*Quest Journals*
*Journal of Research in Environmental and Earth Science*
*Volume 4~ Issue 1 (2018) pp: 01-14*
*ISSN(Online) : 2348-2532*
www.questjournals.org

**Research Paper**

# INFLUENCE OF POPULATION GROWTH ON LANDUSE IN CALABAR METROPOLIS, NIGERIA

1. DIGHA, OPAMINOLA N., 2. IMAITOR, EBINEMI EDITH., 3. ARIWADUM MARTHA EKUNDAYO.,& 4. OSUJI, CHINWENDU LOVELYN

1. DEPARTMENT OF GEOGRAPHY AND PLANNING
ABIA STATE UNIVERSITY, UTURU, ABIA STATE NIGERIA
P.M.B 2000 UTURU.
2 & 3. DEPARTMENT OF GEOGRAPHY
ISSAC JASPER BORO COLLEGE OF EDUCATION, SAGBAMA,
BAYELSA STATE NIGERIA
P.M.B 74 YENAGOA.
4. DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL SCIENCE
UNIVERSITY OF CALABAR, CALABAR, NIGERIA
P.M.B. 1115 CALABAR.

**R**eceived 20 January, 2018; **A**ccepted 09 February, 2018 © The Author(S) 2018. **P**ublished With Open Access At **Www.Questjournals.Org**

***ABSTRACT*:** *This study was designed to the influence of population growth on land-use in Calabar Metropolis. Specifically, four objectives were formulated to guide the study with two null hypotheses as stated below; there is no significant relationship between population growth and the urban land-use in Calabar metropolis, the approaches to reducing urban sprawl have no significant impact on land-use of the study area. Stratified random sampling techniques was employed in determining the sample size, while simple random sampling techniques was used in the distribution of questionnaire to the 6 selected unit within the study area. However, population figures for the year 2000, 2010, and 2014 were collected from GIS and remote sensing tools were used to acquire images (radiometric and geometric corrected images) from different sources and the years of the images were co-registered. The techniques adopted includes Image pre-processing and pixel re-sampling techniques. Pearson product moment correlations technique and descriptive statistics were used for analysis of the empirical data. It was observed that due to population growth in Calabar Municipality, there has been increase in traffic congestion, rising cost of land, land conversion, urban sprawl and increasing house rent. Therefore it is recommended that zoning regulations be put in place as well as proper land use plannin be enforced by the government. Proper waste management techniques be also adopted to check obnoxious dumping of refuse. Essentially land use subdivision plan are necessary for orderly, economical and aesthetic arrangement of road networks, building structures, recreation areas, public utilities and services so as to create functional, efficient and aesthetically pleasing living environment.*

***KEYWORDS*:** *Population, Growth, Land use and Change*

## I. INTRODUCTION

In recent times population growth has contributed a serious problem especially in urban areas with high demand for commercial land–use. Rapidly, increasing human populations and expanding commercial, agricultural activities and residential purposes have brought about extensive land-use changes throughout the world. Though human beings have been modifying land to obtain food, shelter and other essentials of life for thousands of years, current extents and intensities of such modifications are far greater than ever in history and continue undocumented (Effiong, 2011).

Land is required for various uses in both the urban and rural areas of all society. It is a major factor of production and a vital element in the socio-economic development of any country or society (FMH DUD 2006).

Thus, as nations grew in size and rural areas become urban centres and urban centres become large metropolitan area, there is always increased competition as well as demand for land for different purposes.
Thus, effective urban land control and management particularly in areas with right urban sprawl such as Calabar Metropolis is crucial to tackling growing land use problems such as slum formation, rising costs of land, accessibility to urban land for land housing, incompatible use, flooding, overcrowding and congestion among others for the purpose of achieving sustainable city development and ensure the safety and health of the people. population growth which leads to urbanization has been identified as one of the most powerful and visible anthropogenic forces on earth. It is a process and outcome of social changes, in flow and concentration of people and activities in cities (Adeniji and Ogundiji 2009). They asserted that the dynamics of the process is driven by changes in population, employment opportunities associated with industrialization consumption patterns, international migration and accessibility.

According to Oka (2009) work on the impact of urbanization, said that within the last two and a half decades, Calabar Municipality has experienced unprecedented urban growth, this has led to alternation and alteration of several land uses. These land use alternation and alteration has impacted negatively on the spatio temporal land over features such as urban green areas, wetlands, riparian mangrove forest and other forest and grass land ecosystems, which are currently giving away for the construction of new roads, new residential and industrial layouts recreations and amusement parks etc. This phenomenon has triggered conspicuous land use change.

Atu, Offiong, Eni, Eja and Essien (2012) stated that in the past decades, the city built up area burst out ward in an explosion of sprawl that consumed former agricultural land at a break-neck pace. Thousands of hectares of land are covered by concrete and asphalt as new roads are created and existing ones are extended. Atu et al further stated that over 5,200.09 hectares of land at Ekorinum, Esuk Utan, Edim Otop and Ikot Efanga have been converted to low density residential, commercial and industrial uses as these areas are merged with urban areas. The development is consequent on the growth of the population of Calabar Metropolis for instance in 1991 the population of Calabar Municipality was 143,089, with a density of less than a thousand person per square kilometers. In 2006, the population recorded was 176,392 with a population density of above a thousand persons square kilometer according to (Cross River State Economic Blue Print 2007-2008).

In Calabar the high influx of people into the state capital for recreation and tourism has caused a high demand for commercial land use in the Metropolis which is the centre for commercial activities. Besides, the high rural urban migration in the area generated demand for socio-economic activities, this causing high demand for the land. Apart from this, the unique characteristic of the area has equally caused investors not to abide to the planning laws. This has resulted to negative look of certain parts of the city fire explosion, hazards, dust and noise congestion, residential traffic and high cost of land.

The rapid population growth and urbanization of the Calabar Metropolis has been fueled by the massive influx of people from the surrounding hinterland to the city for job opportunities in various commercial enterprises has made land use charges difficult. These land use worsen traffic situation due to clustering in space. Also, population growth has led to the issue of poor housing quality because of the rush by some land owners to change the landuse pattern for quick profit for providing sub-standard building. The slum housing condition in most house of the low income socio-economic group in some area is dehumanizing thus, study is to critically examine the pattern of land use in Calabar Municipality with respect to the major factors influencing the land-use changes in the study area.

### 1.2 Objectives

The aim of the study is to examine the influence of population growth on land-use changes in Calabar Metropolis. To meet the objective the study, the following specific objectives were generated:

1) To examine population growth and its impacts on land-use changes in Calabar Metropolis
2) To investigate (determine) the population related land use changes in Calabar metropolis.
3) To ascertain the extent and trend of land use change within and around Calabar Metropolis.
4) To examine the various approaches identified to reduce population growth on land use changes in Calabar Metropolis.

### 1.3 Research hypothesis

The following were hypotheses formulated:

*Corresponding Author: *DIGHA, OPAMINOLA N* 
*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

$H_O$: There is no significant relationship between population growth and urban land-use change in Calabar Metropolis.

$H_O$: The approaches to reducing urban sprawl have no significant impact on land-use changes in Calabar Metropolis.

### 1.4 Location and extent of the study

The study area (Calabar municipality and its environs) lies between latitudes $4^0 40^1$ and $5^0 05^1$ N of the Equator and longitudes $8^0 35^1$ and $8^0 50^1$ E of the Greenwich Meridian. It covers a total land area of about 331.551Km$^2$. Accessibility of the area can be through the major road Murtala Mohammed Highway, various tarred and un-tarred roads also lead to the study area (see Fig. 1), (Eni, Upla and Ubi, 2014).

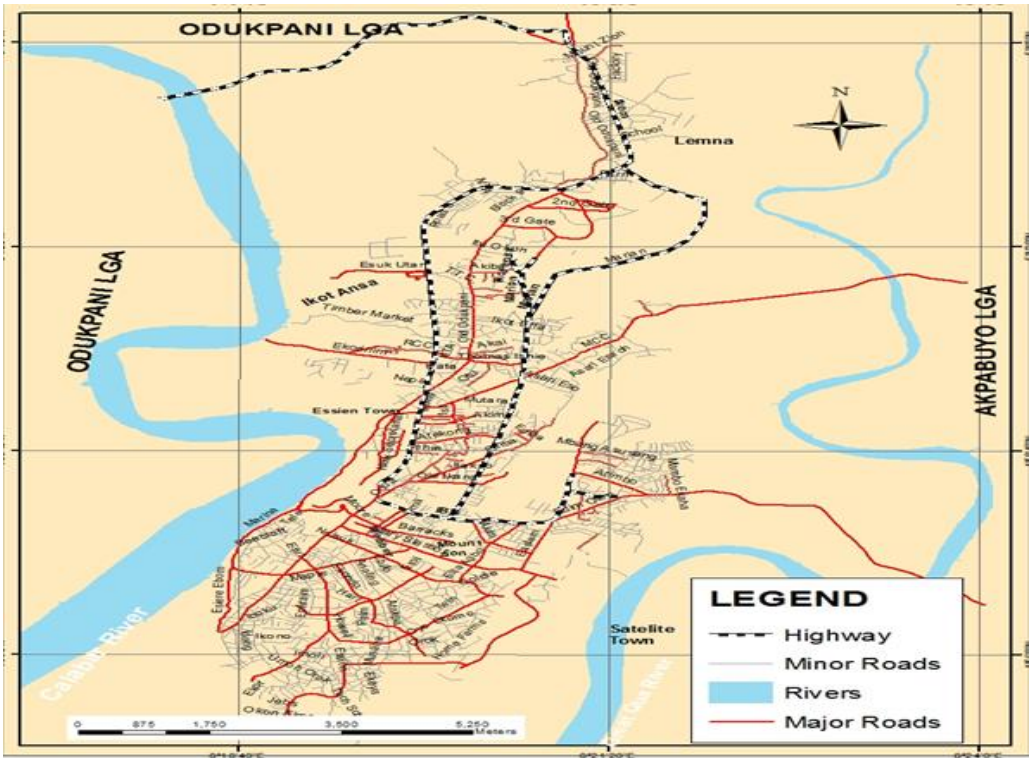



**FIG. 1: Map of Calabar Municipality Showing Sample Locations**

**Source: Geographic Information System (GIS) Laboratory, Department of Geography and Environmental Science, University of Calabar.**

The study area is highly undulating, rugged topography comprising dissected, regular terrain of weathered ridges and deep troughs. The altitude vary from about 10-65 meters above mean sea level with sharp gradation down slope. The site lies within the Calabar Flankgeosyncline which extends from the southern margins of the Oban massif in the eastern hinge line of the Niger Delta, in the West structural Charlot ocean transform fault separates the Calabar flank basin from the Niger Delta Basin. Rocks of cenomenians age occur only north of Calabar which units together to from the Odukpani group (Nwankwoala, 2010).

Rainfall is very high in Calabar with an annual rainfall average of 2000mm to 3000mm, (Inyang, 1980). Average temperature varies between 25-28$^O$C (Iloeje, 1991). The vegetation of the study area is the tropical rainforest and it was characterized by these layer canopies with the emergent trees. It is a closed canopy forest (60 – 100 species per sqkm) with 3-4 layers the canopy weight of this forest was between 25-50m tall with emergent trees up to 100m (Eya, Nwachi, Sunday, Inah and Ita 2011).

Two ethic groups from the indigenous population these are Quas and Efiks. However because of its cosmopolitan status there abound people from all parts of the state Nigeria in the city. As at 2006 National population census the population of Calabar stands at 370,292 (Eni, Upla and ubi, 2011).

*Corresponding Author: *DIGHA, OPAMINOLA N*

*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

## 1.5 MATERIALS AND METHODS

To achieve the objective of the study, the following data were required: the population data of study area, satellite imagery of 2000, 2010 and 2014 covering the entire study area. Multiple-choice questionnaire were used to carry out the investigation on the influence of population growth on land use changes within the Calabar metropolis. Also, personal observation and interview were made to supplement the data on the questionnaire. The questionnaire was fashioned to meet the objectives of the study and provide necessary information. Also, Geographic Information Systems (GIS) were used to analysis and determine the extent of change in the land-use type in 2000, 2010 and 2014. To obtained manageable sample size of residents of the study area that were interviewed using the multiple-choice questionnaire, the study area was divided into 50 clusters. The clusters in each district were then reduced to a manageable size without losing their identity. This was achieved through the application of stratified random sampling of the clusters in the 6 districts. 12 different strata were obtained from each of the six districts using the method mentioned above. And 20 questionnaires were administered within each stratum using random sampling which amount to 120 questionnaires administered in each of the six districts of the study area.

The Figure 2 shows the flow chart adopted for the land-use change analysis. Image (Landsat imagery) processing of the study area was carried to determine the area extent of land-use changes, with use ERDAS imagine 2010 and ArcGIS 10.1 software. The Landsat imagery used for this study was acquired from the US Geological Survey GLOVIS web-based data service (glovis.usgs.gov), in L1T (level 1 Terrain-corrected) format. This is an orthorectified product that generally has sufficient spatial accuracy to allow direct comparison between images. These images are identified as Landsat path 188, row 57 and cover the entire study area. For the early date, 2000, 2008 Landsat 7 (ETM+) images were used while 2014 landsat (LDCM) was used for 2014 date, (Figure 3, 4 and 5). This typically involves the harmonization of the images acquired to ensure that they conform to the same spatial resolution (Pixel Size).
Following the acquisition of images (radiometric and geometric corrected images) from different sources and years, they were co-registered. This was to ensure that pixel comparison can be carried out from images acquired on different date and from different sensors.

This study used the post classification comparison method, where multiple dates of satellite images were first classified into land cover images and then compared to assess changes in land-use over time. To prepare the images for classification, spectral enhancement was performed on the rectified image. Spectral enhancements are modifications of the pixel values of an image. They can be used to improve interpretability, reduce information redundancy, and extract information from the data which is not readily visible in its raw form. The enhancements utilized for this study was principal components analysis. Principal Components Analysis (PCA) is a spectral enhancement which can be used to compress the information content of a multispectral data set (Sabins, 1997). PCA uses mathematical algorithms to transform n bands of correlated data into n principal components which are uncorrelated, such that the coordinate axes of the components are mutually orthogonal (Corner, 2012). The first principal component (PC-1) describes most of the variation of the brightness values for the pixels of the original bands (Jensen, 1996). Subsequent components explain less and less of the data, with the final PC usually corresponding to atmospheric noise in the data rather than any ground features (Sabins, 1997). The main benefit of principal components analysis is that it can reduce the amount of data (bands) without losing much of the information and typically reducing redundancy (Jensen, 1996).

Once processed, unsupervised classification method was used to obtain land cover type. This method assigns pixels to one of 60 unique clusters based on the spectral response of the pixel across all spectral bands, using the ISODATA unsupervised classification technique (ERDAS, 2010; Jensen, 1996). Next, each pixel cluster was assessed to determine the predominant land cover type of the pixels within the cluster. The assignment of a predominant land cover type was based on a visual inspection of the location and appearance of the pixels and ancillary data, including 2014 field data. If an original cluster contained a mix of more than one land cover class, it was set aside for further processing. This processing involved running the ISODATA algorithm on the mixed cluster to further break it apart into ten new clusters. These ten clusters were again visually inspected, class trajectories identified and incorporated back into the original scene.

## 1.6 RESULTS AND DISCUSSION

*Corresponding Author: *DIGHA, OPAMINOLA N* 
*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

**Table 1: Problems associated with land use change in Calabar**

| **Options** | **Frequency** | **Percentage** |
|---|---|---|
| Development visitation | 30 | 25.0% |
| Flooding | 21 | 17.5% |
| Congestion (traffic) | 27 | 22.5% |
| Increasing land value | 25 | 20.83% |
| Others | 17 | 14.17% |
| Total | 120 | 100 |

Table 1: shows that 30 respondents representing 25% indicated that the problem associated with land-use charge in Calabar is development visitation, 21 respondents representing 17.5% says flooding is the problems associated with land-use change in Calabar; 27 respondents representing 22.5% says traffic congestion is the problem associated with land-use in Calabar; 25 respondents representing 20.83% says increasing land value is the problem associated with land-use in Calabar; while 17 respondents representing 14.17% maintained that other problems such as pollution, indiscriminate waste disposal and high crime rate.

**Table 2: Population induced activities that influence land use change**

| **Options** | **Frequency** | **Percentage** |
|---|---|---|
| Urban agriculture | 13 | 10.83% |
| Urban sprawl | 21 | 17.50% |
| Urban housing | 39 | 32.50% |
| Industrialization | 41 | 34.17% |
| Others | 6 | 5.00% |
| Total | 120 | 100 |

Table 2 shows that 13 respondents representing 10.83% says population affect land use change through urban agriculture, 21 respondents representing 17.50% says that population affect land use change through urban sprawl; 39 respondents representing 32.50% says that population affect land-use change through urban housing; 41 respondents representing 34.17% maintained that population affect land use change through industrialization; while 6 respondents representing 5% says population affect land-use change in other ways.

**Table 3: The most significant evidence of population growth in Calabar**

| Options | Frequency | Percentage |
|---|---|---|
| Congestion of traffic on the streets | 36 | 30.0% |
| Rising cost of land | 41 | 34.17% |
| Urban sprawl | 18 | 15.00% |
| Land use conversion | 15 | 12.50% |
| Crime rate | 7 | 5.83% |
| Others | 3 | 2.50% |
| Total | 120 | 100 |

Table 3 shows that 36 respondents representing 30% says the most significant evidence of population growth is the congestion of traffic on the streets of Calabar; 41 respondents representing 34.17% says rising cost of land is the most significant evidence of population growth in Calabar; 18 respondents representing 15% says urban sprawl is the most significant representing 12.5% says land-use conversion to the most significant evidence of population growth in Calabar; while 3 respondents representing 2.5% says other issues such as high rent charges and lack of accommodation is the most significant evidence of population growth in Calabar.

**Table 4: The main effect of land use change in the study area**

| Options | Frequency | Percentage |
|---|---|---|
| Flooding | 28 | 23.33% |
| High cost of land | 19 | 15.33 |
| Poor urban design and aesthetics | 23 | 19.17 |
| Poor land use planning and management | 47 | 39.19 |
| Others | 3 | 2.50 |
| Total | 120 | 100 |

*Corresponding Author: *DIGHA, OPAMINOLA N*

*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

Table 4 shows that 28 respondents representing 23.33% says flooding is the main effect of land use change in the study area, 19 respondents representing 15.83% says high cost of land is the main effect of land use change in the study area, 23 respondents representing 19.17% says poor urban design and aesthetics is the main effect of land use change in the study area; 47 respondents representing 39.17% says poor land use planning and management is the main effect of land use change in the study area; while 3 respondents representing 2.5% says other issues like none zoning of land use in the main effect of land use change in the study area.

**Table 5: Responses as to which area of Calabar metropolis has been affected as a result of land use change**

| Options | Frequency | Percentage |
|---|---|---|
| Atimbo | 9 | 7.50% |
| Eight miles | - | - |
| Akai Effa | 5 | 4.17% |
| Ekorinim | - | - |
| All of the above | 106 | 88.33% |
| Total | 120 | 100 |

Table 5 shows respondents representing 7.5% says Atimbo is the area mainly affected as the result of land use change in Calabar; 5 respondents representing 4.17% says AkaiEffa area is the major port affected by land use change in Calabar; while job respondents representing 88.33% says al the listed areas mentioned above has been affected as a result of land use changes in the study area.

**Table 6: The environmental consequences of land use change in Calabar**

| **Options** | **Frequency** | **Percentage** |
|---|---|---|
| Loss of ecological zone within Calabar | 31 | 25.83% |
| Loss of gender and nature species | 8 | 6.67% |
| High incidence of flooding | 30 | 25.00% |
| Urban heat island | 21 | 17.50% |
| Loss of biodiversity | 23 | 19.17% |
| Contamination of ground water | 4 | 3.33% |
| Others | 3 | 2.50% |
| Total | 120 | 100 |

Table 6 shows that 31 respondents representing, 25.83% says loss of ecological zone within Calabar is the major environmental consequences of land use change in Calabar, 8 respondents representing 6.67% says it is loss of garden and nature spaces; 30 respondents representing 25.0% says high incidence of flooding in the environmental consequences of land use change in Calabar; 21 respondents representing 17.5% says it is urban heat island, 23 respondents representing 19.17% says loss of biodiversity is the environmental consequences of land use change in Calabar; 4 respondents representing 3.33% says contamination of underground water is the main environmental consequences of land use in Calabar; whiles 3 respondents representing 2.5% says others environmental consequences of land use change in the study area include pollution, and indiscriminate dumping of waste.

**Table 7: The positive impact of land use change**

| **Options** | **Frequency** | **Percentage** |
|---|---|---|
| Industrialization | 40 | 33.33% |
| Increased commercial activities | 35 | 29.17% |
| Flourishing land rent market | 12 | 10.00% |
| Immigration | 2 | 1.67% |
| Improved urban landscape | 31 | 25.83% |
| Total | 120 | 100 |

Table 7 shows that 40 respondents representing 33.33% indicated that the positive impact of land use change in the study area is industrialization, 35 respondents representing 29.17% says increased commercial activities is the possible impact of land use change in the study area; 12 respondents representing 10% says

*Corresponding Author: *DIGHA, OPAMINOLA N* 
*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

flourishing land rent market is the positive impact of land use charge in the study area; 2 respondents representing 1.67% says immigration is the positive impact of land-use change in the study area.

**Table 8: How government can ameliorate the impacts of land use change in the study area**

| Options | Frequency | Percentage |
|---|---|---|
| Effective land-use/zoning control | 45 | 37.5% |
| Effective implementation of master plan | 24 | 20.0% |
| Mass housing development | 6 | 5.0% |
| Effective land-use planning/ management | 42 | 35.0% |
| Others | 3 | 2.5% |
| Total | 120 | 100 |

Table 8 shows that 45 respondents representing 37.5% indicated that government should adopt effective land use/zoning control measures to ameliorate the impact of land use change in the study area, 24 respondents representing 20% plans should be encouraged to ameliorate the impact of land use change in the study area; 6 respondents representing 5% says government should adopt mass housing development in the study area to check the impact of land use planning/management should be adopted to ameliorate the impact of land use change in the study area; while 3 respondents representing 2.5% says other ways such as land subdivision and layouts techniques can be used to check the incidence of or impact of land use change in the study area.

**Hypothesis one**

This hypothesis states that there is no significant relationship between population growth and urban land-use use changes in Calabar Metropolis.

The null hypothesis was tested using Pearson Product Moment Correlation Coefficient Analysis. The result is presented below:

**Table 9: Pearson Product Moment Correlation Coefficient Analysis between population growth and urban land-use changes.**

| Variables | ∑X | ∑Y | ∑XY | $\sum Y^2$ | r | t | Critical | df |
|---|---|---|---|---|---|---|---|---|
| Population growth | 1296 | 4356 | | | | | | |
| | | | | | | | | |
| | | | | 29836 | | | | |
| | | | | | | | | 198 |
| Urban land-use | | | | | | 1.00 | 1.96 | |
| Changes | | 120 | | | | | | |
| | | | 20406 | 10478 | | | 3.51 | |

The r-value of 1.00 was converted to calculated t-value 3.509 having compared the calculated t-value (3.51) with that of critical t-value (1.96) at 0.05 level of significant with 198 degree of freedom, the calculated the null hypothesis is rejected and this implied that there is a significant relationship between population growth and urban land-use changes in Calabar Metropolis.

**Hypothesis two**

The approaches to reducing urban sprawl have no significant on land-use changes impact on land-use changes in Calabar Metropolis. To test this, Pearson moment correlation coefficient analysis method was applied the result is shown below:

| Variables | ∑X | ∑Y | ∑XY | $\sum Y^2$ | $\sum x^2$ | r | t | Critical | df |
|---|---|---|---|---|---|---|---|---|---|
| Approaches to reducing urban sprawl | 1296 | | | 3848 | 3892 | | | | |
| Urban land-use Changes | | | 3605 | | | 0.73 | | | |
| | | 120 | | 29836 | 49481 | | 3.73 | 1.96 | 198 |

*Corresponding Author: *DIGHA, OPAMINOLA N*

*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

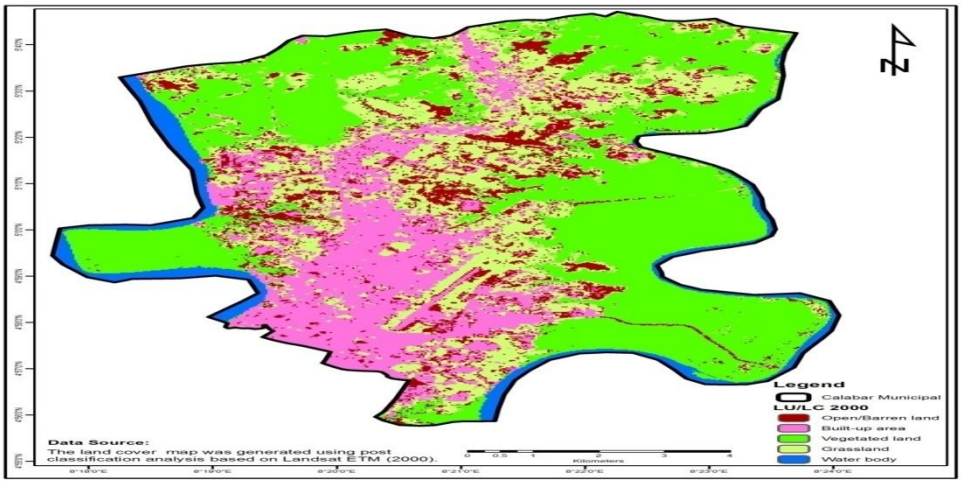
The r-value of 0.73 was converted to calculated t-value of 3.73. Having compared the calculated t-value (3.73) with the critical t-value (1.96) at 0.05 level of significance with 198 degree of freedom. The calculated t-value is greater than the critical t-value thereby disqualifying the null hypothesis and the implied that the approaches to reducing urban sprawl have a significant impact on land-use changes in Calabar Metropolis.

Hypothesis one reveals that there is a significant relationship between population growth and urban land-use changes in Calabar Metropolis, the result shows that the calculated t-value of 3.51 was found to be greater than the critical t-value of 1.96 when tested at 0.05 level of significance. This result agreed with the views of Effiong (2011) who asserts that rapidly increasing human population and expanding agricultural activities have brought about extensive land-use changes throughout the world. Also according to Omojola and Jegede (2013) identified the most striking feature of the urban land use changes as, over population, limited access to technical knowledge, high rate of unemployment, etc.

Hypothesis two reveals that the approach to reducing urban sprawl has significance impact on urban land use changes in Calabar Metropolis. This finding shows that the calculated t-value of 3.73 was found to be greater than the critical t-value of 1.96 when tested at 0.05 level of significance. This finding is supported by Sule (2010) who asserts that poor zoning restriction could hinder the optimal efficient usage of a given area. That zoning is a device for land use planning used by governments to Mapped out zones which separate one set of land uses from another. Therefore the approach for reducing urban sprawl has significant impacton land use changes not only in Calabar Metropolis but other major cities in Nigeria.

Once processed, unsupervised classification method was used to obtain land cover type. This method assigns pixels to one of 50 unique clusters based on the spectral response of the pixel across all spectral bands, using the ISODATA unsupervised classification technique (ERDAS, 2010; Jensen, 1996). Next, each pixel cluster was assessed to determine the predominant land cover type of the pixels within the cluster. The assignment of a predominant land cover type was based on a visual inspection of the location and appearance of the pixels and ancillary data. If an original cluster contained a mix of more than one land cover class, it was set aside for further processing. This processing involved running the ISODATA algorithm on the mixed cluster to further break it apart into ten new clusters. These ten clusters were again visually inspected, class trajectories identified and incorporated back into the original scene.

This process led to six land cover classifications, one each for 2000, 2010 and 2014 images. Next, the multiple land cover types in each scene were re-classed into five land-use type: open/barren land, built-up area, vegetated land, and grassland and water body. This was done because of the need to focus mostly on transitions from other land-use to built-up area in order to better model land-use change rate and to ensure a higher overall classification accuracy. The results of this process are the final land cover maps shown in figure 5, 6, and 7.These maps depict the spatial land-use of Calabar metropolis as it was in 2000, 2010 and 2014. There was a major increase in the built-up from 2000 to 2010 and as well as from 2010 to 2014 as shown on the maps. This gain in built-up was actually at expense of other land-use type (open/barren land, vegetated land and grassland)




*Corresponding Author: *DIGHA, OPAMINOLA N* 
*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

**Figure 6: Land-usemap of the study area as at 2000 derived from 2000 Landsat (ETM).**

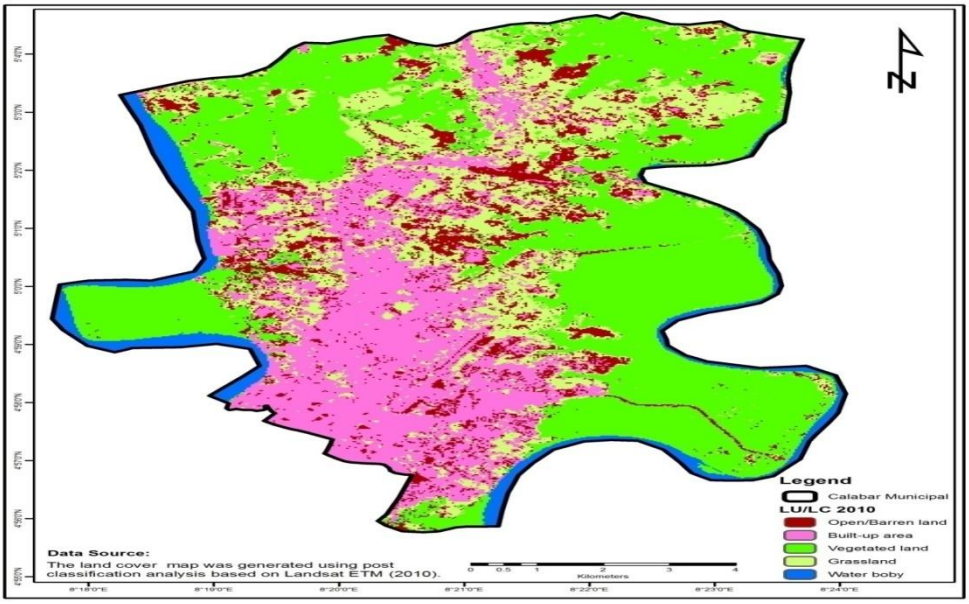



**Figure 7:Land-use map of the study area as at 2010 derived from 2010 Landsat (ETM).**

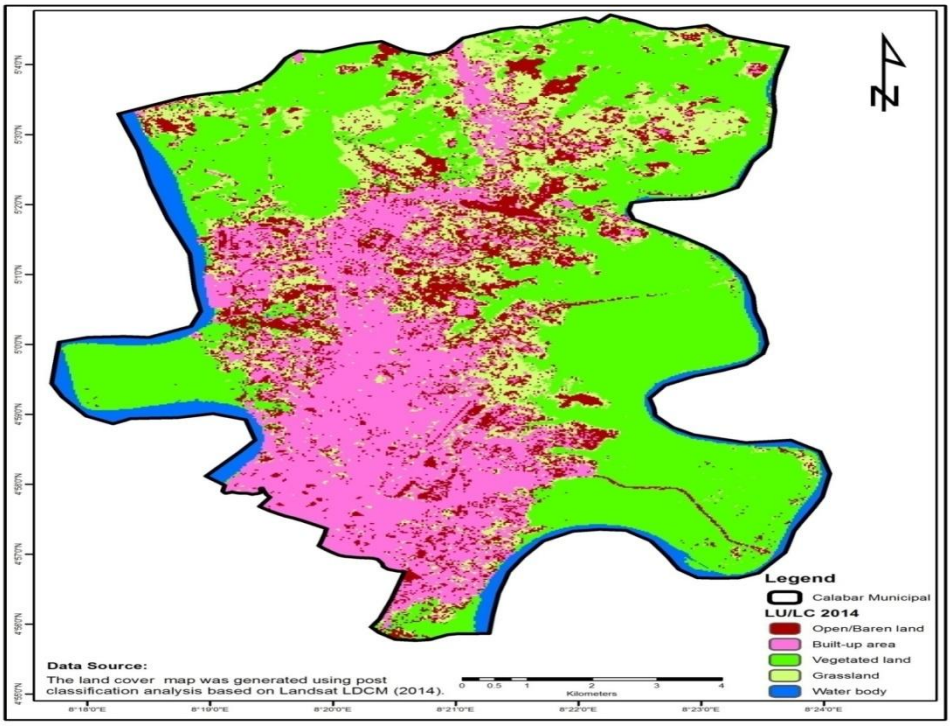



**Figure 8: Land-use map of the study area as at 2014, derived from 2014Landsat (LDCM).**

The quantity of changes occurred in land-use type that occurred in the study area across the three time periods (2000, 2010 and 2014) is captured in the table 2, 3 and 4. From the reference baseline of 2000, out of a total study area of 11,311.74ha; the open/barren land, built-up area, vegetated land and grassland were 3,175.29ha (28.07%); 2,885.51ha (25.51%); 3,340.98 (29.54%) and 1,290ha (11.40%) respectively as shown in the table 2. From the table 3, there was a decrease of open/barren land from 28.07% in 2000 to 20.21% in 2010 representing about 7.86% loss of open/barren land while in the same period there was an increase in built-up area from 25.51% in 2000 to 42.90% in 2010 amounting to 17.39% gain in the built-area in Calabar metropolis. A similar trend was equally witnessed from 2010 to 2014 as shown in the table 4. Within this period, the built-area increased from 42.90ha in 2010 to 43.22ha in 2014 while the open/barren land, vegetated land, and

*Corresponding Author: *DIGHA, OPAMINOLA N* 
*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

grassland decrease from3,175.29ha; 3,340.98ha and 1,290ha in 2010 to 2,286.38ha; 2,451.00ha and 1,102ha in 2014 respectively.

**Table 15: Areal extent of land use types in the study area in 2000**

| Land use types | Areal extent (ha) | % |
|---|---|---|
| Open/Barren land | 3,175.29 | 28.07% |
| Built-up area | 2,885.51 | 25.51% |
| Vegetated land | 3,340.98 | 29.54% |
| Grassland | 1,290 | 11.40% |
| Water | 619.96 | 5.48% |
| **TOTAL** | **11,311.74** | **100.00%** |

**Table 16: Areal extent of land use types in the study area in 2010**

| Land use types | Area extent (ha) | % |
|---|---|---|
| Open/Barren land | 2,286.38 | 20.21% |
| Built-up area | 4,852.40 | 42.90% |
| Vegetated land | 2,451.00 | 21.67% |
| Grassland | 1102 | 9.74% |
| Water | 619.96 | 5.48% |
| **TOTAL** | **11,311.74** | **100.00%** |

**Table 17: Areal extent of land use types in the study area in 2014**

| Land use types | Area extent (ha) | % |
|---|---|---|
| Open/Barren land | 2,397.49 | 21.19% |
| Built-up area | 4,889.29 | 43.22% |
| Vegetated land | 2,451.00 | 21.67% |
| Grassland | 954 | 8.43% |
| Water | 619.96 | 5.48% |
| **TOTAL** | **11,311.74** | **100.00%** |

The 1991 and 2006 Nigeria population census showed a modest increase of population of Calabar from 283,065 in 1991 to 375,196 in 2006. The projected population of Calabar metropolis as at 2014 is about 469,999 people (Table 1). The impact of this population growth is an attendant areal expansion of the built-up area in Calabar metropolis at expense of other land-use type (Open/barren land, grassland and vegetated area). The data on Table 1 showed three time period of projected population in the study area and their corresponding amount of built-up area.

**Table 18: Population growth and land use changes**

| Year | Population | Built areal extent (ha) |
|---|---|---|
| 2000 | 372,276 | 2,885.51 |
| 2010 | 417,588 | 4,852.40 |
| 2014 | 469,999 | 4,889.29 |

The data on Table 1 were used to test the hypothesis for this study as follows:

$H_o$: There is no significant relationship between population growth land-use changes in Calabar metropolis.

$H_1$: There is significant relationship between population growth land-use changes in Calabar metropolis.

The Pearson Product Moment Correlation technique was used to test the hypothesis. The results of this correlation analysis are presented in Tables 2.

**Table 19: Result of correlation between population Growth and land use changes in Calabar**

| R | Degree of Freedom | T-cal | T-tab | Sign. level |
|---|---|---|---|---|
| 0.85 | 3-2=1 | 15.023 | 4.303 | 0.05 |

From Table 2, the coefficient of correlation is 0.85 which shows a positive relationship between population growth and land-use change in Calabar metropolis. The t-test showed that t-cal of 15.023 is greater than t-tab of 4.303 at 0.05 significance Level. The null hypothesis is rejected while the alternative hypothesis is accepted,

*Corresponding Author: *DIGHA, OPAMINOLA N* 
*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

that is, there is a significant relationship between population growth and land-use change in Calabar metropolis (see fig 8,9 and 10).

**Fig 9: Calabar Land cover/Land cover change 2004**

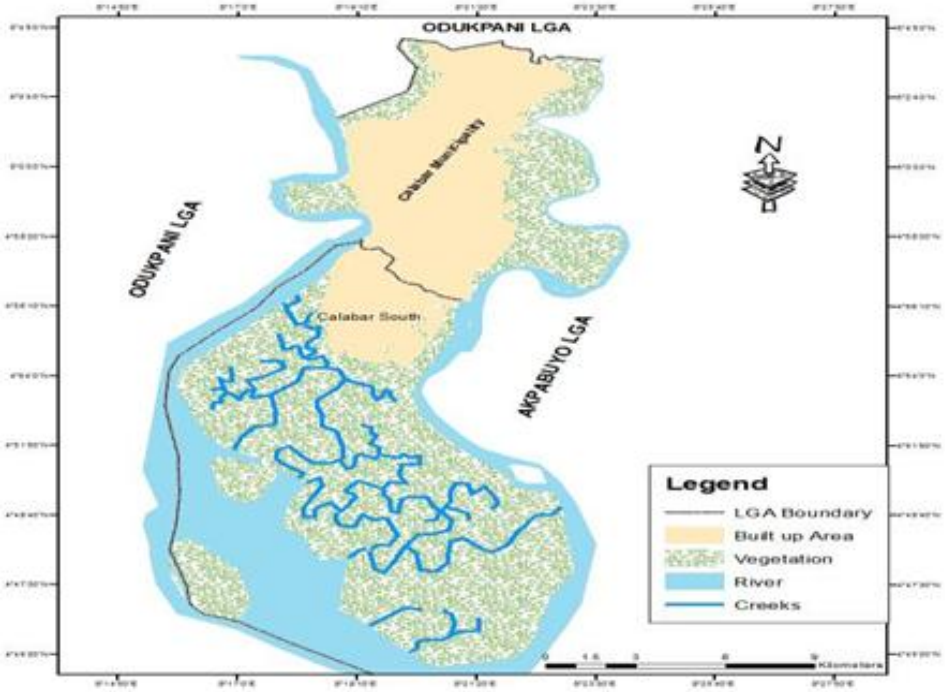



**Figure 10: Calabar Land cover/Land cover change 2005-2006**

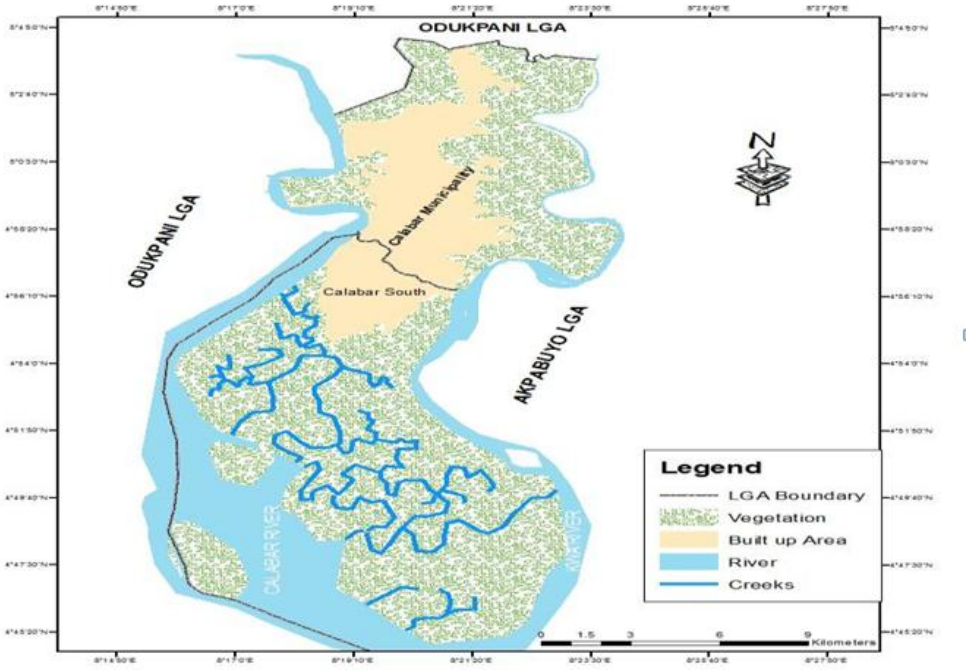
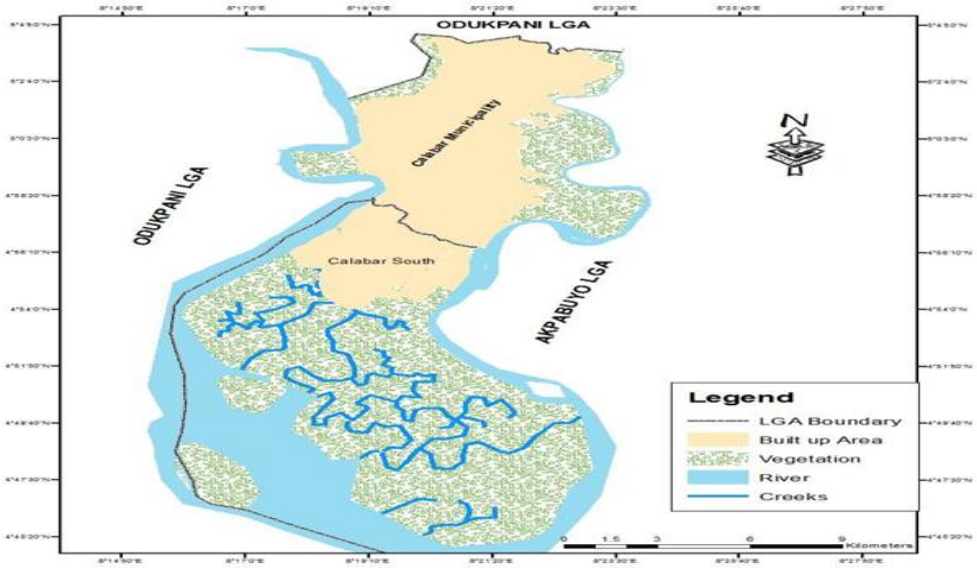



**Figure 11: Calabar Land cover/Land cover change 2010 – 2012**




### 1.7 Conclusion

The study focused on influence of population growth on land-use changes in Calabar metropolis. It is believed that due to rapidly increasingly human population growth and such other as activities this resulted to rapid increase in the use of land and other activities that are done on the land. This has resulted also in urban sprawl or gentrifications which affect land, pressure on amenities/facilities and traffic congestion. Housing problems arising from rapid population growth includes overcrowding, slum and squatter settlements.

### 1.8 Recommendations

- Zoning regulations which are used by local governments in most developed countries can be used or adopted in other to segregate uses that are thought to be incompatible.
- Land use planning, which government can adopt and use to manage the development of land within their jurisdiction, in doing so, the government can plan for the needs of the community while safe guarding natural resources.
- Air and noise control: is another factor of a healthy environment, noise control measures can be put in place by government irritating and excessive noise in the environment can also cause anxiety attacks or lead to distractions, among other things which can lead to accidents and other potentially hazardous situation.
- Recycle and reuse method should be adopted to reduce the rate of pollution.

Land subdivision is the critical step in the growth of any city, it is a step in the land use planning process that cannot be revered as soon as physical developments starts. The mistakes made in subdivision plan can hardly be corrected without having to cause people, developers and government to spend a lot of money.

**Figure 2: The Flow chart**

*Corresponding Author: *DIGHA, OPAMINOLA N*

*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*

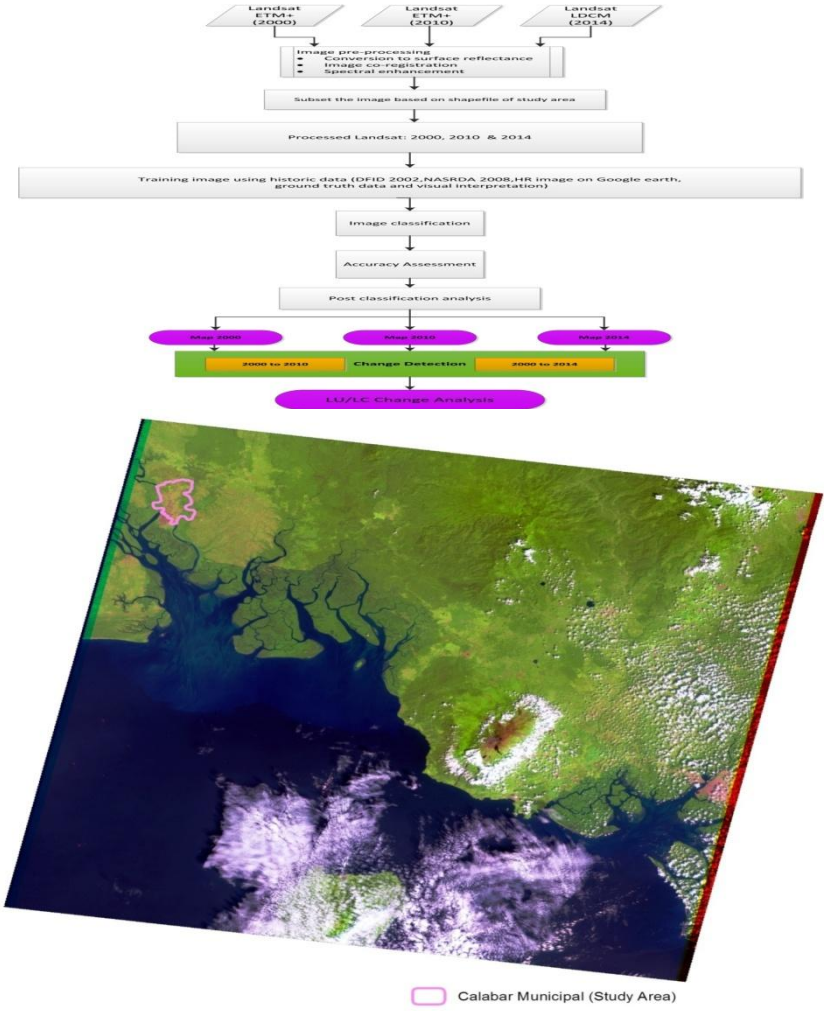
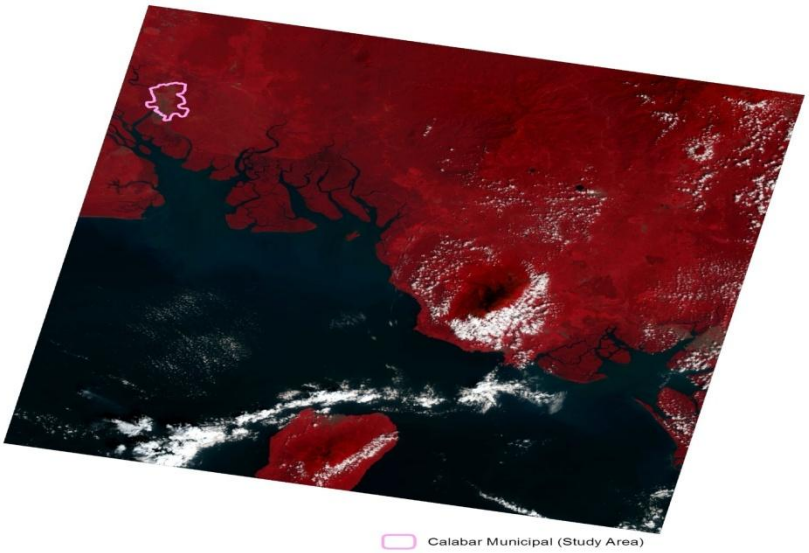



**Figure 5: Satellite image, LDCM 2014 used for the study**




## REFERENCES

[1] Adeniji, G. and Ogundiji, B. (2009). Climatic adaptation in Nigerian cities: regularizing informal and illegal settlements in Ibadan: A paper presentation for the World Bank's 2009 urban symposium June 28-30, Marseille, France.

[2] Aribigbola, A. (2008). Improving Urban Land-use planning and management in Nigeria: the case of Akure Theoretical and Empirical researches in urban management vol. 3 No 9.

[3] Aribigbola, A. (2013). Constraints to urban land use planning and management in Nigeria: evidence from Ondo state. *Journal of environment*, 2(3), 66-73.

[4] Atu, J. E., Offiong, R. A., Imoke, E. D., Eja, E. I. and Essien, O. E. (2012). The effect of urban sprawl on peripheral agricultural lands in Calabar, Nigeria, international review of social sciences and humanities, 2(2), 68-76.

[5] Digha, O.N & Ekanem, J.D. (2015. Effects of Population Density on Water Quality in Calabar Municipality Cross River State, Nigeria. Journal of Environment and Earth Science. 3(6):2224-3216.

[6] Digha, O.N; Eni, D. & Oruatu, M. (2014). Effects of Agricultural Landuse practices on the soils in Cross River Basin, Ogoja Nigeria. Universe of Emerging Technologies and Science. 1(5):2349-655x.

[7] Effiong, J. (2011).Changing pattern of land-use in the Calabar River catchment, South-eastern Nigeria, *Journal of sustainable development*, 4, February.

[8] Eja, E.I, Nwachi, C. C; Sunday, I. B. Inah, S. A and Ita, D. I (2011).Analysis of commercial land-use pattern in Cross River Nigeria, Journal of Environmental Science and resource Management vol. 3 March.

[9] Eni, D. D. and Ukpong, B. J. (2014). The impact of population growth on residential landuse in Calabar, Cross River State, research on humanities and social science, 4(14).

[10] Eni, D. I., Upla, J. I. and Ubi, A. E. (2014).The influence of Topography on the distribution of urban heat Island effect in Calabar Metropolis.

[11] ERDAS (1997). ERDAS field Guide. Atlanta, Georgia: ERDAS, inc.

[12] Fabiyi, O. O. (2006). Urban land use change analysis of a traditional city from remote sensing data; the case of Ibadan metropolitan area, Nigeria, humanity and social science, (1), 42-64.

[13] Federal Ministry of Housing & Urban Development (FMH & UD, 2006) sustainable Human settlement development National urban strategies Abuja: pedal Digital press.

[14] Federal Ministry of Housing and Urban Development (FMH& UD, 2000).Sustainable human settlement development. National urban strategies, Abuja, Petral Digital press.

[15] Jensen, J. R. (1996). Introductory Digital Image Processing. A Remote Sensing Perspective. Second Edition. Prentice Hall.

[16] Nation Population Commission (2007).The 2006 census for Calabar, Cross River State.

[17] National Population Commission Census Report (2007). Federal government of Nigeria official Gazette.

[18] Ogba, Sur. C. and Inah, O. (2012). An assessment of the impact of land use characteristics on residential choice making: implication to urban transit planning in Port Harcourt, Nigeria. FIA working week: knowledge to manage the territory, protect the environment, evaluate the cultural heritage, Rome, Italy 6-10 May.

[19] Oka, P. O. (2009).Managing the impact of urbanization on biodiversity in emerging urban fringe settlement the case of satellite town, Calabar, Nigeria.Global journal of social sciences, 8(1), 13-20.

[20] Oke, I. E. (2009). Intra-city transportation and Land-use planning in Nigeria: The case of Port Harcourt Metropolis, River State. Unpublished PHD research thesis department of Geography & Regional Planning, University of Calabar, Calabar.

[21] Okebukola, P. O. (2001). Perspectives on waste and waste management. In P. O. Okebukola and B. B Akpan (eds) Strategies for teaching waste management. Ibadan: STAN.

[22] Ola, C. S. (1984). Own and country planning and environmental laws in Nigeria, University press Ltd., 73.

[23] Omojola, O. A. and Jegede, A. O. (2013). Challenges of sustainable and urban development: A case study of Ado-Ekiti state, Nigeria. International research, 1(1), 22-27.

[24] Oyesiku, K (1997). Modern Urban and Regional Planning Law and Administration in Nigeria Krafe books Ltd.

[25] Sabins, Floyd F. (1997). Remote Sensing: *Principles and interpretation.* 3rd edition. New York: Freeman, 1997.

[26] Sule, R. O (2004). The Consequences of Rapid Urbanization in countries of the developing world, Calabar: Thump prints international company.

[27] Wu, J. (2013.) environmental Amenities, urban sprawl and community characteristics. Journal of Environmental economics & Management, 52, 527-547.

[28] Yahaya O. Y and Isluak, Y. (2013). Effective urban land use planning in Nigeria issue and constraints Journal of Environmental Management and safety vol. 4, No 3.


DIGHA, OPAMINOLA N "INFLUENCE OF POPULATION GROWTH ON LANDUSE IN CALABAR METROPOLIS, NIGERIA" Quest Journals Journal of Research in Environmental and Earth Science, vol. 04, no. 01, 2018, pp. 01–14.

*Corresponding Author: *DIGHA, OPAMINOLA N*

*1. DEPARTMENT OF GEOGRAPHY AND PLANNING ABIA STATE UNIVERSITY, UTURU, ABIA STATE*