything else at that time i.e. they had their activity fixed in time. This comprises 47.6% who were engaged in home based activities, 51.7% who were engaged in office/work place-based activities, and 0.7% who were engaged in outdoor activities. Only 8.0% respondents did not have their activities fixed in time, these were 6.0% and 2.0% who were engaged in home based and office/work place-based activities.

TABLE 7: Location of Activity and Activity Fixity

Activity Location	Could you have done anything else at that time					
	Yes	%	No	%	Total	%
Home based	6	2.02	135	45.6	141	47.6
Office/work place	2	0.7	151	51.0	153	51.7
Outdoor	_	_	2	0.7	2	0.7
Total	**8**	**2.7**	**288**	**97.3**	**296**	**100**

Source: Field work, 2005

The temporal fixity of activities was further established when it was asked if these activities could be done at some other time. From Table 8, it is evident that only 8.5% of the respondent do not have their activity fixed in time. This include 7.4%, 0.7% in office/work place activities. On the other hand 91.5% of the respondents could not have done their activities at some other time. This includes 40.0% who are engaged in home based activities, 51.0% in office/work place activity and 0.7% in outdoor activities

TABLE 8: Activity Location and Temporal Fixity

Activity Location	Could you have done this at some other time?					
	Yes	%	No	%	Total	%
Home based	21	7.4	119	40.20	141	47.64
Office/work place	1	0.4	153	51.7	153	51.7
Outdoor	2	0.7			2	0.7
Total	**24**	**8.5**	**272**	**91.5**	**296**	**100**

Source: Field work, 2005

Temporal fixity of activity varies with different occupational groups as presented in the Table 9 which shows that the majority of the respondent (82.48%) could not have done their activities at some other time. This consisted of 35.73% civil servants, 15.46% traders/businessmen, 8.29% artisans, 4.46% professionals and 17.52% students. The few (17.52%) who could have done their activities at some other time consisted of people in different occupations as well. The result of this analysis is related to the one obtained for the earlier question that is, could you have done anything else at that time? (Table 4) where 16 respondents (5.4%)

TABLE 9: Temporal Fixity and Occupation Type

Could you have done this at some other time	Occupation													
	Civil Servants		Trading Buss.		Artisan Technical		Professional		Students		Others		Total	
Yes	21	7.21	8	2.74	4	1.37	9	3.0	9	3.0			51	17.52
No	104	55.73	45	15.46	24	8.27	13	3.46	51	17.2	3	0.10	240	82.48
Total	**125**	**42.95**	**53**	**18.21**	**28**	**9.62**	**22**	**7.56**	**60**	**20.61**	**3**	**0.10**	**291**	**100**

Source: Field work, 2005.

From the analysis above, the temporal nature of the activities of the respondents is mainly routine. That is, they perform the same type of activities everyday and these activities are fixed in time irrespective of the socio-economic status of respondent and activity type. Since the activities of the respondents were fixed in time and space, there was a generalized pattern in the sequencing of these activities. The fixity in time of the respondents activity is determined by a number of factors. These factors were analyzed by using the stepwise multiple regression analysis. The result of the stepwise regression is presented in Table 10

TABLE 10: Stepwise regression analysis for determinants of temporal fixity of activities

DAY	Model	Step	Variable Description	B	Standard of b	Beta		Significance level	R	R^2	Adjusted R^2	Standard Error
1	1	1	Age (yrs)	-28.502	4.403	-479	6.474	001	479	.229	.224	526.216
	2	A	Age (yes)	-22.792	4.701	-333	4.849	001			.264	
		B	Estimated annual income (₦)	-6.13	.000	-234	2.959	004	.524[b]	.274		512.318
	3	A	Age yrs	-21.695	4.682	-.364	4.634	001			.280	
		b	Estimated Annual	-6.03	.000	-.230	2.943	004				
		c	Income	69.772	34.585	.145	2.017	046	.542[c]	.295		506.792
			Occupation									
2.	1	A	Estimated Annual Income (₦)	-1.112E.04	.000	-.562	8.004	.000	.562[a]	.315	.311	380.816
	2	b		-9.09E.05	.000	-.454	6.137	.001	.610[b]	.372	.363	366.165
			Estimated Annual Income	-12.069	3.435	-.260	3.514	.001				
	3	c	Age (Yrs)	8.96E.05	.000	-.448	6.102					
				-11.811	3.401	-.225	3.473					
			Estimated Annual Income	53.529	26.746	.134	2.001	.047	.624[c]	.390	.376	362.242
			Age Yrs									
			Occupation									
3	1	A	Estimated Annual Income (₦)	-1.3E-04	.000	-.563	8.038	.000	.563[a]	.317	.312	380.450
	2			-9.18E-05	.000	-.458	6.187	.000				
		b	Estimated annual income (₦)	-11.813	3.438	-.255	3.436	.001	.609[b]	.371	.362	366.470
			Ag (Yrs)									
4	1		Estimated Annual Income (₦)	-1.14E-04	.000	-.555	7.805	.000	.555[a]	.308	.303	397.092
	2	a		-9.64E-05	.000	-.467	6.142	.000				
			Estimated annual income									
		b	(₦)	-10.231	3.663	-.213	2.793	.006	.588[b]	.345	.336	387.592
			Ag (Yrs)									
5	1	A	Age (in Yrs)	-5.597	3.003	-.173	1.864	.065	.181[a]	.033	.011	317.361
			Estimated Annual Income (₦)	1.782E-05	.000	.129	1.385	.168				
				17.522	23.538	.063	.744	.458				
			Occupation									
6	1	A	Age (yrs)	-7.507	2.902	-.226	-2.587	.011	.226[a]	.051	.044	326.226
7	1	A	Age (yrs)	-6.922	3.357	-.194	-2.062	.042	.194[a]	.038	.029	338.251

Source: Authors analysis, 2006

The result of the stepwise regression in Table 10 shows that only three steps are possible. The criterion for selecting variables in the analysis is set at 0.05 level of significance. The result shows that age estimated annual income and occupation of respondents are significant. The level of significance is as high as 0.001. This implies that apart from age, annual income and occupation, all other variables are not significant in explaining time devoted to activities; although these variables differ vary from day 1 to 7. The age factor is significant in the sense that all the sampled respondents fall within the age group of economically viable or productive segment of the population (i.e. between the age brackets of 18 years to 60 years) in all gender, qualification and occupational groups. On the other hand, annual income as a factor significant in explaining time devoted to activities is due to the fact that majority of the respondents belong to low income group, hence they have to work from morning till evening to make ends meet while those in public service engage in multiple occupations. Finally, occupation as a significant factor explains one of the characteristics of third world cities where people engaged in mostly informal sector and self -owned occupations hence they can afford to spend longer time. (Adedokun, 2012, Adedokun and Ajayi, 2012)

Based on the above findings in the study area, we would like to construct a generalized model of land use planning and facility location in a traditional medium size urban center using Ilorin as a case study. (Fig. 2)

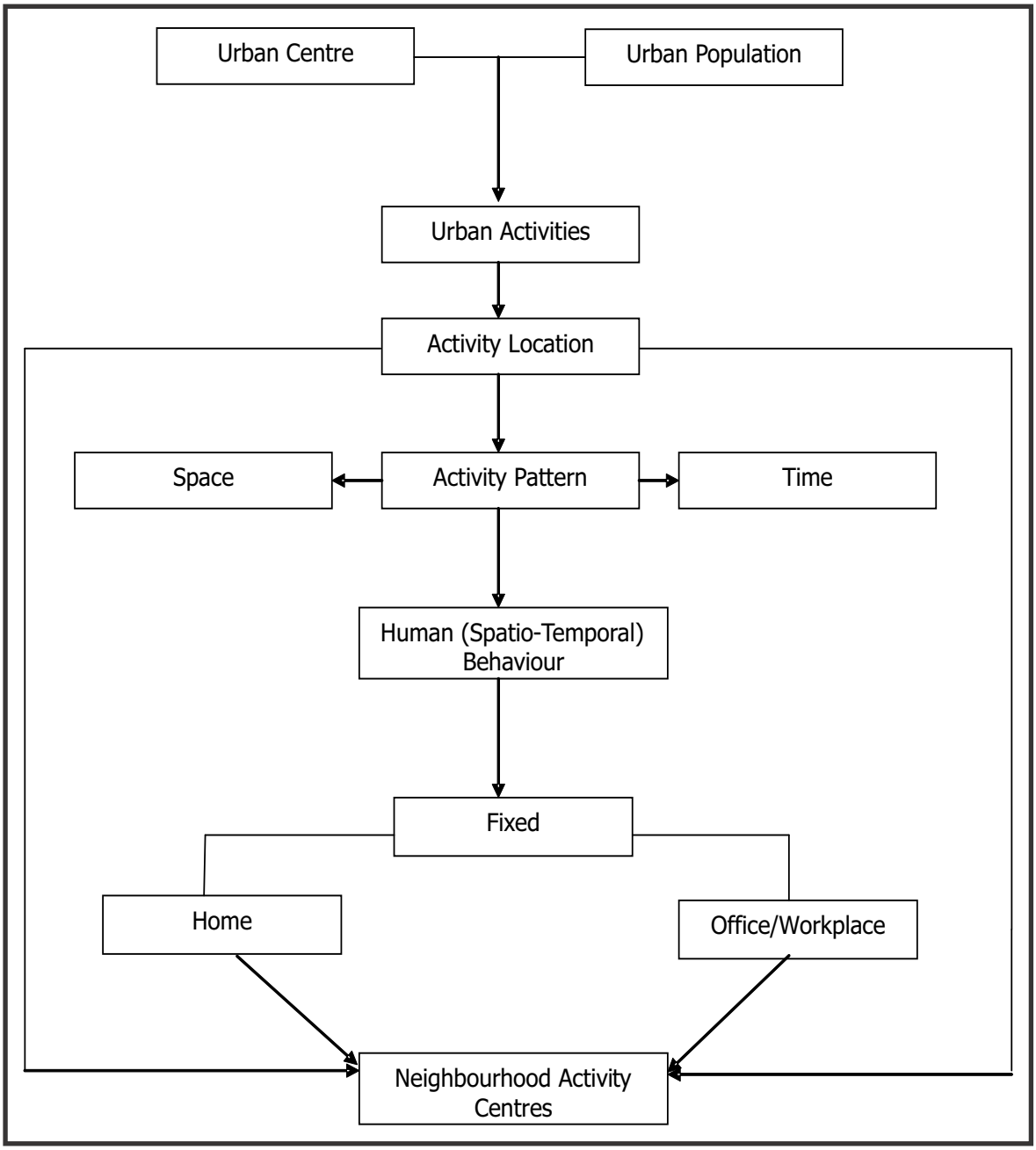

Fig. 2: A Model of Urban Neighbourhood Activity Centers
Source: author's analysis (2009)

Given a medium size urban centre with its population, there would emerge various types of urban activity located in different parts of the city. The location of these activities would in turn generate activity pattern in space. The activity pattern itself would generate human spatial behavior. In the study area, the human

behaviour in time was fixed. The fixity in human spatial behaviour is shared between home and office/work place. The urban neighbourhood activity centre model is of the view, therefore, that in planning for a medium size urban centre in developing world there may be the need to adopt a strategy that would incorporate the behaviour of the people. Instead of strict land use zonation approach, facilities may be located closely to or around neighborhoods where people are fixed to. In this case and as demonstrated, facilities and infrastructures should be located between homes and work places. Obviously, if there is a demonstrable linkage between two activities in space, it makes sense to locate the facilities housing them in the same space so as to eliminate time and energy consuming travel (Adedokun, 2008, 2009, 2011).

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ASSESSMENT OF RAPIDLY CHANGING URBAN LAND USE AND ENVIRONMENTAL DEGRADATION IN AKURE, NIGERIA USING SATELLITE IMAGERY AND GIS TECHNIQUES

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Abstract

The use of satellite imageries and spatial analysis techniques have not been comprehensively explored and exploited in capturing baseline information for monitoring of ecologically fragile areas in most developing countries including Nigeria. This study used Landsat imageries of Akure 1986, 2002 and 2011, and topographical map, DEM, GPS points, mean annual rainfall data and structured questionnaire. Image classification was performed using supervised classification technique. The wetlands were buffered to the radius of 200m to select the target population for questionnaire administration using ArcGIS 9.3. The responses obtained were analyzed using SPSS 17.0. DEM was subjected to spatial analysis using spatial analyst extension of the ArcGIS 9.3 and Global Mapper 13 to identify the watersheds, generate flow direction, flow accumulation and to generate the basin levels. The mean annual rainfall data, drainage basin data and elevation data were integrated and reclassified. These data were subjected to multi-criteria analysis and map overlay operation to generate flood vulnerability index map. The finding observed that area with high vulnerability to flooding occurred along the streams or river channels flowing from the eastern region of the study area towards the northwest region where physical planning standards especially on setbacks were compromised. The need to curb this problem is urgent and imperative if events that are more grievous are to be avoided. Again, it is very expedient to know that the protection of wetlands goes beyond mere channelization of some water bodies or building of floodwalls, rather, wetland misuse should be strictly addressed. Finally, it is canvassed that government at all levels must commit sizeable resources on research and development on wetland management. Such research should evolve proper monitoring and evaluation system for wetland management while addressing the issue of appropriate usage for this fragile ecosystem.

Keywords: Environmental Degradation, GIS, Satellite Imageries, Ecological Sensitive Area, Physical Planning, Flood Vulnerability Index Map

Environmental degradation is more prominent in areas within the wetlands systems than any other ecosystem on earth because they provide many services that contribute to human well-being and poverty alleviation without a sustainable use of the ecosystem (UN Millennium Ecosystem Assessment Board, 2005). Apparently, the wetlands have been increasingly susceptible to intense pressure from multiple human activities such as water diversion, pollution from agricultural wastes, over-exploitation of natural resources, and reclamation for construction purpose. In wetland loss, there is always a chain reaction, because the damage of one aspect of wetland will not only affect the wetland but has a devastating effect on the entire wetland ecosystem and by extension human and animal population. For instance, wetland loss poses threats and dangers to wildlife as well as human population due to its function as a natural protection against flooding by acting as giant pads that soak up the excess rain and surface water being aggravated by the resultant effects of climate change.

In the recent times, studies have shown that a large proportion of wetlands are fast degrading and going into extinction apparently due to drainage and land clearance as consequences of agricultural, urban and industrial development activities (Williams et al., 2009; Tijani et al., 2011). Thus, wetlands degradation could be consequential of either direct or indirect impact of activities on the wetland ecosystem. Activities that occur within the wetlands such as draining and dredging have direct impact on wetland loss or degradation. On the other hand, impacts caused by inputs of storm water, pollutants generated by urbanization, agriculture or other activities within the contributing areas are referred to as having indirect impact on the wetlands.

The Nigeria's wetland resources are currently being threatened by some anthropogenic and bio-geophysical factors, which include increased population pressure, rapid urbanization, mining and pollution among others. Therefore, at present and for the near future, human activities will continue to adversely affect wetland ecosystems if not controlled and regulated. Nigeria has made effort as far back as 1988 by promulgating Federal Environmental Protection Agency (FEPA) Decree No. 59 that provides the legal framework for the implementation of the policies on environmental protection, natural resources conservation and sustainable development. Nonetheless, these efforts are largely uncoordinated. The present state of wetlands in Nigeria tends to be far away from achieving United Nations Millennium Development Goal (MDG) 7 that aims to ensure environmental sustainability, by integrating the principle of sustainable development into the country policies and programs, reverse the loss of environmental resources, and reduce biodiversity loss. For example, Nigeria is fast degrading her wetlands as a number of anthropogenic and biophysical factors is seriously threatening the rich wetlands (Nwankwoala, 2002). In addition, a great deal of the hydrological and water resources problems currently experienced in Nigeria are the resultant effects of wetland degradation in the country

(Nwankwoala, 2002). The challenges posed by the degradation can better be understood and better appreciated when viewed against the backdrop of the benefits derivable from the wetlands.

Wetland as a vital environmental sensitive area in swiftly growing urban center has been seriously under degradation as evident in medium sized and big cities in Nigeria due to increasing population pressure. According to the World Urbanization Prospects (2011), Nigeria has about 49.6% of its population as urban and 3.8% rate of urbanization. With this rapid rate, Nigeria's wetland resources are vulnerable to unprecedented conversion to agricultural lands and reclamation for residential building constructions. The dynamic nature of the wetland resources' degradation in Nigeria in general and particularly in Akure has rendered the use of exploratory approach that is common in wetland studies inadequate. Also, the use of satellite imageries, GIS and spatial analysis techniques have not been comprehensively explored and exploited particularly in capturing baseline information that are germane to monitoring, conservation and sustainable management of ecologically fragile areas such as wetland in the swift growing urban environment.

The two major rivers that run through Akure are Ala River and River Elegbin (Akinseye, 2006). Wetlands often are found in strips and in large quantity around these two water bodies of which quite a substantial proportion has been committed into various uses including dumpsites, housing construction and agriculture with little or no effort on their preservation and sustainability. The State Environmental Protection Agency, which later became the Department of Environment was established in 1992 and saddled with the responsibility of management of the environment. The Department made considerable impacts in the State as a whole but was constrained with paucity of fund and as such has not performed well in the protection of wetland ecosystem within Akure (Akinseye, 2006).

There is the problem of rapid nature of urban encroachment on the wetlands in fast growing Akure and the emerging devastating consequences on the lives and properties of the urban dwellers. Hence, there is need to prevent future calamity arising from unsustainable conversion of wetlands to urban built-ups and practice of urban agriculture. This study thus adopts the use of satellite imageries, GIS and spatial analysis to map the spatial distribution of wetlands. It also seeks to determine the urban expansion rate and temporal changes in the wetlands ecosystem and evaluate the potentials of wetlands in flood attenuation and predict the vulnerability of some areas to flooding in the city. In addition, investigates the extent of level of compliance of urban development to town planning laws and regulations in a bid to ensuring environmental sustainability.

Materials and Methods

Research Locale

Akure, the capital of Ondo State is situated about 282 Km away from Abuja, the capital city of Nigeria. Akure is also the Headquarters of Akure South Local Government Area. It lies between latitudes 7° 4' and 7^{0} 25'N, and longitudes 5° 5' and 5° 30'E (Fig. 1). The city is located on 396 meters high above sea level. According to 2006 Nigerian Population Census, Akure has a population of 360,268. Thus, the current estimated population is about 495,000. The increase in the annual growth of the city's population could be attributed to her role as administrative and economic nerve centre of the state thereby attracting a large spectrum of immigrants (Oyinloye and Kufoniyi, 2011). The outburst in the population growth of the city can also be connected with the recent categorization of Ondo state as an oil-producing state and Akure as a Millennium Development City. The emerging development has multiplier effects on land prices and subject land acquisition for urban development particularly residential to the interplay of market forces, a situation that put some urban dwellers at disadvantage.

High temperatures and high humidity with two distinct seasons characterize the climate of Akure, namely wet and dry seasons. Wet season lasts for about seven months (April to October) with an annual rainfall of about 1524mm. Annual temperature ranges between 28°C and 31°C with a mean annual relative humidity of about 80%. With increasing demand for land, wet climate and unsustainable use of the wetlands in Akure, there is a serious need to be proactive in putting in place measures that will re-direct development away from the ecologically fragile areas, hence the need for this study.

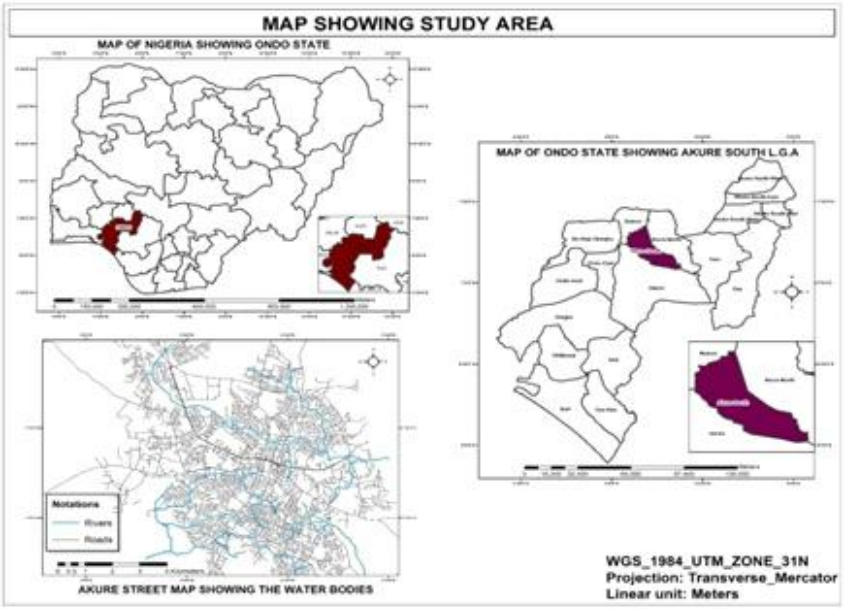


Figure 1: Location of Akure, the study area.

Database Description

For this study, data were sourced from both primary and secondary sources. Primary data were obtained from the targeted population using structured questionnaire designed to elicit information on the effects of the built environment on the wetland ecosystem. The study focused more on the wetlands within the core area of the city because it is the most vulnerable due to the high concentration of population around the Central Business District, where commercial activities and residential buildings are competing for the available space. Ajibola et al. (2012) observed that many wetland losses all over the world are direct result of economic activities engaged in by man.

This is exemplified in Isikan and Isolo areas where the high rate of commercial and economic activities resulting from the presence of markets has attracted quite a large population over the years. For this study, the target population is the households within 200meters radius from the wetlands or water body (Fig. 2) at both Isikan/Odole and Isolo/Oke-Ijebu which comprise of 933 buildings. The selection of respondents was carried out using the stratified/proportional sampling. A 10% sample size of the entire building population was adopted. Isikan/Odole has 543 buildings within 200m radius from its wetland while Isolo/Oke-Ijebu has 390 buildings within 200m radius of its wetland. Therefore, 54 and 39 buildings were sampled in Isinkan/Odole and Isolo/Oke-Ijebu respectively. This implies that 93 buildings were sampled for this study. Each of the respondents was selected at an interval proportional to the building population but the first was selected at random and the next was selected at interval of 10 buildings.

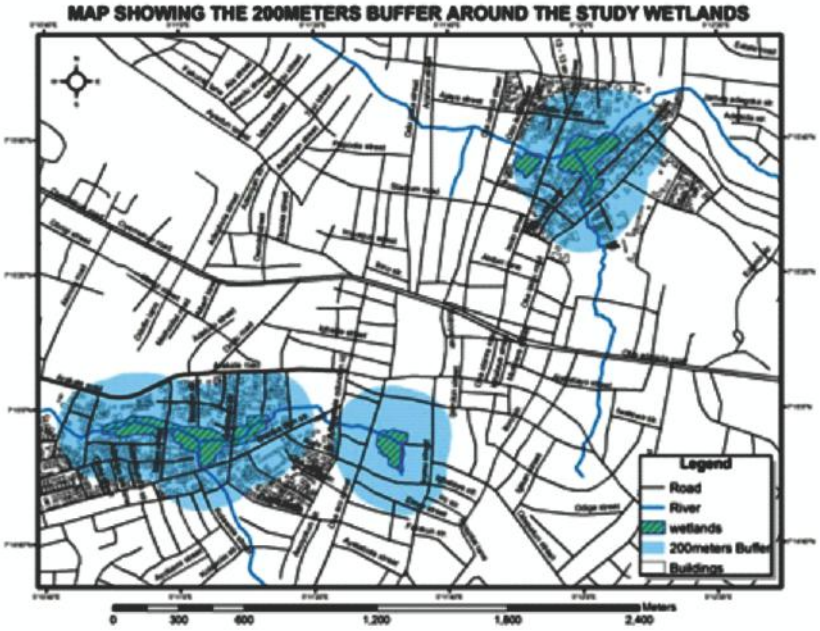


Figure 2: 200m buffer around the selected wetlands

The secondary data, which include satellite imageries of Akure such as Landsat Thematic Mapper (TM) 1986, Enhanced Thematic Mapper (ETM+) 2002 and 2011 were obtained from the Global Land Cover Facility (GLCF). Topographic map of Akure was generated from the satellite imagery acquired through on screen digitizing of roads, rivers and buildings. Digital Elevation Model (DEM) at 90 meters spatial resolution was also acquired, to know the various elevations, generate a contour map, locate the various watersheds within the city and identify various basin levels for further analysis on the identification of areas vulnerable to flooding from excess storm water runoffs. In addition, rainfall data were collected from the Nigerian Meteorological Agency (NIMET). Global Positioning System (GPS) receiver was used to obtain the geographic coordinates of the wetlands and some notable landmarks within Akure metropolis. The satellite imageries were loaded and displayed in the GIS environment using Idrissi Selva 17.0. The imageries were enhanced, filtered, georeferenced and resampled using digital image processing techniques. Subsequently, land use/cover classes were defined as settlement, vegetation, bare surface/rock outcrop and riparian vegetation (wetlands and vegetation along river channels), followed by the training of the system with samples of these land use/cover features. Supervised classification was carried out on each of the imageries to produce land use/cover classified images that facilitated the determination of land use/cover changes and reduction in the riparian vegetation overtime. The ArcGIS 9.3 and Global Mapper 13 were used for the spatial analysis. The Digital Elevation Model (DEM) (Fig. 3) was also subjected to some spatial analysis using the spatial analyst extension of the ArcGIS 9.3 and Global Mapper 13, to identify the watersheds, generate flow direction, flow accumulation and to generate the basin levels. In addition, building encroachment on setbacks from water bodies was observed through buffers created along every river and stream channels at 30meters on both sides of the river as stipulated by the State Ministry of Physical Planning and Urban Development.

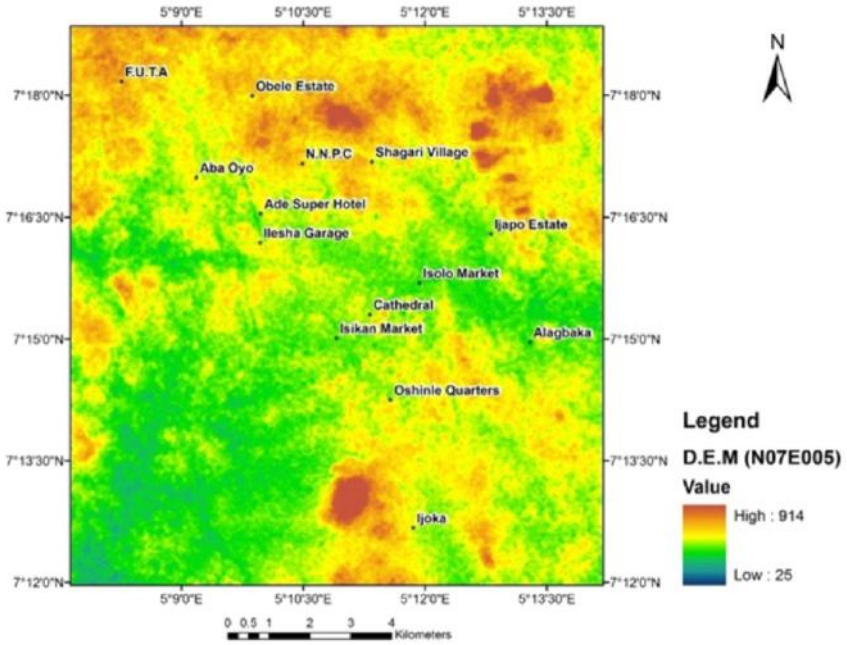


Figure 3: Digital Elevation Model (DEM) for the Study Area

Source: Global Land Cover Facility (GLCF) University of Maryland, USA (2013).

Data analysis was carried out at two levels. The first level involves inputting responses from the administered structured questionnaire into SPSS 17.0 where univariate analyses involving calculations of frequencies, variance and standard deviation on the socio-economic variables of the respondents were carried out. Spatial analysis constituted the second level of data analysis that involved the use of spatial analyst extension of ArcGIS 9.3 to integrate the classified remote sensed data, field data, rainfall data, slope data, elevation data and mean annual rainfall data to perform the flood vulnerability analysis (Fig. 4). The rainfall data was interpolated to produce the mean annual rainfall map. Elevation data was further analyzed to produce the drainage basin map, and delineate watersheds. River channels were also analyzed to find the Euclidean distance because the nearness to the river could increase susceptibility to flooding. The Euclidean distance was used to produce a drainage density map. The elevation map, the drainage density map and the annual mean rainfall map were then reclassified, for assigning a uniform scale of measurement to them all. These data were subjected to multi-criteria analysis and map overlay operation was performed to generate flood vulnerability index map for the study area.

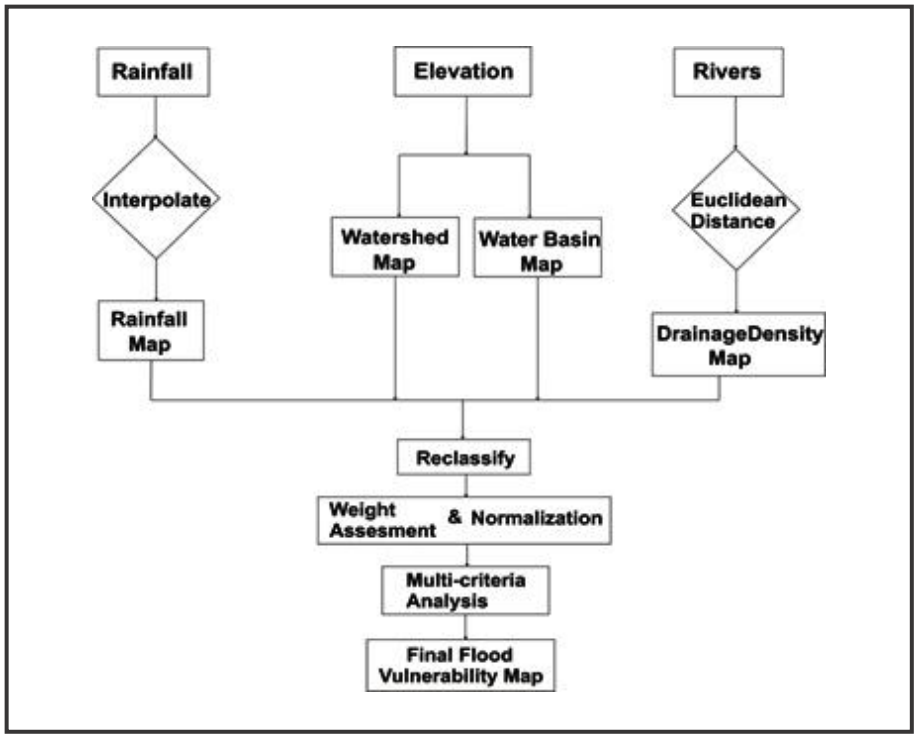
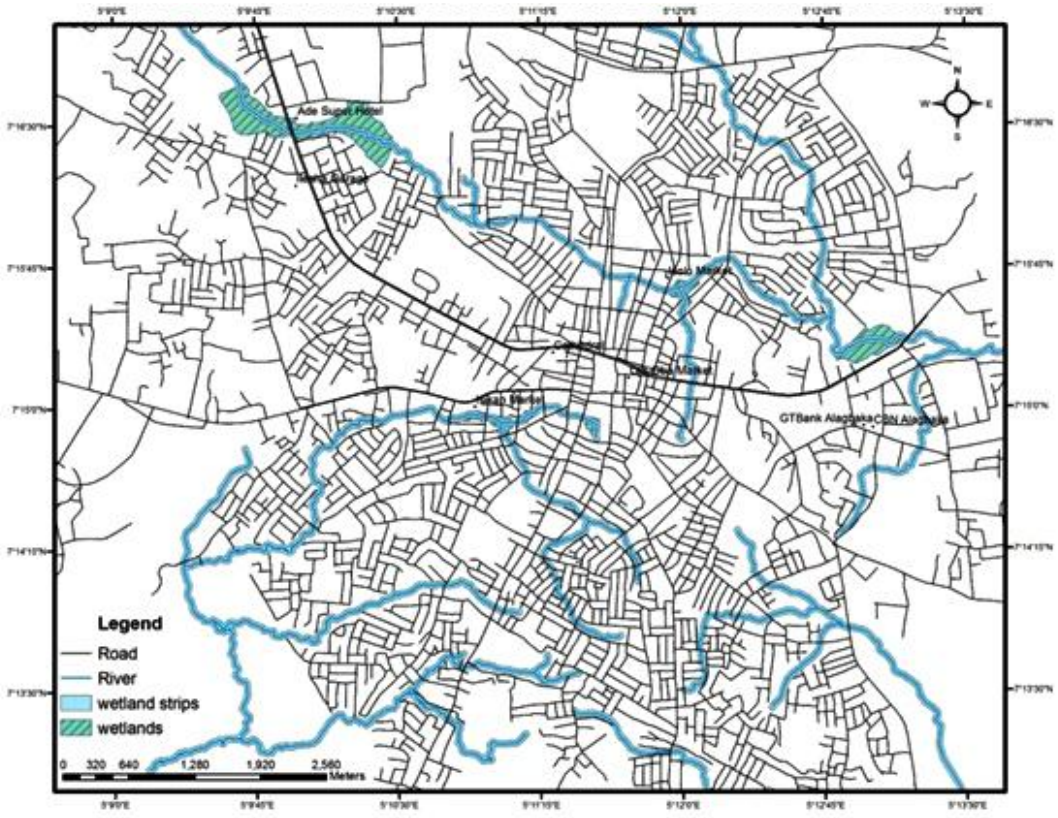


Figure 4: Analytical Procedure for the Flood Vulnerability Analysis

Results and Discussion

Akure is endowed with wetland resources located at Gbogi, Isikan, Oke Aro, Alagbaka, Isolo/Oke-Ijebu, Ijapo, Odole/Odiolowo, Erekesan, Idi-Agbe, Oke Igan and Ayetoro (Fig. 5). Analysis revealed that 56% of the inhabitants around wetlands were non-indigenes against 44% that were indigenes of the city (Table 1). This observation may largely be explained by the fact that Akure doubles as the State capital of Ondo State and a Millennium Development City where majority of commercial activities of the state is domiciled. Its position as a commercial nerve centre attracts migrants from different parts of the country to the city, which consequently triggers the rate of urban growth.

The study also revealed that the highest proportion of the respondents (42%) claimed to have Secondary School Certificate Examination (S.S.C.E) and 17% possessed Ordinary National Diploma/Higher National Diploma. Only 10% have university degrees. However, 16% had only primary school education while 12% had no formal education. In general, about 70% of the respondents held S.S.C.E and below (Table 1). This suggests that the relatively low level of education of the inhabitants might be responsible for the unsustainable use of the wetlands for agriculture and developmental purposes.



AKURE MAP SHOWING THE WETLANDS AND STRIPS

Figure 5: Wetlands and Wetland strips in Akure

TABLE 1: Socio-Economic Characteristics of the Respondents

Socio-economic characteristics	Frequency	%age
Nativity		
Indigenes	41	44
Non -indigenes	52	56
Education		
Primary School	15	16
SSCE	31	42
NCE	3	3
OND/HND	16	17
University Degree	9	10
No formal Education	11	12
Occupation		
Unemployed		22.6
Trading	21	33.3
Farming	31	5.4
Civil Servant	5	6.5
Artisan	26	28.0
Others	4	4.3
Average Monthly Income (₦)	Frequency	Percentage
Under 1800	72	77.4
18001 -36000	14	15.1
36001 -54000	7	7.5
House Ownership		
Owner Occupied	34	36.6
Tenant	59	63.4
Mean of Land Ownership		
From Government	6	6.1
Bought from previous owners	79	84.8
Inheritance	8	9.1
Monthly rent paid (₦)		
Under 1000	9	11.3
1001 -2000	58	72.5
2001 -3000	7	8.8
Above 3000	6	7.5

Source: Fieldwork, 2013

Again, 33.3% of the respondents engaged in trading while 28% were artisans. 5.4% and 6.5% were employed in farming and civil service respectively. However, 22.6% of the respondents were unemployed (Table 1). Educational status appears to have a correlation with occupation in the study area. This is aptly demonstrated by the fact that only few respondents were engaged in the civil service since most of them had S.S.C.E and below. In Nigeria, the minimum monthly wage is about NGN18,000 (National Minimum Wage Amendment Act, 2011). The proportion of the sampled respondents within this class is about 77.4% while others are within the category of the medium income but of a different monthly income. The next to the highest proportion of is 15.1% that earned between NGN18001-36000 monthly, while the remaining 7.5% of the respondents earned between NGN36,001 and 54,000 (Table 1). This result shows that most households in the study area are low-income earners.

The study also showed that most dwellers (63.4%) were tenants while 36.6% owned their houses. A large proportion (84.4%) of those that owned their own houses claimed to have bought the land from previous owners while 9.1% inherited the land. Only 6.1% of the respondents acquired such land from the government (Table 1). It portends that private developers have stronger control over land than the government in the study area. This implies that land values may be subject to the interplay of market forces that often deprives the low-income earners access to land for building construction.

The rental value of buildings in the study area was taken into consideration, because it could be responsible for influx of people into areas if the rental value happened to be relatively low and highly affordable. The highest proportion (72.5%) of the respondents paid about NGN1001-2000 as monthly rent. However, 11.3% paid less than NGN1000 Naira monthly while 8.8% paid between NGN2000 and NGN3000. Only 7.5% paid above NGN3000 monthly (Table 1). This findings indicates that a bulk of the inhabitants in these areas pay below NGN2000 per month suggesting that quite a majority of the people around in the study area are low income earners.

The results of land use/land cover analysis as presented on Table 2, Figures 6 and 7 showed that riparian vegetation as a typical ecological sensitive area covered 14.68 sq. km in 1986 but increased to 33.23 sq. km in 2002 with average rate of 7.9% per annum. In addition, settlements expanded in areal extent from 15.74sq. km in 1986 to 24.65sq. km in 2002. It could be noticed that the rate of urban expansion per annum was estimated at 3.5%, faster than that of Ibadan metropolitan city (3.0%) within the same period as reported by (Oyinloye, 2003; Adegboyega, 2010). It lends credence to the observation made by UN-HABITAT (2008) that African cities with less than 500,000 inhabitants are absorbing two-third of all urban population growth. Rock outcrop/bare ground recorded a remarkable increase of 39.84sq. km within 16 years with highest average rate of change (12.2%) over other land use/cover types in the area. Vegetation was observed to have declined by 67.3sq.

km, recording the lowest average rate of change over the period. The pattern of change is observed to be conversion of area covered with vegetation to other land use/land cover types.

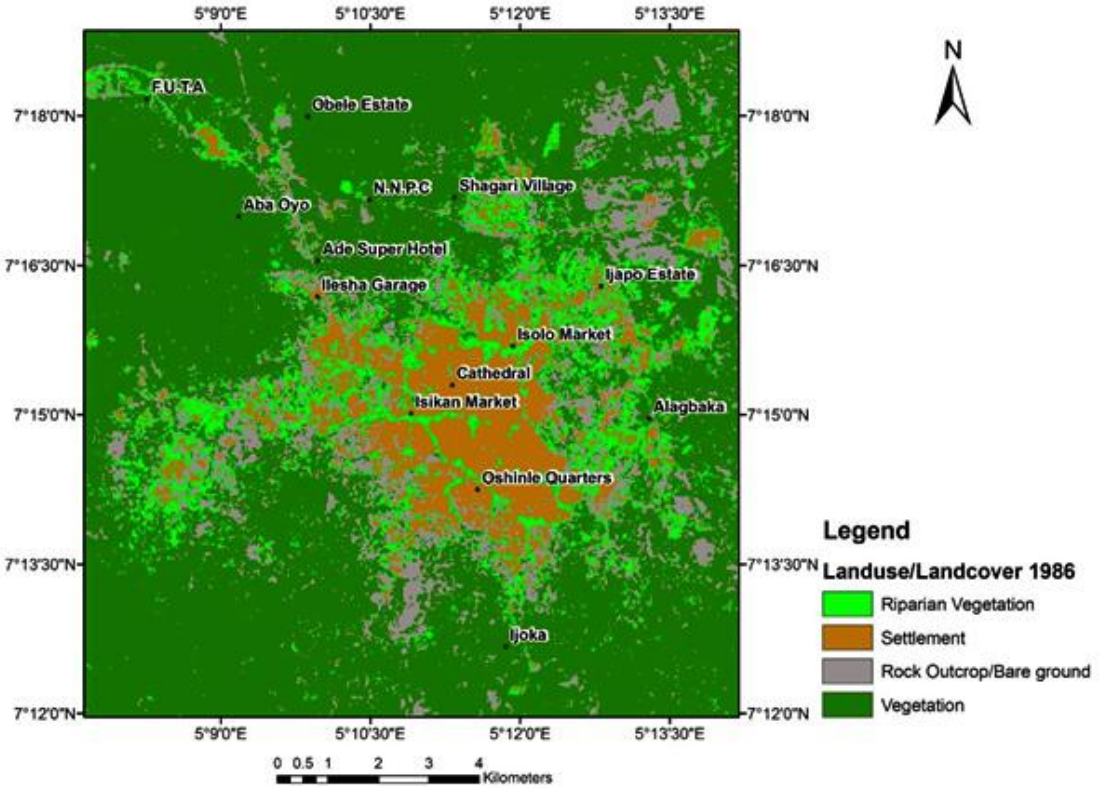


Figure 6: Land Use/Land Cover Map of Akure in 1986
Source: Authors' Image Analysis, 2013

TABLE 2: Land Use/Land Cover Change in Akure Metropolis between 1986 and 2002

LULC Types	1986 LULC area		2002 LULC area		Change between 1986 and 2002		Average rate of Change	
	SQ. KM	%	SQ. KM	%	SQ. KM	%	SQ. KM/Yr	%
Riparian Vegetation	14.68	9.96	33.23	22.54	+18.55	+126.36	+1.16	+7.9
Settlements	15.74	10.68	24.65	16.72	+8.91	+56.61	+0.56	+3.5
Rock Outcrop/Bare ground	20.4	13.83	60.24	40.87	+39.84	+195.29	+2.49	+12.2
Vegetation	96.6	65.53	29.30	19.87	-67.3	-69.67	-4.21	-4.4
Total	**147.42**	**100**	**147.42**	**100**	……..	……	……	……

Source: Fieldwork, 2013

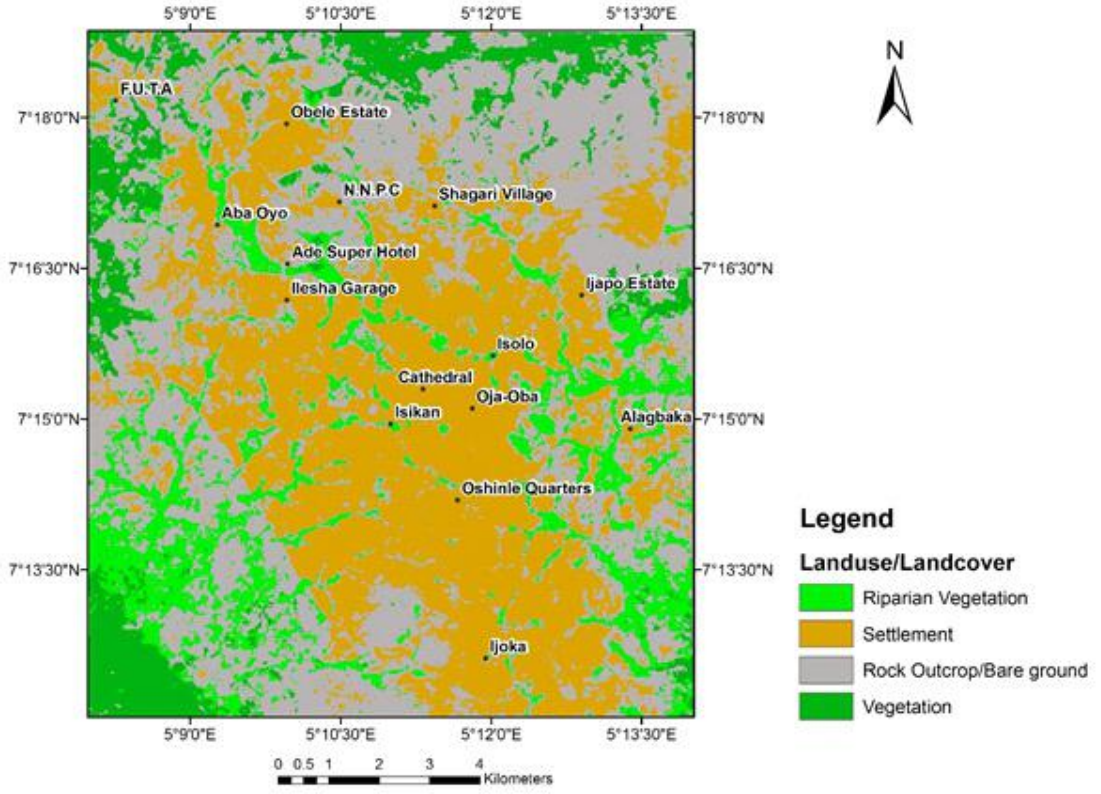


Figure 7: Land Use/Land Cover Map of Akure in 2002
Source: Image Analysis, 2013

However, as revealed in Table 3, riparian vegetation had declined in size from 33.23 sq. km in 2002 to 17.95 sq. km in 2011. Vegetation increasingly reduced from 29.30 sq. km in 2002 to 14.12 sq. km in 2011. In addition, settlements tremendously increased in area by 27.46 sq. km within the period, indicating extension of urban influence on the other land use/land cover types, particularly vegetation and riparian vegetation that comprises of wetlands and wetland strips (Figure 8). Rock outcrop/bare ground increased from 60.24 sq. km in 2002 to 63.23 sq. km in 2011. This may be attributed to anthropogenic activities that relate to urban expansion, widening of transport facilities and other impervious surfaces.

TABLE 3: Land Use/Land Cover Change in Akure Metropolis between 2002 and 2011

LULC Types	2002 LULC area		2011 LULC area		Change between 2002 and 2011		Average rate of Change	
	SQ. KM	%	SQ. KM	%	SQ. KM	%	SQ. KM/ Yr	%
Riparian Vegetation	33.23	22.54	17.95	12.18	15.28	-45.98	-1.70	-5.12
Settlements	24.65	16.72	52.11	35.35	+27.46	+111.4	+3.05	+12.4
Rock Outcrop/Bare ground	60.24	40.87	63.23	42.89	+2.99	+4.96	+0.33	+0.55
Vegetation	29.30	19.87	14.12	9.58	-15.18	-51.81	-1.69	-5.76
Total	**147.42**	**100**	**147.42**	**100**	.....	.....	.....	.....

Source: Fieldwork, 2013

The results of the analysis of extent of development compliance with the physical planning regulations were presented on Table 4. It was observed that a large proportion (54.8%) of the house owners in the study area did not secure approval from appropriate regulator while 45.2% of the house owners claimed to have secured proper approval. This observation indicates that most house owners in the study area are low-income earners that seek to locate their dwellings within marginal land because of their inability to compete favourably for well-drained sites of higher rental values. Perhaps such properties might not have ordinarily met the necessary planning standards that would have qualified them for approval by the appropriate regulators. Despite this shortcoming, 61.3% and 25.8% of the buildings were used for residential and mixed uses respectively. In like manner, 7.5% and 4.3% were deployed for commercial and religious purposes respectively. However, 1.1% was deployed for educational uses.

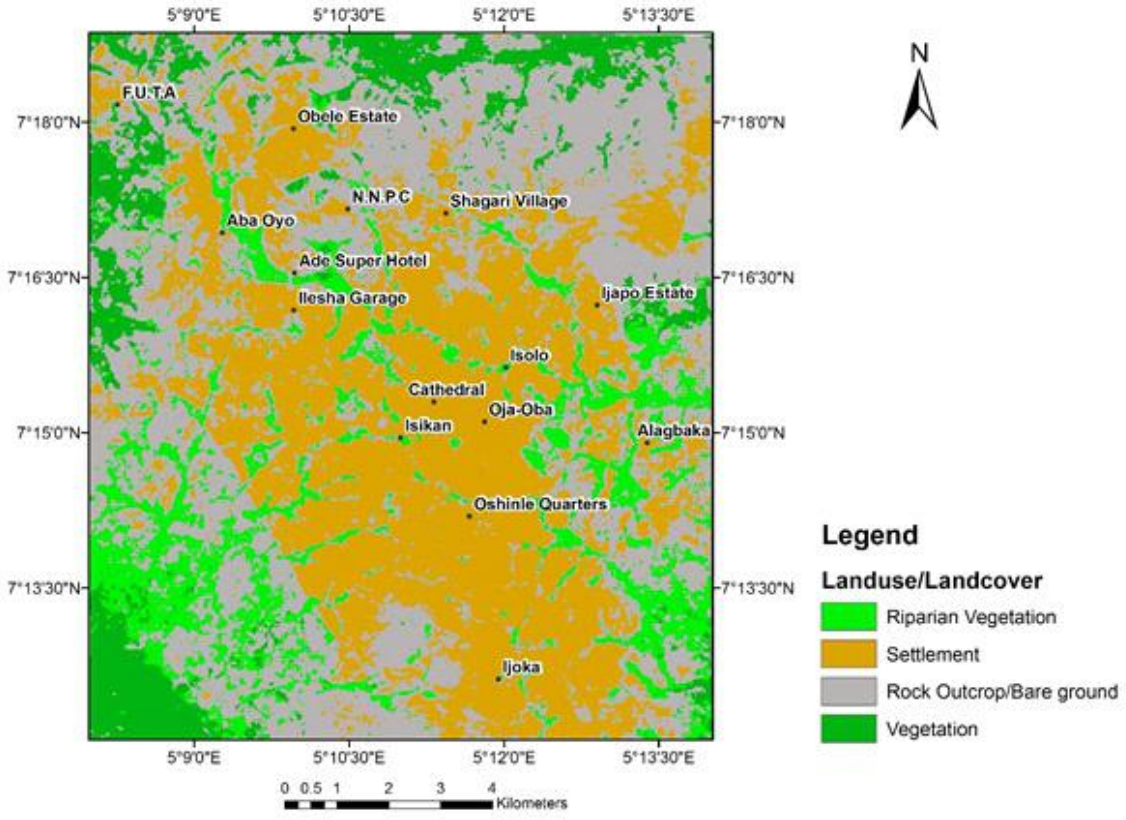


Figure 8: Land Use/Land Cover Map of Akure in 2011
Source: Image Analysis, 2013

A total of 54% of the respondents utilized the wetland for property development while19.4% used it as refuse dump sites. Fieldwork also shows that 10.8% of the respondents utilized it for either fish farming or crop farming while

3.2% engaged it for recreational purposes. The implication of this scenario is that the more the developmental activities on the wetlands and around the rivers/streams that drain the study area, the greater the impervious surfaces and the more vulnerable the area to flooding because of the increasing storm water from the rain and increased water from human activities. Table 4 also provides insight to the condition of the drainage as it has a vital role to play in the occurrence of flooding. 33.3% of the respondents claimed that the study area had no drainage system while 31.2% opined that the existing drainage system was in a poor state such that it facilitated overflow of water on the roads even with a little downpour. Only 7.5% of the respondents agreed that the study area had good drainage while 26% believed the condition of drainage system was only fair. It was revealed that there was a serious disregard to the standard setback from wetland or river as stipulated by the Ministry of Physical Planning (Table 4). 57.5% of the respondents attested to the fact that sinking of buildings was a prominent issue in the study area. 29.8% claimed that the closeness of their houses to the wetland/river had reduced their properties' values while 12.6% declared that there had been occurrences of building collapse in the area. The table further showed strong tendency for the susceptibility of the area to devastating flood as 62.4% of the residents asserted to have been experiencing flooding while 37.6% declared that they had never experienced such environmental hazard because their buildings were relatively farther away.

Field observations established that some of the residents abandoned their houses and temporarily moved their valuable properties on the roadsides whenever it rained against the impending submergence of the buildings by floods. The average flood height experienced by the residents lends credence to the impending devastating effects of flood on the lives and properties of the inhabitants as 65.6% claimed to have experienced below window-level flooding, suggesting that the flood water flew into their residences through the doors. Another 23% experienced window level flooding while 11.5 % experienced above the window level (Table 4). This suggests that the destruction of wetland ecosystem in the study area has heightened the possibility of floods in the rainy periods and so more houses are becoming vulnerable to flood. Again, 40.7% of the urban dwellers were of the opinion that the duration of subsidence of storm water took few hours after the rain before absorption by the ground and 22% noted that it took one day for the storm water to be completely subsided. In addition, 19.8% asserted that the storm water subsided immediately the rain stopped while 14.3% claimed that it took 2 to 5 days for the storm water to subside. However, 3.3% lamented that the storm water occasionally lasted for a week and above for the water fully subside. The emerging situation depicts a serious neglect of town planning laws that supposed to direct development to where it is desired and appropriate.

TABLE 4: Physical Planning Attributes and Degree of Compliance

Physical Planning Variables	Frequency	%
Development Approval status		
Yes	14	45.2
No	17	54.8
Use of Building		
Residential	57	61.3
Commercial	7	7.5
Mixed use	24	25.8
Religious	4	4.3
Educational	1	1.1
Drainage condition		
Good	7	7.5
Fair	26	28.0
Poor	29	31.2
No drainage	31	33.3
Usage of Wetlands		
Agriculture	5	5.4
Property development	50	53.8
Aquaculture	5	5.4
Refuse dump	18	19.4
Recreation	3	3.2
No use	12	12.9
Effect of building close to wetland		
Low Property value	26	29.8
Sinking Buildings	50	57.5
Collapse of buildings	11	12.6
Flooding experience	58	62.4
Yes	35	37.6
No		
Average Flood height experienced		
Below window level	60	65.6
Window level	21	23.0
Above window level	10	11.5
Duration of storm water sink after rainfall		
Few hours after rain		
1 day after	37	40.7
2-5 days after	20	22.0
1 week and above	13	14.3
Immediately after rain	3	3.3
	18	19.8

Source: Fieldwork, 2013

In view of the degenerating situation, the study attempted to model vulnerability of the areas susceptible to flooding. To achieve this, data layers such as annual mean rainfall data, digitized rivers/stream channel data, slope data, elevation data and watershed data were generated. Figure 9 showed the annual mean rainfall distribution in the study area. Places such as Federal University of Technology Akure (FUTA), Aba-Oyo, Ilesa Garage, Orita Obele and Ade Super Hotel area experienced the highest mean annual rainfall of 1514mm. Locations like Ijapo Estate, Isolo Market, Anglican Cathedral, Ijoka and Oshinle Quarters recorded mean annual rainfall ranging between 1504mm and 1509mm while places like Isikan Market area and Shagari Village area experienced mean annual rainfall greater than 1509mm but less than 1515mm. Most of these areas are on the elevation range between 304 meters and 369 meters, which are also drained by rivers, and streams as depicted in Figure 10.

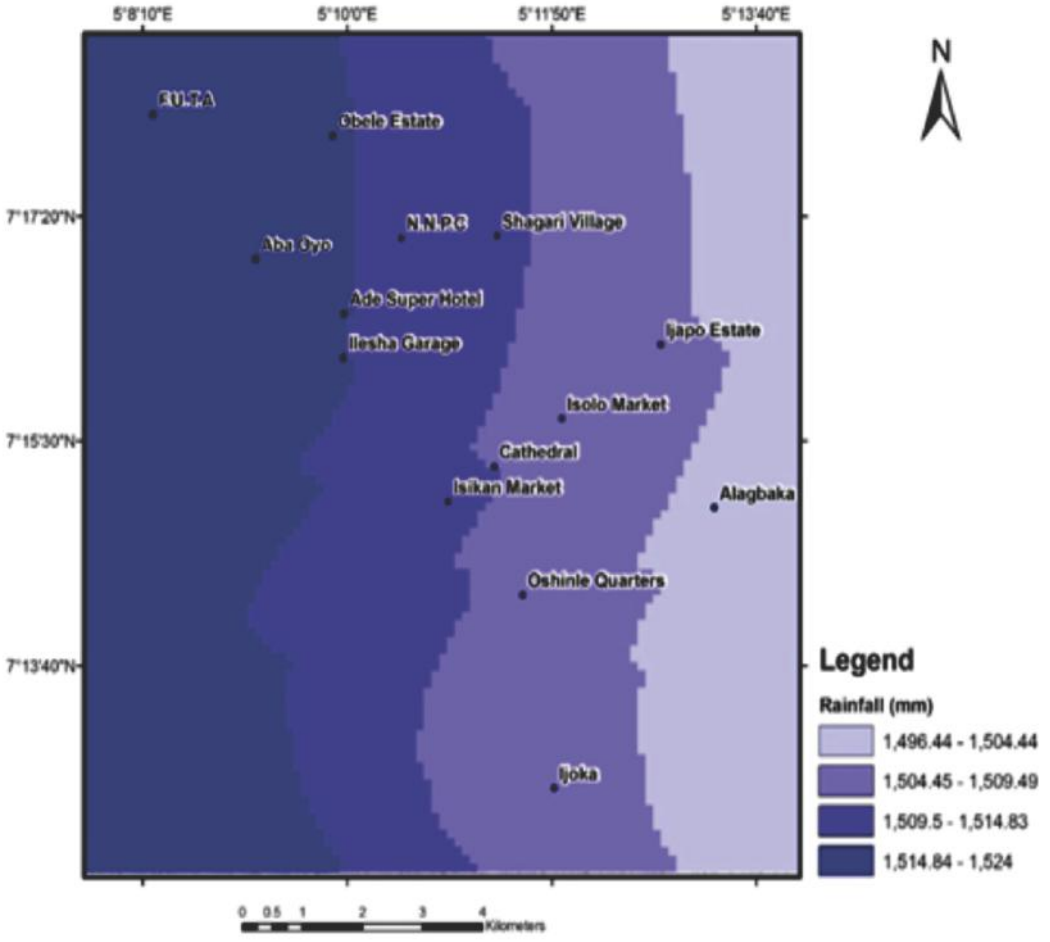


Figure 9: Annual mean rainfall in Millimeters
Source: Fieldwork, 2013

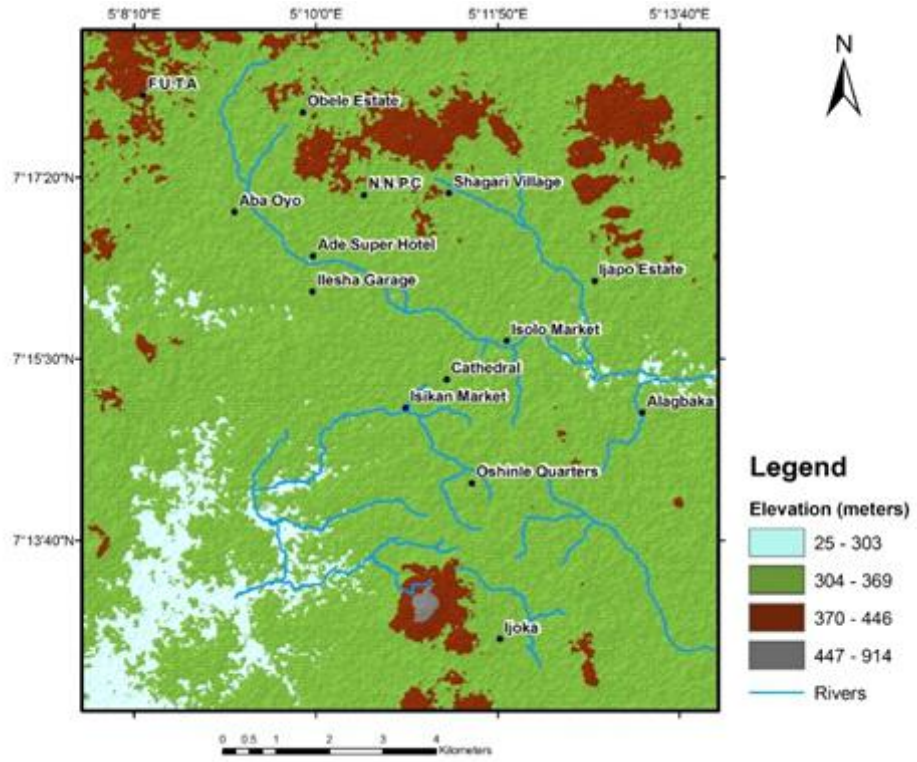


Figure 10: Elevation and River/Stream Channels within the Study Area
Source: Authors' Image Analysis, 2013

The research found out that the areas were characterized by flat or gentle, steep and very steep slope as revealed by Figure 7, which represented slope in percentage values with contours ranging from light yellow to brown. Thus, the Figure showed that areas within 0% to 10% exhibited a flat or gentle slope; areas within 10% to 15% had a steep slope while areas with values greater than 15 % could be referred to as very steep.

As shown in Figure 10, rivers/streams were observed to have been flowing from the very steep slope down to the areas characterized by gentle slope that is naturally suitable for habitation and rich wetland resources. Further, the southern part of the study area was found to have larger proportion of watershed compared to other locations (Figure 11). This implies that they have more pour points that result into more stream channels around the area. The watershed forms a river or a stream because when water falls on a hillside, the water flows down and accumulates into a stream, which is responsible for the more streams formation around the southern region.

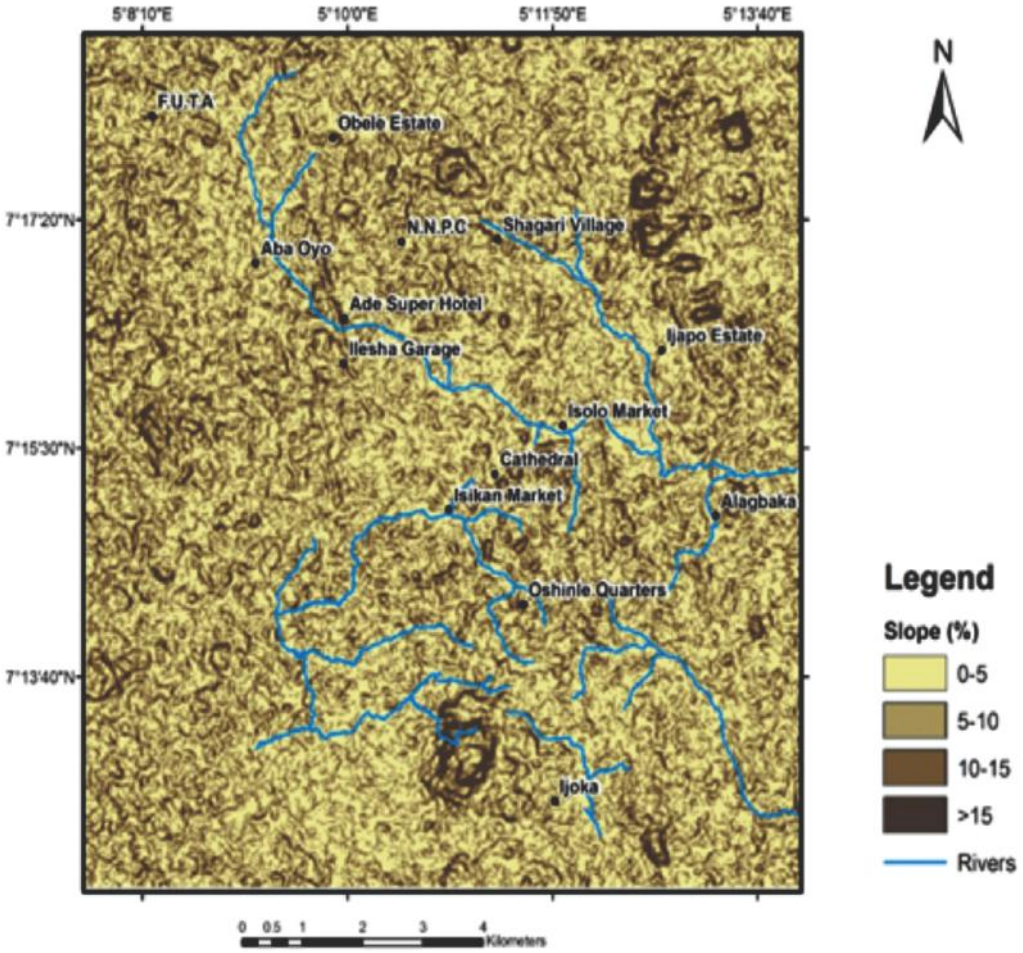


Figure 11: Slope in Percentage and the River Channels within the Study Area

The study therefore attempted to model the vulnerability of the areas susceptible to flooding by integrating the datasets described in the previous paragraphs. The datasets include elevation, drainage density and annual mean rainfall data. Different weights were assigned to each of the datasets, based on their potentials to contribute to the occurrence of flooding. The areas vulnerable to flooding were ranked as high, medium and low vulnerability as shown in Figure 12.

Based on this vulnerability analysis, the area with high vulnerability to flooding were observed to have occurred along the streams or river channels, flowing from the eastern region of the study area towards the northwest region where the standard setbacks had been compromised by physical planning practices. These include locations such as Obele Estate, Aba Oyo, Ade Super Hotel, Isolo, Isikan and Ijapo Estate. Areas around the southwest region of the study area also have high vulnerability to flooding that may be attributed to excess watersheds and

streams. Also from the elevation map and the digital elevation model, this region constitutes a bulk of the lowest altitudes above sea level. Places around FUTA and NNPC recorded medium vulnerability to flooding while low vulnerability is very prominent around the northeast area of the study area.

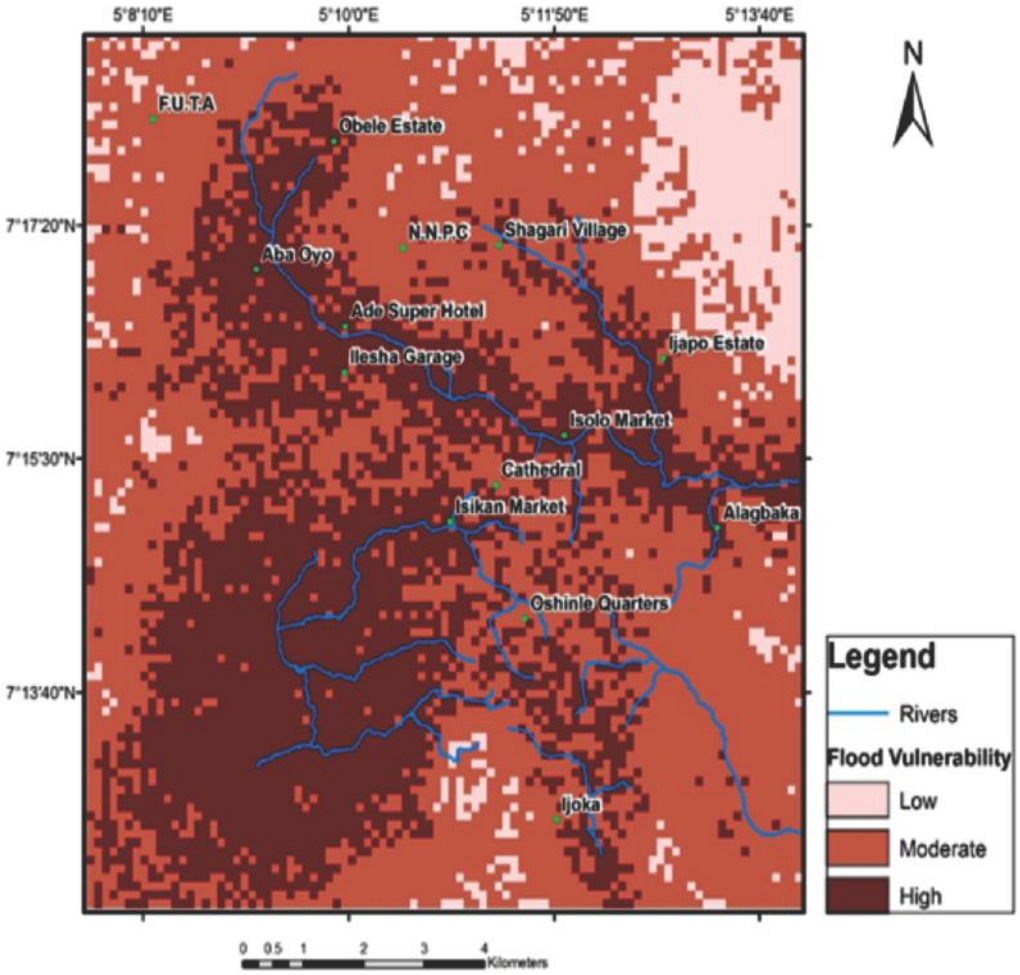


Figure 12: Flood Vulnerability Index of the Study Area
Source: Fieldwork, 2013

It was observed that some precautionary approaches had been taken to avoid or reduce inundation in the study area. These include dredging of some water bodies and creating floodwalls or levees that could temporarily withstand the envisaged inundation. These processes have resulted into converting some small streams into mere drainage channels while others have been straightened from its original course, all with the aim of reducing the occurrence of flooding. However, when such channels could no longer accommodate the volume of water due to increased

stream velocity, storm water will have to flow under pressure with a high possibility of forcefully breaking through the walls. Again, most floodwalls constructed within the study area often have the base of the water body converted to an impervious surface through concrete filling. This further affects water absorption by the soil.

The construction of floodwalls seems to encourage the people to settle in the floodplains. These floodwalls give them a false sense of security against flooding not knowing that they have the tendency of increasing the destructive power of flooding. However, some scholars have observed that such a manipulation of the river is an ill-advised fight against nature. They argue against further development in areas prone to flooding, pointing out that levees raise rivers height by hemming them instead of allowing them to spread out across floodplains. When a river is confined, a levee makes it run faster and thereby increases its destructive power. This was confirmed from the respondents during the questionnaire administration that ever since the levee was constructed, it had only increased their susceptibility to flooding.

Conclusion

This study has demonstrated the capability of satellite imagery and GIS techniques in analyzing wetland degradation that has been occasioned by swift urban development. It has not only established that a large proportion of the wetlands have been lost to urban development but some areas have been made vulnerable to flooding than other. The effect of the degradation is in the incessant flooding often experiences in these settlements. No doubt, this problem portends great danger to lives and properties. The need to curb this problem is urgent and imperative if events that are more grievous are to be avoided. Again, it is very expedient to know that the protection of wetlands goes beyond mere channelization of some water bodies or building of floodwalls, rather, wetland misuse should be strictly addressed. Finally, it is canvassed that government at all levels must commit sizeable resources on research and development on wetland management. Such research should evolve proper monitoring and evaluation system for wetland management while addressing the issue of appropriate usage for this fragile ecosystem.

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AN ASSESSMENT OF JOB-BURNOUT AMONG HOSPITAL NURSES AND COMMUNITY HEALTH WORKERS IN GBOKO METROPOLIS

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Abstract

The study assessed job burnout in hospital nurses and community health workers. It was aimed at ascertaining whether there is a significant difference between hospital nurses and community health workers in the experience of job burnout. Out of the 306 respondents, 155 were hospital nurses and 151 were community health workers .A survey research method was adopted for the study. A standardized questionnaire known as Maslach burnout inventory was used to collect data. The data was analyzed using independent t-test of significance at 0.05 alpha levels. The study established that hospital nurses experience job burnout more than community health workers (t (304) =6.936; p < .05).Observation of the mean and standard deviation also revealed that hospital nurses experience job burnout (X =93.43 SD =76.04) more than community health workers(X = 76.04, SD=8.004). The study recommends that health managers should arrange wellness programmes for both nurses and community health workers to help manage, reduce, prevent or treat the problem of job burnout among hospital nurses and community health workers.

Keywords: Comparative Study, Job burnout, Nurses and Community Health Workers

Introduction

Job burnout as a prototype of stress is being increasingly recognized by health practitioners as one of the most serious occupational health hazards resulting in job dissatisfaction, lowered productivity, absenteeism, low turnover and state of disequilibrium. Work related factors such as

work pressure without support, ever-changing expectations, new job requirements, role conflict and role ambiguity among others comprise some of the stressors which can cause job burnout syndrome. Maslach (1982) viewed job burnout as a response to chronic interpersonal and emotional stressors on the job, resulting to negative feelings such as incompetence, lack of achievement and productivity at work. Emotional exhaustion which is the perception of being used up, frustrated, tired or stressed. Depersonalization which is the perception of treating others impersonally, becoming callous and personal accomplishment which is the perception of having an influence on others, and dealing well with others. As a result of job burnout, people develop negative self-concept and become detached, apathetic, angry or hostile in their work place. It has cumulative effects on mental, quality of life, family and productivity among others.

Job burnout has been long ago a phenomenon that has greatly impaired work behviour particularly among nurses and community health workers. It is a major problem in the helping profession such as nursing and community health. Nursing staff and community health workers face working environment typified with blood and urine, frequent emergency situations, inappropriate expectations from patients and their relatives, lack of authority in decision, all of which can cause job burnout for these category of workers. From many studies, it is now clear that the main sources of nurses and other medical employees including community health workers burnout are found in the work place (Magolis, 2004).

Burnout can be defined as a syndrome that consists of three dimensions namely emotional exhaustion, depersonalization, and reduced personal accomplishment. Emotional exhaustion refers to feeling of being depleted of one's emotional resources. Depersonalization refers to negative, cynical or excessively detached response to other people at work. Reduced personal accomplishment refers to feeling of decline in one's lowered sense of self-efficacy. Several studies have also confirmed that the combination of high demands and low control produces stress and job burnout among nurses and other medical employees including community health workers. Vitaliano, Maiuro and Katon, (2000) in their study about job burnout found that physicians including nurses and other medical employees whose jobs include a very high level of demands but less degree of control suffer from job-burnout.

Control at work has been found to play significant role in job burnout, physical and mental health of nurses and other medical employees including community health workers. Very low level of personal control have been found to be psychologically harmful whereas greater control has been associated with better quality of work and mental health of nurses and other medical employees (Evans and carver, 2001). Bullying management style is detrimental to both nurses and other medical employees, including community health workers; this can cause job-burnout. Hoel, Rayner and Cooper (1999) found that bullying at work is linked with nurses and community health workers ill-health, anxiety and depression etc leading to job burnout.

Repetti (1993) found that poor relationship between the superior and the workers including both the nurses, community health workers and other medical employees contribute to job-burnout. He found that nurses and community health workers including other medical employees experience more negative moods on days when they had distressing interactions with superiors and co-workers. Holt (2003) found that shift-work can lead to job burnout and a variety of physical complaints, including sleep and gastro-intestinal problems among nurses, community health workers and other medical employees.

Albar marin and Garcia-Ramirez (2005) in their study examined the effect of social support on stress, job burnout and emotional exhaustion among hospital nursing staff and other medical employees in Surville, South of Spain. They found that social support had significant buggering effect on the level of burnout, stress and emotional exhaustion experienced by the nurses and other medical employees at work. Nurses and other medical employees that received high kin support and high levels of co-workers and supervisors support experienced low level of job burnout, stress than those who did not.

Akinboye, Akinboye and Adeyeno (2002) reported poor working conditions, excessive work load, shift work, long hours of work, role ambiguity, role conflict, poor relationships with the boss, colleagues or subordinate officers, risk and danger, lack of participation in decision making as the major sources of nurses, community health workers and other medical employees job burnout. It is argued that hospital nurses face unique job challenges compared to their counterparts' community health workers. Given the lack of information, the present study was an attempt to gauge and compare burnout experience between hospital nurses and community health workers in Gboko metropolis, to determine whether there is a significant difference between hospital nurses and community health workers in the experience of job burnout. The study was guided by this hypotheses there is no significant difference between hospital nurses and community health workers in the experience of job burnout.

Many scholars have develop theories and models to help explain the concept of job burnout. These theories include: conservation of resources theory, the cognitive model of job-burnout, the general adaptation syndrome model of stress and burnout, hierarchy of needs theory of burnout, motivational theory of job burnout and the Maslach burnout model and inventory.

The conservation of resource theory was developed by Hobfoll in 1998. This theory states that stress and burnout at work occurs when individuals are either threatened with resource loss or fail to regain resources following resources investment. One of the corollaries of conservation of resources theory is that stress and burnout does not occur as a single event, but rather represent an unfolding process, where in those who lack a strong resources pool are more likely to experience cycles of resources loss. The effective state of burnout is likely to exist when individuals experience a cycle of resource loss over a period of time. This theory is relevant to this study because health workers when faced with resources loss or fail to gain resources following resources investment will certainly become

emotionally exhausted, feel frustrated, stressed or tired which can result to job burnout.

The cognitive model of job burnout and stress was developed by Meconic (1995). The central principle of the cognitive model of human psychological functioning is the process of perception and interpretation of the external world that determines the development of psychological state in the individual. The mental work load of an individual is defined as the local information load that the worker perceive and interpret while performing a task. Meconic and Sandra (1995) states that stress and burnout occurs when this human information processing load is too large for the individual's information processing capabilities. This theory is also relevant to the study because when health workers processing is too large for their processing capabilities, burnout will occur. Nurses and community health workers will become emotionally exhausted and tired and also develop poor sense of personal accomplishment which is the perception of not dealing well with others and their problems or the perception of not having an influence on others.

The general adaptation syndrome model of stress and burnout was developed by Hans-Selye in 1976. This theory consist of three stages: the alarm stage, resistance and exhausted stage. Selyes model is especially useful in helping us understand the link between stress, burnout and health. The first stage called the alarm is the body's first reaction to a stressor, in the alarm stage, there is a temporary state of shock, a time at which there is resistance to illness and stressful situations below normal limits. In trying to cope with initial effects of stress, the body quickly release hormone that in a short time adversely affect the immune system's functioning. It is during this time that the individual; is prone to infections from illness and injury. Fortunately, the alarm stage which is the resistance stage sets in. During the resistance stage, the body's immune system can fight off infection with remarkable efficiency. Similarly, hormones that reduce the inflammation normally associated with injury circulate at high levels. Exhaustion stage as the third stage sets in when the individual has been repeatedly exposed to stressful situation and incapable or unable to show further resistance which may lead to burnout.

The hierarchy of needs theory of burnout was developed by Brenner in 2008. Brenner (2008) maintained that, the Maslow's theory of need can shed light on the development of job burnout. He stated that the famous list of needs ranging from our lowest physiological needs to the highest need of self-actualization provides us with insight into the ways in which people can relate their work environment that satisfied employees tend to be more productive, creative and committed to their employers and work. The theory suggest that our jobs must meet a long list of needs from basic physiological needs up to and including our highest need of self-actualization, that if a job does not provide this then people will begin to dissociate from their work and there is the possibility of job burnout. When nurses and community health workers needs are not met, there is the tendency they will become dissatisfied, frustrated and dissociates themselves from work which can lead to burnout.

The motivational theory of job burnout was developed by Rubin in 2006.

This theory suggest that people who take on a specific job want to be treated in a way that motivates them to do well, to succeed and attain increasingly higher levels of achievement. The theory maintain that most people come into work with the sense of what is in it for me, that the employer must provide incentives to keep people on the job. Rubin (2006) further stated that, if the employer does not, then the employees will be dissatisfied which after a period of time will do increasingly less work, become disgruntled and at high risk of job burnout.

The Maslach Burnout model and inventory was developed by Maslach, in 1983, in which burnout is viewed as a syndrome that consists of three dimensions namely emotional exhaustion, depersonalization and reduced personal accomplishment. Emotional exhaustion refers to feelings of being depleted of one' emotional resources. This dimension was regarded as the basic individual stress components of the syndrome. Depersonalization referring to negative, cynical or excessively detached response to other people at work represents the interpersonal component of burnout. Reduced personal accomplishment, referring to feelings of decline in one's competence and productivity and to one's lowered sense of self-efficacy represents the self-evaluation component of burnout.

METHOD

The study was carried out among hospital nurses and community health workers in Gboko metropolis using 18 hospitals. A survey research method was adopted for the study to sample the opinion of people involved as respondents in order to assess job burnout among nurses and community health workers of hospitals of Gboko metropolis. Three hundred and six (306) hospital nurses and community health workers were randomly selected in Gboko metropolis; from 18 hospitals that constituted the sample unit for the study. Out of the 306, one hundred and fifty five (155) were hospital nurses and one hundred and fifty one (151) were community health workers.

TABLE 1: Selected Hospitals, with Nurses and County Health Workers in Gboko

S/N	Hospital	Nurses	Community Health Workers	Total
1	Gen. Hosp. Gbk	9	8	17
2	Mkar Hosp. Mk	9	8	17
3	TBT Hosp. Gbk	9	8	17
4	Mkar Rehab. Centre	8	9	17
5	Myom Clinic, Gbk	8	9	17
6	Jordan Hosp. Mkar	9	8	17
7	Faith Clinic, Gbk	8	9	17
8	Sefa Clinic, Gbk	8	9	17
9	Bemdoo Hosp. Gbk	9	8	17
10	Formal Clinic, Gbk	8	9	17
11	St. Luke Hosp. Gbk	9	8	17
12	Pewaren Hosp. Gbk	8	9	17
13	Queens Hosp. Gbk	9	8	17
14	Victory Hosp. Gbk	9	8	17
15	Central Hosp. Gbk	9	8	17
16	Comp.Health center Gbk	9	8	17
17	Mercy Clinic, Gbk	8	9	17
18	Rapha Clinic, Mkar	9	8	17
Total		**155**	**151**	**306**

The study was carried out using a standardized inventory known as Maslach Burnout inventory, developed by Maslach in 1983. The standardized inventory by Maslach (1983) was divided into two (2) sections; section A and B. Section A sought information on demographic data and section B sought information on job burnout. The respondents were asked to rate themselves in section b of the questionnaire on a 6-point rating scale (1=a few times a year, 2=many times a year, 3=a few times every month, 4= many times every month, 5=a few times every week, 6=every day.

The standardized instrument (Maslach Burnout Inventory) also has a reliability coefficient of 86 for Cronbach alpha and a concurrent validity coefficient in the range of 01-.36. Permission was obtained from the medical director in all the hospitals visited before the administration of the questionnaire. The researcher explained the purpose of the study to the respondents. Those who express their willingness to participate in the research were studied. The respondents were also free to question the researchers. The data collected after two weeks were analyzed, using independent t-test of significance at 0.5 alpha level.

RESULT AND DISCUSSION

The following represents the response, frequencies and percentages of items that are of major focus.

Table 1 shows that 38 (12.4%) respondents are males and 268 (87.6%) respondents are females. Out of the 306 health workers selected for the study, 155 (50.7%) are hospital nurses and 151 (49.3%) are Community Health workers. Among the health workers, 79 (25.8%) were senior hospital nurses, 76 (24.8%) are junior hospital nurses, 74 (24.2%) are junior community health workers, while 77 (25.2%) are senior community health workers.

Socio-demographic	Frequency	Percentage (%)
Sex		
Males	38	12.4
Females	268	87.6
Occupation		
Hospital Nurses	155	50.7
Community health workers	151	49.3
Rank		
Senior hospital nurses	79	25.8
Junior hospital nurses	76	24.8
Junior community health worker	74	24.2
Senior community health worker	77	25.2
Total	**306**	**100**

TABLE 1: Socio-Demographic Characteristics of Respondents

To determine whether "there is a significant difference between hospital nurses and community health workers in the experience of job burnout", a t-test statistics was employed to test the significance of the difference and the result is presented below in a tabular form.

Variable	N	Mean	SD	t-value	df	Sig-level
Hospital nurses	155	93.43	29.760	6.936	304	05
Comm. health workers	151	76.04	8.044			

t (304) 6.936; p<05

The result above showed a significant difference between nurses and community health workers in the experience of job burnout. Observation of the mean (X) and standard deviation (SD) also showed that hospital nurses experience job burnout more than community health workers in Gboko metropolis. The result obtained from testing to determine whether "there is a significant difference between hospital nurses and community health workers in the experience of job burnout" shows that a significant difference exist between hospital nurses and community health workers in the experience of job burn out ($t(304) = 6.936$; $P < .05$). Observation of the mean and standard deviation also showed that, hospital nurses experience job burnout ($x = 93.43$ ($SD = 76.04$) more than community health workers (x) $=76.04$ ($SD = 8.044$).

This research finding has clearly supported the work of Fagin (2006) on job burnout in hospital nurses and other medical employees including community health workers in Isfahan, Islamic republic of Iran, where the researcher concluded that nurses experienced a higher degree of job burnout ($x= 21.07$ ($SD = 8.87$) as compared to other medical employees including community health workers ($x = 16.64$ ($SD = 7.54$).

Fagin (2006) further showed the correlation between job burnout and the demographic characteristics of the nurse and other medical employee including the community health workers. And for the nurses, there was significant positive correlation between age, years of work experience, and frequency of on calls. In the case of other medical employees including community health workers, there was a negative correlation between their years of work experience and age.

Similarly, Majoyinola (2008) examined the effects of job stress and burnout on health, personal and work behaviour of nurses in public hospitals in Ibadan metropolis. Data was collected from 153 nurses working in two public hospitals in Ibadan metropolis. The study established from the set hypothesis that there is a significance difference in personal and work behaviour of nurses who are highly stressed and burnout, than nurses who are less stressed and burnout. That the work behaviour of nurses who are highly stressed and burnout is affected negatively more than nurses who are less stressed and burnout.

RECOMMENDATION

Following the research findings, the following recommendations are hereby made by the researcher, which when followed could help manage, reduce, treat or prevent the problem of job burnout among nurses and community health workers in Gboko metropolis and Nigeria at large.

1. Stress and burnout should be combated in the workplace. Health managers are expected to determine if their employees including nurses and community health workers are experiencing harmful stress and burnout in the work place before it is too late. They should provide a conducive environment for the employees to talk freely and confidently about their problems.
2. Health Managers should also introduce wellness programmes for both nurses and other medical employees including community health workers by involving them in appropriate physical activities to vent out their anger and hostility.
3. Medical employees liaison services should be provided or involved to provide support to the nurses and community health workers by providing organizational support, peer relationships and individual training courses to improve the quality of patient care and diminish the chances of post-traumatic stress disorder, job dissatisfaction and burnout.
4. Hospitals should also conduct regular training courses for the nurses and other medical employees staff, in order to manage the art of burnout management and develop healthy coping strategies to neutralize the negative impacts of work load.
5. In-service training, workshops and seminars should be organized for nurses and other medical employees including community health workers to update their knowledge and skills. They should be sent for course on human behaviour, resource management, interpersonal relation, stress and burnout management and crisis interventions.
6. The governments (Federal, state and Local), the Ministries of health or the hospital management boards should help in ensuring that efficient nursing and medical care is given to patients. This can be done by reducing the source of stress and burnout in the nurses and other medical employees including the community health workers. Their working conditions needs to be quickly improved by giving them adequate salaries that commensurate with the demands of their jobs. Their promotion should be done when due and they should also be involved in vital decisions concerning their jobs and their patients

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EFFECT OF CROPPING PATTERN ON SOIL PROPERTIES: A CASE STUDY OF WUDIL KANO NIGERIA

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Abstract

The influence of two farming systems (sole and mixed cropping) on soil properties was investigated in the Wudil area of the Kano Close Settled Zone. Soil samples collected from plots under the two practices were subjected to physico-chemical analyses. The results indicated that soil under mixed cropping have higher levels of organic carbon, total nitrogen, Cation Exchange Capacity (CEC), exchangeable bases and available phosphorus than sole cropped plots. The result implies that mixed cropping is not only beneficial in enhancing soil fertility by higher organic matter build-up but also reduces soil erosion and is therefore recommended particularly among peasant and small scale farmers.

Key words: Changes, Soil properties, Management Practices, Kano close-

Introduction

The maintenance of soil fertility includes a range of practices aimed at conserving and improving the soil potentials. The aim of soil management is the control and improvement of soil fertility to give optimal crop production. Soil management has since been a central concern not only to peasant farmers but also to government and other organizations.

There are various methods of improving and maintaining soil fertility. This may include the use of animal manures, grass burning, bush fallowing, crop rotation, mixed cropping cultivation, and cropping system as is shown in this research as well as erosion control techniques. Fertility of a soil is governed by its physical and chemical properties, either or both of which may limit productivity. For this reason, the study of farming systems in any area often makes reference to soil conditions, since soils are the

medium on which plants grow. Soil is said to be fertile, when all conditions-physical, chemical, and biological are favorable to crop development. Absence of any of these, acts as limiting factor and the crop as a whole suffers (Dutta, 1982).

Soil quality is defined as the capacity of a soil to function within the ecosystem boundaries and interact positively with the environment external to that ecosystem (Larson & Pierce, 1991). This however expresses both the inherent properties of a soil and the soil ability to interact with applied input.

Soil management in the agricultural context includes all aspects of soil treatment i.e. subjection, utilization and conservation. This concept can be viewed from two main perspectives, in terms of small holder farmers practice and his ability to do it at a sustainable level.

In view of the land use, management systems and cropping pattern practiced by the farmers in the research area, this paper is aimed at examining the effect of the different cropping patterns on the soil fertility of the study area with a view to making recommendations on the preferred cropping pattern.

Study Area

Wudil is located within latitude 11.59^0 North to latitude 11.922^0 N and between longitude 8.757^0E to longitude 8.973^0E, 35Km from Kano along Kano-Maiduguri road (Fig.1). The town is located in the Kano Close Settled Zone with high population density of 350 persons per $Km^{2.}$ By tropical African standards, the pressure on agricultural land here is high (Mortimore,1967,1987). The soils in the study area are developed over an old land surface, and are derived from sandy loam deposits and are reddish brown in colour. The soils of the area are described as less leached mature shallow soils on a level to gently undulating land slope (FMANR,1990).

The physical characteristics of soils reflects the presence of sandy loam parent materials and the particle size distribution of the soil of the area range from coarse silt to medium sand fractions. The soils of the area are low in organic matter and plant nutrients and are slightly acidic. Cation exchange capacities, soluble salts and available phosphate are low.

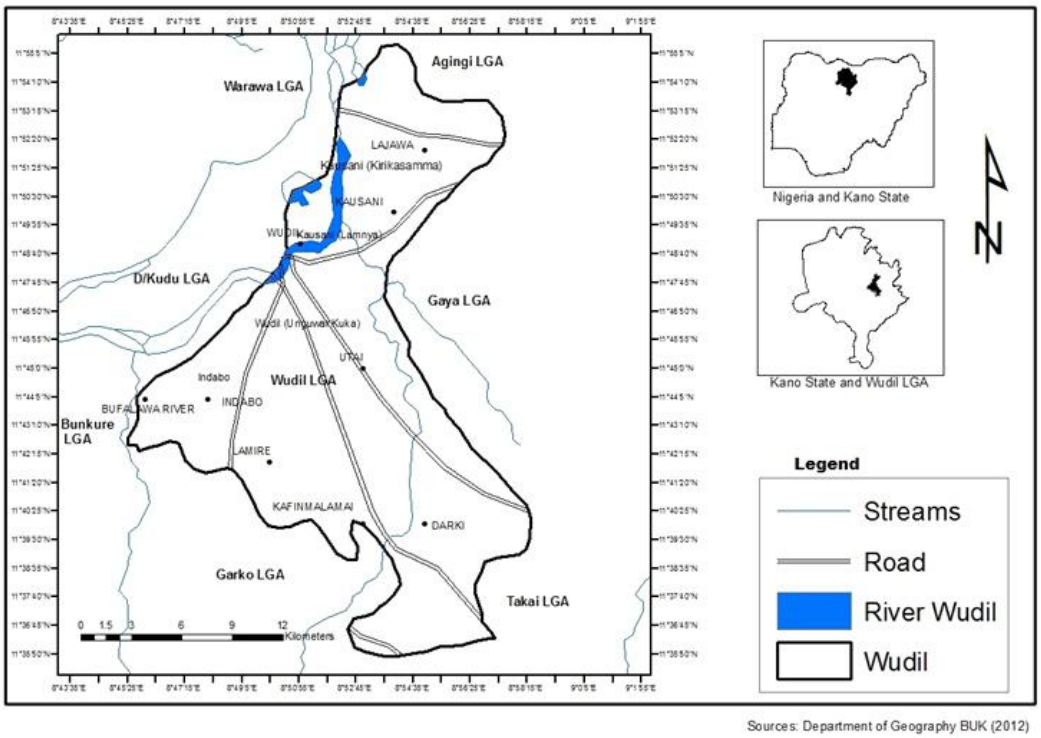

FIG. 1: Showing Wudil Local Government (study Area)

MATERIALS AND METHODS

Field methods

Reconnaissance visit to identify plots under the two farming systems from where soil samples were taken was conducted. A number of fragmented plots were found scattered around the study area. Some of the plots were found to be close to one another some belong to the same family members while others are sold to other people.

Soil characterization

A survey (interview) was conducted with the aim of characterizing the plots under different cropping systems, soil types and land use types. Interview survey series of convenient interviews were conducted with plot owners found on their farms. A total of 50 farmers were found working on their farms and were

interviewed. Issues relating to soil types, soil characteristics, management types, cropping pattern, type of fertilizer applied and why among others. Various reasons for the choice of either mixed or sole cropping were given by the local land users ranging from inadequate land and food supply, nature of soil, soil fertility enhancement etc.

Soil sampling

A total of 100 soil samples were purposively collected from the sole cropping plots at the depth of 0-20cm. The 100 samples were then made to be 10 composite samples which were prepared for the study. Another set of 100 samples were also purposively collected from the mixed cropping plots at the same depth and were equally composited to 10 composite samples, thereby making a total of 20 representative samples: 10 from mixed cropping plots and 10 from sole cropping plots which were treated and analyzed for physical, chemical and fertility related indices.

Laboratory Methods

The samples collected were placed into polythene sample bags taken to the laboratory air dried and sieved with a 2mm mesh sieve for analysis. The treated soil samples were subjected to analyses using the following methods;

Particle size distribution was determined using Bouyouscos method (1957). USDA Textural triangle was also used for determining textural classes.

Organic carbon was determined using the Walkley-Black (1934) method. Phosphorus (P) content determination was done using the colorimeter (CECIL CE 373) method using the sodium hydrogen carbonate extraction. The determination was according to the Bray and Kurtz (1945) method.

The determination of exchangeable bases was done with flame photometer (JENWAY PFP7) after extraction using ammonium acetate extraction technique. The CEC was determined using the ammonium acetate saturation method as outlined by Hesse (1971).

The total nitrogen was determined using the kjeldal Digestion method. pH was determined using the 1:2.5 soil water ratios.

Statistical Analysis

The results of soil analysis obtained were subjected to simple descriptive statistic of mean, median, mode. Standard deviations were used to test for significant difference between the 2 cropping systems under study.

RESULTS AND DISCUSSION

Soil Textural Characteristics

The soil physical characteristics investigated showed that there were variations in the content of sand, silt and clay fraction between land use types. Textural classification and colour did not change (Tables1 and 2). The clay content in soils under sole cropping was lower than that in soil under mixed cropping. This could be attributed to soil erosion under sole cropping especially under grain sole cropping as practiced in the study area. It is therefore necessary to increase the ground cover to reduce soil loss and to incorporate organic manure to aid aggregation and stability of the soil. Grain mono cropping as widely practiced in the area should be discouraged.

TABLE 1: Soil Characteristics under Sole Cropping in Kano Close Settled zone

	SOIL CHEMICAL CHARACTERISTICS											SOIL PHYSICAL CHARACTERISTICS				
								cmol/kg								
Sample	pH H_2O	pH Kcl	Ecms/cm	OC %	T N%	Av. P ppm	CEC	Na	K	mg	Ca	BSP %	Clay %	Silt %	Sand %	Tex. Class
1	6.5	5	0.03	0.23	0.01	22	3	0.02	0.1	0.3	1.5	65	10	18	72	SL
2	6.3	4.6	0.02	0.4	0.03	19	5.2	0.04	0.2	0.4	1.7	45	9	17	74	SL
3	6.5	5	0.04	0.22	0.02	20	3	0.04	0.2	0.4	2.2	96	12	18	70	SL
4	6.7	5.2	0.02	0.2	0.02	25	4.1	0.03	0.1	0.3	1.7	53	8	14	78	SL
5	7.1	5.7	0.02	0.17	0.01	18	2.3	0.02	0.2	0.4	1.6	94	6	20	74	SL
6	6.4	5	0.03	0.3	0.03	20	2.8	0.03	0.2	0.4	2.1	98	10	22	68	SL
7	7	5	0.03	0.25	0.02	23	3.5	0.04	0.1	0.3	2	71	10	16	74	SL
8	6.8	5.2	0.02	0.33	0.02	15	4	0.03	0.2	0.4	1.7	57	8	18	74	SL
9	6.9	5.3	0.03	0.25	0.02	25	2.8	0.05	0.1	0.4	1.9	88	10	12	78	SL
10	6.8	5	0.04	0.21	0.01	20	3.3	0.03	0.1	0.4	1.5	62	9	19	72	SL
MEAN	6.7	5.1	0.03	0.26	0.02	21	3.4	0.03	0.2	0.4	1.8	73	9.2	17.4	73.4	

SL= Sandy Loam

TABLE 2: Soil Characteristics under Mixed Cropping in Kano Close Settled Zone

	SOIL CHEMICAL CHARACTERISTICS											SOIL PHYSICAL CHARACTERISTICS				
								cmol/kg								
Sample	pH H_2O	pH Kcl	Ecms/cm	OC %	T N %	AV .Pppm	CEC	Na	K	mg	Ca	BSP %	Clay %	Silt %	Sand %	Tex class
1	6.3	5.7	0.02	0.35	0.03	18	5.7	0.03	0.2	0.55	2.15	51	14	18	68	SL
2	6.1	5	0.02	0.25	0.03	25	3.5	0.03	0.2	0.43	2.17	81	12	20	66	SL
3	6.5	5.1	0.03	0.33	0.04	18	4	0.04	0.2	0.52	1.53	56	12	18	70	SL
4	6.3	5.3	0.02	0.24	0.03	20	5.1	0.02	0.2	0.34	2	51	14	19	67	SL
5	6.2	5.3	0.04	0.3	0.05	23	3.3	0.03	0.2	0.42	1.7	71	10	20	70	SL
6	6.1	5	0.03	0.38	0.03	25	7.1	0.04	0.4	0.5	3.5	62	16	20	64	SL
7	6.2	5.3	0.02	0.25	0.02	18	3.9	0.02	0.2	0.3	2.1	68	12	18	70	SL
8	6.3	5.1	0.04	0.37	0.05	35	4.5	0.02	0.3	0.5	2.5	74	18	16	66	
9	6.3	5.3	0.02	0.3	0.04	27	5.3	0.03	0.2	0.47	2.9	68	14	20	66	SL
10	6.5	5.1	0.02	0.22	0.02	20	3.5	0.03	0.2	0.51	2	78	16	14	70	SL
MEAN	6.3	5.2	0.03	0.3	0.04	23	4.6	0.03	0.2	0.43	2.26	66	14	18	67.7	

SL= Sandy Loam

Soil pH and Electrical conductivity

The statistical test conducted on pH values obtained indicates significant difference between soil pH in water, while soil pH in KCl solution showed no significant difference, while the electrical conductivity values showed no significant difference in terms of solubility levels. This could be related to indifference in the leaching rate of soluble salts within the area (Table 3). This means that the soil is safe from the salinity hazards the parameters measured in relation to salinity have indicated a soil that is far from being saline or even alkaline. The slightly acid nature of the soil will enhance the availability of nutrients and as shown above may further facilitate the solubilisation of sodium ions which are the primary agents of salinizmination and alkalinisation especially in irrigated soil. This confirms Alhasan's 1996 study results. That is, the farming system has changed and maintained the soil pH level and this affects crop growth.

Table 3: Mean, Standard Deviation And T-values of Soil Properties under the Two Management Systems

SOIL PROPERTIES	SOLE CROPPING			MULTIPLE CROPPING		
	X	SD	t value	X	SD	t value
pH in H_2O	6.7	0.27	4.71*	6.28	0.14	4.71*
pH in KCl	5.1	0.28	1.28^{ns}	5.2	0.21	1.28^{ns}
EC ms/cm	0.03	0.008	0.48^{ns}	0.03	0.01	0.48^{ns}
Organic carbon %	0.26	0.069	1.67^{ns}	0.3	0.06	1.67^{ns}
Total Nitrogen %	0.02	0.007	3.5*	0.04	0.01	3.5*
Available P ppm	20.7	3.13	0.92^{ns}	22.9	5.38	0.92^{ns}
CEC me/1000g	3.39	0.85	2.31*	4.59	1.21	2.31*
Na me/1000g	0.03	0.009	1.08^{ns}	0.03	0.01	1.08^{ns}
K me/1000g	0.15	0.05	4.65*	0.23	0.06	4.65*
mg me/1000g	0.37	0.04	3.73*	0.45	0.08	3.73*
Ca me/1000g	1.79	0.25	2.59*	2.26	0.28	2.59*
Base saturation %	72.9	19.58	0.89^{ns}	66	10.7	0.89^{ns}
Clay %	9.2	1.62	5.2*	13.8	2.39	5.2*
Silt %	17.4	2.88	0.76^{ns}	18.3	2	0.76^{ns}
Sand %	73.4	3.14	4.64*	67.7	2.21	4.64*

Source: Authors Field work

Organic Carbon

The results revealed that the organic carbon content in the multiple cropping plots is higher than those in sole cropping plot. Generally values <1% are regarded as low and 1 – 1.5% are regarded as medium (Adamu, 1997).
The direct implication of this low organic carbon content in the sole cropping soil is that organic matter is also low. This is not unexpected in tropical environments because generally addition of organic residues which determines the organic matter content in the soil is low and their lost through mineralization is high (Binns et al, 2003).

Total Nitrogen

Total nitrogen analysis showed very significant difference between the plots (Table3). The results showed low nitrogen content in the soil of the study area which may be due to the nature and the origin of the soil and inadequate application of nitrogen based chemical fertilizers (Jones & Weld, 1978). Even though, the N contents of multiple cropped plot are a bit higher. However, the N contents of all of the plots were low because the range considered as high starts from 0.02% or 0.03% in extreme cases (Landon, 1991). Most of the N is however in the ammonium form as can be observed in Tables 1 and 2.

Available Phosphorus

The available phosphate values are within the same range, however, the values of the multiple cropping plot is higher than the sole cropping plot. The P content in the soil is also another factor that agreed with the organic matter content of the soil (Adamu and Dawaki 2008).

That is with low organic matter in the soil, the N and P may likely be low because mineralization of organic matter is known to significantly contribute to the concentrations of both. The application of good organic manure is important for the maintenance of available phosphate to the crops.

Cation Exchange Capacity

The CEC results obtained showed significant difference between the plots (Table3). The mean values of CEC are higher in multiple cropping than sole cropping even though, still within low range. The CEC values in all the plots could be regarded as low or medium despite the apparent variability between plots which is not unexpected giving the types treatments given to the soils that led to difference in terms of clay and organic matter content which are the principal determinants of CEC. The soil CEC must have been significantly contributed to by the clay content, because of the poor state of the soil in terms of organic matter (Alhasan, 1996).

Exchangeable Cation

The analysis carried out showed no difference in sodium values between two plots, while a significant difference in mean values of potassium and magnesium are obtained from a multiple cropping plots (Table3). The Mg values are however within the medium range across all the plots, while the K values are however fairly high in the mixed cropping plots. The high amount of K in the mixed cropped soils may have also contributed to the low Ca and Mg values because of its better competitive ability for exchange sites, although their values are not however extremely bad (Foloronsho,1998).

Base Saturation

The results of base saturation percentage obtained from the two plots are all within the acceptable ranges and they all range within BSP soil classification by FAO-UNESSCO, 1974

Because Ca and Mg values are hovering around the Na concentrations, the advantage of which is their effect in lowering the SAR values as shown in Tables 1 and 2.

CONCLUSION AND RECOMENDATIONS

From the results the following generalizations could be made:

i. The soil pH is suitable for most chemical reactions with soil nutrients while the soil salinity may not pose a problem.

ii. The levels of exchangeable bases are low and the total nitrogen and cations exchange capacity values are very low.

However, leaching of bases may pose a problem especially in plots under sole cropping.

To check this problem and also increase the efficiency of the fertilizer added, it is recommended that organic residue be added to the soil.

Sustainability of the management systems should be enhanced through multiple cropping. This has the advantage of ensuring better efficiency of the added fertilizer.

Multiple cropping improves the physical attributes of the soil such as moisture holding capacity and to some extent the control of erosion and is therefore recommended particularly to peasant and small scale farmers.

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Assessment of water quality from hand dug wells in Jalingo Town, Nigeria

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Abstract

The study assesses water quality of hand-dug wells in Jalingo town, Taraba State, with a view to ascertaining its suitability for human consumption. A total of fifteen hand-dug wells were randomly selected in Jalingo town across the residential areas in the wet season in the month of July 2014. This month constitutes the period with the highest rains in the area when pollution of water resources is expected to be high due to solvent action of water. The analyses were done for fourteen (14) water quality parameters; lead, calcium, chromium, copper, zinc, pH, temperature, magnesium, turbidity, electrical conductivity, nitrate, total coliform count, iron and colour and were investigated and reported based on the Nigerian standard for drinking water quality (NSDWQ). Based on the parameters analyzed, the result showed that iron, chromium, temperature, magnesium, lead and total coliform returned values which were above the NSDWQ limits. While copper, calcium, pH, turbidity, electrical conductivity, nitrate and colour returned values which were either very low or closely approximated the limit recommends in the NSDWQ guidelines for drinking water. Zinc was not detected in any of the water samples. Land use and prolonged anthropogenic activities and geology are factors identified to influence the quality of groundwater in the study area. The implication is that the quality of ground water of different units in Jalingo town is not completely safe for drinking without treatment. The study therefore recommended that simple methods like boiling, sieving, addition of adequate dosage of alum, water guards and disinfection with chloride could be employed by the inhabitants to reduce the risk of water borne diseases.

Key words: Jalingo, Hand-dug well, water quality, contaminant.

Introduction

Water is fundamental to life. About 60 percent of human body is water (Fasunwon,Ayeni & Lawal, 2010). Significant uses of water are industrial, domestic, agriculture and as habitat to organisms. It can occur as surface water in lakes, rainwater and streams as well as groundwater in wells, boreholes and springs. Ground water is widely distributed and most common in terms of spatial access, storage and management (Alexander, 2008). It accounts for about 90% of the world's freshwater resources and constitutes about 80% of safe

urban and rural areas in Nigeria (Yerima, Daura, & Gambo 2008; Adebo & Adetoyinbo, 2009). The quality of groundwater is very important whether for industrial or domestic purposes. Ground water has been alternative option that is relied on for the provision of water for adequate use among most inhabitant of Africa. Unfortunately, access to safe drinking water is a major problem facing a large proportion of the inhabitant of the developing nations (UNICEF 2005). The inadequate supply of potable water and frequent pollution of existing supplies create a very serious health problem for people in many urban centres in Nigeria and other developing nations. The United Nations Organization (1995) estimated about 3.3million people dies of water related diseases such as diarrhea every year of which about 2.5 million children and infants. Jalingo town suffers water problems; cases of dry taps are common in virtually every part of the city. This problem of acute water shortage is as a result of difficult terrain, population growth, rural urban migration, managerial problems and the growth of new settlement are a number of factors that have made Jalingo water board unable to provide adequate water for the present population. Although Taraba State Rural Water Supply and Sanitation Agency, the Federal Government, UNICEF/UNDP water supply scheme has provided boreholes, however, the problem still remains. To this end, inhabitants of the city have resorted to hand-dug wells as an appropriate alternative source of water supply. Concern over the quality of water from hand-dug wells have been investigated in many parts of Nigeria (Yerima et al, 2008; Omotoyinbo, 2007; Ocheri & Ode, 2012). None of such study has been carried out on the quality of water from hand-dug wells in Jalingo town. This research focuses on assessing the quality of water from hand-dug wells in Jalingo town against the backdrop of its potability for human consumption.

Materials and Methods:

Study Area

Jalingo town is located at the North Eastern part of the state and Nigeria. It lies approximately between Latitudes 8^{O} 47' N and 9^{O} 01' N and Longitudes 11^{O} 09' E and 11^{O} 30' E. It has a population of 139,845 people (NPC, 2006). The area has a tropical continental type of climate characterized by well-marked wet and dry seasons (Ali 2010, Iloeje 1972). The wet season usually begins around April and ends in October, whereas, the dry season begins November and ends in March. The amount of rainfall is about 1200mm. Temperature is moderately high throughout the year averaging 29^{O}. Relative humidity ranges between 60 – 70% during wet season and about 35 – 45% in the dry season (Oruonye et al, 2011).

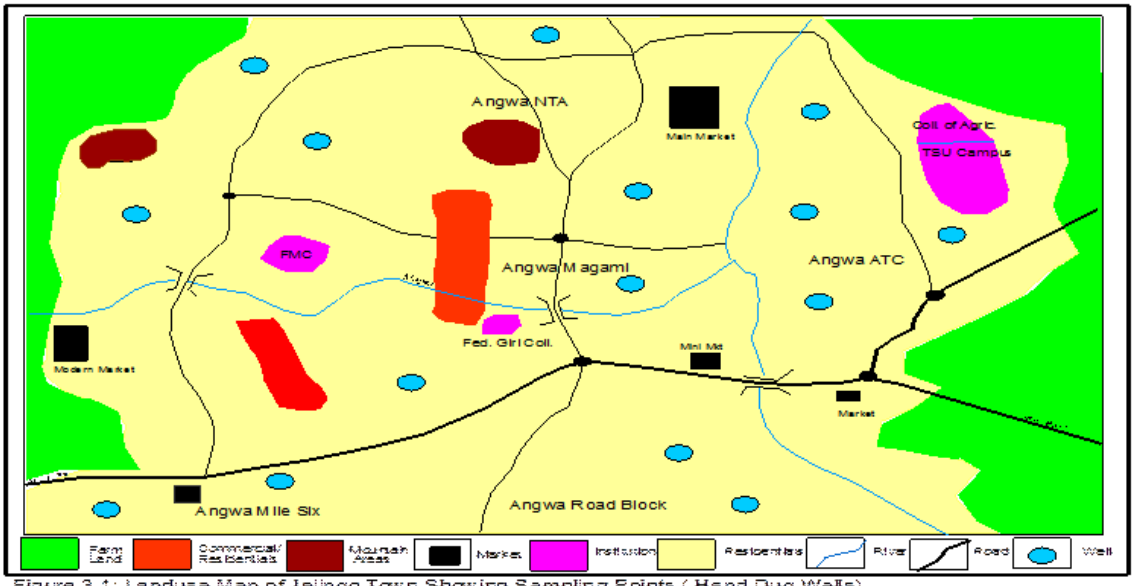

Figure 3.1: Landuse Map of Jalingo Town Showing Sampling Points (Hand Dug Wells)
Source: Ministry of Lands and Survey Jalingo, Taraba State

Slate, mudstone with minor sandstone (Bashir, 2011).
The vegetation is that of Guinea Savannah characterized by grasses interspersed with tall trees and shrubs.

Water Sample

The study area is divided traditionally into five major residential areas, locally called Angwa in Hausa namely: Angwa Mile 6, NTA, Road Block, ATC and Magami. Based on this delineation and observation during field survey, 15 hand-dug wells were randomly selected across the residential areas during raining season. The selection of the wells were spread within length and breadth cutting across different geological setting, land use and varying population densities of the area. The collection, handling, presentation and transportation of the water samples was carried as prescribed in line with standard laboratory procedure. Location of wells were accurately determined using global positioning system (GPS).

Laboratory and Data Analysis

Laboratory analysis of water samples collected from hand-dug wells in the study area were carried out in National Programme for Food Security (NPFD)/FAO/UN Fertilizer/Water Quality control laboratory Kaduna, Kaduna State, to determine their physicochemical and bacteriological properties. Standard equipment and procedures were used during the analysis. Nigeria Standard for Drinking Water Quality (NSDWQ) guidelines was used. Parameters analysed are shown in Table I.
Simple descriptive statistics were used to interpret the raw data on the physicochemical and bacteriological parameters generated in the cause of this research.

Results and Discussion

The results obtained from the water analysis carried out is summarized in Table I. The mean values are given in Table 2 and discussed briefly below the tables.

TABLE 2: Result of bacterialogical , physidological properties in the Water samples

PARAMETERS/ HDW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	NSDWO
Temperature	28	29	30	30	31	30	27	30	28	28	30	30	29	30	28	27-28
PH	6.50	6.35	6.90	6.9	6.9	6.80	7.00	6.45	6.75	6.30	7.10	6.40	6.65	6.50	7.00	65-85
EC	35.50	714.0	1945.0	735.0	315.0	668.0	14.38	158.20	280.0	914.0	789.0	533.0	672.0	177.0	72.6	1000
Turbidity	3.0	2.0	5.0	8.0	7.0	9.0	2.0	4.0	3.0	6.0	2.0	6.0	2.0	5.0	14.0	5NTU
Nitrate	0.4	0.3	0.2	0.3	0.2	0.3	0.2	0.2	0.3	0.3	0.2	0.1	0.3	0.3	0.3	50mf/l
Iron	2.919	1.321	2.098	1.173	1.842	3.598	4.379	0.594	0.004	1.461	2.540	6.259	0.699	3.063	11.144	0.3mg/l
ZINC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3mg/l
Magnesium	5.758	7.638	9.773	7.77	5.513	7.310	7.809	2.873	3.875	7.940	7.958	6.087	6.712	3.214	1.726	0.2mg/l
Copper	0.274	0.306	0.332	0.277	00.466	0.207	0.414	0.139	0.316	0.439	0.596	0.511	0.510	0.398	0.541	1mg/l
Chromium	ND	0.371	0.141	0.294	0.064	-	-	-	-	-	0.450	-	-	-	-	0.05mg/l
Calcium	15.579	38.429	75.610	37.538	13.985	23.919	48.173	2.096	5.353	32.016	30.504	14.611	25.109	5.011	0.54	150mg/l
Lead	-	-	0.112	0.093	0.240	0.023	-	-	-	0.007	-	-	0.020	-	-	0.01mg/l
TCC	-	-	-	-	-	>300	>300	>400	>300	-	-	-	-	1.80	1.50	10
Odour	3.0	2.0	5.0	4.0	5,0	8.0	3.0	4.0	3.0	5.0	4.0	3.0	3.0	4.0	18.0	15TCU

(Source: Field Work, 2014)

TABLE 2: Descriptive statistic of the physicochemical and microbial properties of hand-dug wells in Jalingo

PARAMETERS	MINIMUM	MAXIMUM	MEAN	STD.DEV	C.O.V. %
Temperature	27	31	29.2	1.107498	3.79
PH	6.30	7.10	6.67	0.225610	3.38
EC	14.38	1945.0	769.15	508.55168	66.12
Turbidity	2.0	14.0	5.2	3.33	64.0
Nitrate	0.1	0.4	0.26	0.07118	27.38
Iron	0.004	11.144	2.87	2.7070911	94.32
Zinc	ND	ND	ND	ND	ND
Magnesium	1.726	9.773	6.131	2.2088552	36.03
Copper	0.139	0.596	0.3814	0.1197412	31.40
Chromium	0.064	0.450	0.084	0.127142	151.4
Calcium	0.521	75.610	24.56	20.5158612	83.53
Lead	0.007	0.240	0.033	0.0597986	181.21
TCC	150	>400	102	148.8659352	145.95

(Source: Field Work 2014)
ND – Not Detected

Temperature: Temperature of water samples analyzed ranged from 27 to 31^{O}C with a mean of 29.2^{O}C and coefficient variation of 3.79% as shown in Table 2. Temperature values recorded were above the NSDWQ stipulated standards of 27^{O}C - 28^{O}C for drinking water (NSDWQ, 2007). Thus, this might increase metabolic activities of organisms, speed dissolution of oxygen and could amplify odour due to anaerobic reaction in all the wells, with which the water will be unwholesome for drinking (Obeta et al 2013). The variability of temperature among the sampled hand-dug wells is shown in Figure 1.

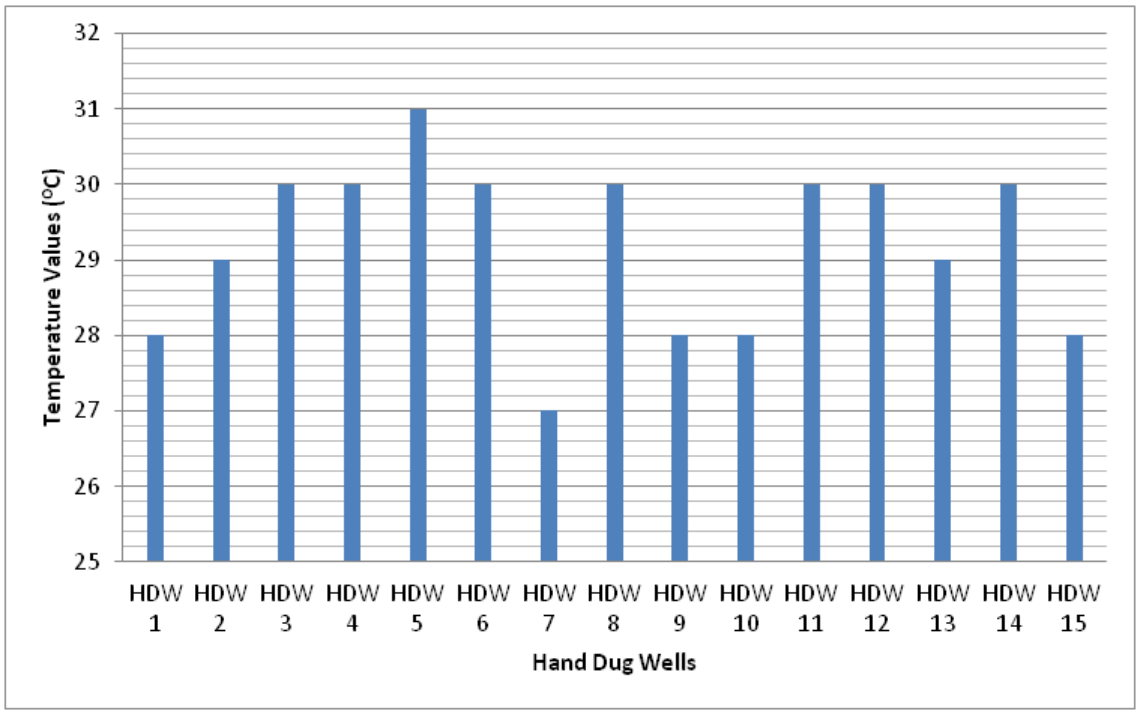

Fig. 1: Temperature of Hand Dug Wells

pH: The pH of water samples analyzed ranged from 6.30 – 7.10 with a mean of 6.67 and a coefficient variation of 3.38%. From the analyses, pH values of all water samples in the study area are within the standard range limit of 6.5 to 8.5 as recommended by NSDWQ for drinking water. Fig. 2 shows the variability of pH among the sampled hand dug wells. According to Stumn and Morgan (1981) pH values of natural water ranged from 6.0 - 9.0. Hence the pH values of the area fall within the NSDWQ set standard for drinking water. This means that all the hand dug wells in the study area are slightly acidic, soft and mildly corrosive, which would pose health risk. A similar study carried out by Yisa (2012) in Maikunkale, Niger State also revealed pH concentration of underground water. Low pH values are found in natural waters which are rich in organic matters Wetzel (1983) and this was observed in all the HDW in all the study areas (See Table 1). According to him, presence of abundant decaying aquatic weeds cause lowering in pH values as a result of their decomposition.

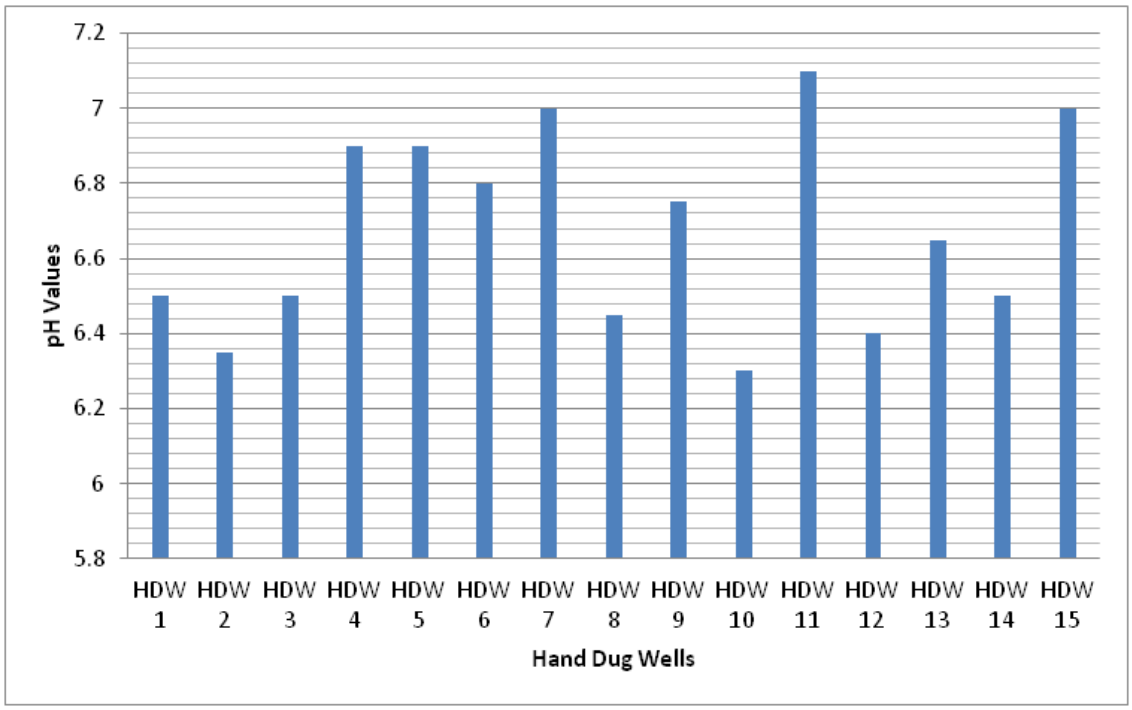

Fig. 2: pH values of the Hand Dug Wells

Electrical Conductivity (EC): In the present study, the EC of water samples ranged from 14.38 µs/cm to 1945.0 µs/cm with a mean of 769.15 µs/cm and a coefficient variation of 66.12%. Most of the hand-dug wells have EC level below the maximum limt of 1000 (µs/cm) prescribed by NSDWQ except HDW 3 with the highest value of 1943.0(µs/cm). Relative electrical conductivity concentration for individual hand dug wells sampled is indicated in Fig. 3. Elevated EC values in water could be possibly high as a result of dissolved inorganic source level and some effluents from the area believed to have been discharged directly into the wells and some via seepage. Ademoroti (1995) reported that conductivity is a function of amount of dissolved solutes. Langenegger (1994), Adekola (2007) stated that electric conductivity is not a good indicator of water quality with regard to health hazards. It is however an indicator of salinity, which is an important factor in taste and taste is an important factor in user acceptance of water points.

The effects of high EC may include disturbances of salt and water balance and high salt concentration in water and effluent samples. High salt concentration may result in adverse ecological effect on the aquatic biota (Fried, 1991). Some of the adverse effects of high salt concentration include heart problem, high blood pressure and renal disease (DWAF 1998).

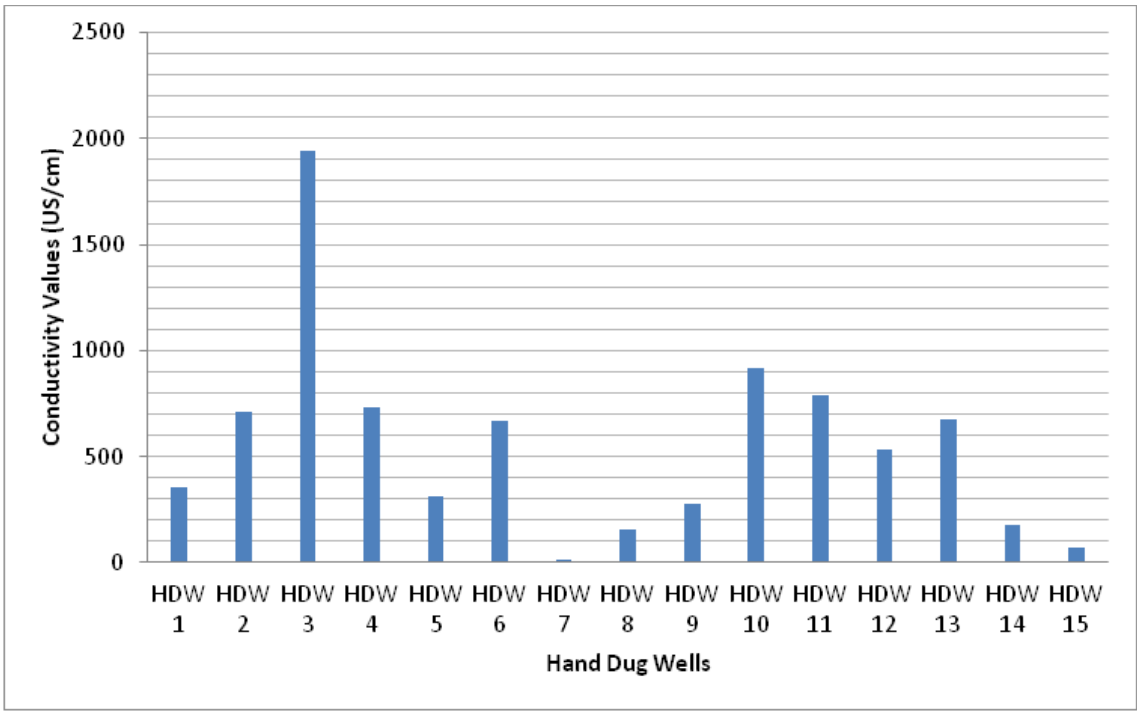

Fig. 3: Electrical Conductivity Values in Hand Dug Wells

Turbidity: From Table 1, the results of the analysis show that turbidity in water samples ranges from 2.0 – 14NTU with a mean of 5.2NTU and a coefficient variation of 64.0%. Water samples from HDW 4, HDW 5, HDW 6, HDW 10, HDW 12 and HDW 15 show turbidity concentration far exceeding the standard limit of 5NTU recommended by NSDWQ for drinking water. Turbidity concentration level for individual sample hand dug well is indicated in Fig. 4. The turbidity content may be traced to the fact that some wells are located down slope and lack adequate drainage facilities. Other wells are permanently left open, or location of wells and latrine are close together. Similarly, all hand-dug wells in the study area are operated with bucket and rope and this implies that high level of contamination during abstraction may be expected. This means water samples from all these wells are not suitable for human consumption as their turbidity values exceed the maximum allowable limit recommended by NSDWQ. This investigation is similar to the studies carried out by Sujuar (2012), Ocheje (2013), Nwakor (2013).
Excessive turbidity in drinking water, apart from being aesthetically unappealing, may also present a health threat by providing food and shelter to pathogen (Obeta et al, 2013).

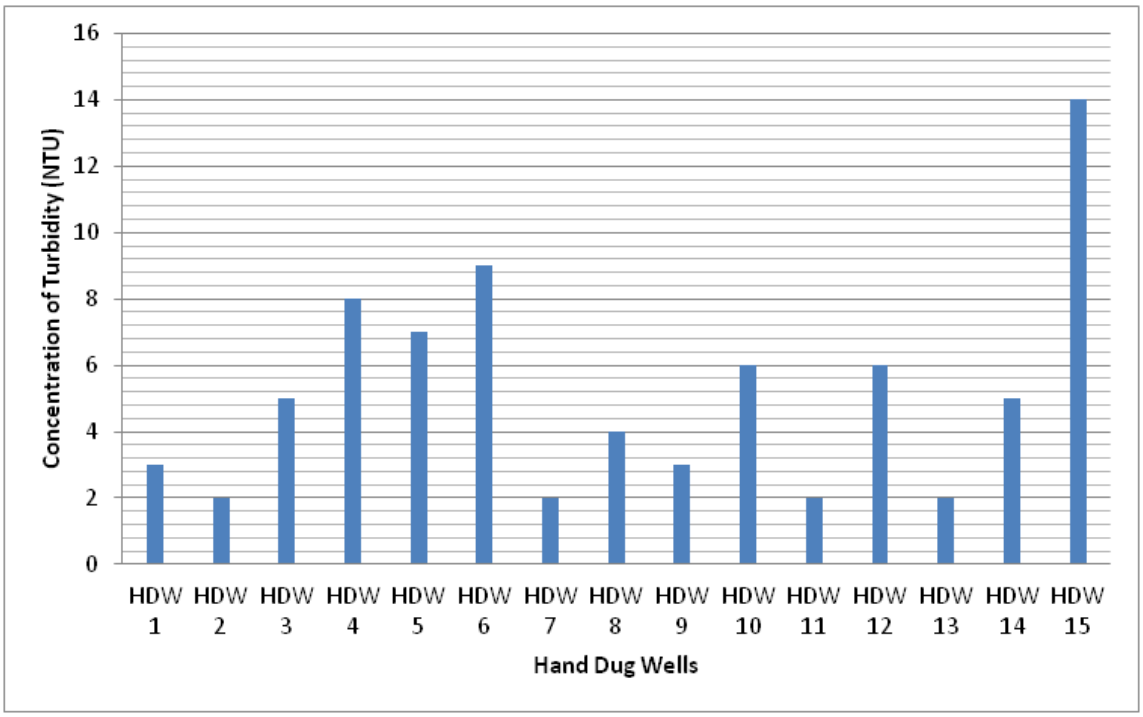

Fig. 4: The Concentration of Turbidity Values in the Hand-Dug Wells

Nitrate: Nitrate (NO_3-) content for all the water samples were below the maximum limit of 50mg/l prescribed by NSDWQ (See Table1. The water samples analyzed ranged from 0.1mg/l to 0.4 mg/l with a mean of 0.26 mg/l and coefficient variation of 27.38%. Fig. 5 shows variation in individual sample concentration of nitrate. In the analysis HDW 3, HDW 5, HDW 7, HDW 8, HDW 11, and HDW 12 had very low values of 0.2 mg/l. Conversely, highest value of 0.4 mg/l was recorded at HDW 1. This may be connected to human waste from soakaway around the HDW and agricultural field, and therefore prone to contamination by various chemicals and waste products. High nitrate content in water fouls the water system and cause methemoglobinemia disease (Adeyemo et al, 2002). This result also agrees with studies carried out by Ayeni (2010) and Nwakor (2013).

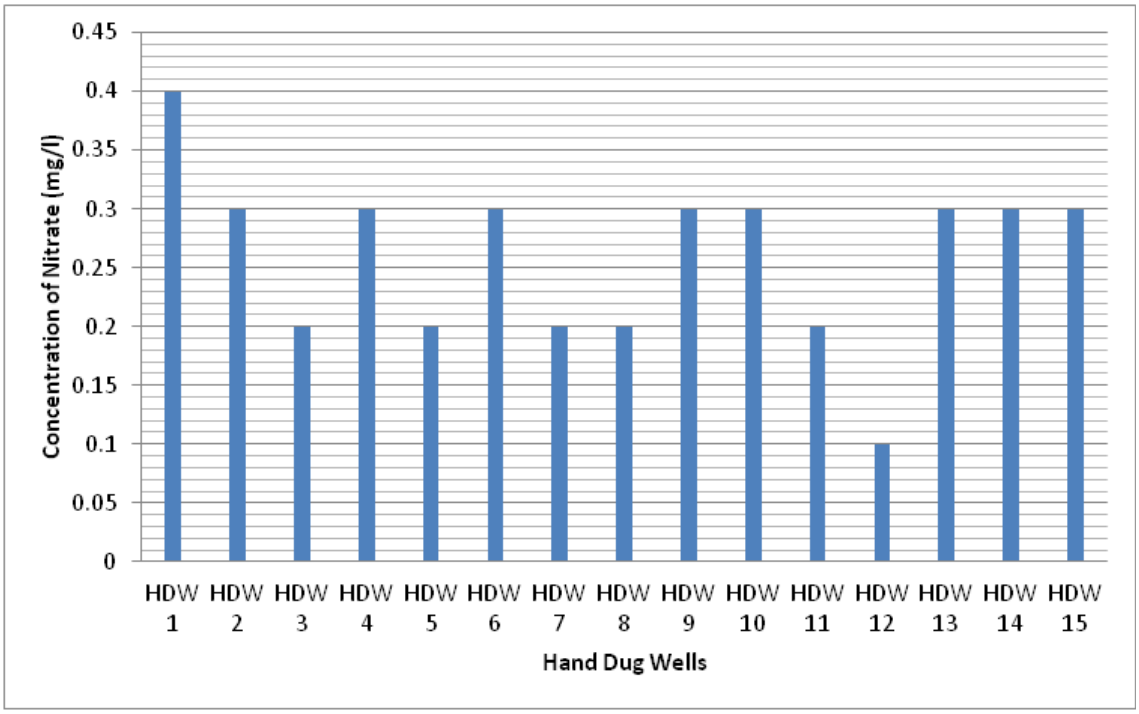

Fig. 5: Nitrate concentration in Hand Dug Wells

Iron: The results of analysis show iron concentration ranges from 0.004 mg/l to 11.144 mg/l with a mean of 2.87 mg/l and coefficience variation of 94.32% (see Table 2). The concentration of iron in HDW 9 shows value of 0.004 mg/l below the levels prescribed by NSDWQ limit of 0.3mg/l for drinking water. The highest iron concentration is recorded in HDW 15. However, all other HDW values were above the recommended limit set by NSDWQ as indicated in Table 1. High iron concentration in water can be attributed to geological composition of the area because most ground water supplies contain some iron because it is one of the most abundant metals in the earth crust. This investigation agrees with similar studies carried out by Longe (2010), Ujoh (2010) and Chiroma (2013). Excess iron in drinking water can cause damage to cells of gastrointestinal tract and may also cause damage to the cell in the heart and liver, formation of blue baby syndrome in babies and goiter in adults (Adraino, 2001; Kola and Akinbile, 2004 and Shyamala et al, 2008).

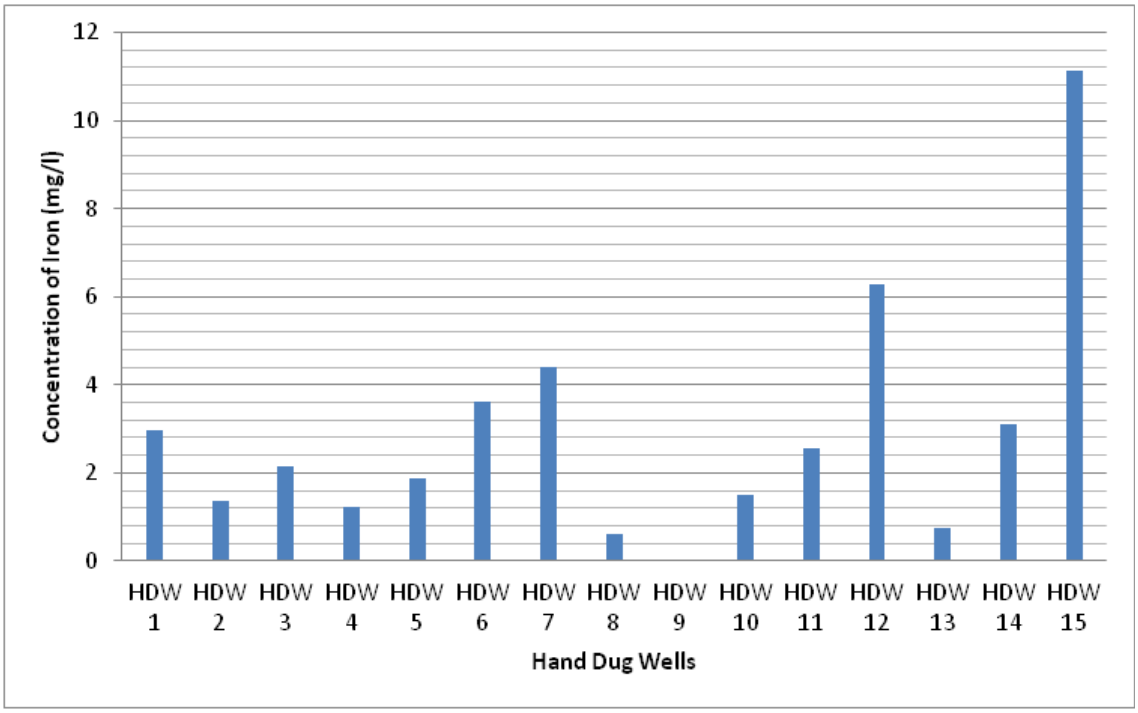

Fig. 6: Concentration of Iron in Hand Dug Wells

Zinc: Zinc concentration in all the wells tested were not detected. This implies that all the well investigated are zinc free and do not pose serious health risk, only with respect to zinc, as it mainly affects the aesthetics but can become toxic or aesthetically undesirable at high concentration (Gambarino et al 1995).

Magnesium: The magnesium content for all the water samples were above the maximum limit of 0.2mg/l prescribed by the NSDWQ. Magnesium in the investigated water samples ranged from 1.726 to 9.773 mg/l with a mean value of 6.131 mg/l and a coefficience variation of 36.03%. HDW 15 from Angwa Mile 6 had magnesium concentration very low (see table 1). This low concentration may be attributed to the dilution effect of rain water since the study was carried out in rainy season. Priscillia (2008) reported low concentration of magnesium in the ground water of Mubi, Nigeria.

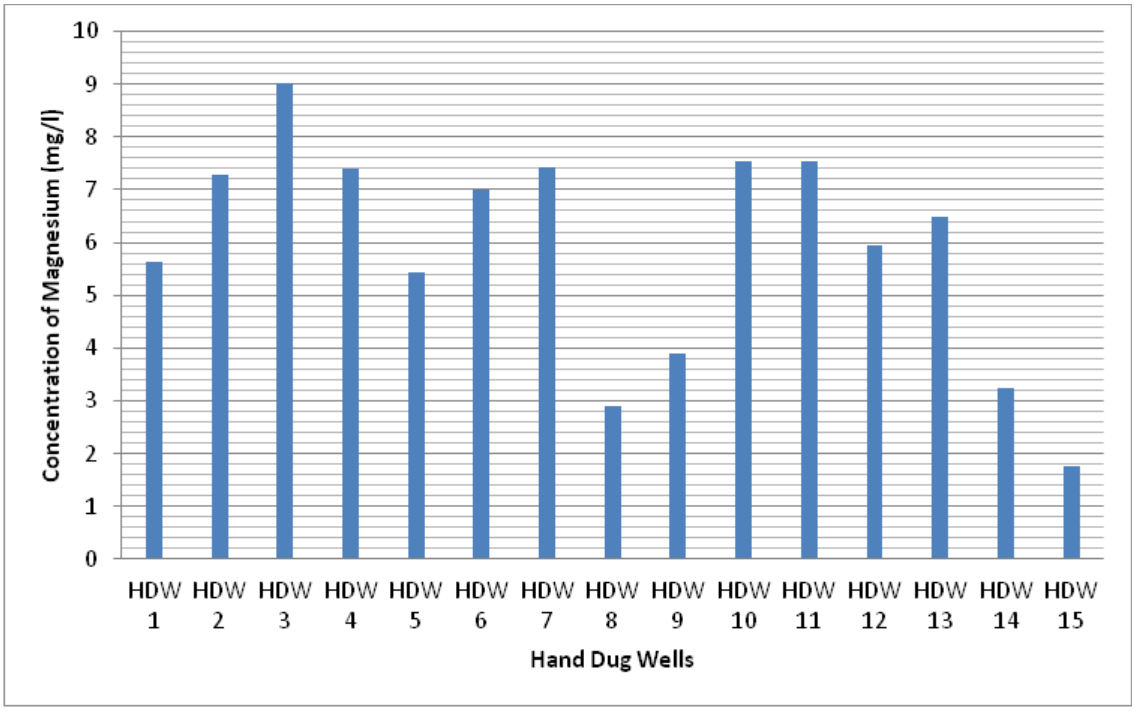

Fig. 8: Concentration of Magnesium in Hand Dug Wells

Copper: In the present study, copper is detected in the water samples collected and was very low and far below the recommended limit of 1.0mg/l set by NSDWQ (see Table 1). Copper concentration was observed to range from 0.139 mg/l to 0.596mg/l with a mean value of 0.3814mg/l and a coefficient variation of 3.140%. Copper readings were found to be lower in HDW 8 and higher in HDW 11. This phenomenon can be attributed to the geochemical environment that might have been responsible for the levels of copper detected in the water samples. Though this levels are below the NSDWQ guideline for drinking water, those who rely on the water may suffer in the long run of copper induced health effect such as headache, vomiting, diarrhea, liver and kidney failure, dizziness, intestinal discomfort and circulatory collapse (Johnson and Kays, 1993).

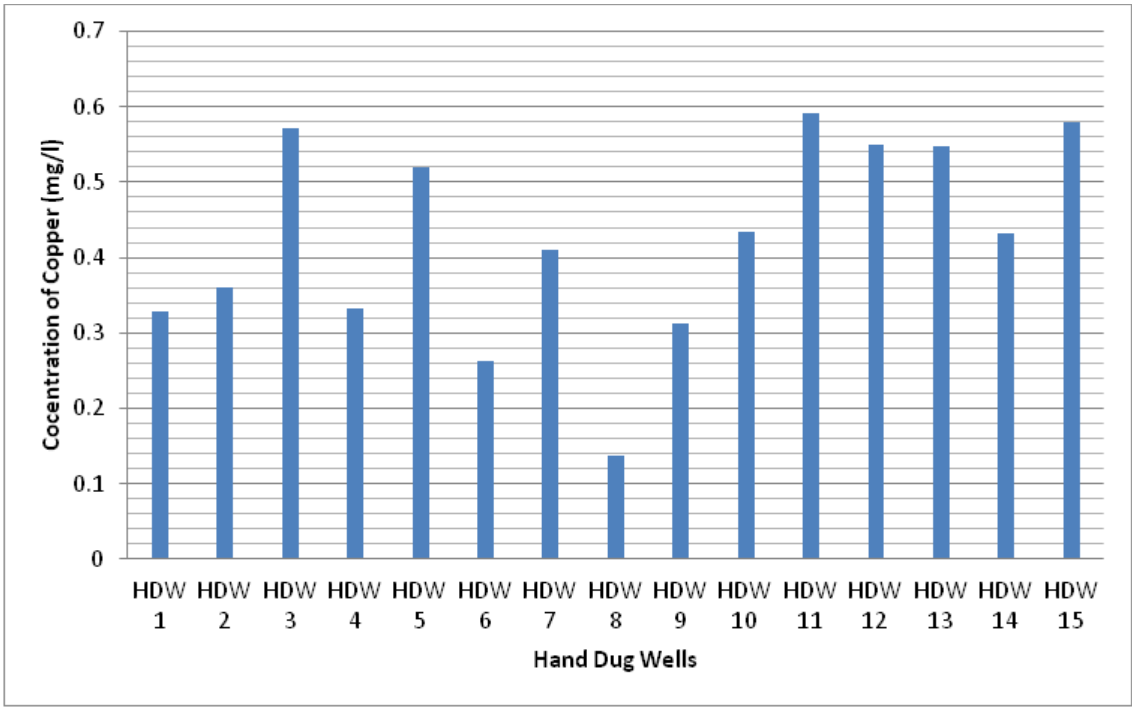

Fig. 9: Concentration of Copper in the Hand Dug Wells

Chromium: The concentration of chromium in the hand-dug wells investigated ranged from 0.064 to 0.450 mg/l with mean value of 0.084 mg/l and a coefficient variation of 151.4% chromium in HDW 1, HDW 6, HDW 7, HDW 8, HDW 9, HDW 10, HDW 12, HDW 13, HDW 14 and HDW 15 were not detected. However, HDW 2, HDW 3, HDW 4, HDW 5, and HDW 11 shows high values above 0.05 mg/l value limit as prescribed by the NSDWQ (See Table 1). The high level of chromium in the water samples could be as a result of long term anthropogenic inputs from contaminated sites, corroded utensils used for water fetching in some instances and also the geological composition of the study area. Excess chromium concentration in water is highly toxic to organisms at higher oxidation states (Eneji et al, 2012). Also, there is the risk of lung cancer from chromium concentration in water (Koller et al, 2004).

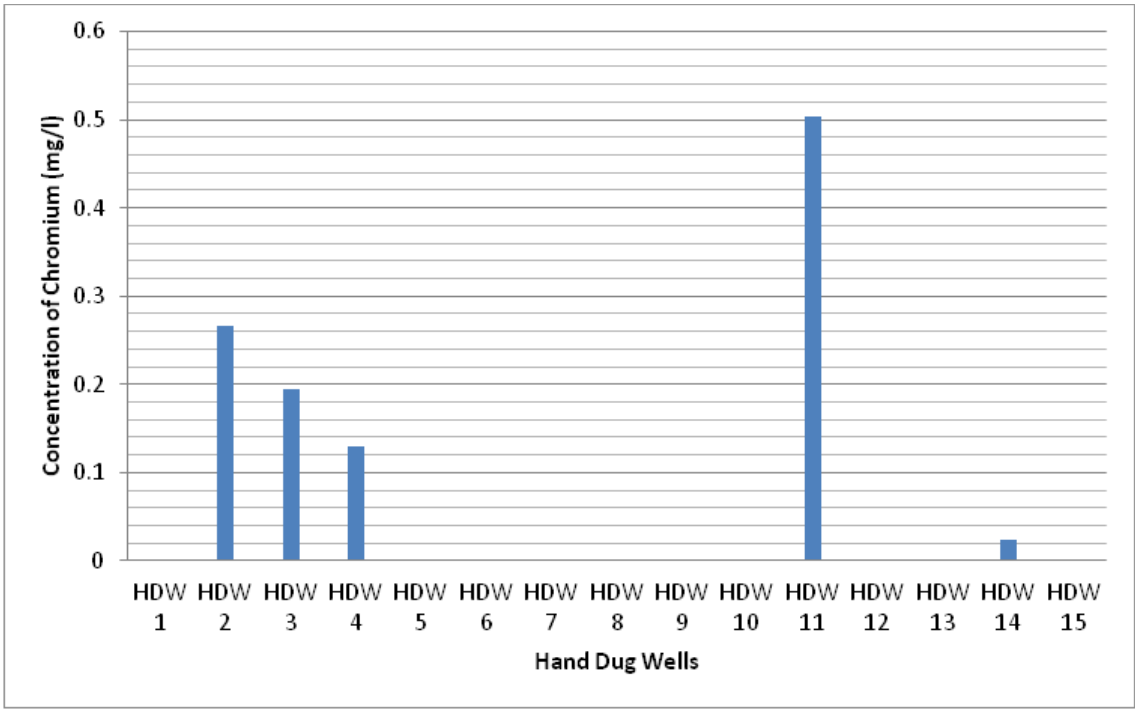

Fig. 10: Chromium concentration in Hand Dug Wells

Calcium: Calcium (Ca^{-}) for most of the water samples investigated were below the maximum limit of 50mg/l prescribed by the NSDWQ. Calcium ranged from 0.521 mg/l to 75.610 mg/l with a mean value of 24.56 mg/l and a coefficience variation of 83.53% (See Table 2). Calcium content found in the hand-dug wells in the study areas can be attributed to their relative concentration in the basement complex rock that characterize the study area. According to Picolos and Orlando (2005) calcium is found in chalk, limestone, marbles, calcite, Iceland spar and aragonite. Ujoh et al (2010) reported low calcium concentration in hand-dug well water in Masaka – Abuja.

Excessive intake of calcium in drinking water have adverse effect as it can cause hypercalcemia (elevated levels of calcium in the blood), impaired kidney function and decreased absorption of other minerals such as iron, zinc, magnesium and phosphorus (NIHCC, 2009).

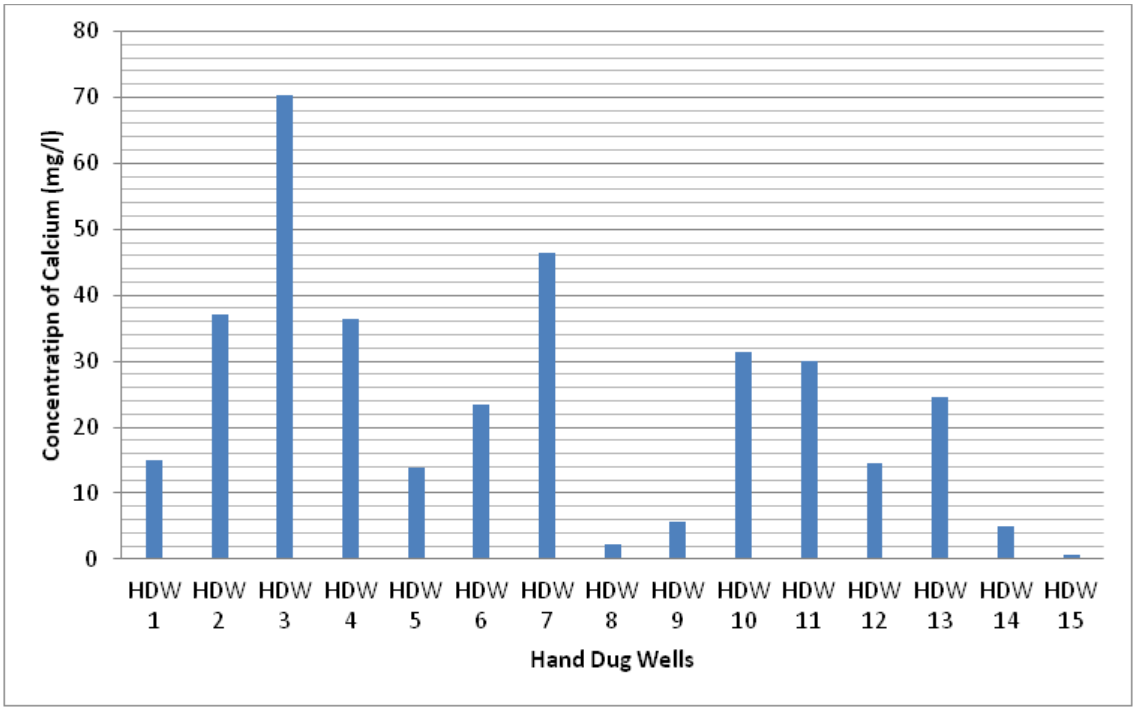

Fig. 11: Calcium concentration in Hand Dug Wells

Lead: The concentration of lead in the hand-dug wells examined ranged from 0.007mg/l to 0.240mg/l with a mean value of 0.033mg/l and a coefficience variation of 181.21%. (See Table 2). The concentration level of lead in HDW 3, HDW 4, HDW 5, HDW 6 and HDW 13 were above the recommended limit of 0.01µg/ml lead for drinking water set by NSDWQ (NSDWQ 2007).

The elevated lead level content or otherwise in the hand-dug wells in the study area may be an indication of surface pollution resulting from unguarded disposal of used lead acid batteries, alloys, soldering metals and uninformed open air incineration of waste materials at dump sites. All these activities could increase lead content of ground water resources through percolation (Oyekunle et al, 2012). Lead is toxic, even at low concentration, there is no level below exposure is harmless (Goyer 1996). Similar studies carried out by Fullmer, 1992; Boeckx, 1986; Rabinowltz, 1988 reveal that lead poisoning can cause nausea, vomiting, abdominal pain, restlessness, hyper activity, confusion and memory impairment, convulsions, coma and sudden death of both children and adult.

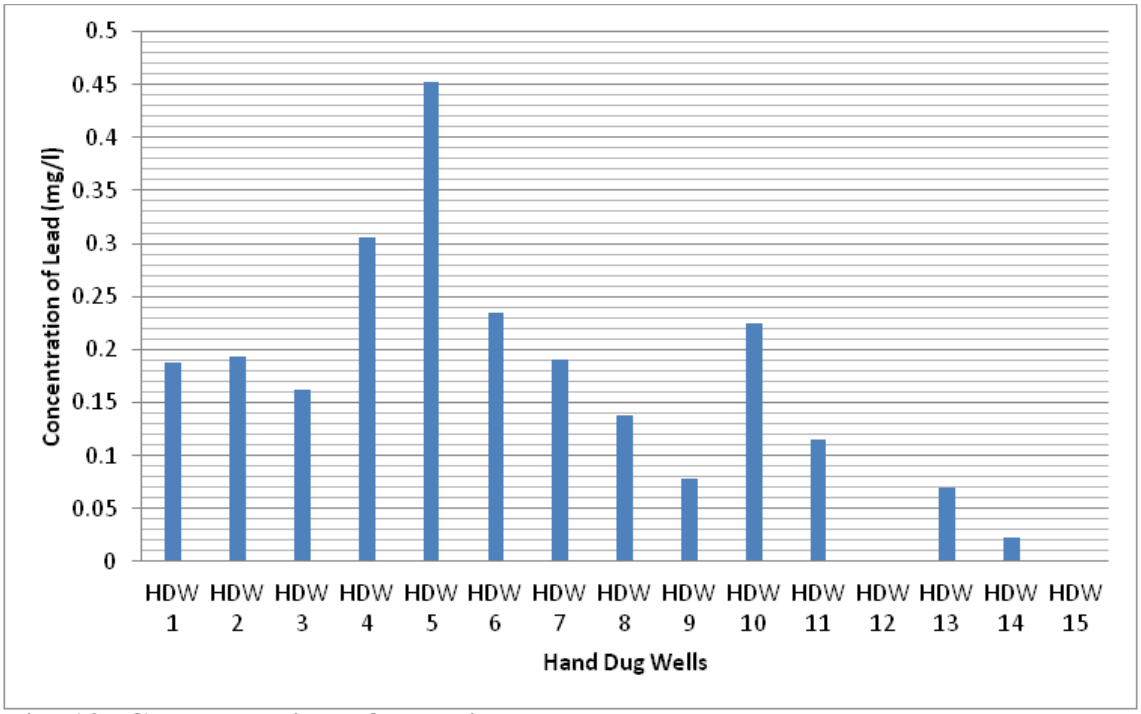

Fig. 12: Concentration of Lead in Hand Dug Wells

Total Coliform Count (TCC): The bacteriological analyses of the sample points reveal that HDW 6, HDW 7, HDW 8, HDW 9, HDW 14 and HDW 15 were detected and their values ranged from 150 to > 400 cfu/100 ml with mean total of 102 cfu/100ml and a coefficient variation of 145.95% (See Table 2). Values detected include; > 300, > 300, > 300, > 400, 180 and 150 cfu/100ml respectively. And were above the limit of 10/100mg for drinking water set by NSDWQ (2007). The rest of the hand dug wells were undetected. These situation is attributed to be a direct consequence or otherwise of close proximity of the wells to the polluting sources (pit toilet, soakaway), poor maintenance and shallow nature of the wells.

Bolaji and Martins (2008) and Onoja et al (2011) reported microbial quality of water wells with varied depth and nearly all the wells investigated were faecally contaminated. Water sources with faecal contamination can cause typhoid fever, amoebic dysentery and cholera.

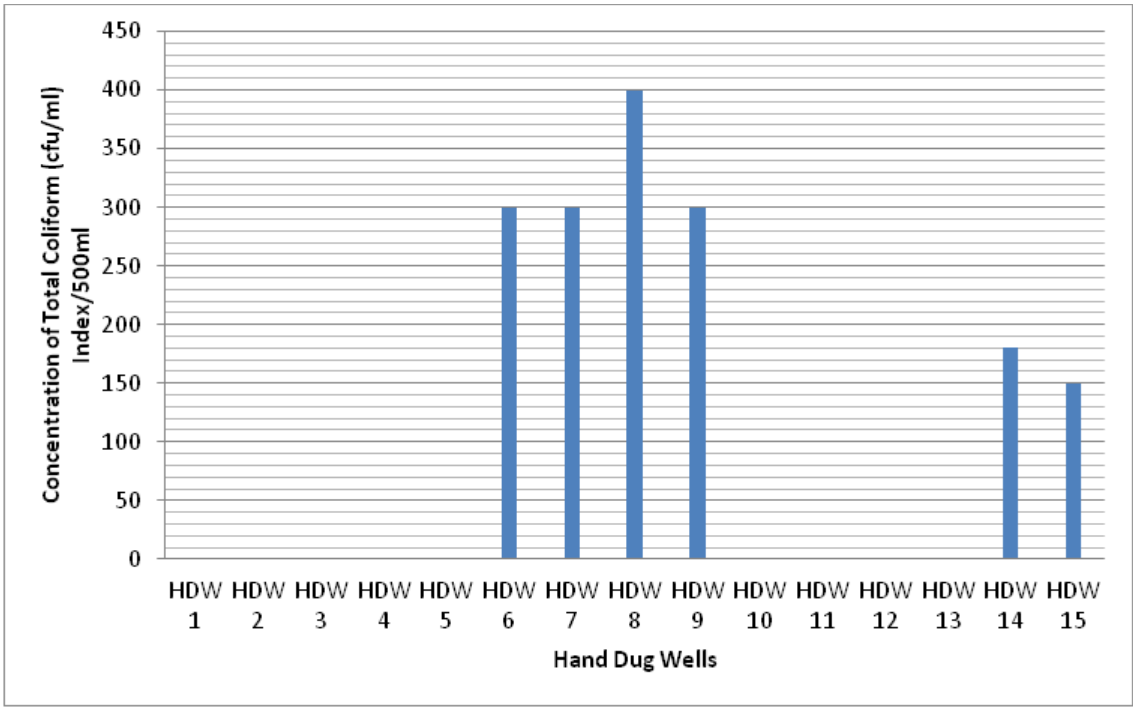

Fig. 13: Total Coliform Count in Hand Dug Wells

Colour: Colour values ranged from 2.0 to 18.0 TUC with mean value of 5.0 TUC and coefficient variation of 75.2 (See Table 2). Most of the hand dug wells indicated the level of colour concentration below the recommended 15 TUC by NSDWQ for drinking water except HDW 15 with highest value of 18.0 TUC far above NSDWQ standard. This could be attributed to the local conditions around the well. For instance, the well is a public well and is open, no concrete lining and rope and bucket are being used for collection of water from the wells. These factors could be responsible for affecting the clarity of the water and consumers' acceptability.

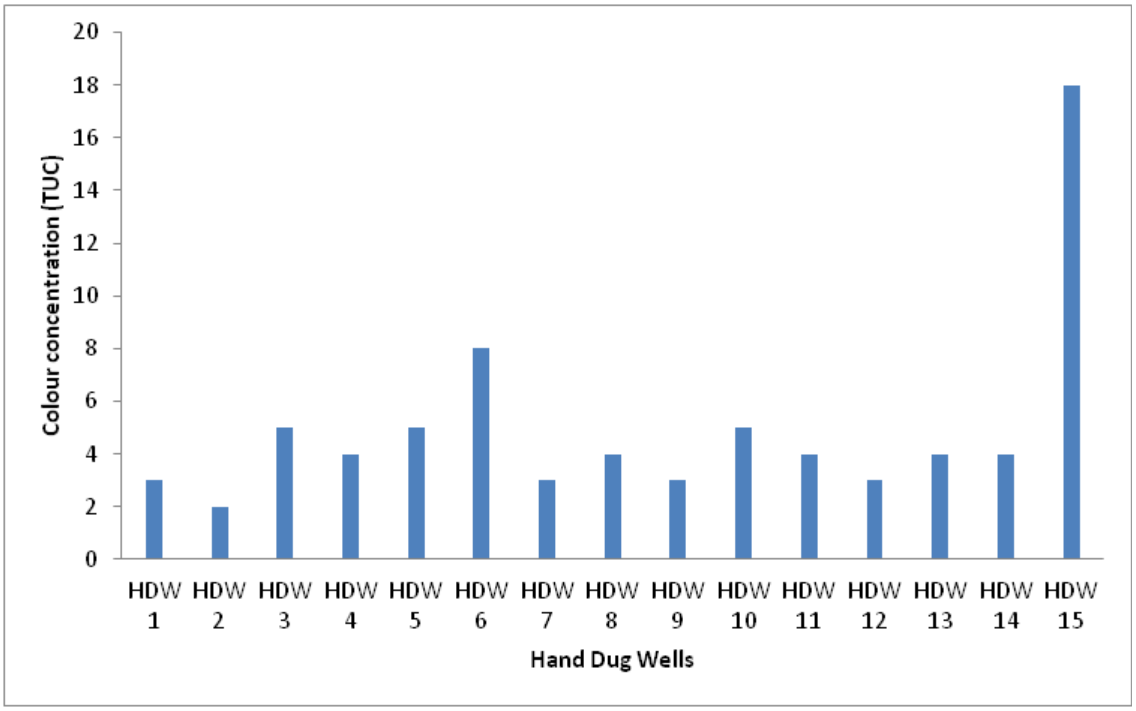

Fig. 14: Colour of water in Hand Dug Wells

Conclusion and Recommendation

The results of the present study revealed that most of the parameters returned values fall within the acceptable limits set by Nigerian Standard for Drinking Water Quality (NSDWQ), while in some water samples iron, temperature, magnesium, chromium, lead and total coliform count, returned values which exceeded the stipulated limits by NSDWQ for drinking water (NSDWQ, 2007). Based on the analysis, these results are worrisome as their implication for human health could be devastating. It is therefore recommended that people residing within the study area be educated with respect to the danger associated with drinking water from such polluted hand-dug wells, standards for location; construction and operation of Hand dug well be maintained by the Taraba State Environmental Protection Agency, simple methods of treatment like boiling, sieving, addition of adequate dosage of alum water guards and disinfection with chlorine be employed to reduce the risk of water related diseases; public awareness on the importance of basic hygiene and efficient waste disposal methods should be constantly carried out to boost the role of

general public in curtailing anthropogenic activities that degrade groundwater quality. Finally, the Federal and State government should construct and develop good boreholes for the people in the study area.

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Effect of water fetching among school children in Makurdi town

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Abstract

Water fetching for household use ought not be a labourious, energy sapping, time consuming and health implicating were it readily available and accessible. Water scarcity with all its attendant hardships is a common scenario in most urban areas of Nigeria. Water fetching is generally viewed as a domestic duty of women and children. However, children seem to bear the brunt of water fetching. A total of 220 primary school children in Makurdi town were randomly selected for this study. The analysis was done using principal component analytical (PCA) technique. The PCA results of analyses reveal the following effects water fetching has on school children in Makurdi urban: academic performance, time, leisure and recreation, health and physical well being. It is recommended that parents and guardians should take into cognizance the effects water fetching has on children's academic performance and health and relief them

Key words: Water fetching, school, children, women, domestic.

Introduction

Water is essential for both life and livelihood. Not only is it required for consumption by humans and animals alike, bringing along essential micro-nutrients such as iron and fluoride, it is required for personal hygienic needs as washing, bathing, laundering, dish washing, sewage and sewerage and general cleaning(Faniran,1991;UNEP, UNICEF and WHO,2002).Even though, water plays an essential role in organisms physiological functioning and general life sustainence, its availabity and accessibility is often a problem in most urban areas of developing countries of the world.

In Nigeria,water scarcity with all its attendant problems is a common sight in most urban areas(Akintola and Areola, 1990, Ocheri,2006). Public water supply is generally inefficient. Water hardly runs in the tap and even when they do, the supply is highly irregular or intermittent. Besides, a greater proportion of urban population does not have access to public supply. Consequently, the urban inhabitants have to depend heavily on unsafe supplementary sources of water supplies from rivers, streams, hand dug wells, boreholes and water vendors. A sizeable proportion of family time, leisure and income is expended in search of water for household use. Abrams (2000) painted a grim picture of the situation by

asserting that, providing water for daily needs is a burden on households in a number of ways in addition to direct health threats. Often water is carried long distances to the house, which takes time and effort, a burden borne mainly by women and children. In urban fringe areas water is often available from water vendors at a price, which is several times more expensive than the water provided through formal and of a poor quality.

This paper examines the effect water fetching has on primary school children in Makurdi urban. Several studies on Makurdi urban water supply have concentrated on households water demands and consumption pattarns, spatially variations, water vending (Ocheri,2006;Ogbaje,2008).Others focused on quality of water from both surface and groundwater sources with all their health implications (Mile,2005,Ameh,2005; Damian,2008, Edwin,2009;Ocheri, Mile and Obeta,2010;Chagu,2010). None of these studies have examined the effect water fetching has on children who are main drawers of water for family. This study therefore is a contribution in this direction. A common sight frequently encountered during dry season is children are found washing; bathing and carrying water from river Benue to their homes, fetching water from neighbours hand dug wells and boreholes, collecting water from broken pipes in the streets. This situation apparently lends itself for investigation as to the implication this will have especially on the school children.

The Study Area

This study area is Makurdi , the capital city of Benue State. It lies between Lat.7^0 44^N and Long.8^0 54^N and is drained principally by river Benue which divide the area into Makurdi South and Makurdi North (Fig. 1). River Benue constitutes the major source of water supply to the inhabitants and for the pubic water supply. Temperatures are generally high throughout the year due to constancy of insolation with the maximum of 32^oC and mean minimum of 26^o C. The hottest months are March and April resulting into drying up greater proportion of water from River Benue causing a lot of water scarcity. Rainfall distribution is controlled by the annual movement and prevalence of Inter-Tropical Discontinuity(ITD).The mean monthly relative humidity varies from 43% in January to 81% in July-August period (Tyubee, 2009).The geology is of cretaceous sediments of fluvio-deltaic origin with well –bedded sandstones of hydrogeological significance in terms of groundwater yield and exploitation(Kogbe et al,1978).Makurdi town which started as a small river port in 1920 has grown to a population of 297,393

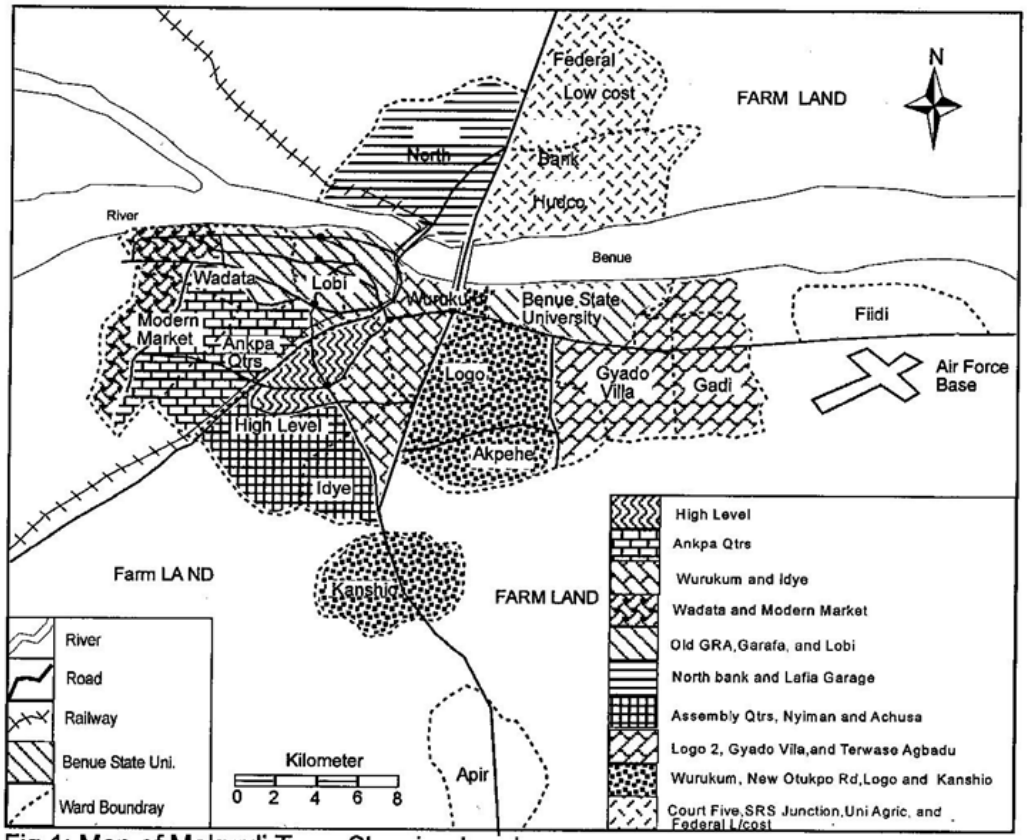

Fig 1: Map of Makurdi Town Showing Land use .
Source: Ministry of Lands and Survey Makurdi.

Materials and Methods

Data for this study were obtained mainly from primary sources. Questionnaires and personal observation were main instruments with which the data were collected. Questionnaires were designed and administered the primary school children in Makurdi. Primary school teacher assisted the children in completing the questionnaires. A total of 220 primary school children in Makurdi urban were randomly selected. Data were collected on: age of the school children, occupation of the parents/guardian, sources of water supply to the family, distance covered to fetch water daily; number of times a child engages in water fetching in a day; time spent to collect water, type of container used in water fetching; means of carrying water; lateness to school due to water fetching; study time taken over by water fetching; and poor performance in the school as result of water fetching. Data collected were subjected to statistical treatment using principal component analytical(PCA) technique.

Results and Discussion

Variable considered having significant effects of water fetching among school children in Makurdi are as follows.

Variable	Description
X1	Age of the school children
X2	Occupation of the parents/guardian
X3	Main source of water to the family
X4	Distance covered to fetch water
X5	Time of the day a child engages in water fetching
X6	Number of times a child fetches water in a day
X7	Time spent averagely to fetch water in a day
X8	Type of container used in water fetching
X9	Means of how water is carried
X10	Difficulty encountered in carrying the container used in water fetching
X11	health problems suffered as result of water fetching
X12	Lateness to school as result of water fetching
X13	Time taken for personal study and assignment through water fetching
X14	Poor performance due to water fetching

To analyse the strength of contributions of the variables to the phenomenon under investigation, principal component analysis was employed. This technique is a veritable tool used to condense whole information into a manageable number of variables without losing any vital information about the variation in the original set of data. The technique is further strengthened by varimax rotation, enabling determination of distinctive loading of the variables so that each variable has the highest load on and only one component. Explanations are given with the reference to the structure of the variable loadings on the joint contributions to the variance of loading pattern. Significant loadings are considered from the threshold on + 0.50 which is statistically significant at 95% confidence level(Johson,1991).The component loading of variable is shown in Table 1.

TABLE 1: Varimax Rotated Component Matrix

Variables	Component					
	I	II	III	IV	V	VI
X1	0.150	0.155	0.104	0.691*	0.12	0.370
X2	0.097	0.503*	0.207	0.473	0.128	0.289
X3	0.217	0.138	0.333	0.621*	0.105	0.155
X4	0.192	0.222	0.460	0.386	0.492	0.237
X5	0.113	0.205	0.600*	0.259	0.321	0.065
X6	0.315	0.094	0.175	0.063	0.648*	0.074
X7	0.191	0.275	0.069	0.145	0.561*	0.113
X8	0.357	0.511*	0.111	0.375	0.360	0.470
X9	0.095	0.792*	0.087	0.399	0.264	0.131
X10	0.360	0.073	0.774*	0.674	0.386	0.219
X11	0.059	0.096	0.282	0.156	0.200	0.838*
X12	0.490	0.316	0.329	0.437	0.063	0.193
X13	0.842*	0.110	0.259	0.0.163	0.086	0.281
X14	0.864*	0.460	0.057	0.109	0.106	0.152
Eigen value	12.9	9.8	9.4	9.2	8.9	7.9
% Variance	12.9	22.8	32.2	41.5	50.5	58.4

Significant loading 0.50 are starred.

From Table 1, component I has an eigen value of 12.9 and accounts for 12.9% of the total variance. The component comprises number of factors that are highly correlated. These variables are: X14 (poor performance due to water fetching) with strongest positive loading of (0.86) followed by X13 (time for personal study and assignment taken over by water fetching(0.84). This component may be described as effect water fetching on child performance in the school.

Component II has an eigen value of 9.8% and accounts for 22.8% of the total variance. The variables are:X9(means of water carriage (0.79), X8 (type of container used in water fetching)(0.51),X2(occupation of the parents/guardian)(0.50). This component is described as means of transporting water to the house.
The variables with significant positive loadings in component III are:X10 (difficulty encounter in the container used in fetching water) (0.77), X5 (time of the day a child engages in water fetching) 90.06).This component is described as the size of the container used in water fetching by the child. This component has an eigen value of 9.4% and accounts for 32.2% of the total variance.

Component IV has eigen value of 9.2% and accounts for 41.5% of the total variance. The variables area: X1 (age of the school child)(0.69),X3(source of water supply to family) (0.62). This component is described as over laboring a child.
Component V has eigen value of 8.9% and accounts for 50.5% of the total variance. Variables are:X11(number of times a child engages in water fetching in a day)(0.64)X7(time spent daily to fetch water)(0.56).This component is described as priority of water fetching over child,s school time
Component VI has eigen value of 7.9 and accounts for 58.4% of the total variance. The variables is X11(health problems suffered as result of water fetching) has a strong positive loading of 0.83.It is the only variable in the component with significant contribution to the explained variance in water fetching. This variable is described as effect of water fetching on child health.

From the component analysis factors identified to be the effects of water fetching on school children in Makurdi urban are follows:
Academic performance: The analyses showed that school children experience poor academic performance which is linked to water fetching. This is because the time they could have devoted to personal study and doing assignment given from school is used in search for and getting water for family use. We cannot underrate the importance of personal study and assignment to the child's general performance at school.

Means of water carriage: Water is mostly fetched is carried mostly on the head and a times in wheel barrows. This can have implication on the child, s health if this overpowers his strength. Once this occur he may suffer some health problems which will go along way to affect his attendance in school.

Lack of consideration for the child's ability and convinence: When a child uses water container that is beyond his ability coupled with water fetching at time when ne/she needed rest his academic and health may likely suffer. Responents constituting 95% of the school children indicated that they have difficulty in carrying the container used in fetching water to the family.

Child's labour: when a child engages in a task beyond what appropriate for his age it amount to child labour. Our investigation reveals that parents/guardian send their children to far distant water sources to fetch water for use without minding their age.
Time: Achievement is a function of time utilization. When time scheduled for a particular task is used for or overtaken by other events the implication is always there.
Frequency of water fetching
to the family was identified affecting the school children negatively. The study has shown that children fetch water to family up to three to four times in a day coupled with other domestic duties which has implication both on their health and academics.

Child's health: Respondents up to 75% of the children indicated that water fetching has caused them series of health problem ranging from fatigue, headache, chest pain and to generally body weakness. This has led to some of them missing school days. This was noted mostly among respondent from North bank and Ankpa ward which are among the areas worst hit by water scarcity in Makurdi.

Conclusion

The study has evidently shown the effects of water fetching on school children in Makurdi town.Water fetching has caused school children poor academic performances, health related problems, time /leisure and recreation. Parents/guardian were noted to undermine the effects of water fetching on the childs general well being. Children have a lot of potential which can be harnessed for all round development parent should create an enabling environment to realize these potentials.

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