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CONTENTS

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ASSESSMENT OF CHANGES IN SOIL PROPERTIES UNDER DIFFERENT LANDUSES IN PART OF BIU PLATEAU, BORNO, NIGERIA

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Abstract

There is a growing concern on the diminishing quality of soil resources occasioned by changes in land use which has resulted in loss of vegetation cover, changes in fertility status of soil, disturbance of soil structure, soil erosion and reduction in productive potential of the soils. This study assesses changes in selected soil physicochemical parameters under different land uses. Soil samples were drawn from four land use categories viz, cultivated land, scrubland, forested land and bare surface across five settlements in the study area. For each land use category at the study sites, surface soil samples were augered at 0-15 cm depth. A total of 20 composite samples were collected from 80 plots within the four land use categories in the study settlements and from which one kilogram (1kg) each was taken to the laboratory for analysis. The results showed that soil organic matter and soil texture were significantly affected by land use change ($P< 0.05$) and soil organic matter declined following deforestation and continuous cultivation with a mean of 2.03 g/kg^{-1} recorded for forest land and 1.41 g/kg^{-1} for cultivated land while scrubland and bare surface recorded 1.34 g/kg^{-1} and 1.25 g/kg^{-1} respectively. The soil texture was generally sandy clay. In contrast, pH, soil moisture content, cation exchange capacity, bulk density and porosity were not significantly ($P > 0.05$) different, although comparisons between cultivated land, forest land, scrubland and bare surface revealed some degree of difference for the physicochemical parameters. Soil pH is slightly acidic (6.68-6.33), relatively high bulk density (1.49 g/cm^3-1.44 g/cm^3), and medium to low mean porosity values (42-44%). The mean moisture content is highest in cultivated land (23.76%) and lowest in bare surface (15.38%). CEC values for cultivated and bare surface are low (10.47cmol/kg^{-1}) and (8.79 cmol/kg^{-1}) respectively. Findings from this study showed that the soils are acidic with generally low organic matter content and low porosity with high bulk density over cultivated, scrubland, and forest land use respectively. Recommendations made based on the findings include integrated use of inorganic and organic fertilizers and application of liming and soil conservation practice amongst others.

Keywords: Land use, Soil properties, Soil quality, Soil fertility, Soil management

Introduction

Soil properties are influenced by vegetation characteristics under which the soils are located (Senjobi and Ogunkunle, 2011). Soil management approaches involving biomass burning, soil tillage, mulching and application of fertilizer among other cropping systems play vital role in the degree of changes in soil properties. The conversion of natural vegetation to farmland and grazing reserves triggers the processes of soil degradation which hampers soil quality (Materechera and Mkhabela, 2001; Jaiyeoba, 2003; Yang et al., 2004; Liu et al., 2010; Kilic *et al.,* 2012). Frequent cropping has been observed to cause decline in soil fertility by reducing organic and inorganic colloidal materials and reduction in soil microbial activities (Celik, 2005). Landuse/ landcover change (LULC) is used to explain the modification of earth's terrestrial surface. Though man has been modifying the land through agricultural practice to produce food and other livelihood support activities, the current rates, extents and intensities of landuse/ landcover changes is far greater than ever in history, driving unprecedented changes in ecosystems and environmental processes at local, regional and global scales (Erle, 2007).

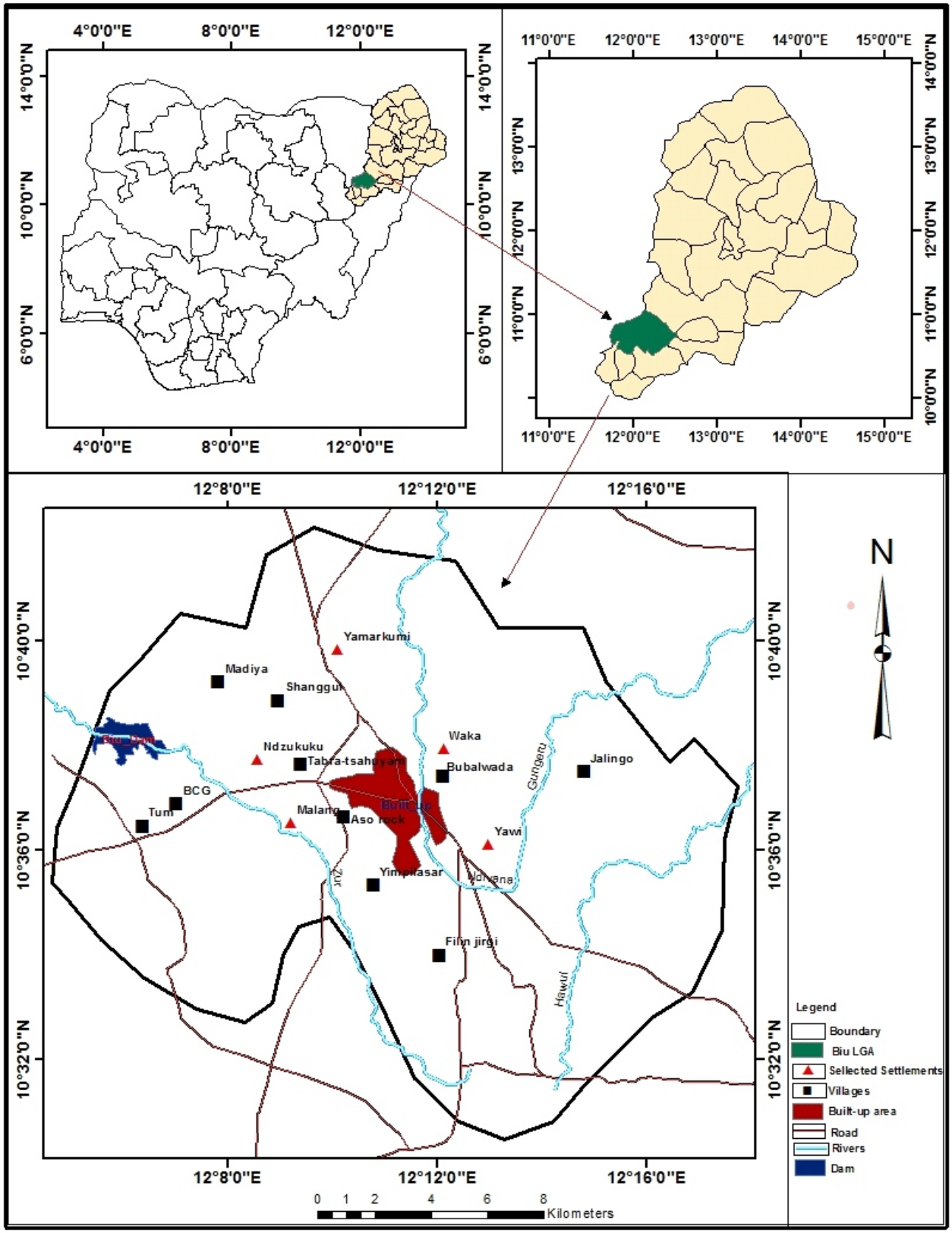

Fig. 1: Location of the Study Area

Changes in land cover due to agricultural intensification result in loss of soil productive capacity in many parts of the arid and semi-arid areas (Zewdie, 2001). Studies have shown that land use changes affect the physical and chemical properties of the soil thereby leading to soil degradation (Kilic et al, 2012; Aminu and Jaiyeoba, 2015). However, the rate and extent of changes in soil properties through human intervention is location specific given that soils of different localities that experienced similar pedogenic processes can be differentially affected depending on the intensity of landuse practices. Therefore, the objective of this study is to assess the conditions of soil physical and chemical properties under different land uses and their implications on soil fertility in the study area.

Materials and Methods

Description of the study area

Biu plateau is located in the southern part of Borno State on latitude 10°30□0□□N-10°40□11□□N and longitude 12°4□0□□E-12°20□0□□E. The entire Biu area covering the plateau has a land area of 2,492.4km^2 with an average elevation of over 626 m above sea level (Fig. 1). The climate over the plateau is described as tropical continental climate. Temperature is high all year round with a mean annual air temperature of 30°c. The highest temperatures are recorded during the dry heat wave months of between March and May with maximum air temperature of above 37°c. During the rainy season, the temperature drops considerably due to dense cloud cover between July and August as well as during the harmattan period of November to February. Rainfall is strongly seasonal due to the oscillation of the inter-tropical convergence zone (ITCZ) which controls the Tropical Maritime and the Tropical Continental air masses of contrasting air moisture and relative humidity over the study area. The mean annual rainfall total ranges from 835 mm to 982 mm and the geology of the Plateau is mainly fine grain basaltic materials of tertiary and quaternary age. Extension of the geology is also the weathered basement complex of granites, gneiss and lenses of schist, shale among others. The plateau is drained by River Hawul which flows southward and discharges into the Gongola River. Soils derived from weathered basement complex vary from clayey loamy soil, sandy soil to silt. The soils are reddish brown and experiences fertility decline under continuous cropping. Vegetation of the study area falls within the Sudan Savannah characterized by short grasses and scattered short deciduous trees. Commonest trees found in the area include neem, acacia, shea-butter, locust bean, tamarind, baobab, gum arabic among others. The vegetation has been altered by human activities of deforestation resulting from logging, construction, grazing, bush burning and continuous cropping (Daura, 2001).

Landuse and landcover classification scheme

Land use/ land cover categories of built-up area, water bodies, cultivated land, bare surface, forest area and scrubland were identified and classified in the five study settlements of Malang, Ndzukuku, Waka, Yamarkumi and Yawi each located 15km from Biu central business district. From the classified landuse/landcover, only four categories appropriate for the study (cultivated land, scrubland, forest area and bare surface) were selected. The classification scheme for the landuse/ landcover category is presented in Table 1.

Table1: Land Use/Land Cover Classification Scheme Adopted for the Study

S/N	Landuse/Landcover classes	Description
1	Cultivated Land	All agricultural land uses such as farm lands under cultivation.
2	Bare surface	Degraded lands, bare land left to fallow, areas with scanty or no vegetation cover. Expose and open grounds that are neither vegetated nor built-up.
3	Forest Area	Areas of wooded savannah vegetation, reserves and plantation.
4	Scrubland	Areas covered b y grasses, herbaceous and shrubby plants of low height trees usually less than 2 metres tall used for animal grazing and livestock farming.

Source: Adapted from Anderson et al, 1976

Method of soil sample collection, preparation and analysis

Soil samples collected for this study were drawn from four land use categories from the settlements of Malang, Ndzukuku, Waka, Yamarkumi and Yawi. For each land use category at the study sites, surface soil samples were augered at 0-15 cm depth. For each land use category at the study sites, surface soil samples were augered at 0-15 cm depth. Soil sample was collected at four different plots per landuse and at 20 cm apart to form a composite sample. A total of 20 composite samples were collected from 80 plots within the four land use categories in the study settlements and from which one kilogram (1kg) each was taken to the laboratory for analysis. The collected soil samples were air dried, crushed and passed through 2 mm mesh sieve size to remove stones and other organic residues before laboratory analysis.

Analyzed soil properties include particle size distribution (texture), bulk density, porosity, moisture content, soil pH, cation exchange capacity (CEC) and soil organic matter (SOM). Soil particle size distribution (texture) was determined by the Bouyoucos hydrometer method (Bouyoucos, 1962) and sodium hexametaphosphate was used as a dispersing agent. Bulk density was determined from undisturbed soil samples using the core sampling method after drying a defined volume of soil in an oven at 105°C for 24 hours (Blake, 1965). It was calculated as the ratio of the mass of oven dried soil to the volume of the sampling core. Porosity was calculated from the values of bulk density (BD) and particle density (PD) (Brady and Weil, 2002) as:

$$\text{Total porosity (\%)} = (1 - \frac{BD}{PD})X100$$

Soil moisture content was determined using the gravimetric method. It was calculated as soil field weight minus oven dried soil weight divided by the dry soil weight. Soil pH was measured potentiometrically using a digital pH-meter in the supernatant suspension of 1:2.5 soil to water ratio (Agbenin, 1995). The soil organic carbon (OC) was measured by wet digestion method (Nelson and Sommer, 1982). Values of soil organic carbon was multiply by a factor of 1.72 to obtain soil organic matter while cation exchange capacity (CEC) was determined by using ammonium acetate saturation method (Agbenin, 1995).

Statistical analysis

Mean, standard deviation, coefficient of variation and one-way analysis of variance (ANOVA) at $p< 0.05$ significant level was used to test the interaction of land use types on changes in soil properties.

RESULTS AND DISCUSSION

The result of the variation of soil properties under different land uses is presented in Table 2. The selected soil properties show variation among the different land uses under study with the soil pH sensitive to soil management practice resulting from human activity and changes in the natural environment. The mean pH value under the different land uses is acidic. The mean pH value for cultivated land, Scrubland, forest and bare surface are 6.33, 6.53, 6.35 and 6.68 respectively. The analysis of variance shows that the changes in pH values over the different land uses are not statistically significant. The lower pH value recorded over cultivated land is attributed to changes in land use from forest to cultivated land. Studies have shown that slightly acid nature of the soil can be attributed to the leaching of some basic cations especially calcium from the surface horizons of the soils, continuous removal of basic cations by high yielding crop varieties, use of inorganic N and P fertilizers and intensive cultivation (Wakene and Heluf, 2003; Iwara et al; 2011).

Changes in land use from forested area to cultivated field and open grazing lands usually results in reduction of both the concentration and stock of soil organic matter (SOM). Soil organic matter varied significantly under soils of different land uses ($p<0.05$). The mean soil organic matter content was highest on soils under forest land (2.03 g/kg-^{1}) and lowest (1.25 g/kg-^{1}) on bare surface with cultivated land and scrubland recording (1.41 g/kg-^{1}) and (1.34 g/kg-^{1}) respectively. The decline in soil organic matter content in the cultivated land can be attributed to deforestation and removal of crop residue after harvesting to feed livestock.

Table 2: Variation of Soil Properties Under Different Land Uses

Land uses	pH (1:2.5)	SOM (g/kg^{-1})	MC (%)	CEC (cmol/kg)	Sand (%)	Silt (%)	Clay (%)	BD (g/cm^3)	Porosity (%)
Cultivated Land									
Mean	6.33	1.41	23.76	10.47	59.80	12.60	27.60	1.49	43.00
SD	0.15	0.29	6.22	1.32	24.44	10.03	16.67	0.00	1.55
CV%	2.37	20.57	26.18	12.61	40.87	76.60	60.40	0.00	3.60
Scrubland									
Mean	6.53	1.34	18.97	10.97	62.80	16.00	21.20	1.46	44.00
SD	0.26	0.19	6.53	4.56	10.38	11.01	9.85	0.06	3.03
CV%	3.98	14.18	34.42	41.57	16.53	68.81	46.46	4.11	6.89
Forest									
Mean	6.35	2.03	22.33	10.66	65.56	13.24	21.60	1.46	42.20
SD	0.28	1.19	8.81	0.60	26.20	12.55	13.66	0.12	0.40
CV%	4.14	58.62	39.45	5.62	39.96	94.79	63.24	8.22	0.95
Bare surface									
Mean	6.68	1.25	15.38	8.79	58.56	16.60	27.00	1.44	42.40
SD	0.06	0.56	4.53	1.46	26.19	14.12	14.68	0.12	1.69
CV%	0.90	44.80	29.45	16.61	44.72	85.06	54.37	8.33	3.99
ANOVA	4.20^{ns}	5.04^{*}	1.11^{ns}	0.78^{ns}	0.16^{*}	0.38^{*}	1.81^{*}	0.31^{ns}	0.53^{ns}

** Statistically significant at $p < 0.05$; ns not significant*
Source: Laboratory analysis, 2018

The reductions on the bare surface and scrubland is a reflection of diminishing vegetal cover as a result of urbanization, extension of paved urban surfaces and the increasing rates of animal grazing. The result of this study is in agreement with the findings of Lobe et al, (2001); Jaiyeoba, (2003); Aminu and Jaiyeoba, (2015) who reported that soil organic matter content decreases in soils under continuous cultivation and pasture with the top soil containing less organic matter compare to forest land due to forest clearance and rapid oxidative decomposition resulting from high temperatures.

Soil moisture content shows slight variation in the mean values of cultivated land (23.76%) and forest land (22.33%). On the other hand scrubland and bare surface recorded a mean value of 18.97% and 15.38% respectively. The coefficient of variation for soil moisture content is high over the forest (39.45%) and lowest over the grazing land (22.98%). Result of analysis of variance shows no significant difference in soil moisture over the different land uses at 0.05 significant levels. The observed difference in the moisture content of the soil across the different land use can be partly attributed to the undulating plateau nature of basement complex that is not thoroughly weathered and fissured in parts of the study area. Other factors that contributed to differentials in the moisture content include surface compaction from logging activities and animal grazing. The higher mean values of soil moisture content over cultivated and forest land use may be attributed to the nature of the soils which is mostly clayey loam with improved water holding capacity. The result of this study is in agreement with the findings of Wakene, (2001); Ahmed, (2002); Tilahun, (2007) and Chemeda et al, (2017) who reported that soils under different land use differed in their water content both at field capacity (FC) and permanent wilting point (PWP) because they vary in sand, silt and clay contents.

Changes in land use and variable surface accumulation of organic matter affect the CEC of soils. The mean value of CEC is highest over scrubland ($10.97cmol/kg^{-1}$) and lowest over the bare surface ($8.79cmol/kg^{-1}$) while the cultivated land and forest land recorded mean values of $10.47cmol/kg^{-1}$ and $10.66cmol/kg^{-1}$ respectively. The proportion of CEC recorded did not vary significantly under soils of different land uses ($p>0.05$). The highest CEC value recorded on scrubland is attributable to the concentration of organic matter from animal dung on the surface by grazing animals. In comparison to cultivated land, the relatively higher values of CEC recorded in forest soils is attributable to the concentration of large amount of biomass whose

decay contribute humus to forest soil and therefore increase the capacity to hold cations thereby resulting greater potential fertility in the soil. Findings from the studies of Alemayehu and Sheleme, (2013); Wasihun et al, (2015) also reported high cation exchange capacity (CEC) values for soils under grassland and grazing land compared to cultivated land where crop residues are largely removed to provide folders for animals.

The soil particle size distributions were affected by the interaction of land use and reveals significant variation in soil textural classes under soils of different land uses ($p<0.05$) with higher mean value of 65.56% (sand) and 16.60% (silt) contents recorded on forest land and bare surface respectively. In like manner, the highest mean value (27.60%) clay content was recorded on cultivated land, whereas the lowest mean value (21.20%) clay content was observed on scrubland. The result of this study is also in agreement with the findings of Shiferaw (2004) who reported an increase in clay content with depth under cultivated lands due to long period of cultivation. Similarly, studies have shown that continuous cropping and intensive land use affected soil particle size distribution (Voundi and Tonye, 2002; Jaiyeoba, 2003; Agoume, 2009).

The values of bulk density show relative homogeneity amongst the land use and were not statistically significant at ($p<0.05$). However, numerically higher mean value (1.49 g/cm^3) of bulk density was recorded on farm land and the lowest mean value (1.44g/cm^3) on bare surface while scrubland and forest land use both recorded (1.46g/cm^3). It is most likely that surface compaction resulting from intensive cultivation, grazing animals, haulage vehicle used for logging of timber might have caused the relatively higher bulk density values observed in the surface soil layers of the cultivated land, scrubland and forest land respectively. The findings from the studies of Chemada *et. al.* (2017); Kerenku and Orkpe (2017) also reported higher mean values of bulk density for soils under cultivated land use. Their studies attributed lower bulk density to the high soil organic matter, porosity and less disturbance of the land under forest and higher bulk density under the cultivated areas were attributed to compaction of soil surface by intensive cropping and deforestation.

Porosity mean value ranges from 44.00% to 42.20%. The lower value of porosity over cultivated land in comparison to the higher value over scrubland is attributed to the higher bulk density recorded for cultivated land that impede infiltration minimally. However, the changes in porosity value as observed were not statistically significant at ($p<0.05$). The result of this study is in agreement with the earlier findings of Islam and Weil, (2000); Jaiyeoba, (2003); Chimdi et al, (2012); Heluf, (2013); Aminu and Jaiyeoba, (2015) who reported that conversion of natural forest ecosystem to cultivated with continuous tillage and cropping subject the soil to compaction that subsequently decreased porosity.

Generally, the drive towards food security is anchored on good soil management practice, however, changes in land use causes important changes in physical and chemical characteristics of soil. Soil fertility is declining in many parts of sub-Saharan Africa and the major constraints to crop production faced by smallholder subsistence farmers is the inadequate supply of nutrients. Farmers are entirely abandoning the traditional practice of natural fallow to restore soil fertility as a result of population pressure and increasing demand for land. The use of mineral fertilizers is declining as they are increasingly beyond the means and reach of most small scale farmers. Accelerated soil erosion and severe run-off are further depleting existing soil nutrient reserves, while levels of soil organic matter are declining as land is subjected to agricultural intensification.

Conclusion and recommendations

The findings of this study indicate changes in the soil physical properties under different land uses. The study showed that the soils are slightly acidic with generally low organic matter content and low porosity with high bulk density over cultivated, scrubland, and forest land use respectively. Deforestation, animal grazing and agricultural intensification without adequate soils management practice in the study area had a far reaching effect on soil quality leading to soil degradation and ultimately loss of land productive value. Based on the findings, the following recommendations were made:

i. Farmers should recycle crop residues after harvest in such a way that it will decompose to improve soil nutrient and soil fertility.

ii. Periodic bush fallowing should be encouraged to increase soil organic matter and stabilize soil aggregates.

iii. Towards reduction of accelerated soil erosion and soil degradation, the practice of agro-

forestry, conservation tillage and mulching should be encouraged to improve the soil micro-climate that is required for bacteria, fungi, micro-fauna and other soil microbes that facilitate organic matter decomposition, thereby facilitating carbon sequestration in the soil.

iv. Controlled animal grazing that reduces cattle trampling and lowers soil mean bulk density so as to increase porosity should be practiced.

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UTILIZATION OF PRIMARY HEALTH CARE SERVICES BY MOTHERS FOR MATERNAL AND CHILD HEALTH SERVICES IN RURAL NIGER STATE, NIGERIA

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Abstract

The overall aim of the study was to identify factors which determine utilization of Primary Health Care (PHC) services for Maternal and Child Health Services (MCHS) in rural Niger State. Following World Health Organization's 1991 systematic cluster sampling technique, three clusters with twelve households from each cluster were selected through Probability Proportional to Size basis to ensure equal spread of population across the selected study area. The data collected through the household survey were processed using SPSS version 18.0 software. A codebook was developed for using the data files indicating the variable name, label, description of code values and column locations, and finally estimates of the overall effects of independent variables on the use of PHC services for MCHS were determined using logistic regression. It was found that family education was associated with the use of PHC facilities: the higher the education levels the higher the use of PHC. Socio-economic condition of people was also found to be a factor in the use of the PHC: people of relatively higher socio-economic condition use the PHC more than people of low and medium status. People are not well informed about the services that are meant to be available in the PHC. Poor quality of services was found to be the main reason for underutilization of the PHC. The study recommends the formation of a "Local Health Authority" comprising representatives from different government and non-profit organizations along with people's representatives as this will improve the utilization of PHC in rural Niger State.

Keywords: Primary Health Care, Maternal and Child Health, Mother, Logistic Regression, TT vaccination

Introduction

More than 150 million women become pregnant in developing countries each year and an estimated 500,000 of them die from pregnancy-related causes (Maternal Mortality, 2005; Gilda *et al.,* 2007; Lynn *et al.,* 2009). Maternal health problems are also the causes of more than seven million pregnancies resulting in stillbirths or infant deaths within the first week of life (Hotchkiss, 2005; Save the Children, 2009). Maternal death, the death of a woman in reproductive age, has a further impact by causing grave economic and social hardship for her family and community. Other than their health problems, most women in the developing countries lack access to modern healthcare services and this increases the magnitude of death from preventable problems (Adeyemo, 2005; Omoleke, 2005; Gilda *et al*, 2007; Abiodun, 2010).

The major determinants of maternal morbidity and mortality include pregnancy, the development of pregnancy-related complications, including complications from abortion and, the management of pregnancy, delivery, and the postpartum period. However, a lot of factors contribute to the low health status of women in the developing countries including Nigeria. These factors include socio economic development of the country that has serious impact on morbidity and mortality (USAID, 1994; Gatrell, 2000; Meade &Earickson, 2001; Galloway, 2002; WHO, 2003; Gupta, Gauri, and Khemani, 2004). It is evident that the Infant Mortality Rate (IMR), Under Five Mortality Rate

(UFMR) and Maternal Mortality Rate (MMR) are still at unacceptable levels in rural areas of Nigeria (World Bank, 2003; Federal Ministry of Health, 2004; Ehiri, Oyo-Ita, Anyanwu, Meremikwu, and Ikpeme, 2005). So it is important to obtain information about the MCHS provided through the PHC to identify reasons for utilization of those facilities (Guidelines for Implementing Supportive Supervision, 2003; Sustainable Development Goals, 2015).

The focus of this study is on mothers and child health care services since improvement in Maternal and Child Health (MCH) is an important aspect of any health care delivery system. The success of PHC mostly depends upon the reduction of Maternal and Child Deaths (MCD) (Sule, Ijadunola, Onayade, Fatusi, Soetan and Connell, 2008). Data from Niger State's Ministry of Health indicates the dwindling health status of women; Maternal mortality rate: 500 – 700 per 100,000; Malnutrition among women in reproductive age group: 17%; Total fertility rate: 6.2; Teen-age pregnancy: 20%; Low birth weight deliveries: 17%; Weight gains during pregnancy: 5-6 KGs; Ante natal care utilization: 20%; Deliveries assisted by trained health worker: 14%; and Family planning coverage less than 10% (Wunsch and Olowu, 1996; National Bureau of Statistics (NBS), 2012; Nigeria Demographic and Health Survey (NDHS), 2013; National Population Commission (NPC) and ICF Macro, 2009). Thus, in Niger State, there is a research gap in this field due to inadequate research on the utilization issue from the perspective of users and what should and/or could be done to improve the situation.

Research hypothesis

H_o: Utilization of health services is not determined by the population's socio-economic factors such as peoples' income and level of education.

H_1: Utilization of health services determined by the population's socio-economic factors such as peoples' income and level of education.

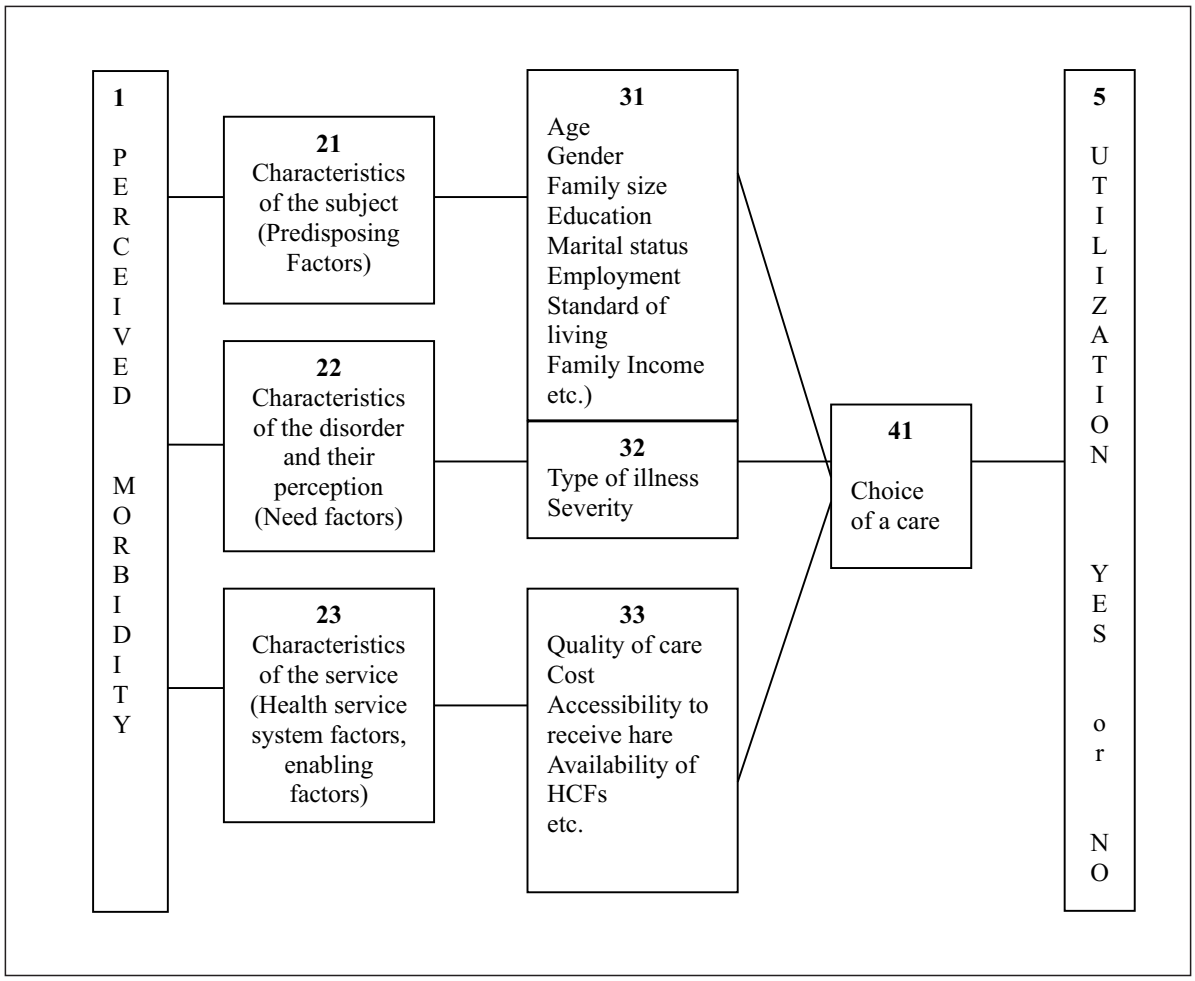

Figure 1: Utilization Model (Modified after Aday and Andersen, 1974)

Healthcare services utilization model

This model was introduced by Aday and Andersen (1974) to explain variations in use of healthcare services. It also serves as a proxy for measuring socioeconomic and cultural barriers of accessibility to healthcare utilization. The model classifies determinants of health care use into Need, Predisposing and Enabling components (Figure 1). The goal of PHC is to provide accessible health for all by the year 2000 and beyond, but regrettably, the rural populations in Nigeria are seriously underserved when compared with their urban counterparts (Gupta et al., 2004; NBS 2008a, 2009; 2009a; 2009b). While most PHC facilities are in various states of disrepair, with equipment and infrastructure being either absent or obsolete, the referral system is almost non-existent. The health services, based on PHC, include among other things: education concerning prevailing health problems and the methods of preventing and controlling them, promotion of food supply and proper nutrition; Material and Child Care (MCC), including family planning immunization against the major infectious diseases, prevention and control of locally endemic and epidemic diseases and provision of essential drugs and supplies (Alma-Ata, 1978; Adeyemo 2005; Federal Ministry of Health, 2004).

The Study Area

Niger State is located on latitude $8^0 15'$N to $11^0 20'$N and longitude $3^0 30'$E to $7^0 25'$E bounded to the south by the Niger River. The Federal Capital Territory, Abuja is on Niger state's eastern border, and the Republic of Benin is its western border, while Kebbi, Zamfara, and Kaduna States were to its northern border. The State housed a Federal University of Technology; a Polytechnic in Bida; a Rice Research Institute and an Agricultural Research Station in Mokwa. Most of the inhabitants are engaged in farming. The 2006 population census put Niger State's at 3, 975, 526 people (National Population Commission (NPC), (2009a; 2010). In 1999, there were 938 hospitals in Niger state of which 650 were government hospitals (NDHS 2013). The total hospital beds in 1999 were 38,106, which represent a rate of one bed for 3,261 persons. In addition to the Tertiary Health Center (THC), there are 3,275 Family Welfare Centres constructed at the Local Government Level all over the state. There were 546-registered physicians in the State in 2013 of which 347 work in the government health services.

Methodology

Data Sources and Sampling Techniques

Community based household survey was conducted among 180 mothers in households to understand the utilization pattern of the health services, characteristics of the users and non-users of PHC services, particularly Maternal and Child Health Services (MCHS). Following a systematic cluster sampling technique (WHO, 1991a; 1991b), 3 cluster village with fifteen households (15x3 = 45 households) from each cluster were selected from each zone.

The sample frame for this study is the total number of mothers in rural areas in the categorized zones (A, B, and C) in Niger State. Given that the 2018 mothers' population in rural areas of Niger State in each of the sampled Local Government Area is between 102 to 130 mothers (Niger State's Ministry of Agriculture and Rural Development, 2018). The sample size was calculated by controlling *type I* error with probability α; the variance (σ) of the population is unknown and the sample size is large ($n \geq 30$). Since σ is not known and we have a random sample, we estimate o by the standard deviation of the sample on hand. By replacing σ by the sampling (margin of) error E = 0.29 (Moors, 1991; Casley and Kumar, 1998) in the below z-interval, we reach at the following interval, that is, $100(1 - \alpha)\%$ Confidence Interval (C.I) on μ, and $z\alpha/2 = 1.96$ (two tail) indicating the heterogeneity of the survey population (1):

$$\tilde{e} - z_{\frac{\alpha}{2}}\sqrt{\frac{\tilde{e}(1-\tilde{e})}{n}} < E < \tilde{e} + z_{\frac{\alpha}{2}}\sqrt{\frac{\tilde{e}(1-\tilde{e})}{n}} \quad \ldots\ldots\ldots(1)$$

Consequently, the upper limit of the computed 95% C.I. is taken as the percentage of sample size (that is, 37%), therefore, 37% of 130 = 48.1 copies of questionnaire to be administered for each of the surveyed population. However, an analysis which involved multivariate analysis (logistic regression) needs large samples such as 100 – 180 (Israel, 1992). Hence it was increased to 180 (that is, 60 copies of questionnaire x 3 clustered areas = 180 copies of questionnaire); to take care of autocorrelation and to avoid poor prediction of the model's coefficients.

The clusters were found to be distributed all over the study area. The clusters include; Doko village in Latin Local Government Area (Zone A); Gunu village in Shiroro Local Government Area (Zone B); and Wabe village in Paikoro Local government Area (Zone C). The total population of mothers in each of these zones is not known. The field work lasted from

31st October, 2018 to 30th December, 2018. The household was considered as the basic sampling unit. A central point of the cluster (village) was located and then the number of household from the central point to the edge of the village was counted. One household in the middle of each village was selected randomly as a starting point and identified the first household. The rest of the households were selected to provide widespread coverage of the villages.

Two female Research Assistants one supervisor were recruited for this study. Adequate training was provided to them through a five days training session before starting the actual survey. The training related to interview and supervision technique, explanation of the questionnaire and the way of collecting relevant information for the study. The supervisor was responsible for identification of the village and starting point for questionnaire administration and ensured quality of data in the field.

The Household Survey

The questionnaire administered elicited information on the demographic, socio-cultural and economic characteristics of the users, illness experiences and use of healthcare services, the knowledge and attitude of the people towards health services, and the cost of using services by mothers who are the respondents in this study. The final part contained questions relating to MCHC that includes antenatal care, delivery, post-natal care, immunization of children and expectant mother, acute respiratory infection (ARI) and Diarrhea diseases. The pilot survey was conducted four weeks before starting the final fieldwork. Piloting was done in a similar situation with 45 respondents. A few changes were made to improve pre-coding and record entry for interviewees on the basis of the field experiences of the interviewers, supervisors and the researcher (Mike, 2010).

Method of Data Analysis

Data Storage and Processing

Initial data entry and storage involved the use of Microsoft Office Excel, where all the responses were recorded and handled. The statistical software SPSS for windows (version 18.0) was used for the analysis because it provides a better means of analyzing the data.

The data were coded (Robson, 2011) using SPSS for easy interpretation and analysis. The analysis uses logistic regression modeling to explain some of the patterns of usage among mothers in the study area.

Dependent variables (Y)

In this analysis use of MCHS such as Tetanus (Toxic) (TT) vaccination during pregnancy, place of TT vaccine, received antenatal care, place of antenatal care, number of antenatal care visit, place of child delivery, types of person attending the delivery, received postnatal care, and place of post natal care, are considered as dependent variables.

Independent variables (X)

The independent, categorical or predictor variables were explored using tabular analysis in order to provide an initial impression of the response data structure; they include; Socio-economic condition, mother education, mother income, occupation of the respondent's husband and age of the respondents. (X) = All the independent variables are grouped into three categories as follows; X1= Socio-economic condition of the people (1=low, 2=medium, 3=high); X2=Family education (1=no education, 2=up to primary level education, 3=above primary education); X3=Age of the respondent (1=up to 20 years, 2=21-30 years, 3=31-49 years; X4= Family income of the respondent (1=low, 2=medium, 3=high); X5=Occupation of the respondent's husband. (1=Day-labour, 2=service/business, 3=agriculture).

Three logistic regression analyses were performed to examine the unadjusted and adjusted effects of the above selected independent variables on the utilization of MCHS in rural Niger State. Regression models are as follows: Three different logistic regression models were tested in these analyses;

1. Model 1. Logistic regression performed with single independent variable to see the unadjusted odds ratio. (Equation for Model 1) Y (TT vaccination of mother during pregnancy) = f (Socio-economic condition (Xl), or family education (X2) or the age of the respondent X3 or family income (X4) or husbands occupation (X5).

2. Model 2, Socio-economic condition, family education, and age of the respondent are uses as independent variables. (Equation for model 2) Y (Consultation for antenatal care) = f (Socio-economic condition (Xl), family education (X2), and the age of the respondent (X3).

3. Model 3, family income, occupation, education,

and age of the respondent are used in the analysis (Equation for model 3) Y (Place of child delivery) = f (Family education (X2), age of the respondent (X3) family income (X4), husbands occupation (X5)

The above three logistic regressions were performed using SPSS and backward step technique was used to fit the model. Results are presented in terms of odds ratios with significance level and confidence interval. The Logistic: likelihood-ratio test performed to see the chi square and P values.

Logistic Regression

Logistic regression was used to investigate the relationship between the outcome (independent) variables and each of the dependent variables whilst controlling for all other independent variables. For the purpose of this analysis, all the dependent variables (Y) are coded as binary variables in the following ways: Y=1 If the respondent uses PHC facilities for MCH services; Y=0 If the respondent uses other than public health care facilities; Y=1 Yes if the respondent received any type of MCHC; and Y=0 No if the respondent did not receive any types of MCHC.

The choice of logistic regression is because, the response variable is binary (nominal) for example, 1 or 0 (yes or no) rather than continuous or a mixture of the two (see Field, 2009 for more detail). Logistic regression calculates the probability of success (1) over the probability of failure (0) which is one of the advantages of logistic regression. For example, taking one of the binary categorical values 1 or 0, the expected value is simply the probability, (p), that the variable takes the value 1. Therefore, applying other regression methods for this kind of probability test could lead to predicted values of the probabilities outside the interval binary values (Landau & Everitt, 2004). The approach in logistic regression is the modeling of the predicted probability value, p, indirectly via what is known as the logistic transformation of (p) or logit (p) (Landau and Everitt, 2004, pp.222-223; Agresti, 2007; Field, 2009; Paulant, 2010).

Logistic regression is calculated as follows:

$\text{logit}(p) = \ln [p/(1-p)]$ ..... (2)

Or

$$p = \frac{exp\ (\beta_0 + \beta_1 X_1 + \cdots + \beta_q X_q)}{1 + exp\ (\beta_0 + \beta_1 X_1 + \cdots + \beta_q X_q)} \quad \ldots\ldots\ldots\ldots (3)$$

From equation 3, *p* is the probability that a case is in a particular category; *exp* is the base of natural logarithms; β_0 is the constant of the equation; and, β... are the respective coefficients of the predictor variables.

The computation of the logistic regression was undertaken using SPSS statistical software for Windows. The Stepwise method of entry was used in computing the logistic regression because the study is for exploratory purposes (Field, 2009). The stepwise method of entry is considered optimal in a situation where there is no previous research or theory that exists on which to base the hypothesis for testing the results (Field, 2009). This is particularly relevant to this study where the investigation only tries to find a relationship between events. The stepwise method was chosen using the forward LR method in SPSS (Field, 2009, p.272). The advantage of this entry method is that it uses the likelihood ratio test (chi-square difference) to automatically add the variables with the most significant statistics score into the model (Field, 2009).

Results and discussion

Factors that are Important in Choosing Health Care Services by Mothers

TT Vaccination of Mother during Pregnancy

The TT vaccination of the mothers during pregnancy was not found to be significantly associated with the socio-economic conditions of people, though the results show that the medium socio-economic group received TT vaccine 25% less than the low socioeconomic group. No major difference in receiving TT vaccine was found between the low and the high socio-economic group. Family education was found to be associated with the TT vaccination. The adjusted odds ratios of TT vaccination show that families with above and primary education received TT vaccine 30% and 22% more than the non-educated families. The difference was larger when assessing the effects of education individually (Table 1). The respondents over 31 years of age received TT vaccine 47% less compared to the respondents of young age. It indicates that older women are relatively less likely to receive TT during pregnancy compared to the younger women.

Table 1: Estimates of the Influence of Independent Variables on TT Vaccination of Mother during Pregnancy

Independent Variables	Odds Ratios			
	Odd Ratios Unadjusted (95% CI)	P > | Z |	Odd Ratios Adjusted (95% CI)	P > | Z |
Socio-economic condition				
Low	1.00		1.00	
Medium	0.80 (038-1.67)	0.568	0.75 (034-1.67)	0.496
High	1.04 (0.35-3.22)	0.945	0.94 (0.27-3.22)	0.927
Family education				
No Education	1.00		1.00	
Primary Education	1.66 (0.49-2.70)	0.727	1.22 (0.50-2.97)	0.647
Above Primary Education	1.57(0.51-2.55)	0.739	1.30 (0.52-3.22)	0.569
Age of mother				
15-20 Years	1.00		1.00	
21-30 Years	0.71(033-1.50)	0.379	0.71(033-1.53)	0.392
31-+	0.53 (0.17-1.63)	0.275	0.53 (0.17-1.65)	0.277

Table 2: Odds Ratios of TT Vaccination of Mother during Pregnancy by the Categories of Independent Variables

Independent Variables	Odd Ratios			
	Odd Ratios	95% CI	P | Z |	Model p-value
Socio-economic condition				
Low	1.00			0.829
Medium	0.80	0.38-1.67	0.568	
High	1.04	0.35- 3.22	0.945	
Family income				
Low	1.00			0.734
Medium	0.79	0.34- 1.86	0.604	
High	0.69	0.24-1.93	0.438	
Husband's occupation				
Day labour				
Service/Business	1.00			0.555
Agriculture	1.29	0.57- 2.87	0.534	
	1.57	0.67- 3.68	0.294	
Family education				
No Education				
Primary Education	1.00			0.922
Above Primary	1.66	0.49- 2.70	0.727	
	1.57	0.51- 2.55	0.739	
Age of respondent				
15-20 Years				
21-30 Years	1.00			0.492
30-+	0.71	0.33-1.50	0.376	
	0.55	0.17-1.63	0.275	

Husbands' occupation seems to be a factor for vaccination. The respondents from the agriculture and the service/business families received TT vaccine 57% and 29% more than the respondents of the day labour families. However, differences in vaccination between the occupation groups were not found to be statistically significant. In the case of income group respondents from the higher and medium income group received less TT vaccine than their counterparts (Table 2). Irrespective of the socio-economic condition, family education, age of the respondents, the majority of women received TT vaccine. This was partly due to the availability of TT vaccine free of charge within the reach of rural population at the village PHC and partly due to the frequent home visits of community level health and family planning workers for this purpose.**Table 2:** Odds Ratios of TT Vaccination of Mother during Pregnancy by the Categories of Independent Variables

Place of TT Vaccination

The unadjusted odds ratios of place of TT vaccination show that the middle and the high-income groups visited PHC facilities 71% and 88% respectively less than the low-income group. Individually the family income was found to have significant relationship with the place of TT vaccination (P=0.0004). The choice of the place of TT vaccination was found to be associated with the husbands' occupation. It was found that the respondents from the agriculture and the service /business 'families made 30% and 53% less visit to the public sector health care facilities for vaccination respectively (Table 3) although this association was not found to be statistically significant (p = 0.357).**Table 3:** Odds Ratios of Place of Receiving TT Vaccine during Pregnancy by the Categories of Independent Variables.

Table 3: Odds Ratios of Place of Receiving TT Vaccine during Pregnancy by the Categories of Independent Variables

Independent Variables	Odd Ratios			
	Odd Ratios	95% CI	P | Z |	Model p-value
Socio-economic condition				
Low	1.00			0.015
Medium	0.25	0.09-0.69	0.008	
High	0.31	0.08- 1.17	0.086	
Family income				
Low	1.00			0.004
Medium	0.29	0.10-. 83	0.022	
High	0.12	0.04-. 34	0.000	
Husband's occupation				
Day labour				
Service/Business	1.00			0.357
Agriculture	0.47	0.16- 1.34	0.160	
	0.70	0.22- 2.15	0.537	
Family education				
No Education				
Primary Education	1.00			0.155
Above Primary	0.59	0.17- 2.02	0.408	
	0.39	0.12-1.03	0.058	
Age of respondent				
15-20 Years				
21-30 Years	1.00			0.453
30-+	1.09	0.43- 2.76	0.852	
	0.40	0.13-1.67	0.250	

Table 4: Estimates of the Influence of Independent Variables on the Place of TT Vaccination

Independent Variables	Dependent Variable: Y = 0 if use of other Health Care Facility and 1 if PHC			
	Odd Ratios Unadjusted (95% CI)	P > | Z |	Odd Ratios Adjusted (95% CI)	P > | Z |
Socio-economic condition				
Low	1.00		1.00	
Medium	0.25(0.09-0.69)	0.008	0.30(0.10-0.87)	0.027
High	0.31(0.01-1.17)	0.085	0.42(0.10-1.77)	0.239
Family education				
No Education	1.00		1.00	
Primary Education	0.59(0.17-2.02)	0.408	0.83(0.23-2.96)	0.780
Above Primary Education	0.39(0.12-1.03)	0.058	0.58(0.17-1.93)	0.380
Age of mother				
15-20 Years	1.00		1.00	
21-30 Years	1.09(0.43-2.76)	0.852	1.08(0.42-2.82)	0.861
31-+	0.48(0.13-1.67)	0.250	0.62(0.17-2.23)	0.468

The choice of the TT vaccination place was found to be influenced by the socioeconomic conditions of people in an adjusted analysis. The respondents from the middle and the high socio-economic families received TT vaccination from the PHC facilities 70% and 58% respectively less than the respondents of the low the socio-economic families (Table 4). The association between the medium socio-economic group and the place of TT vaccine was found to be statistically significant even after adjusting for family education and age of respondent (P=0.027). In the case of family education, the adjusted odds ratios of place of TT vaccination show that families with above primary education received TT vaccine from the PHC facilities 42% less compared to the non-educated families. The unadjusted odds ratios show significant association with above primary education. Though it was not found to be statistically significant after adjusting for the socio-economic condition and age of respondents. The respondents aged 31 years or more visited public sector facilities 38% less than that of the respondents of 15-20 years of age. The difference was not found to be statistically significant and no major difference was observed between the young and the middle age group respondents.**Table 4:** Estimates of the Influence of Independent Variables on the Place of TT Vaccination

Consultation for Antenatal Care

Consultation for antenatal care was not found to be related to the socio-economic condition of the population. The possible explanation of this finding is that, the majority of respondents from all the socio-economic conditions received TT vaccine during their pregnancy that was considered as an antenatal care consultation (Table 5). The family education was found to have influence on antenatal consultation. The adjusted odds ratios show that families with above primary education consulted PHC clinics 66% more than the non-educated families. However, the findings were not statistically significant ($p = 0.405$).

Age of mother was found to be a significant factor for antenatal consultation (P=0.044). The adjusted results show that the respondents of 31 years and over age consulted health care providers for antenatal care 73% less than those of 15-20 years of age (Table 2). This finding indicates that the younger women are more likely to consult a PHC for antenatal care than the older women.**Table 5:** Estimates of the Influence of Independent Variables on Consultation for Antenatal Care during Pregnancy

Table 5: Estimates of the Influence of Independent Variables on Consultation for Antenatal Care during Pregnancy

Independent Variables	Dependent Variable: Y = 0 if no consultation and 1 if consulted			
	Odd Ratios Unadjusted (95% CI)	P > | Z |	Odd Ratios Adjusted (95% CI)	P > | Z |
Socio-economic condition				
Low	1.00		1.00	
Medium	0.90(0.36-2.28)	0.838	0.88 (032-2.39)	0.806
High	1.32 (0.28-6.16)	0.718	1.09 (0.21-5.66)	0.917
Family education				
No Education	1.00		1.00	
Primary Education	0.97(0.35-2.72)	0.968	1.11 (0.50-5.51)	0.844
Above Primary Education	1.38 (0.47-3.99)	0.552	1.66 (0.31-2.30)	0.405
Age of mother				
15-20 Years	1.00		1.00	
21-30 Years	0.85 (0.31-2.29)	0.750	0.84 (0.31-2.30)	0.742
31-+	0.30 (0.08-1.01)	0.053	0.27 (0.08-0.96)	0.044

Table 6: Estimates of the Influence of Independent Variables on the Place of Antenatal Care Consultation

Independent Variables	Dependent Variable: Y -0 If use other health care facility and 1 if use PHC source			
	Odd Ratios Unadjusted (95% CI)	P > | Z |	Odd Ratios Adjusted (95% CI)	P > | Z |
Socio-economic condition				
Low	1.00		1.00	
Medium	0.23 (0.08-0.62)	0.004	0.27 (0.09-0.78)	0.016
High	0.24 (0.06-0.83)	0.025	0.31 (0.08-1.21)	0.093
Family education				
No Education	1.00		1.00	
Primary Education	0.52 (0.16-1.70)	0.285	0.73 (0.21-2.51)	0.629
Above Primary Education	0.32 (0.11-0.94)	0.040	0.59 (0.18-1.91)	0.379
Age of mother				
15-20 Years	1.00		1.00	
21-30 Years	0.90 (0.37-2.21)	0.828	0.90 (0.36-2.25)	0.826
31-+	0.45 (0.12-1.57)	0.211	0.56 (0.15-2.01)	0.377

Place of Antenatal Care during Pregnancy

The use of PHC facilities for ANC was found to be associated with the socio-economic conditions of people. The adjusted results show that the respondents from the middle and the high socio-economic families visited PHC facilities 73% and 69% less than the respondents of the low socioeconomic families respectively (Table 6). The association was found to be statistically significant in the case of middle socio-economic group (P=0.016). The unadjusted results show that individually the high socio-economic status also has significant effects on ANC consultation. Among the family education groups, families with above primary education used public sector health care facilities 41% less compared to the non-educated families. The difference was found to be more (68%) and statistically significant when checking its association individually with the place of antenatal care consultation (P=0.04). However, the association

became non-significant when socio-economic conditions and age of respondents were controlled for.

The unadjusted and adjusted results show that the women aged 31 years and over age used PHC facilities 55% and 44% less than the respondents of 15-20 years. These findings indicate that comparatively older women are less likely to visit PHC facilities compared to the younger women.**Table 6:** Estimates of the Influence of Independent Variables on the Place of Antenatal Care Consultation

Number of Antenatal Care Visit

The numbers of antenatal care visits among the low, the middle and the high socioeconomic groups were found to be similar, though the unadjusted odds ratios show that the respondents from the high socio-economic families made three or more antenatal care visits (76%) more than the low socio-economic group (Table 7). The level of the family education was found to be significantly related to the number of antenatal care visits (P=0.013). Both the adjusted and unadjusted odds ratios show that families having above primary education made three or more antenatal care visits and that were more than twice as many as non-educated families. However, no significant difference was found between the primary levels educated families and non-educated families.

The results show that the number of antenatal visit decreased while the age of the respondent increased. The respondent of higher age (31+years) made three or more antenatal visits 71% less compared to respondents of younger age. A similar trend was found in the case of middle age (21-30 years of age) respondents. However, the association was found to be statistically significant only in the case of higher age group (P=0.020). This finding indicates that the mother of comparatively older age are less likely to make more antenatal care visit than the younger women. Husband's occupation was a factor in the use of antenatal care. It was found that the respondents from the service/business families made three or more antenatal visits, 48% higher than that of the day labour families. It is likely that those who are involved in service or business have more interaction opportunity with different people and latest information that may help them to have better understanding of antenatal care that leads them to go for more antenatal visit.

Table 7: Estimates of the Influence of Independent Variables on the Number of Antenatal Care Visit during Pregnancy

Independent Variables	**Dependent Variable: Y=0 if up to two visits and 1 If three + visits**			
	Odd Ratios Unadjusted (95% CI)	**P > | Z |**	**Odd Ratios Adjusted (95% CI)**	**P > | Z |**
Socio-economic condition	1.00		1.00	
Low	1.22 (0.74-2.03)	0.426	1.02 (0.58-1.78)	0.935
Medium	1.76 (0.87-3.54)	0.111	1.19 (0.54-2.62)	0.657
High				
Family education	1.00		1.00	
No Education	1.09 (0.59-1.90)	0.777	1.08 (0.58-2.04)	0.791
Primary Education	2.14 (1.24-3.70)	0.006	2.20 (1.18-4.11)	0.013
Above Primary Education				
	1.00		1.00	
Age of mother	0.74 (0.46-1.20)	0.227	0.71(0.43-1.17)	0.183
15-20 Years	0.34 (0.12-0.95)	0.041	0.29 (0.10-0.82)	0.020
21-30 Years				
31-+				

The Number of Antenatal Care Visit was found to be associate with the Age of Women.

Place of Child Delivery

The high and the medium socio-economic groups used PHC facilities for delivery 34% and 42% respectively less than the low socio-economic groups. On the other hand the families with primary and above primary level education used PHC facilities 29% and 27% respectively more than the non-educated families. The results for age group show that none of the respondents of 31 years of age and over used PHC facilities for delivery. The older age people are more likely to deliver their baby at home than their counterparts. The birth experience of the older women may be a factor that deters them to deliver their child at the PHC facilities. However, the place of delivery was not found to be significantly associated with the socio-economic condition or level of family education (Table 8).

This result was found to be consistent with the national statistics that in rural areas of Nigeria, the majority of child deliveries are performed at home (NDHS, 2013). This was partly due to the traditional culture of rural population and partly due to non-existence of appropriate institutional child delivery facilities within the reach of the rural population.

Table 8: Estimates of the Influence of Independent Variables on the Place of Child Delivery

Independent Variables	Odds Ratios			
	Odd Ratios Unadjusted (95% CI)	P > | Z |	Odd Ratios Adjusted (95% CI)	P > | Z |
Socio-economic condition				
Low	1.00		1.00	
Medium	0.46 (0.09-2.25)	0338	0.46 (0.08-2.44)	0.363
High	0.64 (0.07-5.39)	0.687	0.58 (0.05-5.94)	0.652
Family education				
No Education	1.00		1.00	
Primary Education	0.98 (0.21-4.48)	0.982	1.29 (0.27-6.14)	0.748
Above Primary Education	0.82 (0.18-3.76)	0.805	1.27 (0.23-6.92)	0.779
Age of mother				
15-20 Years	1.00		1.00	
21-30 Years	1.23 (034-4.40)	0.751	1.25 (034-4.57)	0.779
31-+	00	00	00	00

Table 9: Estimates of the Influence of Independent Variables on the Person Attended the Child Delivery

Independent Variables	Dependent Variable: Y=0 if non -qualified and 1, if qualified person			
	Odd Ratios Unadjusted (95% CI)	P > | Z |	Odd Ratios Adjusted (95% CI)	P > | Z |
Socio-economic condition				
Low	1.00		1.00	
Medium	1.33 (0.65-2.74)	0.427	0.93 (0.42-2.03)	0.856
High	2.14 (0.86-5.27)	0.098	1.10 (0.40-3.01)	0.839
Family education				
No Education	1.00		1.00	
Primary Education	0.91(0.33-2A8)	0.856	0.92 (0.33-2.55)	0.876
Above Primary Education	3.22 (1.47-7.02)	0.003	3.20 (1.34-7.64)	0.009
Age of mother				
15-20 Years	1.00		1.00	
21-30 Years	0.88 (0.73-3.22)	0.727	0.84 (0.42-1.67)	0.628
31-+	0.40 (0.08-1.82)	0.240	0.31(0.06.1.146)	0.140

Person Attended the Child Delivery.

The use of a trained person in child delivery was found to be low among the study population. Irrespective of socio-economic conditions, an untrained person attended the majority of all deliveries (Table 9). No major difference was found between the socio-economic groups. The choice of the delivery person was found to be significantly associated only with the education level of the family (P=0.009).

The results show that the families having above primary education use the services of trained person three times compared to non-educated families (OR 3.22). No difference was found between the non-educated and primary educated families.

Age of the respondent was found to be associated with choice of health person in child delivery. The result show that the respondents of 31 years or more age used the service of a trained person 69% less compared to the respondents of 15-20 years of age. However, this association was not found to be statistically significant. The unadjusted results show individually high family income has significant effects on the use of a trained person in delivery. The high-income families used the services of a trained person three times more than the low-income families (OR 3.10). But the difference between the low and the middle-income group were not found to be significant. A significant individual association was found between the service/business occupation group and the types of person was attended the delivery (P=0.008). The service/business group used the services of trained person during delivery almost three times (OR 2.95) more than the day-labour group (Table 10).

Postnatal Consultation

The postnatal care consultation was found to be low among the study population, only 31% of respondents had a postnatal consultation. The adjusted odds ratios of postnatal consultation show that the respondents from the middle and the high socio-economic families consulted a PHC 30% and 44% less compared to the low socioeconomic families. However, the difference was not found to be statistically significant.

Table 10: Odds Ratios of the Person Attended during the Child Delivery by the Categories of Independent Variables

Independent Variables	Odd Ratios			
	Odd Ratios	95% CI	P | Z |	Model p-value
Socio-economic condition				
Low	1.00			0.266
Medium	1.33	0.65- 2.74	0.427	
High	2.14	0.86- 5.27	0.098	
Family income				
Low	1.00			0.038
Medium	1.69	0.76- 3.75	0.194	
High	3.10	1.31- 7.34	0.010	
Husband's occupation				
Day labour	1.00			
Service/Business	2.95	1.32- 6.57	0.008	0.018
Agriculture	1.42	0.58-3.48	0.441	
Family education				
No Education	1.00			
Primary Education	0.91	0.33-2.4	0.856	0.001
Above Primary	3.22	1.47- 7.02	0.003	
Age of respondent				
15-20 Years	1.00			
21-30 Years	0.88	0.73- 3.22	0.727	0.427
30-+	0.40	0.08-1.82	0.240	

The role of family education was found to be important in the case of postnatal consultation. The families with above primary education made postnatal consultation about three times more (OR 2.68) and the primary level educated families consulted 80% more than the non-educated families. The effect of education level on the postnatal care consultation was found to be statistically significant even after controlling for socio-economic condition and age of respondents (P=0.052, P=0.002). The higher the education levels the higher the evidence of postnatal care consultation.

The postnatal consultation was also found to be associated with the age of respondents. The results show that the respondents of 3l years and above consulted PHC for postnatal care 55% less than the respondent of 15-20 years of age. A similar trend was found between the respondent of 21-30 years and 15-20 years of age. The effect of age was found to be marginally significant (P=0.078). The finding indicates that education was the main determinant factor for postnatal care, though other factors; socio-economic conditions, family income, husband's occupation, and age of the respondent have some influence on it.

Place of Postnatal Care

The high and the medium socio-economic group used public sector health care facilities for postnatal care 50% and 20% more respectively than the low socioeconomic condition group (Table 11). Among the family education groups, families with primary education used PHC facilities, 48% less compared to the non-educated families. However, no major difference was found between the above primary educated families and the non-educated families for this purpose.

The respondent's age was not found to be significantly associated with the use of PHC facilities for postnatal care though the respondents of 21-30 years used PHC facilities 61 % less than the respondents of young age (15-20 years). Among the income groups, the high-income group visited PHC facilities 47% more than the low-income groups. In the case of occupation group, the agriculture group visited PHC facilities two times (OR 2.20) than the day labour groups, though the relationship was not found to be statistically significant (Table 12).

Policy implication

Achievements in the coverage of TT vaccination and consultation for ANC are remarkable, a policy decision could be taken by the government to involve people in the management and operation of PHC facilities at rural areas. Formation of a "**Local Health Authority**" comprising representatives from different government and non-profit organizations along with people's representatives could be considered as a strategy for a greater utilization.

Table 11: Estimates of the Influence of Independent Variables on the Place of Postnatal Consultation

Independent Variables	Odds Ratios			
	Odd Ratios Unadjusted (95% CI)	P > | Z |	Odd Ratios Adjusted (95% CI)	P > | Z |
Socio-economic condition				
Low	1.00		1.00	
Medium	1.42 (0.35-5.68)	0.616	1.20 (0.23-6.14)	0.821
High	1.90(0.32-10.97)	0.473	1.50(0.19-11.71)	0.694
Family education				
No Education	1.00		1.00	
Primary Education	0.58 (0.09-3.74)	0.570	0.48 (0.07-3.34)	0.466
Above Primary Education	1.36(0.31-5.92)	0.677	1.07 (0.17-6.44)	0.941
Age of mother				
15-20 Years	1.00		1.00	
21-30 Years	0.41(0.10-1.68)	0.217	0.39 (0.09-1.62)	0.195
31-+	0.93 (0.09-8.82)	0.956	0.94 (0.08-9.92)	0.961

Table 12: Odds Ratios of the Place of Postnatal Consultation visit by the Categories of Independent Variables

Independent Variables	Odd Ratios			
	Odd Ratios	95% CI	P | Z |	Model p-value
Socio-economic condition				
Low	1.00			
Medium	1.42	0.35- 5.68	0.616	0.750
High	1.90	0.32-10.97	0.473	
Family income				
Low	1.00			
Medium	0.91	0.17- 4.72	0.912	0.889
High	1.47	0.27- 7.90	0.652	
Husband's occupation				
Day labour				
Service/Business	1.00			0.603
Agriculture	1.26	0.26- 6.03	0.767	
	2.20	0.45-10.73	0.328	
Family education				
No Education				
Primary Education	1.00			0.573
Above Primary	0.58	0.09- 3.74	0.570	
	1.36	0.31- 5.92	0.677	
Age of respondent				
15-20 Years	1.00			
21-30 Years	0.41	0.10-1.68	0.217	0.424
30-+	0.93	0.09-8.82	0.956	

Conclusion

Use of PHC was found to be universal for two specific MCHS; TT vaccination of mother during pregnancy, and consultation for ANC, which seems to be a big achievement of the government. This service needs to be continued by improving accessibility to and availability of MCHSs. This finding suggests that government needs to concentrate its efforts on increasing use of PHC facilities, if it wants to ensure that PHC services have the impact on health of the rural population.

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AN ASSESSMENT OF ROAD TRANSPORT SAFETY STANDARDIZATION SCHEME INFLUENCE ON FREIGHT TRANSPORT CRASHES IN LAGOS METROPOLIS, NIGERIA

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Abstract

This study seeks to assess the influence of road transport safety standardization scheme (RTSSS) on freight transport crashes in Lagos Metropolis of Nigeria. The data used for this work was acquired through primary and secondary sources. The primary source was through administration of one hundred and forty (140) questionnaires to freight transport operators, drivers and Federal Road Safety Commission (FRSC) staff. The study makes use of the Stratified Sampling technique method. Data from the Federal road safety publications on accidents (1960 -2013), the Federal Office of Statistics publication, the Lagos State Motor Vehicle Administration Agency, Lagos Bureau of Statistics (MEPB) and the Lagos State Traffic Management Authority (LASTMA) formed the secondary data used for the study. The data was processed and analyzed using both descriptive and inferential statistical techniques. The study revealed there is a significant awareness of the scheme among the operators and drivers of freight transport in the study area with a low level of patronage and compliance. It further shows that freight transport accident is still on the increase even after the introduction of the scheme. It is recommended that there should be more awareness and wide publicity of the scheme in Lagos and Nigeria at large. All agencies that are set-up for the implementation of the scheme should be more determine and committed to the realization of the objectives of the scheme.

Keywords: Freight transportation, Operators, Drivers, Road Safety Scheme, Lagos State

Introduction

Road freight vehicle movements clearly play an important role in the functioning of towns and cities, distributing goods to numerous locations that are vital to urban life. As noted by Agyemang et al., (2016), not only does freight vehicle facilitate the smooth transportation of goods and services from source(s) to respective destination(s), but also serve as a huge source of employment which is a critical economic indicator to development. The trucking industry serves the Nigerian economy by transporting large quantities of raw materials, works in process, and finished goods over land—typically from manufacturing plants to retail distribution centers. Trucks in Nigeria are responsible for the majority of freight movement over land, and are tools in the manufacturing, transportation, and warehousing industries. As observed by Badejo, (1997), the road-based freight vehicles have monopolized the movement of cargo over space in Nigeria, because no other mode of transport offers strong competitions with the road transport, and especially in terms of swift delivery of cargo and provision of door to door services. In delivering these services, heavy- goods vehicles are used in the movement of cargos which include the general cargo, the containerized and the wet cargos. Heavy-goods vehicle are Motor Vehicles (Articulated or Non-Articulated) other than cars including tippers, tractors-trailers, tankers, Lorries, luxury buses, etc. FRSC (RTSSC), (2010). There is a significant growth in heavy vehicle transportation across the road network not only in high-income countries but also in many developing and newly industrialized countries as a consequence of the rapid, export oriented

economic growth. China for example, is observing an annual increase of 466,000 heavy vehicles on their roads (Stevenson et al, 2010). In Nigeria, the economy is import oriented and the contributions of the freight transport vehicles to the national economy in distributing the imported goods is huge, the FRSC reported that Nigeria has an average of approximately 5,000 tankers involved in wet cargo haulage, moving about 150 million litres of fuel, and 2,500 trailers in dry cargo plying Nigeria's roads daily (Olagunju, 2010). Agyemang *et al.*, (2016) observed that the transport sector has been plagued with quite a number of traffic crashes; already the contribution of Freight (heavy) vehicle crashes to road-related deaths is substantial. In Australia for example, heavy vehicle crashes are responsible for as much as 20% of the total road-related deaths, whilst in the United States, approximately 15% of road related fatal crashes involve heavy vehicles. In Nigeria, between 2007 and June 2010, a total of 4,017 tanker/trailer crashes were recorded on Nigerian roads, with a yearly average of 1,148 crashes, monthly average of 96 crashes, and a total of 4,076 persons killed and 12,994 persons were injured in such crashes involving tankers and trailers (Olagunju, 2010). The situation as it concerns freight transport vehicle crashes is not encouraging in Nigeria especially in the Lagos metropolis where the busiest port is located. The menace of falling freight containers causing injuries, deaths and gridlocks to road users is becoming rampant, and the spate increase in these forms of road traffic accidents has therefore become a worrying and growing concern to most residents of the metropolis in recent times. In view of this, the Federal Government mandated the Federal Road Safety Commission (FRSC) to establish Minimum Safety Requirements for heavy good vehicles, which is aimed at abating potential risks on the highway and this lead to the creation of Road Transport Safety Standardization Scheme (RTSSS) by law in the National Road Traffic Regulations (NRTR) (2004) Section 115 made pursuant to Sections 5 and 10 (10) of the FRSC (Establishment) Act 2007 for the establishment of safety units by all transport operators so as to bring professionalism into the industry, promote and develop rapid safe, efficient and convenient fleet transportation system in the country. To this end, the aim of this research paper is to examine the relationship between the road transport safety standardization scheme (RTSSS) and freight transport crashes before and after the introduction of the scheme using Lagos Metropolis as an example. Among the specific objectives of this study are to: 1) determine the rate of freight vehicle crashes before and after the introduction of the scheme, 2) examine the rate of compliance to the scheme by the freight transport operators, 3) assess the effectiveness of the enforcement method used for the scheme. The study further recommends solutions to the identified problems inhibiting the effectiveness of the policy in Lagos State and Nigeria at large.

Review of Literature

Despite the vital services freight vehicles provide, they are perceived as menaces on the road by many. Steady increases in highway traffic have exacerbated long standing freight vehicle safety problems. (Office of Technology Assessment (OTA), 1987). Government and safety experts have long sought ways to achieve a responsible balance between ensuring road traffic safety of the freight vehicles and facilitating the flow of commerce, to this end, The federal road safety corps has the mandate of entrenching safety standards in the Operational activities of Fleet Operators in Nigeria with a view to sanitizing the Nigerian roads which has been characterized by uncoordinated and unprofessional practitioners. The driving engine room for this program is the Road Transport Safety Standardization Scheme (RTSSS) activities as provided in the FRSC (Establishment) Act 2007, pursuant to Section 198 captured in the new National Road Traffic Regulations (NRTR) (2012). The Scheme was formally launched on 11/09/07 and the office was established in 2009 with set up strategies of achieving the task through collaborative Stakeholders' forum in the effective supervision of Drivers' Safety Standards, Vehicle Safety Standards and Operator's Safety. The transport industry is regulated to help minimise the adverse impact of heavy vehicles on road safety, the environment and road infrastructure. An additional objective is to ensure fair competition across the industry and, through enforcement and monitoring activities, prevent less scrupulous operators from gaining a competitive advantage through non-compliance. To achieve these objectives regulation and enforcement in road transport has focused on vehicle registration, driver licensing, speed, driver behaviour, fatigue, drug and alcohol use, vehicle roadworthiness, vehicle standards and operational characteristics. (Baas andTaramoeroa,2008). According to Wegman, (2016), the most common measure used to define road safety is the number of road crashes and/or the number of casualties and the associated negative

consequences resulting from such crashes. Balogun (2006), describe Safety as being used widely in the context of protection from personal harm. It can be described as an experience of personal security, freedom from danger and situations that can cause harm, injury or health-related problems it is a protection against injury and traumatic issues. Regha (2010) observed that safety is a conscious precaution which is taken against any danger that has been pre-determined to occur. The precaution is deliberately done and not an accidental precaution against danger. Dammen (2010) observed that motor carrier safety starts with the firm. While government safety regulations attempt to ensure a minimum level of highway safety in the form of highway laws and enforcement, provision of infrastructure and motor carrier safety inspections—ultimately, most trucking safety investment decisions are made at the firm level. Government safety regulations attempt to discourage or promote certain firm behavior. Lave (1968) focused on the role of government in providing transportation safety. Asserting, "We cannot be too safe," he goes on to make the case that safety is a scarce resource (p. 512). He indirectly questions whether there was too much safety provided in the regulated transportation industries, because train, bus, and air passenger-fatality rates were all significantly lower than private automobile passenger-fatality rates. According to (Starrs and Moore 2003), in Australia, accreditation is a formal means of recognizing operators who have good safety and other (e.g. mass) management systems in place. Those systems need to be properly documented and audited by third parties to verify that the systems have been implemented and are used on a routine basis. (Wegman,2013), observed that risks in road traffic are considerably higher than in other transport modes, and the amount of injuries in road traffic is far higher than the numbers in trains, planes or ferries. Although crashes in these other modes attract a lot of public and media attention, road crashes kill far more people, but in a diluted way, resulting in only limited media coverage and relatively limited attention from the public and politicians. While trucks experience fewer crashes per mile than passenger cars, the majority of all fatally injured persons involved in truck-related crashes were occupants of passenger cars (Scheinberg 1999). According to Fructus, 1987, accidents usually result from a chain of events, often initiated by a single occurrence, and complicated by a number of interacting factors. The potential for an accident is partially a function of the characteristics of the driver, including experience, training, age, attitude, physical condition (fatigue, intoxication, other debilitations), and psychological state. Other factors include the condition of the vehicle, highway design, and roadway characteristics; regulatory oversight, such as licensing and traffic enforcement; and the type of management supervision exercised by the carrier. Raftery, *et al.*, (2011),in their studies found that the most common factors involved in Freight vehicle crashes are speed, the mechanical condition of the vehicle (particularly brakes), and the characteristics of the load being carried (including overloading). Khattak e*t* a*l*, (2003) used the highway safety information system data from North Carolina USA for the years (1996 – 1998) to examine the injury severity of single trucks crashes, the authors found that dangerous driving behaviors such as drugs and alcohol use, speeding and not wearing seatbelts increases the injury severity. Most safety studies come to the conclusion that vehicle operator or driver factors (or human error) are the main cause of accidents as observed by Agbonkhese, et al., (2013).

Materials and Methods

Study Area

Lagos State is in the Western part of Nigeria and lies approximately on longitude 3° 24' E and latitude 6° 27'N. It covers an area of 3,577 Sq.km (Figure.1) with coastal deposits of tertiary beds from the Benin Formation stretch from Calabar in the Far East through the state to the borders of Benin Republic in the west. Topographically, Lagos state lies entirely within the coastal plain which is characterized by sand bars, lagoons and creeks In the Köppen climate classification system, Lagos has a tropical wet and dry climate (Aw) that borders on a tropical monsoon climate (Am) and experiences two rainy seasons, with the heaviest fall between April and July. There is a brief relatively dry spell in August and September and a longer dry season from December to March. Two main vegetation types are identifiable in Lagos State: Swamp Forest of the coastal belt and dry lowland rain forest. Lagos has one of the largest and most extensive road networks in West Africa. It also has suburban trains and some ferry services. The metropolitan Lagos extends over sixteen (16) of the twenty (20) Local Government Areas of Lagos State and contains 88% of the population of Lagos State. The actual population was disputed between the official Nigerian Census of 2006 of about 8 million and a much higher figure at approximately 16 million claimed by the Lagos State Government.

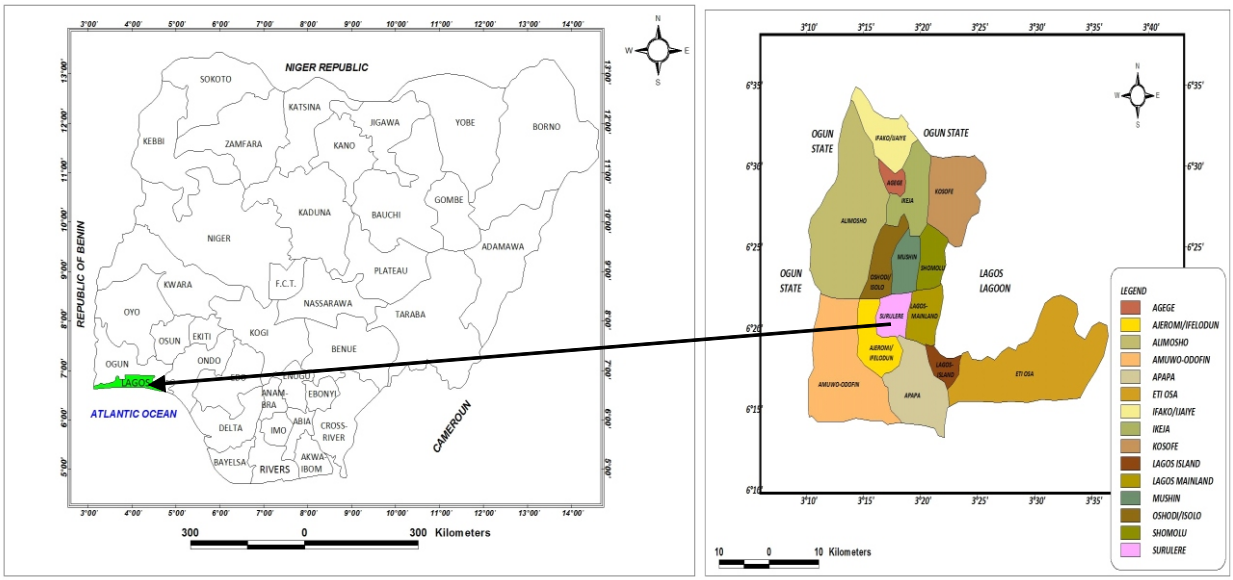

Figure 1: Maps showing the Study Area
Source: Lagos State Ministry of Lands and Survey, 2016.

As at 2015, estimated unofficial figures put the population of Lagos and its surrounding metro area, extending as far as into Ogun State, at approximately 21 million [Lagos State government, 2011]

Data Collection

The data used for this work was collected through primary and secondary sources. The primary data was sourced through questionnaire and personal interview. Three set of questionnaires and interview guide were employed. The questionnaires contained combination of closed and open-ended questions. The open-ended questions permitted respondents to give detailed answers in cases where their experiences could not be articulated into few options. The close-ended questions contain dichotomous questions for the freight transport drivers, since they are not well educated while the others contain the agree-disagree questions for both the operators and road safety personnel. Questionnaires addressed to the operators consisted of questions that covered the tenets of the road transport safety standardization scheme and to examine how well they have complied and if the scheme has achieved the stated objectives. The freight transport vehicle driver questionnaires were designed to reveal what the operators are actually doing as compared to what they revealed. The road safety commission questionnaires were designed to obtain information as to the effectiveness of the road transport safety standardization scheme in the study area. The population for this study comprises of freight operators, freight transport drivers, and the officials of the Federal road safety commission (FRSC). The total population of freight transport companies in the study area was drawn from the Haulage and Logistics magazine issue 45.of 2016, with a population of 140 freight transport companies, using Cochran (1977) sample size calculator at 5% error margin, and at 95% confidence level, the required respondent was 104, at 80% estimated response rate, 140 respondents were invited from the data pool in order to achieve the required sample size. The sample size of one hundred and four(104) freight transport companies was divided into two groups of operators and drivers and a sampling fraction of ½ (52 each) was used in order to randomly sample fifty-two (52) operators and fifty-two (52) drivers while the remaining thirty-six (36) were administered among the Federal Road Safety Personnel. The study makes use of the Stratified Sampling technique to ensure that different groups of this population are adequately represented in the sample. The secondary data were acquired from the Federal road safety publications from 2006 - 2015, the Federal ministry of statistics publication, the Lagos state Motor Vehicle Administration Agency , Lagos Bureau of Statistics (MEPB) and data from the Lagos State Traffic Management Authority (LASTMA). Accident data as regards freight transport vehicles prior to and after the lunching of the road transport safety standardization

scheme, the number of freight transport companies that have registered for the scheme was sourced from the Federal road safety commission.(FRSC).

Data Analysis

Generally, the data for this study was processed and analyzed using both inferential and descriptive statistical techniques, which involved the use of simple percentage distribution and tables.

Results and Discussion

Rate of Freight Vehicle Crashes before and after the Introduction of Road Transport Safety Standardization Scheme in 2007

Table 1 shows rate of freight vehicle crashes before and after the launching of road transport safety standardization scheme (RTSSS) in the study area. The table shows that freight transport crashes in the study area are still on the high side both prior and after the establishment of the scheme in the study area. A very high (412) freight transport accidents was recorded in year 2012, the very year the scheme was established. The least incidence of freight transport was found to be in year 2006 (175) and year 2015 (149) respectively. This shows that the scheme is yet to record a positive impact on the freight transport prior to and after its introduction in the study.

Rate of Compliance to the Scheme by the Freight Transport Operators and Drivers in the study area.

(a) Freight Transport Drivers

Table 2 present the freight transport drivers' view about road transport standardization scheme compliance in the study area. Almost, (40.4%) of the drivers in the study area are aware of the scheme while (59.6%) are not aware. A good number of companies (48.1%) had registered for the scheme while (51.9%) have not. Majority of the company (75%) are into dry cargo haulage and (25%) indicated wet cargo haulage. Many of the drivers (65.4%) sampled, are of the opinion that the road transport safety standardization scheme is good enough to reduce trailer accidents while (34.6%) said the scheme is not good enough to reduce trailer accident but a large number of drivers (66.1%) agreed that if the drivers obey the rules highlighted in the scheme, road freight will reduce significantly. The analysis above shows that there is strong awareness of scheme among the freight transport drivers in the study area.

Table 1. Freight Vehicle Crashes before 2007 and from 2007 to 2015

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2006	0	0	0	0	0	0	22	32	17	29	43	32	175
2007	0	0	0	0	27	20	31	27	27	34	41	13	220
2008	23	25	22	23	20	26	28	33	30	15	46	22	313
2009	28	18	14	28	33	41	34	34	33	28	23	46	360
2010	29	24	31	33	33	26	41	28	31	32	20	39	367
2011	19	17	22	41	27	26	44	33	36	33	28	25	351
2012	18	29	37	33	42	33	45	38	39	31	45	22	412
2013	24	33	30	21	28	43	35	34	21	24	25	26	344
2014	33	41	36	25	27	30	27	30	62	18	25	20	374
2015	18	19	22	24	24	26	16	0	0	0	0	0	149

Source: Documents obtained from FRSC/NPF (2017)

Table 2 Opinion of the drivers about road transport safety standardization scheme compliance

Opinion of the driver	Frequency	Percentage
Have you heard about road transport safety standardization scheme		
Yes	21	40.4
No	31	59.6
Has your company registered for the scheme		
Yes	25	48.1
No	27	51.9
What type of cargo do you haul		
Dry	39	75
Wet	13	25
Have you ever been involved in an accident		
Yes	28	53.8
No	24	46.2
Have you ever been involved in a n accident before 2010		
Yes	19	36.5
No	33	63.5
Have you involved in an accident after 2010		
Yes	32	61.5
No	20	38.5
Has your company sent you to driving refresher course		
Yes	17	32.7
No	35	67.3
Road safety scheme is good enough to reduce trailer accident		
Yes	34	65.4
No	18	34.6
Accident of trailer have reduced because of road safety standardization scheme		
Yes	22	42.3
No	30	57.7

Source: Authors Field Work, 2017

(b) Freight Transport Operators

Tables 3a&b shows the road freight operators opinion on road transport safety standardization scheme compliance in the study area. Almost all the operators of freight transport 67.3% sampled in the study area are aware of the scheme while 32.7% are not aware. About 53.8% of the operators are registered with RTSSS while 46.2% are yet to register. Going by the FRSCN classification of haulage companies, few of the companies 57.7% in the study area are categorized under group C (i.e. less than 25 vehicles) while others 42.3% are under group B (between 25 and 99 vehicles). More than half of the operators 56.9% usually carry out maintenance services on vehicles. Many of the operators 71.2% operate the safety standardization scheme policy in their company while others account for 28.8%. Majority of the operators 59.6% use to organize drivers' training courses regularly in curbing freight transport accidents in the study area.. A significant number of operators sampled in the study area 94.2% strongly agreed that the main objective of the road safety standardization scheme is to curb road transport accident. More so, 76.9% of the operators strongly agreed that the rate of freight transport accidents prior to the launch of the scheme was very high with 19.2% of them agreed that the scheme has drastically reduced the rate of freight transport accident while 2.0% strongly disagreed. In summary, there is a strong awareness of the scheme among the freight transport operators in the study area.

Table .3a Opinions of the road freight transport operators about freight transport safety standardization scheme

Opinion of the road freight transport operators	Frequency	Percentage%
Type of cargo		
Wet	20	38.5
Dry	32	61.5
Have you heard about Road Transport safety standardization scheme		
Yes	35	67.3
No	17	32.7
Have you been registered for the scheme		
Yes	28	53.8
No	24	46.2
How many vehicle do you have in your fleet		
1-5	3	5.8
11-20	27	51.9
21-30	22	42.3
Do you have maintenance record on vehicle, driver and road traffic accident in your company		
Yes	31	59.6
No	21	40.4
Do you have safety policy in your organization		
Yes	37	71.2
No	15	28.8
Do you organize driving course for the driver		
Yes	31	59.6
No	21	40.4
Do you forward records on drivers, vehicle and accident to agencies		
Yes	15	28.8
No	37	71.2

Source: Authors Field Work, 2017

Effectiveness of the enforcement method used for the scheme in the study area

The table 4 shows the view of Federal Road Safety Commission officers in the study area on the effectiveness of road transport standardization scheme. Majority of the officers sampled (75%) strongly agreed that the scheme is the best policy that can mitigate the rate of freight transport accidents in the study area with 72.2% confirming that the scheme has reduced the rate of freight transport accidents in the study area. The table further revealed that a large number of freight transport operators in the study area are already captured (86.1%) in the FRSC data base and 80.6% of the officers agreed that fractional part of the operators in the study area registered for the scheme with an appreciable number of operators 35.9% being monitored by the commission. More than half of the officers interviewed (56.4%) agreed that freight transport operators do comply with the scheme rules and regulations through enforcement (97.2 %) and this method is of International standard (72.2%). Almost all the officers sampled (100%) agreed that the commission has made enough awareness of the scheme to all freight transport operators in the study area. About 47.2% of the officers interviewed are of the view that no freight transport operator's certificate has been revoked since the inception of the scheme in the study area. This shows that there is a significant level of compliance to and effectiveness of the method of enforcement of the scheme in the study area.

Table. 3b. The impact of the scheme (RTSSS) on curbing freight transport crashes

Road transport safety standardization scheme is to curb transport accident	Frequency	Percentage
Strongly agreed	49	94.2
Agreed	3	5.8
The rate of freight transport accident prior to the launch of the scheme was high		
Strongly agreed	40	76.9
Agreed	3	5.8
Disagreed	5	9.6
Strongly disagreed	4	7.7
The scheme has reduced the rate of freight transport accident		
Strongly agreed	31	59.6
Agreed	10	19.2
Disagreed	10	19.2
Strongly disagreed	1	2.0
Rate of freight transport accident remain the same after the launch of the scheme		
Disagreed	22	42.3
Strongly disagreed	30	57.7
Majority of the freight transport operatorsin lagos state have registered for the scheme		
Strongly agreed	7	13.4
Agreed	1	2.0
Disagreed	16	30.8
Strongly disagreed	28	53.8
The registered operator are complying with the tenet of the scheme		
Agreed	9	17.3
Disagreed	27	51.9
Strongly disagreed	16	30.8
Registration for the scheme is just to get certified by the commission		
Strongly agreed	12	23.1
Agreed	17	32.7
Disagreed	11	21.2
Strongly disagreed	12	23.0
The scheme has positive impact on the freight transport accident		
Strongly agreed	2	3.8
Agreed	13	25.0
Disagreed	12	23.1
Strongly disagreed	25	48.1
The scheme has negative impact on the freight business		
Strongly agreed	18	34.6
Agreed	17	32.7
Disagreed	13	25.0
Strongly disagreed	4	7.7
Method employed to enforce the scheme is adequate for accident reduction		
Agreed	45	86.5
Disagreed	6	11.5
Strongly disagreed	1	2.0
Fine is the best method to correct the non-conformist operator		
Strongly agreed	21	40.4
Agreed	13	25.0
Disagreed	9	17.3
Strongly disagreed	9	17.3
The method of enforcement does not meet upwith international practice		
Strongly agreed	14	27.0
Agreed	32	61.5
Disagreed	6	11.5
The standard checklist in the scheme is strong enough to mitigate the cause of accident		
Strongly agreed	25	48.1
Agreed	15	28.8
Disagreed	12	23.1
The content of the scheme is not strong enough to impacted positively on freight accident causation and reduction		
Strongly agreed	28	53.8
Agreed	24	46.2

Source: Authors Field Work, 2017.

Table 4. Federal Road Safety Commission view on the effectiveness of road transport standardization scheme in the study area.

Items	Frequency	Percentage
Road transport safety standardization scheme is the best policy		
Strongly agreed	27	75
Agreed	9	25
Scheme is not popular in Lagos since it seek to interpret the existing road traffic rules		
Disagreed	21	58.3
Strongly disagreed	15	41.7
Rate of freight transport accident in Lagosis high before the introduction of the safety standardization scheme		
Strongly agreed	4	11.1
Agreed	31	86.1
Disagreed	1	2.8
Accident has drastically reduced through emergence of the scheme		
Strongly agreed	26	72.2
Agreed	10	27.8
FRSC Captured all freight operator in Lagos in the data base		
Agreed	31	86.1
Strongly disagreed	5	13.9
All freight operators have registered for the scheme		
Agreed	5	13.9
Strongly agreed	23	63.9
strongly disagreed	8	22.2
Fractional part of operator registered for the scheme		
strongly agreed	7	19.4
Agreed	29	80.6
All registered operators are monitored by the commission		
Strongly agreed	14	38.9
Agreed	12	33.3
Disagreed	10	27.8
Safety audit are conducted on certified operator		
Strongly agreed	15	41.7
Agreed	20	55.6
Strongly disagreed	1	2.7
All the registered operators are complying with the tenets of the scheme		
Agreed	22	61.1
Disagreed	12	33.3
strongly disagreed	2	5.6
despite the scheme the rate of freight transport accident remained the same		
Disagreed	12	33.3
Strongly disagreed	24	66.7
Commission has method to coerce the operatorto register		
Strongly agreed	1	2.8
Agreed	35	97.2
The commission has publicized the scheme known to all freight transport operator		
Strongly agreed	15	41.7
Agreed	21	58.3
The method of enforcement of the scheme meet international standard		
Strongly agreed	10	27.8
Agreed	26	72.2

Source: Authors Field Work, 2017.

Items	Frequency	Percentage
Method of enforcement of the scheme is not adequate enough to make policy effective in Lagos		
Agreed	3	8.3
Disagreed	14	38.9
Strongly disagreed	19	52.8
No mechanism for the feedback on the performance of the scheme		
Agreed	23	59.0
Disagreed	13	33.3
Provision is strong enough to mitigate the cause of accident		
Strongly agreed	20	55.6
Agreed	9	25.0
Disagreed	7	19.4
No operator certificate has been revoked		
Agreed	17	47.2
Disagreed	19	52.8

In 2007, Road Transport Safety Standardization Scheme was created by law in the National Road Traffic Regulations (NRTR) (2004) Section 115 made pursuant to sections 5 and 10 (10) of the FRSC (Establishment) Act 2007, to entrench a culture of safety consciousness in organizations and companies with fleet of vehicles, ensure safe and standardized fleet operations for all and check the excesses of transport operators which often lead to loss of lives and property.. Between 2007 and 2015, eight (8) years after the introduction of road transport safety standardization scheme (RTSSS), a total number of 2,890 freight transport crashes were recorded with the highest (412) in 2012, five (5) years after its introduction. It shows that in terms of road safety, the scheme had performed below expectation in the study area. On the positive side, there is strong awareness but low of compliance to the tenets of the scheme (RTSSS) among the freight operators and drivers with nearly half of the freight operator companies fully registered for the scheme. The type of cargo haulage in the study area is dry. A yearly refresher course for drivers to enhance their competency needs to be enforced. Even though the method of enforcing the tenets of the scheme is of international standard yet it is not strong enough to mitigate the cause of freight transport crashes in the study area.

Conclusion and Recommendation

The study examined the performance of road transport safety standardization scheme since its introduction in 2007 particularly freight transport using Lagos Metropolis, Nigeria as a case study. Freight transport crashes is still on the high side despite the introduction of road transport safety standardization scheme (RTSSS). It was observed that there is a significant awareness of the scheme among the operators and drivers of freight transport in the study area with a low level of patronage and compliance. The study also shows that freight transport crashes are still on the increase even after the introduction of the scheme. It is recommended that there should be more awareness and wide publicity of the scheme in Lagos and Nigeria at large. All agencies that are set-up for the implementation of the scheme should be more determine and committed to the realization of the objectives of the scheme. Finally, it is recommended that periodic appraisal of the scheme should be carried out in line with emerging contemporary issues in Road Safety Management.

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STREET ENCROACHMENT BY THE INFORMAL METAL CONTAINER OPERATORS IN OSOGBO, OSUN STATE, NIGERIA

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Abstract

The attendant consequence of the urbanization in the developing countries, Nigeria in particular, is the influx of informal activities. This paper examines the encroachment of streets by the informal metal container operators in Osogbo with the view to evolve a policy framework that will guide the activities of these illegal shop operators and to enhance effective city management. The study examined the socio-economic characteristics of the people in this informal sector, determined their tenure status and measured impacts of these container shops on the environment. Primary data was used for the study. The data was derived from fieldwork which involved direct interview and group discussion with the pedestrians and motorists in the study area and administration of questionnaire to eighty (80) operators of the container shops. Purposive sampling techniques were used in the selection of respondents in the area. Descriptive statistics was used such as tabulation and percentages in the presentation and analysis of data. The study, however, shows that most (75%) of the containers are erected on the road setbacks which has constituted nuisance to the environment. The study also shows that only 15% of the operators enjoyed hereditament while others are on lease and rentage arrangement. The sector is mostly dominated by the female (56.25%) respondents. The paper, therefore, suggested policy framework to guide the activities of this informal sector.

Keywords: Street, Encroachment, Informal, Urbanization

Introduction

It was observed that one in two people will live in cities in 2008 and that by 2030; over 60% of the world population will live in cities, majority of which will take place in the developing world (UNFPA, 2007). Nigeria, is urbanizing at an unprecedented high rate, the urban population percentages in 1970 was 20%, 29% in 1980, 35% in 1990, 42% in 2002, 49% in 2010 and by 2013 it was 51% (World Bank Group, 2014). Thus, the rate of urban population growth of between 7 – 8% far exceeds the national population growth rate of 3%. However, international forecast indicates that by the end of the century, there will be at least 250 urban centres in Nigeria with not less than 18 of them having a population of above 1 million (UNFPA, 2007).

The attendant consequence of the urbanization in the developing countries, Nigeria in particular, is the influx of informal activities. This is largely responsible for the unmet demand in virtually all urban infrastructural facilities and particularly economic demand of the population. Associated with the rapid growth in urban population is a concomitant city space; for example, an indiscriminate encroachment of streets and open spaces by the informal metal container shop operators in the cities and at Osogbo in particular. Such encroachments are very often at the expense of road access, safety and environmental hygiene, and affect the quality of city life. They usually cause nuisance, inconvenience and hazards to pedestrians and traffic. In some cases, pedestrians are even forced to walk on the carriage way intended for vehicles due to obstruction on the walk way.

The aim of this paper is to explore the encroachment of streets and open spaces by the informal metal

container shop operators in Osogbo, Osun State, with the view to evolving policy frameworks that will guide the activities of these illegal shop operators and to enhance city development and management. The objectives set for the study are to determine socio – economic characteristics of people in this informal sector, their tenure and examine the impacts of these container shops on the environment.

Study Area

Osogbo is situated between latitude 7° .46' N, longitude 4°.34' E and latitude 7°.767' N, longitude 4°.567' E. The city is the capital city of Osun State and also headquarters of both Osogbo and Olorunda Local Government Areas. The position of the city justifies the influx of the informal sector into the city. Based on the 2006 census (provisional result) the population of Osogbo is about 287,156 people (Adedotun, 2015). The city has been a commercial centre since the arrival of railway in 1907 which brought the colonial government to the threshold of the city. The city is now a bursting commercial city with a lot of illegal erection of metal container shops in all nooks and crannies of the city (Figures I & II).

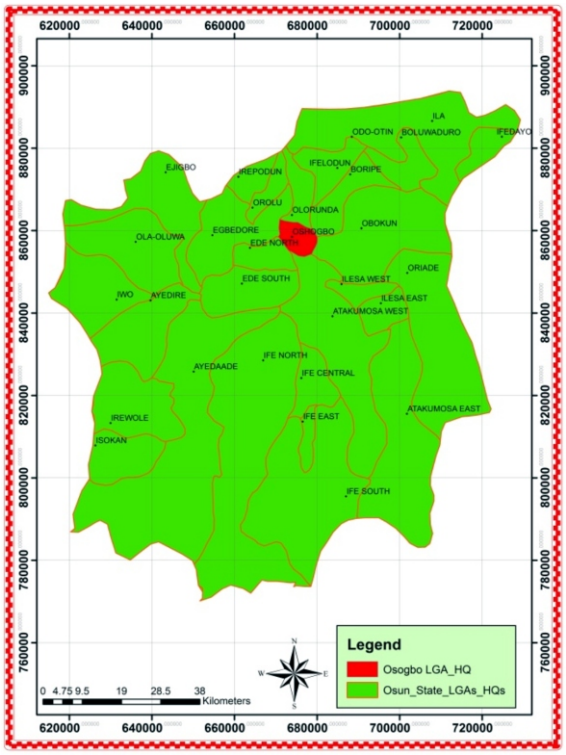

Figure1.1: Osogbo within the context of Osun State

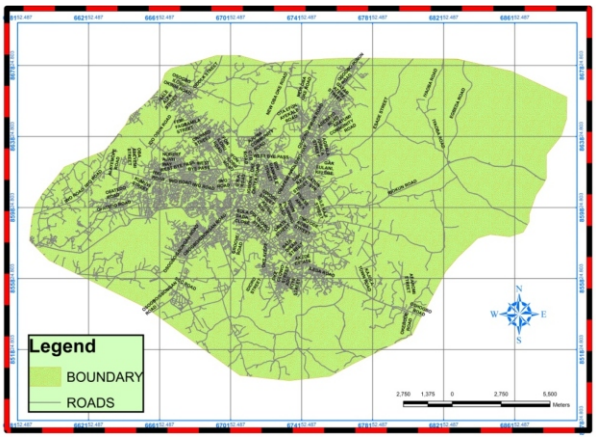

Figure1.2: Map of Osogbo

Concept of Urbanization and Informality

Urbanization has become critically important to international development, but there has been a considerable confusion over what urbanization actually is; whether it is accelerating or slowing; whether it should be encouraged or discouraged; and more generally, what the responses should be. By definition, urbanization refers to the process by which rural areas become urbanized as a result of economic development and industrialization. Demographically, the term urbanization denotes the redistribution of populations from rural to urban settlements over time. However, it is important to acknowledge that the criteria for defining what is urban vary from country to country, which cautions against a strict comparison of urbanization across nations. The fundamental difference between urban and rural is that urban population live in larger, dense, and more heterogeneous cities as opposed to small, more sparse, and less differentiated rural places. Urbanization happens because of the increase in the extent and density of urban areas. The density of population in urban areas increases because of the migration of people from less industrialized regions to more industrialized areas.

The history of urbanization can be traced back to the Renaissance times in 16th century. For instance, Turkish assaults resulted in movement of Christians from the east to western European countries. This resulted in the growth of trade and European cities along the coasts developed greatly. A further boost for urbanization was created with the advent of the "Industrial Revolution" in the 18th and 19th centuries when the population of cities in Europe and USA started to increase significantly. However,

urbanization started in Asia and Africa in the 20th century when the countries obtained independence from colonial rule (McGranahan and Satterthwaite, 2014).

Table 1: Urbanization in the world today

	1950	1990
World	30%	51%
MEDCs	53%	74%
LEDCs	17%	34%

Source: *McGranahan and Satterthwaite, 2014*

Table 1 presents the urbanization trend in the world. MEDC refers to Most Economically Developed Countries and LEDC to Least Economically Developed Countries.

Urbanization usually occurs when people move from villages to cities to settle, in hope of a higher standard of living. This usually takes place in developing countries like Nigeria. Cities in contrast, offer opportunities of high living and are known to be places where wealth and money are centralized.

Urbanization brings with it, several consequences both adverse and beneficial. It impacts on social and environmental areas. It increases competition for facilities due to the high standard of living in urban areas, which has triggered several negative effects. Many people who move to cities in search of a better life end up as casual labourers as they lack adequate education and skills for good job. This leads to one of the worst problems of urbanization – the growth of informal activities such as spontaneous growth of container shops.

To address the question of 'informality', the existing literature has come up with various definitions and concepts. De Soto (1989) observed that there is no distinct border between formality and informality in the legal sense. He noted that individuals are not informal, but their actions and activities are. However, broadly speaking, informal activities are those that are beyond the purview of the state. Informality of a production unit, or an unemployment relationship, is mostly defined through the absence of one or more forms of state mandate regulations, such as registration for taxes, enrolment into a social security system, minimum wage regulation, etc. (Kanbur and Sinha, 2012).

Lipton (1984), in his review of informality identified several strands of conceptualization including small size of enterprise, overlap between capital and labour, and "prevalence of perfect or rather near-perfect competition". This has been argued by Guha-Khasnobis, Kanbur and Ostrom (2006) that these features of activities or a sector, are outcomes of an economic process rather than core defining aspects of informality. They were of the opinion that the core concept has to be the relation of the activity to state regulations. Hussmanns (1996), described informality as a term that designates a range of phenomena, such as absence of regulation, smallness of size, competition etc, that generally go together.

Harriss-White and Sinha (2007) characterize the informal sector broadly as consisting of units engaged in production of goods or services operating typically at a low level of organization, with little or no division between labour and capital as factors of production and on a small scale. However, it has been observed that activities performed by firms in the informal sector are not necessarily performed with the deliberate intention of evading the payment of taxes or social security contributions, or infringing labour or other legislation or administrative provisions.

An empirical work of Chen (2006) and a few others show that those working in the informal sector are predominantly poor in income and in non – income dimensions. For example, in India, the NCEUS (2007, p. 24) estimated that workers in the unorganized sector had a much higher incidence of poverty (20.5%) than their counterparts in the organised sector (11.3%), almost double. This is an indicator of inadequate income levels and the extent of vulnerability of workers in the informal sector. Ju Hing and de Laglesia (2009) maintained that informal jobs are often precarious, have low productivity and of low general quality and that young people and women seem to be over represented within this category of jobs.

Kanbur (2009) made the following proposition of classification of economic activities to help structure thinking about evolution of informality. Firstly, specified the regulations relative to which formality and informality are being defined. Category A can be activity which is in the purview of the regulations and which is complying with them. This is the formal sector as normally conceived and measured in official statistics. The rest are informal. There are three categories of informality. Category B is the activity that comes under the purview of regulations but which is not complying – in other words illegality. Category C is activity which has adjusted out of the purview of the regulation. Finally, category D is activity which is outside the purview of regulations

in the first place and is so not affected by it.

In Nigeria and in the study area in particular the unprecedented growth in urbanization has resulted in all sorts of informal activities in the urban centres among which this study is interested to explore the encroachment of streets by the informal metal container shop operators.

Research Methods

Primary and secondary sources of data were used for this research work, such as administration of questionnaires to the operators of metal container shops and oral interview and small group discussion with motorists and pedestrians in the selected streets within the city. Eighty metal container shop operators were purposively selected across the major streets in the study area. The questionnaire sought information on the socio – economic characteristics of respondents, source of tenure, reasons and purpose for the use of metal container shops among others. Information was sought on the experience of motorists and pedestrians with the erection of containers on the streets in the study area. Descriptive statistics such as tabulation and percentages were used in the presentation and analysis of data. Secondary data were sought from texts, journals and internet browsing for concepts and literature review.

Results and Discussion

Socio-Economic Characteristics of Metal Shop Operators:

The socio – economic characteristics of the respondents considered in this study are; gender, age, education, marital status, and monthly income. The study reveals that 56.25% of the metal shop operators in the study area are female, while the remaining 43.75% are male (Table 2). The study shows that women are more involved in an informal metal shop operation in the study area.

A significant proportion of the respondents (61.25%) in these informal metal shop operations are in the age bracket of 20 – 40 years. The study also reveals that 30% are within the age bracket of 40-60 years. The analysis reveals that most of the people in this sector are in their prime age of production (Table 3). This however calls for government attention on the need to integrate this set of people into the formal sectors of the economy.

Table 2: Gender of respondents

Gender	No	Percentages
Male	35	43.75
Female	45	56.25
Total	80	100

Source: Field work, 2018

Table 3: Age of respondents

Age	No	Percentages
Less than 20years	05	6.25
20-30 years	28	35
30-40 years	21	26.25
40-50 years	15	18.75
50-60 years	09	11.25
Above 60 years	02	2.5
Total	80	100

Source: Field work, 2018

Another socio-economic characteristic of the metal container shops operator examined is the educational status of the respondents. The result shows that 60% of the respondents have post secondary school education (Table 4), while only 5% are without formal education. It was established from the study that the involvement of people in this informal metal container shops operation is as a result of unemployment in the formal sector of the economy.

Table 4: Educational status of respondents

Educational level	No	Percentages
None	04	5
Primary School	07	8.75
Secondary School	21	26.25
Post Secondary School	30	37.5
Graduate	18	22.5
Total	80	100

Source: Field work, 2018

The analysis further reveals that most of the respondents are married (73.75%), while 22.5% are single (Table 5). Table 6 shows that 37.5% of respondents in this sector of the economy earned less than #20, 000 per month, 20% earned between #20, 000 and #30, 000 per month, while only 13.75% earned above #50, 000 per month. The analysis shows that most of the people in this sector are poor and of low-income earners. The study reveals that taking care of the family is a serious challenge for people in this sector of the economy.**Table 5:** Marital status of respondents

Table 5: Marital status of respondents

Marital Status	No	Percentages
Married	59	73.75
Single	18	22.5
Widowed	03	3.75
Total	80	100

Source: Field work, 2018

Table 6: Monthly income of respondents

Income (₦)	No	Percentages
Less than 20,000	30	37.5
20,000 - 30,000	16	20
31,000 - 40,000	13	16.25
41,000 - 50,000	10	12.5
Above ₦50,000	11	13.75
Total	80	100

Source: Field work, 2018

Informal Metal Container Shop operations

Table 7 shows the length of operation of the metal container shops by the respondents. 43.75% started the operation of the metal container shop within the last five years, 35% started within the last 10 years, 17.5% within the last fifteen years, while only 3.75% started within the last twenty years. The study reveals that the activity of these informal metal container operators is a product of influx of people to the city (Osogbo) without corresponding government job for their employment.

The study also examined nature of tenure system enjoyed by the operators of these metal container shops. It shows that 35% are on lease arrangement, 32.5% on rental arrangement, 17.5% acquired the land by purchase from the land owners, while only 15% enjoy hereditament (Table 8). It was observed from the study that most of these metal container shops operator occupied their site on temporary arrangement.

Table 7: Length of stay in the shop

Length of stay	**No**	**Percentages**
Less than 5 years	35	43.75
5-10 years	28	35
11-15 years	14	17.5
16-20 years	03	3.75
Total	80	100

Source: Field work, 2018

Table 8: Land tenure system

Source of tenure	No	Percentages
Family land	12	15
Lease arrangement	28	35
Through government	-	-
Purchase	14	17.5
Rentage	26	32.5
Total	80	100

Source: Field work, 2018

The study further shows that only 26.25% of the people in this sector secure temporary approval for the erection and sitting of their container shops, while 73.75% have no approval for their activities. This shows that the operation of metal container shops in the study area is illegal, which should be discouraged. It is worthy to mention that despite the illegality of these activities, oral interview with the operators in the sector reveals that a token of one thousand and five hundred naira is being paid as tenement rate annually to Local Governments' purse. Table 9 further shows reasons for metal container shops in the study area. 43.75% of the respondents in this sector opted for the use of metal container shops because it is moveable. It can be easily relocated when the need arises. It is never a permanent structure. 26.25% however, do not have access to permanent "cement block" shops within the commercial area, while 18.75% were of the opinion that to build permanent structure for shop is very expensive, hence the option of metal containers.

Table 9: Reason for container shops

Reasons	No	Percentages
Cheap to erect	04	5
No permanent shops	21	26.25
Expensive to build shops	15	18.75
Cannot afford shop rents	05	6.25
Easily moveable	35	43.75
Total	80	100

Source: Field work, 2018

The study also considered the usage of the metal container shops as revealed in Table10, 25% of the respondents use metal containers for sales of provisions, 16.25% use it as business centre (computer and photocopy services), and 15% as cement store, while 12.5% use it for food vending. Further study reveals that 45% of the respondents identified too much heat as the greatest challenge associated with the use of metal container shops,

28% identified spoiling of goods, while 15% identified the risk of closeness to the road.

Table 10: Uses of the containers

Uses	No	Percentages
Office	05	6.25
Sales of food stuff	10	12.5
Sales of provisions	20	25
Cement store	12	15
Work shop	07	8.75
Business center	13	16.25
Food vending	09	11.25
Others	04	5
Total	80	100

Source: Field work, 2015

Oral interview and group discussion with the motorists and pedestrians in the study area reveals that proliferation of metal container shops continues to compromise the safety and access of pedestrians, drivers and other street users. The interview reveals that owing to high shop rentals and keen business competition, many metal container shop operators are tempted to extend their business areas onto the pavements. However, people maintained that placements of these containers often obstruct pedestrian traffic and causes nuisance, inconvenience and hazards to pedestrians and traffic. Further observation also reveals that 75% of the containers surveyed were placed on the kerbs and gutters. It also affects the aesthetics and landscape of the city due to improper coordination in the size, usage and placement of the container, hence the ugly outlook of the city.

Conclusion

The study reveals that the attendant consequence of urbanization in the developing countries like Nigeria is the influx of informal activities. This resulted in the unmet demand in urban facilities especially organised shops. The study examined the encroachment of street with illegal metal container shops in Osogbo with the view to evolving policy guidelines for these informal sectors.

The study shows that women are dominant in the operation of informal metal container shops in Osogbo, while most of the people in this sector are within the age of adulthood. Most of these people also have post secondary education and are married. The study further reveals that, most of the people in this sector of the economy are low income earners. The result also shows that most people in this sector began in the last 10 years. This is truly the products of urbanization since it all started when Osogbo became tne state capital of Osun State. Most of the operators are squatters; they occupy their site on a temporary lease and rental arrangement. Furthermore, the study reveals that the operators opted for the use of metal containers because it can be easily relocated if need arises and because of lack of access to commercial shops. Most of the shops are used for provision stores, business centres and cement store. Problems identified with the metal container shops are too much heat, spoilt of goods and risk of closeness to the road.

It has been confirmed from the study that erection and placement of metal container shops on the streets causes obstruction and inconvenience to road users – drivers and pedestrians, hence the need for urgent attention to address this ugly urban sprawl scenario.

The following recommendations are therefore made: First, government should through the Ministry of Lands and Physical Planning embrace urban design that will provide for adequate and affordable shopping complex in the nook and crannies of our cities.

Government should consider enforcement of the existing law against erection and placement of containers on road sides. Thirdly, there must be legislation by the appropriate authority guiding the construction, erection, and placement of metal container shops in our cities.

Finally, media outfit should be involved in the public education and publicity on the risk involved in the street encroachment by the metal container shops, exhorting these operators not to extend their business areas and obstruct the pavements. Pamphlets or leaflets on legal consequences of street obstruction in general may be produced and distributed to shops and other businesses that operate on the streets.

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AN ASSESSMENT OF THE POTENTIAL OF GIDAN DAN HAUSA MUSEUM FOR SUSTAINABLE TOURISM DEVELOPMENT IN KANO STATE, NIGERIA

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Abstract

This study assesses the potential of Gidan Dan Hausa (Hall of Fame) museum for sustainable tourism development in Kano State, Nigeria. An inventory of collections/galleries for tourism development, analysis of the available facilities around the site and major problems affecting the development of the museum were achieved. The data for the study were obtained from primary and secondary sources. Data pertaining to infrastructural facilities were collected using checklist, interview and observations at museum and its environs. Accessibility by road of the museum from tourist transit camp (TTC) was determined in the GIS environment. ArcGIS 10.3 version and SPSS version 17.0 were used for the analysis of the data obtained. The study revealed that, Gidan Dan Hausa museum promotes cultural tourism in the state and has six (6) collections/galleries centers. The result of the facilities assessment revealed that Gidan Dan Hausa was found to have great potentials to meet tourism market demand. The distance of the museum from the TTC was found to be 5.73km. Lack of government commitments and low level of patronage by the community was the major problems affecting the development of the museum. The study recommends that governments, private sector and individuals should gear up towards developing the museum in order to promote and diversify the economy of the State. Adequate funding should be provided by the government and non-governmental organizations to sustain the activities of the museum. Provision of adequate facilities through public-private partnership should be encouraged at the museum. Campaign and awareness should be undertaken vigorously by the museum officials in order to sensitize the community.

Keywords: Gidan Dan Hausa, Museum, Tourism, Infrastructure and Sustainable Development

Introduction

Visiting Museum as a historical and cultural heritage sites is one of the most popular tourist activities today where families, students, groups and even national and international visitors choose to visit when on vacation or study tour (Valence 2008). This makes museums to be among the fastest growing institutions in the world, particularly in promoting tourism especially in cultural services, when considering expenditures and the number of visitors its generate globally (Graburn, 1998). As opined by Adeniji and Ekanem (2013), a museum is a cultural institution that has to do with collection, presentation and display of natural and cultural objects for the advancement of knowledge. This makes it to be part of the heritage tourism due to its cultural identity that often provides the primary important contribution to knowledge. It is through this collection and exhibition of materials that one creates links between the people's past and present, and views them as avenues through which future generations can have an opportunity of seeing and appreciating the relics of the past (Adeniji and Ekanem, 2013). Thus, the general mandate of museums is to educate their visitors about the history, cultural and natural heritage of a city, region or country or about a chosen subject of special interest, while also preserving these elements for future generations (Culley, 2010). On the basis of this International Council of Museums (ICOM) (2010) defined museum as a nonprofit making,

permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for the purpose of study, education, and enjoyment, material evidence of people and their environment. In fact museums play a major role not only in the wider sphere of arts, but also within tourism industry due to its ability to attract cultural tourists.

According to Onyejegbu, (2014), the formal organization, preservation and display of valuable items of cultural heritage in a museum came into being in Nigeria as a result of recognition of the presence, abundance and value of rich cultural patrimonies in the nation which need to be preserve and organize in a way that will benefit the people and the world by the British expatriates such as K.C. Murray, E.H. Duckworth and Bernard Fagg. These According to Afigbo and Okita (1985) gave birth to a solid foundation for the establishment and development of formal museum such as the Esie Museum in 1945 and the Jos museum in 1952, and today, there are museums in almost every state of the Federation including national, state and university-based museums (Onyejegbu, 2014). In Nigeria museums basically revolve around three or four major types, namely; ethnographic, archeological, and colonial as well as war museums. A visit to any one of these numerous Nigerian museums, especially the archaeological and ethnographic museums, will really make one to understand the country's rich heritage and cultural traditions (Onyejegbu, 2014). Therefore, museums as a means of preserving cultural heritage of the nation play great roles in the success of the nation tourism industry.

This industry is the largest and fastest growing industry that has significant positive change in the world today in terms of employment in areas characterized by natural and man-made attractions. Tourism as a product and service-oriented industry, could generate widespread benefits and impacts to the economy and society which could contribute to the achievement of Sustainable Development Goals (SDGs) particularly those concerning poverty alleviation, conservation, and generation of employment opportunities (Aser and Dulce, 2011) and plays a vital role in the integration of cultural setting. As such when properly developed and managed, can serve as a mechanism for preserving historical, archaeological and religious monuments; and stimulating the practice of local cultures, folklore, traditions, arts and craft and cuisine (Federal Republic of Nigeria, 2006).

Nigeria possesses a number of heritage sites (Museum) which make the nation to be a custodian of varied and fascinating cultures, (Ayeni, Igbokwe, Onojeghuo, Onojeghuo and Ojiako 2012) amongst which is Gidan Dan Hausa Museum of Kano state that has the potential to be incorporated in the overall tourism and sustainable development. With all its potential in tourism promotion, the heritage tourism potential has been given little attention by tourism managers, planners and researchers of the country. This can evidently be seen from the study of Akpan and Obong, (2012), Adeniji and Ekanem (2013) and Hannu, Otto and Arttu (2014) that focuses on the economic advantages of the tourism development without looking at their potential of attracting tourists in relation to facilities they possess. On the basis of this, the study intends to take an inventory of collections/galleries of the Gidan Dan Hausa Museum for tourism development, analysis of the available facilities around the site that has the potential to attract tourist and market the site to the global communities as well as major problems affecting the development of the museum.

Conceptual Framework of Sustainable Tourism Development

To successfully achieve sustainable museums for tourism development, Christer and Akram, (2017) opined that, successful museums are deeply involved and engaged in the surrounding environment and community by developing a sustainable activities and programs. Because Museums that are isolated from their surrounding development always suffer from low visitation due to their disconnection with other services that serve as a reinforcing activity in order to achieve the three pillars of sustainability: economic, social, and environment protection. Therefore, Museum is a cultural hub of social and cultural activities that are dependent on sustainable development principles. The idea of tourism sustainability or sustainable development according to Guðbrandur, (2004) is the ability of a destination to maintain the quality of its physical, social, cultural, and environmental resources against risk of being lost either through physical destruction or loss of knowledge so as to compete in the global market. On the basis of this McKercher and du Cros (2002) stresses that; sustainable cultural tourism addresses the management complexities incorporating both use and conservation values because where the asset is fragile or has not much market appeal or tourism potential, tourism might be discouraged. Hence, to

achieve this, the obligation of museum as a Cultural heritage site is to sustain and conserve their collections for the present and future generations use (figure 1). In essence museums as an important tourist attraction provides cultural experiences and brings infrastructural development to the host community, need to be sustained, preserve and conserve it's in order to achieve the economic, social, and environment protection.

Tourism Facilities and Accessibility for Sustainable Development

Tourism resource involves multiple agencies and different kind of information to assist a quite complex decision-making process in tourism planning and management. It is made up of interrelated functions; lodging, catering, transportation, attraction, entertainment, etc. that work together to offer tourists experiences that lead to repeat visits or word of mouth commendation (Bassey, 2012). For a tourism site to be fully harnessed, it should follow the criteria set by Smith, (1994) in his tourism product model;

The model illustrates how the tourism products evolve and are spaced out. At the center is the Physical Plant (site) which term as PP Where the actual site of the attraction occurs. Closed to it is where other services are found that will make the tourists to feel at home, such as transportation, catering services, accommodation, and Guide services termed as (S). In (H) which tells the Hospitality aspect of the tourism products where pleasant activities of the destination such as space, recreation and leisure activities are taking place which make it an attractive place to live in. However, at the Freedom of choice denoted by (FC) is a place where the tourists have freedom to choose from the variety of goods and services available at the destination, such as; clothing shops, souvenirs, banks, chemists, restaurants and other services.

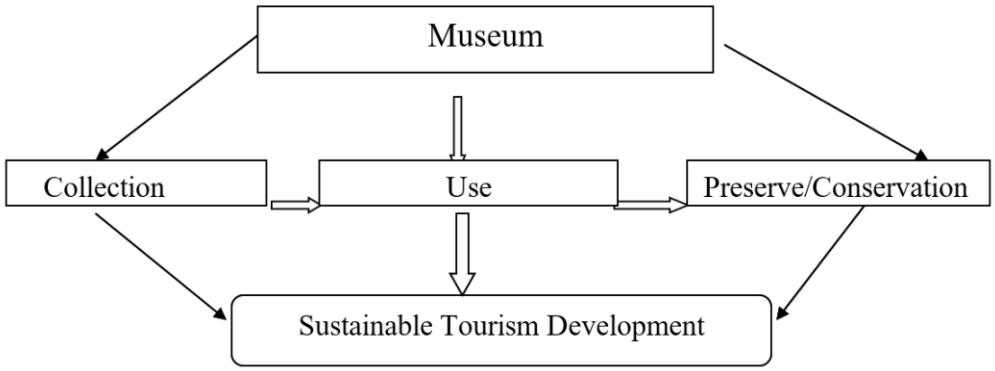

Figure 1: Model of Museum as a Cultural Heritage Site for Sustainable Tourism Development
Source: Author (2018)

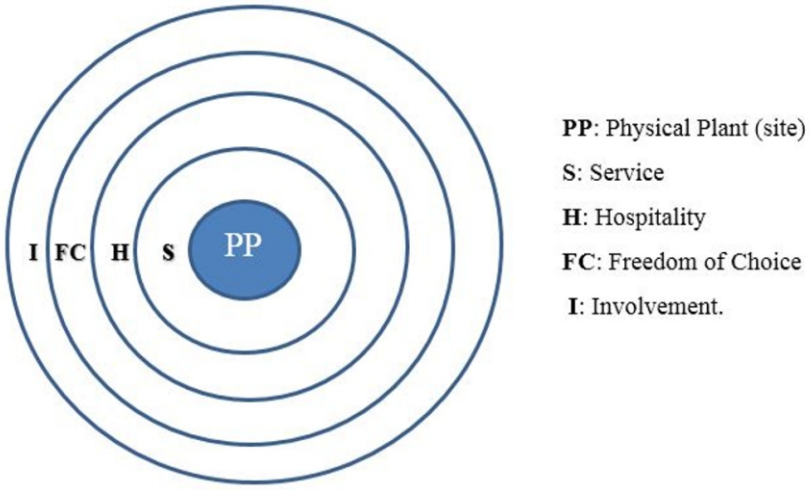

Figure 2: Tourism Product Model
Source: Smith (1994)

At the end of the circle, is the zone of Involvement (I) where other organizations that are involved in tourism directly or indirectly are found, such as travel agencies and tour operators that package several of these services together and sell them to the tourists. In essence, for a tourist site to be fully harnessed in should have the ability to arouse the interest of the tourist by providing necessary experience and activities that tourists need.

However, no matter how potential a tourist's site is in terms of availability of facilities, access to it will also determine its potential or otherwise within the tourist's communities because of it's important as geographical element in the tourism system. Generally, accessibility is used to measure the spatial interaction and the performance of the transportation system modes that can be used to identify areas with low accessibility (Handy and Kelly 2001 and Bhat, 2000) and this also applies to common services such as health care, schools and shopping centers as well as tourist sites (Aldakhil, 2007). Therefore, accessibility as stated by Aldakhil (2007), typified not only the in-between places which may be visited *en route*, but also the short period of travel to get to the destination.

Description of the study Area

Gidan Dan Hausa museum located in Tarauni Local Government Area of Kano Metropolis lies approximately on latitudes 11^0 59^I 09.0^{II} North of the Equator and longitudes and 8^0 29^I 08.8^{II} East of the Greenwich Meridian. It shares boundaries with Nassarawa local government area in the North, in the south and southwest it borders with Ungogo local government area and Kano Municipal to the west (Figure 3). The house became first modern school in the whole Northern Nigerian Protectorate in 1909 where *Tamarindus indica* trees served as the classes. The students of the school were princes drawn from various parts of Northern Nigeria, who later became emirs, pioneer teachers, and administrators for the region. It is now a historic site (a museum).

The area shaped by the process of pediplanation that made it possible for the older granites to give way to flat terrain in this area and gives the area advantage to offers a good opportunity for human settlement and makes the Museum in the areas to be easily accessible. The climate of the study area is the tropical dry-and-wet type, with four distinct seasons, *Rani* (warm and dry)*, Damina* (wet and warm), *Kaka* (cool and dry) and *Bazara* (hot and dry) closely associated with the movement of the Inter Tropical Discontinuity (ITD) zone (Olofin 1987; Olofin, 2008). The average temperature is a bit hot, even during the Cool Harmattan period where the minimum temperature hardly falls below 11°C and the monthly average temperature is not less than 20°C, whereas during the hot season usually Mid – March to Mid-May, the maximum temperature may be as high as 40°C with average temperature range between 30°C and 32°C (Ayila, Oluseyi and Anas, 2014).

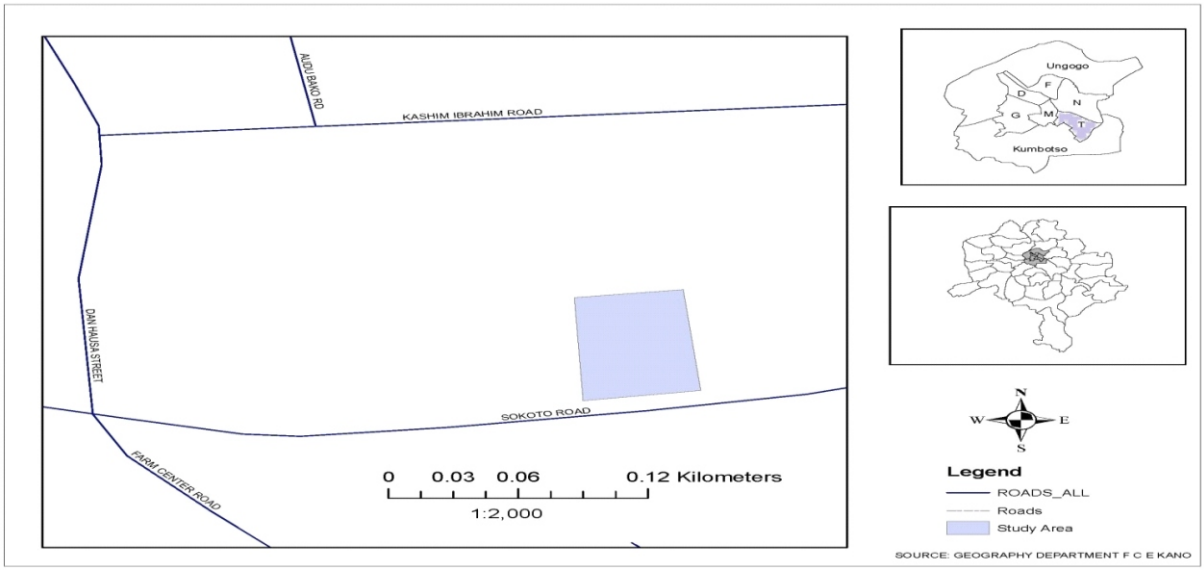

Figure 3: Gidan Dan Hausa Museum Kano Metropolis

Materials and Method

This research adopted a survey design using primary and secondary data. The primary data were obtained through checklist and were complemented with oral interviews and observations. Data on the infrastructural facilities were also collected through direct field observations and interviews using checklist at the point of taking the coordinate. Information sourced includes nature of the road, average duration of power availability/supply per week, access to communication network, accommodation (distance from the center, condition of the accommodation, capacity, Internet, catering and laundry), catering services (Suya spot, local/modern restaurant, Snacks shop, and soft drinks shop). Other information includes Souvenirs shops, their distances from the tourism center, varieties and types (local or imported). The authorized speed limit per hour from the Federal Road Safety Corps was also used.

However, accessibility was examined to determine the distances from tourist transit camp (TTC) to the museum using the Arc GIS ruler. Therefore, travel time using minutes as the unit of measurement was used. The use of travel time adopted in this study as suggested by Aldakhil (2007) gives a more accurate measure of the accessibility of tourist site. For this purpose, the road categories and the average speed on the road networks were identified from the Federal Road Safety Corps (Table 1). Thus, distance or road length was adopted as the impedance for this study and the drive time was calculated by dividing the road length in Kilometers by the speed limit and multiplies by 60 which represents minutes. Drive Time = length in Km / speed limits multiply by 60.

$$\text{Travel Time} = \frac{\text{Length of arc (in KM)}}{\text{Average speed limit}} \times 60$$

This formula was adopted and modified from Aldakhil (2007) in his study. Data obtained from the checklist on the level of facilities around the center on a scale of 0- 5 (very good 5, Good 4, moderate 3, poor 2, very poor 1, absent 0) using Tourism facility Index (TFI) were analyzed using SPSS technique version 17.0 in order to observe the potentials available at center. The mean infrastructure scores (that is, X1+X2+X3+X4+X5+X6/6) were used as yardstick for determining the overall level of infrastructure development in a destination. The assessment was done such that the mean infrastructure score within the range 1.00 - 1.99 was adjudged "poor" while scores; 2.00 - 2.99; 3.00 - 3.99; and 4.00 and above were adjudged to be moderate, good and very good respectively.

Results and Discussions

Inventory of galleries at Gidan Dan Hausa Museum

The total numbers of existing galleries in the museum that are worthy for attracting tourists are six (6), Table 2. Though at the time of data collection Ado Bayero gallery (Number 6) was under renovation and the artifacts were promised to be brought by the family of late Emir of Kano, Ado Bayero.

The artifacts available in the galleries range from traditional cultural artifacts before colonial masters, colonial and post-colonial artifacts such as Traditional Shoes Jewelries, Old Currencies of Coins and Notes, War stone tools, Chain armor, Gown of Emir Sunusi I, Silver Staff of the Office of the emir of Kano Alhaji Abdullahi Bayero (1926-1953), Trumpet, Pictures of Past Emirs of Kano, Pictorial Grave of Usman Dan fodio and Pictures of Hanns Vischer in a Class, War Drum, Animals Leather, Traditional Crafts, Tanneries, Traditional bowl, Agricultural Implements, Weaving tools, Army war equipment's, etc. This indicates that Gidan Dan Hausa Museum is a home of cultural tourism that portrayed the people of the past and their activities.

Table 1. The roads categories and types of vehicles speed limit in Nigeria.

S/N	Types of Vehicle	Built-up	Highway	Expressway
		(Average speed limit in Km/ hr)		
1.	Motorcycles	50	50	
2.	Private cars	50	80	100
3.	Taxis and Buses	50	80	90

Source: Modified from FRSC (2015)

Table 2. Inventory of galleries at Gidan Dan Hausa Museum

S/N	Name of the gallery	Artifacts
1.	Waiting Room	Traditional Shoes before Colonial Masters, Jewelries, Old Currencies (Coins and Notes), War stone tools, Grinding stone, Chain armor, Local treasurers, War Drum, Animals Leather etc.
2.	Dining Room	Gown of Emir Sunusi I, Silver Staff of the Office of the emir of Kano Alhaji Abdullahi Bayero 1926-1953, Trophet, Pictures of Past Emirs of Kano since from emir Suleiman bn Hama 18051819 to Alhaji Ado Bayero 2014, Pictorial Grave of Usman Dan fodio and Pictures of Hanns Vischer in a Class etc.
3.	Family Setting Room	Traditional Crafts, Tanneries, Traditional bowl, Agricultural Implements, Weaving tools, Army war equipment's, Hunting implements
4.	Children Bedroom	Traditional singers such as Uwaliyya Mai Amada, Dan Kwairo, Haruna Uji and Mamman Shata, Rattle, Drum gourd, Hausa Guitar, Reed wind Instrument, Dressed hide vessel, Ceremonial dress of late Governor Audu Bako of Kano State, Royal Regalia of Sir Ahmadu Bello Sardaunan Sokoto
5.	Master's Bedroom	Silver Ceremonial sword, Grammer Phone, Pictures of Nigerian Leaders before Independence, British armor, Hand written Holy Qur'an, slate etc.
6	Ado Bayero Gallery (Kitchen)	Ado Bayero Royal regalia, Royal Cars and Pictures etc.

Source: Field work (2018)

Accessibility of Gidan Dan Hausa Museum as a tourism site in Kano

In terms of accessibility Gidan Dan Hausa is found within the built-up areas of Urban Kano where the speed limit is 50km per hour. This makes the Museum to be accessible and thus creating the possibility of attracting more people to visit the site. The distance between the Museum from the tourist transit camp is 5.73km with travel time of 6.87 minutes. This affects the choice of the destinations, travel behavior of the tourists in relation to his activity and duration of stay at the site. Thus, the distance of tourism destination from the tourist origin or his place of residence determines destination choice by the tourist. Because choice of destination is largely controlled by distances which influence the cost of travel in relation to travel time, transportation, tourist guide allowance, tourist activity at the destination and access to tourism facilities and in turn affect the overall level of patronage (Muhammad, 2017).

Infrastructural Facilities around Tourist Sites

Based on the analysis, the results revealed that the museum has mean values of 4.00 (Table 3) that makes it to have good potential for attracting and be able to compete with the market demand. This good potential of the site has relation to its closeness to the availability of tourism facilities (transport, electricity, communication, accommodation, catering services and souvenirs shops). This is attributed to its location close to State road, Yahuza catering services, Join and Joy restaurant and little per distance with Grand Central Hotel and Abubakar Rimi Market where tourist can purchase different types of souvenir. However, the site (Gidan Hausa) is the first western school in Northern Nigeria where a Swiss Sir Hanns Fischer taught students in 1909 and now the site serves as the Headquarter of Kano State History and Culture Bureau.

Table 3: Facility Assessment

Variables	Value
Nature of the road	4
Duration of electricity per week	4
Access to Communication	5
Distance accommodation from the center	4
Type of the Accommodation	4
Capacity of the accommodation	5
Internet services in the accommodation	0
Catering Services in the accommodation	4
Laundry Services in the accommodation	4
Distance of Catering Services from thecenter	5
Suya /Fish Spot	5
L/M Restaurant	5
Snacks Shop (s)	4
Soft drinks	4
Distance of Souvenir shop from the Centre	3
Variety of Souvenir	5
Types of Souvenir	3
Mean Value	**4.00**

Data Analysis (2015)

This situation can be understood when looked at the model of Smith, (1994) where the model practically explained the fundamental role of infrastructure and other facilities in tourism development, because where destinations are lacking in other basic infrastructure such as guesthouses, catering services, access to communication that tourists can commute from the urban centers to such destinations provided the destinations are linked by good and quality facilities. Thus, for tourism resource to flourish and promote economic growth and development it must have good facilities around it that may influence the choice of the tourist.

Major Challenges affecting the development of the Museum

Based on the interview conducted, the study revealed that lack of government commitments, improper maintenance of the building, inadequate marketing and promotional materials and low level of patronage by young and senior adults were the major problems affecting the development of the museum.

Conclusion and Recommendations

This research inventoried the galleries available in Gidan Dan Hausa Museum, accessibility in relation to time to reach the tourist transit camp and the assessment of facilities found around the destination.

The study revealed that, there are six galleries at the museum that houses important cultural landscape of the state that are waiting for consumers (tourist) at any moment for exploration. The travel time from tourist transit camp showed that the museum is located close to tourist transit camp with travel time of 6.87 minutes. Also the study concluded that, Gidan Dan Hausa Museum has good potential to meet market demand with calculated mean value of 4.00. Hence, with all these developments the museum suffered from lack of government commitments, improper maintenance of the building, inadequate marketing and promotional materials and low level of patronage by community were the major problems affecting the development of the museum.

Following the findings and limitations in this study, the following recommendations are made.

1. The study recommends that Government, private sector and individuals should gear up towards developing the museum in order to promote and diversify the economy of the State.
2. Adequate funding should be provided by the Government and Non-governmental organization to sustain the activities of the Museum.
3. Provision of adequate promotional materials through public-private partnership should be encouraged at the museum.

4. Campaign and awareness raising should be undertaking vigorously by the museum officials in order to attract more international tourist to patronize the museum
5. There is need to provide measures that would protect the building as a cultural tourism resources for future use.
6. To continue harnessing its potentials of rich Cultural resources values, the artifacts needs to be sustain for the future generation to appreciate what past hold for them.

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QUALITY OF URBAN OPEN SPACES IN A SOUTHWESTERN NIGERIAN CITY

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Abstract

Open spaces are multi-functional and beneficial in diverse ways to both residents and the general environment. However, most attention has been on formal open spaces, other typologies are commonly ignored especially in developing countries where different types of informal open spaces exist. This study examined the quality of open spaces in Osogbo, Osun State, Nigeria. Primary data were obtained through a multi-stage sampling technique. Three neighborhoods each were purposively selected from the high, medium and low-density areas. Typologies of open spaces were identified through direct observation. Geographic information systems were used to obtain information about features and quality of open spaces. Descriptive and inferential were used to analyse the data. The results showed that school playgrounds were the most common (63.6%); open spaces in the high-density areas had the best quality and overall, the neighbourhood park had the best quality. The results of chi-square analysis show differences in open space typologies within the residential densities were statistically significant (χ^2 = 244.832, df = 6, p<0 .001). Findings show that quality of open spaces differ by residential densities. The study recommends design interventions that consider the potentials of informal open spaces to improve the quality of urban residential neighborhoods.

Keywords: Built environment, Geographic Information Systems, Open space quality typologies, Urban neighborhoods.

Introduction

Open spaces are very important in the design and planning of residential environments. Open spaces play prominent roles in defining physical and environmental characters of residential neighbourhoods. Open spaces are generally considered as avenues through which people are able to interact with nature, recreate and socialise (Omoleke, 2012). Findings from literature review revealed that open space is inter-disciplinary in nature. An overview of these studies suggest that scholars have studied open spaces from physical sciences, managerial, economic, policy, health, socio-ecological and environmental-psychology perspectives (Cafuta, 2015; Wang, 2015; Vaughan et al., 2013; Elizalde, 2013; Bununu, 2012; Sutton, 2008).

This suggests that a universal meaning for this subject may be challenging. However, terminologies such as urban green spaces, green infrastructure, public open spaces, urban recreational spaces, green space network, neighbourhood open space and urban greening are used interchangeably in literature as urban open space.

The most commonly used term is open space. Kellett and Rofe (2009) defined open space as space within the urban environment which is readily available to the community regardless of its size, design or physical features and which is intended for, primarily, amenity or physical recreation, whether active or passive. This definition implies that urban or public open spaces can be put to different types of uses by residents at various planning scales. At the individual plots in residential areas, open spaces exit as

driveways, parking spaces, interior courtyards, household gardens, kitchen gardens and play spaces. Similarly, at the neighbourhood level open spaces exist as playgrounds, sport facilities, parks, incidental space, streetscape, communal spaces, driveways, courtyards, small private and public gardens. Open spaces at national scales can exit as national parks, stadia, game reserves and agriculture fields.

Stanley *et al.* (2012) posits that open spaces are not limited to residential areas alone but can also be found in other land uses in the urban fabric. Stanley et al., (2012) defined open space as any urban ground space, regardless of public accessibility, that is open or covered by an architectural structure. The urban environment can be broadly categorised into green and grey (non-green) space. Non-green open spaces are the paved surfaces of playgrounds, sport facilities, walkways, cycling routes, yards and hard-surfaced squares (Jurkovič, 2014; Thawaba, 2014).

Another term which sometimes refers to the open space but which emphasizes more on the green content is green space. Terms such as public green space, urban green space and green space network are used interchangeably in this context. It can also differ in ownership (public or private) size, accessibility (open to general public or restricted to certain categories) of users. Green space typically includes parks, both designed for formal and informal physical activities, playgrounds and nature reserves (Regional Public Health, 2010; Brodhead, 2009). According to the Greenspace Scotland (2008), green space refers to any vegetated land or water within or adjoining an urban area and includes natural green space, green corridors and amenity grassland, parks and gardens. It also includes outdoor sports facilities, playing fields, cemeteries and allotments and derelict, vacant and contaminated land.

While research on open spaces is growing, almost all existing studies are domiciled in developed cities of western countries. In view of the clear cultural and socio-economic differences, it is not certain if the findings of these studies are generalizable to other countries, especially developing countries (Chen et al., 2016; Green Health, 2014; Omoleke, 2012). This is especially necessary in low income countries like Nigeria, because the literature on open spaces is few and studies on open spaces in urban environments were defined and conceptualised in very limited ways (Sati et al., 2016; Simon, 2016; Sati et al., 2014). For example, these studies have limited their focus on parks, usually excluding other types of open spaces such as school playgrounds, gardens and incidental open spaces. Hence studies are needed to capture a variety of open spaces. Therefore, this research aims to provide contextual information on the types and attributes of neighbourhood open spaces in Osogbo in order to inform researchers, policy makers and built environment professionals.

Literature review

Typologies of Open Spaces

Findings from studies show that open spaces have been categorised as food production areas, parks, gardens, amenity space, incidental space, recreational space, plazas and streets (Stanley et al.,2012; Aziz, 2012; Schipperijn, 2010; Mell, 2010).

The external environment is made up of two main entities, green space and grey space. The green space may either be linear (occurred along transport routes such as roads, railways), semi-natural (wetlands, woodland), functional (allotments, churchyards, school grounds) or amenity (parks and gardens) (Adjei Mensah, 2014; Dunnett et al., 2002). The second component of the external environment, which is grey space covers land that to a greater extent is sealed, impermeable and has hard surfaces such as concrete, paving or tarmac. The grey space is of two types, functional grey space which provides a specific purpose such as roads, pavements, car parks and other hard surfaced areas related to different types of built development and civic grey space publicly accessible areas planned basically for public enjoyment such as town squares, plazas and esplanades (Urban Development Vienna, 2015; Adjei Mensah, 2014).

Parks and gardens are very common type of open spaces used in studies. Typically, classification schemas of parks are based upon the size, function, geographic location, target population and the types of facilities present and sometimes the degree of naturalness of the open space (Stanley et al., 2012; Byrne and Sipe, 2010; Coorey, 2007). Findings from studies show that open spaces are categorised as urban parks, nature parks, pocket parks, district parks, community parks and neighbourhood parks. For instance, pocket parks, also known as mini-park or vest-pocket parks, are urban open space at the very small scale usually no more than one-quarter of an acre. Functions can include small event space, play areas for children, spaces for relaxing or meeting friends, taking lunch breaks (Byrne and Sipe 2010). Amenity open space is another common typology. Spaces such as informal recreation spaces, children's

play areas, playing fields, communal green spaces within housing areas, domestic gardens, village greens, urban commons, other incidental space and green roofs are in this category (Shi, 2013; Elizalde, 2013). Because of the diverse and multifaceted nature of urban open space in literature, open space is defined in this study as all amenity or incidental space, playgrounds and parks at neighbourhood and residential scale regardless of its size, design or physical features and use.

Open Spaces Attributes

Broadly speaking, open spaces have physical and social attributes. Personal safety from fear of crime and anti-social behaviour concerns are examples of social issues relating to open spaces while conditions, facilities, amenities, size, accessibility and aesthetics of open spaces are examples of physical attributes that have been extensively studied (Chen et al., 2016; Vaughan et al., 2013; Brunnet et al., 2012). Preferences, attitudes, meanings and value of open space were examined either qualitatively or quantitatively. In some studies, respondents were asked for their level of agreement with attitudinal statements using quantitative methods while meaning and values of open spaces were explored via qualitative means (Jorgensen and Gobster, 2010).

McCormack et al. (2010) examined the characteristics of parks associated with park use. Results showed that attributes such as personal safety, aesthetics, amenities, maintenance and proximity are important for encouraging open space use. It also reported that perceptions of the social environment entwine inextricably with perceptions of the physical environment. Similarly, in a study carried out by Coorey (2007), social qualities such as interaction, privacy, safety and crowding were reported to be significant in a study of open spaces in high density zones of public housing estates in Hong Kong.

Other physical factors such as aesthetic preferences and visual perception of open spaces have been studied by scholars. The category of aesthetics incorporates the perceived attractiveness and appeal of the various design elements of an open space. A study shows that having something beautiful or interesting to look at while exercising or visiting an open space can be a powerful motivator for physical activity (Bedimo-Rung et al., 2005). Some other studies have suggested aesthetics of open space as the most important attribute that influence use. For instance, Sugiyama et al. (2010) posits that attractiveness of open space may be more important for physical activity than is size or number of open spaces alone. Thus, simply increasing the numbers of open spaces in neighbourhoods may not be effective in promoting residents' use, unless it has features that make them attractive.

Hidalgo et al., (2006) deconstructed aesthetics of open spaces into variables for in depth examination in two European cities. Vegetation, visual diversity, congruence, openness, luminosity, historical place, cleanliness, maintenance, place for leisure activities, meeting place, and novel place were used in two different cites of Malaga (Spain) and Padova (Italy) to examine aesthetics attributes of open spaces. In a qualitative review of the characteristics of open space associated with use and physical activity, presence of tress and hedges, flowers, grass, flowers, natural settings, water features, presence of distinctive smell in open spaces were attributed as aesthetic qualities (McCormack et al.,2010).

Features of open spaces can positively or negatively affect use. Features as conceptualised in most studies are made up of facilities and amenities. Facilities of an open space can be used for active and passive activities while amenities are the elements that support activities (Vaughan et al., 2013; McCormack et al., 2010; Bedimo-Rung et al., 2005). For example, Vaughan et al. (2013) explored the distribution of park availability, features, and quality across Kansas City, Missouri. Results showed that low-income neighbourhoods contained significantly more parks, but also had fewer parks with playgrounds and more quality concerns per park. It was also reported that high minority neighbourhoods had more parks with basketball courts, but fewer parks with trails, while medium-income neighbourhoods contained more aesthetic features per park (Vaughan et al.,2013).

Physical conditions and availability of facilities in open spaces are important issues that have been examined in literature. Findings from McCormack et al. (2010) submitted that poor conditions of features such as uneven playing surfaces, courts with cracks and poor quality footpaths might deter park use. While poor maintenance and condition in themselves can discourage park use, poor maintenance negatively affects aesthetics, perceptions of safety, functionality, and the overall perception of park quality as well. Unsafe or poorly maintained parks may discourage use even when they are located within easy walking distance of home.

Studies like Fermino et al. (2013), conducted in Curitiba, Brazil also reported that attributes such as presence of attractions, low traffic, trees and the neighbourhood environment were all associated with increased open spaces use. It stated further that aesthetics, traffic and crime safety attributes of neighbourhood open space encouraged use rather than any feature alone. Dunnett et al. (2002), asserts that the provision of dog litter bins, seating, litter bins, information centre/boards, children's play area, sports areas, provision of a café and toilets would particularly encourage infrequent users to use urban green spaces. Use of open spaces is not dependent on features alone but also the condition of the features. Users are more likely to use open space where features are maintained on regular basis and shun those places that are in disrepair (McCormack et al., 2010).

Methodology

Primary data were obtained through a multistage sampling technique. Preliminary investigation via Satellite Imagery from Google Earth (acquired in 2017) and reconnaissance survey revealed the major neighbourhoods in Osogbo. Examples are shown in Figure 1-3. The study of the physical attributes and imageries showed the existence of low, medium and high residential densities in the study area. The investigation from reconnaissance survey also revealed availability of open spaces such as incidental space, playgrounds as well as parks in the study area.

The sample frame comprises all residential zones identified from the preliminary survey of the study area. The first stage of sampling stratified the study area into high density/low quality residential area, medium density/ medium quality residential areas and low density/ high quality residential area was done based on dominant observed characteristics and updates on Adedotun (2016). This stratification was based on previous studies which asserted that open space attributes are better carried out on the basis of residential densities (Rollings et al. ,2015; Vaughan et al., 2013; Astell-Burt et al., 2013; Crawford et al., 2008; Croucher, 2007).

The second stage was the purposive selection of the density areas due the varieties of open spaces in existence these locations. From the high residential density area, Alekuwodo, Owoope/Sabo, and Ogooluwa neighbourhoods were purposively selected. In similar manner, Powerline, Oke-Onitea, and Igbonna were selected from medium density area and G.R.A., Oroki Estate and Oke-Ayepe were selected from the low density area respectively Direct observation schedule was used to examine physical attributes of only publicly accessible open spaces in the selected neighborhoods. information such as the specific locations, sizes of open spaces, types of open spaces, features, conditions, aesthetics elements and amenities were obtained. Frequency tables, cross tabulation, and analysis of variance were used to analyse the data.

Findings and discussion

Types of Open Spaces

Results from direct observation revealed 33 open spaces in the selected neighbourhoods. The open spaces were categorised into four major typologies as identified in literature (Shi, 2013; Elizalde, 2013; Stanley et al., 2012; Byrne and Sipe 2010; Obateru, 2009). The classification categories were school playgrounds, neighbourhood park, incidental open space and pocket parks (Figure 4).

School playgrounds were the most common open space typology observed in the city (63.6%), 27.3% of the open spaces were incidental in nature, while 3.0% was neighbourhood park while 6.1% were pocket parks. In the low-density area, 83% of open spaces were playgrounds of secondary and primary schools, while pocket parks accounted for 6.3%. The medium density area had equal numbers of playgrounds and incidental spaces, 50% for each type. Furthermore, 66.7%, 6.7%, 20% and 6.7% of open spaces in the high-density area were school playgrounds, neighbourhood park, incidental open space and pocket parks respectively. Further analysis reveal that incidental open spaces were only observed in high and medium density areas. Half of the entire proportion (50%) of open spaces in medium density were incidental, whereas incidental open space accounted for 20% of open spaces in high density neighbourhoods. In addition, neighbourhood and pocket parks were observed only in high and low densities. However, only the high-density area had all open space typologies.

The highest proportions of open spaces in high density area in this study substantiate earlier studies (Vaughan et al.2013; Lee et al, 2007). The results of chi-square analysis show differences in open space typologies within the residential densities were statistically significant ($\chi^2 = 244.832$, df = 6, $p<0.001$).

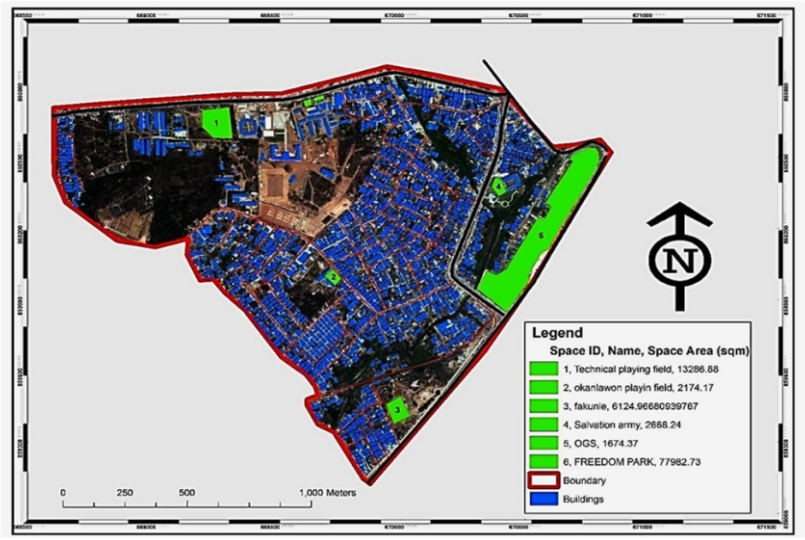

Figure 1: Names and sizes of open spaces in Alekuwodo (high density area)

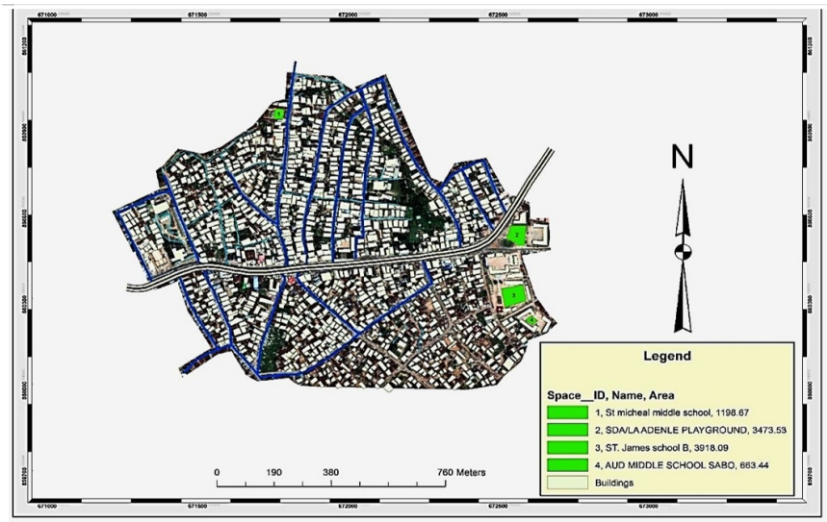

Figure 2: Names and sizes of open spaces in Ayetoro/Igbona (Medium density area)

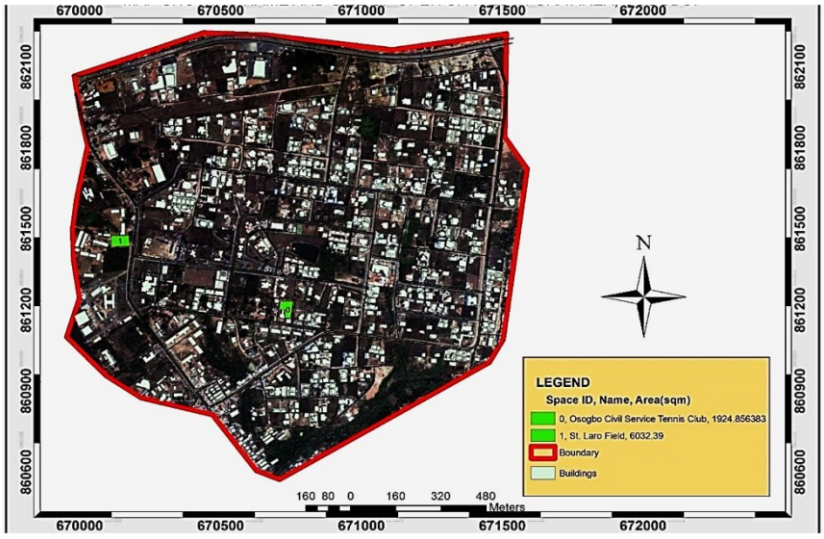

Figure 3: Names and size of open spaces in G.R.A. (Low density area)

The observed typologies of open spaces are indicative of major kinds of open spaces available in the city. For instance, playgrounds of secondary and primary schools are spatially distributed in varying dimensions across the residential densities in the city, this makes this type of open space readily available and most common in the study area. In terms of prevalence, ranking next to playgrounds were incidental open spaces, pocket and neighbourhood parks in that order. Table1 shows the distribution of open spaces in existence across the residential neighbourhoods in the study area.

Features of neighbourhood open spaces

Features as conceptualised in this study are facilities and amenities in neighbourhood open spaces. Facilities of an open space can be used for active and passive activities while amenities are the elements that support activities. Amenities are car parks, toilets, benches, picnic table, shaded places for sitting, things to play or relax with, rain and sun-shading cover, auxiliary seats such as flower bed edges, stone pillars, and sculptures, snack bar and trash can. Direct observations were used to evaluate the attributes of neighbourhood open spaces.

Sizes and locations of neighbourhood open spaces

With the aid of ArcGIS, sizes of the identified open spaces were measured. From the results presented in Table 2 it was revealed that the smallest, largest and mean sizes (m^2) of open spaces in the city were 79 m^2, 77,982 m^2 and 7,253 m^2 respectively.

In the high-density area, sizes of open spaces ranged from the smallest (79m^2) to the largest (77,982m^2) while the mean was 8,212.15m^2. The range in the sizes of open spaces in the medium density areas were 425 m^2 (smallest), 21,253 m^2 (largest) and 6,336.26 m^2 (mean). Similarly, 545 m^2, 21,247 m^2 and 66, 88.87 m^2 were the respective smallest, largest and mean sizes of open spaces in the low density area. This result suggests that the mean size of open spaces in high density area is largest, this may be influenced by the presence of neighbourhood park which is the largest in the city. Further analysis of open spaces typologies sizes by residential densities are presented in Table 3.

Results show that only one neighbourhood park (77,982m^2) exits. This was followed by playgrounds (7,395.70 m^2), pocket parks (2,296.55 m^2) and incidental spaces (2,144 $m^{2)}$ in terms of their respective mean sizes. School playgrounds were the most common type of open spaces in the city. Findings show that the respective mean sizes of school playgrounds in the high, medium and low density areas were 3,459.82 m^2, 11,088.8 m^2 and 7,638.47 m^2 respectively.

Figure 4: Types of open spaces in the selected neighbourhoods

Table 1: Typologies of open spaces identified in Osogbo.

Open Space Typology	Residential Density			
	High	Medium	Low	Total
School Playgrounds	10(66.7%)	6(50.0%)	5(83.3%)	21(63.6%)
Neighbourhood Park	1(6.7%)	0(0.0%)	0(0.0%)	1(3.0%)
Incidental Open Spaces	3(20.0%)	6(50.0%)	0(0.0%)	9(27.3%)
Pocket Parks	1(6.7%)	0(0.0%)	1(16.7%)	2(6.1%)
Total	15(100.0%)	12(100.0%)	6(100.0%)	33(100.0%)

Table 2: Sizes of open spaces

Features	Residential Density			
	High	Medium	Low	Total
Number of Open Space	15	12	6	33
Area of smallest open space (Square Meters)	79	424	545	79
Area of largest open space (Square Meters)	77,982	21,253	21,247	77,982
Mean Area (Square Meters)	8,212.15	6,336.26	6,688.87	7,253.05
Standard Deviation (Square Meters)	19,576.331	7,151.580	7,953.793	13,997.726

Table 3: Types and Sizes of open spaces across residential densities

Residential Density	Type of Open Space							
	School Playground		Neighbourhood Park		Incidental		Pocket Park	
	No of Open Space	Mean Size	Number	Mean Size	Number	Mean Size	Number	Mean Size
High	10	3,459.82	1	77,982.73	3	3,003	1	2,668.24
Medium	6	11,088.8	0	0	6	1,284.2	0	0
Low	5	7,638.47	0	0	0	0	1	1,924.86
Total	21	7,395.70	**1**	77,982.73	9	2,144	2	2,296.55

Amenities in neighbourhood open spaces

The results of direct observation of open space features were categorised into two and they are presented in Tables 4 and 5. The first are features that could be counted and the second category measured the presence or absence of open space features. Presented in Table 4, is the summary of the quantities of regular seats, such as seats and benches, improvised seats that could be sat on, such as flower bed, dustbins and trash cans, and all kinds of sculptures used for decoration found in the open spaces.

It was revealed that 13(39.4%) out of the 33 open spaces in the city had regular seats. Only 38.1% of school playgrounds, 22.2% of incidental spaces had regular seats whereas, all the pocket parks and the neighbourhood park had regular seats. Furthermore, the highest number of regular seats was observed in school playgrounds (350) while incidental spaces had the least (5). The high number of regular seats observed in school playgrounds may be connected to the fact that some school playgrounds, had permanent seating areas. The ANOVA results of the numbers of regular seats in open spaces show a non-statistically significant variation in the distribution across the typologies (F= .254, p=.857). This also confirms that most open spaces did not have seats and the number of seats were significantly higher in school playgrounds. On the other hand, overall

results show that improvised or temporary seats were common in most of the open spaces. Results similarly show that 93.9% open spaces had temporary seats while only 6.1% open spaces in the city did not have, this suggests that residents improvised on the inadequate provision of seats in most of the open spaces.

In addition, it was observed that most of the open spaces (57.6%) in the city had dustbins or trash cans, with the highest number recorded in the neighbourhood park. Findings also reveal that most of the school playgrounds (71.4%) had trash cans while only 11.1% of incidental spaces had trash cans. In terms of decoration, 24.2% of the observed open spaces in the city were decorated with sculptures. The results of the Analysis of Variance show a non-statistically significant variation in the distribution of sculptures across the typologies (F=. 5.524, p=.066).

Table 4: Quantities of neighbourhood open spaces attributes

Open Space features	Count	Typology				
		School Playgrounds	Neighbourhood Park	Incidental Spaces	Pocket Parks	Total
Seats and benches	Number of **open spaces**	**8(38.1%)**	**1(100%)**	**2(22.2%)**	**2(100%)**	**13(39.4%)***
	Average no of seats	75.5	100	3.5	49.5	62.3
	Std. Deviation	129.6	-	2.121	36.0	103.6
	Minimum number of seats	1	100	2	24	1
	Maximum number of seats	350	100	5	75	350
Improvised seats	Number of open spaces	20(95.2%)	**1(**100.0%)	8(88.9%)	2(100.0%)	31(93.9%)*
	Average no of seats	13.3	50	9.1	12.5	13.3
	Std. Deviation	7.7	-	4.2	10.6	9.7
	Minimum number of seats	5	50	3	5	3
	Maximum number of seats	35	50	14	20	50
Dustbins and trash cans	Number of open spaces	15(71.4%)	1(100.0%)	1(11.1%)	2(100.0%)	19(57.6%)*
	Average no of trash cans	3.7	10	2	6	4.21
	Std. Deviation	1.4	-	-	1.4	2.1
	Minimum number of features	2	10	5	2	2
	Maximum number of features	7	10	2	7	10
All kinds of sculptures used for decoration	Number of open spaces	4(19.0%)	1(100.0%)	2(22.2%)	1(50.0%)	8(24.2%)*
	Average no of **sculptures**	3.6	8.	2	2	3.0
	Std. Deviation	1.2	-	1.4		2.2
	Minimum number of sculptures	1	8	2	1	1
	Maximum number of sculptures	4	8	3	2	8

Note: * Number of open spaces where attributes were found.

The patterns of distribution also reflected the concentration of decorations in the neighbourhood park. This was followed by pockets parks (50%), incidental spaces (22.2%) and school playgrounds (19%).

The presence of outdoor lights, parking spaces (formal and informal), public toilet, snack bars, water bodies, trees and flowers were observed and the results are shown in Table 5.

The overall results show that most of the open spaces (69.7%) did not have outdoor lights while only 30.3% of open spaces had outdoor lights. It was further revealed that outdoor lights were present in the neighbourhood park and 50% of pocket parks. None of the incidental open spaces had outdoor light whereas it was observed in 38.1% of the school playgrounds. This result may affect the time spent in utilisation of open spaces owing to safety and security concerns at night. Residents are likely to avoid the open spaces as the sun sets when natural lighting recedes.

Findings show that 84.8% of the open spaces had one form of parking spaces (both formal and informal) while 15.2% of the observed open spaces had no parking facility. This indicates that most of the open spaces have motorised access, which may influence the utilisation of the spaces by users across the socio-economic groups. In addition, most of the spaces (63.6%) had public toilets, although majority were not in good and hygienic conditions. The distribution of open space without toilets in the study area revealed that 23.8% and 77.8% of the school

Table 5.: Presence of neighbourhood open space attributes

Open Space attributes	open space	Typology				Total
		School Playgrounds	Neighborhood Park	Incidental Open Spaces	Pocket Parks	
Outdoor lights	Yes	8(38.1%)	1(100.0%)	0(0.0%)	1(50.0%)	10(30.3%)
	No	13(61.9%)	0(0.0%)	9(100.0%)	1(50.0%)	23(69.7%)
	Total	21(100.0%)	1(100.0%)	9(100.0%)	2(100.0%)	33(100.0%)
Parking spaces (formal and informal)	Yes	18(85.7%)	1(100.0%)	7(77.8%)	2(100.0%)	28(84.8%)
	No	3(14.3%)	0(0.0%)	2(22.2%)	0(0.0%)	5(15.2%)
	Total	21(100.0%)	1(100.0%)	9(100.0%)	2(100.0%)	33(100.0%)
Public toilet	Yes	16(76.2%)	1(100.0%)	2(22.2%)	2(100.0%)	21(63.6%)
	No	5(23.8%)	0(0.0%)	7(77.8%)	0(0.0%)	12(36.4%)
	Total	21(100.0%)	1(100.0%)	9(100.0%)	2(100.0%)	33(100.0%)
Snack bars	Yes	3(14.3%)	1(100.0%)	1(11.1%)	1(50.0%)	6(18.2%)
	No	18(85.7%)	0(0.0%)	8(88.9%)	1(50.0%)	27(81.8%)
	Total	21(100.0%)	1(100.0%)	9(100.0%)	2(100.0%)	33(100.0%)
Fountains,	Yes	0(0.0%)	1(100.0%)	0(0.0%)	0(0.0%)	1(3.0%)
	No	21(100.0%)	0(0.0%)	9(100.0%)	2(100.0%)	32(97.0%)
	Total	21(100.0%)	1(100.0%)	9(100.0%)	2(100.0%)	33(100.0%)
Lakes and streams	Yes	1(4.8%)	1(100.0%)	0(0.0%)	1(50.0%)	3(9.1%)
	No	20(95.2%)	0(0.0%)	9(100.0%)	1(50.0%)	30(90.9%)
	Total	21(100.0%)	1(100.0%)	9(100.0%)	2(100.0%)	33(100.0%)
Trees and flowers	Yes	12(57.1%)	1(100.0%)	3(33.3%)	2(100.0%)	18(54.5%
	No	9(42.9%)	0(0.0%)	6(66.7%)	0(0.0%)	15(45.5%)
	Total	21(100.0%)	1(100.0%)	9(100.0%)	2(100.0%)	33(100.0%)

playgrounds and incidental spaces had no toilets. Results also show that 54.5% of open spaces had some amount of greenery (trees and flowers) while 45.5% do not. It was further observed that 42.9% and 66.7% of school playgrounds and incidental spaces did not have greenery.

Conclusion and recommendations

The results show that neighbourhood open spaces in high density had the best amenities and facilities. This observed high quality of open space attributes in high density area is at variance with Vaughan et al. (2013), which submits that high density neighbourhoods had the least quality open spaces. These findings might be explained by the scale of urban renewal projects of the Osun State Government. The high-density area of the city benefitted immensely from the programmes with the creation of Nelson Mandela Freedom Park (Neighbourhood Park), Salvation Army Park (pocket park) and the renovations of schools and their playgrounds.

These interventions have changed the physical configurations and outlooks of high-density neighbourhoods from the hitherto blighted scenarios usually attributable to high density. Meanwhile most open spaces in the medium and low-density areas are playgrounds of privately-owned schools and incidental spaces. Similarly, the neighbourhood park had the best attributes. This was followed by pocket parks, school playgrounds and incidental open spaces. The results show that school playgrounds were the most common neighbourhood open space. Therefore, the potentials of playgrounds should be fully maximized by architects. Conscious design programmes that will transform playgrounds facilities to an aesthetically appealing multi-use spaces which could attract all categories of residents in the neighbourhood should be made. Facilities and amenities that will attract and encourage all user groups should be provided in open spaces. In addition, the untapped natural sites such as derelict quarried land, steep slopes, rock outcrops, flood plains and wetlands in the city can be conserved and developed by private and government agencies to standard parks and playgrounds. Furthermore, surface water bodies and water fronts are prominent features in the study area. They have the potentials of attracting residents of different ages and social classes if they are developed into linear parks along the water bodies.

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APPENDIX

Sizes of different types of open spaces across residential densities

	Name of Open Space	Size(M^2)	Typology	Density
1.	Okanlawon Playing Field, Alekuwodo Area	2,174.17	School Playground	High
2.	Fakunle Playing Field, Alekuwodo Area	6,124.97	School Playground	High
3.	Salvation Army	2,668.24	Pocket Park	High
4.	Technical Playing Field, Alekuwodo Area	13,286.88	School Playground	High
5.	Osogbo Grammar School,	1,674.37	School Playground	High
6.	Freedom Park, Alekuwodo Area	77,982.73	Neighbourhood Park	High
7.	Open Field besides L.A Adenle,Igbonna	2,314.76	Incidental	High
8.	Saint James High School, Owoope	3,918.09	School Playground	High
9.	Playing Field beside Celestial church, Owoope	4,382	Incidental	High
10.	AUD Playing Field,Owoope	4,728.25	School Playground	High
11.	Idowu Estate Field, Ogooluwa Area	2,312	Incidental	High
12.	ADEKID Playing Field, Ogooluwa Area	78.5	Playground	High
13.	Adedayo Kareem Playing Field, Ogooluwa Area	1632	School Playground	High
14.	FOMWAN Playing Field, Ogooluwa Area	632	School Playground	High
15.	GOF Playing Field, Ogooluwa Area	349	School Playground	High
16.	St Marks Ayetoro	18,867.89	School Playground	Medium
17.	St Michael Middle School,Ayetoro	1,198.67	School Playground	Medium
18.	Unity High School, Power line area	21,253.88	School Playground	Medium
19.	Mobinu Football Pitch, Power line area	424.51	Incidental	Medium
20.	Steel Rolling Football Pitch, Power line area	9,705.91	School Playground	Medium
21.	Nomadic School Football Pitch, Power line area	8,568.88	School Playground	Medium
22.	Open Space Beside Aroma of God, Oke-Onitea Area	2,894.13	Incidental	Medium
23.	El-Shaddai Playing Field, Oke-Onitea Area	1,837.92	Incidental	Medium
24.	Open Space Beside Grace Bible Mission Field, Oke-Onitea Area	1,298.44	Incidental	Medium
25.	Iya Elewa Playing Ground, Oke-Onitea Area	736.4	Incidental	Medium
26.	St. Leo Playing Field, Oke-Onitea Area	6,938.02	Playground	Medium
27.	Open Space Beside Excellent Group of School, Oke-Onitea Area	514	Incidental	Medium
28.	St. Charles Playing Field, Oke-Ayepe Area	21,247.24	School Playground	Low
29.	Ifeoluwa Playing Field, Oke-Ayepe Area	9,609.71	School Playground	Low
30.	Osogbo Civil Service Tennis Club, G.R.A Area	1,924.86	Pocket Park	Low
31.	Laro Middle High School, G.R.A Area	6,032.39	Playground	Low
32.	First Foundation Field, Oroki Estate	545	School Playground	Low
33.	St Andrews Field, Oroki Estate	758	School Playground	Low

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LANDOWNER AND LAND FRAGMENTATION IN KANO METROPOLIS, NIGERIA

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Abstract

This study examined land owners and land fragmentation in Kano Metropolis, Nigeria. The practice of land fragmentation or sub-division is gaining prominence particularly along the fringes of Kano Metropolis. Land owners with large parcel of land engages in informal land subdivision without involving planners and land administrators resulting in emergence of fragmented land lots which are often too small and below the approved standard. Data for the study was obtained primarily through the administration of structured questionnaire to 84 prominent land owners in the metropolis selected through a combination of purposive and snowballing sampling techniques. Major findings of the study revealed that there is high incidence of land fragmentation in the study area. Majority of the respondents (82%) fragments land below 50x50ft. The main reasons for engaging in land fragmentation according to the respondents were to maximize returns from the land and fragmented lands are more affordable and preferred by the urban poor according to 44% and 31% of the sampled respondents respectively. The study further reveals that 87% of the respondents do not involve government officials in the course of fragmenting land due to fear of losing the land or part of it as well as the huge charges that will be incurred if officials of the State Ministry of Lands and Survey are involved. The study recommends among others that Government should make it mandatory for land owners to contact or liaise with the State Ministry of Lands and Survey before fragmenting any land. This is with the view to ensure compliance with planning rules and regulations and at the same time give the area a semblance of planned neighborhood.

Keywords: Landowner, Land fragmentation, Kano Metropolis

Introduction

Land is a vital tool in agricultural production and growth of towns and cities. The emergence, growth and sustainability of any urban area relies heavily on how land is accessed, managed and controlled. Urbanization in sub-Saharan Africa is altering traditional livelihood strategies and displacing agricultural land uses in many areas (Angel *et al.*, 2005; Adeboyejo and Abolade, 2007). Olima (2003) opined that population growth rate in both urban and rural areas do not commensurate with the quantity of land supplied. The rising demand for urban land therefore tends to be met primarily by converting peri-urban agricultural land at the periphery of the existing built-up area (UN-Habitat, 2010; Toulmin, 2008). Land is needed to provide housing, infrastructure, food production and animal rearing and to absorb the ever-increasing influx of migrants into urban setting. This made land to be in high demand and a commodity desired by all and sundry. One critical issue about land whether in urban or rural setting is ownership. The ownership vested all rights to land on the owner. The right could be customary/traditional or in modern days the right vested on landowners by the Land Use Act of 1979. Right over land in Nigeria could be either statutory or customary. The statutory right of occupancy as interpreted in Section 50 of the Act is a right of occupancy granted by the Governor under the Act for a maximum holding period of 99 years mostly in urban areas. Customary right of occupancy as also

interpreted in that section of the Act is the right of a person or community lawfully using or occupying land in accordance with customary law and includes a customary right of occupancy granted by a Local Government under the Act (FGN, 1978). Population increase coupled with economic development or rise in income level resulted in increased demand for residential land by the populace. Thus, making the land owner particularly with large parcel of land a powerful actor in urban land development process with the immense opportunity of engaging in land fragmentation or subdivision. Land owners are those individuals or agencies bestowed with the right to own and use land. Land owners' decision to release land for development is the first stage in urban land conversion process (Martin,1975). The willingness to release land for sale or development could be influenced by the encroaching built-up area or interest (pressure) from prospective buyers.

Kano metropolis, one of the fastest growing urban area in Northern Nigeria has been experiencing growth and expansion both in terms of population and land uses. For instance, in 1952, the total population in Kano metropolis was 127,000, the population increased to 1.5 million in 1991 and it is expected to reach 3,801,000 by the year 2020 based on the 2.8% annual growth rate. Similarly, Land use change in Kano metropolis like elsewhere has generally occurred at the expense of agricultural land (Sustainable Kano Project 1997) particularly on the fringes of the city. From 1966 – 2016, the residential land use has increased by 44.94% (from a mere 28.19Km^2 – 144.5km^2) while agricultural land has declined tremendously by 32.56%. Going by this trend in growth, it is obvious that land is in high demand in Kano metropolis by both individuals and agencies of government and the fact that the demand outweighs the supply leads to the emergence of land fragmentation. Land fragmentation has been defined by Dovring (1965) as the division of land into a great number of distinct plots. Agarwal (1972) defines land fragmentation as a decrease in the average size of land holdings and a decrease in the size of the individual plots in a farm holding. Fox (2010) defines land subdivision as "the division of a parcel of land into two or more lots, plots, sites, or other divisions of land for the purpose, whether immediate or future, of sale or of building development".

For the purpose of this study, the fragmentation or subdivision referred to is the informal not the formal fragmentation. Informal land fragmentation often affects the direction and quality of urban development, it engendered spontaneous growth as well as add-on development (Agheyisi, 2018). The informal fragmentation connotes negativity which in the context of human settlements refers to nonconformity with urban planning laws and development control norms, and to some extent, land tenure regularization (Durand-Lasserve, 2006; Agheyisi, 2016). Angel *et al* (1993) averred that informal subdivision occurs when landowners subdivide and sell their plots in contravention of government subdivision regulations. As the motive behind their development is maximum profit, they often have no provision for public amenities and land for public uses. Furthermore, as the plots are developed, contravention of planning rules and a lack of coordination of transport access to subdivision blocks can cause traffic problem in the future (Brennan, 1993).

Major informal settlements emerging in Kano metropolis are products of fragmented land lots despite the numerous planning challenges they pose. If this trend is allowed to continue it will have an adverse effect on the development and sustainability of metropolitan Kano in the foreseeable future. There is dearth of study or literature in the study area on land fragmentation for residential purposes. Bulk of what exists focus on fragmentation of agricultural land and its effect on productivity as well as how society members get access to development land (Dankani, 1998, 2008, 2011 and 2013; Agheyisi 2016). The behaviors and actions of land owners in Kano metropolis need to be studied in order to unearth the reason(s) behind fragmentation of residential land by land owners and its implication on the environmental quality and sustainable development of metropolitan Kano.

The study seeks to provide answers to the following research questions:

i. How do the landowners get access to large parcel of land?
ii. What are the factors responsible for the proliferation of land fragmentation?
iii. What are the likely implications of land subdivision on environmental quality?
iv. What is the role of government or planning agencies in addressing this issue?

Study Area

Kano State lies between latitude 10^o 31' 41.14'N and 12^o 34' 10.57'N and between longitude 7^0 41'26.40'E and 9^0 23' 17.50'E. Kano metropolitan area lies

between latitude 11^0 55' 23.93'N and 12^0 3' 53.10'N and longitude 8^0 27' 42.26'E and 8^0 36' 41.62'E and is 1549 feet above sea level. The estimated area of Kano metropolis increased from 122.7 square kilometers in 1962 to 154.6 square kilometers in 1981, an increase of about 25% based on the average expansion rate of two square kilometers per annum (Na'Abba, 2002 see Figure 1).

For many centuries, Kano has been the largest and most influential commercial town in the Sudan zone. The settlement is probably over one thousand years old and was first situated on the vicinity of Dala Hill, the source of iron, which the inhabitants smelted and fabricated (Urquhart, 1977). The Kano chronicle records the first king of Kano as Bagauda whose ascension was stated to be in the year 999 AD. The 19.2 square kilometer of the city walls were completed by the twelfth century.

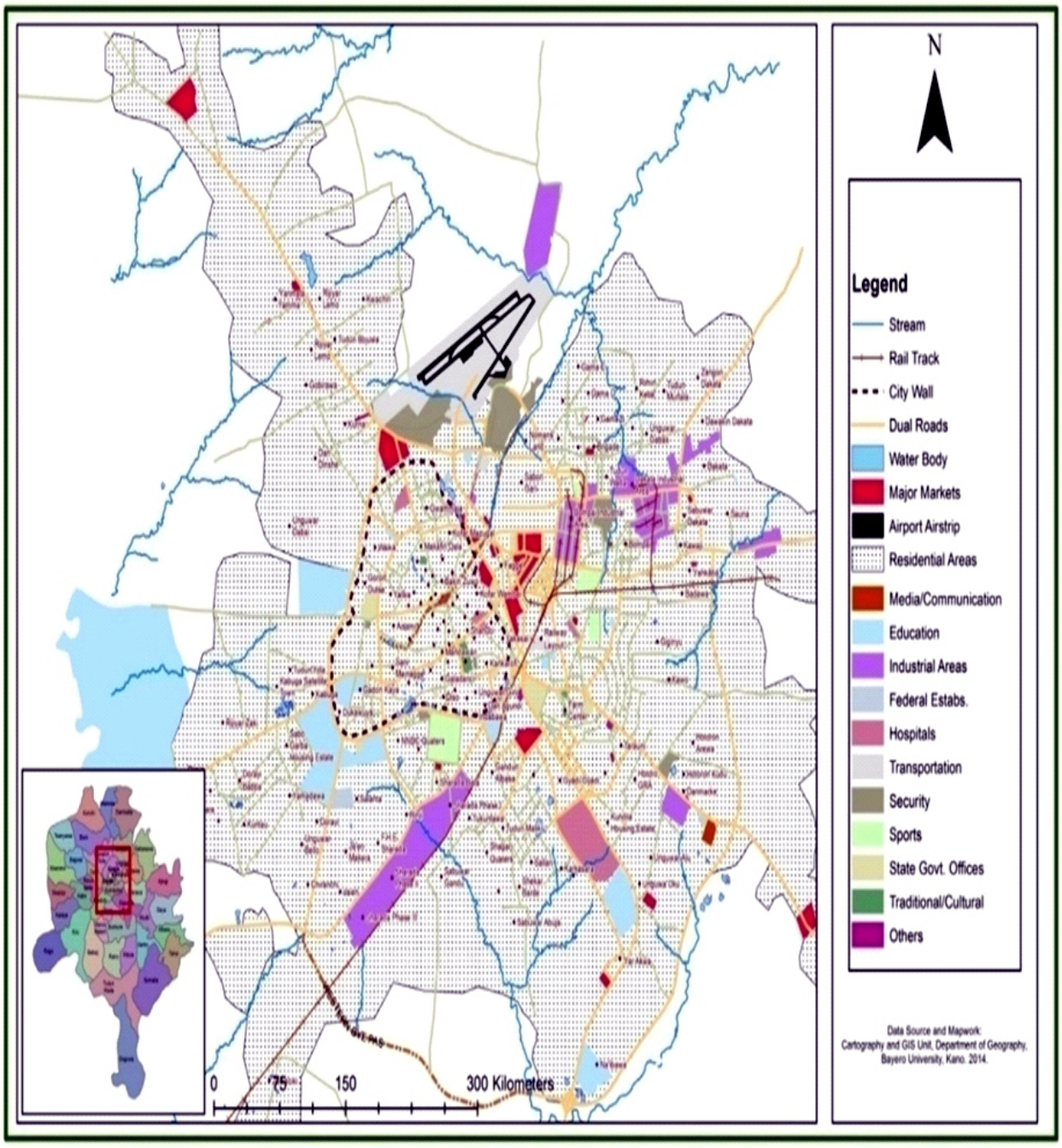

Figure 1: Kano metropolis
Source: Cartography and GIS unit, Bayero University, Kano

Morphologically, Kano has ceased to be confined to its wall. Because the original city became a unit by itself while Fagge, Nasarawa, Sabon Gari, Gwagwarwa, Tudun Wada, Tarauni, Na'ibawa, Hausawa, Gyadi-Gyadi and Kurnar Asabe all grew into distinct morphological unit. This phenomenal growth (both real and anticipated) is the influence of the preparation of the Trevallion plan in 1963 with a view to setting a statutory framework that could guide, influence and control the development of metropolitan Kano. The desired goal however could not be achieved due to lack of proper and effective implementation of the plan.

Presently, there are a lot of infilling going on as well as outward expansion into adjoining villages. Metropolitan Kano has been redefined vide Edict No. 15 of 1990. By the edict, Kano metropolitan area consists of all land within the radius of 32 km from Kurmi market. Thus, the metropolitan area includes;

i. The Dala, Municipal, Nasarawa, Fagge, Tarauni, Gwale, Kumbotso and Ungogo Local Government Areas.

ii. Parts of Dawakin Tofa, Gezawa, Kura and Rimin Gado Local Government Areas.

Materials and Methods

Data for this study were principally obtained via primary source. The instrument of primary data collection used was a structured questionnaire administered to landowners who were engaged in the act of land fragmentation from selected areas of the metropolis.. The questionnaire was divided into two key sections. The first section (A) focused on the socio-economic characteristics of the respondents while section B dwells on what motivated them to engage in land fragmentation, how they go about the process of fragmentation and the challenges they experience in the course of their activity. Similarly, supporting information was also obtained from key actors in land transfer and development processes such as land dealers and officials of the Ministry of Lands and Survey and Kano State Urban Planning and Development Agency (KNUPDA). The essence of interacting with these actors is to shed more light on the factors facilitating land fragmentation as well as the efforts or lack of it from urban managers and policy makers to address the situation considering its negative impact on the built environment. Secondary information was also obtained from published document both print and online.

Respondents for the study were selected via the combination of purposive sampling and snowballing sampling techniques. The operation of the purposive sampling technique employed here involves the identification of major landowners who are known to the land dealers, District and ward heads as well as officials of the State Ministry of Lands and Survey, Kano State Urban Planning and Development Agency (KNUPDA) on the basis of their involvement in land fragmentation in the study area. A total of 37 names were collected from the field through this way and were compared in order to avoid duplication of names. These names served as the initial sample frame and the snowballing technique was employed on the basis of the list of names.

The Snowball technique entails asking the first interviewee to name other land owners known to him who could be included in the sample. The same applies to subsequent land owners. The essence of this was to ensure that no other major land owners who engages in land fragmentation was left out of the list. This list was then used as the sampling frame from which land owners were selected using purposive sampling technique. Snowball technique was also employed here, because of the fact that it is one of the best ways of reaching those land owners who usually prefer to operate without much publicity (Abrahamson, 1983). It also provides a way of introducing the researcher to other land owners by the land owners themselves. This method would surely enhance the co-operation of the sampled land owners. In all a total of 84 key land owners were selected through the methods described above.

In analysing the responses to the questionnaire, statistical tables showing frequencies and percentages were used. Tables were followed with the descriptive analysis of our findings.

Results and Discussion

Table 1 shows the socio-economic characteristics of the sampled landowners in metropolitan Kano who engaged in the act of land fragmentation for onward disposal to interested buyers.

Tables 1: Socio- economic characteristics of the respondents

	Frequency	%
Sex		
Male	81	96
Female	03	04
Main Occupation :		
Business/Trading	56	67
Civil Servants	07	08
Land Dealing	13	15
Others (specify)	08	10
Duration in the Act of Land Fragmentation		
Less than 5 years	07	08
6-10 years	26	31
11-15 years	13	16
Above 15 years	38	45

Source: Author's Fieldwork, 2018

Investigation into the sex of the respondents shows that males constitute the majority (96%) while only 4% were females. Occupationally, 67% of the respondents are into business and trading, 15% are into land dealing, 10% are into other occupations such as transportation, and manufacturing activities while civil servant accounted for 8% of the sampled respondents. An inquiry into the duration of respondents in the act of land fragmentation reveals that 45% of the respondents have been in the act for over 15 years and 31% between 6-10 years. Kano has been a renowned center of commerce for a time immemorial. Majority of the populace engages in one form of trading/business or the other. Dealing in land or act of buying and selling land in Kano is one of the most lucrative businesses particularly to those traders and businessmen who view it as a secondary occupation as well as a lucrative way of saving excess profit in landed property which often acts as a hedge against inflation (Ajayi, 1997; Mamman, 1996; Dankani, 2008). Land is a commodity in high demand by residents of Kano metropolis to build houses both for owner occupation or to provide rental accommodation to those who could not afford to build their personal houses. There exists in metropolitan Kano group of individuals who engaged solely in land dealing. Apart from linking buyers and sellers of land these categories of people do purchase large parcel of agricultural land from peasant farmers and subdivide it into small plots for residential purpose. History has eloquently shown that private land transfer or acquisition has been widely practiced in the study area and to some people it has been a source of livelihood for decades (Mortimore,1967; Main 1988; Dankani, 2013).

The major means of land acquisition by the landowners is through purchase as depicted by the responses of 94% of the sampled respondents and 6% of the respondents claimed that they inherited the land they fragmented. This finding is in line with studies by Dankani, (2013); Rakodi, (2005 and 2007) and Agheyisi, (2012) which shows that purchase is widely regarded as the major means of land acquisition by over 70% of the people in the study area and the Northern region at large. One major finding here is the absence of land acquisition by the respondents from the state government or the local government. Several studies such as Dankani, (2011, 2012, 2013); Agheyisi (2012) and Rakodi, (2005, 2007) have clearly shown how difficult it is to acquire land from the government through statutory allocation. The process of land allocation by the state nowadays is entirely tortuous, lengthy, expensive and full of so many bottlenecks which often compelled individuals to resort to the informal land market in order to acquire land (Mamman,1996; Abubakar and Dankani, 2013). The emergence of the informal land market was borne out of the failure of the government to provide sufficient land for development and the increasing pressure and demand for land (Onokerhoraye, 2010).

Analysis of data in respect of the average size of land respondents fragment shows that 42% claimed they often fragment land above 5 hectares, 19% fragments land that is between 2-3 hectares. From the findings it is obvious that respondents prefer fragmenting large parcel of land that can produce lots of plots of varying sizes. The bigger the land the higher the number of plots that can be carved out of the land and the higher the returns from the investment. Respondents were asked the average size of plot they often carve out of the large parcel of land they own.

Their responses reveal that majority 82% normally carve out plots of less than 15m x15m. Only 4% of the respondents claimed the average size of plot they carve out is 15m x 20. In the study area the standard size of land approved by the government is 15m x15m particularly in a high density residential areas but the landowners having large parcels of agricultural land usually took advantage of the encroaching city and engages in fragmentation of land parcel below the approved standard size (15m x15m) without recourse to planning bodies. Such fragmented plots locally referred to as '*Awon Igiya*' are often small in size (as small as 6m x 9m), irregular in shape and with poor accessibility. These plots are carved out by farm owners often without seeking government's consent or intervention though the sale of the land is usually with the consent of the Local Traditional Authority contrary to the provisions of the 1979 Land Use Act which states that all land holding within the urban areas are under the control and disposition of the State Governor. The Act also made it clear that no right or interest may be assigned, mortgaged, transferred, sublet or otherwise be alienated without the consent of the state Governor. Under the Act, it is illegal to sell plots or undeveloped land and the transfer of farmlands is a serious offence. Sections 21; 22 and 26 of the Act are clear about illegal transfer of lands without obtaining permission.

A study by Dankani and Shera (2018) on the implications of fragmented residential land on the built environment in Kano metropolis reveals that neighborhood streets are narrow most often not up to 3 meters in width, in some areas only one car can pass at a time while in others cars cannot pass through at all. In some areas around Kurna and Dorayi houses were separated by narrow alley popularly known as *lungu* in Hausa language typical of what is obtainable in the traditional city of Northern Nigeria..

With respect to means of ownership, landowners give to buyers of land, data in Table 2 shows that 87% of the respondents claimed that the only document they give to purchasers of land is the 'sale agreement documents; which comprises of signature of buyer, seller, ward head or District head and witnesses to the transaction which in most cases includes the land dealers who linked up buyers of land with the sellers. On the other hand 13% of the respondents claimed they hand over Letter of Grant to prospective buyers obtained from the State Ministry of Land which can be used at a later stage to apply for issuance of C of O following the dictates of land administration policy in the state. The dominance of sale agreement document as a means of land ownership is a clear testimony of the proliferation of and preference for informal land acquisition in the study area.

Respondents were asked in Table 4 why they engaged in the act of land sub-division or fragmentation, 44% claimed they were into the act to maximize returns from the land. On the other hand 31% of the respondents stated that the land when fragmented are easily disposed while 25% are of the view that fragmented land is often more affordable to the urban poor. One major reason behind sub-division of land by the respondents is to maximize profit. Value of land is continuously rising and land owners do make a lot of profit from investing in land.

Tables 2: Land Fragmentation Issues

	Frequency	%
Major Means of Land Acquisition		
Purchase	79	94
Inheritance	05	06
Average original Size of Land being fragmented		
Less 1 Ha	06	07
2-3 Ha	16	19
4-5 Ha	27	32
Above 5 Ha	35	42
Average size of plots after fragmentation		
Less than 15m x 15m	69	82
15m x 20m	12	14
Above 20m x 75m	03	04
Ownership Document given to buyers		
Letter of Grant	11	13
Sale Agreement Document	73	87

Source: Author's Fieldwork, 2018

Tables 3: Reasons for Land Fragmentation

	Frequency	%
Why do you fragment land?		
To maximize return from the land	37	44
It is easily disposed	21	25
It is affordable to the urban poor	26	31
Do you involve officials of State Ministry of Land before fragmenting?		
Yes	11	13
No	73	87
If yes why?		
It makes the area to have semblance of Planning	04	36
It guaranty ownership as C o O or Letter of Grant are issued	05	45
Its enhances the value of the land	02	18
If No, why?		
Fear of losing land or part of it	29	40
Huge Charges incurred	34	46
Others (Specify)	10	14

Source: Author's Fieldwork, 2018

Furthermore, the view that fragmented lands are often affordable to the urban poor could be buttressed by the fact that financial limitation often compelled people to acquire fragmented land. With their meager income, they cannot afford land in the inner city or planned areas with standard plot sizes. Fragmented plots are most often cheaper, affordable and preferable to the populace due to ease of acquisition and with little or no pressure from planners during development (Dankani and Shera, 2018).

It is interesting to note that among the respondents there are those who liaise with government officials before fragmenting land. An inquiry into whether respondents involve officials of the State Ministry of Lands and Survey before fragmenting land reveals that 87% of the respondents responded with no while 13% responded with yes. Those who responded with yes were further asked why they involve the officials of the State Ministry of Land and Survey before fragmenting land. From their responses, 45% of the responded stated that involving the official of State Ministry of Lands and Survey guaranty ownership of land as most often Certificate of Occupancy (C of O) and Letter of Grant are issued to the buyer of land by the government agencies. 36% of the respondents also stated that involving the officials makes an area to have a semblance of planning while 18% stated the involving the officials in fragmenting land enhances the value of land in the area. One major essence of involving officials of the State Ministry of Lands and Survey and other professionals in subdivision or fragmentation of land lots is that it allows for orderly and efficient development of the land by provision of adequate sites and spaces for general public uses so that residents could have access to community services. Emphasis is given to safety and control measures to guide against danger to health, fire outbreak, flooding and other adversities as enshrined in the Town and Country Planning Law, CAP, 123, (1975).

On the other hand, responses of those who do not involve the officials before fragmentation shows that 46% do not involve the officials because they have to pay a huge charges which majority could not afford, 40% claimed they do not involve the officials of State Ministry of Lands for the fear of losing their land completely or part of it.

The fear expressed here is that whenever officials of state ministry of lands are involved in land subdivision they always insist on reserving land for public use such as roads, drainages, at times schools and markets and this according to the respondents greatly reduced the sizes of their land affecting their expected return from initial investment. In the same vein this category of respondents also alleged that some land officers will insist on giving some parcel of land during sub-division. Other respondents (14%) gave other reasons such as involving government often results in a lot of delay and paper works as well as the desire to work independently without involving government officials. In Kano just like other states in Nigeria, provision of land administration services are often characterized by delays, bureaucratic and administrative bottlenecks and corrupt practices and this scare a lot of citizen

Tables 4: Engagement in Provision of Basic Infrastructure

	Frequency	%
Do you provide infrastructure on the fragmented plots		
Yes	00	00
No	84	100
If no, Why?		
Not considered as landowner responsibility	49	58
Do not have the financial strength	24	29
Others (Specify)	11	13

Source: Author's Fieldwork, 2018

from seeking formal consent of the government in land related matters

Information in Table 4 focuses on whether respondents provide infrastructure on the sites they fragmented. The entire respondents (100%) responded with "No" signifying that they do not provide infrastructure on the sites. Further inquiry revealed that 58% of the respondents were of the view that provision of infrastructure is not their responsibility, 29% of the respondents also opined that provision of infrastructure involve huge financial investment and they do not have such financial resources to engaged in such. 13% of the respondents cited other reasons such as increase in value of land which may scare prospective buyers particularly the urban poor is the reason they don't engaged in provision of services. Other respondents within the same group of those who cited other reasons stated that they do not engage in provision of infrastructure for the fear of involving government officials in their activities. The fact that fragmentation of land occurs in contravention of government sub-division regulation(s), the settlement that emanates from such areas are often devoid of clearly defined recognizable structure or layouts, public amenities and land for public uses. This often results in a random character that confuses the identity of city communities, creates chaos in the pattern of land uses and prohibits coherent patterns of any kind.

Conclusion

Cities in Nigeria are evolving and growing in a highly unsustainable manner. Land as a vital resource for urban development and means of livelihood needs to be properly distributed and managed. Informal fragmentation of land does not augur well for good urban planning, wellbeing of residents (due to space constraints) and the quest for sustainability. Growth of urban areas in Nigeria should be well regulated with the view of creating a healthy environment for the residents. One major step in ensuring sustainability of our cities is by regulating the fragmentation of land lots so that the built-up environment that will emanate from such areas conforms to standard spatial planning guidelines. Regulating land fragmentation will surely prevent misuse of land and haphazard development. One obvious reasons for the proliferation of informal land fragmentation and development in Nigerian cities was borne out of planning failure and the inability of the government and its agencies to force compliance with the standard rules governing land ownership and administration. It is important to note that the way land is acquired, used and managed goes a long way in determining the sustainability or otherwise of any urban area. It is indeed a fact that cities are notoriously difficult to govern, but if managed inclusively, effectively and holistically, it could be one of the most important gateway to a sustainable future.

In order to ensure orderly growth and development of our cities using land as the building block, the study wishes to recommend as follows:

i. Government should make it mandatory for land owners to contact or liaise with the State Ministry of Lands and Survey before fragmenting any land. This will ensure compliance with planning rules and regulations and at the same time give the area a semblance of planned neighborhood.

ii. There is a need for the Government to summon the much desired political will to ensure that rules governing land development are adhered to and sanction be imposed on defaulters to serve as deterrent.

iii. Government should try to reduce the excessive delays encountered in the provision of land administration services. The delay most often than not compelled land owners to by-pass the government and act independently.

iv. Government should engage in a kind of Public-Private- Partnership in the provision of basic infrastructure, this will lessen the financial burden that scares land owners from provision of infrastructure.

v. There is a need for a holistic approach to ensure that land as a vital tool in urban growth and development is properly distributed and managed using efficient tools of land administration and land use planning.

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ASSESSMENT OF CLIMATE VARIABILITY PERCEPTION AMONG FARMERS IN KEFFI LOCAL GOVERNMENT AREA, NASARAWA STATE, NIGERIA

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Abstract

Agricultural production is sometimes affected by the effects of variations in the climate which subsequently affect crop production. In this study, climate variability perception among farmers and its effects on cassava crop in Keffi Local Government Area is examined. Data of rainfall and temperature over a period of sixteen years in Keffi LGA were obtained from the Nigeria Meteorological Agency, National Programme on Food Security and Nasarawa State Ministry of Agriculture. This data was analysed using the correlation and regression analysis of the SPSS statistics package version 17 and trend function of the Microsoft Excel package. The result showed an increase in minimum temperature coupled with unreliable rainfall distribution over the investigated period. It identified poor yield with non-significant positive effect of rainfall, maximum and minimum temperature on cassava yield. The study recommends access to weather information for farmers which could serve as an adaptive strategy for positive crop yield production. The need to deploy Agricultural Extension Officers (AEO) to serve as guide to farmers through sensitization programmes and routine visit is imperative.

Keywords: Climate, Variability, Perception, Farmers, Crop

Introduction

There is a growing understanding that climate variability and change poses serious challenges to development in Nigeria (Dickson, 2010). The country is expected to experience changing pattern of rainfall, increased temperature leading to elevated evaporation rates and flooding. This will in turn lead to greater levels of land degradation, transmission of infectious diseases, and loss of surface and ground water potential. In addition, the Intergovernmental Panel on Climate Change (IPCC) projects that average global temperatures will increase by 1.4°C to 5.8°C every century (IPCC, 2004).

The United Nations Framework Convention on Climate Change (UNFCCC, 2012) in its Article 1 defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods". The UNFCCC thus makes a distinction between climate variability attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes, (Field and Van Aalst, 2014).

Climate change, according to Bernstein *et al* (2007), is a change in the state of the climate that can be identified e.g. by using statistical test, by changes in the mean and/or the variability of its properties that persist for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.

According to the World Meteorological Organization (WMO, 2015), variation in the mean state and other statistics of the prevailing climate

variables on temporal and spatial states beyond normal weather is climate variability. It is used to denote changes in climate variables over a given period of time as compared to long-time statistics of respective climate variables. Climate variability is measured by calculated deviations, which are termed as anomalies (WMO, 2015).

Human activities such as fossil fuel burning and deforestation have altered the global climate resulting in increased temperature variability amount, intensity and distribution of precipitation and sea level rising (IPCC, 2007). According to some report, this anthropogenic effect is expected to continue in the foreseeable future; with changes in ecosystem service which affects people. Nasarawa State, Nigeria, had experienced adverse effect of climate change and variability. The overall natural resource base of the State is highly degraded. Its initial potential together with the current global warming aggravates the vulnerability of the people to climate change impacts. Various reports agree with the flooding that have occurred in different parts of the State is indicative of susceptibility of the State to climate change and variability.

Nasarawa Broadcasting Service (NBS) News Bulleting (2012) indicated that the most significant climate change in Nasarawa State is due to flooding and post-harvest loss of crops. Thus, people in Keffi Local Government Area of Nasarawa State are facing a variety of shocks and become vulnerable. Sometimes farmers' perception about climate change has no evidence from weather monitoring stations (Maddison, 2006). In most cases of Keffi, people perceived decline in rainfall and increase in frequency of drought, but it is not confirmed from weather station. Research report from Oxfam (2010) indicated that observations on meteorological station lack correlation with local farmers' perception. This could have resulted due to the fact that farmers assess rainfall in relation to the needs of particular crops at particular times; small changes in the quality, onset and cessation of rain over days or even hours can make a big difference, whereas meteorological data is more likely to measure totals and larger events.

Agriculture is extremely vulnerable to climate variation. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failure and long-run product decline. The overall impacts of climate variation on agriculture is expected to be negative although there will be gains in some crop in the region of the world threatening global food security (Nelson *et al,* 2009).

Objectives

The following are the objectives of the study:

i. Examine the trend of rainfall in Keffi Local Government Area from 2000 - 2016.

ii. Examine the trend of temperature in Keffi Local Government Area from 2000 -2016.

iii. Determine the relationship between rainfall and temperature in Keffi Local Government Area.

iv. Examine the effects of rainfall and temperature on crop yield in Keffi Local Government Area.

The Study Area

Keffi is within the central part of Nigeria, located between latitude 8°90'N to 9°00'N and longitude 7°75'E to 8°00'E (Fig. 1). Keffi has an area of 138km^2 and a population of 92,664 at the 2006 census. Keffi is bounded in the west by Karu Local Government Area of Nasarawa State and Federal Capital Territory, Abuja, in the north by part of Kaduna State, in the south by Nasarawa Local Government Area and in the east by Kokona Local Government Area. Keffi town consist of 10 political wards namely; Rimi, Liman Abaji, Tudun Kofar, Yara, lya I, lya II, Goriya, Jigwada, Sabon Gari and Gangaren Tudu wards.

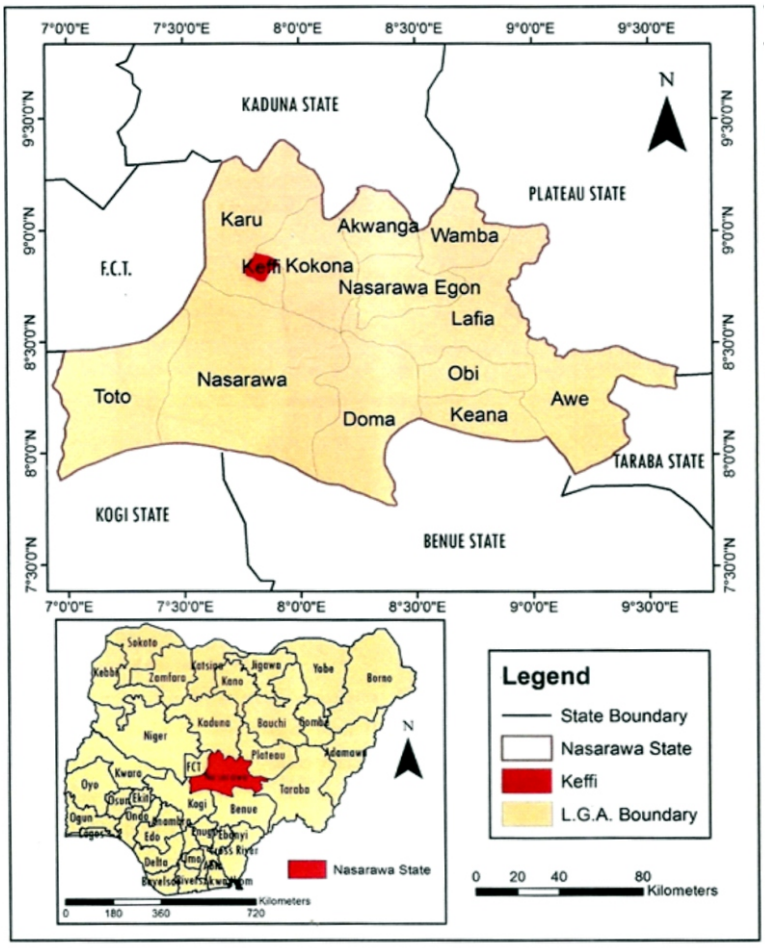

Figure 1: Map of the study area.
Source: NAGIS, 2018.

Materials and Methods

Nature and Sources of Data

The study utilized the use of secondary data in the analysis of the effect of rainfall and temperature variations on agricultural production in the study area. Climate data constituting of annual rainfall and temperature for Keffi Local Government Area were obtained from Nigeria Metrological Agency (NIMET) Lafia, while data on the selected crop yield was obtained from the National Programme for Food Security, Nasarawa State Ministry of Agriculture, Lafia (Table 1).

Data Analysis

The data for this study was be processed and analyzed quantitatively. The quantitative data will be analyzed using both descriptive and inferential statistics with the aid of the Microsoft excel and SPSS statistics software version 17. The inferential statistics that were employed in this study was a correlation and regression analysis. The findings of the study are presented in forms of tables, charts and graphs.

Trend Analysis

The Microsoft Excel function of linear trend as well as line chart was used to analyze the trend of climate variability in the district. The line charts, trend lines, trend equations and the degree of variations were used to determine the nature and direction of the trend of the variable under investigation i.e. temperature (maximum and minimum) and annual rainfall.

Regression Analysis

To measure the effect of key climatic variables (temperature and rainfall) in the selected crops yield while controlling the influence of the other confounding (independent) variables as irrigation, regular weeding, soil types, use of agro-chemical and crop variety, the hierarchical multiple regression model was used. Hierarchical multiple regression is used to measure changes that occurred in the dependent variable with change in the independent (Predictor) variable.

Results and Discussion

Rainfall trend in Keffi Local Government Area

Figure 2 shows the detailed account of the rainfall variability trend in Keffi LGA. The annual rainfall amount indicates a decreasing trend, irrespective of the increase in temperature over the period under consideration. From the graph, it can be observed that there was a sharp decrease in annual rainfall from 1414.5mm in 2001, to 1192.7mm in 2002. This decrease was however quickly followed by a sharp increase in the years 2003 by 1406.8mm. A careful observation of the trend graph indicates that the increase was only temporal, as the year 2004 recorded a decrease in rainfall at 1305.0mm. A careful look at the graph indicates a fluctuating increase and decrease in annual rainfall between the years 2005-2007, at 1290.7mm, 1319.9mm and 1279.6mm respectively. Hence, we can conclude that the variation in rainfall recorded for these three years was almost the same. The year 2008 however, recorded a very steep decrease in annual rainfall at 1141mm. A sharp increase was recorded for the year 2009 at 1595.7mm. This increase however was not steady as it was quickly accompanied by a decrease in 2010 and 2011 at 1438.3mm and 1261.4mm respectively. The trend graph further indicate an almost the same amount of rainfall between the years 2011-2015, at 1261.4mm, 1321.2mm, 1297.8mm and 1322.3mm, while a drastic decrease was recorded in 2016, at 1198.1mm.

Hence, It is obvious from the graph that there has been an experience in the number of variation in rainfall in Keffi LGA over the period of time under consideration (2001-2016), with the highest rainfall recorded in the year 2009 at 1595.7mm, while the least amount of rainfall was recorded in the years 2007 and 2016 at 1141mm and 1198.1mm respectively.

The trend equation and trend line of the annual rainfall indicates a gradual decreasing trend (0.656x). This by implication simply implies that the annual rainfall pattern over the period of 2001-2016 is at gradual and steady rate.

The general decrease in annual rainfall may be due to the fact that some years recorded low rainfall which might have gradually influenced the overall trend. For instance, from the trend graph, it can be observed that the annual rainfall recorded in the area had the following data: 2002 (1192.7mm), 2005 (1290.7mm), 2007 (1279.6mm), 2008 (1141mm), 2011 (1261.4mm), 2014 (1297.8mm) and 2016 (1198.1mm). This by implication simply implies that even though annual rainfall decreased over the time period, the rate of decrease was gradual. The gradual declining records of rainfall in some periods of the years under consideration may be of invaluable benefits to some crop production, especially those crop that do not require excessive rainfall. It is also important to stress that the decrease in the amount of rainfall in the area of study may be due to the low temperature recorded, due to the decrease in evapotranspiration rates. Low temperature ensures an appropriate amount of moisture in soil, which tends to have positive effects on crops.

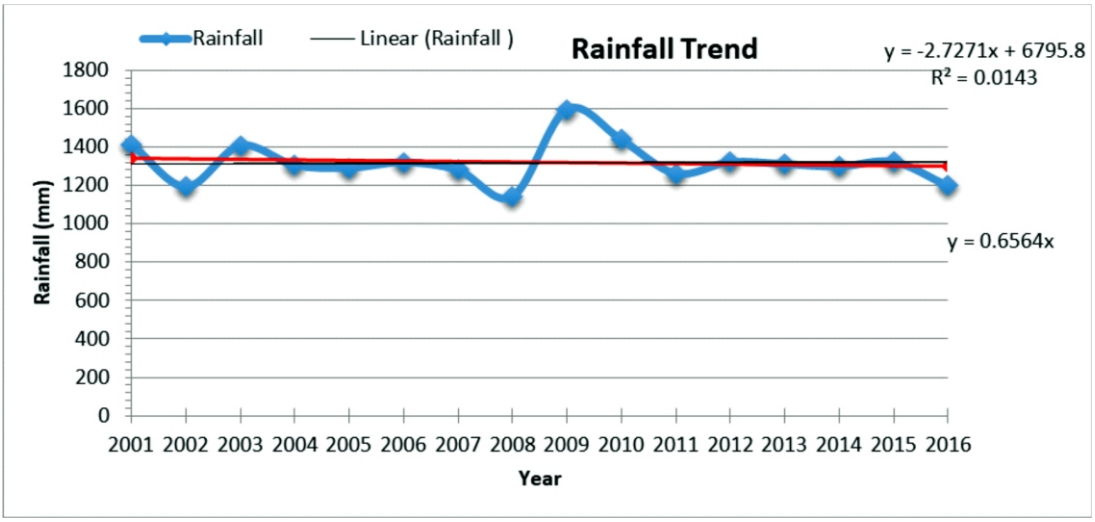

Figure 2: Annual rainfall trend in Keffi LGA.
Source: field work, 2018.

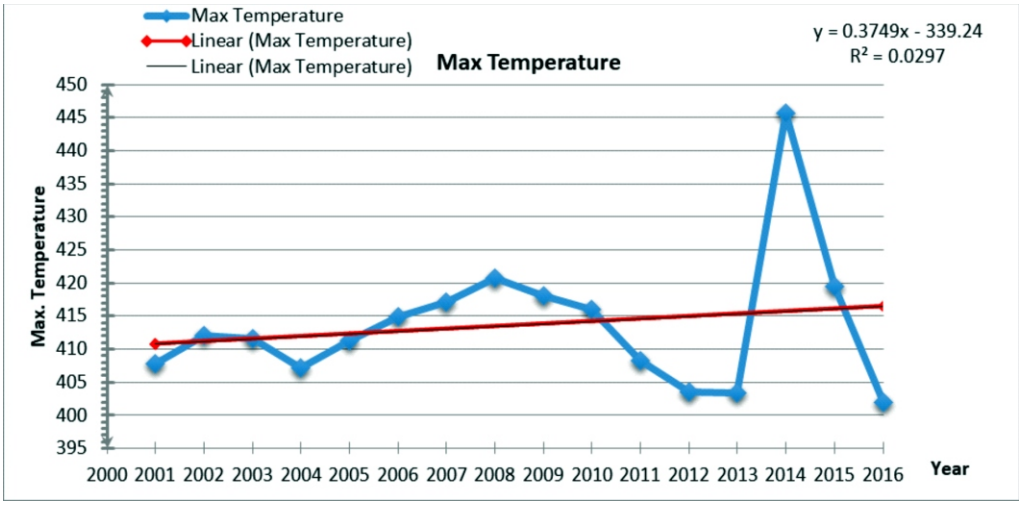

Figure 3: Maximum temperature trend in Keffi LGA.
Source: field work, 2018.

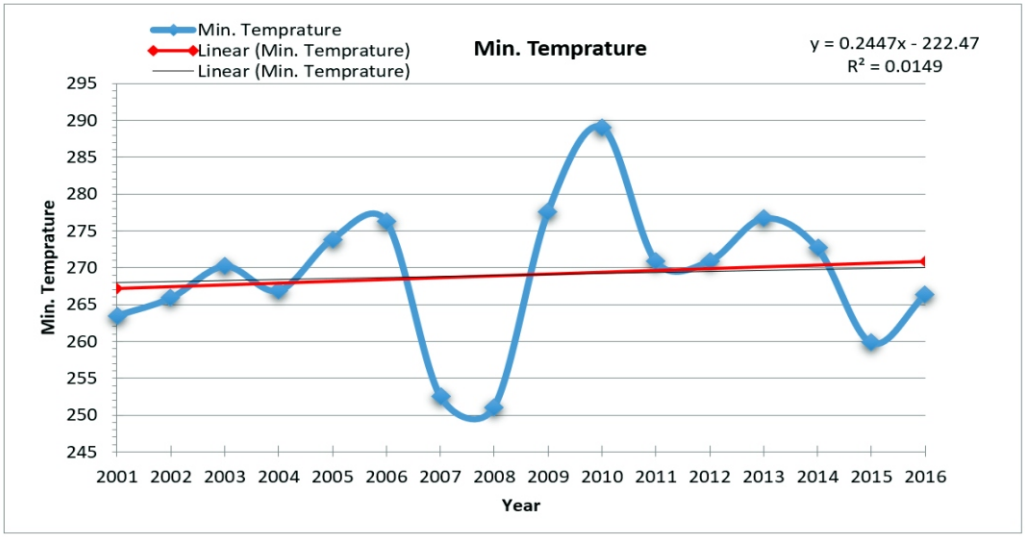

Figure 4: Minimum temperature trend in Keffi LGA.
Source: field work, 2018.

Maximum Temperature in Keffi Local Government Area

In determining trend, the temperature variable was subjected to trend analysis with the aid of Microsoft excel function of trend. From the trend graph in Figure 3, it is quite evident that the maximum temperature has been on a constant variation over the period of study. This oscillate behaviour is most notably within the first eight years (2002-2008) of the period under study. However, the period between the years 2009-2013 experienced a steady decrease in maximum temperature. The time series trend reveals that the year 2014 recorded the highest maximum temperature, at 445.6°C. The preceding years 2015-2016 however, recorded a steep decrease in maximum temperature at 259.8°C and 266.3°C respectively. The trend equation shows a gradual increasing trend (0.206x) implying a gradual increase in the average temperature over the period of 2001-2016.

Minimum Temperature in Keffi Local Government Area.

Figure 4 depicts the minimum temperature trend in Keffi Local Government Area. A careful look at the figures suggests a cyclical trend in minimum temperature in the area of study over the time span. A gradual and steady increase in maximum temperature was recorded within the periods of 2001-2006 at 263.5°C, 265.9°C, 270.2°C, 273.9 and 276.3°C respectively. However, it is important to note

that within these periods; only the year 2004 recorded and slight dip minimum temperature, at 266.9°C. A steep decline in minimum temperature was recorded for the year 2007 and 2008, at 252.6°C and 251.1°C. The year 2009 and 2010 recorded an astronomical increase in minimum temperature, with the 2010 having the highest record of minimum temperature at 289.1°c. A slight constant decrease occurred in 2011 and 2012 at 270.9°C, respectively, while the preceding year (2013) recorded a minuet increase in minimum temperature at 276.7°C. The year 2014 and 2015 recorded a dip in minimum temperature, preceded by a slight increase in 2016 at 266.3°C. The trend equation and trend line indicates a gradual increase in minimum temperature (0.133x) in Keffi Local Government Area over the period under study.

The implication here is that an increase in minimum temperature to crop will affect photosynthetic activities of crops which may in the long run affect the yield of crops.

Relationship between Rainfall, Temperature and Crop yield in Keffi Local Government Area

The relationship between rainfall, temperature and sampled crop was examined through correlation analysis as shown by the result extract in Table 2. The result by interpretation indicates a weak positive relationship between rainfall and cassava yield (0.028) in the area of study. The results further reveal a weak negative relationship between maximum temperature (-0.222) and cassava yield in the study area. The relationship between the sample crop (cassava) and minimum temperature was also tested. From the result extract in the table above, there is a weak negative relationship between minimum temperature and cassava yield.

Effect of rainfall and Temperature on Crop Yield in Keffi Local Government Area

In order to evaluate the effects of rainfall and temperature on crop yield in Keffi Local Government Area, a multiple regression analysis was done. Regression analysis is a set of statistical processes for estimating the relationships among variables. A regression analysis was employed because it helps one understand how the typical value of the dependent variable (or criterion variable) changes when any one of the independent variables is varied, while the other independent variables are held fixed.

The result extract in Table 3 depicts the effect of the variation in rainfall and temperature on cassava yield in the area of study. The coefficient of determination (R^2), which is the proportion of the variance explained in the dependent variable (cassava yield in this case), that is predictable from the independent variable(s) (Rainfall, Maximum and Minimum Temperature), was arrived at 0.111.

Table 1: Average Rainfall and temperature data with crop yield (2001-2016)

Year	Rainfall (mm)	Max Temperature (T ºC)	Min. Temperature (T ºC)	Cassava (mt)
2001	1414.5	407.7	263.5	669.2
2002	1192.7	412.1	265.9	655.9
2003	1406.8	411.6	270.2	643.6
2004	1305	407.1	266.9	618.4
2005	1290.7	411.2	273.9	393.4
2006	1319.9	414.9	276.3	246.8
2007	1279.6	417.1	252.6	271.5
2008	1141	420.7	251.1	246.8
2009	1595.7	418.1	277.6	253.7
2010	1438.3	416	289.1	201.4
2011	1261.4	408.3	270.9	189.2
2012	1321.2	403.5	270.9	149.4
2013	1311	403.3	276.7	137.8
2014	1297.8	445.6	272.7	205.7
2015	1322.3	419.4	259.8	137.9
2016	1198.1	401.9	266.3	294.6

Source: Nigerian Metrological Agency and National Program for Food Security

Table 2: Correlation analysis of Rainfall, Temperature and Crop yield

Crop (mt)	Rainfall (mm)	Max Temperature (T °C)	Min. Temperature (T °C)
Cassava	0.028	-0.222	-0.172

Table 3: Regression analysis of Rainfall, Temperature and Crop yield

Variables	R-Square (r^2)	Unstandardized Coefficients		Standardized Coefficients	Sig.(P-value)
		B	Std. Error	Beta	
Constant	0.111	3426.803	2726.594		0.233
Rainfall		0.371	0.599	0.203	0.547
Max. Temperature		-4.681	5.234	-0.245	0.389
Min. Temperature		-6.122	6.806	-0.294	0.386

a. Predictors: (Constant), Minimum Temperature, Maximum Temperature, Rainfall
b. Dependent Variable: Crop Yield (Cassava)

This thus implies that 11% of the variation in cassava yield is explained by the variation in rainfall, minimum and maximum temperature between the periods of 2001-2016 in Keffi Local Government Area. It is important to further state that the magnitude of effect by the predictors (rainfall, minimum and maximum temperature) varies. Rainfall had a non-significant effect as indicated by a level of significance (P-value) of 0.547 which is greater than 0.05 (P-value > 0.05) level of significance and a coefficient value of 0.371. This by extension implies that for every unit (mm) decrease in rainfall over the period of investigation, cassava yield decreases by 0.371mt.

In the same vein, maximum temperature had a non-significant effect at 0.389 level of significance which is > 0.05 level of significance. With a coefficient of -4.681, it thus implies that a unit increase in maximum temperature resulted to a negative effect on cassava yield in the study area, as yield decreased by -4.681mt per unit increase in temperature (1°c). Similarly, minimum temperature had a positive non-significant effect on cassava yield as indicated by 0.386 level of significance, which is > 0.05 level of significance. The result further reveals a coefficient of -6.122.

Conclusion

The study established that there is a minimal variability in rainfall and temperature characteristics, which translates into proportional variability in cassava yield in Keffi Local Government Area. Data were collected over a period of sixteen (16) years from the Nigeria Metrological Agency and National Program for Food Security, Abuja. The data were analyzed using correlation and regression analysis with the aid of the SPSS statistics package version 17, while the trend function was done with the aid of Microsoft Excel. The result shows an increase in minimum and maximum temperatures, coupled with unreliable rainfall distribution over the investigated period. The study identified poor yield with non-significant positive effect of rainfall, maximum and minimum temperature on cassava yield. To ensure that the negative effect of rainfall and temperature variability on crop yield is reduced and cassava production generally enhanced in Keffi Local Government Area, access to weather information by crop farmers can enhance adaptive strategies of farmers. This can reduce the adverse effects of climate variability on their activities. Therefore, efforts should be made to provide a forecast of the weather on a regular basis through the electronic media such as radio stations in the Local Government Area, to update farmers on the weather dynamics to enable them plan well for their farming activities. Agricultural Extension Officers (AEOs) should be deployed to guide farmers through routine visits, sensitization programs on variability in rainfall and temperature characteristics, use of farm inputs and monitoring of crop-climate relationship in the area in order to achieve improved crop yield.

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SOCIAL AND MEDICAL IMPLICATIONS OF ICT IN TOURISM AND HOSPITALITY INDUSTRY IN NIGERIA

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Abstract

This paper explores the prospects of attaining social and medical wellbeing through tourism and hospitality industry in the contemporary ever-dynamic Information and Communication Technology (ICT) driven age. The paper specifically focuses on teleconferencing technology. Its uses and benefits were given attention so also are its effects on hospitality sector and its impact on the social and medical wellbeing of the people. The thesis of this paper was anchored on the promising status of this technology in Nigeria in terms of adoption among the people; the likely negative implications of this technology on the hospitality if fully embraced were also noted. This was done within the available statistics on international tourism arrival into the country as well as the current trends in recreational attitudes and tourism patronage at domestic level. The main concern here is that in no distance time Nigeria will surely be overwhelmed by this value system of digital culture. With lack luster attitude to conventional leisure and recreation and ineffective tourism management in Nigeria, what will become of the hospitality sector when everybody per adventure decided to embrace ICT to take care of their overseas activities rather than take to travelling? What effects will this have on social and medical wellbeing of the citizenry? These and other issues formed the major concerns of this paper. While this clearly points at the need for reorientation of the people on the advantages in leisure and recreation and necessity of a developed domestic tourism, suggestions were equally made on what to do to prevent the shock that may arise as a result of non-preparedness.

Keywords: Teleconference, Technology, Hospitality, Digital age, Web, Video

Introduction

Man continues to be insatiable with its environment hence the emergence of culture of moving around even from their own homes on short term and temporary visits. Such mobility either within or outside their own countries is done for a host of reasons, which range from vacation, business, conference, visiting friends and relatives, and so on. During this period, the basic provisions for food, drinks, and accommodation become inevitable. It is within this backdrop that the issue of *hospitality* emerged. Awosanya (2016) noted that hospitality as a concept encompasses accommodation (the provision of a roof shelter or sleeping facilities), and catering (the provision of food and drinks).

Hospitality is a phenomenon that usually draws two things to mind; this includes caring and entertainment. Elebor (1995) sees hospitality as friendly and generous reception, and entertainment of guests, visitors, or strangers into one's group or home with goodwill and cordiality. From whatever perspectives hospitality is viewed, the meeting point is the issue of rendering services to make live comfortable for the end-users. These services therefore make it central to tourism industry; this is because any successful outing in the field of tourism is a product of accompanied hospitality. The idea here is that whether tourists leave home for leisure or business, the basic necessity of life, which include food, drinks and accommodation must be met. The quality of hospitality (accommodation and catering) therefore has an enormous influence on the success of any tour. The meaning of hospitality is providing a

safe and enjoyable environment for patrons. Hospitality industry thrives in the presence of dynamic tourism sector because it is the supplier of the services for tourism. The implication of this is that an 'organic' relationship exists between hospitality and tourism sectors because the purpose of the people for travelling to destinations where they want to experience recreational and leisure activities (tourism activities) becomes worthwhile with accommodation, food and beverage (hospitality services).

In Nigeria, studies have been showing steady increase in level of apathy towards recreation and tourism by the citizenry. Many Nigerians were noted as lacking in knowledge of the essence of leisure, which was attributed as a major contributing factor to low level of development of tourism culture, poor awareness of how recreation can help in improving the quality of one's mental and physical well-being. The resultant effects of the foregoing were asserted as robbing the citizenry the benefit of knowing that recreation as part of tourism activities provides payoffs for the individuals by redeeming them from routine and fatigue through participation in recreational activities especially those activities that enhance the exhibition of creative ability, achievement of self-fulfillment and relief from day-to-day stress.

Lack of knowledge of the essence of recreation further reflected in the general attitude of Nigerians with respect to the provision of recreational facilities (Igbojekwe, *et al.,* 2013) hence the indifference to the provision of recreation facilities by urban planners and public officials (Akinola-Arikawe, 1985). These revelations in contrast to what obtains in more developed countries such as the United States of America and Britain where the provision of recreational facilities have long been made a routine component of plans for urban cities and the society at large (Linden, Ike, and Voogd, 2004; Wates, 2000; Newman and Thornley, 1996; Harris, 1989). Unlike the scenario in Nigeria, individuals in developed countries especially in United States of America have the culture of consciously saving towards leisure trips to places of tourist interest and attractions within their country and in different parts of the world thereby contributing immensely to the growth of domestic tourism (Lou-Hon and Uysal, 1994).

Poor attitude towards conservation of nature and environmental resources (Okunola and Lawal, 2013; Marguba, 2001; Aina, 2000; Gbadegesin, 2000a, 2000b; Ayeni, 1995; Bashir, 1995; Fuwape and Onyekwelu, 1995; Fuwape, 1991) is another manifestation of Nigerians' indifference to recreation. This has further entrenched the people's inability to turn these resources into revenue generating ventures by developing them as tourist attractions. The sum total of this is responsible for the under-utilization of existing tourist and recreational facilities that abound in Nigeria. The subsequent result of this is the frustration being experienced by the private investors within the industry because of low patronage received by their investments. Yahaya (2017) lent credence to this with observation that the little boost being enjoyed by the tourism industry in Nigeria was a product of the patronage by the international tourists. This observation by Yahaya (2017) portends a grim picture of tourism future in Nigeria. The question here is that, what would be the future of tourism in Nigeria in this digital age where virtually every segment of the society continues to be engulfed by the ever-expanding influence of information and communication technologies? What would be the prospect of attaining social and medical wellbeing through tourism and hospitality industry in the face of an ever-dynamic information and communication technology driven age? The concern arose as a result of the way information and communication technology (ICT) is affecting every facet of human life either positively or negatively, and the possibility that hospitality industry will not be an exception, especially since some of the key factors which can warrant this are already here and available particularly the Internet and other emerging technologies like 'teleconferencing technology' (a type of ICT).

For instance, when GSM (Global System for Mobile Telecommunication) came, several people resisted it, but some years after, the reverse is the case. Secondly, the Internet, which came almost the same time, is gradually taking the usual 'toll' this time of good effect on all and sundry. Moreover, during the past twenty years or more, the technology, specifically the ICT has advanced so well, and to such an extent that almost everyone everywhere comes into contact with it in one way or the other (Preece *et al.,* 1994). At this point, it is necessary to know what Teleconferencing is all about.

Conceptual Clarification of Teleconferencing

Teleconferencing is an interactive group communication that involves several people in two or more locations, through the use of electronic

medium (Teck-Kuen and Pheanis, 2008; Rogan and Simmons, 1984). The process has the ability to bring people together under one roof even though they are separated by hundreds of kilometers (Rogan and Simmons, 1984). The term teleconferencing may be a meeting or conference held via a telephone or network connection between participants in remote cities or work sites. Teleconference can also refer to a live event that is transmitted via satellite to various locations simultaneously (Teck-Kuen and Pheanis, 2008).

There are many types of teleconference meeting, but the simplest form of it involves the use of a speakerphone at each location to conduct an audio conference. The breakthrough in ICT has engendered more sophisticated teleconference meeting which made possible the exchange of both audio, video and text-like data/information transmission; all happening simultaneously and seamlessly. In a broad term, teleconference includes a variety of options, but the basics for all teleconferencing involve the use of telecommunication equipments by users at multiple locations thus ensuring collaborative communication between the participants. The followings are the commonly employed teleconference technology: Audio graphic, video teleconferencing or conferencing and Web conferencing.

Audio graphics allows participants to share graphics (either still graphics or motion graphics commonly known as animation), documents, and video. To achieve this, additional equipment such as electronic tablets, scanners, webcams, and voice data terminals are employed. *Video teleconferencing* uses additional equipment, which is primarily a television camera to establish a face-to-face meeting that incorporates the ability for each participant to view each other at all locations. Teleconferencing can also be conducted online, along with other types of online conferencing services using all forms of Internet Relay Chart (IRC) resources such as messengers, e-mail, and so on. All these are very useful alternative ways and yet similar to teleconferencing techniques that are found everywhere and within the reach of all irrespective of status. In addition, with the Internet, companies can now use both live web feedback and audio to conduct meetings and make result-oriented business plan (Firestone *et al.,* 2007; Cook and Haver, 1994; Chapanis *et al.*, 1977).

Video teleconferencing enables individuals or groups in distant locations to hold virtual meetings while sharing real-time video materials (data/information) between the participants (Ferran and Watts, 2008; Wolfe, 2007). In the case of web conferencing, the participants also share electronic documents with other team members. Web conferencing is clearly a very advantageous way of handling important business communication between clients and colleagues who are in very different locations. Its possibility and ability is due to advances in the speed and efficiency of the Internet (Ferran and Watts, 2008; Gharai *et al.,* 2002); while the ability and possibility of the Internet is due to the presence of high speed performing communication devices such as computers, telephones, radio equipments, satellite, and others on one hand, and factors like the presence of high skilled personnel who man the equipments as well as the ever-decreasing price of the needed equipment as compared to a proportional increase in the capacity in terms of processing speed and efficiency of performance.

Uses and Benefits of Teleconferencing Technology

Web conferencing can be an alternative to traditional teleconferencing or the two can be combined to provide a better conferencing experience. Multiple participants through this system use web-based text messaging to communicate with each other. The software in use here typically includes features, which allow participants to display part or all of their computer desktops with other conference users (Arapis *et al.,* 1998; Gemmell and Bell, 1997). Web camera is one of the main features, which make this possible. Video conferencing can be used in a host of different environments, which is one of the reasons the technology is so popular. General uses for video conferencing include business meetings, educational training or instruction and collaboration among health officials or other representatives. So far, video conferencing has been used in the field of telemedicine, telecommunication, education, surveillance, security, and emergency response (Breiteneder *et al.,* 1996).

In whatever form this technology may appear, the aim is to increase productivity (Gemmell and Bell, 1997). To ensure this, teleconferencing technology has provided businesses with an entirely new way of communicating over long distances. In fact, it helps business save money on travel expenses and has also helped business owners increase productivity of their business through provision of ability to communicate via telecommunication methods (Teck-Kuen and Pheanis, 2008; Liu and Zarki, 2004;

Breiteneder *et al.,* 1996; Arapis *et al.,* 1998; Gemmell and Bell, 1997). Teleconferencing technology gives businesses the ability to have meeting over long distances, conduct business briefings, employees training sessions, workshops, seminars, lectures, and more between individuals who might not otherwise be able to easily get together. With various web conferencing features, businesses can benefit together from the use of special software applications like that in Excel, Access, PowerPoint, and can transmit various images from one place to another within a matter of moments. Conversely, a simplistic method of web conferencing includes using instant messaging system and privately designed chat rooms in which business executives can conduct discussions, meetings, planning of projects and more (Curry *et al.,* 2012). At the same time, it is also available to individuals in their homes.

Effects of Teleconferencing on Hospitality Sector as an Arm of Tourism Industry

Considering its relevance and effects on human life in general, one should note that teleconferencing technology like all other forms of Information and Communication Technology (ICT) is impacting greatly on all facets of human endeavours. With this technology, there is no need of traveling over a long distance before businesses could be conducted. At the same time, travel related costs (lodgings, airfare, and meals) are no longer there. These avoided expenses could now be ploughed back into the business for optimum results and fantastic dividends. Along with this is the prospect of reduction in rate of accidents, traffic congestion and environmental pollution that usually occur due to influx of people into the community. This is because vehicular movement will be less as a result of people confining themselves to the comfort of their homes and offices to communicate with business partners in far distances, courtesy of improved ICT. It is therefore very difficult to ignore the benefits that teleconferencing technology brings and is still capable of bringing to establishments, and to individuals employing its usage. From this, it is pertinent to note that its popular adoption as a necessity in human dealings for optimal productivity is a matter of time.

However, as these positive sides are being revealed, it will also be of immense value to look at the other side of the continuum, especially the effects of this technology on the service sector of tourism industry, particularly the hotels and guest houses. As said earlier the concern of this paper is to know the situation of things within this discourse in developing societies like Nigeria. It becomes more imperative in view of the fact that hotels have come to stay as veritable ventures and indispensable arm of tourism industry particularly at this point in time, when attention is being shifted to tourism in developing countries as a veritable means of supplementing their revenue drives. In developed countries where teleconference technology has become widely accepted and highly employed, the issue of vacations is always given high priority by the people therein. Such vacation periods are usually spent by visiting exotic places with fantastic tourist attractions that are spread across the globe. As a result of these visits, incomes in foreign currencies are generated by the host countries. However, in a country like Nigeria where people have poor attitude towards hotel patronage (Igbojekwe, 2013; Lawal and Asala, 2008; Akinola-Arikawe, 1985), the patronage of tourist attractions was never encouraging likewise the hospitality sector. The survival of hospitality sector is hanging on the grace provided through the patronage from those on business/conference tour.

Table 1 shows data from World Tourism Organisation (2017) on international tourist arrivals across the world with specific reference to African countries. Algeria recorded 1.4 million in 2010; 2 million in 2011, 2.3 million in 2014 and 1.7 million in 2015. Kenya on the other hand had 1.3 million in 2010; 1.4 million in 2011; 1.2 million in 2014 and 1.1 million in 2015. Within the same periods under review, Morocco and South Africa records appreciated from 2010 till 2014. South Africa record dropped slightly in 2015 but appreciated in 2016 while on the other hand, Morocco maintained its advancement in terms of tourists' arrival till 2016. The rate of appreciable performance commences from 2010 till 2015 for Benin Republic, Cape Verde, Central Africa Republic, Mauritius, Uganda, Sudan, Ethiopia, and others (see table 1). In Nigeria, the story was not encouraging in spite of her endowment in terms of tourism resources. In 2010, 1 million tourist arrivals were recorded in Nigeria, this increased to 1.5 million in 2011, in 2014 and 2016 no record was available on rate of tourist arrivals into the country. However, a total of 1.2 million was recorded in 2015 which was less than what was recorded in 2011 (UNWTO, 2017).

Table 1: International Tourist Arrivals (2010 – 2016) for African Countries

Countries	2010	2011	2014	2015	2016
Algeria	1,443,000	2,070,000	2,301,000	1,710,000	-
Angola	210,000	425,000	595,000	592,000	-
Benin	176,000	199,000	242,000	255,000	-
Burkina Faso	245,000	274,000	191,000	163,000	-
Cape Verde	198,000	336,000	494,000	520,000	598,000
Central African Republic	12,000	54,000	96,000	121,000	
Chad	29,000	71,000	122,000	120,000	-
Cote d'Ivoire	-	252,000	471,000	1,441,000	-
Ethiopia	227,000	468,000	770,000	864,000	-
Gambia	108,000	91,000	156,000	135,000	
Ghana	429,000	931,000	825,000	897,000	-
Kenya	1,399,000	1,470,000	1,261,000	1,114,000	
Madagascar	277,000	196,000	222,000	244,000	293,000
Malawi	438,000	746,000	819,000	805,000	-
Mali	143,000	169,000	168,000	159,000	-
Mauritius	761,000	935,000	1,039,000	1,151,000	1,275,000
Morocco	5,843,000	9,288,000	10,283,000	10,177,000	10,332,000
Mozambique	578,000	1,718,000	1,661,000	1,552,000	1,639,000
Niger	58,000	74,000	135,000	135,000	-
Nigeria	1,010,000	1,555,000	-	1,255,000	-
Reunion	409,000	421,000	406,000	426,000	458,000
Senegal	769,000	900,000	963,000	1,007,000	-
Seychelles	129,000	175,000	233,000	276,000	303,000
Sierra Leone	40,000	39,000	44,000	24,000	54,000
South Africa	7,369,000	8,074,000	9,549,000	8,904,000	10,044,000
Sudan	246,000	495,000	684,000	741,000	-
Swaziland	837,000	868,000	939,000	873,000	947,000
Tanzania	590,000	754,000	1,113,000	1,104,000	-
Togo	81,000	202,000	282,000	273,000	-
Tunisia	6,378,000	7,828,000	7,163,000	5,359,000	5,724,000
Uganda	468,000	946,000	1,266,000	1,303,000	-
Zambia	669,000	815,000	947,000	932,000	956,000
Zimbabwe	1,559,000	2,239,000	1,880,000	2,057,000	2,168,000

Source: United Nations World Tourism Organization (UNWTO) – Tourism Barometer
Data as collected by UNWTO June, 2017

Nigeria as an adopter of Information and Communication Technologies could still experience unprecedented rate of adoption in short possible time. With expositions that Nigerians have poor recreation/tourism culture (Igbojekwe, Okoli and Ugo-Okoro, 2013), tourism sector may not survive as ICTs are being widely adopted if one considers the revelation of Malan (2006). According to Malan (2006), 60% of tourists' arrival to Nigeria came for business/conference purpose; 13% on visitation to their friends and relatives; only 5% for vacation while 20% came for other issues (not classified) and another 2% unaccounted for by the author. Assuming the statistics presented by Malan (2006) still remain valid till date, it then means that 60% of these arrivals who came for business/conference purpose may decide to carry out these activities through various ICT resources without necessarily wasting their money for travelling to Nigeria. Also, 13% on visitation to their friends and relatives may decide to interact with their loved ones through social media like Twitter, Telephone Conversations etc. By the objective of teleconferencing technology, which is to save the people the trouble of frequent traveling and maximize costs, it is necessary to inquire on what will become of tourism and hospitality industries in Nigeria if she should lose the 60 percent of tourists entering the country for business/conference purposes?

Implications of ICT adoption on Tourism Situation, Social and Medical Wellbeing

Where a country is well-prepared, ICT penetration (in whatever guise or mode) into economic system will make little or no damage. With positive economic environment on ground, it will end up in

consolidating what it met on ground by creating a virile populace and roboust economic system. A society of this nature must have developed culture of participation in recreation activities (an aspect of tourism). Recreation in such clime often time remains means by which individuals engage in stress reduction, engendering opportunity for relaxation, rest and revitalization. Embedded benefits therein always serve as major motivator in the usage of recreation. The personal rewards and satisfaction people achieve through their participation further indicated that recreation has been accepted by the participants as an integral component of life as well as the means of providing the impetus for work and participation in community activities.

On the other hand, society that is ill-prepared will obviously experience a scary situation. It is obvious that as poor economic returns set in as revenue being generated from this sector is dwindling thereby leading to downsizing of manpower in the sector. When this happens, it may increase the rate of unemployment in the country, and the dependants of the laid-off manpower will also feel the hardship. The resultant effect of this will be increasing social vices in the society and aggravation of security system of the country. The effect of economic insecurity may spread like wildfire among the populace. This will lead to more commitment to jobs and little time for rest or recreation for those who are lucky to keep their jobs. It may also lead to total apathy in the usage of domestic tourism resources for physical and mental development. Working round the clock in order to make ends-meet will eventually lead to stressful lifestyle, increase in health problems and lower productivity at work. Creativity for dynamism in professional life may be lost or reduced drastically. A situation of this that is not well managed will give room to poverty and social exclusion, fear of unknown over job security, and subsequently the adoption of coping strategies like taking alcohol, drug and tobacco.

Aside this, development and maintenance of environmental infrastructural facilities such as planting in public parks and gardens, upgrading of street amenities, clearing of derelict land may not be possible. This will be due to inadequacy of finance to effect constant attendance to such infrastructural facilities and absence or drastic reduction in patronage of existing facilities. With this in place, local communities will lose their hard-earned positive image as boisterous tourist destinations and subsequently inability to attract investment of all kinds. In such situation, detrimental environmental activities such as unplanned tree felling, destruction of coral reefs and damage to wildlife species may not be ruled out and likely to be widespread in the name of making-ends-meet by the gradually impoverished residents. Highly prevalent in such situation will equally be an increasing disregard for public health practices, overcrowding of cities, rise in population of disease-carrying vectors such as mosquitoes and ticks. At household level, communities will be vulnerable to poor sanitation and unsafe water sources. Water-borne diseases and illnesses due to poor hygiene will be contributing immensely to the disease burden. Respiratory infections that are mostly caused by smoke from charcoal, wood, and other biomass fuels are potential health burden to be experienced.

From the foregoing, it is obvious that people found in this situation are already enmeshed social and medical quagmire. This is because Fajemilehin (2016) postulated wellbeing to entail an equilibrium or otherwise between environmental factors such as winds, temperature, water, soil and food, and an individual's way of life. Such way of life is supposed to include the individual eating, drinking and sexual habits as well as work and recreational behaviour. In this situation, emerging challenges will lead to disarticulation of people's ways of life thereby preventing equilibrium for optimal wellness. At the end of the day, development and accumulation of stress in day to day activities may become more pronounced. In line with Marmot (2004) and Raphael (2004) observation of similar scenario, the stress thus accumulated will damage health, increases the risk of disease; lead to poverty and social exclusion, which will cost lives; job insecurity, unemployment, causes illness and premature death; absence of viable social supports and supportive networks because substantial proportion of the populace would have become vulnerable to the unfolding calamities.

Conclusion and Recommendations

Outright reliance on international tourists' arrivals for the country to reap tourism-endowed economic dividends therefore portends grave dangers for sustainable development. This could however be avoided for a functional social and medical wellbeing where positive tourism culture is developed among the populace. The first step toward this is to have a virile and sustainable tourism sector where necessary facilities are in place for unbroken chain of patronage

from both domestic and international tourism. As this is bringing about good health, it will equally assist economic development and subsequently provide the means by which the available tourism resources could be further developed. Equally worthy of mentioning among the benefits are what Goudie and Ladd (1999) and Goodwin *et al.* (1997) listed as infrastructural development, revenue and employment generation, international peace and understanding. Peaceful and understanding populace will further usher in an enabling environment for provision of facilities like good road network, steady supply of water and electricity, good communication network, efficient security system, hospitable destination and so on (Oduyoye, 1994). These infrastructures will enhance accessibility of tourist destinations and subsequently the tourism growth. To this end, the following are possible suggestions, which could make the task a worthwhile affair:

Private Partners/Stakeholders

- Every hotel operator in the country should be serious and committed to working together as a formidable association (irrespective of whether it is publicly or privately owned). When seriousness and commitment are established within such association of this nature, necessary backing (be it legal, moral, financial or whatever) should be given to it because it has the task of keeping the hotels in business. Whatever is invested in this task will assist the sector and prevent unnecessary reliance on government's assistance which may not come more so, that government is already in the process of shedding some of its responsibilities to the private individuals and organisations in the name of *privatization*. This task could obviously be onerous, but would certainly ensure a safe landing for the hospitality sector as a whole in the case of unpalatable eventuality from emerging technology in the country.
- The association in question on behalf of its members should liaise with the mass media (as an important organ of the society) to develop the tourism industry, through the projection of Nigeria's cultural heritage far and wide. Both prints and electronic media have very important roles to play in this regard. Through this, interest in tourism will be awakened at domestic level, and the tourism frontiers will also be developed for positive patronage by the international tourists. So by the time teleconferencing is full blown, improved patronage from other types of tourists aside from business tourists would have conveniently cushioned the shock that would have emanated.
- Hotels and other forms of hospitality sector should be established at rural areas, and every point where we have tourists' attractions in Nigeria. This should be of international standards to accommodate visitors. This will prevent the agony of having to travel far distances for accommodation, and thus encourage further patronage.

Public Partners/Stakeholders

- In conjunction with the anthropologists and other experts in the field, efforts should be made to revive various dying cultures in the country, and where necessary introduce innovations in such a way that it will not remove the natural flavours from such festivals. Collaborate with other well-meaning individuals and corporate bodies to improve the transport and communication systems particularly land and air transports should also complement this.
- Educate and raise awareness among the populace on the need for positive behavioural change towards their cultural affinity and the need for their participation in tourism and encourage them to receive visitors in their midst. At the same time, effort should be made to develop and publish national programs that are of tourist interest including cultural calendar, conference schedules for national and international awareness. This will make the country a place where people will be looking forward to visit for one cultural festival or the other. The overall implication of this is that a very viable avenue would be opened up for the hospitality sector to both showcase and market their products and also further their sustenance.
- Aggressive marketing is another option. This involves organizing large-scale advertising campaigns overseas on availability of festivals as tourists' attractions in the country. On the same note information system should be overhauled by placing information about various festivals, arts and crafts available as souvenirs on the Internet for wide circulation.

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ASSESSMENT OF URBAN LANDUSE EXPANSION ON AGRICULTURAL LAND IN KWADON DISTRICT OF YAMALTU-DEBA LOCAL GOVERNMNT AREA, GOMBE STATE

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Abstract

The study sought to evaluate urban landuse expansion on agricultural landuse in Kwadon District. The information derived for this study was mainly through field survey, oral interview, questionnaire administration and imageries from Google earth from 1999 and 2015. The geo-referenced Google earth image of the area was digitized (on-screen) using ArcGIS 10.4.1 version. The GIS analysis result for change detection over landuses for the time period of 1999 to 2015 was a decrease in agricultural land from 49.31% to 34.22%, while built-up area increases from 9.04% to 25.58%. The study revealed the causes of the expansion which were population growth, migration and developmental project. It also revealed the dominant activities that took over farmlands in the area, included residential, commercial and semi-industrial uses among others. The study also revealed that reduction in crop production, loss of farmlands, changes in type of crops grown, which lead to food insecurity, are the effects of landuse expansion on crop production. Hence, farmers developed the following strategies; intensification of the use of remaining farmland, engaging in off-farm activities, changing crops grown and acquisition of new farm plots. The study recommended that an appropriate planning and zoning should be adopted with impact studies and scenarios, in order to protect agricultural lands from urban landuse encroachment.

Keywords: Landuse, Landcover, Kwadon, Encroachment, Satellite, Image

Introduction

Land is an important national resource for agricultural production and other developments. Despite the tremendous changes in socio-economic and technological development all over the world in recent decades, agriculture still remains a crucial sector in human endeavour. In Nigeria, over 80% of the populations were engaged in agriculture before the discovery of petroleum, either on part time or full basis (Baker, 2008). According to Adindu and Ogbonna (2003) and Ekpenyon, 2008), the conversion of agricultural land to urban landuse activities is a potential threat to agricultural production. Agriculture is in direct conflict with the process of urban expansion in the immediate hinterland (Josiah, 2003 and Simon, 2004). This has been as a result of population increase and migration into the hinterland in large numbers, as they require land for the provision of public utilities, services and residential activities. The implications include reduced farm plots size, reduced fallow period, changes in traditional farming system, changes in land tenure system, changes in crops grown, changes in value and culture, land speculation and increase land prices, conflict within the family, land degradation and loss of soil fertility, distances location of new farms from road and residences, trespass on land, farm fragmentation, increase in services costs and general disruption of rural communities (Dami, et al; 2011).

The population of Gombe town was estimated to be over 399,761 (National Population Commission, 2010). This change in population size implies pressure on agricultural land surrounding the state capital. Statistics from the state's Ministry of works show that from 2000 to 2010, a total of 290.8km of new roads have been constructed while over 302.60km has been planned for construction in the

next eight years. Housing development to accommodate the demands of increasing population is also taking large portion of agricultural lands. Available data on land use statistics from the Ministry of Land and Surveys, Department of Town planning Gombe indicate that urban landuse have changed dramatically in the last two decades. For instance from 1991-2010, over 4,772 hectares of peripheral agricultural lands have been approved for conversion to residential use by relevant authorities, 607 hectares was approved for commercial uses, over 90 hectares of agricultural land have given way to industrial use. These expansions into peripheral agricultural lands reduced the spatial extent of agricultural land and fragment them into smaller patch sizes of less than 1 hectare.

Kwadon district in historical perspectives was a rural community, with abundant agricultural land. Over the years, the area has experienced changes in its landuse type resulting to increasing competition for agricultural land and settlement. And the area is experiencing changes in its characteristics from rural settings to urban characteristics due to increasing expansion of Gombe town to the extent that one hardly differentiates the boundary between them. It is against this statement that the researcher seeks to assess urban landuse expansion on agricultural land in Kwadon district of Yamaltu – Deba LGA of Gombe State.

Aim and Objectives of study

This research aimed at assessing rate of urban landuse expansion on agricultural landuse in Kwadon district of Yamaltu-Deba Local Government Area of Gombe State.

The specific objectives are:

i. to classify landuse/landcover of the study area from 1999-2015.
ii. to find out the causes and the major urban landuses encroaching on agricultural land in the study area.
iii. to find out the effects of landuse expansion on agricultural production in the study area.
iv. to determine the way farmers respond to the conversion of agricultural landuse to urban landuses in the study area.

The Study Area

Kwadon district is an area within Yamaltu-Deba local government area of Gombe State. It lies between latitude10^0 00^1N to 10^0 30^1N and longitudes11^0 11^1E to $11^0$45E respectively. The study area is located about 7km away from the state capital, along Gombe Biu-road. (See Fig.1)The area under study is part of extreme tropical continental type of climate. One of the basic characteristics of this climate zone is its relative short rainy season and a comparatively long dry season. The beginning and the end of the rainy season changes from year to year. It usually begins in late April to early May and ends in late September or early October. The area has a rainfall distribution ranging from 970.7mm to 1,142mm annually, with a mean of 850mm and a mean maximum and a mean minimum temperature of 32.8^0 c and 18.3^0 c respectively.

The relief of Yamaltu Deba L.G.A comprises part of the upper Benue trough of northern Nigeria. The plain has generally undulating characteristics especially towards the northern part of kwadom where the height of the area is estimated to be 274m above sea level. The area is drained by Wango stream through Kwadom, Zambuk down to Dadin-kowa which is a tributary to River Gongola. The soils are shallow to deep loamy, sandy, clay, vertisols and cracking clay that have weathered and are very fertile and support intensive agriculture. The soil of the study area is developed on the sand stone parent material (Gombe sandstone). The vegetation of the area is Sudan savannah, most of the forest cover in the area has been reduced to semi desert shrubs. The inhabitants of kwadom are predominantly farmers who depend on this activity for their livelihood inherited from their fore fathers.

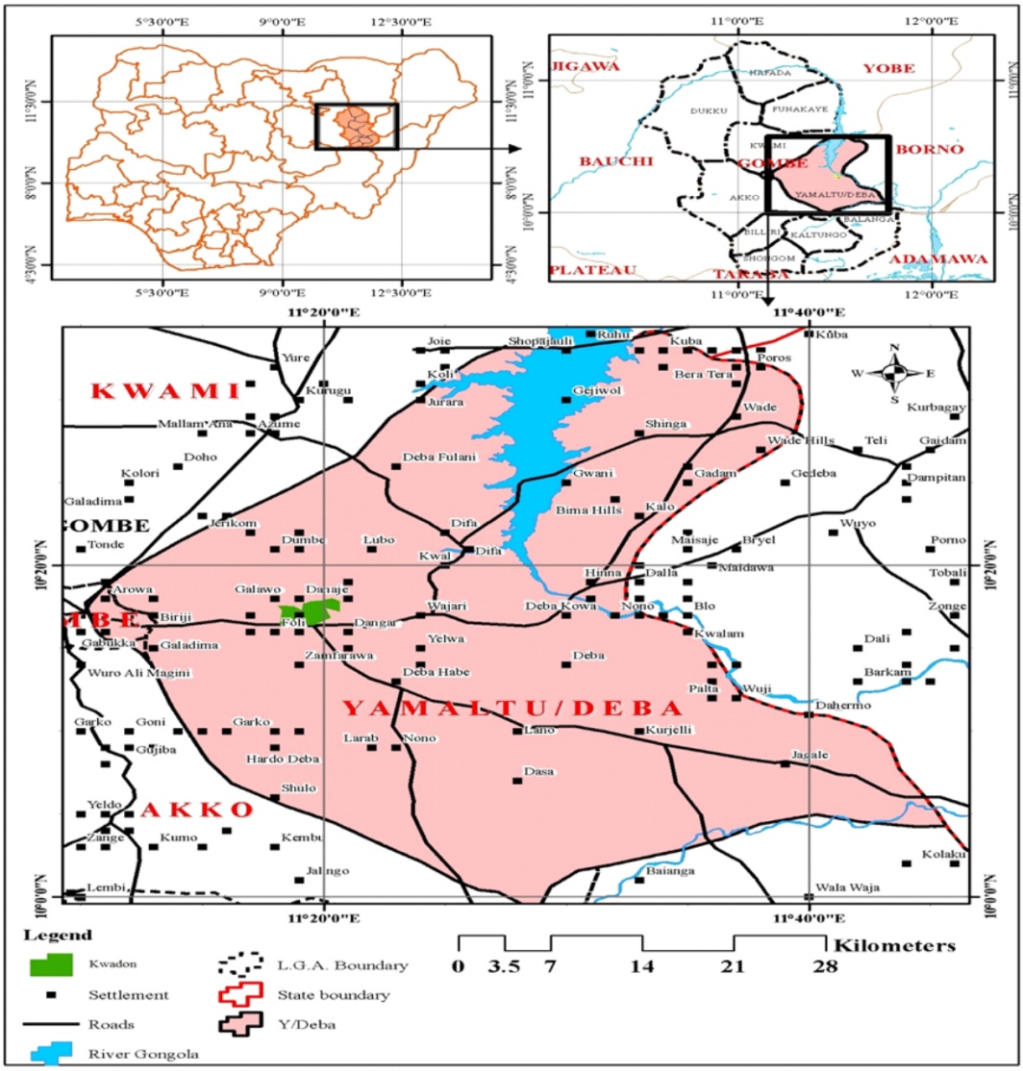

Figure: 1: Kwadon District the study Area in Yamaltu –Deba LGA
Sources: National Centre for Remote Sensing (NCRS) Jos, (2017)

Materials and Methods

Sources of Data

The sources of data used include both primary and secondary sources. The primary data used for this study included field observation, and administration of questionnaires to residents and farmers (farmers association of Kwadon). The secondary data was sourced NCRS, Jos where two sets of satellite imageries of kwadon (1999 and 2015) were obtained.

Tools and Equipment

i. Computer hardware and related accessories like mouse, printer etc

ii. ArcGIS 10.41 Software: This was used basically for digitizing the base map, development of Landuse landcover classes and subsequently for change detection analysis of the study.

iii. Hand held GPS (Germin): For taking coordinates of the study area.

iv. Topographic Map: This map was used to delineate the study area and extract settlements information in the study area. It was obtained from National Centre for Remote Sensing.

v. Satellite Images: Satellite images of 1999 and 2015 were obtained. These images were used to generate the land use and land cover information within the study area between1999-2015 was obtained from Google earth.

vi. Information obtained from farmers, farmers association in Kwadon was through a well-structured questionnaire and focus group discussion.

Sampling Technique

A purposive sampling technique was used. The reason for choosing purposive sampling is to avoid contact with non affected areas and non interest groups that lacked knowledge about the subject matter. Thus, the study only focuses on the areas and the farmers that are seriously being affected by the stated problem. A total of sixty (60) questionnaires were administered. The questionnaire has three sections. The first section seek for the Demographic, social and economic characteristics of the respondents; the second section seek for the characteristics of their previous and present farmlands, while the third section seek for the information on the effect, adjustment/ adaptation strategies employed by the farmers.

The data collected from were analyzed using descriptive method such as the use of tables, percentages, charts and graph. While satellite imageries of kwadon district were analyzed using ArcGIS 10.4.1 by screen digitization, editing of the various layers and colour composite to enhance major landuses change between 1999 and 2015 in GIS/Remote Sensing Laboratory Geography Department, Gombe State University.

Results and Discussion

Land use land covers classification map.

The spatial growth or expansion in other land cover types is directly taken place on the agricultural land as indicated by been the land cover type with significant decrease in area coverage for the period under study. The figures 2 and 3 are the Landuse/Landcover maps of kwadon derived from the satellite imageries of 1999 and 2015 respectively that showed different landuse classes of the study area as they appeared in these years.

Land use land covers classification analysis

This characterizes the landuse and land cover class of Kwadon over sixteen years in Hectares and percentage. Table 1 shows the total area covered by each features in hectares and their respective proportions (in percentage). It also reveals the percentage of changes of land cover types that occurs in the area between the given periods. A negative percentage change indicates loss of land cover/landuse type. From the analysis, between 1999 and 2015, farm lands were decrease /lost by 15.09%, bare surface by 0.66%, Vegetation by 0.79%, while built up areas increased by 16.54%.The implication of this is that, it will lead to reduction of farmlands and farming activities which will also lead to food insecurity to the community, state and the entire country at large.

The areal extent of land cover in kwadon as illustrated in figure 4 below. In 1999, the area is covered mostly by farmland while in 2015, bare surface is the dominant land cover followed by buildup and vegetation.

The result in Figure 5 indicated that farmlands have a negative change between 1999 and 2015. That is, large proportion of farmlands was lost within the 16years period covered by the study. It was also observed that the areas covered by built up increased greatly which has implication on livelihood and food security.

Types of urban Landuse encroaching on agricultural land

Table 3, reveals that the majority of the landuse encroaching agricultural land are residential with 36.7% and commercial uses with 28.35% constituted the two dominant urban landuses encroaching on agricultural land in kwadon district while the rest being minor ones. This indicated that from now to 100years to come farmland will be continue reducing drastically which will lead to the shortage of food.

Farmers Affected by Encroachment

Information provided by sampled farmers on the number of farmers affected and non- affected by encroachment shows that about 68.3% of the sampled farmers were affected by the encroachment while only 31.7% were not affected (Table 4). The farmlands of some affected farmers are located close to the central market of the district, which will force them to go farther away to new farm plot which will require more time, energy and cost of transportation.

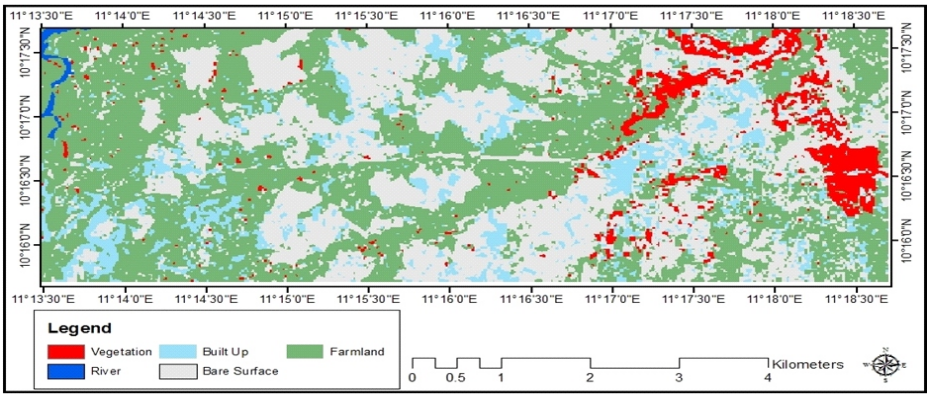

Figure 2a: Landuse/Land cover Classification of Kwadon district as at 1999 satellite imagery
Source: Field/GIS Lab. GSU (2017)

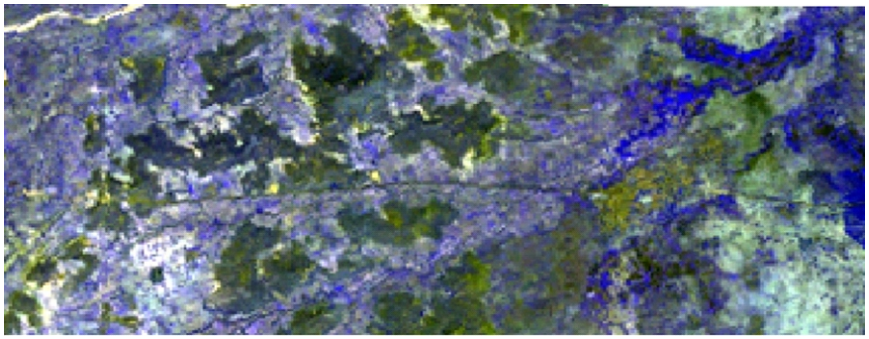

Figure 2b: Satellite image of Kwadon district as of 1999. *Sources: Google Earth 1999*

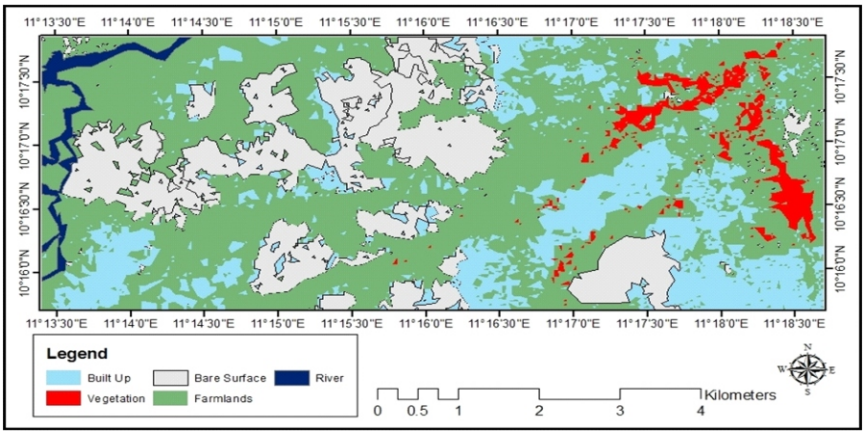

Figure 3a: Landuse/Land cover Classification of Kwadon district as at 2015 satellite imagery.
Source: Field/GIS Lab. GSU (2017)

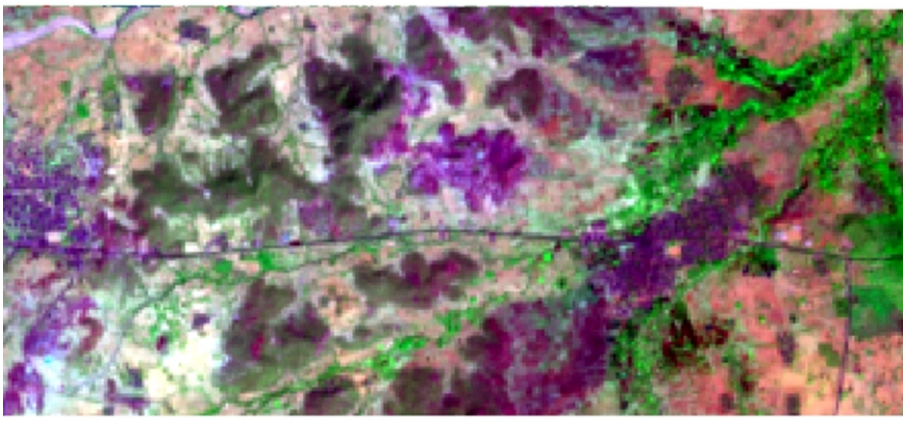

Figure 3b: Satellite image of Kwadon district as at 2015. *Sources: Google Earth 2015*

Table 1: Changes in land cover / landuse pattern between 1999 and 2015

Landuse/landcover	Total Area (Ha)		Total Area (%)		Change (%)	Years
	1999	2015	1999	2015		
Vegetation	513.82	408.75	3.84	3.05	- 0.79	16
Build up	1,210.23	3,424.23	9.04	25.58	16.54	16
Bare surface	5,062.16	4,974.36	37.81	37.15	- 0.66	16
Farmland	6,602.43	4,581.3	49.31	34.22	-15.09	16
Total	13,388.64	13,388.64	100	100		

Source: Field/GIS Lab. GSU (2017)

Table 2: Landuse classes description.

CODE	LANDUSE/LANDCOVER	DESCRIPTION
1	Farmlands	Agricultural Lands used for farming (plantation, cropland orchard)
2	Built-up land	Lands used for residential, industrial, commercial, etc.
3	Vegetation	Lands covered with natural and man made vegetation (any plant species)
4	Bare surfaces	Lands devoid of vegetation, exposed soil

Source: Field/GIS Lab. GSU (2017)

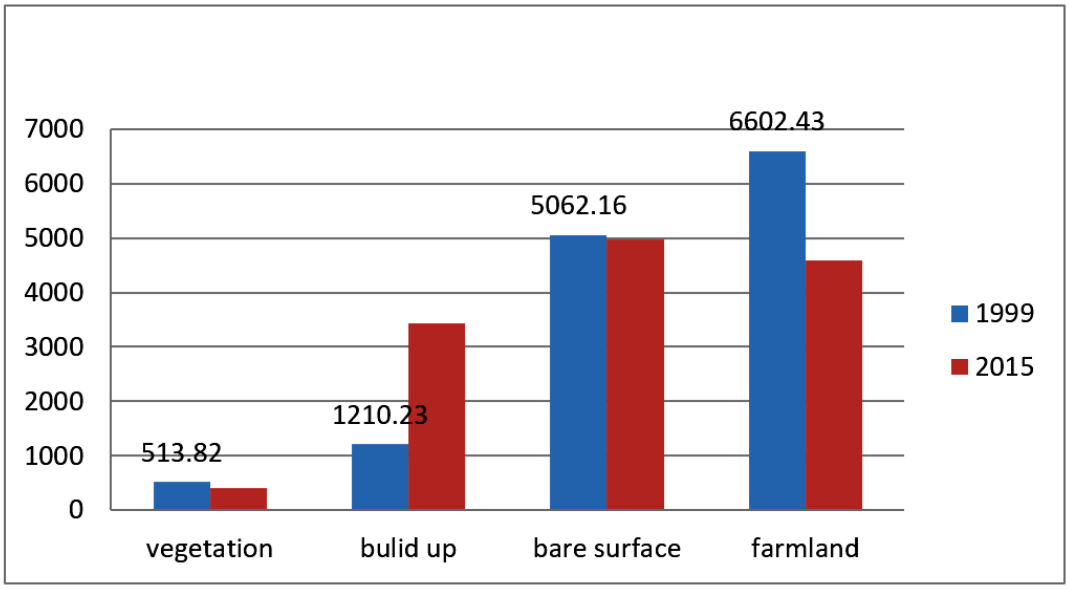

Figure 4: Areal extent of land cover in hectares
Source: Field work (2017)

Consequences of urban landuse expansion on agricultural production

Table 5, reveals the consequences of urban landuse expansion on agricultural production which include loss of farm land with 43.33%, reduction in crop produce with 40%, and changes in crop grown with 16%. This shows that agricultural lands are being threatened, as farm land size and crop production were drastically reduced thereby threatening food security of the people of kwadon and the state in general.

Adjustment/adaptation strategies employed by the farmers

Figure 6 reveals that farmers employed one or more response strategies. It also revealed that the most prominent response options adopted by the farmers are acquisition of new farm plots, intensification of the use of remaining farmland, engaging in off-farm activities and changing crops grown due to variation in soil fertility.

Acquisition of new farmland in farther rural areas

One of the forms of response adopted by the affected farmers is to acquire new farm plots in the outlaying rural areas. 35 respondents representing 58.3 % of those, whose farmlands suffered from encroachment, have acquired new farmland elsewhere. Information provided by them on locations and size of new farms is summarized in Table 6 and 7 respectively.

From Table 6, 34.3% of farmers acquired new farmlands within a distance of less than 2 kilometers; about 48.6% acquired new farmland within distance 3-5 kilometers while the rest acquired new farmlands were located above a distance of 5 kilometers. The implication of this is that the affected farmers require more energy, time, money and effort to reach their post-encroachment newly acquired farmlands.

Table 7 shows that more than 68.6% of the respondent had new farm size less than 2 hectares, 22.9% had new farms ranging from 2 -5 and only 8.6% had new farm plots whose sizes are above 5 hectares. This shows that urban expansion has displaced farmers of their farmland and acquired few hectares due to competition and high cost of acquiring new farmland.

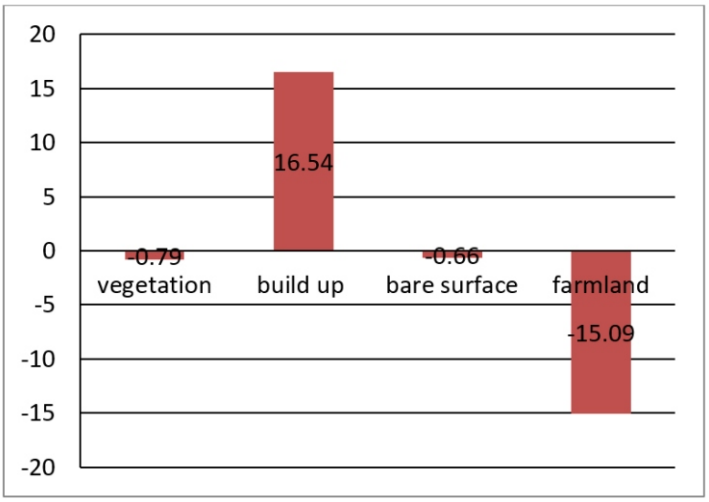

Figure 5: Percentage Change in landuse/landcover
Source: Field work (2017)

Table 3: Types of urban Landuse encroaching on agricultural land

Type of urban landuse	Frequency	Percentage (%)
Residential	22	36.7
Commercial	17	28.3
Educational	6	10
Medical	4	6.7
Religious	3	5
Industrial	8	13.3
Constructional	0	0
Recreation	0	0
Total	60	100

Sources: Field survey, June, 2017

Table 4: Distribution of Affected Farmers by Urban Encroachment

Category of farmers	Frequency	Percentage (%)
Affected farmers	49	68.3
Non-affected farmers	11	31.7
Total	60	100

Source: Field work 2017

Table 5: Consequences of urban landuse expansion on agricultural production

Effects	Frequency	Percentage (%)
Reduction in crop production	24	40
Loss of farmland	26	43.33
Changes in crop grown	10	16.66
Total	60	100

Source: field survey, June, 2017

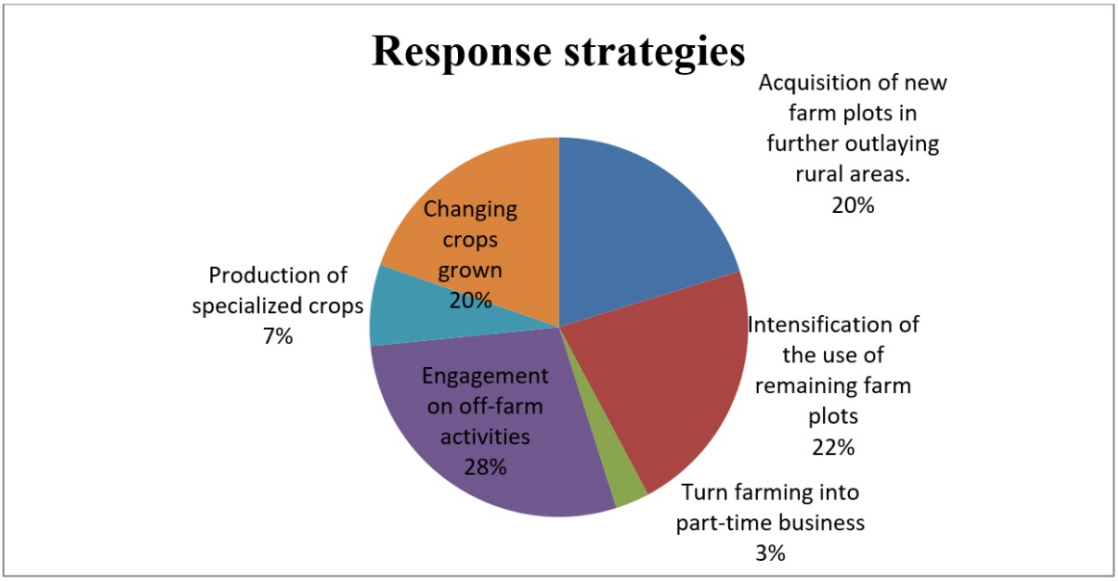

Figure 6: Adjustment/ Adaptation Strategies Employed by the Farmers
Source: Field Survey, June, 2017.

Intensification of the use of land

Another strategy employed by the farmer to cope with the encroachment was using the remaining farmland intensively through application of fertilizer/ manure, pesticide, herbicide and adoption of crop rotation and mixed cropping system and planting of improved seed varieties.

Figure 7 indicated that application of fertilizer and adoption of mixed cropping system constituted two commonest measure employed by farmers in intensification use of the remaining farmland. While more than 50% of the 49 respondents used at least one of the following measures of manure, herbicides, improved seed and crop rotation.

Off-Farm activities of affected farmers

Another important measure adopted by affected farmers is to engage on off-farm activities. This group of farmers combined farming and off-farm work in order to supplement their farm incomes as indicated in Table 8. However, the three most important activities of those respondents are petty trading, labour work and motorcycle riding.

Table 6: Location of new farms plots.

Distance from residence (km)	Frequency	Percentage (%)
<2	12	34.3
3-5	17	48.6
>5	6	17.1
Total	35	100

Source: field survey, June, 2017

Table 7: Size of newly acquired farmland

Farm size (Ha)	Frequency	Percentage (%)
<2	24	68.6
2-5	8	22.9
>5	3	8.6
Total	35	100

Source: field survey, June, 2017

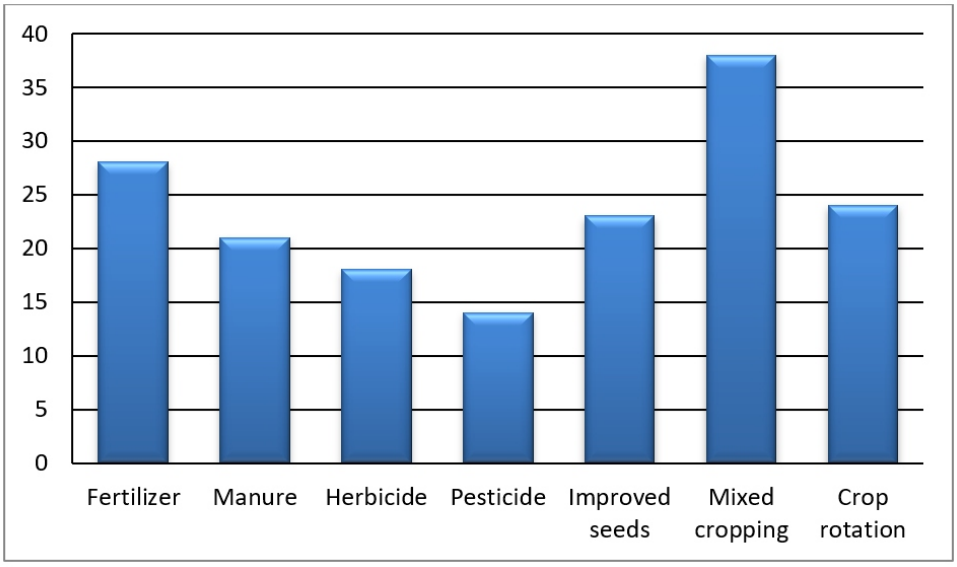

Figure 7: Measures of intensification use
Source: Field survey, June, 2017

Table 8: Off-farm activities of farmers in the study area

Type of off-farm activities	Frequency	Percentage (%)
Petty trading	11	22.4
Labour work	19	38.8
Blacksmith	4	8.2
Okada	9	18.4
Bicycle mechanic	2	4.1
Barbing	1	2.0
Tailoring	3	6.1
Total	49	100

Source: field survey, June, 2017

Conclusion and Recommendations

Expansion of urban landuse into farmlands is at an alarming rate, changing large productive farmlands into builds up by displacing farming activities. Consequently, farmers are exposed to joblessness and increase food insecurity. Therefore, a lot needed to be done in adoption of an appropriate planning in order to protect agricultural lands from urban landuse encroachment. On the basis of the planning implications and findings, there should be:

1. Agricultural intensification in a sustainable manner should be encouraged as farmland is reduced and there is market for the produce.
2. Proper and adequate land capability assessment study in identifying areas that are suitable for agricultural production, residential development, commercial use, and agricultural unproductive areas suitable for other uses.

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SPATIAL ANALYSIS OF ADOLESCENTS' ACCESSIBILITY TO CONTRACEPTIVES IN OSUN STATE, NIGERIA

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Abstract

This study analyzed the spatial patterns of adolescents' access to contraceptives and examined the relationship between the patterns of outlet and access to contraceptives among secondary school adolescents in three urban and three rural Local Government Areas (LGAs) in Osun State, Nigeria. Primary and secondary data were used for the study. Primary data involved the use of handheld GPS to obtain the geographic coordinates of all the secondary schools and contraceptive outlets in the study area. Also, questionnaire was administered to collect data on the socio-demographic characteristics of students and their access to contraceptives. Multi-stage sampling procedure was used to select respondents. The rural-urban variation in the distribution of outlets and adolescents' access to contraceptive was analyzed using statistical analysis tools. The results showed that there are more contraceptive outlets in the urban LGAs (70%) than in the rural LGAs (30%). Ninety percent of the adolescents affirmed that they had either full or partial access to contraceptives, while 10% had no access to contraceptives. Fifty percent of the adolescents reported that societal disapproval is a factor that hinders their access to contraceptives. Furthermore, results showed that correlation between the patterns of outlet and accessibility to contraceptive in study area is ($r2 = 0.580$; $p>0.05$), this shows that there is no relationship between the pattern of outlets and access to contraceptive in the study area. The study concluded that to reduce the problem of teenage pregnancy, there is a need to address the problem of societal disapproval of modern contraceptives among adolescents.

Keywords -Spatial, Analysis, Adolescents, Accessibility, Contraceptives

Introduction

Amidst the most enigmatic public occurrences and a major concern to the society, is the snowballing involvedness of the socio-economic implications and the health and demographic consequences of adolescents' sexuality and fertility behavior. The inclusive nature of such issues as teenage child bearing, teenage pregnancy and abortions, against the ambiance of a typically poor knowledge of and negative mind-set towards contraceptive methods among adolescents, and their premature introduction to unprotected sexual activities with its apparent implications for the spread of STIs and HIV are intermittent themes in literature (Adeniji *et al,* 1998; Adeboyejo *et al,* 2005). This therefore suggests the need to articulate and assess adolescents' access to contraceptives in relation to the patterns of contraceptive's outlets in their immediate environment. (Erica *et al*, 2014; Darroch *et al,* 2016).

Pre-marital exposure to pregnancy risk has increased, with a widening gap between sexual debut and age of marriage, and increased sexual activity prior to marriage; placing adolescents at increased risk when they are most socially and economically vulnerable. Reported sexual activity among adolescents in developing countries is generally high, and data validity is often poor (Chandra-Mouli *et al*, 2014). In sub-Saharan Africa, 75% of young women are reported to have had sex by age 20 (Guttmacher, 2007). Half of the world's population of about 7 billion people are adolescents, hence addressing the critical challenges facing the largest youth generation in

history is an urgent priority if social and economic development efforts are to succeed and the reproductive health endemic is to be reversed (UNEFPA, 2013). Nigeria has a population of 170 million people (NPC 2006) which makes her the most populated nation in Africa. One third of the population which is over 56 million constitutes young people between the ages of 10 to 24 years (UNEFPA, 2015). Many of the works done on adolescents' reproductive behaviour and access to contraceptives in Nigeria dwell much on the demographic and sociological aspects of the study. The relationship between the pattern of contraceptives' outlets and adolescents' access to contraceptives have not been given enough attention. Hence, this Research focuses on the spatial pattern of access to contraceptives among adolescents in the study area (Osun State). The Research concentrated on secondary school adolescents because they constitute the largest percentage of adolescents. The Research examined the spatial pattern of secondary schools, the spatial variation of the contraceptives' outlets and the relationship between the outlets' pattern and adolescents' access to contraceptives in the rural and urban areas of Osun State. This is important in order to determine what problem is peculiar to a certain group in a specific place and suggest solutions based on such finding.

Previous studies in the field

Lots of glitches associated with marriage and other interpersonal relationships are in no doubt directed towards sex and sexual inadequacies. Myles (1981) opined that in Hong Kong, it is illegal under the Sexual Offences Act of 1956 for a boy to have sexual intercourse with a girl under the age of 16 years. She further stated that it is logical for a person to do away from prescribing contraceptive pills to girls at puberty and that if pregnancy should occur; both the boy and the girl are embarrassed and disturbed. The girl bears the brunt of abortion or child birth, her career and future marriage prospects may be jeopardized. Okpani and Okpani (2000) discovered that out of six hundred and five (adolescent) respondents used for a study in Port Harcourt, 51% had been exposed to more than one sexual partner: 6% respondents had had five or more sexual partners: 21.5% admitted that they had been pregnant before, 11.3% admitted that they had been pregnant more than once. Cadelina (1998) reported that as age at marriage rises, opportunity increases for pre-marital friendships, dating and more serious partnership between young males and females (Hassan and Creastas, 2000). Lisa et al, (2009) observed that there is the need for the Health system to overcome the lack of communication in many families on matters of sexuality. Improving reproductive health is central to achieving the Millennium Development Goals on improving maternal health, reducing child mortality and eradicating extreme poverty. This requires that women have access to safe and effective methods of fertility control (adolescents inclusive). The improvement of family planning, in order for women to be able to avoid unwanted pregnancy, is fundamental to the World Health Organisation's work on improving maternal health and is core to achieving the Millennium Development Goal.

In developing countries, maternal mortality is high, with 440 deaths per 100,000 live births; in sub-Saharan Africa, this figure reaches 920. One in three women gives birth before age 20 and pregnancy-related morbidity and mortality rates are particularly high in this group. One quarter of the estimated 20 million unsafe abortions and 70,000 abortion related deaths each year occur among women aged 15–19 years, and this age group is twice as likely to die in childbirth as women aged 20 or above. It is estimated that 90% of abortion-related and 20% of pregnancy-related morbidity and mortality, along with 32% of maternal deaths could be prevented by use of effective contraceptives (WHO, 2014). In sub-Saharan Africa, it is estimated that 14 million un-intended pregnancies occur every year, with almost half occurring among women aged 15–24 years (WHO, 2010)

Pre-marital exposure to pregnancy menace has been amplified with a broadening gap between sexual introduction and age of marriage, and increased sexual activity prior to marriage, placing young women at increased risk when they are most socially and economically vulnerable. However, few sexually active adolescents in developing countries use modern contraceptive methods such as oral contraceptives and condoms, and although there is considerable variation between countries, uptake is generally much lower than in developed countries (Guttmacher, 2010). For example, 69% of adolescent women in a UK study are reported to use modern contraceptive methods during sex, compared with 12% in Mali, and in the US, 54% of 15 – 19 year old females reported condom use, compared with 21% in Tanzania. Overall, it is estimated that 37% of un-married, sexually active women aged 15–24 years in sub-Saharan Africa use contraceptive but only 8%

use a non-barrier method. Hubacher, Mavranezouli and McGinn (2008) suggest that the choice of implant rather than oral or injectable contraceptives could have a big impact on un-intended pregnancy in this age group. However, greater promotion of any modern method has to be informed by better understanding of why uptake is so low among adolescents in the first place.

Most students in the Secondary schools in Nigeria are at the adolescent age. Among students who supplied information about their sexual activity, 40% had had intercourse; the proportion of those who were sexually experienced climbed from 26% of 14-year-olds to 54-55% of 18-19year olds. While 36% of the young women had had sexual partners who were roughly their age, 25% had been involved with older businessmen; the young women said they have intercourse more frequently and are less likely to restrict intercourse to the safe period of their cycle when they are involved with older partners than when they have boy friends of their own age. Only 17% of sexually active students had ever used a contraceptive method other than abstinence (Guttmacher Institute, 2007)

Improving the reproductive health of young women in developing countries requires access to safe and effective methods of fertility control, but most rely on traditional rather than modern contraceptives such as condoms or oral/injectable hormonal methods (William *et al*, 2009).

The permeating nature of adolescents' problems has been attributed to biological and social reasons. The early commencement of menarche among female is the most important biological reason (Akinnubi, 2005). Socio-economic reasons include rapid urbanization and modernization and increased rural to urban migration in search of jobs, proliferation of institutions of higher learning or opportunities for apprenticeships which enable young people to break away from constraints traditionally imposed by their families and village communities. In times of rapid social change, external forces such as the mass media and peer groups are more influential on adolescents' behaviour than parents and traditional community leadership. The alarming rate and escalating intensity of the health and socio-economic repercussions of adolescents' sexuality and reproductive health are some of the terrifying social phenomena of concern to society (Nancy *et al,* 2013). The persistent nature of such issue as unprotected heterosexual activities among youngsters with the related health implications are some of the persistent themes in the literature (Makinwa, 1981, 1991; Nicholas *et al,* 1986; Oringanje, *et al,* 2009).

The study of adolescents' behaviour which has consequences on rapid social and economic changes in recent years in Nigeria and in Osun State in particular is important and necessary for many reasons. The sheer size of the adolescents' population commands attention. The large number of adolescents is a result of high fertility which is being complicated on daily basis. The demographic impacts of this large number of adolescents in a country with a tradition of early marriage is tremendous. A study of the spatial variation of the factors affecting the adolescents' access to contraceptives will help to determine what to do to solve existing problems. Finally, the use of GIS tools in this study will allow easy storage, analysis and display of both spatial and non-spatial data of the study.

Study area

Osun State came into being on August 27, 1991, along with eight other states. The State is located in the South Western part of Nigeria. It covers an area of approximately 14,875 square kilometers. It lies between latitudes 7°00N and 8°10′N and longitudes 4°03′E and 5°05′E. It is bounded by Ogun, Kwara, Oyo, Ondo and Ekiti States in South, North, West and East respectively. The State lies within the Tropical Rain Forest vegetation zone.

The 2006 National Population Census puts the population of the State at 3,416,959. Osun State is made up of 30 LGAs. The indigenes of the States are Yorubas who comprises of Ifes, Ijesas, Igbominas and Oyos. There are 246 registered private secondary schools, 581 public secondary schools, two Federal Institutions, five State-owned Institutions of higher learning and other privately owned Institutions in the State. Osun State is one of the Western States in Nigeria where priority is given to Western Education. This therefore, leads to elongation of Adolescence period that also has effects on the reproductive behaviour of their adolescents.

Politically, the State is divided into three senatorial districts namely: Osun Central, Osun West, and Osun East Senatorial Districts. Each Senatorial district is made up 10 LGAs.

Research methodology

Both primary and secondary data were sourced and used for the study. The geographic coordinates of selected Secondary Schools and contraceptive outlets were obtained with a handheld GPS Garmin Map 76CSX. Questionnaires were used to obtain attributes of the selected schools such as population of the students, ages, sex, parental background of students, sexual activities and access to contraceptives among students.

The analogue map of the State was obtained from the State's Ministry of Lands and Physical Planning, Osogbo and the Record of Secondary Schools in each local government area obtained from the State's Ministry of Education (Planning, Research and Statistics Department), Osogbo. Multi Stage sampling procedure was employed in selecting respondents to the questionnaire. First, Osun State was stratified into the three existing senatorial districts. Second, two LGAs were purposively selected from each senatorial district; one rural and one urban. Third, two schools -one public and one private were selected randomly from the selected LGAs, using the list of schools as data frame. Also, in each selected School, 5% of students were randomly selected for interview from each level of the Senior Secondary Schools class i.e SSS 1-3 using the school register as data frame. In all, 360 questionnaires were administered.

The analogue map of Osun State was scanned and added to views in Arcview 3.3a software, where it was geo-referenced using the Universal Transverse Mercator, Zone 31N (Minna). Thereafter, layers of spatial entities such as LGA boundary, roads, rivers, railway tracks) of the map were created through onscreen digitizing, attribute tables were also created for each spatial entity. Thereafter, the coordinates for each school were downloaded as shapefiles, the attribute of each school was linked to the theme for the school. GIS analysis (in the form of spatial and non-spatial queries) was carried out to determine the relationship between the schools' adolescents' access to contraceptives and contraceptives outlets. The level of accessibility of the students to the contraceptives was determined through proximity analysis. Attribute data collected was analysed using descriptive and inferential statistics.

Correlation analysis was carried out to determine the nature of relationship between the level of accessibility of the students to contraceptives and the contraceptives outlets available in the study area.

Table 1: Distribution of Respondents

Name of School	Frequency	Percent	School ID	LGA's
Islamic comprehensive high sch Osu	21	5.8	OSESD/Pr	Rural
O.A.U International Sch Ife	29	8.1	OSESD/Pr	Urban
Apara Memorial Sch Atakunmosa	25	6.9	OSESD/Pu	Rural
Moreemi High Sch Ife	36	10.0	OSESD/Pu	Urban
Muslim comprehensive high sch Iwo	13	3.6	OSWSD/Pr	Urban
Vico hope International college Kuta	15	4.2	OSWSD/Pr	Rural
Iwo Grammar School	53	14.7	OSWSD/Pu	Urban
Kuta community high school	49	13.6	OSWSD/Pu	Rural
Royal ambassador Int'l college Otan	14	3.9	OSCSD/Pr	Rural
Divine inter'l group of sch Osogbo	14	3.9	OSCSD/Pr	Urban
Community high school Eripa	34	9.5	OSCSD/Pu	Rural
Fakunle comprehensive high sch Osogbo	57	15.8	OSCSD/Pu	Urban
Total	**36**	**100**		

Source: Author's Field Survey, 2012

OSESD/Pr- Osun East Senatorial district Private school
OSESD/Pu- Osun East Senatorial District Public school
OSWSD/Pr- Osun West Senatorial District Private school
OSWSD/Pu- Osun West Senatorial District Public school
OSCSD/Pr- Osun Central Senatorial District Private school
OSCSD/ Pu- Osun Central Senatorial District Public school

Research findings and discussion

Since the focus of the Research is the spatial pattern of secondary school adolescents' access to contraceptives in the study area; presentation of finding focused on the distribution of contraceptives outlets in the rural and urban Local Government Areas, pattern of access to contraceptives and factors affecting access to contraceptives in the study area.

Research findings in this study are discussed under: socio-economic characteristics of adolescents; distribution of contraceptives outlets; pattern of access to contraceptives and factors affecting access to contraceptives.

Table 2 reveals that 45.8% and 54.2% constitute male and female adolescents respectively. The percentage distribution of the respondents by age as at the time of the survey showed that 40.3% were between ages 14-15, 45% were 16-18, 10% were 19-20, 4.2% were 20- 22 and 0.5% were > 22 years. Statistics showed that 52.5% of the respondents were Christians while 45.6% were Muslims, 1.9% were neither Christian nor Muslim. The table also presents an overview of the number of respondents per each level of class. 28.1% were in SSS1, 38.9 % were in SSS2 while 33.1% were in SSS3. Majority of the respondents are in SS1 and SS2 which are likely to be sexually experienced adolescents.

Locational pattern of contraceptive outlet

The location pattern of the contraceptive outlets in the selected LGAs of Osun State shows that the outlets are not evenly distributed. There are more outlets in the three urban LGAs (Osogbo, Ife Central and Iwo) compared with the rural LGAs (Atakunmosa, Ayedire and Boluwaduro)

Figure 1 reveals that Osogbo has 35%, Ife Central 20%, Iwo 15%, Boluwaduro 12%, Atakunmosa West 10% and Ayedire 08%. In figure 2 the result shows further that a heuristic view of pattern of contraceptive outlets in the study area showed a higher concentration (70%) of contraceptive outlet in the urban LGAs) and (30%) in the rural LGAs., This is expected since a locational factor of outlet is market orientation or population concentration where threshold population is required to sustain sales.

Pattern of access to contraceptive

Pattern of access to contraceptives can be influenced by a number of factors such as societal disapproval, high cost of the product, cost of transport to the place of sale and so on. Table 3, shows that 33.9% of the population sampled had full access to contraceptives while 56.1% had partial access to contraceptives though access is mainly from illegitimate sources and only 10% has no access at all.

Table 2: Socio-demographic Characteristics of the Respondents

Characteristics	**Frequency**	**%**
Male	165	45.8
Female	195	54.2
Age of Respondent		
14-15	145	40.3
16-18	162	45
19-20	36	10
20-22	15	4.2
>22	2	0.5
Religion		
Christian	189	52.5
Islam	164	45.6
Others	7	1.9
Class		
SSS1	101	28.1
SSS11	140	38.8
SSS111	119	33.1

Source: Author's Field Work (2012)

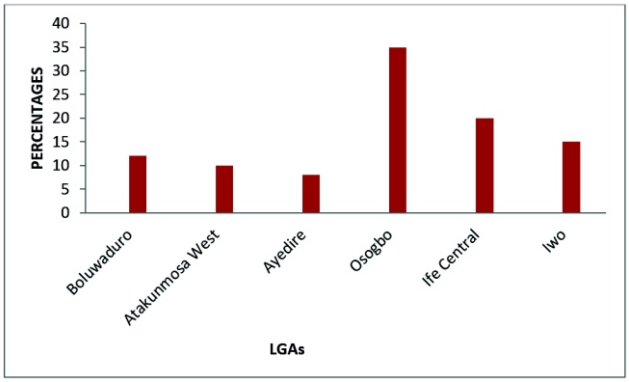

Figure 1: Pattern of Contraceptive Outlets

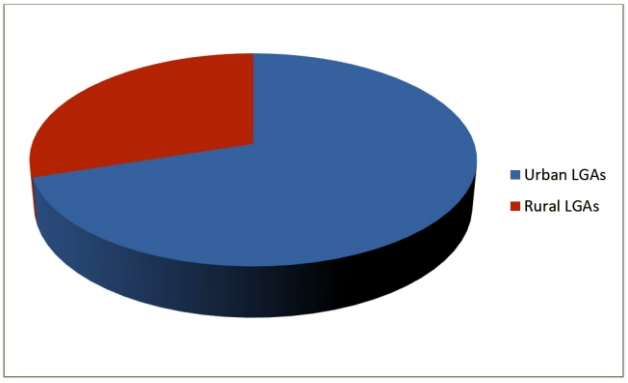

Figure 2: Proportion of Contraceptive Outlets in Urban and Rural LGAs

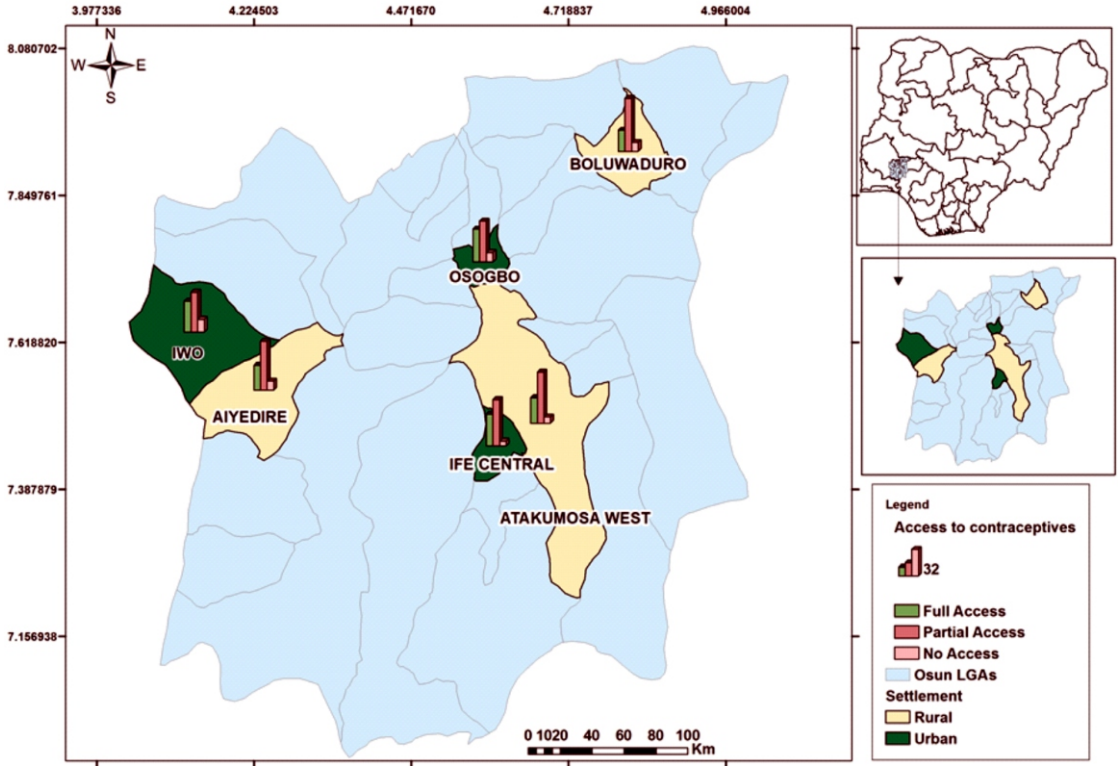

Figure 3: Pattern of access to contraceptives among adolescents in the study area

Figure 3 also expressed the pattern of access to contraceptive in each selected LGAs. Higher percentage of partial access to contraceptives was seen across the selected LGAs. Boluwaduro (rural LGA) has the highest followed by Ife Central (urban LGA) with 63.8 and 61.5 respectively. Atakunmosa (rural LGA) has the least with 47.8, followed closely by 49.3 in Osogbo (urban LGA). Majority of the respondents actually claimed partial access to contraceptive. Furthermore Osogbo has the highest percentage of full access to contraceptive followed by Iwo with 39.4 and 38.2 respectively both are urban LGAs although, this was followed closely by Atakunmosa (rural LGA) with 37 percent. In view of the above expression, It could be stated that partial access to contraceptive is generally higher in the study area whether in rural or urban areas. This may be due to the high level of societal disapproval of contraceptive among adolescent.

Relationship between pattern of contraceptive outlets and access to contraceptives

Table 4 shows that there is no significant relationship between pattern of contraceptives outlets and accessibility ($p>0.05$). This suggests that across the

LGAs, access to contraceptives is not determined by pattern of contraceptive outlets. That is, contraceptive accessibility is not a function of pattern/ number of contraceptive outlets. Hence, whether the number of outlets increase nor decrease does not improve access to contraceptives among the adolescents, based on the available data from the study. The above findings may be traceable to the fact that many of the adolescents does not have courage to obtain the products from nearby or authorized sources, hence their access to contraceptives is hindered.

Factors that affect access to contraceptive

Similarly, the Research opined that 50.3% of the adolescents' sampled emphasized societal disapproval was a factor that militates against easy access to contraceptive among them. 27.8% claimed that the cost of contraceptives was too high for them to afford and 21.9% said the cost of transportation to the sources of contraceptive outlet was their problem. See Table 5 for the spatial pattern of factors that affect access to contraceptives in the study area.

It was also revealed in Table 5 that factor of cost of transportation to the place of purchase was actually noted to be higher in the rural LGAs with highest in Ayedire followed by Boluwaduro and Atakunmosa with 30.1, 25.5 and 23,9 respectively. Meanwhile the highest percentage of high cost of transportation to the place of purchase in the urban LGAs was 20% in Ife Central followed by Osogbo (19.7) and Iwo (14.7). This is not strange for the fact that contraceptive outlets are more concentrated in the urban LGAs compared to the rural LGAs. Many of the adolescents in the rural areas may have to travel through far distance, sometimes to the urban centers to acquire contraceptive (the fear of being seen by people that know them) due to the homogenous setting of most rural settlements coupled the societal disapproval of contraceptive use among adolescents.

Furthermore, the Research revealed that the percentage of the factors of societal disapproval was higher in the urban LGAs. Iwo has the highest followed by Ife Central and Osogbo with 58.8, 55.4 and 54.9 respectively. Among the rural LGAs, Atakunmosa has the highest followed by Boluwaduro and Ayedire with 43.5, 42.6 and 41.3 respectively. This however looks strange, one will expect the level of the societal disapproval of use of contraceptive to be higher in the rural area than the urban area, meanwhile this may be as a result of the fact that many of the secondary school adolescents in the urban areas are younger adolescents within the range of 14 to 16 years while the majority of the secondary school adolescents in the rural areas are older adolescents.

Table 3: Pattern of access to contraceptives among adolescents in the study area

S/N	LGA	Frequency	Full Access %		Partial Access %		No Access %		Total % of Access
1.	Boluwaduro	47	12	(25.5)	30	63.8	05	10.7	89.3
2.	Osogbo	71	28	(39.4)	35	49.3	08	11.3	88.7
3.	Atakunmosa West	46	17	(37)	22	47.8	07	15.2	84.8
4	Ife Central	65	20	(30.8)	40	61.5	05	7.7	92.3
5	Ayedire	63	19	(30.2)	37	58.7	07	11.1	88.9%
6	Iwo	68	26	(38.2)	38	55.9	4	5.9	94.1%
	Total	360	122		202		36		90%
		100	33.9%		56.1%		10%		

Source: Author's Field Work (2012)

Table 4: Correlations between pattern of contraceptive outlets and access to contraceptives correlations

		Contraceptives outlets	Accessibility
Contraceptives	Pearson correlations	1	.580
	Sig. (2-tailed)		.277
	N	6	6
Accessibility	Pearson correlations	.580	1
	Sig. (2-tailed)	.227	
	N	6	6

Table 5: Factors that affect access to Contraceptives

S/N	LGA	Frequency	Societal Disapproval	%	High Cost of Contraceptive	%	Cost of Transport	%
1.	Boluwaduro	47	20	(42.6)	15	(31.9)	12	(25.5)
2.	Osogbo	71	39	(54.9)	18	(25.4)	14	(19.7)
3.	Atakunmosa West	46	20	(43.5)	15	(32.6)	11	(23.9)
4.	Ife Central	65	36	(55.4)	16	(24.6)	13	(20)
5.	Ayedire	63	26	(41.3)	18	(28.6)	19	(30.1)
6.	Iwo	68	40	(58.8)	18	(26.5)	10	(14.7)
		360 %	181	(50.3)	100	(27.8)	79	(21.9)

Source: Author's Field work (2012)

Conclusion

This study has shown the distribution and characteristics of contraceptives' outlets in the selected LGA's of Osun State in order to provide a framework for the efficient location and distribution of facilities for Adolescents' use in the State. Specifically, the study analyzed the spatial patterns and characteristics of contraceptives' outlets; examined rural-urban variation in the distribution.

The spatial analyses of the phenomena of interest were carried out on the basis of the LGAs. Two schools; a public and a private school from a rural and an urban LGA selected from the 3 existing senatorial districts of the State were targeted for the study. Twelve secondary schools; six public and six private Schools were purposively selected for the study.

Also, the level of accessibility of the students to the contraceptives was determined through proximity analysis and attribute data collected were analysed using descriptive and inferential statistics.

The study discovered that there are greater numbers of contraceptives' outlets in the urban LGA's of the State compared to the rural LGA's. This may be as a result of their population demand. The three urban Local Government Councils; Ife Central, Iwo and Osogbo have 70% of the total number of contraceptive outlets in the six selected Local Government Councils while the three rural LGA'S, Atakunmosa West, Ayedire and Boluwaduro have 30%.

Contraceptive outlets are spread widely in the three urban LGA'S than the rural. About 90% of the adolescents claimed they have partial or full access to contraceptive. The Result shows that there is no relationship between distribution of contraceptive outlets and adolescents access to contraceptives in study area. Societal disapproval of contraceptive was the major factor that affects access to contraceptives among the respondents, followed by cost of transportation to the place of purchase especially in the rural LGAs.

Recommendations

Health workers and the entire society should stop looking down on adolescents that seek for contraceptives knowledge and usage in order to reduce the problem of societal disapproval of contraceptives among adolescents.

Government at all levels should pay greater attention and commit more resources to the sexual health needs of adolescents in Nigeria, particularly in the rural areas where access to information about contraceptive is limited.

Finally, increasing modern contraceptive methods and access require governmental and communal interventions and support. The provision of information, life skills, support and access to youth-friendly services by Government and non-Government agencies will further aid access to contraceptives among adolescents. Interventions should aim to counter negative perceptions of modern contraceptive methods

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TELEMATICS (ICT) USAGE IN NIGERIAN RAILWAY OPERATIONS: A CASE STUDY OF IDDO – IJOKO ROUTE

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Abstract

Over the years and in different parts of the world, railway transport carries more passengers and freight (solid and liquid) of long journeys within inter and intra regions. The issue of efficient functionalities of railway operations has been of serious concern especially in the applicability of telematics to the day-to-day operations. This study therefore is premised on the usage of ICT in railway operations with the specific objectives of evaluating the trend in passenger and freight carriage between 1963 and 2014; examining the use of ICT for sales of tickets and notification of passengers for trips cancellation as well as the functionalities of automation in railway operations. Data collection was based on secondary and primary sources as existing records on operations were collected from the Nigerian Railway Corporation while customers' perception as to the implementation of telematics were gathered through questionnaire administration. The results show that the rate of passenger and freight carriage has reduced; 82% prefer to buy train tickets online and non-terminus outlets; 70% of the respondents were never notified of trips cancellation before getting to the terminus. The study therefore recommends that the sales of train tickets be decentralized to accommodate online as well as other outlets. More so, various media such as radio, SMS, phone calls should be adopted in notification of trips delays and cancellations to prospecting passengers and cargo owners.

Keywords: Telematics, Railway, Cancellation, Delay, Check-in

Introduction

Transport before now has been a connecting factor that had allowed, and still allows the diffusion of ideas and information from one geographical location to another, as well as the movement of goods and services. Since the early 1980s, the transport infrastructure of Nigeria has been formulated around personal vehicles and expanding road infrastructures. This has often come at the expense of public transport services such as railways, and severely congested roads have been the result. The origin of rail transport dated back 1760 in England when the wooden rail tracks were covered with cast iron plate which caused the running resistance to diminish to such an extent that the application of such plates soon proliferated (Esveld, 2001).

The heavy traffic congestion on road, which the expansion and the construction of road furniture as well as infrastructures have not been able to eliminate; Over time, many researchers have come up with the fact that it is paramount to revive the rail system so as to reduce the dependency on the road transport system. According to the 'Draft National Transport Policy, published in August 2010 by the federal government, "the Nigerian railway system has the potential to provide an efficient and cost-effective means of transportation, particularly on long distance routes serving high density traffic flows".

Obaleye (2012) stated that the revitalization of railway service which is more protective and affordable would further reduce the rates of road accident, plane crash and armed attacks amongst other negative vices. It would also improve efficient service delivery on movement of goods and services like petroleum products, food items, animals, spare

parts and bulky materials (mails) amongst others. He further stated that the system can help to serve as a source of tourist attraction for passengers/travelers especially for the inquisitive ones who wish to know more on our environments. Hence the system can serve dual purposes of transport and tourism.

In recent time, the Nigerian Government has invested huge capital into the revitalization of rail transport which has been on for the past 16 years. Despite the huge investment into the rail transport, some issues still battle with the system. This also can be drawn by a fact stated by Obeche (2012) that after more than 50 years of neglect, the Federal Government seems to have realized the importance of efficient rail transport system in solving the country's transportation and economic problems. And having committed hundreds of billions of naira into revitalizing the hitherto comatose industry, the government feels it is time Nigerians enjoy rail transport again. But it appears the challenges of providing efficient rail transport system in Nigeria transcend the euphoria of putting the trains. This shows that more is required to be done within the system if the rail transport system in Nigeria will be compared to those operated in other countries (developed).

Effective operations of enterprises in every sector of the economy require a well-functioning transport system. Transport is a set of activities related to the movement of people and material goods by appropriate means (Grabara et al, 2014). It plays a very important role in logistics, because of the goods movement and the creation of ancillary services. Transport in the national economy enables the exchange of goods and services. Transport helps to move raw materials and semi-finished products for production and finished products for personal consumption.

Rail transport is the transport of passengers and freight by means of wheeled vehicles along designated rail way or rail road. It can also be referred to as an energy-efficient and capital-intensive means of mechanized land transport with its own right of way. Rail transport is part of logistics chain, which facilitates the international trading and economic growth in most countries.

Transport and logistics in developed countries are key enablers of social and economic activities in human society. As a result of ICT and economies of scale and scope, they have become globalized, streamlined organizations (Hamilton et al, 2013). This has had a "cascade effect" across supply chains, driving greater consolidation of transport and logistics between and across value and supply chains (Lakshmanan et al, 2011). In Nigeria, transport has evolved significantly over the last 60 years and has an ever-increasing and active role to play in a globalizing economy. Significantly, technical and technological improvements in the transport sector, most especially in the rail way system is of utmost importance as this will boast the systems performance. Apparently what is obtained in most developed countries based on rail system is as a result in advancement of technology. Rail services in most developed countries has the implant of ICT in almost all its functionalities (e.g ticketing, clock-face service, information to passengers, mode of movement etc) gives a better integration to mobility strategies. These innovative ICT based operations are missing in Nigeria. Oni and Okanlawon (2012) have pointed out on railway operations that part of the reasons why the laid down schedules are not followed is delay. When this happens, it does not only affect timing at a station but all the stations are affected. This in turn discourages people from patronizing the service due to non-adherence to schedules.

Statement of Problem

Railway service was the major means of transportation in Nigeria since the country's independence in 1960 to the 1980s. It was much more convenient and cheaper for commuters and haulage purposes due to the existence of many rail lines linking big cities across the country with commercial activities in its major routes. However, the railways lost its glorious past as Nigerians took to other means of transportation through road, air and water in the riverine areas.

In recent time, the Federal Government brought the idea of revitalizing the railway system (MTT - mass train transit and DMU - diesel multiple unit) which has not been able to bring back its lost glory, rather it serves as a means of escape from road congestion for few populace.

However, transport is tilting towards the need for data analysis as well as the need for information and communication facility to give prompt feedback at all times. This is absent within the railway system as information and communication gap has brought about delay in trips, overloading of cabins, and trip cancellation with no provision of other alternative means to convey commuters. Aside from this, long queues at each station to obtain ticket as no other

outlet can issue train ticket makes the ticketing system monotonous.

Since the rail system of transportation serves as a means of escape from road congestion, it is quite unfortunate that railway has not played important roles in Nigeria as it has in other countries even in a country like India where its social and economic activities have improved tremendously through the railway services. This improvement came as a result of telecommunication and information technology which was applied into its (India) rail system. But this seems undermined in Nigeria as the system still operates on the single-narrow-gauge railway line and the same old functionalities carried out during the colonial period. The implication is that, where there is an incoming train the other one at the opposite direction has to reverse to an interchange and wait for the incoming to sail through before proceeding on. This often causes delay and elongation of elapse time of the journey.

Aim and Objectives

The aim of the study is to evaluate the use of telematics (ICT) in Nigerian railway operation.

The specific objectives are to:

1. evaluate the trend in railway operation since 1960 till date.
2. determine the use of ICT in ticket sales and notifying of trip cancellation.
3. assess the functionalities of automation in railway operation.

Methodology

Data collection was based on primary and secondary sources as the research adopted direct interview with operators, questionnaires administration to passengers as well as existing records and maps were used. A total of 250 questionnaires were sent out on board to both Mass Transit Train (MTT) and Diesel Multiple Unit (DMU) users to sample their opinion on the usage of telematics in railway operations. Out of which 201 questionnaires were returned and hence used for the analysis. Also direct interview with the Director of Operations was conducted to ascertain the corporation's views as to the application of telematics in their operations. We further cut and digitize road/rail map using ArcMap GIS software in order to come up with the rail route between Iddo terminus, Lagos State and Ijoko terminus, Ogun State. These data collected were analyzed based on the research objectives using descriptive statistical analysis.

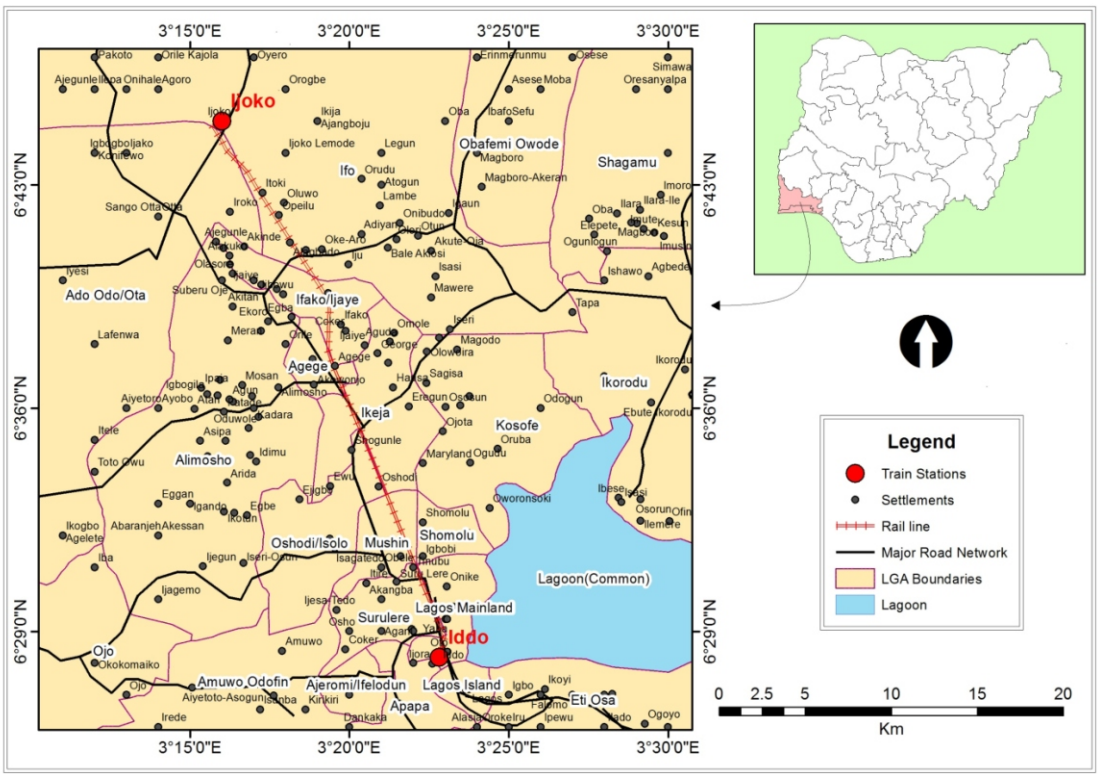

Figure 1: Rail route from Iddo terminus through Ijoko terminus
Source: MGIS Lab-Unilag, 2015

Table 1: NRC (summary of operational performance 1963 to 2014)

Year	Passengers	Freight/tons
1963/64	11,288,000	2,960,000
1964/65	10,630,000	2,834,000
1965/66	11,621,000	2,884,000
1966/67	10,005,000	2,481,000
1967/68	6,916,000	1,868,000
1968/69	8,007,000	1,614,000
1970/71	8,942,000	1,311,000
1972	5,819,000	1,519,000
1973	5,131,000	2,129,000
1974	4,342,000	1,098,000
1975	6,755,000	1,612,000
1976	7,491,000	1,452,000
1977	6,747,000	2,375,000
1978	6,750,000	1,592,000
1979	6,771,000	1,543,000
1980	4,917,000	1,153,000
1981	9,638,000	1,932,000
1982	11,612,000	2,815,000
1983	13,142,000	1,619,000
1984	15,553,000	1,458,000
1985	11,324,000	1,182,000
1986	9,878,000	852,000
1987	7,383,000	353,000
1988	4,196,000	326,000
1989	6,520,000	202,000
1990	6,345,000	198,000
1991	3,443,000	237,000
1992	1,747,000	204,000
1993	1,502,000	106,000
1994	784,491	106,000
1995	2,889,977	107,878
1996	2,626,026	137,661
1997	2,946,940	535,000
1998	1,070,424	1,513,077
1999	1,788,171	737,239
2000	2,610,435	116,837
2001	1,283,986	132,713
2002	987,088	98,190
2003	1,622,271	58,790
2004	1,751,159	62,575
2005	752,482	84,652
2006	708,802	41,495
2007	1,478,700	55,032
2008	1,996,324	63,326
2009	1,285,080	52,489
2010	1,514,215	138,533
2011	3,493,443	341,396
2012	4,155,988	182,465
2013	3,839,445	25,407
2014	3,007,673	45,338

Source: NRC Records, 2015

Findings

The trend in railway operation since 1963- 2014.

The table below shows the summary of operational performance (1963 to 2014) of passengers and freight carried.

Table 1 shows that a larger number of commuters used the train as at 1963/64 to 1970/71, with a slight reduction between 1972 and 1987. Nigerian Railway Corporation (NRC) experienced a drastic reduction in passengers in 1988 with a continuous rise and fall that can't equate what was recorded between the 1960's and early 70's. Freight carried per tons on the train between 1963/64 to 1967 was stable, but a slight reduction was recorded in 1967 to 1985 with a sharp reduction from 1986 till 2014. From the interview with the Director of Operations, the sharp reduction in passengers was due to the neglect in the railway sector and this led to the over-dependence on road transport, but its disadvantage (congestion & accident), brought the thought of reviving the railway system which till date, has not gone back to its former glory. The drastic drop in freight haulage was and is due to lack of proper handling and insecurity of these hauled goods as most of them get damaged and stolen in transit.

ICT in ticket sales and notifying of trip cancellation

Table 2 shows a high number of preferences to online sales and sales of ticket (165) in other outlets by respondents against sales (35) at the terminal. This large number is as a result of the long queue and ill treatment given to customers by ticket sellers in terms of customers' oriented services. At times due to the long queue some commuters do not get to board the train, leaving them to a waste ticket and an extra cost as those who do not board the train opt for public buses.

Table 3 shows that most respondents were never aware of a cancelled trip till they got to the terminal. 141 out of 201 respondents stated lack of awareness. At times most commuters that use the train "to" and 'fro' wish to purchase in-bound and out-bound ticket the same time, but such opportunity is never played by the railway authority for ticket purchase. Table 4 shows that a larger number of respondents prefer to be called or sent "SMS" on cancelation o trip rather than to get to the station before being notified.

Generally, the study shows that commuters using the railway service largely prefer the use of modern technology such as telephone calls, SMS, radio service to broadcast for trip delays and cancellations.

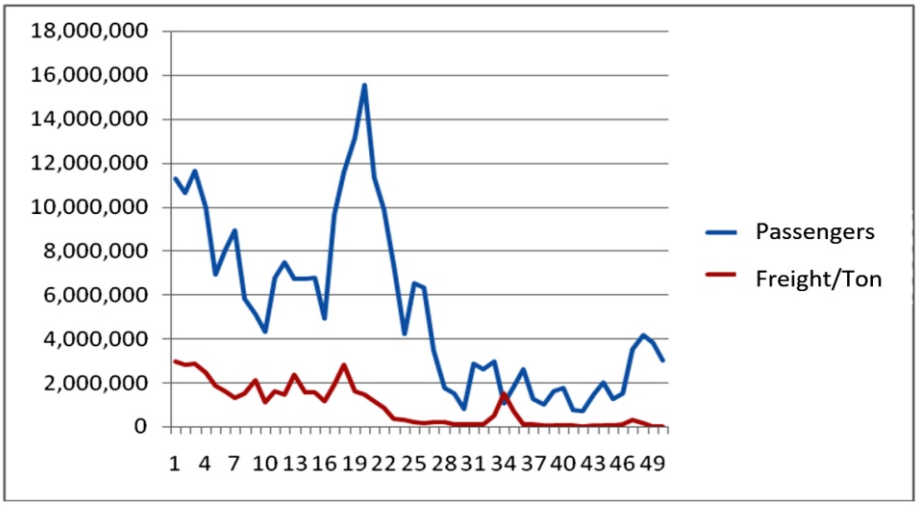

Figure 2: Variations in rise and fall of both passengers and freight recorded in 1963 to 2014.

Table 2: Respondents' preference of ticket sales online and other sales outlet .

Use of train	Options				Total
	Indifferent	Terminal	Online	Sale outlets	
	1	0	0	0	1
Daily	0	24	80	39	143
Weekly	0	6	14	6	26
Bi-weekly	0	0	3	1	4
Occasionally	0	5	10	12	27
Total	1	35	107	58	201

Source: Field work, 2015

Table 3: Notification of respondents to trip cancellation at the station

Use of train	Options					Total
	No information	At the station	Through a friend	Others	Indifferent	
	1	0	0	0	0	1
Daily	13	112	10	7	1	143
Weekly	8	13	4	1	0	26
Bi-weekly	1	3	0	0	0	4
Occasionally	10	13	2	2	0	27
Total	33	141	16	10	1	201

Source: Field work, 2015

The functionalities of automation in railway operations

Table 5 shows that a large number of respondents (107 out of 201) are dissatisfied by the checking system. Based on survey carried out on the train, checking is done while the train is on motion. Checkers are most times very rude to passengers and sometimes put up quarrels in the bid to affirm their right to check their tickets.

Table 6 shows that a large number (176 out of 201) of respondents prefer to be checked online and electronically before boarding than to be checked on board the train. This practice of checking had been since the advent of the railway system in Nigeria.

Based on the field survey carried out on the train while in motion, the reason for a standstill is not communicated, no form of relaxation is in the cabins (e.g. television).

More so, the public address system at Iddo terminus is used for playing music other than passing information as at when due (arrival and departure of vessels, report of any eventuality on outgoing or incoming train).

Table 4: Preferred notification means to cancellation of trips

Use of train	Options					Total
	indifferent	SMS	Radio services	Telephone	Others	
	1	0	0	0	0	1
Daily	4	83	29	21	6	143
Weekly	1	11	6	4	4	26
Bi-weekly	0	2	0	2	0	4
Occasionally	4	5	10	4	4	27
Total	10	101	45	31	14	201

Source: Field work, 2015

Table 5: Level of satisfaction based on ticket checking system

Use of train	Options				Total
	Indifferent	Yes	No	Void	
	1	0	0	0	1
Daily	3	55	84	1	143
Weekly	0	14	12	0	26
Bi-weekly	0	3	1	0	4
Occasionally	0	17	10	0	27
Total	4	89	107	1	201

Source: Field work, 2015

Table 6: Checking preference by commuters

Use of train	Options				Total
	On the train	Electronically	before boarding	Online	
	1	0	0	0	1
Dailv	22	66	45	10	143
Weekly	5	7	13	1	26
Bi-weekly	1	2	1	0	4
Occasionally	6	10	10	1	27
Total	**35**	**85**	**69**	**12**	**201**

Source: Field work, 2015

Recommendations

Despite Government's effort at revitalizing Nigerian Railway Corporation (NRC), the system presently is faced with a lot of challenges which need to be addressed for it to achieve its goal.

Government should ensure that the sales of tickets are decentralized as well as given to other organizations in other to break the congestion created at the station during ticket sales. Online and bulk purchase should also be encouraged as it is done in the aviation sector.

Government should ensure that the functionality of the railway system is backed up with adequate technology to improve the system such facilities as: an electronic gadget like transponder to check-in and out passengers, central communication unit to pass information on the train; while in motion, television and radio system to help while away the period of travelling.

The issue of overloaded cabin should be checked as those who do not get a seat, stand till they get a space or alight from the train. Freight carried in the train is not properly handled and secured as some of the goods get stolen in transit or damaged. Improvement of freight haulage is required and adequate security facility such as CCTV cameras to serve as surveillance.

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REMOTE SENSING/GIS SOFTWARE UTILIZATION AND CHALLENGES – AN EXPLORATORY STUDY IN NIGERIA

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Abstract

The paper is an exploratory study of the use of Remote Sensing/GIS Software particularly by the researchers in tertiary institutions and utilization challenges by the urban managers in Nigeria. Among the questions addressed in the paper are: What are the broad areas of research and topics that are addressed? What type of remote sensing and GIS software are used? What are the sources of satellite images used? What are the types of institutional affiliation and departments of the researchers? What are the utilization challenges? The data used in the study is from an extensive published article search and the administration of 101 questionnaires to public servants. Descriptive statistics are used to analyze the data. The study shows among others that most of the researches are on analysis and applications. Most of the research topics are on land use/land cover. ESRI software products are the most used products. Top on the list of problems affecting use of GIS/Remote Sensing applications is financial problem, followed by power supply (electricity) problem, lack of knowledge about GIS/Remote Sensing applications, lack of incentives and motivation, and technical nature of the applications. Policy implications of the findings are highlighted in the paper.

Keywords: Geographical Information Systems; Remote sensing; Urban manager; Nigeria

Introduction

Dangermond (2011) underscored the importance of GIS applications in our dynamic contemporary world characterized with rapid changes and facing many challenges and difficult problems - such as climate change, urbanization, security, poverty, inequality – which we must deal with and which are affecting us as individual as well as impacting our organizations and governments. He notes that geography has always been a critical type of information that humans – in fact, all animals – collect, organize, and use and place-based information is vital to survival on our planet. According to him as our world has become complex and our ability to understand has grown, GIS technology has evolved to help us process information about place and put it in a context that allows us to act (Dangermond, 2011:7). Observation in the literature show that the areas in which GIS and remote sensing are applied are widespread (Heywood et al, 2006; ESRI, 2006; Dangermond, 2011; Coetzee et al., 2013; Mhangara and Odindi, 2013; Ademola, 2015): land use management, management of traffic, crime control, flood control, fire hazard control, hazardous materials, storm control, urban planning and management, tourism development and management, business and marketing analysis, etc. The aim of this paper is to examine the use of Remote Sensing/GIS software particularly by the researchers in tertiary institutions and utilization challenges by the urban managers in Nigeria. Among the questions addressed in the paper are: What are the broad areas of research and topics that are addressed? What type of remote sensing and GIS software are used? What are the sources of satellite images used? What are the type of institutional affiliation and departments of the researchers? What are the utilization challenges by the urban managers?

The paper is divided into five sections. The first section is this introduction followed by the second section which is an overview of GIS and Remote Sensing in Nigeria. The third and fourth section are the method of data collection and research findings respectively, while the fifth section is the summary and conclusion.

GIS and Remote Sensing in Nigeria – An overview

Geographical Information Systems (GIS)

In Nigeria, the Federal Government is the first to start the implementation of GIS. The Government of the Federation took a bold decision in the year 2003 to embark on complete computerization of the cadastral and land registry of the Federal Capital Territory (FCT) – Abuja. This decision led to the establishment of an agency known as Abuja Geographic Information Systems (AGIS). As stated on the website of the agency (www.abujagis.com), AGIS project includes the introduction of Spatial Data Infrastructure (SDI) for FCT; the computerization of spatially related workflows in selected Federal Capital Development Authority (FCDA) departments and agencies and the buildup of the AGIS Resource Centre. The AGIS Resource Centre is intended to be a service company for spatially related data and services for the FCT and a computerized front and back office ("one stop shop") for FCDA departments. The AGIS projects objective is to establish AGIS as an independent service provider and as the only official source for Geospatial Data on FCT, covering all of FCT. AGIS is to provide a comprehensive, all-inclusive, state-of-the-art, foolproof, computerized, geospatial data infrastructure for the FCT; computerize the Cadastral and Land Registry for the Federal Capital City (FCC), the Area Councils and the Satellite Towns of the Federal Capital Territory (FCT). The AGIS Resource Centre is operating in the AGIS Building as an independent service provider, as a professional GIS/LIS Resource Centre, as the only official source for Geospatial Data on FCT, covering all of FCT. As stated on the website of the agency, the services offered by the agency include: preparation and issuance of Certificates-of-Occupancy and other certificate evidencing titles, preparation and issuance of Right-of-Occupancy, production and printing of Titled Deed Plan(TDP), street naming and house numbering in FCT, provision of Geospatial information infrastructure for FCT, the only official source of Geospatial Data for FCT, textual and graphic data on FCT, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building, property search and verification of land record, and application for land allocation. Some State Governments are also trying to do the same. A number of Government parastatals are also introducing GIS unit or department into their organization.

Also, in Nigeria, a number of institutions have set up a GIS laboratory either for training, consulting or both. Also, there are few private GIS firms in Nigeria. Such GIS private consulting firms includes: Atlas GeoSolutions Limited, E-Sense Technologies Limited, Geographic Integrated Services Limited, MAPIT Nigeria Limited, MapNTL.com, Spatial Technologies Limited, Virtual Vision Visualisation Limited, Third Dimension Technologies and GISKOSULT, etc.

Remote Sensing

In an attempt at building remote sensing capabilities in Nigeria, in 1993, the National Agency for Science and Engineering Infrastructure (NASENI) set up a committee to formulate a National Space Science and Technology Policy for the country. The policy recommended among other things the creation of centres of excellence for the development of space science and technology; and the enhancement of the capabilities of institutions offering space related courses of study in the country. In 1999, the National Space Research and Development Agency (NARSDA) was established to pursue the development and application of space science and technology for the socio-economic benefits of the nation. In 2001, the government approved the National Space Policy and Programmes to serve as roadmaps for transforming Nigeria from the status of a consumer nation to active participant in space technology and allied fields. The objective of the National Space Policy and Programmes was to make space research and development activities part of the overall strategies for sustainable national development. The main thrust of the National Space Policy and Programmes were: development of human resources and capacity building in various areas of space science and technology; to develop and build competence in space technologies of direct relevance to national development; to develop strategies and space applications; to undertake national resource management; defence, national security and law enforcement; study of the earth environment; communication and information;

education and training; provide support for universities and other academic institutions in space related research and development projects; promote private sector participation in the space industry; promote international cooperation. In order to achieve these, six centres were created to act as the operational limbs of the National Space Research and Development Agency (NARSDA). These NARSDA's centres are:

a. Centre for Satellite Technology Development (CSTD): this centre has the primary focus on satellite technology development with indigenous critical mass of engineers and scientists in all rudiments of satellites technology – building, launching, telemetry, tracking and control of all kinds of satellites such as earth observation, communication, weather, scientific research, etc.

b. National Centre for Remote Sensing (NCRS): the centre is charged with the sole responsibility of harmonizing research and development in space science and technology application for sustainable socio-economic development in the country.

c. Centre for Space Science and Technology Education (CSSTE): this centre is affiliated to United Nations African Regional Centre for Space Science. Its main function is to develop curriculum, skills and knowledge of university educators, research scientists and train other professionals and personnel in applications of satellite remote sensing, meteorology, communication and geographic information system to sustainable development.

d. Centre for Space Transport and Propulsion: the centre focuses on rapid advances in the science and technology of rocketry, which are the main transportation vehicles.

e. Centre for Geodesy and Geodynamics (CGG): this centre was established to facilitate capacity for geodetic surveying and mapping, as well as monitoring of coastal deformation and subsidence due to excessive oil and gas exploitation, floods and global mean sea level rise and other related seismic and geodynamic phenomena including implementation of international agreements with respect to satellite laser ranging (SLR), very long baseline interferometry (VLBI) and cooperative international GPS network.

f. Centre for Basic Space Science (CBSS): the centre is mandated to provide a sound education, research and knowledge in basic space science, astronomy/astrophysics, rocketry and balloons, geomagnetism, etc as well as designing and fabricating appropriate systems and instrumentations and telescopes.

Method of data collection

The data used in the study is from two sources. The first source of data is from extensive published article search from 2009 to 2013. The total number of articles used in the study is seventy-seven (77). The second source of data is from administration of 101 questionnaires to urban managers - public servants who are in environmental related professionals such as town planning, architecture, estate management, surveying, etc. - in the five local governments in Ibadan metropolitan area and at the Oyo State Government Secretariat in 2015. Descriptive statistics is used to analyze the data. Descriptive statistics used include frequencies and percentages.

Research Findings

In GIS and remote sensing, there are diverse research areas, topics and topic applications. All these diverse areas of research can be broadly divided into two which are method development and analysis/application. The articles used in the study are sorted into these two broad areas of research. It is observed that all the seventy-seven articles focus on analysis/application and none of the article focus on method development (Table 1). Observation from the literature shows that there has been low scientific research output contribution from African countries. For instance in East African countries, the greatest knowledge, skill and productivity gap identified is developer (Simons, 2013). It is also observed from a concept note of a recent workshop on "expanding and sustaining excellence in doctoral programmes in Sub-Saharan Africa: what needs to be done?" organized by South Africa's National Research Foundation and the Carnegie Corporation of New York held in South Africa that while rapidly expanding economies elsewhere had more than doubled their rates of scientific publication in the past decades, Sub-Saharan Africa contributed only 0.7% to World scientific output and this percentage was decreasing and only three countries in Africa – South Africa, Egypt and Nigeria – produced three quarters of Africa's output (McGregor, 2013).

Table 1: Findings on some of the research issues

	Title	**Category**	**%**
1	Broad Areas of research (n = 77)	Analysis/Application	100.0
		Method Development	0.0
2	Broad Topics (n = 77)	Land use/land cover	87.0
		Socioeconomic	5.2
		Disaster Management	7.8
3	Broad topics applications (n = 77)	Change detection/use and cover patterns	42.9
		Damage assessment/vulnerability	9.0
		Population	1.3
		Urban and regional planning	18.2
		Agriculture	7.8
		Health	1.3
		Geology	11.7
		Climatology	6.5
		Energy	1.3
4	Software used (n = 82*)	Arcview 3 (18.3)	40.2
		ArcGIS 9 (19.5)	
		ArcGIS 10 (2.4)	
		ENVI	2.4
		ERDAS IMAGINE	8.5
		Idrisi	13.4
		ILWIS	35.4
5	Sources of satellite images used (n = 54)	United States National Aeronautical and Space Administration (NASA)	5.6
		National Centre for Remote Sensing, Jos, Nigeria	13.0
		Global Land Cover Facility (GLCF) of the University of Maryland, Maryland, USA	18.5
		National Space Research and Development (NARSDA), Abuja, Nigeria	16.7
		Google Earth imagery	18.5
		www.digitalglobe.com	3.7
		Institute of Food Security, Environmental resources and Agricultural Research (IFSERAR), University of Agriculture, Abeokuta (UNAAB)	1.9
		National Population Commission of Nigeria	1.9
		Ministry of Agriculture and Rural Development, Federal Department of Forestry (FORMECU), Nigeria	7.4
		Regional Centre for Training in Aerospace Surveys, (RECTAS) Obafemi Awolowo University, Ile-Ife, Nigeria	3.7
		Department of Geography, Ahmadu Bello University, Zaria	1.9
		Department of Geography, Obafemi Awolowo University, Ile-Ife	1.9
		United States Geological Survey EROS Data Centre	3.7
		National Emergency Management Agency (NEMA)	1.9
6	Department of Researchers (n = 166**)	Department of Urban and Regional Planning	9.0
		Department of Geography/ Geography and Environmental Management/ Geography and Planning/ Department of Geographic Information System	47.0
		Department of Environmental Management/ Environmental Management & Toxicology	4.8
		Department of Surveying and Geoinformatics	4.8
		Department of Geology and Mineral Sciences /Department of Applied Geology/ Earth Science/Geoscience	9.0
		Department of Physics and Solar Energy/ Pure and Applied Physics	2.4
		Research Institutes/Agencies/Centres	12.1
		Others	10.8

7	Types of Institutional affiliation of the Authors (n = 166**)	University	81.3
		Polytechnic	1.8
		College of Education	0.0
		Research Institute/Agences/Centres	12.1
		Others	4.8

* In some of the articles more than one type of software were used (that is why the total frequency number of software used is 82). **Total number of authors

When these articles are further sorted into broad areas of topic and topic applications (see Table 1), three broad areas of topics are identified which are land use/land cover, socioeconomic and disaster management, while nine topic applications are identified which are change detection/use and cover patterns, damage assessment/vulnerability, population, urban and regional planning, agriculture, health, geology, climatology and energy. Majority of the researches are on land use/land cover (87.0%) followed by disaster management (7.8%) and socioeconomic (5.2%). Also most of the topic applications are on change detection/use and cover patterns (42.9%) followed by urban and regional planning (18.2%), geology (11.9%), damage assessment/vulnerability (9.0%), agriculture (7.8%), climatology (6.5%), population (1.3%), health (1.3%), and energy (1.3%) in that order.

It is observed that researchers use diverse kind of remote sensing and GIS software as shown in Table 1. In most cases researchers used more than one type of software. Overall, the table shows that in Nigeria, ESRI software products are the most used products. Also, table 1 shows that the sources of images used by the researchers are from diverse sources prominent among which are Global Land Cover Facility (GLCF) of the University of Maryland, Maryland, USA (18.5%); Google Earth (18.5%); National Space Research and Development (NASRDA) Abuja, Nigeria (16.7%); and National Centre for Remote Sensing (NCRS) Jos, Nigeria (13.0%).

Furthermore, Table 1 show the department of the researchers and institutional affiliation of the researchers. The Table show that majority of the researchers are from Department of Geography/ Geography and Environmental Management/ Geography and Planning/Geographic Information System (47.0%), followed by those from Research Institutes/Agencies/Centres (12.1%), Department of Urban and Regional Planning (9.0%), Department of Geology and Mineral Sciences/ Applied Geology/Earth Science/Geoscience (9.0%), Department of Environmental Management/Environmental Management & Toxicology (4.8%), Department of Surveying and Geoinformatics (4.8%), and Department of Physics and Solar Energy/ Pure and Applied Physics (2.4%). The table also shows that majority of the researchers are from University institution (81.3%), followed by those from Research institutes/Agencies/Centres (12.1%), and Polytechnic institution (1.8%).

Table 2: Urban managers' responses to questions relating to their interest in GIS and Remote Sensing.

S/N	Questions	Response	Percentage % (n = 101)
1	Do you have interest in GIS/Remote Sensing?	Yes	77.2
		No	22.8
2	What are the constraints you have in building your knowledge in GIS/Remote Sensing?	Financial constraint	58.4
		Time constraint	60.4
		Lack of interest	20.8
		Lack of permission from the place of work	43.6
		Lack of access to computer	17.8
		Others	1.0
3	Do you have interest in GIS/Remote Sensing training/retraining programmes?	Yes	80.2
		No	19.8
4	What do you think are your constrain in attending GIS/Remote Sensing training/retraining programmes?	Financial constraint	60.4
		Time constraint	63.4
		Lack of interest	19.8
		Lack of permission from the place of work	41.6
		Lack of access to computer	16.8
		Others	0.0

Source: Field survey, 2015

Table 3: Problems affecting use of GIS/Remote Sensing application

Response	Percentage (%) (n = 101)
Lack of knowledge about it	75.2
Technical nature of the applications	65.3
Financial problems	86.1
Lack of incentives/motivation	66.3
Power supply (electricity) problem	79.2
Lack of interest	33.7
Others	1.0

Source: Field survey, 2015

In the questionnaires administered, urban manager respondents were asked as to whether they have interest in GIS/remote sensing. The result of the analysis of the response (Table 2) shows that majority (77.2%) of the respondents have interest in GIS/remote sensing. When asked about the constraints they have in building their knowledge in GIS/Remote Sensing, the result shows that time constraint (60.4%), financial constraint (58.4%) and lack of permission from the place of work (43.6%) are the top three constraints they encountered. Respondents were probe further as to whether they have interest in GIS/Remote Sensing training/ retraining programmes. The result shows that majority (80.2%) of the respondents have interest in GIS/remote sensing training/retraining programmes. Again, when asked about what they think are their constraints in attending GIS/remote sensing training/re-training programme, the result of their response shows that time constraint (63.4%), financial constraint (60.4%), and lack of permission from the place of work (41.6%) are the top three constraint they encountered.

Table 3 shows the problems affecting urban managers' use of GIS/Remote Sensing applications. The table shows that financial problems (86.1%) is top on the list, followed by power supply (electricity) problem (79.2%), lack of knowledge about GIS/Remote Sensing applications (75.2%), lack of incentives/motivation (66.3%), technical nature of the applications (65.3%), and lack of interest (33.7%).

Summary and Conclusion

This study examined remote sensing/GIS software utilization and challenges in Nigeria. The study shows among other things that most of the remote sensing researches in Nigeria are on analysis/applications, most of the broad research topics are on land use/land cover, and most of the broad topics applications are on change detection/use and cover pattern. The most used remote sensing and GIS software is ESRI products. Sources of images used are from diverse sources prominent among which are Global Land Cover Facility (GLCF) of the University of Maryland, Maryland, USA, Google Earth, National Space Research and Development (NASRDA) Abuja, Nigeria, and National Centre for Remote Sensing (NCRS) Jos, Nigeria in that order. The study reveals that majority of the researchers are from Department of Geography/Geography and Environmental Management/Geography and Planning/ Geographic Information System, and, majority of the researchers are from university institutions. The result of the questionnaires administered show that majority of the urban managers have interest in GIS/Remote Sensing training/re-training programme; time, finance, and lack of permission from the place of work are the three top constraints in building their GIS/Remote Sensing knowledge. Top on the list of problems affecting urban managers' use of GIS/Remote Sensing applications is financial problems, followed by power supply (electricity) problem, lack of knowledge about GIS/Remote Sensing applications, lack of incentives/motivation, and technical nature of the applications.

In order to improve utilization of GIS and Remote Sensing software in Nigeria, there is the need for improvement in power (electricity) supply. There is also need for motivation and encouragement of the urban managers by the government through financial support for the training/re-training of urban managers in GIS and Remote Sensing educational programmes.

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ANTHROPOGENIC ACTIVITIES, PRESSURE AND THREAT ON GIREI FOREST RESERVE, ADAMAWA STATE, NIGERIA

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Abstract

In Nigeria, since the last three decades, there has been a tremendous pressure on forest to provide economic resources leading to unabated deforestation. The potential negative effects of such changes on forest quality, quantity and production are wide. The objective of this study is to evaluate the degree of pressure and its threat from anthropogenic activities on protected area of Girei Forest Reserve, Adamawa State, Nigeria, through the application of Remote Sensing and GIS techniques. The images of Landsat TM 1987, ETM+ 2000, Nigeriasat-1 2010 and Spot5 2015 were analyzed to derive information on environmental changes between 1987 and 2015. The results of the analyses revealed that fuel wood extraction and cultivation are the main causes of deforestation in the area, followed by urbanization. It also revealed that forest area has reduced from 177.03 km^2 in 1987 to 125.53 km^2 in 2000 and then further reduced to 112.74 km^2 in 2010 and then dropped to 75.98 km^2 in 2015. This implies that land-use such as built-up areas and cultivated areas were increasing through time i.e. from 3.33 km^2 in 1987 to 5.1 km^2 in 2000, 7.47 km^2 in 2010 and 8.95 km^2 in 2015. This indicated that the rate of deforestation in the area is high at about 33.68 km^2 per year thereby confirming the perception of 58% of the respondents. Decrease in rainfall, increase in temperature and erosion were observed as the most serious effects of deforestation in the area. The study recommends that government and traditional authorities should provide affordable alternative source of energy to cushion and reduce pressure on fuel wood as principal source of domestic energy supply and the need to enforce environmental laws.

Keywords: Anthropogenic, Pressure, Threat, Landsat, Nigeriasat-1, Change detection.

Introduction

In Nigeria, like in many other sub-Saharan African countries, there has been a serious concern on environmental changes since the last three decades. The country is increasingly faced with the challenges of desertification, deforestation, erosion and flooding, which have manifested in multi-faceted problems such as loss of agricultural soil and productivity. Deforestation is one of the major environmental issues not only affecting countries and locations, but also from a global perspective. The degree of international attention to deforestation is commensurate with the role of forests in the global, national and local ecosystems. The rate of deforestation in Nigeria exceeds the rate of regeneration (Aweto, 1990; Iroye, 2010). Tropical forest of all varieties are disappearing rapidly as human clears the natural landscape to make room for farms and pastures, to harvest timber for construction and fuel, and to build roads and urban areas (Robert, 2007).

Many studies showed negative effect of human activities on forest biodiversity. Effects of these activities are manifested at all ecological scales, from short-term changes in the behavior of an individual animal through local extirpations and global extinctions. Abundant fauna and flora resources in Nigeria are being threatened due to the increasing rate of anthropogenic activities across the protected areas in the country (Oladeji et al, 2012). Between 1990 and 2000 Africa lost 52million hectares of forest, this amounts to a decrease of 0.8percent per year and 56 percent of the global total. It is estimated that 60% of the tropical forest areas cleared in Africa

as a whole between these periods were converted to permanent agriculture small holdings (UNEP, 2010). Human activities often referred to as land-use, such as mining, forest exploitation, tourism, hunting, fishing, agriculture, have resulted in the loss of forest resources, such as deforestation and forest degradation which demonstrate the impact of those activities on forest resources by looking at the percentage of forest cover change and meteorological changes (Kiki et al, 2012). Developing countries including Nigeria are saddled with problems emanating from environmental deterioration which has great impact on the forests (Dagba et al, 2017). Clearing of forest reserves and plantations to pave way for farming and urbanization account for over 80% of the factors responsible for the depletion of forest resources in Nigeria. According to (Ogunwale, 2015), in developing communities, social amenities such as roads, hospital, water plants etc. are regularly provided by the government and or the communities themselves, and most times without proper planning whereby primary forests are cleared to site such projects.

Forests are important plant communities that consist of trees and other woody vegetation that performs life supporting functions on earth (Ladan, 2014). Forest reserves are areas of forest designated by the government for the protection of trees growing or planted for the purpose of their ecological benefits among others (Usman and Adefalu, 2010). Forest reserves are areas of land that are protected and managed in order to preserve a particular type of habitat and its flora and fauna which are often considered rare or endangered (Farlex, 2014). Okpiliya (2013) analyzed the flora species abundance in the tropical rain forest ecosystem of Boki, Cross River State which still remains one of the few ecosystems that have been highly valued for its species diversity despite the spate of indiscriminate logging. Ihenyen et al (2009) evaluated the tree composition of Ehor Forest Reserve in Edo state, southern Nigeria, where they observed that several tree species are under threat of extinction from the reserve which is quite alarming and calls for a more resourceful and sustainable management techniques. The study further suggested that the reserves should be protected from further timber and fuel wood exploitation in order to allow it to regenerate itself fully. Akinsoji (2013), carried out a vegetation analysis of Ngel Nyaki Forest Reserve on the Mambilla Plateau, Nigeria. The results indicated that the vegetation of Ngel Nyaki Forest Reserve is stable and self-sustaining. Several studies focus on decline in forest reserves, changes in forest tree species, depletion of forest reserves and forest degradation. Kankara (2010) noted that over the years there is decline in forests in Katsina State, northern Nigeria caused by neglect and human interference which results in the disappearance of wild animals that once roam through the forest across the State. Omale (2011) observed that in Nigeria, there is the depletion of forest reserve through improper wood harvesting methods.

Oduntan et al (2013) evaluate the degree of pressure from human activities on protected areas in Yelwa Division of Ogun State, Nigeria.The findings revealed that all the reserves were severely threatened by logging and grazing while other reserves were severely threatened by conversion of land use. Mmon and Mbee (2014) carry out a study on Gele Gele Forest Reserve, Edo State and the results show that there is a steady growth of the population of the communities around the reserve which leads to rapid decline and depletion of the rich biodiversity and biological resources in the reserve due to over-dependence on the forest resources. Olaniyi et al (2014) determine the intensity of anthropogenic activities that took place within the Chimpanzee's distribution area in Oluwa Forest Reserve, south west Nigeria. The study observed that anthropogenic activities are having significant influences on the occurrence of species and recommended control measures such as encouragement of forest guards to intensify anti-poaching and encroachment patrol.

Anthropogenic influences on the landscape can result in the alteration of habitat, such as the loss and fragmentation of natural vegetation, creation of novel habitat type, alteration of resources flows including reduction in net primary product, increase in regional temperature and degradation of water quality, alteration of disturbance regimes with many habitats experiencing more frequent disturbances, alteration of species composition commonly comprising reduction in the richness of some taxonomic group in areas of intense urbanization (Eniolorunda, 2010). These environmental challenges have no doubt compounded the poverty levels of more than 80 million people that depend on agriculture for their livelihood (Ba et al, 2012). Therefore we need to monitor the quality of our environment as well as to control our developmental processes very closely.

Study area

Girei lies north of the Benue River between Latitude 8^0 N and 11^0 N and Longitude 11.5^0 E and 13.5^0 E (Figure 1). It covers a total land area of 1151.64 square kilometers (Saka *et al*, 2013). The geology of Girei area consists of two strati-graphic units; these are the quaternary river coarse alluvium and feldspar sand-stone. The alluvial deposits occur mainly along the bank of river Benue and its tributaries, consists of sand, clay, silt, silt-clay and pebble sand (Adebayo and Tukur, 1999). The landform type of Girei area is characterized by grouped hills of synclinical folds about 600 meters developed on cretaceous sand stone and lowlands (Adebayo and Tukur, 1999). Climate factor of the area controls the regime and other characteristics of the river. The few rivers in the area are Mayo Pambambi, Maita, Beti-Mayel,Wuro-modi,Toja, river Gede and Wari forming a dendritic drainage pattern that drained in to the Benue River which flows along the Southern part of the area (Adebayo and Tukur, 1999). The area is characterized by two well defined seasons, which are rainy (wet) and dry seasons. The rainy season starts from May through October, while the dry season commences from November and ends in April which is characterized by dry, dusty and hazy wind that bring harmattan dust from the Sahara Desert through the influence of tropical continental air mass, it reduces visibility to less than 100 meters. The average annual rainfall is about 972mm with an average of 62 rainy days. Temperatures are relatively high almost all year round. The temperature of the area ranges from 30^0C to 44^0C (Adebayo, 1999). The vegetation of Girei area is of sub-Sudan Savanna vegetation zone of Nigeria, which is characterized with short grasses, thick vegetation around hills and mountain ranges and inter-sparse by short trees and shrubs (Adebayo and Tukur, 1999). The tree vegetation has over the years been modified by human activities such as farming which involve bush burning, fuel wood exploitation, deforestation and also construction works (Uyanga, 2000). Girei Local Government Area has a population number of 129,955, with 66,906 Male and 62,949 Female, with an annual growth rate of 2.5 percent (NPC, 2007).

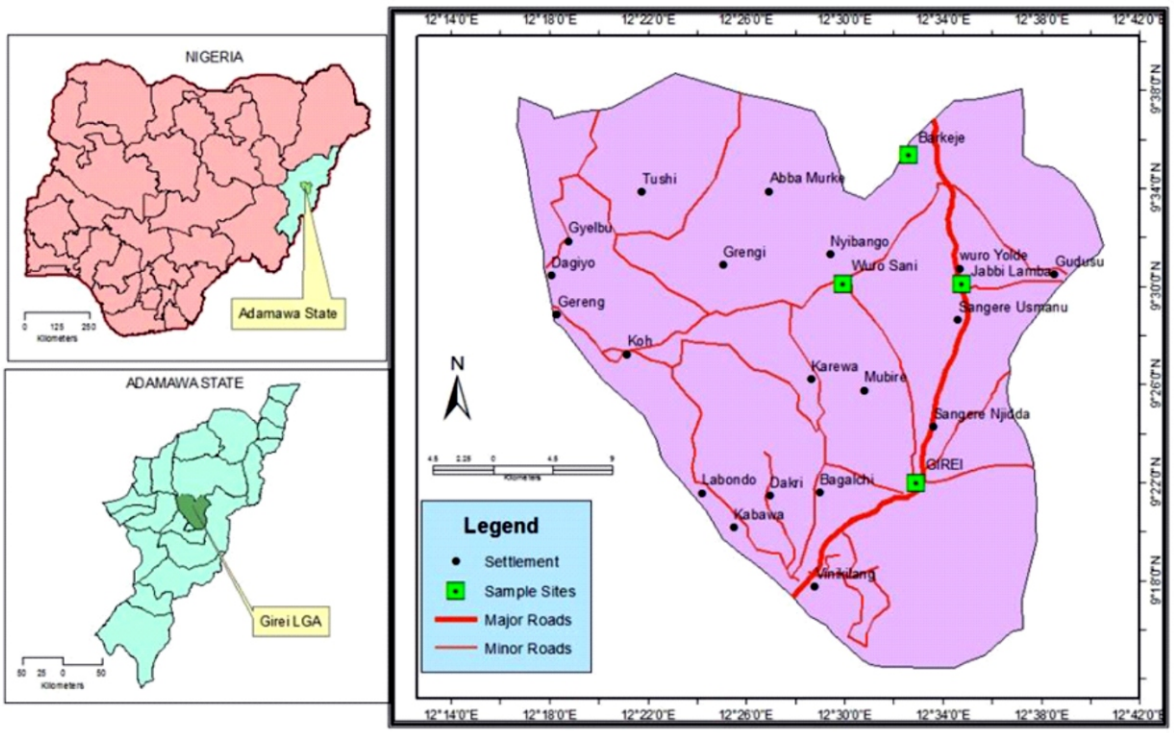

Figure1: Map of the study area

Methods and materials

The data used for this study include satellite imageries of Landsat TM 1987, ETM+ 2000, Nigeriasat-1 2010 and Spot5 2015. Arcgis 10.3 versions, Eradas 9.3 Geographic Information System (GIS) software packages were also used to analyze and perform feature identification, recognition, classification, overlay analysis, accuracy assessment, change detection and prediction for feature scenario.

Data processing and extraction

This involves the reduction of satellite data through cutting out the study area from the selected scenes, geo-referencing and preparation of false color composite (FCC). Analysis of the spectral signatures of individual pixels of the acquired imageries was conducted through different types of band ratios and vegetation indices in order to identify and interprets information from the acquired multi-spectral images. The spectral signatures of the study area capture the characteristic features of land-cover conditions and biotic activity through spectral absorptive properties of features. Vegetation dynamics represented by long-term data series act as a quantitative indicator of vegetation response to both climate and human activities during the period of study.

Classification scheme

This was used to distinguish different features on the landscape such as forests, lakes, build-up areas, farmlands etc. To categorize the image features (pixels in the image) into cover types, training sites were identified and grouped into cover classes. Thus, a six class land cover types were identified and used in a supervised classification procedure. These features could then be identified and recognized by the map user (Congalton and Green, 1999). Specific area covered by the feature classes or cover types identified during the ground truthing were identified on the multi-spectral imageries and their spectral characteristics were then used to train and assign each pixel in the image to one of the classes. The identification of spectral characteristics was done through sampling, which is the assignment of class names to group of pixels, which have similar spectral values to those classes that have been identified on the ground. According to Akinola *et al*. (2012), the only limitation of image classification is that, if classes do not have distinct clusters in the feature space it does not give reliable results.

Change detection

This allowed identification of difference in the state of the forest reserve. Change that occurred in the study area for the study period of 1987-2015 (28 years) were analyzed by crossing the classified landsat TM 1987 image with the classified landsat ETM+ 2000 image through the OPERATION/RASTER/PROCESSING/CROSS/SHOW subroutine. The same procedure applied on the remaining classified Nigeriasat-1 2010 and Spot5 2015 images. Direct comparison of land use statistic was carried out highlighting the extent and rate of land use changes over the period of study. The results were presented essentially by maps and graphs that have been analyzed to explain the rate and extent of deforestation and implications associated with it. The basis of using remote sensing data for change detection was that, changes in land-cover result in changes in radiance value which can ultimately be remotely sensed. The total forest loss was calculated by using the intervals of 1987-2000, 2000-2010, 2010-2015 and for the total period of 1987-2015.

Future scenario

The future scenario made in this research stretch from 2016-2056 and consists of forest area calculations. The calculation was doned with an assumption that, the annual deforestation rate in the area will be fixed during the time period. The overall annual deforestation rate calculated for the intervals of 1987-2015 was used to create the future scenario.

Results and discussion

With respect to the land-use land-cover of the study area, figure 2 shows the land-use land-cover extent for the study period (1987-2015) with a view to understanding the changes in Girei forest Reserve during the period.

The results show that in 1987, forested areas occupied the highest expanse of land in Girei Forest Reserve with 33.89% (177.03 km^2) of the land mass, shrubs and farm lands occupied 23.83% (124.45 km^2), while built-up environment took only 0.64% of the study area with 3.33 km^2 as shown in Figures 2 and 3.

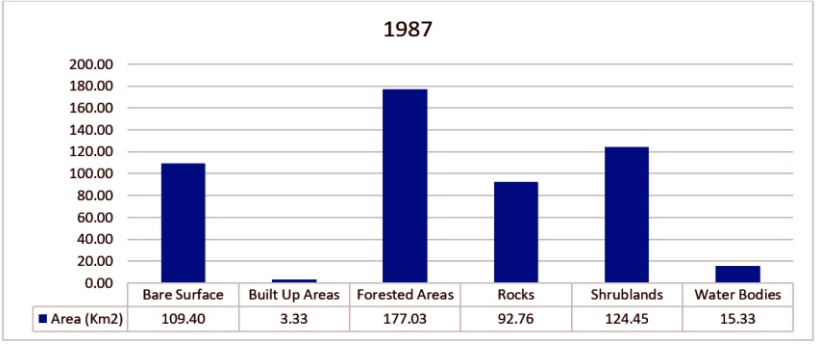

Figure 2: LULC of the study area in 1987

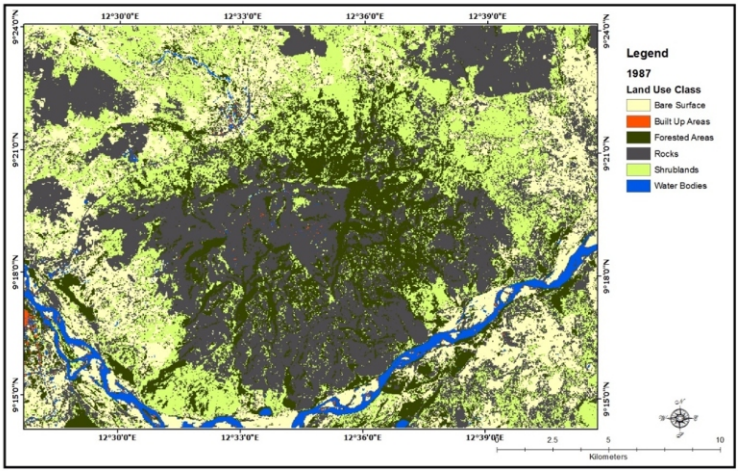

Figure 3: Land use classification of the study area in 1987

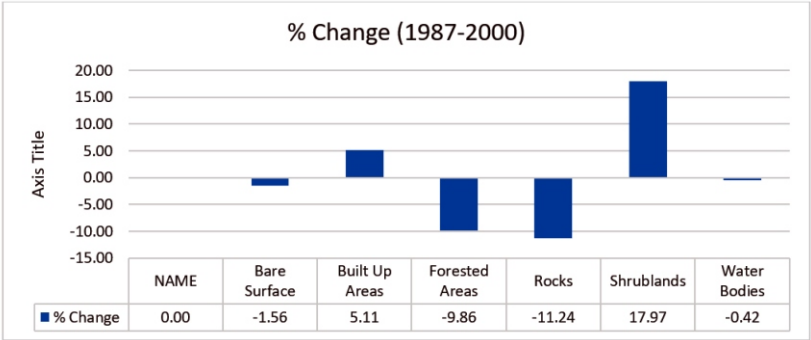

Figure 4: Changes in LULC of the study area between 1987 and 2000

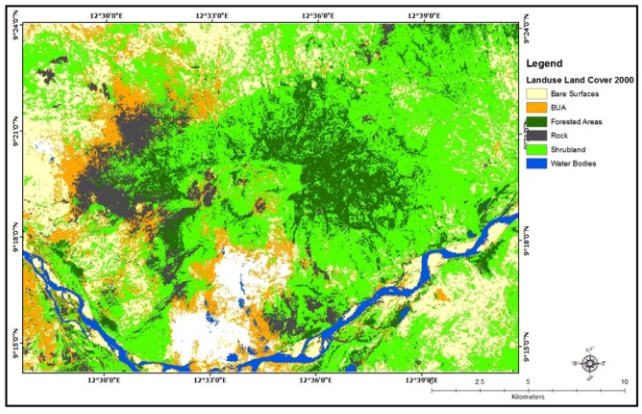

Figure 5: Land-use classification of the study area in 2000

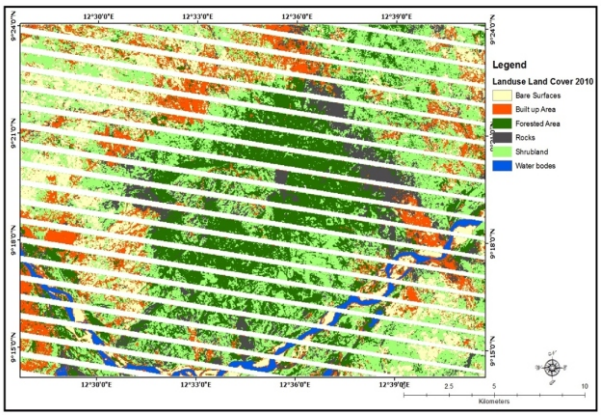

Figure 6: Changes in LULC of the study area from 2000 to 2010

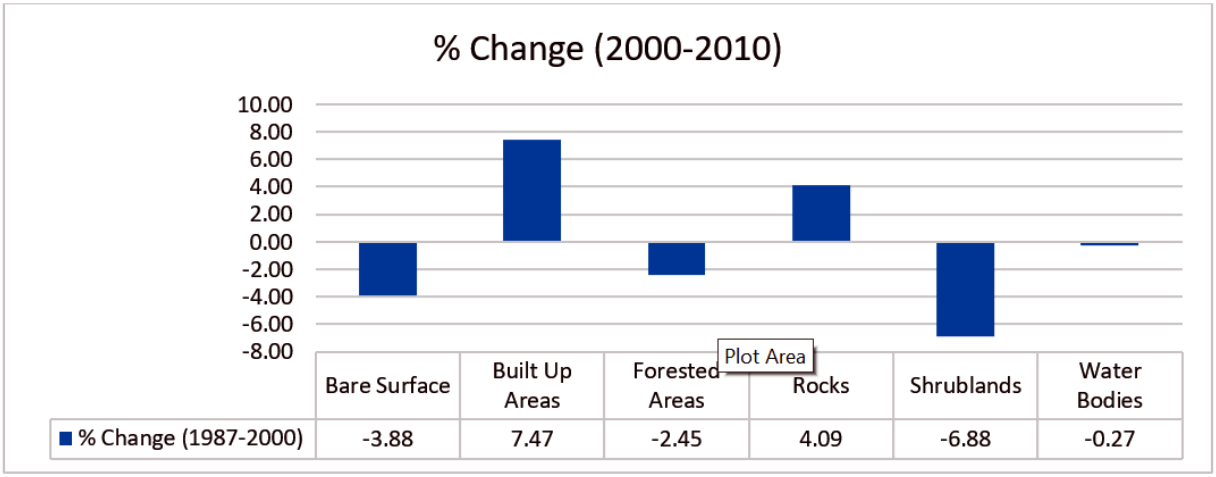

Figure 7: Land-use classification of the study area in 2010

As at year 2000, the forested areas has reduced to 125.53km^2, a reduction of -23.83%, while Built up areas has increased with 10.86% to 30.03km^2, Farmlands increased with 19.9% while bare surfaces and water bodies had very slight increases and decreases respectively as indicated in Fig 4.

This implies that conversion of forested areas to farmlands and built-up areas became prevalent during this period with the noticeable rise in built-up areas by 10%. Between 1987 and 2000, the conversion of forested areas to residences and in some cases farmlands is evident by the 19.9% increase recorded within the period under review.

Between year 2000 and 2010, forested areas declined further by -2.45%, while built-up areas picked up by 7.47%, bare surface reduced by -3.88%, and shrub lands reduced by -6.88% (Figure 6). This indicated that the trend of deforestation has continued in the area due to more clearance of forested land for residential areas to meet the pressing demand of more houses for the growing population. This is in line with David (2004) study where he discovered that demographic processes are among the essential drivers of frontiers deforestation. He concluded that population dynamics are but one of several sets of factors determining human impacts on the environment.

Forested areas continued its declining trend by giving way for urban expansion and farm lands, such as Asmau Farm Limited, Andabe Farm Nigeria Limited, Jibirojo Farm Limited, Jibiro Farms Limited and Bakari Agroallied Farm Limited were established. Figures 5 and 6 show the land use land cover extent of the study area in 2000 and 2010 respectively while Figure 6 shows a chart depicting the change.

Between 2010 and 2015, forested area continued its downward trend with a decline of -7.04% in five years, the spate of increase in built-up areas and bare surfaces had small decreases in the region by -0.95 and -0.63 respectively. Shrub lands and farmland were the highest gainers with a high of 13.12% within the five years.

This implies that while the spates of erecting buildings are reduced, the number of farms has increased. The continuous decline of this forestry however is of major concern especially in this era of climate change and its adverse effects of which deforestation is a major contributor. Figure 8 shows the land-use land-cover of the study area in 2015 while Figure 9 depicted the changes that occurred. This is in harmony with Akinola et al (2012), where they identified five land use practices that are heavily depleting forest reserve; these are built-up area i.e. settlement, farmland, fuel wood gathering, farming and logging.

Changes in Forest Estate

An assessment of the changes in forest extent from 1987 shows that forest reserve in the study area has been on decline and this is due in part to the extent of urban expansion as well as increase in farming activities during the period.

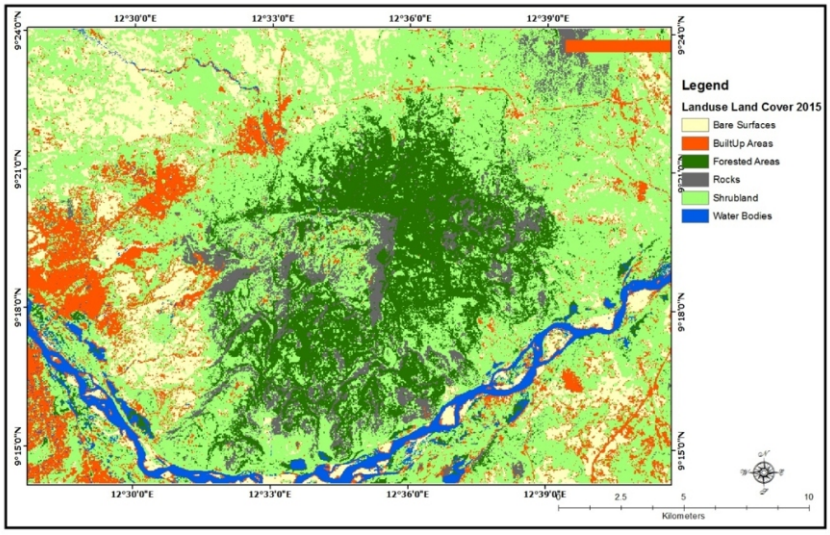

Figure 8: Land-use classification of the study area in 2015

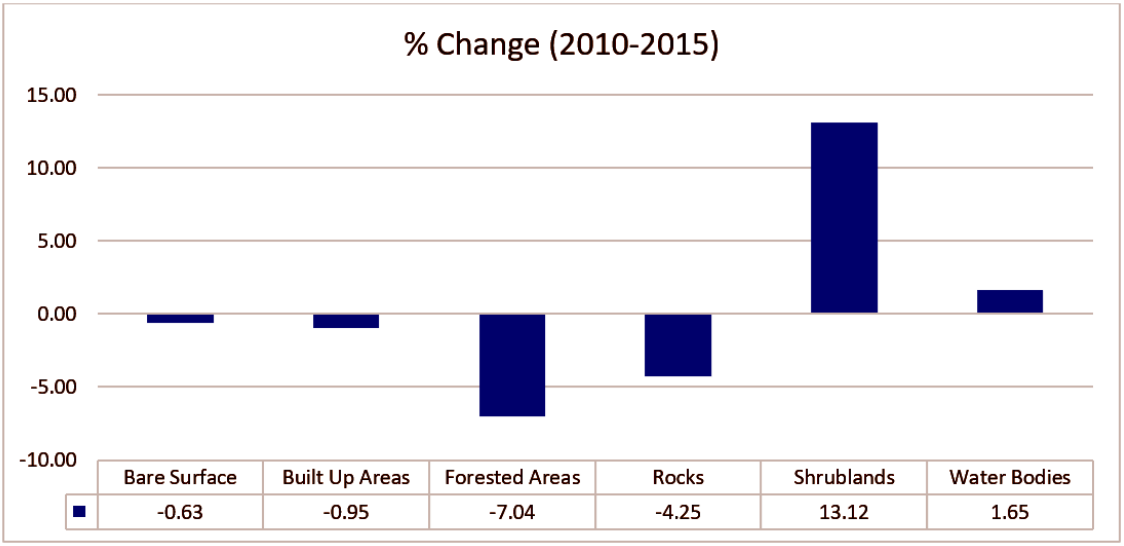

Figure 9: Changes in LULC of the study area between 2010 and 2015

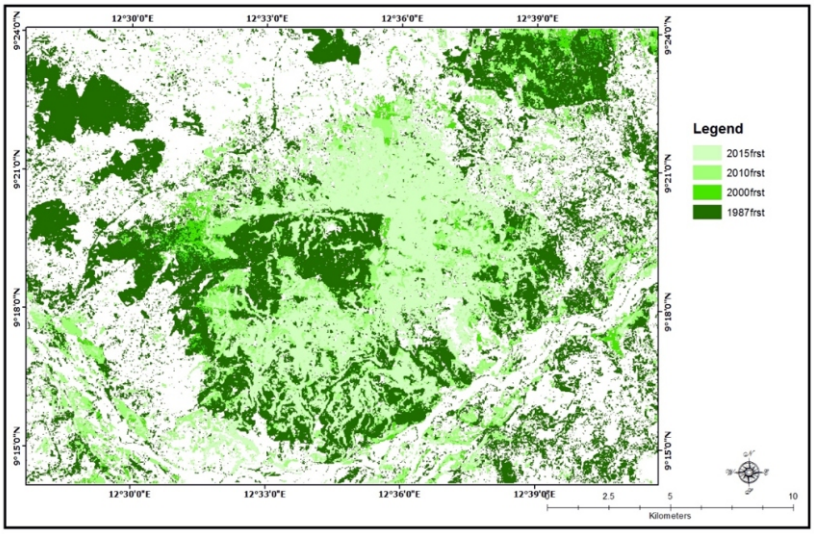

Figure 10: Overlay of Forested Areas of the study area between 1987 and 2015

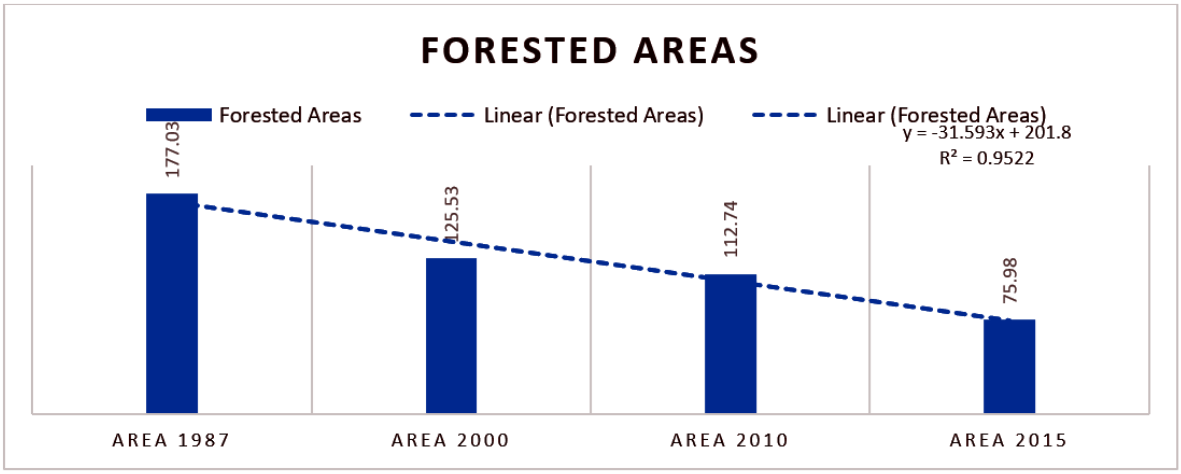

Figure 11: Changes in forested areas of the study area from 1987 to 2015

Table 1: Annual deforestation rates and forest loss between 1987 and 2015.

Deforestation			
Year	**Rate (%)**	**Annual Forest Loss (ha)**	**Forest Loss in total (ha)**
1987-2000	-9.86	51.50	669.50
2000-2010	-2.45	12.79	127.90
2010-2015	-7.04	36.76	183.80
1987-2015	-6.45	33.68	981.20

The forest estate lost 101.05 km^2 of its extend during the 28 year period under review and Figure 10 shows the overlay of forest covers from 1987 to 2015.

The trend of decline was plotted and the trend line equation shows that the forest estate will continue its decline by about 32 square kilometers for every decade if the current rate of exploitation is not checked. The R Squared shows a 95% certainty that decline in forest estates will continue as shown in Figure 11.

During the time period from 1987 to 2015, the total forest loss was 981.20 hectares, which corresponds to a loss of 14 percent of the total forested area that existed in 1987. The overall annual forest loss for the same time period was 33.68 hectares. This corresponds to a mean annual deforestation rate of -6.45 percent. Between 1987 and 2000 the yearly deforestation rate was -9.86 percent and during this period 669.50 hectares of the former forest was cleared. Between 2000 and 2010 the yearly deforestation rate decreased to -2.45 percent. Hence, the processes of deforestation have slowed down in the area and picked up from 2010 to 2015 where deforestation rate reached -7.04 percent and a total of 183.80 hectares was cleared as indicated in Table 1.

Future scenario

The overall annual deforestation rate from 1987 to 2015 was calculated. This annual deforestation rate (-6.45%) was used to create the future scenario (by calculating the forested area in Girei forest reserve in a possible future). The future scenario stretches from 2016 until 2056 and is based on the fixed deforestation rate of -6.45 per percent Table 1. The annual loss of forest was calculated and the predicted forested areas are shown in Table 2 and by the middle of this century the forested area will consist of only 50.18 hectares compared to 177.03 hectares in 1987.

This means that the area will have lost 45 percent of its forests in the year 2056 compared to 1987 Table 1. Today there is approximately 75.98 hectares. Evidently, there is no existing sustainable forest management in the area. To stop this trend,

investments in forest conservation must be made. It should be mentioned that this is a simplified future scenario, where no other factor than the deforestation rate is taken into account.

Table 2: Predicted Forested Area from 2016 to 2056.

Year	Forested Areas (ha)
2016	75.98
2026	69.53
2036	63.08
2046	56.63
2056	50.18

Conclusion and recommendations

The main objective of this paper has been to assess the anthropogenic activities and their threat on Girei Forest Reserve of Adamawa State, Nigeria using remote sensing and GIS techniques. Based on the datasets obtained and analyzed, the study therefore concluded that

i. There is an alarming increase in the rate of deforestation in the study area 125.53km^2 per year (1987-2000). This loss in natural vegetation results to the increase in bare surface whereas increase in built-up areas and farm lands leads to decrease in vegetation.

ii. Fuel wood gathering and over-cultivation are the most causal factors of deforestation with total average of 45% and 35% respectively. Others are over-grazing, population growth and urbanization and bush burning.

iii. People should find other means of domestic energy other than fuel wood, which is the most popular source of energy in the area. For example, kerosene and gas should be used, as this will relieve the vegetal cover from indiscriminate removal.

iv. Unnecessary cutting down of trees should be stopped. Slash and burn system of farming should be stopped by the farmers, as this will render the lands useless whereby erosion of all types will set in and washed away soil nutrients. It is paramount to encourage vegetation conservation, sustainable use of vegetation resources and wildlife, as the well-being of the people is closely related to the quality of their environment.

v. Legislation: there is a need for stiffer laws concerning cutting down of trees to be made by the government; which should be enforced and the defaulters should be given stiffer penalties. This will go a long way in maintaining the vegetal resources in the area. Hence, there is a need to involve traditional rulers at the grass root level for the enforcement of the laws, as this would in turn mitigate indiscriminate falling of trees for various purposes in the study area.

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COMPARATIVE ANALYSIS OF THE CHARACTERISTICS OF RAINSTORMS OVER IBADAN, NIGERIA

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Abstract

This study analysed the spatio-temporal variations of areal coverage (AC) of rainstorms over Ibadan with respect to variations in the AC of rainstorms during early and late rainy seasons in 2013 and 2014 rainstorm events. AC of rainstorms equals to the area covered by the rainstorms as observed by the 50 recording raingauges using square method. Student's t-test was used to test if there is significant difference in the AC of rainstorms during early and late rainy seasons, at $p \leq 0.05$. Of the 154 AC of rainstorm events studied, 21% and 32% occurred during early and late rainy seasons, respectively. The highest AC of rainstorms was recorded in April, as 426.4 km^2 (about 82.7% of the total area) followed by 389.6 km^2 (75.6%) in October. The study also revealed that the AC of rainstorms varied over the city of Ibadan during early and late rainy seasons. There was no significant difference in the mean AC of rainstorms during early and late rainy seasons (t=2.75). This study has provided a basic climatological investigation of Ibadan early and late rainy seasons AC of rainstorms conditions. The result could potentially be used in establishing guidelines for the use of rainwater in agriculture.

Keywords: Spatio-temporal variations, Rainstorm characteristics, Areal coverage, Ibadan

Introduction

A rainstorm is a relatively short period of uninterrupted and intense rainfall and usually lasts for less than two hours. Such storms constitute an important feature of tropical climate for at least three reasons. First, rainstorms account for most of the rainfall received in the tropics. In fact, in some inland areas, they contribute up to 95% of the total annual rainfall. Secondly, they produce moderate to high intensity of rainfall which generates a lot of runoff and sediment yield especially in areas without adequate vegetal cover, and finally, they frequently occur in a random pattern both temporally and spatially. They therefore contribute to the high variability both over time and space of rainfall in the tropics (Ayoade and Akintola, 1982; Oguntoyinbo and Akintola, 1983).

In spite of their predominance as a feature of tropical climate and the relevance of their many characteristics to land conservation and water resources management, only a few studies of rainstorms exist (Ayoade and Akintola, 1982; Oguntoyinbo and Akintola, 1983). These few studies have concentrated on two rainstorm characteristics, seasonality and variability. This is due to the fact that data on rainstorms are generally not available (Ayoade and Akintola, 1986). For the analysis of their spatial characteristics, a large number of such autographic raingauges is required over relatively small areas. The temporal as well as other non-spatial characteristics of rainstorms can, however, be studied through careful analysis of autographic rainfall charts at given locations (Walter, 1967; Ayoade, 1970; Jackson, 1977; Walsh and Lawler, 1981; Oyebande, 1982; Ayoade and Akintola, 1982; Oguntoyinbo and Akintola, 1983; Sekoni, 1992, Chin, 2007; Indrani, 2009; Omogbai, 2010; Kundzewicz, 2012; Audu et al., 2013; Terranova and Gariano, 2014; Oreste et al., 2015 and Zhang and Changhe, 2016).

However, the existing literature suggests that rainstorm characteristics are very important, although they can pose problems if not seriously considered (Ayoade, 2012). When rainstorm characteristics, such as rainfall amount and duration of storms, occur in excess, they become a hazard to the people and farmers in particular. When rainstorms occur in high intensity and long duration, they cause havoc rather than good (Singh, 2002b; Kaixi et al., 2016). Continuous rainstorm events can produce more run-off than single and separated events with significantly higher precipitation depths (Indrani, 2009; Jin, 2009; Kundzewicz, 2012; Audu et al., 2013; Keggenhoff et al., 2014 and Zhihe et al., 2015).

The present study therefore differs from existing studies on rainstorms in Nigeria and other West African countries in that an attempt is being made in this work to analyse the variations in the areal coverage of rainstorms in Ibadan metropolis, Nigeria. The need to undertake a detailed comparative analysis of the areal coverage of rainstorms over Ibadan metropolis become evident as this will provide a better understanding of the magnitude and character of the areal coverage of tropical rainfall over urban areas.

Justification of the Study

The humid tropical environment is blessed with an abundant supply of rainstorms (Oguntoyinbo and Akintola, 1983; Audu et al., 2013; Dao and Hoang, 2016). Rainstorms provide rainfall for a variety of natural and anthropogenic uses, from groundwater and stream recharge to water for domestic uses.

In the tropics, the distribution characteristics and variability of rainstorms are extremely vital. Rainstorms are primary features of the climate over areas in the tropical sub-region of the world and they occur variably over space and time (Kane, 2000; Gbuyiro, 2002; Jin, 2009; Audu et al., 2013 and Ivana et al., 2016). This contributes to the high variability of rainfall that is characteristic of tropical areas. However, a proper understanding of the magnitude of areal coverage of rainstorms aids proper planning and physical development. Flooding, damage to infrastructure and amenities, water issues and agricultural difficulties could arise if a proper understanding of rainstorms magnitude is not achieved before man undertakes any endeavour.

In general, several authors have written on rainstorm pattern, rainstorm characteristics and their implications for human welfare (Jackson, 1977; Walsh and Lawler, 1981; Oguntoyinbo, 1982; Ayoade and Akintola, 1986; Sumner, 1988; Sekoni, 1992; Adefolalu, 2001; Kundzewicz, 2012; Ayoade, 2012; Audu et al., 2013; Keggenhoff et al., 2014; Zhihe et al., 2015 and Ivana et al., 2016). These studies did not consider the variation in the magnitude of areal coverage of rainstorms. Studying the areal coverage of rainstorms is important for two reasons. First, it can aid forecasters in urban regions, both on the meteorological level as well as for local and regional climate modelling. Secondly, results from such analyses could potentially be used to inform urban planners in considerations, such as assigning appropriate zoning types for precipitation-enhanced regions.

Study Area

Ibadan is located approximately on latitude 7° 22□ N and longitude 30° 58□ E of the Greenwich Meridian. Nevertheless, the expanse of land normally referred to as the metropolitan (urban) area lies in the portion lying between latitudes 7° 15□ and 7° 30□ North of the Equator; and longitudes 3° 50□ and 3° 00□ East of the Greenwich Meridian. It covers an area about 450 km^2 (Figure 1). The area is in the vegetational transitional zone between the forest and savanna. The area experiences two seasons, the dry and the wet.

The onset of the wet season is estimated at 15 March within a two week variation period and 15 November as the tentative end of the wet season with the same level of variation (Oguntoyinbo and Akintola, 1983; Ayode, 2012). The area also experiences the double maxima rainfall regime with the characteristic break in August known as the "little dry season" (Ayoade and Akintola, 1986; Ayoade, 2012). The mean annual rainfall over the study area is about 1500 mm.

According to Ayoade and Akintola (1986), four seasons of rainfall events exist in Ibadan and they include, dry (November to February), early (March to April), rainy (May to August) and late (September to October) rainy seasons. More than 30% of annual rainfall is received during early rainy season. The study area experiences the double maxima rainfall regime characterized by two peaks, one in June and the other in September/October with a period of relatively lower rainfall in between (Figure 2). This period is often referred to as the 'little dry season'. The

mean monthly temperature is about 27°C (Figure 2). Hottest months coincide roughly with the movement of overhead sun. The first hottest months occur between March-April, while the second is between November-December (Ayoade and Akintola, 1986).

Data Base and Analysis

Data on areal coverage of rainstorms were recorded from five synoptic stations (A1-A5) and 45 improvised rainfall stations (B1-B45) in Ibadan (Adediran, 2017). Similarly, a 3x3 km grid was superimposed on the map of Ibadan metropolis and one raingauge was installed in each of the 50 resultant grids (Figure 2). The areal coverage of rainstorms equals to the area covered by the rainstorms as observed by the recording raingauges (Adediran, 2017). This was calculated using measurement of area of irregular shapes (square method). The values obtained were expressed in square kilometre (km^2) (Summer, 1988 and Ayoade, 2008).

The statistical methods employed for this study were descriptive methods and paired samples *t*-test statistics, respectively. The descriptive statistical method was used to summarize the observed areal coverage of rainstorms data collected, while the analytical method was used to draw inferences within a known degree of accuracy regarding the weather data under analysis and the distribution of each of the areal coverage of rainstorms. The interpretation of the result of the descriptive statistics was done based on percentages as well as absolute values. The data recorded for the period of the study were aggregated, examined and analysed. Data collected were analysed using paired samples *t*-test statistics at $p \leq 0.05$. This was done to determine the difference between the areal coverage of rainstorms at two separate seasons in Ibadan and determine whether or not one period is significantly had wider areal coverage of rainstorms than the other (Adediran, 2017; Ayoade, 2008). The paired samples *t*-test statistics, expressed as:

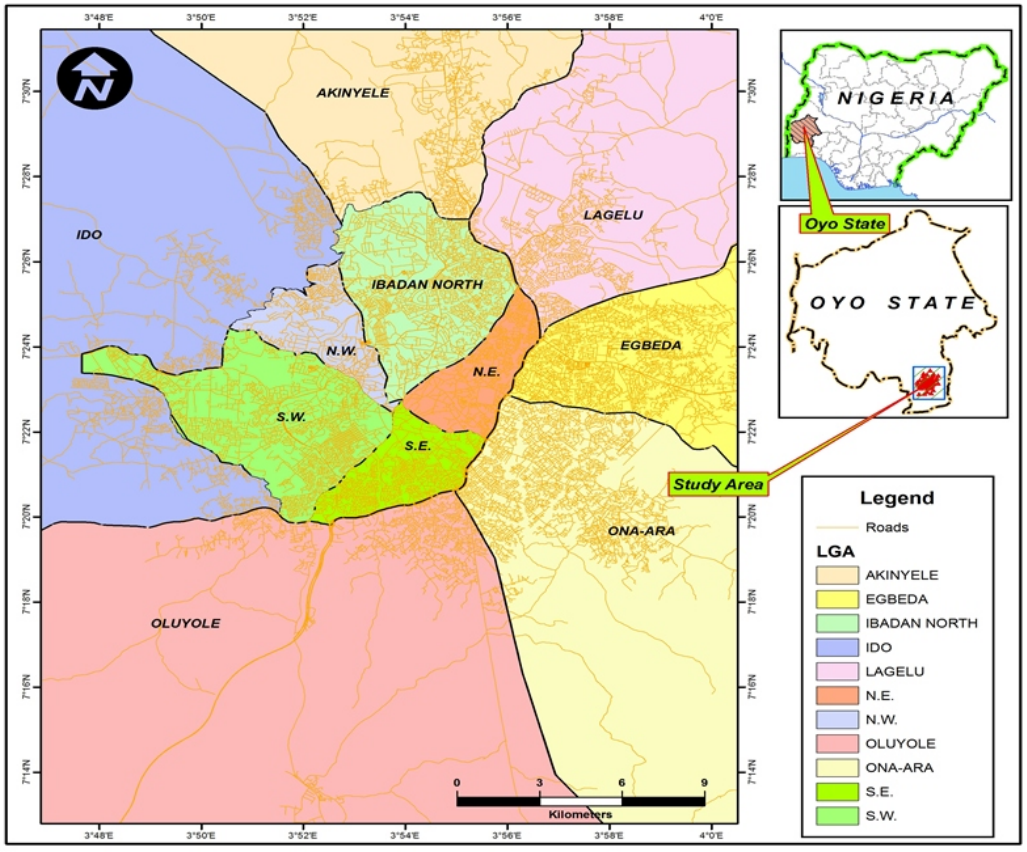


Figure 1: The Study Area

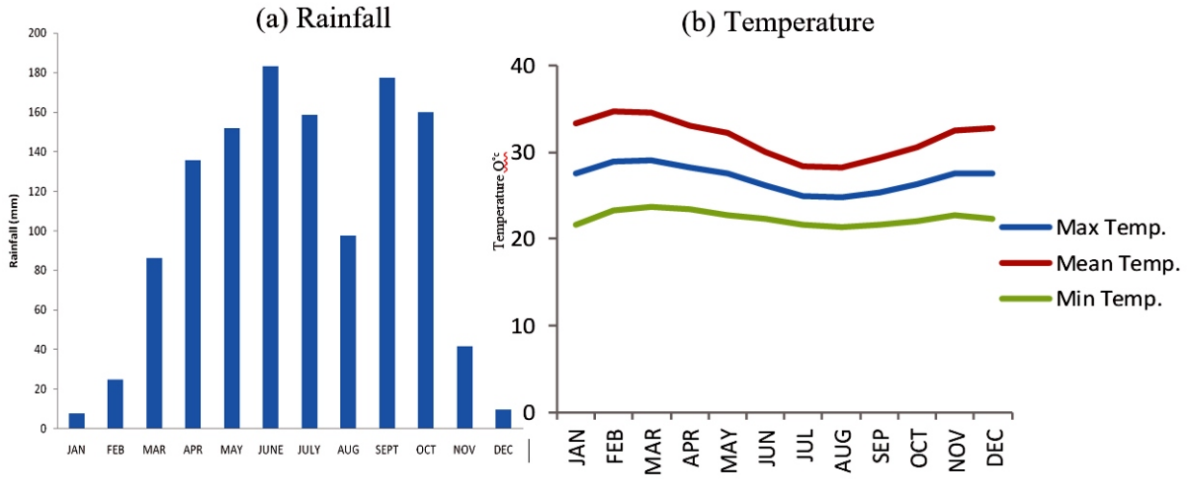


Figure 2: Monthly Distribution of Rainfall & Temperature at Ibadan (1981-2012)
Source: *NIMET Lagos Synoptic Station Report, 2012*

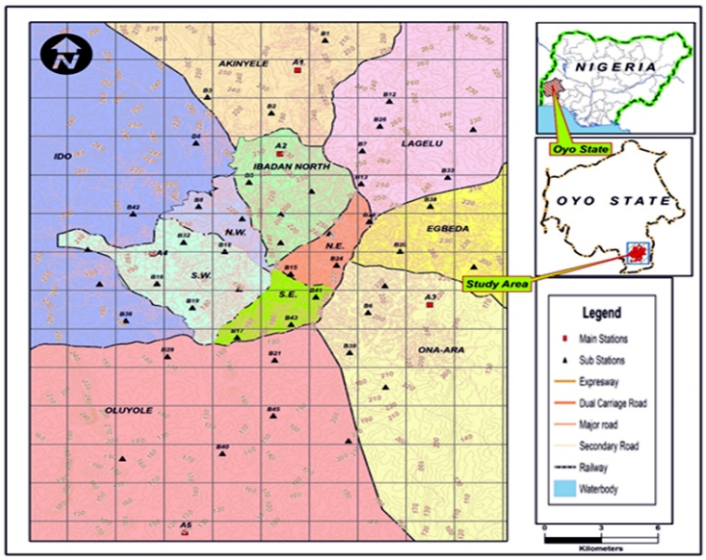


Figure 2b: Location of the rainfall stations in the city of Ibadan

$$t = \frac{|\bar{a} - \bar{b}|}{\sqrt{\frac{\sigma a^2}{n_a} + \frac{\sigma b^2}{n_b}}} \quad (1)$$

where (a) is mean of the areal coverage of rainstorms during early rainy season, (b) represents mean of the areal coverage of rainstorms during late rainy season, (σ) is standard deviation, (n) represents number of observations.

Results

Temporal Pattern of Areal Coverage of Rainstorms in Ibadan

Of the total areal coverage rainstorm events studied, 14% occurred during dry; 21% during early rainy; 33% during rainy and 32% during late rainy seasons. The areal coverage of rainstorms during dry season showed a range and mean value of 310 and 133.6, respectively. The standard deviation was put at 110 (Table 1). During early rainy season, the range value of areal coverage of rainstorms was 412.7. The mean and standard deviations were 210 and 136. In the rainy period, the areal coverage of rainstorms showed a range of 310 with a mean value of 133. The standard deviation was computed as 70. Besides, during late rainy season, the areal coverage of rainstorms showed a range of 364. The mean value was 203. The standard deviation was put at 109. The coefficient of variation of the dry, early, rainy and late rainy seasons values were put at 55.2%, 78.0%, 67.6% and 63.4%, respectively (Table 1). The results

showed that there was temporal variability in the areal coverage of rainstorms during dry, early, rainy and late rainy seasons in Ibadan (Olaniran et al., 2001; Sekoni, 1992).

However, Figure 3 depicts the frequency distribution of the areal coverage of rainstorms during dry, early, rainy and late rainy seasons in Ibadan. As evident in the total data, 36.4% of the areal coverage of rainstorms measured less than 50.0 km^2, 18.2% measured between 50.0 and 100.0 km^2, 9.0% measured between 100.0 and 200.0 km^2, while 36.4% measured between 200.0 km^2 and above during dry season. Besides, 9.3% of the areal coverage of rainstorms measured less than 50.0 km^2, 18.8% measured between 50.0 and 100.0 km^2, 25.0% measured between 100.0 and 200.0 km^2, while 46.9% measured between 200.0 km^2 and above during early rainy season (Figure 3).

More so, 7.8% of the areal coverage of rainstorms measured less than 50.0 km^2, 33.4% measured between 50.0 and 100.0 km^2, 43.1% measured between 100.0 and 200.0 km^2, while 15.7% measured between 200.0 km^2 and above during rainy season. In addition, 4.1% of the areal coverage of rainstorms measured less than 50.0 km^2, 18.4% measured between 50.0 and 100.0 km^2, 34.7% measured between 100.0 and 200.0 km^2, while 42.8% measured between 200.0 km^2 and above during late rainy season (Figure 3).

Distribution Pattern of the Areal Coverage of Rainstorms

The pattern of the areal coverage of rainstorms events in during this period exhibited four distinct patterns (Figure 4). One during dry season months; two, during early rainy season months; three, during main rainy season months and four, during late rainy season months. Generally, the rainy phases during the "dry season rains" began in February and ended in November. On the western part, the rains set in slightly earlier, to the east, in the area around Alakia area, a bit later, which means about the first week of February. The same held true for the northeastern part of the city (Figure 4). The rainy phases and the areal coverage of rainstorms shared similar patterns during the dry season months.

The pattern of the areal coverage of rainstorms

Table 1: Descriptive Statistics of Areal Coverage of Rainstorms in Ibadan

Season of Areal coverage	N	Range	Mean	Std. Deviation	Coefficients of variation (%)
Dry	22	310.00	133.6909	110.98360	55.2
Early	32	412.70	210.3344	136.21610	78.0
Rainy	51	310.80	133.2784	70.95832	67.6
Late	49	364.10	203.5796	109.18756	63.4
Valid N (listwise)	22				

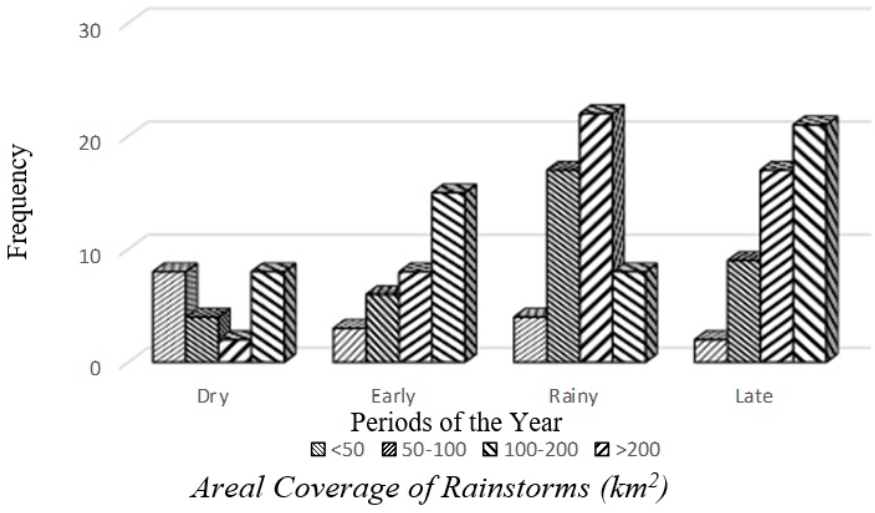
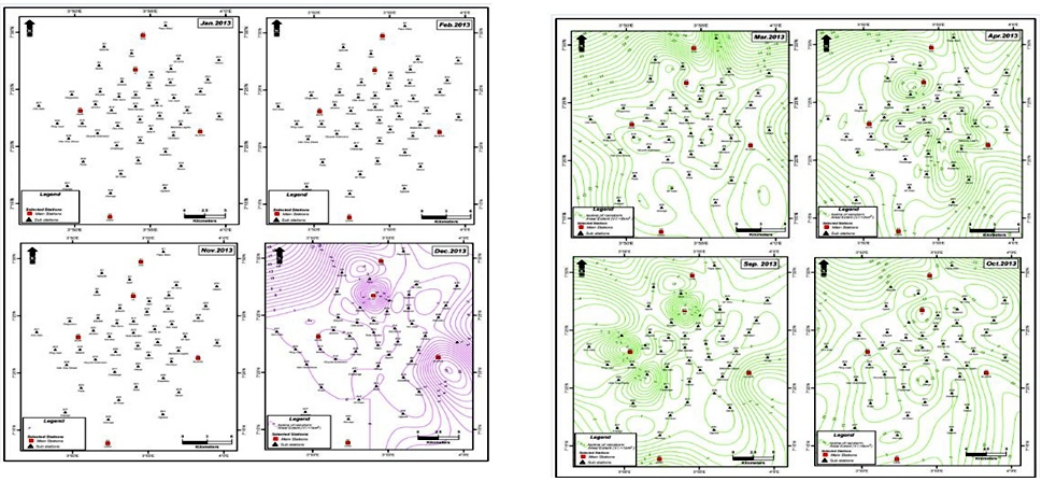
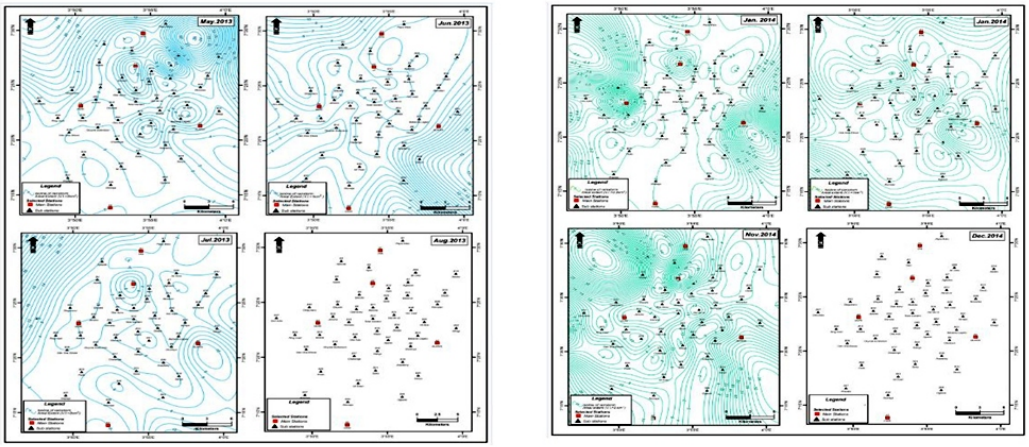


Figure 3: Areal Coverage of Rainstorms at different periods in Ibadan

(a) Dry Season



(b) Early & Late Rainy Season



(c) Rainy Season

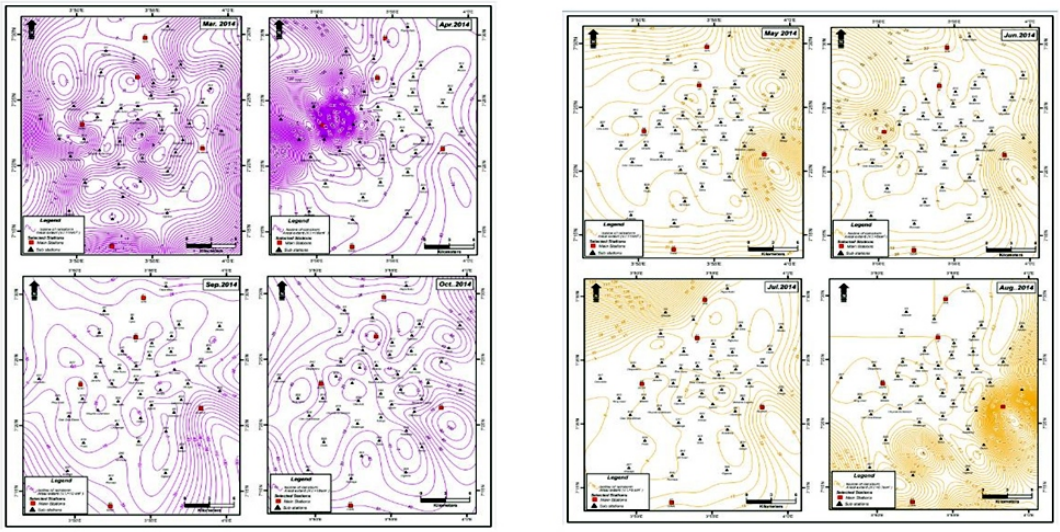


Figure 4: Distribution Pattern of the Areal Coverage of Rainstorms at different Periods (a-c)

relatively increased during early rainy season, as a result of the prevailing moisture-laden maritime airmass over the city. During this period, the highest areal coverage of rainstorm events was recorded in April, as 426.4 km^2 (about 82.7% of the total area) followed by 313.4 km^2 (60.8%) in March (Figure 4). Besides, during rainy season, the areal coverage of rainstorms was highest in the area around Alakia area and east of the city, here the figure stood at 54.7 km^2 (about 12.1% of the total area) (Figure 4). Towards the south, west and north, areal coverage of rainstorm events decreased rapidly. The central axis showed areal coverage of rainstorm events about 100 km^2 (about 22.2% of the total areal) (Figure 4).

By the late rainy season, the areal coverage of rainstorms changed and there was almost a northwest-and-southeast pattern. The areal coverage of rainstorms again decreased from the southern section to the northern section of the study area. Generally, during late rainy season, the highest areal coverage of rainstorm events was recorded in October as 389.6 km^2 (about 75.6% of the total area) followed by 364.0 km^2 (70.6%) in September (Figure 4).

Comparison of Areal Coverage of Rainstorms during Early and Late Rainy seasons

This section is aimed at comparing the areal coverage of rainstorms examined in this study during early and late rainy seasons in Ibadan. The analysis of two-independent sample comparison of means of areal coverage of rainstorms between the early and late rainy seasons was done using paired sample *t*-test method. Paired sample *t*-test method was adopted due to inequality in the total number of observations of the areal coverage of rainstorms during early and late rainy seasons. The summary of the result is shown in Table 2. The results of the analysis of the differences between the mean of areal coverage of rainstorms between the early and the late rainy seasons (Table 2) revealed that there was no significant difference in the speed of rainstorms during the early and the late rainy seasons, with calculated T-value of 2.75, which was less than the T-critical value of 2.06 at 0.05 confidence level. This result means that the areal coverage of rainstorms between both the early and the late rainy seasons did not vary significantly.

Discussion

The study revealed some features about the urban climatology of Ibadan with respect to areal coverage of rainstorms. Of the 154 areal coverage of rainstorm events recorded, 32 and 49 (about 21% and 32%) of the areal coverage of rainstorms were recorded during early and late rainy periods, respectively. The average areal coverage per storm were about 210.3 and 203.5 km^2 during early and late rainy seasons. This result supported the findings of Huff and Changnon, 1971, Grimmond et al., 1998 and Arnfield, 2003. The pattern of the areal coverage of rainstorms relatively increased during early rainy season, as a result of the prevailing moisture-laden maritime airmass over the city. Generally, during this period, the highest areal coverage of rainstorm events was recorded in April, as 426.4 km^2 (about 82.7% of the total area) followed by 313.4 km^2 (60.8%) in March.

By the late rainy season, the areal coverage of rainstorms changed and there was almost a northwest-and-southeast pattern. The areal coverage of rainstorms again decreased from the southern section to the northern section of the study area. Generally, during the late rainy season, the highest areal coverage of rainstorm events was recorded in October as 389.6 km^2 (about 75.6% of the total area) followed by 364.0 km^2 (70.6%) in September. It can be deduced from these results that there is seasonal variation in the pattern of the areal coverage of rainstorms over Ibadan during early and late rainy seasons.

Table 2: Summary of the Analysis of T-Test for Two-Independent-Sample Comparison of the Areal Coverage of Rainstorms between the Early and the Late Rainy Seasons

Season	T-cal	T-critical	Level of significance
Early and late rainy	2.75	2.06	Not significant at 0.05 level

The implication of these variations in the pattern of the areal coverage of rainstorms over the city of Ibadan is that the rainstorm events associated with the highest areal coverage prevailed over the city during early rainy period especially, while those with lowest areal coverage prevailed over the city during late rainy period. The rainstorm events associated with highest areal coverage covered a large area while those with lowest areal coverage covered only a small area. However, the seasonal variations in the areal coverage of rainstorms during early and late rainy periods could be attributed to the climate change phenomenon.

Conclusion

The study also revealed that the AC of rainstorms varied over the city of Ibadan. The result showed that there were temporal variability in the areal coverage of rainstorms during dry, early, rainy and late rainy seasons. The statistical result showed that there was no significant difference between the areal coverage of rainstorms during early and late rainy seasons in Ibadan. This result means that the areal coverage of rainstorms between the early and late rainy seasons did not varied significantly. These findings are in consonance with studies conducted by Huff and Changnon (1971), Grimmond et al. (1998) and Arnfield (2003). The results from this study could potentially be used to inform urban planners in considerations, such as assigning appropriate zoning types for precipitation-enhanced regions as well as used in establishing guidelines for the use of rainwater in agriculture.

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THE EFFECTS OF HEAVY METALS DISCHARGED INTO RIVER KADUNA ON THE QUALITY OF IRRIGATED FARMLANDS AT KADUNA METROPOLIS, KADUNA STATE

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Abstract

The farmlands along River Kaduna used for irrigation farming, suffer enormous pollution as a result of addition of water from the River Kaduna that had become contaminated. The study determines the concentration of selected heavy metals of the surface waters, the soil physico-chemical characteristics of the irrigated farmlands and examines the implications of the surface water pollution on the soils of farmlands used for irrigation along River Kaduna. The water samples were collected using grab method along River Kaduna at five points – Bypass, Barnawa, Down quarters, Kakuri-Makera drains and Kudendan at rainy season and dry season. Soil samples were also collected at the irrigated farmlands alongside the points. The water samples were taken to the laboratory and analyzed for Cr, Ag, Fe, Cu, Be, Al, Cd, Cyanide and Zn using Atomic Absorption Spectrophotometer and the soil samples were analyzed for pH, EC, OC, N, Ammonia, P, K, Ca, Na, Mg, Fe, Cu, Zn and Al. The concentrations of the parameters were observed to be higher than WHO acceptable limits. This revealed that the soils have become contaminated by heavy metals discharged into the farmlands from the River Kaduna and may cause serious ecological and health hazards. The paper recommends that there should be proper monitoring of effluents and there is the need for mass education of people on the impact of indiscriminate waste discharge on the water quality.

Keywords: Heavy metals, Pollution, Farmlands, Industrial wastes, Effluents.

Introduction

Heavy metals are among the major contaminants of food supply and are considered as problem to the environment (Zaidi, Asrar and Farooqu, 2005). Heavy metals contamination may occur due to irrigation with contaminated water, the addition of fertilizers, metal-based pesticides, industrial emissions, transportation, harvesting process and storage. Advancement in technology has led to high levels of industrialization leading to the discharge of effluents bearing heavy metals into our environment. The various activities by man in recent years have increased the quantity and distribution of these heavy metals in the atmosphere, land and water bodies (Zaidi et al., 2005). Human exposures to heavy metals occur primarily through inhalation of air and ingestion of food and water. The concentration of these metals in the environment varies considerably depending in the soil concentration and proximity to sources of emission (Muchuweti, Biekett, Chiyanga, Scrimshaw and Lester, 2006).

Excessive accumulation of heavy metals in agricultural soil through wastewater irrigation may not only result in soil contamination but also lead to elevated heavy metal up take by crops and thus affect food quality and safety (Muchuweti et al., 2006). Heavy metal accumulation in soil and plants is of increasing concern because of the potential human health risk. This food chain contamination is one of the important pathways for the entry of these toxic pollutants into the human body. Heavy metal accumulation in plant depend upon plant species and soil to plant transfer factors of the metal (Rattan, Dattan, Chhonkar, Shuribabu, and Sigh, 2005).

There are many sources of trace metals contaminants that can be accumulated in soils. Lead, nickel and

boron are gasoline additives that are released into the atmosphere and carried to the soil through rain and snow (Igwe, Ogunewa and Abia, 2005).

Farmlands were irrigated with water from Kaduna River and drainages within Kaduna Metropolis. For the past decades, water from these rivers was clean, however, with the increase in urban population and industrialization it now becomes contaminated with various pollutants among which are heavy metals (Igwe et al., 2005).

River Kaduna is a major source of water supply to the Kaduna city. The river basin is a booming crop farming area in both dry and raining seasons. The bank of River Kaduna is predominantly used for peasant vegetable crop farming of lettuce, cabbage and dry season fresh corns. Fertilizers, herbicides and insecticides are used on these crops – and are eventually washed into the river. Most of the industries (textile factories, NNPC Refinery and Peugeot Automobile Assembly Plants among others) located in the southern part of the city derive their water requirements from the river and discharge their wastes directly into the river (Federal Ministry of Environment, 2002). Trade wastes (from auto-mechanics, metal fabrication/finishing and abattoirs among others) are also directly or indirectly discharged into the river. Domestic sewage and refuse also found their way into the river from many settlements along the river via leaching, direct discharge. These suggest that there is every possibility of contamination of water, sediments and fish of River Kaduna by heavy metals since industrial effluents and municipal wastes are known to contain high amounts of heavy metals (Federal Ministry of Environment, 2002).

It has been demonstrated by Ali, Oniye, Balarabe and Auta (2005) that the use of industrial effluents and wastewaters for growing of crops have serious impacts in contamination of soils by heavy metals. A number of research have been carried out on the concentration of heavy metals of certain crops around the Makera Drain (Ali et al., 2005; Dadi-Mamud, Oniye, Balarabe, M.L, Auta and Gudugi 2011; Etonihu and Lawal, 2011), but none have considered the effects of heavy metal from the river on the irrigated farmlands along river Kaduna.

The aim of the paper is to examine the concentration of some of the River Kaduna heavy metal pollutants and the effects on the irrigated farmlands. The study determines the concentration of the heavy metals of the surface water of River Kaduna, the soil physico-chemical characteristics of the irrigated farmlands and examines the implications of the surface water pollution on the soils of the irrigated farmlands along the River Kaduna.

The study area

Kaduna Metropolis has a total land area of about 3,080km^2. It is located between Latitudes 10^0 52' and 10^0 30'N and Longitudes 7^0 15' and 7^0 45' east, (Figure 1)

The area is situated on a relatively low plain liable to flood (Bureau for Land and Survey Kaduna, 2010). The topography of the area consists of a rolling park-like terrain with little relief situated about 100ft (33m) above sea level (Adetola, 2000). The soils of the study area fall within the tropical ferruginous soils. The topsoil is coarse sandy loamy to clay loamy (Adetola 2000). The area was initially characterized by over 80% agricultural land-use. However, owing to the petroleum industry, the land-use pattern is fast changing.

The climate of the study area is part of the tropical wet and dry climate of Nigeria. The climate is characterized by the wet and dry seasons. The wet season begins in April and ends in October. Though, there are fluctuations in the beginning and the ending of the seasons from year to year in some years it begins early May (Adetola, 2000). The area has a mean annual rainfall of about 1204 to 1567mm, mean daily temperatures of between 27^{0}C and 33^{0}C, and relative humidity of about 99% during the wet season and less than 55% in the dry season (Adetola, 2000).

The river Kaduna took its source from Jos Plateau. The river divides the Kaduna metropolis into two major areas, thus: Kaduna north and Kaduna south. The north houses mostly the commercial centers, residences and business activities and the south is mostly the industrial area.

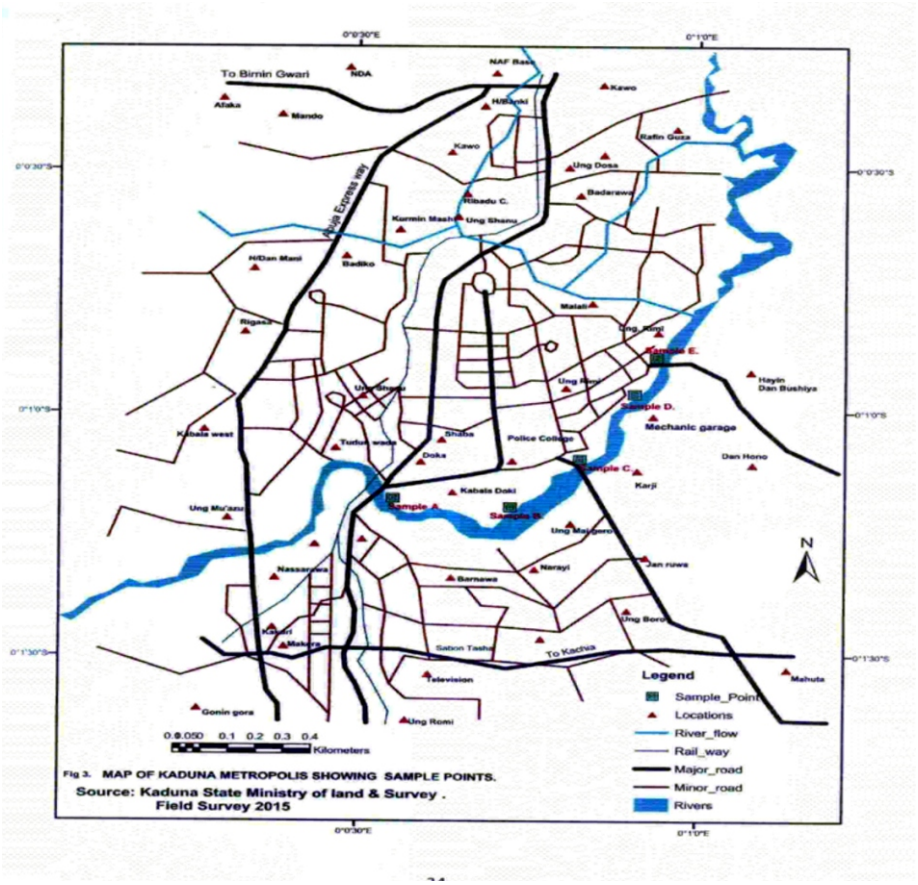


Fig. 3. MAP OF KADUNA METROPOLIS SHOWING SAMPLE POINTS.
Source: Kaduna State Ministry of land & Survey .
Field Survey 2015

Fig. 1: Map of Kaduna Metropolis showing sample points

Materials and methods

Water samples collection

For this research, five water sampling points were chosen along the river Kaduna. The surface water samples were collected at the mid-stream using grab method. The collections were done at the depth of 20 - 30cm directly into clean 1 litre plastic bottles at the intervals of two kilometers each. The samples were marked A, B, C, D and E. The samples were collected for two seasons (rainy and dry). The first samples were collected on the 25th of July and 3th August, 2015 when the volume of the water had increase in the rainy season. The same procedure of collection of samples was repeated on 28th February and 3rd of March, 2015 when the volume of the water had reduced during the peak of dry season. Sample **A** was collected along the Kaduna eastern by-pass, sample **B** at Barnawa area, sample **C** was collected at Down quarters, sample **D** was collected at Kakuri – Makera drains and the last sample **E** was collected at downstream of Kaduna river at Kudedan. The samples were immediately taken to the Kaduna State Water Board laboratory for analysis.

Soil samples collection

Five soil samples were also collected at the irrigated farmlands alongside the points of water samples collected along the River Kaduna. The collections were done at the depth of 30cm using Auger at a distance of 40meters from the river bank. The samples were marked A, B, C, D and E and were taken to the Institute of Agricultural Research, Zaria for analysis.

Water samples analysis

The collected samples were analyzed for Lead (Pb) Chromium (Cr) Arsenic (As) Iron (Fe), copper (Cu), Berium (Be), Aluminium (Al), Cadmium (Cd), Cyanide and zinc (Zn) which are considered as those very critical for water quality. The Atomic Absorption Spectroscopy (AAS) method was employed in the analyses of the parameters. The results of the analysis were compared with the World Health Organization (WHO) Water Quality Standard.

Soil samples analysis

In carrying out the soil analyses, emphasis was placed on those soil properties directly affecting soil quality and served as the support pillar for plants survival. The parameters analyzed were pH, Electrical conductivity, Organic Matter, Nitrate, Ammonia, Phosphorus, Potassium, Magnesium, Calcium, Sodium, Copper, Zinc and Iron. The pH was determined using pH meter and for nitrate and phosphorus Iceldak method was adopted. The Atomic Absorption Spectroscopy (AAS) method was employed in the analyses of the heavy metal parameters. The results were plot in Bar graph using FEPA recommended Standard as control parameter to compare the concentration level of the observed parameters.

Results

Water sample results of the rainy season heavy metals of River Kaduna

The result shows that the concentration of Chromium at all the observed points A, B, C, D and E are above the standard limit of WHO. At point A, the value of Chromium was 144mg/l, 1.65mg/l, at B and at C is 1.55mg/l. The value increases at point D and E to 3.72mg/l and 3.69mg/l respectively due to the addition of metal content from the industrial wastes. The lowest value (144mg/l) was recorded in sample A.

The results of Iron obtained during the rainy season indicate that the values show a progressive increase from point A with the values of 0.976mg/l and 0.986mg/l at point C. The Samples D and E also shows a sharp increase of 5.20mg/l and 2.57mg/l at Makera-Kakuri drain and downstream respectively. All these values observed are above 0.3mg/l the limit standard of WHO. It was observed that the lowest value (0.97mg/l) was recorded in sample A and highest in sample D (5.20mg/l), with a mean of 2.14.

Copper values at points A, B and C as observed from the analysis are within the acceptable limit of 1.0mg/l of WHO standard. But at points D and E, the values were to 3.16mg/l and 1.22mg/l above the 1.0mg/l of WHO acceptable limit. The lowest value (0.502mg/l) was recorded in sample A and highest in sample D

Table 1: Rainy Season Water Samples Results along River Kaduna

Parameters	Point A (Bypass)	Point B (Barnawa)	Point C (D/qtrs.)	Point D (Kakuri - Makera Drains)	Point E (Kudedan)	WHO Standard
Chromium (mg/l)	1.44	1.65	1.55	3.72	3.69	0.1 mg/l
Iron(mg/l)	0.976	0.976	0.986	5.20	2.57	0.3 mg/l
Copper (mg/l)	0.502	0.502	0.614	3.16	1.22	1.0 mg/l
Zinc(mg/l)	0.408	0.427	0.434	2.32	1.19	1.0mg/l
Arsenic (mg/l)	0.448	0.467	0.765	2.59	1.01	0.5 mg/l
Lead(mg/l)	0.627	0.648	0.765	3.67	1.45	0.1 mg/l
Cyanide (mg/l)	0.0004	0.0014	0.009	0.007	0.006	0.1mg/l
Barium (mg/l)	3.01	3.2	3.2	8.1	7.89	0.1mg/l
Aluminium (mg/l)	0.15	0.37	0.37	0.14	0.9	0.1mg/l
Cadmium(mg/l)	0.002	0.002	0.03	0.2	0.01	0.01mg/l

Source: Authors, 2017

Table 2: Dry Season Water Samples Results along River Kaduna

Parameters	Point A (Bypass)	Point B (Barnawa)	Point C (D/qtrs.)	Point D (Kakuri - Makera Drains)	Point E (Kudedan)	WHO **Standard**
Chromium (mg/l)	1.94	1.76	1.75	3.97	3.96	0.1 mg/l
Iron(mg/l)	1.676	1.876	1.986	5.45	2.95	0.3 mg/l
Copper (mg/l)	0.704	0.704	0.714	3.61	1.42	1.0 mg/l
Zinc(mg/l)	0.218	0.627	0.644	2.43	1.20	1.0mg/l
Arsenic (mg/l)	0.648	0.967	0.965	2.99	1.13	0.5 mg/l
Lead(mg/l)	0.827	0.828	0.965	3.97	1.67	0.1 mg/l
Cyanide (mg/l)	0.0006	0.0016	0.011	0.009	0.008	0.1mg/l
Barium (mg/l)	3.42	3.42	3.14	8.10	7.89	0.1mg/l
Aluminium (mg/l)	0.15	0.77	0.77	0.97	0.92	0.1mg/l
Cadmium(mg/l)	0.00	0.004	0.04	0.3	0.11	0.01mg/l

Source: Authors, 2017

Table 3: Mean and Range (max. and min.) values of the Rainy Season Heavy Metals characteristics of the River Kaduna

Parameter	Rainy season	Dry season
Chromium mg/l	2.41(3.69-1.44=2.25)	2.68(3.97-1.75=2.22)
Iron mg/l	2.14(5.20-0.976=4.22)	2.79(5.45-1.68=3.77)
Copper mg/l	1.20(3.16-0502=2.66)	1.43(3.61-0.704=2.91)
Zinc mg/l	0.96(2.32-0.41=1.91)	0.91(2.43-0.218=2.22)
Arsenic mg/l	1.06(2.59-0.448=2.14)	1.34(2.99-0.648=2.34)
Lead mg/l	1.43(3.67-0.63=3.04)	1.65(3.97-0.827=3.14)
Cyanide mg/l	0.024(0.009-0.004=0.005)	0.006(0.011-0.006=0.006)
Barium mg/l	5.08(8.1-3.0=5.09)	5.19(8.10-3.14=0.01)
Aluminium mg/l	0.39(0.9-0.37=0.53)	0.72(0.97-0.15=0.82)
Cadmium mg/l	0.244(0.2-0.002=0.20)	0.091(0.11-0.004=0.11)

Source: Authors, 2017

The results of zinc obtained during the rainy season from the analysis indicate that the values at points A, B and C are within the accepted limit of 1.0mg/l of WHO standard. The values at points D and E did not conform to the standard of 1.00mg/l as stipulated by WHO. There is a sharp rise of 2.32mg/l and 1.19mg/l respectively. The lowest value (0.408mg/l) was recorded in sample A and highest in sample D (2.32mg/l),

The rainy season samples at points A, B, and C show that Arsenic parameter values are within the acceptable limit of WHO standard except at the point D and E where the values are 2.59mg/l and 1.01mg/l above the accepted limit of WHO.

As observed from the table, the values of Lead increases from point A, to the last point E where the values are above the acceptable limit of WHO standard of 0.1mg/l.

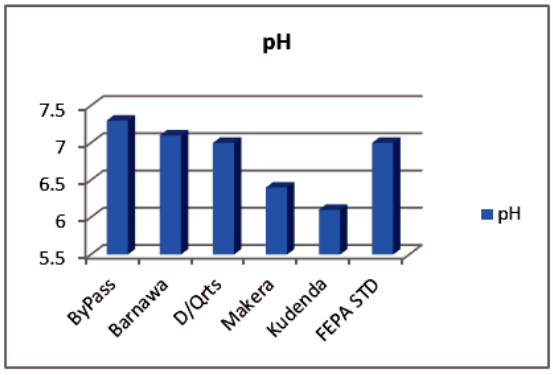
Cyanide, zinc, aluminum and copper with the exception of Iron, were observed to be low and are in agreement with FEPA standard. However their concentrations decreased both upstream and downstream from the discharge point.

Barium at sample point A was 3.01mg/l, point B 3.2mg/l, point C 3.2mg/l point D 8.1mg/l and point E recorded 7.89mg/l. the record observed is above the limit 0.1mg/l stipulated by FEPA. Aluminium was above the FEPA standard at all point of samples collected.

Cadmium was also observed to have the lowest value (0.002mg/l) recorded in sample A, B.

***Water sample results of the dry season heavy metals of river Kaduna*:**

The dry season sample results vary with the rainy season results because of the reduction in the volume of effluents discharged and the volume of water. It was observed that the results of the dry season water sample of River Kaduna in table1 shows a sharp increase in the concentration of the heavy metal parameters determined. The concentration of chromium in the river Kaduna is observed to be as high as 3.96mg/l at Kakuri – Makera drain and Kudenda above the permissible limit of WHO of 0.1mg/l. Other parameters observed such as iron, copper, zinc arsenic, lead, Barium Aluminium and Cadmium are highly concentrated in the water sample above the permissible values of WHO standard.



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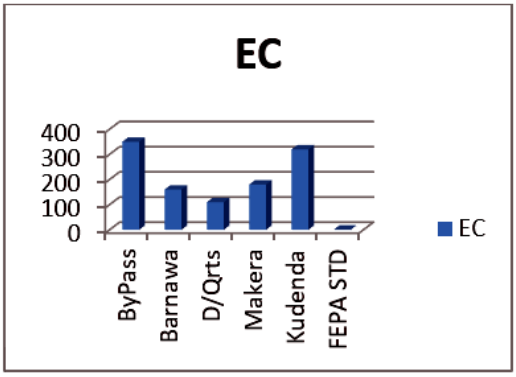

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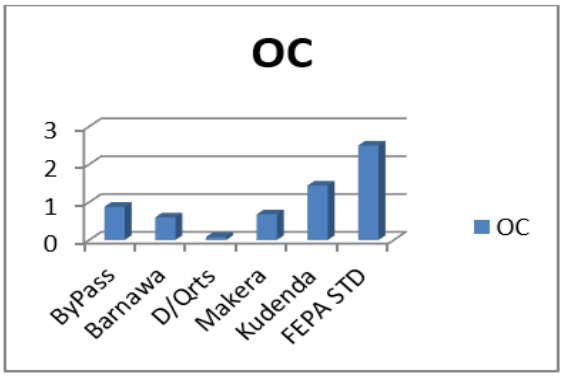
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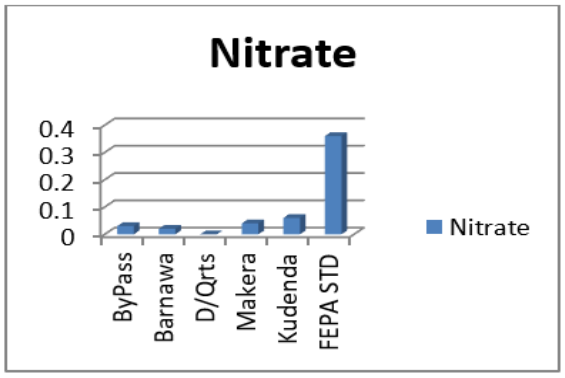
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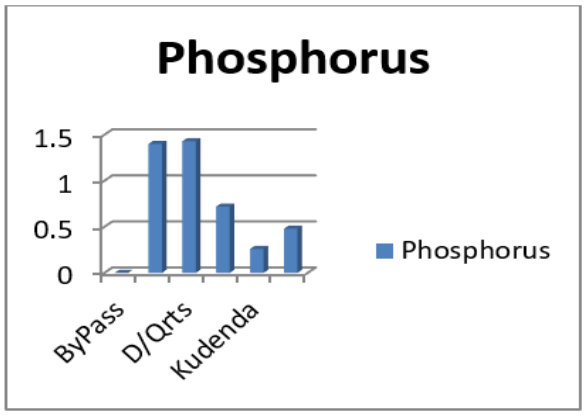
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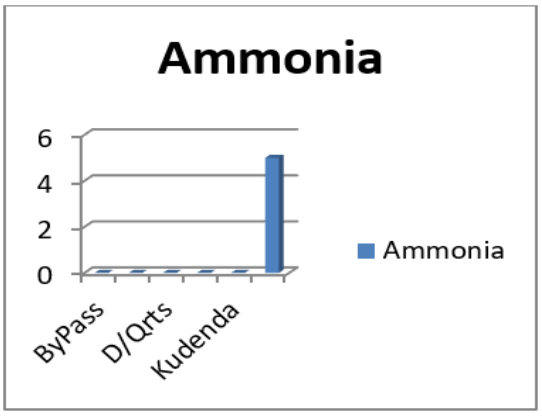
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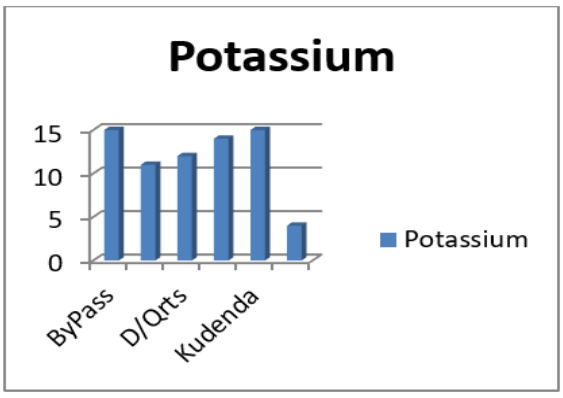
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Potassium

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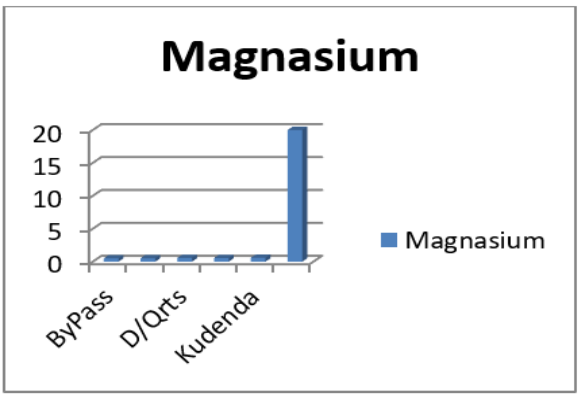
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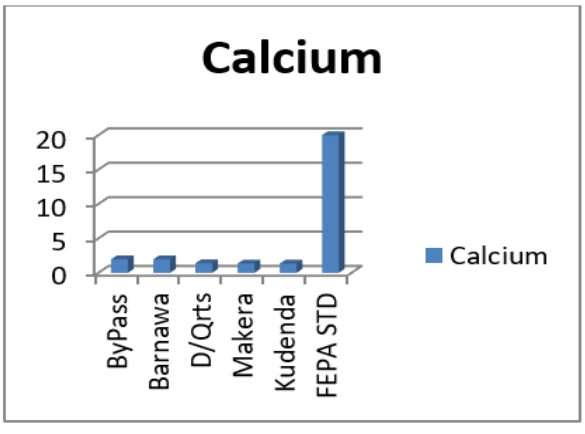
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Calcium

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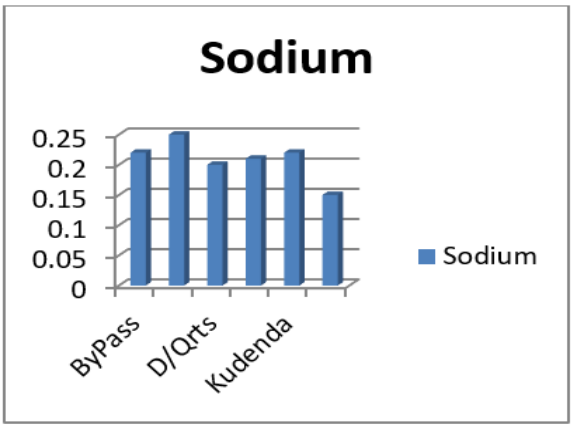
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Kudenda
Sodium

j

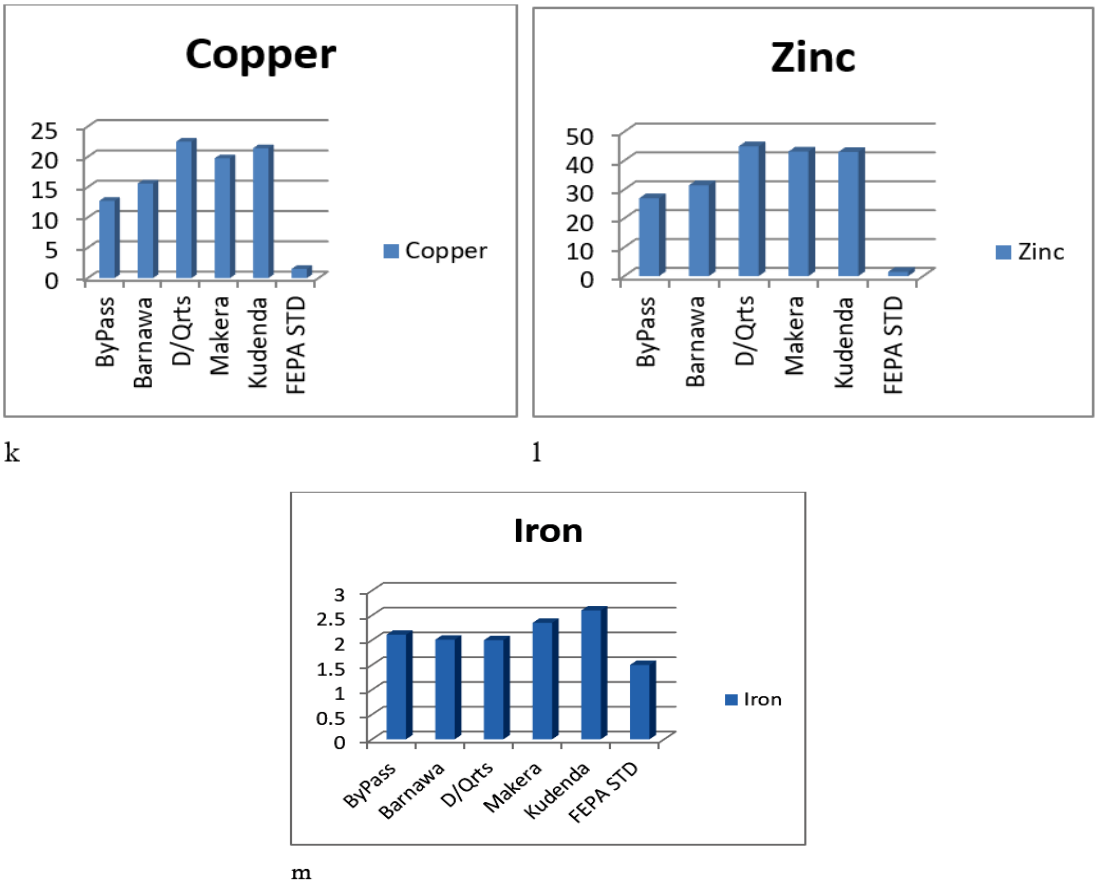

Fig. 2: Concentration values of soil parameters

Discussion

The results of the soils samples of the farmlands in figure 2 – 14 along river Kaduna used for irrigation have been revealed to be significantly altered. The quality of the soils may have been altered due to the addition of the water from the river used for irrigation over time.

From the results of the water samples parameters investigated in table 1, it shows that river Kaduna had become contaminated and its contaminants may be due to the content of the industrial and municipal effluents and waste discharges into the river. As observed the water samples parameters show that with the exception of Cyanide, the values of all other parameters were significantly higher. The dry season results values of all the parameters shows higher concentration than the rainy season due to the reduction in the volume of the water (Table 2)

As observed, the soils pH of the study area in figure 1 falls within the range of neutral to slightly acidic. It is indicative that the soil pH range was optimum for the most crops but with proper management. According to Yunana, Siaka and Danjuma (2014), soil with high acidity is detrimental not only to plants but also to other elements in the environment. An appreciable amount of micronutrients such as Zinc and Copper become toxic to plants

It was observed in figure 3 and 4, that the Organic carbon and Nitrate in the soils of the irrigated areas along river Kaduna is low. According to Yunana, et al, (2014), the slightly acidic values obtained in soils may affect the nitrifications and decomposition activities of the soils organisms. Hence, the effect is noticed in the low concentration of the organic and nitrate component of the soils. The mineralization of organic residues by bacteria and fungi, i.e. "microorganisms", releases inorganic nutrients such as nitrate, sulphate and phosphate that can then be utilized again by plants and other organisms. According to Purse glove, (1976), Nitrate seems to have the quickest and most pronounced effects on the yield of crops. It encourages the percentage of protein in the crops.

The micronutrients (Copper, Zinc and Iron) have been observed to exceed the permissible limits of FEPA standard. These micronutrients are needed in small quantity by the plants and therefore, if high in the soils they become harmful to the crops. Soil contamination by heavy metals is one of the problems threatening soil fertility and element cycling most seriously in many areas (Kandeler, Tscherko, Bruce, Stemmer, Hobbs, Bardgett, and Amelung, 2000). If present in sufficiently high concentrations, tend to reduce the size of the microbial populations, to destruct their community structure and to reduce their activity (Kandeleret al., 2000; Wang, Luo , Wei and Hua , (2004).

The results show that two of the exchangeable cations concentration (magnesium, and calcium) in the soils of irrigated farmland along river Kaduna is low. These elements are required in sufficiently large quantities for crops production because of the role they play in plant growth. For example, magnesium is an important constituent of chlorophyll and is needed in process of photosynthesis, while potassium encourages the developments of a strong fibrous root system. Similarly, calcium plays a role during photosynthesis process.

The results obtained in this study confirm the study carried out by Yunana *et al* (2014) who observed that the effluent discharge into the environment is detrimental to the farmers who cultivate the land by polluting the soils and creating certain conditions, which make essential nutrients, such as Nitrogen unavailable to the plants.

Conclusion and recommendation

The study has shown that the soil along river Kaduna used for irrigation have been revealed to be significantly altered due to the addition of the water from the river Kaduna over time. The used of the river for irrigation result to low nitrogen, phosphorus and increase the values of the Micronutrients in the soil. It is obvious that the river cannot be relied upon as a good source of water for irrigation. The farmers have been experiencing decline in crops outputs from their farmlands over the years. It is obvious the deteriorating crop outputs may be attributed to the nature of the water from river.

The study therefore, recommends that good soil management can improve the soil condition and build up soil fertility. The proportion of the organic matter can be increased by adding manure, compost and green materials.

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ASSESSMENT OF STRATEGIC PERI-URBAN STRUCTURE OF OJOO AND SASA AREAS OF IBADAN, NIGERIA

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Abstract

The study is an assessment of strategic peri-urban structure of Ojoo and Sasa areas of Ibadan. The study area was stratified into four zones namely; A, B, C and D according to distance from the municipal boundary with each zone 1,000m apart, purposely chosen to allow comparison of results. The first zone was 0-1000m from the municipal boundary. A set of 200 questionnaires was administered (50 in each of the four zones) while 180 duly filled were returned for computation. Descriptive statistic was used to analyse the administered questionnaire. The study showed that urban to peri-urban migration accounted for 59% of population growth in the area induced primarily by availability of cheap land and rental apartments. The Ojoo/Sasa peri-urban interface is an area of micro industries and center of informal enterprises mainly dominated by the self-employed. Infrastructure like road, waste disposal and sanitary facilities are inadequate while pipe borne water supply is generally unavailable. Development is noticed to be sprawling but diminishing the agricultural land of the peri-urban area. The study concludes that the pattern and rate of growth is unsustainable in view of infrastructure available to the increasing population. Therefore, planning intervention is considered necessary.

Keywords: Peri-Urban, Structure, Infrastructure, Ojoo/Sasa, Ibadan

Introduction

The process of making rural areas resemble urban ones and the diminishing geographic and civilizational distance between them entails an evolution in the perception of urban and rural areas as two opposite categories. Peri-urbanisation is a process of urban transformation that occurs in rural areas which are located in a catchment zone of urban forces and predisposed towards a multifunctional development (Idczak and Mrozik, 2016).

Peri-urbanisation affects areas under increasing pressure from urban centres that are commonly defined as a transitional zone between urbanised areas (densely built up areas) and rural areas dominated by agricultural activities. A sharp distinction between urban and rural settlements generally assumes that the livelihoods of the inhabitants can equally be reduced to two main categories: agriculture based in rural areas and manufacture and services based in the urban centers. However, this assumption bypasses the stage or phase between the two entities. These areas are characterized by a mixed land use and have indeterminate inner and outer formal boundaries. They usually cover territories split between different administrative areas (Webster and Muller, 2009). In a functional sense, they constitute a transitional (mixed) zone of urban and rural areas that on the one hand, strongly influenced by urban processes and on the other hand, characterized by the typical morphology of rural areas (Caruso, 2001). Gallent et al. (2006) noted that these areas are places where urban and rural changes are closely dependent and their main characteristics are land uses that are often "peculiar to the fringe".

Although peri-urban areas may be structurally and functionally different from urban and rural areas,

they are considered an inherent component of urbanisation (Butt, 2013). Their occurrence in the form of "areas of transition" is determined by the strong influence of large cities and more specifically by progressive urbanisation drives. The power of such forces is not limited to a city's administrative boundaries but covering a functional urban region.

In general, large cities are places from which new patterns of development spread to the surrounding areas as confirmed on the European scale by Kasanko et al. (2006) that the demographic and socio-economic growth over the last decades has put massive pressure on metropolitan areas. As a result, the traditional compact cities have expanded into adjacent rural areas. A remarkable feature of this process has been a variety of urban expansion patterns in both physical and functional terms.

Most developing countries in the sub-Sahara region experienced high rate of urbanization and rapid urban growth that was not catered for in the development plans of the government. The urbanization problems are particularly complex and daunting in Nigeria, with inadequate and ineffective development control and very rapid growth in urban population (UNICEF, 1998), running at an estimated average of 5.5% per annum in recent times. Ibadan has long been regarded as the largest city in Sub-Saharan Africa with a clear symbol of rapid but unbridled urbanization in Nigeria. The urban landscape in Ibadan had spread to 101.9km^2 by 1973 (Ayeni, 1982) and had significantly expanded to 209.4km^2 by 2000 (Oyinloye, 2003). With this phenomenal growth and uncontrolled urbanization in Ibadan, it is obvious that Ibadan cannot escape a few related problems that come in the form of unbridled peripheral expansion, poor infrastructures and other social vices of the time.

Moving away from the urban centers depicted, the peri-urban areas in most cases are bedevilled with inadequacy of life-support systems such as pipe-borne water, medical facilities and infrastructures such as roads, electricity and communication facilities. In all major cities in Nigeria, peri-urban areas have rapidly developed on the fringe of the urban centers and most of these peripheral development and growth has been as a result of individual initiative to subdivide land and construct structures ahead of any formal planning regulations (Lukman and Doyen, 2000).

The peri-urban area has become a 'no man's zone' as it is termed the 'rural area' by the urban municipalities and the rural authorities consider it 'urban' because of the change in the physical set-up. The town planning regulation which should be responsible for development control in urban areas have not been effectively and efficiently utilized for physical planning and management in these areas.

This study seeks to identify why the people settle in these areas, what influences their decision to stay in the area and to assess the spatial characteristics of the peri-urban areas. As the peri-urban interface will eventually become incorporated into the urban area, it is therefore imperative to understand the peri-urban development because their existence finally becomes a reality for the city to manage, coordinate and share resources with the newly incorporated areas.

Methodology

The study area

Ojoo and Sasa are among the numerous peri-urban districts of Ibadan. Initially, they were villages which over the years have grown and expanded to overall expansion of Ibadan-city proper. Ojoo and Sasa communities, which are the focus of the study, are located at the northern edge of Ibadan municipality, a linear form of settlement development on either side of the two highways that lead to the northern part of the country. Specifically, the study area lies within Latitudes 07^0 29' 30"N and 07^0 28' and Longitude 003^0 54'E and 003^0 55'E (See Fig. 1).

Historically, Ojoo and Sasa have been in existence since 1829 when Ibadan was founded but as a rural village. Like many other settlements around such as Ijaye, Iroko and Ikereku, Ojoo and Sasa were originally occupied by the Egbas who came there purposely to trade. But during the war between the Ibadan and the Egbas, the Egbas were defeated and as such the Egba residents of Ojoo and Sasa were sent away and the people of Ibadan occupied the place. However, the resettlement of people displaced from various villages by the establishment of International Institute of Tropical Agriculture (IITA), to the present location of Sasa can be said to be the first phase in the gradual urbanization and physical expansion of Sasa in particular.

With the gradual increase in the population of Ibadan City, physical development mainly in terms of housing extended in all directions into adjourning rural local government areas and to the study area and beyond which is some 15km away to the assumed center of the city of Ibadan (Mapo Hill). Gradually, the study area (Ojoo and Sasa) started growing and their spatial scope extended to gulp

nearby villages of Ikiye, Ewena, Jagun and Kajorepo among others. Ojoo and Sasa fall within the ambit of Akinyele Local Government Area, classified as a rural local government. However, these two communities have a level of development that surpasses what can be termed as rural and possessing more of urban characteristics. The proximity of Ojoo and Sasa- boundary settlements between Akinyele Local Government and Ibadan Northeast Local Government (an urban local government) has resulted into an urban development that actually frog-jumped to the current status.

The earlier head count of the area was lumped together with those of other settlements within the local government. With time, commercial activities in the area began to spread due to the strategic location of the area. With the increase of the commercial activities, people from far and near where attracted to the area to trade thereby increasing the population of the area. It is therefore not surprising seeing different tribes like the hausa, ibo, tiv, Idoma, among others in the area. According to National Population Commission, the whole Akinyele local government was 140,118 in 1991. It rose to 224,745 in 2006 and projected to 327,979 in 2018. The figure for Ojoo and Sasa were respectively 13,915 and 7,992 in 1991; 22,319 and 12,819 in 2006 and 32,571 and 18,707 in 2018. Together the population of Ojoo and Sasa added up to 51,278 inhabitants in 2018 based on the projected statistical estimate of the population using the 3.2% annual growth rate adopted by the national population commission.

Data collection and analysis

The study area was stratified into four zones namely; A, B, C and D according to distance from the municipal boundary with each zone 1,000m apart. This distance is an arbitrary one but purposely chosen to allow more classes for comparison of the results. The first, zone A was 0-1000m, zone B: 2,000m, zone C: 3,000m and zone D: 4,000m away respectively from the municipal boundary. A set of two hundred (200) questionnaire was administered 50 in each of the four zones. The respondents were adult male or female as the case may be in residential housing units. Field observation and visual interpretation were also used to capture data on the field to assess the standard and the nature of the infrastructure available. The criterion used was based on availability and non-availability. The infrastructure includes availability of services like: electricity, water, drainage and waste management facilities, accessibility network among others. The breakdown of the 180 satisfactorily answered questionnaires returned for computation in each of the four zones were 48, 42, 45, and 45 for zones A, B, C and D respectively. Descriptive statistic was used to analyse the administered questionnaire.

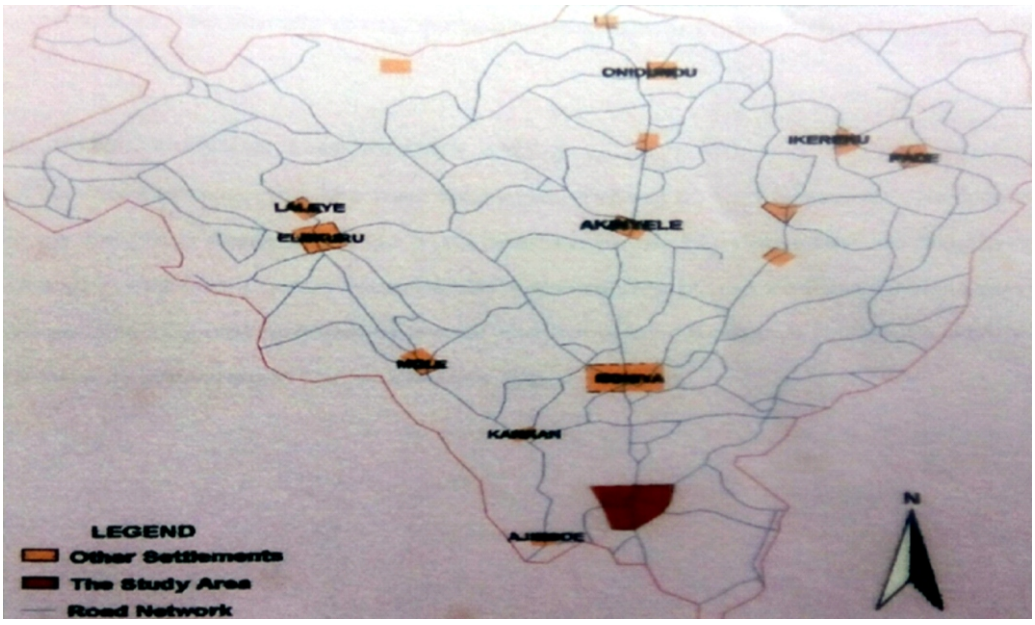

Fig. 1: Map of Ojoo/Sasa and the NeighboursScale 1 : 250,000

Results and Discussion

This section presents and discusses the results of the questionnaire administered to respondents in Ojoo/Sasa per-urban area. The spatial growth of unplanned settlements may be attributed to socio, economics and cultural behaviour of the population concerned. It may also be a reaction of external forces like regional and national socio-economic activities (Lin, 2000).

Gender of Respondents: Majority of the respondents (62.2%) are male while 37.8% are female as shown in Table 1. The sample population is dominated by male gender when compared with that of the female.

Table 1: Gender of Respondents

Sn	Item	Frequency	Percentage
i.	Male	112	62.2
ii.	Female	68	37.8
Total		180	100

Monthly income: Table 2 shows the distribution of monthly income of respondents in the study area. The income group of 20,000-30,000 toped the group with 25% and closely followed by income group of N10,000-20,000 (20%) while respondents with <N10,000 (10%) income group came last. There is variation of income levels between tenants and landlords. While the larger percentage of the tenants are in the less than N30,000 income category in a month the land lord lies on the income group of > N30,000.

Table 2: Income

Sn	Income category	Frequency	Percentage (%)
i.	<10,000	18	10.0
ii.	10,000-20,000	36	20.0
iii.	20,000-30,000	45	25.0
iv.	30,000-40,000	27	15.0
v.	40,000-50,000	25	13.9
vi.	>50,000	29	16.1
Total		180	100

Previous studies of peri-urban areas by Timothy (1995) suggests that a large proportion of the residents found in the area are low income migrants. But Browder et al (1995) however disputed this theory that peri-urban interface is a zone of low-income residents. In Ojoo/Sasathe peri-urban interface, though there are household from low income category (less than N10,000 per month), there are as well people with high income earners (more than N50,000). The finding of this study is in agreement with Oladotun (2005) and that of Browder's findings, of the peri-urban households in Jakarta, Indonesia and Santiago in Latin America. The increase in the number of luxurious properties in the peri-urban areas is another indication of some high-income settlers in the area. The assumption that peri-urban settlers are poor and cannot afford shelter in well-planned settlements cannot be applied to all cases of peri-urban growth. It therefore suggests that peri-urban residence did not settle in the area because of low income but there could be other reasons why people preferred the peri-urban area as majority of residents have stable jobs and resources.

Employment status: Table 3 showed an employment status of respondents. Self-employment is the main sources of living for most of the households in the peri-urban interface as 65% respondents derive their source of living on their own inform of engaging in artisanship, business and farming activities. However, there is equally a quite high rate of payed employment (35%). The level of employment varied with distance from the city boundary as showed in Table 3. More so, the rate of self-employment for the female respondents is higher than the male. This result conforms with the findings of Allen and Da-Silver (1999) who noted that peri-urban areas are areas of micro industries and center of informal enterprises and Oladotun (2005) who previously indicated that 33.53% of the peri-urban residence engaged in an informal sector while the majority derived their employment from internal enterprises in their immediate local environment and from Ibadan metropolis.

Browder et al 1995 says that not all peri-urban areas are functionally integrated with rural areas. In most cases, this integration is observed in the form of rural oriented activities (especially farming) that are occurring in the peri-urban environment. The residents of Ojoo/Sasa demonstrated that they integrated into the service, business and manufacturing sectors of the urban economy as opposed to the rural economy in the case of Kumasi, Ghana by Corubolo (1999).

Migration: The growth of peri-urban areas in most Sub-Saharan African cities consists of two migratory flows. Direct rural-urban (peri-urban) and urban to peri-urban migration. As a coping strategy towards poverty, rural people migrate to urban areas for employment and other income enhancing opportunities. Some of the rural migrants en route to

the urban areas are absorbed in the peri-urban and establish themselves in the peri-urban. As shown in Table 4, most of the respondents came from urban areas (58.9%), followed by those who came from the rural area (22.2%) while 15% settlers were bore in the area. There are seven respondents (3.9%) who migrated from another peri-urban area. Zone A which lies within 0-1,000m from the city boundary could be an entry point for most immigrants from the city because the percentage of urban responses is highest in this zone than any other zone. This finding is in agreement with Oladotun (2005), but in disagreement with Timothy's (1995) finding that rural-urban migration is the major contributor to peri-urban growth.

Residency duration: Usually, settlers arrive to a destination at different points in time. Table 5 shows the residency duration of respondents who settled in Ojoo/Sasa area which largely responsible for the growth of the areas. 28.3% respondents have been in the area from 16 to 20 years. This is closely followed by respondents who have settled there between 11 and 15 years with 26.1% while the least group of settlers (10.6%) are those who newly arrive between 0-5 years.

Reason for relocation: Table 6 shows the number respondents who indicated their reason for relocating to the present peri-urban area. 73 respondents (40.5%) were due to cheap housing, followed by 56 respondents (31.1%) who migrated there because of cheap land at the peri-urban area. The general picture obtained from the above is that intra-migration (migration from peri-urban to another peri-urban) and urban to peri-urban migration is related to land factors like affordability and cheap housing. From the interview held with landlords, they admitted that cheap land was the major reason for their migration to the peri-urban area while on the part of the tenants, the attractive force was the relatively cheaper housing obtainable in the area. There are tenants who moved from one zone to another zone in search for comfort, better and cheaper accommodation.

Table 3: Employment Status

Sn	Employment Status	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	Self Employed	27	56.3	26	61.9	34	75.6	30	66.7	117	65
ii.	Employed	21	43.7	16	38.1	11	24.4	15	33.3	63	35
Total		48	100	42	100	45	100	45	100	180	100

Table 4: Previous Location of Respondents

Sn	Previous Location	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	Urban Area	35	72.9	24	57.1	27	60.0	20	44.4	106	58.9
ii.	Rural Area	2	4.2	11	26.2	13	28.9	14	31.1	**40**	**22.2**
iii.	Peri-urban	-	-	2	4.8	2	4.4	3	6.7	7	3.9
iv.	Born in the Area	11	22.9	5	11.9	3	6.7	8	17.8	27	15.0
Total		48	100	42	100	45	100	45	100	180	100

Table 5: Residency Duration

Sn	Residency Duration	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	0-5 years	7	14.6	4	9.5	5	11.1	3	6.7	19	10.6
ii.	6-10 years	9	18.7	10	23.8	1	2.4	5	11.1	25	13.9
iii.	11-15 years	13	27.1	12	28.6	10	22.2	12	26.7	47	26.1
iv.	16-20 year	11	22.9	12	28.6	13	28.8	15	33.3	51	28.3
v.	>20 years	3	16.7	4	9.5	16	35.5	10	22.2	38	21.1
Total		48	100	42	100	45	100	45	100	180	100

Table 6: Reason for Relocation

Sn	Reason	Frequency	Percentage
i.	Better opportunity	20	11.1
ii.	Cheap housing	73	40.5
iii.	Avoiding urban congestion	18	10.1
iv.	Cheap land	56	31.1
v.	Employment	13	7.2
Total		180	100

Table 7: Ownership of House

Sn	Residency Duration	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	Landlord	17	35.4	16	38.1	15	33.3	20	44.4	68	37.8
ii.	Tenant	31	64.6	26	61.9	30	66.7	25	55.6	112	62.2
Total		48	100	42	100	45	100	48	100	180	100

Ownership of house: Majority of the respondents 62.2% are tenants while only 37.8% are landlords. The need for housing in the area is very high especially tenant housing. The demand for rental accommodation and the willingness to meet this need accounted for the current hike in the price of land acquisition in the area and consequently accommodation. The cost of land, though, is still cheaper at the peri-urban when comparing with what is obtainable at the Ibadan metropolis.

Family size: Most families in Ojoo and Sasa are extended families. In this study, a family of 3-4 persons is considered a 'small family', a family of 5-6 members is considered to be 'medium-size family' while a family of 7 members and above is considers as a 'large family'. From Table 8, the increasing order of the family size is; small family size (19.4%), medium family size (30.6%) and large family size (50%). This result contradicts the 38% (small), 47% (medium) and 15% (large) family sizes respectively obtained by Oladotun (2005). Household size for the study area ranged between 2-12 persons and the average family size is 6. Mabogunje (1968) argues that urbanization indirectly encourages the downsizing of the typically large Nigerian family. Urban families live in one house with a number of rooms or in a room (in the case of low income families living in an informal settlements) whereas in the rural areas a single family lives in a number of houses within homestead.

Table 8: Family Size

Sn	Size	Frequency	Percentage
i.	Small	90	19.4
ii.	Medium	55	30.6
iii.	Large	35	50.0
Total		180	100

Electricity supply: Ojoo and Sasa are connected to the national grid and the level of electricity supply is very high in the area. Findings from this study show that about 88% respondents are connected to electricity on a household level while only 12% are not due to one reason or the other (see Table 9). The study area is densely populated which means high demand for the supply of electricity. Promoting peri-urban electrification could be a win-win solution for utilities and poor consumers by preventing illegal connections through a well-planned electrification scheme. The absence of service roads or their poor state within settlements causes problems of easy reach to some of their clientele.

Table 9: Regularity of Electricity Supply

Sn	Electricity Supply	0–1000m		1000–2000m		2000-3000m		3000-4000m		**Ground Total**	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	**Freq.**	**%**
i.	Yes	46	95.8	38	90.5	39	8.7	35	77.8	**158**	**87.8**
ii.	No	2	4.2	4	9.5	6	13.3	10	22.2	**22**	**12.2**
Total		48	100	42	100	45	100	45	100	**180**	**100**

Transport: Ojoo and Sasa are accessible through Lagos-Ibadan expressway, Ibadan-Oyo highway and Ibadan-Iwate-Fiditi route. However, internal accessibi1ity within the peri-urban area is severely limited by the absence of planned and well-maintained local and service roads. Accessibility problem is well noticed especially in the raining season when some of the routes are not passable. Most of these roads are just single lane that started as footpaths leading to homestead and often they have dead ends. As indicated in Table 10, most of the households in the study area depend on public transport as attested by 57.2% respondents while 42.8% respondents have private means of mobility. It was also observed that the use of private transport increases with distance from the city boundary from approximately 25% at the 0-1,000m zone gradually to 50% at the 3,000-4,000m zone. This goes on to show that as settlement gets further away from the main city, the rate of public transport patronage decreases due to bad road and low patronage.

Water supply: Water is one of the major essential things in life. It is an essential resource needed for day-to-day activity of man in both rural and urban areas. Public water supply was never planned for the study area; hence the major source of water is from well. As shown in Table 11, only few houses derive their water through borehole which accounts for 20.6% while majority (72.4%) depend on well. Though all the houses do not have private wells but may be jointly owned or publicly sunk for their use. Acute water scarcity occurs in the area especially during the dry season when most of the wells dry up and only the boreholes are left functioning. Whenever this happens, residents have to move far distance to either fetch or buy water from water selling neighbour.

Drainage: Major parts of the study area lack drainage facility with the exception of the major roads that pass through the area which have good drainage system. Though water flows along natural depressions, however, water flow becomes a problem especially during the rainy season when most of the roads are gullied by strong water flows. Sewage from domestic wastewater originating from household waste is freely discharged on the ground surface without concern which may result in health hazard for people living in the area.

Solid Waste disposal: Solid waste disposal is a huge problem in peri-urban because there is a high prevalence of dumps. In Table, 67.8% respondents use waste container, followed by waste pit (14.4%), open dumps (12.2%) and others (5.6%) to dispose their solid wastes. Some of these methods of disposal are used in combination with other method like burning. In most cases, refuse is dumped on any vacant land found within the area. This form of unplanned dumping constitute an eyesore in any place where such is found. The situation is worsened in raining when the refuse is sometimes washed from the heaps to the streets. This finding is in tandem with Yakubu and Giwa (2006) who noted that the prominent habit in most peri-urban areas in Nigeria is the dumping of refuse on roadsides, available depression, open pits, drainage channels and rivers/stream channels. This indiscriminate disposal of solid waste is linked to urbanization, population

Table 10: Transport Mode

Sn	Transport Mode	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	Private	13	27.1	18	43.0	20	44.4	26	57.8	77	42.8
ii.	Public	35	72.9	24	57.0	25	55.6	19	42.2	103	57.2
Total		48	100	42	100	45	100	45	100	180	100

Table 11: Water Supply

Sn	Water Supply	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	Well	30	62.5	35	83.3	38	84.4	40	89.0	143	72.4
ii.	Borehole	18	37.5	7	16.7	7	15.6	5	11.0	37	20.6
Total		48	100	42	100	45	100	45	100	180	100

growth, poor governance, poverty and low level of environmental awareness (Ogu, 2000; Yakubu and Abdulkarim, 2015). On the other hand, the solid waste management in Nigeria is characterized by inefficient collection methods and insufficient coverage of the collection system (Yakubu, et al., 2015).

Sanitation: From Table 13, the use of water closet toilet is common and popular among the respondents as 76.7% use it. This is closely followed by pit toilets (20.6%) and lastly, bush method (2.7%). Single families exclusively own some of these pit toilets and landlord household and their tenants share some. Where there are no toilets; the inhabitants make use of nearby bush, streamside or the available undeveloped land to excrete.

In Ojoo and Sasa areas, the external forces have shaped and controlled the development of the settlements. According to Gardner (2000), sanitation that is sustainable spends the minimal amount of energy and resources with the least loss of useable matter to contain and convert it to its usable form. In the study area, individual efforts are made to improve sanitation at the household level but less at the communal level which result in the loss of land that could be conserved for future development.

The growth of settlements in Ojoo and Sasa does not support principles of sustainable sanitation as used by Gardener (2000) and can therefore be defined as unsustainable growth as development in the peri-urban area occur in a haphazard manner. Studies by Amoateng et al. (2013) indicate that peri-urban areas are experiencing unplanned physical growth characterised by an unregulated pattern of physical development, resulting in complex organic urban growth. Such areas often and predominantly expand with horizontal developments, turning potential areas of activity and human attraction into a "mini-city". This growth results in land use changes which, according to Sarfo-Mensah and Adam (1998), can classified into two major forms: land used for agriculture at the expense of fallow and forest land and land used for building development, especially housing, at the expense of agricultural land.

In summary, the attributes of peri-urban areas are not constant but can change according to time and place. They constitute some areas influenced intensively by urban drives and situated very close to large city as in the case of Ojoo and Sasa but still within the urban functional area of Ibadan where specific urban features such as industries, new investments, employment opportunities and population growth beyond those provided by agriculture alone coexist with that of the rural features of agricultural and non-agricultural functions. This according to Idczak and Mrozik (2018) are zones of transition or a new kind of multi-functional territories that evolve and can be shaped by spatial governance processes.

Table 12: Solid Waste Disposal

Sn	Methods of Disposal	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	Open dump	2	4.2	3	7.1	7	15.6	10	22.0	22	12.2
ii.	Waste container	38	79.1	32	76.2	23	51.1	29	65.0	122	67.8
iii.	Waste pit	8	16.7	6	14.3	10	22.2	2	4.0	26	14.4
iv.	Others	-	-	1	2.4	5	11.1	4	9.0	10	5.6
Total		48	100	42	100	45	100	45	100	180	100

Table 13: Sanitation

Sn	Sanitation	0–1000m		1000–2000m		2000-3000m		3000-4000m		Ground Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i.	Water closet	45	93.8	40	95.2	30	66.7	23	51.1	138	76.7
ii.	Pit toilet	3	6.2	2	4.8	15	33.3	17	48.8	37	20.**6**
iii.	Bush method	-	-	-		-	-	5	11.1	5	2.7
Total		48	100	42	100	45	100	45	100	180	100

Conclusion and Recommendation

The peri-urban areas of Ojoo and Sasa have grown rapidly over the years which resulted in change of land use. Vacant land has been transformed into built-up areas and the trend shows no sign of abating unless interventions of some sort are introduced. The study area is characterized by large number of tenant households compared to non-tenant households. There are few households that are indigenous to the area and large proportions of the households in area are migrants' households. These households ranged from low income households to large income households although large proportion fall into the low and middle income groups. A large proportion of the peri-urban households have access to some urban services especially electricity supply, however, there is a general lack of pipe borne water, sanitation systems and effective solid waste disposal mechanism. Migration to peri-urban and lack of adequate administrative control are the major causes of unplanned, spontaneous growth in the peri-urban area of Ojoo and Sasa. To control growth and manage settlements on the peripheries of urban areas, adequate planning with infrastructure is considered necessary.

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SOCIO-ECONOMIC IMPACT OF SMALL-SCALE INDUSTRIES IN OGBOMOSO TOWNSHIP, OYO STATE, NIGERIA

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Abstract

The role of the small scale industries in peoples' socio-economic development cannot be over emphasized. Small scale industries play a considerable role in the employment of manpower and productivity, distribution of income through increased investments and profits. This study evaluates socio-economic impacts of small scale industries in Ogbomoso Township. It examines the adequacy, and dispositions of people towards the existence of small scale industry. The study used primary data which were generated from random sampling of 145 residents using structured questionnaire. The data collected were analysed using descriptive statistics inform of frequency counts in percentages. Regression analysis was used to examine relationship between socio-economic characteristics of people and number of small scale industry. Findings reveal that small scale industries were fairly in existence as noted by 2.6919 mean computation of respondents. It was also found out that majority of small scale industries (60.7%) were owned by the private individuals. Results also indicated that 48.3% of respondents claimed that the small scale industries generated employment for the people of the town. Problem of inadequate finance is one of the major challenges that residents described as militating against the development of small scale industries in the study area. Finding from regression analysis (R^2=0.817) indicated that 81.7% of the variability in observed number of small scale industries is explained by socio-economic characteristics. This implies that existence of small scale industries has no doubt boosted the socio-economic characteristics of residents. Adequate funding and provision of infrastructure among others by government were suggested for effective improvement of small-scale industries in the study area

Keywords: Socio-economic characteristics, Small scale, Industry, Enterprises

Introduction

Small scale enterprises, are a vital part of the Nigeria economy. There is no doubt that small scale industry, as a veritable tool for rural and urban communities' development has attracted a lot of attention and comments from various schorlars, and governmental institutions. This implies that a lot has been said and written on small scale industry, particularly now that the government has placed emphasis on Self-employment as a means of achieving national development. In realization of the importance of the small-scale industries in economic development, the Federal and State Governments in their industrial policy stated that cities and townships will hence forth made to feel the positives impact of industrial development through a programmed of rational dispersion of industries to cover the neglected areas of the country. The government believes that such dispersion of small-scale industries provide employment opportunities, hence reducing the unemployment problem.

The small scale industries division of the Federal Ministry of industries defined small scale industries as enterprises having investment capital (investment in land, building, machinery and working capital) of up to 60,000 naira and employing not more than fifty (50) people. This definition was later revised to embrace all manufacturing units with a total capital investment (excluding cost of land) up to 750,000 naira but including working capital, and paid

employment of up to 50 persons. (Ayuba, 1989). Thus such an establishment must be wholly Nigerian-owned (all companies in schedule 1 of the 1977 Nigerian Enterprises Promotion Decree (NEPD)). In addition, manufacturing units exceeding the limit of investment and employment as stated above may still be considered a small business if the scale of output is relatively small compared to prevalent size of plants and the technology is fairly labor-intensive. This study therefore examines the socio-economic impacts of small scale industries in Ogbomoso, Nigeria.

Materials and Methods

The study area

Ogbomoso Town is located approximately on 4° 15' east longitude and 8° 7' latitude. The town is situated on an important transport route linking the north and south of Nigeria, and towns in the southwest region. Ogbomoso is 53 kilometres from Oyo on the northeast, 57 kilometres southwest Ilorin in Kwara state, 104 kilometres northwest of Ibadan the Oyo state capital and 58 kilometres northwest of Osogbo the Osun state capital. Ogbomoso is an administrative, political and traditional centre for all the rural communities within its jurisdiction.

Ibrahim et al., (2018) noted that Ogbomoso is characterized by a fairly uniform temperature across year (12 moths). The seasonal rainfall and relative humidity are moderate as well. Only daily rainfall records are kept in the town, but measurements from close climatologic stations in Ilorin and Osogbo are considered to be representative of the region. The mean annual temperature is 26.20degree C. the lowest temperature are experienced in August with 24.3°C as mean and the highest in march with a mean of 28.7 °C the regions around Ogbomoso have two season like other areas in the southwest of Nigeria. These include:

i. The wet season between April and October.

ii. The dry season between November and March.

Ogbomoso lies within the western uplands. The large part of this plateau lies between 300 and 650 metres above sea level. The relief of Ogbomoso is moderate with low-forested hills, but occasionally very steep sided ridges rise abruptly from the surrounding country. Ogbomoso is situated in the transitional zone between the rainforest of Ibadan geographical region and the northern savannah zone. They are therefore regarded as the derived savannah. The existing land use in Ogbomoso is characterized by compact development of residential zones. The land use is typical of any urban settlement where a large proportion of the developed land is devoted to residential use and only a small proportion is used for commercial, industrial and other uses. At present Ogbomoso occupies a land area of 3527 hectares (Ibrahim et al., 2018).

Methods of data collection and analysis

The study used both secondary and primary sources of information. The secondary information were through literature review on the subject matter, while the primary sources involved: first, a reconnaissance survey of the study area to determine the existence of small scale industry activities; second, about 145 structured questionnaire designed were administered to solicit information on the adequacy of small scale industry; its impact in the town; and factors militating its development in the area. A Random sampling technique was used to solicit information using questionnaire. Data collected, were subjected to descriptive and inferential statistical analysis. The descriptive statistics include frequency counts in percentages where results are put in tables. Regression analysis was used to examine relationship between socio-economic characteristics of people and number of small scale industry in the study area.

Research Findings

Inventory and adequacy of small scale industries in the study area

Under this sub-section of the study, attempt is made to examine the inventory of small scale industries in existence in the study area.

Table 1 shows the list of the small scale industries as given by respondents in the study area. According to the table, 11%, 17.9%, 17.2% and 9.7% of respondents mentioned saw mill, block making, cassava processing and oil farm. Another 3.4%, 4.1%, 2.1% and 9.0% of respondents identified calabash carving, coal making, soap making and bakery, while 3.4%, 9%, 10.3% and 2.8% of respondents reported the existence of printing press, mechanic workshop, tailoring shop and other industries respectively.

Table 1: List of Small Scale Industries in the Study Area

S/N	Industries	Frequency	Percentage (%)
1	Saw Mill	16	11.0
2	Block Making	26	17.9
3	Cassava Processing	25	17.2
4	Oil Farm	14	9.7
5	Calabash making	5	3.4
6	Coal making	6	4.1
7	Soap making	3	2.1
8	Bakery	13	9.0
9	Printing press	5	3.4
10	Mechanic workshop	13	9.0
11	Tailoring shop	15	10.3
12	Others	4	2.8
	Total	145	100

Source: Authors' Fieldwork, 2018

Table 2: Residents' perception of Adequacy of Small Scale Industry

S/N	Industries	Ranking					NR (f)	SWV	MWV
		5	4	3	2	1			
1	Saw Mill	30	76	135	106	22	145	369	2.5448
2	Block Making	35	116	147	90	15	145	403	2.7793
3	Cassava Processing	50	84	174	92	10	145	410	2.8276
4	Oil Farm	30	60	147	122	14	145	373	2.5724
5	Calabash making	10	64	138	116	23	145	351	2.4207
6	Coal making	5	88	174	100	14	145	381	2.6276
7	Soap making	10	60	192	106	11	145	379	2.6138
8	Bakery	75	132	138	28	4	145	377	2.6
9	Printing press	20	52	147	112	23	145	354	2.4414
10	Mechanic workshop	35	116	198	74	6	145	429	2.9586
11	Tailoring workshop	80	140	213	40	3	145	476	3.2828
12	Others	10	80	183	94	15	145	382	2.6345
	Total								**32.303**

Mean of ΣMWV/n = 32.303/12 = 2.6919
Source: Authors' Fieldwork, 2018

Table 3: Ownership of Small Scale Industries in the study area

Ownership	Frequency	Percentage (%)
Individual	88	60.7
Private Organization	48	33.1
Government	9	6.2
Total	145	100

Source: Authors' Fieldwork, 2018

Table 4: Household Patronage of Small Scale Industries

Patronage	Frequency	Percentage (%)
Yes	125	86.2
No	20	13.8
Total	145	100

Source: Authors' Fieldwork, 2018

To examine adequacy of small scale industry, attempt is made to adopt a surrogate for rating adequacy of small scale industry in the study area. Twelve variables (industries) were identified as indicated in Table 2. They are saw mill; Block Making; Cassava Processing; Oil Farm; Calabash making, Calabash making; Coal making; Soap making; Bakery; Printing press; Mechanic workshop; Tailoring workshop; and other industries.

The scaling of adequacy rating involves a method reminiscent of Likert scaling method to weight the ordinal rating of respondents converting the data into interval type which is more reliable in making conclusions and for parametric tests. Weights of 5, 4 3 2, 1 was attached to "very adequate", "adequate", "fairly adequate", "not adequate", "not at all adequate".

It is observed in table 2 that existence of tailoring workshop has the highest mean weighted value of 3.2828. This implies that existence and adequacy of tailoring workshop of different kinds are highly in existence and adequate in the study area. This situation is followed in decreasing order by Mechanic workshop which has mean weighted value of 2.9586., Cassava Processing (2.8276); Block making (2.7793) among others, indicating decreasing level of adequacy of small scale industry in the study area. Moreover, the small scale industry which has highest feeble adequacy mean weighted value is Calabash making with 2.4207.

The overall mean value computed for small scale industry adequacy is **2.6919**. This implies that mean responses of the people were above average indicating that small scale industry were fairly or averagely in existence. This situation no doubt is not too good at a moderate extent. This is because residents may have to pay high for the services of small scale industry.

Concerning the ownership of the small scale industries in the study area, respondents as shown in table 3 gave accounts for the fact that individual (60.7%) owns these industries, while 33.1% and 6.2% of respondents stated that small scale industry is owned by private organization and government respectively. It is observed that majority of respondents are of the opinion that small scale industries are owned by the individual in the study area.

Table 4 shows household patronage of small scale industries as given by the respondents. Accordingly, 86.2% of respondents noted yes, while the remaining 13.8% of respondents stated otherwise. The implication of these as observed here is that there is high level of household patronage of small scale industries in the study area.

Disposition of Residents to Small Scale Industrialization

In this section, attempt is made to give comprehensive analysis of the household response to small scale industrialization in Ogbomoso Township. We are interested in knowing the ownership nature of these small scale industries, desirability to be a worker and advertiser of these industries. These shall be explained across different socio-economic backgrounds.

In table 5, the willingness of people to get involved in the ownership of small scale industries according to their gender is situated. According to male respondents, 2.7%, 5.4%, 40.5, 33.8% and 17.6% of them reported very low, low, moderate, high and very high responses for owning small scale industries. Concerning female, 8.5%, 11.3%, 33.8%, 23.9% and 22.5% of respondents declared their interest to own small scale industries to be very low, low, moderate, high and very high respectively. It is observed here that male respondents are those that are more interested in the ownership of small scale industries in the study area.

Table 5: Gender and Ownership of Small Scale Industries

Gender		Owner					Total
		Very Low	Low	Moderate	High	Very High	
Male	N	2	4	30	25	13	74
	%	2.7	5.4	40.5	33.8	17.6	100
Female	N	6	8	24	17	16	71
	%	8.5	11.3	33.8	23.9	22.5	100
Total	N	8	12	54	42	29	145
	%	5.5	8.3	37.2	29.0	20.0	100

Source: Author's Fieldwork, 2018

Table 6: Gender and Worker of Small Scale Industries

Gender		Worker					Total
		Very Low	Low	Moderate	High	Very High	
Male	N	7	21	23	22	1	74
	%	9.5	28.4	31.1	29.7	1.4	100
Female	N	7	21	26	15	2	71
	%	9.9	29.6	36.6	21.1	2.8	100
Total	N	14	42	49	37	3	145
	%	9.7	29.0	33.8	25.5	2.1	100

Source: Author's Fieldwork, 2018

Table 7: Gender and Advertiser of Small Scale Industries

Gender		Advertiser					Total
		Very Low	Low	Moderate	High	Very High	
Male	N	12	19	17	24	2	74
	%	16.2	25.7	23.0	32.4	2.7	100
Female	N	8	19	29	11	4	71
	%	11.3	26.8	40.8	15.5	5.6	100
Total	N	20	38	46	35	6	145
	%	13.8	26.2	31.7	24.1	4.1	100

Source: Author's Fieldwork, 2018

Table 8: Education and Ownership of Small Scale Industries

Educational Level		Owner					Total
		Very Low	Low	Moderate	High	Very High	
No formal	N	1	0	6	5	9	21
Education	%	4.8	0.0	28.6	23.8	42.9	100
Primary	N	3	3	12	9	3	30
	%	10.0	10.0	40.0	30.0	10.0	100
Secondary	N	2	4	15	14	6	41
	%	4.9	9.8	36.6	34.1	14.6	100
Tertiary	N	2	4	20	13	9	48
	%	4.2	8.3	41.7	27.1	18.8	100
Others	N	0	1	1	1	2	5
	%	0.0	20.0	20.0	20.0	40.0	100
Total	N	8	12	54	42	29	145
	%	5.5	8.3	37.2	29.0	20.0	100

Source: Author's Fieldwork, 2018

Table 9: Education and Worker of Small Scale Industries

Educational Level		Worker					Total
		Very Low	Low	Moderate	High	Very High	
No formal	N	0	7	6	8	0	21
Education	%	0.0	33.3	28.6	38.1	0.0	100
Primary	N	2	9	10	9	0	30
	%	6.7	30.0	33.3	30.0	0.0	100
Secondary	N	4	11	15	11	0	41
	%	9.8	26.8	36.6	26.8	0.0	100
Tertiary	N	8	14	17	6	3	48
	%	16.7	29.2	35.4	12.5	6.3	100
Others	N	0	1	1	3	0	5
	%	0.0	20.0	20.0	60.0	0.0	100
Total	N	14	42	49	37	3	145
	%	9.7	29.0	33.8	25.5	2.1	100

Source: Author's Fieldwork, 2018

Just like responses of household in the ownership of owning small scale industries, male was also found on the majority side concerning those who are willing to be the workers of these small scale industries as shown in table 6 above. According to the table, male respondents who reported very low, low, moderate, high and very high for willingness to be workers of industries are 9.5%, 28.4%, 31.1%, 29.7% and 1.4% respectively. The female counterparts who are 9.9%, 29.6%, 36.6%, 21.1% and 2.8% noted their intention to be very low, low, moderate, high and very high respectively as responses to be workers of small scale industries in the study area.

Talking about whose gender is more interested in becoming advertiser of small scale industries in the study area, table 8 shows that 16.2%, 25.7%, 23%, 32.4% and 2.7% of male respondents revealed very low, low, moderate, high and very high, while female respondents whom are 11.3%, 26.8%, 40.8%, 15.5% and 5.6% reported very low, low, moderate, high and very high respectively for them to be advertiser of the small scale industries in the study area. It can also be deduced from this table that male respondent

constituted majority among those who are willing to get involved as advertiser of the small scale industries in the study area.

In table 8, the level of education of respondents were examined concerning their willingness to own the small scale industries in the study area. According to the table, it is observed that 27.1% and 18.8% of respondent with tertiary education reported high and very high for the fact that they are ready to get involved in ownership of small scale industries in the study area. This means that generally, people who have tertiary education are those who are more interested in owning small scale industries in the study area.

Educational level and tendency to be a worker of small scale industries according to the respondents is contained in table 9 above. According to the table, 26.8% of respondents who have secondary education found to have reported high responses for willingness to be a worker of small scale industries in the study area. This is followed closely by the respondents who have tertiary education (12.5%) in the study area. Meanwhile, one may be tempted to report here that people who have secondary education are majorly found to have shown more interest in working in these small scale industries in the study area.

The willingness of respondents according to their educational level to get involved in small scale industries as advertiser is contained in table 10 above. It is observed from the table that 24.4% and 7.3% of respondents who have secondary education noted their intention to be high and very high, followed closely by those who have tertiary education (high 25%). The implication of this is that respondents who have secondary education accounted for highest proportion for those who want to get involved in small scale industries by virtue of advertiser in the study area.

Table 10: Education and Advertiser of Small Scale Industries

Educational Level		Advertiser					Total
		Very Low	Low	Moderate	High	Very High	
No formal	N	4	5	6	5	1	21
Education	%	19.0	23.8	28.6	23.8	4.8	100
Primary	N	5	7	11	7	0	30
	%	16.7	23.3	36.7	23.3	0.0	100
Secondary	N	6	10	12	10	3	41
	%	14.6	24.4	29.3	24.4	7.3	100
Tertiary	N	5	13	16	12	2	48
	%	10.4	27.1	33.3	25.0	4.2	100
Others	N	0	3	1	1	0	5
	%	0.0	60.0	20.0	20.0	0.0	100
Total	N	20	38	46	35	6	145
	%	13.8	26.2	31.7	24.1	4.1	100

Source: Author's Fieldwork, 2018

Table 11: Occupation and Owner of Small Scale Industries

Occupation/ Profession		Owner					Total
		Very Low	Low	Moderate	High	Very High	
Farming	N	1	1	8	10	10	30
	%	3.3	3.3	26.7	33.3	33.3	100
Artisan	N	3	6	10	12	10	41
	%	7.3	14.6	24.4	29.3	24.4	100
Civil Servant	N	1	3	23	12	4	43
	%	2.3	7.0	53.5	27.9	9.3	100
Student	N	3	2	13	8	5	31
	%	9.7	6.5	41.9	25.8	16.1	100
Total	N	8	12	54	42	29	145
	%	5.5	8.3	37.2	29.0	20.0	100

Source: Author's Fieldwork, 2018

Table 12: Occupation and Worker of Small Scale Industries

Occupation/ Profession		Worker					Total
		Very Low	Low	Moderate	High	Very High	
Farming	N	3	8	8	11	0	30
	%	10.0	26.7	26.7	36.7	0.0	100
Artisan	N	3	13	12	12	1	41
	%	7.3	31.7	29.3	29.3	2.4	100
Civil Servant	N	2	13	19	8	1	43
	%	4.7	30.2	44.2	18.6	2.3	100
Student	N	6	8	10	6	1	31
	%	19.4	25.8	32.3	19.4	3.2	100
Total	N	14	42	49	37	3	145
	%	9.7	29.0	33.8	25.5	2.1	100

Source: Author's Fieldwork, 2018

Table 13: Occupation and Advertiser of Small Scale Industries

Occupation/ Profession		Advertiser					Total
		Very Low	Low	Moderate	High	Very High	
Farming	N	4	6	7	10	3	30
	%	13.3	20.0	23.3	33.3	10.0	100
Artisan	N	4	11	13	12	1	41
	%	9.8	26.8	31.7	29.3	2.4	100
Civil Servant	N	6	15	15	7	0	43
	%	14.0	34.9	34.9	16.3	0.0	100
Student	N	6	6	11	6	2	31
	%	19.4	19.4	35.5	19.4	6.5	100
Total	N	20	38	46	35	6	145
	%	13.8	26.2	31.7	24.1	4.1	100

Source: Author's Fieldwork, 2018

The occupation of respondents was also examined in relation to household responses to own small scale industries in the study area. Table 11 shows that 29.3% and 24.4% of respondents who are artisan reported high and very high for the fact that they are willing to involve in small scale industries by way of owning them. In actual fact, artisan were found majorly in the study area who are ready to own small scale industries in the study area as noted by most of the respondents.

Table 12 shows that artisan with proportion of 29.3% and 2.4% are found to have reported high and very high responses for the willingness to get involved in small scale business as worker. This is followed closely by the farmers (36.7%), while civil servant was also reported 18.6% of high for willing to get involved as a worker in the small scale industries business. Generally, it necessary to report here that artisan is found majorly to have nurtured interest in becoming worker for the small scale industries business in the study area.

Concerning the occupation of respondents and their willingness to involve in small scale industries as advertiser, table 13 shows that 29.3% and 2.4% of respondents who are artisan noted high and very high for insinuation that they are interested to be advertiser of small scale industries in the study area. It could be noted that farmers were also reported high (33.3%) and very high (10%) for disposition to be advertiser of small scale industries. It can therefore be deduced from the table that majority of respondents who are artisan were said to have involved in the small scale industries business as advertiser in the study area.

The disposition of respondents to own small scale industries based on monthly income according to respondents is presented in the table 14 above. According to the table, 33.3% and 28.2% of respondents who are earning between #5,100 and #10,000 reported high and very high respectively for owning small scale business in the study area. This is followed by respondents who earn #10,100-#20,000 in which 23.7% each reported high and very high for involvement in owning small scale industries in the study area.

Table 14: Monthly Income and Owner of Small Scale Industries

Monthly Income		Owner					Total
		Very Low	Low	Moderate	High	Very High	
Below #5,000	N	3	1	7	8	3	22
	%	13.6	4.5	31.8	36.4	13.6	100
#5,100-#10,000	N	1	2	12	13	11	39
	%	2.6	5.1	30.8	33.3	28.2	100
#10,100-#20,000	N	0	4	16	9	9	38
	%	0.0	10.5	42.1	23.7	23.7	100
#20,100-#30,000	N	4	3	10	10	4	31
	%	12.9	9.7	32.3	32.2	12.9	100
#30,100 & above	N	0	2	9	2	2	15
	%	0.0	13.3	60.0	13.3	13.3	100
Total	N	8	12	54	42	29	145
	%	5.5	8.3	37.2	29.0	20.0	100

Source: Author's Fieldwork, 2018

Table 15: Monthly Income and Worker of Small Scale Industries

Monthly Income		Worker					Total
		Very Low	Low	Moderate	High	Very High	
Below #5,000	N	3	7	6	6	0	22
	%	13.6	31.8	27.3	27.3	0.0	100
#5,100-#10,000	N	5	13	10	10	1	39
	%	12.8	33.3	25.6	25.6	2.6	100
#10,100-#20,000	N	2	8	17	11	0	38
	%	5.3	21.1	44.7	28.9	0.0	100
#20,100-#30,000	N	4	9	8	9	1	31
	%	12.9	29.0	25.8	29.0	3.2	100
#30,100 & above	N	0	5	8	1	1	15
	%	0.0	33.3	53.3	6.7	6.7	100
Total	N	14	42	49	37	3	145
	%	9.7	29.0	33.8	25.5	2.1	100

Source: Author's Fieldwork, 2011

Table 16: Monthly Income and Advertiser of Small Scale Industries

Monthly Income		Advertiser					Total
		Very Low	Low	Moderate	High	Very High	
Below #5,000	N	4	6	4	7	1	22
	%	18.2	27.3	18.2	31.8	4.5	100
#5,100-#10,000	N	6	10	12	7	4	39
	%	15.4	25.6	30.8	17.9	10.3	100
#10,100-#20,000	N	6	8	13	11	0	38
	%	15.8	21.1	34.2	28.9	0.0	100
#20,100-#30,000	N	4	7	12	7	1	31
	%	12.9	22.6	38.7	22.6	3.2	100
#30,100 & above	N	0	7	5	3	0	15
	%	0.0	46.7	33.3	20.0	0.0	100
Total	N	20	38	46	35	6	145
	%	13.8	26.2	31.7	24.1	4.1	100

Source: Author's Fieldwork, 2018

jThe monthly income of respondents and their willingness to be a worker of small scale industries is contained in table 15. Accordingly, 25.6%, 25.6% and 2.6% of respondents who are earning between #5,100 and #10,000 reported moderate, high and very high respectively for willing to be a worker in small scale business in the study area. This is followed by respondents who earn #10,100-#20,000 of which the highest proportion (28.9%) indicated high for involvement in working for small scale industries in the study area.

The table 16 shows monthly income and advertiser of small scale industry in the study area. According to the table, 30.8%, 17.9% and 10.3% of respondents who are earning between #5,100 and #10,000 indicated moderate, high and very high respectively for willingness to be advertiser of small scale business in the study area. This is not completely different from the respondents who earn #10,100 - #20,000 in which 34.2% and 28.9% of them indicated moderate and high responses for involvement as an advertiser for small scale industries in the study area. Therefore, majority of those who are willing to be advertiser of small scale industries earning between #10,100 and #20,000 and also #5,100-#10,000, according to most of the respondents' opinion in the study area. It can therefore be deduced that people who are earning less than #20,000 are the household who are willing to involve one way or the other in small scale business in the study area.

Table 17 shows that 28.3% of respondents identified location factor as responsible for patronage of small scale industry in the study area, while 31.7%, 31% and 9% of respondents mentioned quality of products, price of products and other reasons as being behind patronage of small scale industries in the study area. It is however, observed that majority of respondents are of the opinion that quality of products determine the level of patronage of the small scale industries in the study area.

It is observed from table 18 that 48.3% of respondents claimed that some of their household was given employment by the small scale industries, while 51.7% of respondents reported otherwise. Although sizeable amount of people were given employment by these small scale industries, but majority of respondents disclosed the facts that they were not employed by these small scale industries.

Table 19 shows that 42.1% and 7.6% of respondents disclosed that 1-5 peoples and 6-10 peoples were employed per household by the small scale industries in the study area, while 48.3% reported that nobody was employed in their household. It could be noted that 2.1% of respondents refused to respond. One can deduced from this study that some people were employed by these small scale industries.

Table 17: Factors Responsible for Patronage of small scale industry

Patronage	Frequency	Percentage (%)
Location factor	41	28.3
Quality of Products	46	31.7
Price of Products	45	31.0
Others	13	9.0
Total	145	100

Source: Author's Fieldwork, 2018

Table 18: Employment from household by these industries

Employment	Frequency	Percentage (%)
Yes	70	48.3
No	75	51.7
Total	145	100

Source: Author's Fieldwork, 2018

Table 19: Number of people employed

Employment	Frequency	Percentage (%)
1-5 people	61	42.1
6-10 people	11	7.6
None	70	48.3
No Response	3	2.1
Total	145	100

Source: Author's Fieldwork, 2018

Impact of small scale industries in Ogbomoso township

Linear regression analysis was computed to determine the impacts of small scale industry on the socio-economic characteristics of residents in the study area. The dependent variable is socio-economic characteristics, while the independent variable is number of small scale industry. To make the dependent variable suitable for regression analysis, they have to be summarized into one composite variable. This was done and variable of socio-economic characteristics was statistically obtained. It (dependent variable) was regressed on variable of number of small scale industry (independent variable). The results is contain in the following tables.

With F- value of 635.102 and P- value of 0.000 in table 20b, it is observed that the relationship between peoples' socio-economic characteristics and number of small scale industry is significant at $p<0.05$ confidence level. Moreover, with correlation coefficient (R) of 0.904 and coefficient of Multiple Determination (R^2) of 0.817, as shown in table 20a, one observes that 81.7% of effects of socio-economic characteristics may be attributed to a magnitude increase in number of small scale industry. In other words, close to 82% of the variability in observed number of small scale industry is explained by socio-economic characteristics in the study area. The remaining 18% as observed here may be due to other factors that enhance socio-economic characteristics, like government policy, political stability, good governance among others.

Table 20a: Regression Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.904[a]	.817	.816	4.414

a. Predictors: (Constant), number of small scaleindustries

Table 20b: Test of Statistical Significance of Regression Model

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12372.284	1	12372.284	635.102	.000[a]
	Residual	2766.271	142	19.481		
	Total	15138.556	143			

a. Predictors: (Constant), number of small scale industries

b. Dependent Variable: Socio-economic Characteristics

Table 20c: Regression Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.271	1.321		-1.720	.088
	number of small scale industries	14.077	.559	.904	25.201	.000

a. Dependent Variable: Socio-economic Characteristics

Source: Author's Fieldwork, 2018

To determine the weight of the components of number of small scale industry, reference is made to the regression coefficients as shown in table 20c. Using the standardized beta coefficients, the constant "a" would disappear and the regression equation is of the form:

$Y = a + bx$

Becomes:

Y (i.e. socio-economic characteristics) = 0.904x

This implies that for each change or increase of one unit in independent variable (x) (number of small scale industry), the mean value of dependent variable (y) (socio-economic characteristics) is estimated to change/increase by 0.904 units.

Conclusion and Recommendations

This study examines socio-economic impact of small scale industries in Ogbomoso Township. The importance of small scale industries in physical planning cannot be over-emphasized. It was found out that small scale industry were fairly in existence as noted by 2.6919 mean computation of respondents. It was also found out that majority of small scale industries (60.7%) were owned by the private individuals. Results also indicated that 48.3% of respondents claimed that the small scale industries generated employment for the people of the town. Problem of inadequate finance is one of the major challenges that residents described (orally) as factors militating against the development of small scale industries in the study area. Finding from regression analysis indicated that 82% of the variability in observed number of small scale industry is explained by socio-economic characteristics. This implies that existence of small scale industry has no doubt boost the socio-economic characteristics of residents. The following policy issues are recommended for improvement and effective development of small scale industry in the study area:

i. Small Scale business should be linked up with larger financing windows like the SMEEIS fund or Strategic Partners as suggested by Ojo (2003). The linkages should be such that the entrepreneurs would be serviced through their MFBs based on social capital. This will enable MFBs to introduce loan products and strategies targeted at financing technology acquisition by small scale industries.

ii. The Government should urgently tackle the problem of infrastructure development and maintenance. These include electricity, water and efficient transportation system which impact greater on small scale industry operations. The bureaucratic bottleneck involved in small business registration should also be removed.

iii. A National Science and Technology policy that is properly funded; and an educational policy with emphasis on technology and entrepreneurship education, should be formulated and implemented for small scale industry growth and expansion in the country.

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RISK ASSESSMENT OF TOXICITY POTENTIAL FOR CRITERIA AMBIENT AIR POLLUTANTS IN SELECTED AREAS OF LAGOS STATE, NIGERIA

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Abstract

The quality of ambient air is determined by the extent of pollution of the environment. The United States Environmental Protection Agency identifies six pollutants namely particulate matter, ground level ozone, carbon monoxide, sulphur oxides, nitrogen oxides and lead exposure as toxic and injurious because of their potentials to cause or trigger various human health problems. This study examines the toxicity potential of criteria ambient air pollutants in selected areas of Lagos State, Nigeria. The data for the study include five-year data of criteria pollutants for selected areas of Lagos and World Health Organization (WHO) guideline values of criteria pollutants. Data analysis adopted the use of Toxicity Potential Model for the calculation of the toxicity potential of the criteria pollutants. GIS procedure was employed to produce a map showing the spatial pattern and hotspot areas of criteria pollutants. Criteria pollutants in the study area were also compared with the WHO standards with a view to determining areas of excessive pollution and toxicity potential in the area. The study reveals that $PM_{2.5}$, $PM_{10,}$ SO_2 and NO_2 in Lagos areas clearly exceeded the benchmark set by WHO. Furthermore, CO and O_3 are well below the WHO standards. The toxicity potential values for $PM_{2.5}$, $PM_{10,}$ SO_2 and NO_2 in the area of study are greater than unity while the values for CO and O_3 are lesser than unity which indicates that such concentration has a tendency of causing harm to people and hence should be avoided. The study recommends that governments, and other stakeholders in health should harmonize efforts, resources and ideas towards effective planning, monitoring, and provision of facilities that could control and ameliorate the presence of these pollutants to which urban residents are exposed thereby reducing the health effects from such exposures.

Keywords: Ambient air, Pollution, Health, Toxicity, Criteria pollutants

Introduction

The quality of ambient air is determined by the extent of pollution of the environment. Pollution on the whole is caused principally by human activities, though it can also be a natural process (Dara, 2004). The United States Environmental Protection Agency (USEPA, 2012) classified air pollutants into two groups: criteria and hazardous air pollutants. The criteria pollutants are those that can have adverse effect on health and the environment. They include particulate matter, oxides of nitrogen, oxides of sulphur, carbon (II) Oxide and lead. Criteria pollutants are toxic and injurious to health. Apart from their natural presence in air, they can be introduced into the air by various types of anthropogenic activities such as incomplete combustion from engines, bush-burning, electricity generating plants, decaying of accumulated organic and domestic wastes, and other industrial processes (Raheem and Amole, 2015).

Air quality can be a critical reflection of the ambient atmospheric pollution, relative to the potential to inflict harm on the environments (WHO, 2002). Air is said to be polluted when there is 'the presence in the outdoor atmosphere of one or more contaminants such as dust, fumes, gas, mist, odour, smoke, or vapour in such a characteristics and duration as to make them actually or potentially injurious to human, plant or animal life, or property or which interferes with the comfortable enjoyment of life and

property' (World Bank, 1978). Human health is threatened with diseases and early mortality particularly in emerging economies facing rapid industrialization and urbanization like Lagos. Epidemiological studies of occupational diseases on the working population had shown negative effects of the environment on people working in a contaminated environment over a lifetime of employment (The MACBETH project 1999, and Samoli, E. 2003). According to WHO (2014), by reducing air pollution levels, countries can reduce the burden of disease from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma. Moreover, reduction in outdoor air pollution also reduces emissions of CO_2 and short-lived climate pollutants such as black carbon particles and methane, thus contributing to the near and long-term mitigation of climate change (WHO, 2014).

Air quality has a strong link to human health and wellbeing as shown in many studies (Zhu *et al*. 2002, Parakash, *et al*. 2006). The rapid expansion, population increase and transformation of the Lagos city, one of the most industrialized cities in the world have contributed to its present polluted states. Akinola *et al*. (2014) posited that the increasing human activities, especially industrial and vehicular emissions are posing great environmental challenges that have resulted in loss of life and destruction of properties in the state. The overall effects of air pollution on Lagos residents and environments contribute to drag in the efforts for its most sustainable programs (Akinola *et al.* 2014).

Statement of the problem

According to Brunekreef (2005), ambient particulate matter levels in cities of developing countries including Nigeria are generally much higher than in developed countries because of dispersed heating with small-scale solid fuel use, uncontrolled industrial emissions, and the large numbers of non-catalyst two-stroke engine vehicles. Ediagbonya *et al*. (2012) posited that atmospheric environmental problems, had previously received scanty attention in Nigeria but have become a subject of increasing importance. Air pollution is a major threat to human life and most people inhale pollutants while at home or commuting to work irrespective of the mode of transportation (Ekpenyong *et al*. 2012). Depending on the dose and the exposure time, these pollutant gases have the potential to cause far reaching adverse health effects in man, but principally affect the respiratory and cardiovascular systems.

The World Health Organization (2002), argued that about 2.4 million people worldwide (including about 93,700 Nigerians) die each year from causes directly attributable to air pollution. Akinola *et al*. (2014) posited that studies have shown that in Lagos state Vehicular Emissions are the highest point source contributors of carbon dioxide (CO_2) into the environment, followed by the manufacturing industries. Unending traffic jams in Lagos metropolis results in commuters spending several unproductive hours in traffic and increased avoidable emissions of CO_2 and other pollutants. A study conducted by the Lagos Metropolitan Transport Management Authority (LAMATA) on air quality between 2003 and 2007 indicated that vehicular emission contribute approximately 43% ambient air pollution in Lagos. The continuous expansion, population increase and transformation of the Lagos city have contributed to its present polluted states. However, assessment of the effect of air pollution in developing countries is difficult because of a lack of cohesive air quality policies in combination with poor environmental monitoring and a paucity of disease surveillance data (Briggs, 2003). Therefore, this study becomes imperative in examining the hotspot areas and toxicity potential for criteria ambient air pollutants in selected area of Lagos State.

Study Area

Lagos State is located between latitudes 6º.35N to 6.58ºN and longitudes 3º.45'E to 3.75ºE of the Greenwich meridian in the south western part of Nigeria. The state has a tropical wet and dry climate with an all year-round precipitation in many parts of the state. Wet season is characterised by a double maximum of rainfall usually from March to July and the other in late August to early September. A dry spell may occur from late September to early November. The annual mean rainfall is between 1381.7mm and 2733.4mm in recent time from one location to another. The maximum temperature ranges between 29°C - 34°C, the lowest being in the month of July and the highest in February and a minimum temperature varies between 24°C -28°C. The relative humidity varies seasonally with an average of 70% throughout the year.

The vegetation of the study area is made up of two types namely; swamp forest of the coastal belt and

dry lowland rain forest. The swamp forest is a combination of mangrove forest and coastal vegetation developed under the brackish conditions of the coastal areas, swamp fresh water lagoons and estuaries. Lying to the north of the swamp forest is the lowland (tropical) rain forest zone and stretches from Ikeja through Ikorodu. The economic valuable trees such as teak, tripochiton, seletrocylon (arere), banclea diderrichil (opepe) and terminahia (idigbo) can be to be found in some parts of the study area. Lagos State occupies an area of 3,577 square kilometres, which represents 0.4% of Nigeria landmass with a marine shoreline of about 180km extending inland to a maximum distance of about 32km. Lagos is the most populous city in Nigeria, the second fastest-growing city in Africa and the seventh in the world (www.lagosstate.gov.ng). The NPC (2016) estimates of the population of Lagos state was 21 million, making Lagos the largest city in Africa.

The study area accounts for over 60% of the federation's total industrial investment and the largest concentrations of industries can be found in Ikeja, Alimosho and Kosofe local government areas (www.lagosstate.gov.ng). Other specific locations of numerous industries include Apapa, Surulere, Shomolu, Mushin, Oshodi-Isolo, Agege, Amuwo Odofin, and Ikorodu among others. See fig. 1 for the map of the study area.

Aim and objectives

The aim of the study is to identify the hotspot areas and toxicity potential for criteria ambient air pollutants in selected area of Lagos State. To achieve this aim, the specific objectives are to: compare criteria pollutants in Lagos area with the WHO standard for the pollutants and identify hotspot areas and toxicity potential for criteria pollutants based on deviations from the WHO benchmark.

Materials and Methods

Data required and sources

The US Environmental Protection Agency (USEPA, 2012) identifies six common air pollutants also known as criteria pollutants. This are particulate matter (PM $_{2.5}$, PM_{10}), ground level ozone, carbon monoxide, sulphur oxides, nitrogen oxides and lead. These pollutants are critical because of their implications for human health and the environment. Out of the six, particulate matter and ozone are the most widespread health threats because of their association with Asthma, Chronic Obstructive Pulmonary Disease (COPD) and respiratory diseases as prominent air pollution related diseases (WHO, 2014).

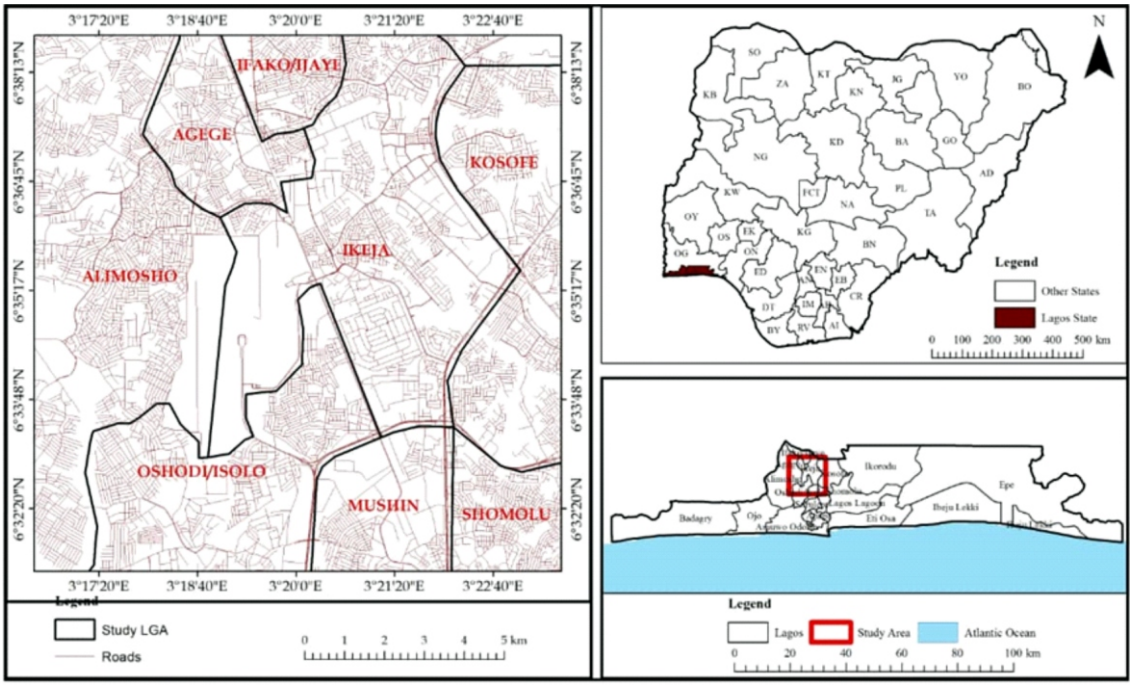

Figure 1. Lagos State showing sample areas with Nigeria as inset

Based on the foregoing the data required and sources of data for this study are both primary and secondary. The primary sources includes the coordinates of the sample sites. The secondary data includes five (5) years data of criteria pollutants, the pollutants are Particulate matter ($PM_{2.5}$, PM_{10}), Ground level (O_3) Nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and carbon dioxide (CO), WHO Guidelines for $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO and Ground level O_3, maps, and statistical data obtained from WHO published works.

Table 1: Showing Study Sites Distribution within the Study Area.

LANDUSE TYPE	LOCATIONS/SITES
RESIDENTIAL	Agege Housing Estate; Oko-oba Ikeja G.R.A: SoboArobiodu street. Magodo Estate: CMD Road, Shangisha Ogba Staff Quarters; Ogba Secretariat; Alausa: front of Skye bank Maryland Junction, Ikeja
HIGH TRAFFIC	General Hospital: Frontage of LASUTH Ojodu-Berger: Berger Roundabout Iyana-Ipaja: Under Bridge Oshodi B/Stop: Oshodi Specomil: Inside Ikeja Industrial Estate
INDUSTRIAL	Wemabod: Adjacent Guinness Nigeria PLC office Wempco: Industrial Estate Ogba Ize-Iyamu Matori

Source: Author's Fieldwork, 2016

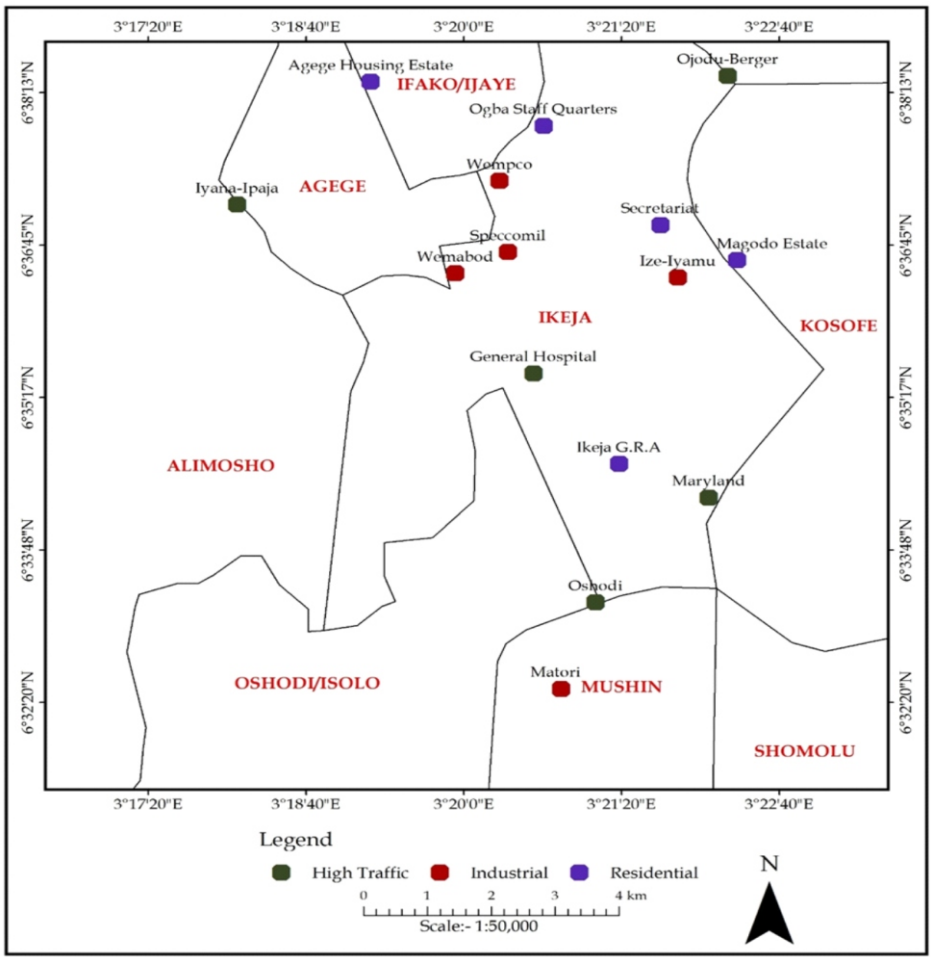

Figure 2: Sampling Sites in the Study Area
Source: Author's Fieldwork, 2016

Methods of Data Collection

Study sites were selected with a view to giving a holistic representation of air quality status of the study area. The study area was categorised into three (3) base on the predominant landuse types. Thus, Lagos was divided into high traffic, industrial and residential areas. Residential areas were defined as landuse types in which housing predominates. In the light of the above, State Government staff quarters and Estates owned by private agencies were considered. The high traffic areas are the major road intersections where high volumes of traffic are experienced during the working hours of the day while areas with high concentration of industries were considered as industrial areas. It must be noted that this categorisation is not water tight as these characteristics may occur in all areas with varying intensities (Laro, 2016)

Geographic coordinates: Direct measurement of coordinates of fifteen (15) sample sites from the field with the aid of the global positioning system (GPS).

Data on Criteria pollutants: The data on criteria pollutants was obtained from Ministry of Environment, Lagos State. The data are particulate matter ($PM_{2.5}$ and PM_{10}), Ground level Ozone ($O_{3)}$, Nitrogen dioxide ($NO_{2)}$, Sulphur dioxide (SO_2) and Carbon monoxide (CO).

Guideline value for criteria pollutants: The data was sourced from the WHO air quality guideline book. The data are annual, daily and 8 hours mean of $PM_{2.5}$, $PM_{10,}$ $SO_{2,}$ $NO_{2,}$ CO and ground level (O_3).

Methods of Data Analysis

Descriptive statistics was employed to compare Criteria Pollutants in Lagos area with the WHO standard**.** For the purpose of this study, WHO Values which are presented in $\mu g/m^3$ are converted to mg/m^3 using gas detection calculator (www.gasdetection calculator.com). This was because the data on criteria pollutants collected from Lagos state Ministry of Environment were presented in mg/m^3. Hotspot areas and toxicity potential for Criteria Pollutants were obtained as deviations from the WHO Guidelines and Standard defining the permissible level of each criteria pollutants

Toxicity Potential is expressed as the ratio of measured ambient pollutants concentration to the statutory limit of ambient concentration (Sonibare *et al*. 2005). It is useful in assessing the deleterious effects of air pollutants emissions on human health. It was computed using Eqn (1) taking into consideration the ambient air quality standards of World Health Organisation (WHO) as reported in WHO Air quality guidelines (2005).

The toxicity potential of the pollutants measured was computed using the following equation:

$$TP_i = \frac{Ci(t)}{Sli(t)} \qquad \text{.....eq. (1)}$$

Where TP represents the toxicity potential of pollutant 'i'

This equation takes into consideration the ambient air quality standard of WHO as reported in WHO air quality guidelines (2005)

In the same vein, the use of tables was employed to identify the hotspot areas in ArcGIS environment. The discussion and interpretation of the results are presented in the section below.

Results and Discussion

Benchmarking criteria pollutants in Lagos

The WHO (2005) air quality guidelines book presents revised guideline values for the four most common air pollutants - particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide, sulphur dioxide and ozone based on a recent review of the accumulated scientific evidence. The rationale for selection of each guideline value is supported by a synthesis of information emerging from research on the health effects of each pollutant. Based on the foregoing, these guidelines are apply globally (WHO, 2005). The details of the WHO Air Quality guidelines is as shown in table 2

As shown in Table 3, Ambient $PM_{2.5}$ and PM_{10} level in the study area were observed to be higher than the internationally permitted standard of 0.01 mg/m^3 and 0.02 mg/m^3 respectively over an annual average period (WHO, 2005). The ambient level of carbon monoxide (CO) in the study area were observed to be lower than the statutory standard of 10 ppm. Also, $PM_{2.5}$ and PM_{10} level in the study area are higher than the WHO recommended value of 0.02 ppm and 0.01 ppm respectively except for Agege housing estates, which is a residential area where 0.01 ppm was recorded for both pollutants. Ambient ground level ozone (O_3) concentration in the study area were

observed to be lower than the WHO statutory standard of 0.05 ppm over an eight (8) hours averaging period.

Hotspot areas for criteria pollutants and toxicity potentials in Lagos Metropolis

As indicated in Table 4, the hotspot areas are where there was high concentration of criteria pollutants in the area of study. These areas deviate above the recommended WHO standard, the areas were highlighted in 'reds' signifying hotspot areas. The table also reveals that a minimum of two (2) and maximum of four (4) pollutants across different landuse in the study area exceeds the statutory recommended value.

The minimum toxicity potential with WHO standard for $PM_{2.5}$ was 8 computed for Agege housing estate, a residential area, while the maximum was 33 in Ojodu Berger, a high traffic area (see Table 5). The minimum toxicity potential for PM_{10} was 7 in Ogba Staff quarters which is a residential area, while the maximum was 23 in Iyana-Ipaja, a high traffic area. Also, the minimum toxicity potential for CO was 0.01 in Ogba Staff quarters and Secretariat, a residential area, while the maximum was 0.18 in Ojodu Berger which was a high traffic area. The minimum toxicity potential for NO_2 was 0.5 ppm in Agege housing estate, a residential area, while the maximum was 17.5 ppm in Ojodu Berger a high traffic area. The minimum toxicity potential for SO_2 was 1 in Agege, a residential area, while the maximum is 43 in Ojodu Berger a high traffic area. Minimum toxicity potential for O_3 was 0.08 in Ikeja GRA, a residential area, while the maximum is 0.6 in General Hospital and Iyana-Ipaja a high traffic areas, and Ize-Iyamu and Matori, an industrial areas. It follows therefore that high traffic areas recorded the highest values of criteria pollutants, followed by industrial and residential areas for instance 33, 19 mg/m^3 and 17.5, 43ppm was recorded for $PM_{2.5}$, PM_{10} and NO_2, SO_2 respectively in Ojodu Berger. By implications, High traffic and industrial areas as indicated in Table 5 has the highest toxicity level of criteria pollutants.

Table 2: Conversion of WHO Guideline values for pollutants from microgram ($\mu g/m^3$) to milligram (mg/m^3)

Pollutants	Guideline value in ($\mu g/m^3$/ ppm)	Value in (mg/m^3/ ppm)
Particulate matter ($PM_{2.5}$)	10 $\mu g/m^3$ (annual mean)	0.01 mg/m^3
Particulate matter (PM_{10})	20 $\mu g/m^3$ (annual mean)	0.02 mg/m^3
Nitrogen dioxide (NO_2)	40 $\mu g/m^3$ (annual mean)	0.02 ppm
Sulphur dioxide (SO_2)	20 $\mu g/m^3$ (daily mean)	0.02 ppm
Ozone (O_3)	100 $\mu g/m^3$ (8hr mean)	0.05 ppm
Carbon monoxide (CO)	10 ppm (8hr mean)	10 ppm

* Conversion factor: gasdetectioncalculator.com

Source: Authors computation, 2016.

Table 3: Criteria Pollutants and International Standards

Landuse type		$PM_{2.5}$ (mg/m^3)	PM_{10} (mg/m^3)	CO (ppm)	No_2 (ppm)	So_2 (ppm)	O_3 (ppm)
Residential Areas	Ogba S/Qtrs	0.12	0.14	0.12	0.03	0.03	0.01
	Secretariat	0.14	0.10	0.14	0.03	0.02	0.01
	Magodo	0.14	0.13	0.24	0.06	0.05	0.01
	Ikeja GRA	0.16	0.14	0.20	0.04	0.04	0.004
	Agege H/Estate	0.08	0.09	0.09	0.01	0.01	0.01
High Traffic Areas	Maryland	0.22	0.11	0.85	0.22	0.30	0.02
	Oshodi	0.26	0.27	1.10	0.26	0.36	0.02
	Ojodu Berger	0.33	0.38	1.76	0.35	0.43	0.02
	Gen.Hospital	0.25	0.19	0.87	0.23	0.34	0.03
	Iyana-Ipaja	0.30	0.46	1.16	0.40	0.38	0.03
Industrial Areas	Specomil	0.26	0.28	0.49	0.06	0.09	0.02
	Wemabod	0.17	0.15	0.37	0.04	0.07	0.02
	Wempco	0.17	0.19	0.35	0.09	0.11	0.02
	Ize-Iyamu	0.23	0.26	0.73	0.13	0.12	0.03
	Matori	0.23	0.19	0.70	0.07	0.09	0.03
Int. Standard	**WHO**	**0.01**	**0.02**	**10**	**0.02**	**0.01**	**0.05**

Source: Author's Computation, 2016

Table 4: Hotspots in the Three Land use Areas

Locations		$PM_{2.5}$ (mg/m^3)	PM_{10} (mg/m^3)	CO (ppm)	No_2 (ppm)	So_2 (ppm)	O_3 (ppm)
Residential Areas	Ogba S/Qrtrs	0.12	0.14	0.12	0.03	0.03	0.01
	Secretariat	0.14	0.10	0.14	0.03	0.02	0.01
	Magodo	0.14	0.13	0.24	0.06	0.05	0.01
	Ikeja GRA	0.16	0.14	0.20	0.04	0.04	0.004
	Agege H/Estate	0.08	0.09	0.09	0.01	0.01	0.01
	Maryland	0.22	0.11	0.85	0.22	0.30	0.02
High Traffic Areas	Oshodi	0.26	0.27	1.10	0.26	0.36	0.02
	Ojodu Berger	0.33	0.38	1.76	0.35	0.43	0.02
	Gen.Hospital	0.25	0.19	0.87	0.23	0.34	0.03
	Iyana-Ipaja	0.30	0.46	1.16	0.4	0.38	0.03
	Specomil	0.26	0.28	0.49	0.06	0.09	0.02
Industrial Areas	Wemabod	0.17	0.15	0.37	0.04	0.07	0.02
	Wempco	0.17	0.19	0.35	0.09	0.11	0.02
	Ize-Iyamu	0.23	0.26	0.73	0.13	0.12	0.03
	Matori	0.23	0.19	0.70	0.07	0.09	0.03
Int. Standards	WHO	0.01	0.02	10	0.02	0.01	0.05

*Reds signifies hotspot areas

Source: Authors Computation, 2016.

Table 5: Computed Toxicity Potential of the Criteria Pollutants

		$PM_{2,5}$ (mg/m^3)	PM_{10} (mg/m^3)	CO (ppm)	No_2 (ppm)	So_2 (ppm)	O_3 (ppm)
Locations		TP_{WHO}	TP_{WHO}	TP_{WHO}	TP_{WHO}	TP_{WHO}	TP_{WHO}
Residential Areas	Ogba S/Qrtrs	12	7	0.01	1.5	3	0.2
	Secretariat	14	5	0.01	1.5	2	0.2
	Magodo	14	6.5	0.02	3	5	0.2
	Ikeja GRA	16	7	0.02	2	4	0.08
	Agege H/Estate	8	4.5	0.09	0.5	1	0.2
	Maryland	22	5.5	0.09	11	30	0.4
High Traffic Areas	Oshodi	26	13.5	0.11	13	36	0.4
	Ojodu Berger	33	19	0.18	17.5	43	0.4
	Gen. Hosp.	25	9.5	0.09	11.5	34	0.6
	Iyana-Ipaja	30	23	0.12	20	38	0.6
	Specomil	26	14	0.05	3	9	0.4
Industrial Areas	Wemabod	17	7.5	0.04	2	7	0.4
	Wempco	17	9.5	0.04	4.5	11	0.4
	Ize-Iyamu	23	13	0.07	6.5	12	0.6
	Matori	23	9.5	0.07	3.5	9	0.6

*Reds signifies toxicity potential values above unity

Source: Author's Computation, 2016

It must be noted that toxicity potential values greater than unity indicates that such concentration has a tendency of causing harm to people that are exposed to it in such an environment and hence should be avoided. The toxicity potentials values highlighted in Table 5 are areas with concentration of criteria pollutants that has a potential for harmful effects to people. Fig. 3 shows the map of the hotspot areas.

Subsequently, Figure 3 shows the hotspot areas with high toxicity potential, these areas pose a serious health threat to the inhabitants around the areas and major road user's. For instance, Burnnet *et al* (1998) found a 4.3% increase in all-cause mortality for an increase in 24-hour average NO_2 levels 47μgm-^{3}. Dennison *et al* (2002) summarises the health effects of associated with exposure to Ozone as increase in daily Mortality, Respiratory and Cardiovascular diseases such as High blood Pressure, Cough, Phlegm and wheeze.

Long-term exposure to $PM_{2.5}$ is associated with an increase in the long-term risk of cardiopulmonary mortality by 6–13% per 10 $\mu g/m^3$

of $PM_{2.5}$ (Pope, C.A. III, 2002). Susceptible groups with pre-existing lung or heart disease, as well as elderly people and children, are particularly vulnerable. For example, exposure to PM affects lung development in children, including reversible deficits in lung function as well as chronically reduced lung growth rate and a deficit in long-term lung function (WHO, 2011). Dennison *et al* (2002) concludes that because of the correlations between SO_2 and other contaminants in the air it is difficult to confidently attribute the observed effects in the epidemiological studies to SO_2 alone.

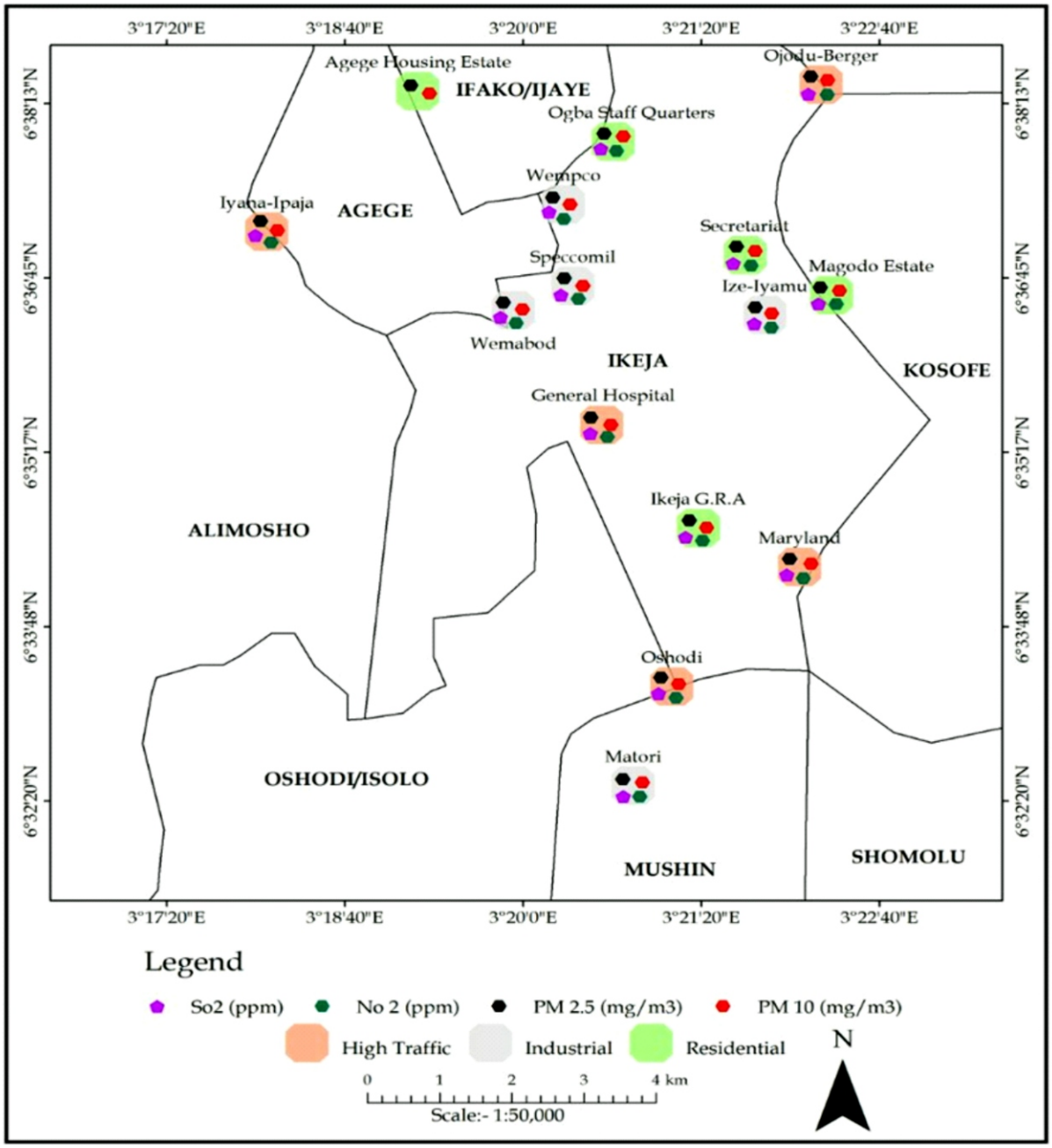

Figure 3: Spatial pattern of Hotspot areas of pollutants
Source: Authors Fieldwork, 2016

Conclusion

Spatial variation in the distribution of Criteria pollutants in Lagos was established. From the findings, it was evident that $PM_{2.5}$, $PM_{10,}$ SO_2 and NO_2 in sample areas clearly exceeded the regulatory limit set by WHO especially in the high traffic zones. Furthermore, CO and O_3 are well below the statutory standards. Areas such as Ojodu-berger, Oshodi, Ojota, Ikeja and Iyana-ipaja were classified as high risk areas. Also, the toxicity potential values for $PM_{2.5}$, $PM_{10,}$ SO_2 and NO_2 in the area of study are greater than unity while the values for CO and O_3 are lesser than unity. However, toxicity potential values greater than unity indicates that such concentration has a tendency of causing harm to people and hence should be avoided. This was because most of the criteria pollutants exceeded the recommended WHO value.

Recommendations and Policy Measures

There is need for better air quality in the state in order to reduce the health effect of air pollutants. These could be achieved, if only the Government could implement the following recommendations that was made based on the findings of this study. Government should create Lagos State air quality health index (AQHI) and report on cumulative health impacts associated with criteria pollutants to be monitored at suitable locations within the state. Enforcement agencies such as Lagos State Traffic Management Agency (LASTMA) and LAMATA should ensure the compliance of Industrial and vehicular emission standard and provision of database for determining air quality in major metropolitan area of the state. There are needs to encourage mass transportations throughout the state, cleaner modes of transportation and more sustainable energy generation in the state. Also, tree planting and greening of the environment should be sustained and improved upon throughout the state for aesthetics and carbon sequestration purposes.

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