Implication of Urban Sprawl on Land Use and Forested Areas in Calabar Municipality, Cross River State, Nigeria

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Abstract

The study examined the impact of urban sprawl on land use and forested Areas in Calabar Municipality, Cross River State. The main objective was to assess the rate of change in urban expansion between the period of 2000 and 2019. Data on land use cover change between 2000 and 2019 was gotten from Erdas imagine. The result proved that in the year 2000 built-up area was 132 sqkm and in the year 2019 built-up area was 232 sqkm, in the year 2000, water bodies covered an area of 14.7 sqkm and in the year 2019, water bodies covered an area 15.7 sqkm. Cultivated area as of 2000 was 112.3sqkm and reduced to 97.3sqkm in 2019, forested area was 147sqkm as at 2000 and reduced to 61.1sqkm. This showed that there was a drastic change between the year 2000 and 2019 with forested areas reserved as carbon sink being reduced drastically and thus implying that urban expansion has negative impact on land use particularly ecologically protected areas. The study recommends that government should strictly enforce its sustainable urban policies so as to control rapid urbanization to mitigate the impact of land use on ecologically protected zones in Calabar Municipality.

Keywords: Implication, Urban Sprawl, Land Use, Calabar Municipality, Forested Area

Introduction

The implication of rapid urbanization on land uses is a serious concern in recent times. While the process of urbanization has important implications for changes in demographic characteristics and transformation of the physical landscape, rapid urbanization can cause profound impacts on various environmental components, especially on land and water (Patra, Mishra & Mahapatra, 2018). A detailed understanding of the dynamics of urbanization induced land-cover change is therefore necessary for coping with environmental changes and facilitating sustainability. This is so because most of the urban areas in the world have experienced considerable land-cover changes over the years. Furthermore, these urban areas consume majority of the energy reserve and cause serious environmental problems and degradation of ecosystems through pollution, invasion and succession as well as forced migration (Battista & Vollaro, 2017).

Many studies have been conducted to understand the relationship rapid urbanization, forest removal and land use change (Singh & Shi, 2014). The conclusion of many studies observed that rapid urbanization induced rapid and unplanned land use changes globally. According to Nigerian National Population Commission (NPC, 1991) as cited in Jimmy et al (2025), most urban areas in Nigeria have grown beyond their environmental carrying capacities and existing infrastructure. For instance, most of the urban areas in Nigeria with small land mass have already exhausted or have extremely limited capacities to accommodate further increase in population (Jimmy et al (2025). The implication of this is that there is disequilibrium between the population and the environment, and this has adversely affected the carrying capacity of the urban areas in the country; hence the increasing poor quality of the living conditions and the low livability index of urban areas in Nigeria (Imoh et al, 2025).

The high influx of people into Calabar Municipality from the rural areas to take advantage of the perceived opportunities without adequate planning and effective management strategies to accommodate this influx by the government, results in serious land use pressure on in Calabar Municipality and similar experience is found in Uyo likewise other Nigerians cities (Ituen et al, 2025; Imoh et al, 2025). Recently, the increase in urbanization in Calabar Municipality has resulted in expansion of the city into the urban peripheral.

Past studies on impact of urbanization are broad based, focusing on socio-economic issues, which have created gaps in the in-depth analysis of environmental and urbanization linkages. However, without an adequate understanding of the intricate linkages between the environment and urbanization process, it would be difficult to propose effective and efficient strategies to resolving or ameliorating the plurality of the impacts of urbanization on the environment. Hence, this study was aimed to fill the gap in the understanding of the impact of urbanization on other land uses in Calabar Municipality. The objectives of the study are to: assess the change in urban land use in Calabar Municipality between the year of 2000 and 2019, evaluate the rate of urban expansion in Calabar Municipality, between the year of 2000, and 2019, examine the effect of land use change on the environment and evaluate the impact of urbanization on the socio-economic life of the people. In summary, the 2000-2019 study is an essential piece of the puzzle. While a more recent study extending the analysis to the present day would be ideal for a complete picture, the older study provides the foundational context needed to understand the ongoing dynamics of urbanization and historical trend of changes in land cover within Calabar Municipality.

Research Methodology

Materials- Study Area

The study was conducted in Calabar Municipality. It lies between longitudes 8º 21'29" E and 8°21'42.16"E of the Greenwich Meridian and latitudes 4º 58' 33" N and 4°58'7.61"N of the equator. The Local Government Area is bordered by Odukpani to the North, Akpabuyo to East, Uyo to the West and Calabar South to the South. Calabar Municipality is characterized by rapid urbanization regime owing to the massive urban-rural migration. Based on the population census of 1991 the population of Calabar Municipality was 136460, however, at the rate of urbanization, the population of Calabar Municipality is projected to rise to 226833 in 2017 (National Population Census, 1991 and 2017). The implication of this rise in population is the increase in urban land use of the Local Government Area, which would result in loss of contending other land uses in the region

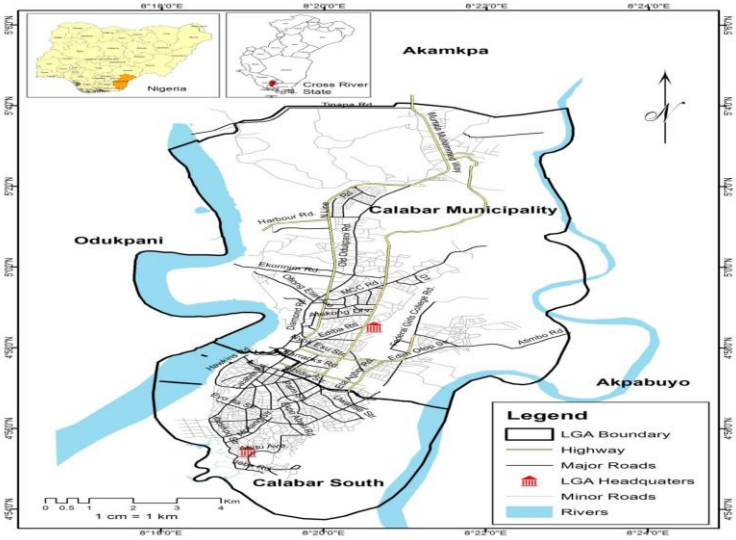


Figure 1: Map of Calabar Metropolis Showing Calabar Municipality to the North
Source: Ministry of Lands and Town Planning, Cross River State (2025)

Methods

The study adopted both primary and secondary sources of data for the study. The data sources are not limited to direct field observation, satellite imagery of the study area, existing literatures reviewed to guide the study, data on the population size of the study area, gotten from the National Population Census (NPC) and geographical coordinate of the study area. The satellite imageries were obtained from the *ESRI Landsat unlock – earths - secrets Platform,* the boundary data of Calabar Municipality, Nigeria was obtained from Google Earth platform, the attributes of the satellite imageries obtained from *ESRI Landsat unlock – earths - secrets Platform.* In the remote sensing procedure, the imageries were classified into several land uses. The imageries were geo-referenced to WGS84 UTM Zone 32^0 North. After the imageries were geo-referenced, the outputs were clipped according to the boundary of the study area, using the clip tool in the QGIS platform. The clipped imageries for the years 2000 and 2019.

A post classification comparison of the change detection techniques was utilized in order to detect the changes within 2000 and 2019. The classification of the images was carried out using ERDAS imagine

pixel-based classification. An unsupervised classification was performed. The two images were classified into different land cover types. This method of classification involves the procedure of identifying pixels possessing the same spectral features automatically (Wakirwa, 2015). ERDAS imagine software was used in digitally processing and identifying the spectral clusters on the Landsat images and QGIS was used for the final embellishment of the ERDAS outputs. The classified raster output was converted to vector (polygons) to allow for measurements to be done. The areas coverage of each of the LULC (Land Use Land Cover) classes were measured (in Square Kilometers [sqkm]) for each of the years under consideration using the export geometry tool in QGIS platform. A comparison of the land cover statistics assists in identifying the change in percentage, trend and rate of change in Calabar Municipality, Cross River State over the periods of 2000 and 2019.

Data gotten from the satellite imagery was computed into an excel sheet, where the area coverage of the different land uses as well as the percentage were computed to estimate the percentage coverage of each land use. These data were presented in charts, tables and maps for effective visualization of the outputs.

Results and Discussion

Table 1: Land use characteristics of Calabar in the year 2000

Year	Land Use Classes 2000	Area (Sqkm)	Percent
2000	Uncultivated area/forest	147	36.20
	Cultivated area/open spaces	112.3	27.66
	Built up area	132	32.51
	Water bodies	14.7	3.62
		406	100

Source: Researcher's analysis, 2025

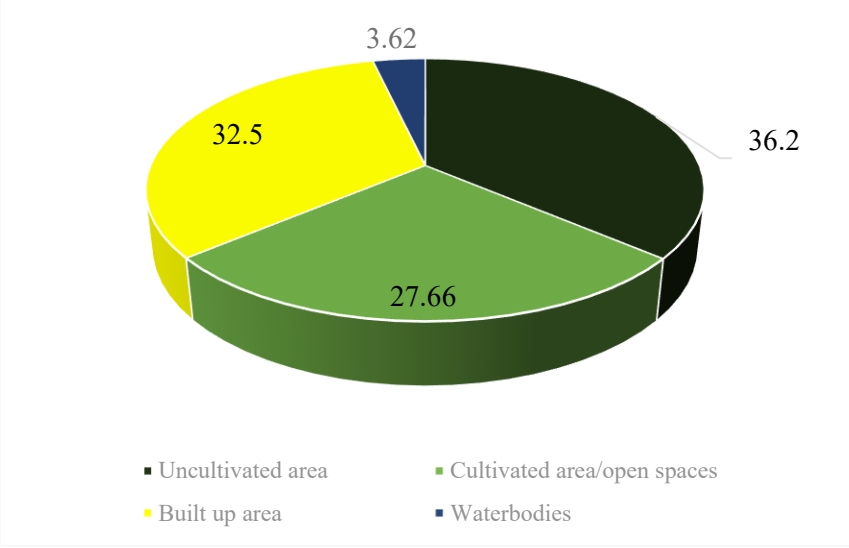


Figure 2: Output of LULC analysis in the year 2000
Source: Researcher's analysis, 2025

Table 2: Land use characteristics of Calabar in the year 2019

Year	Land Use Classes 2019	Area (sqkm)	Per cent
2019	Uncultivated area/forest	61.1	15.04
	Cultivated area/open spaces	97.3	23.96
	Built up area	232	57.14
	Water bodies	15.7	3.86
		406.1	100

Source: Researcher's analysis, 2025

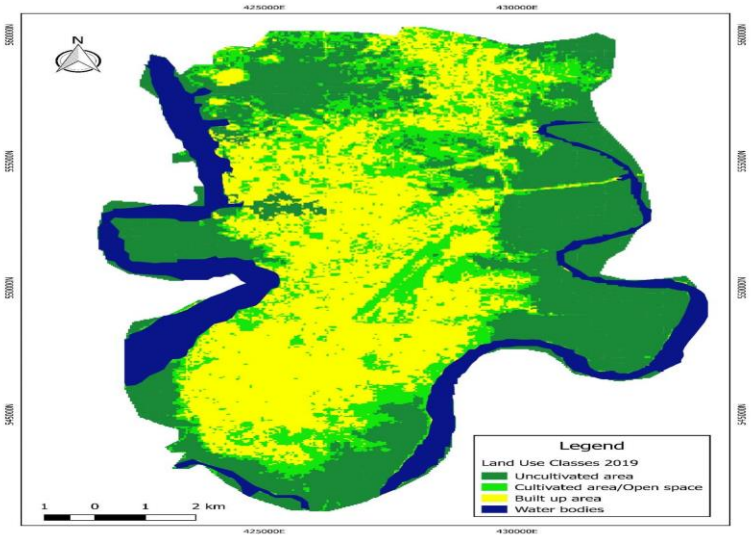
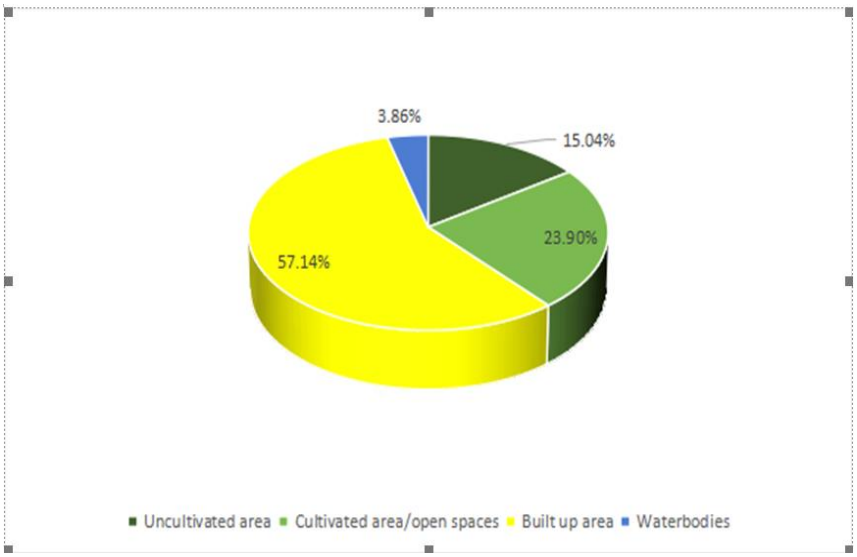


Figure 3: Output of LULC analysis in year 2019
Source: Researcher's analysis, 2025



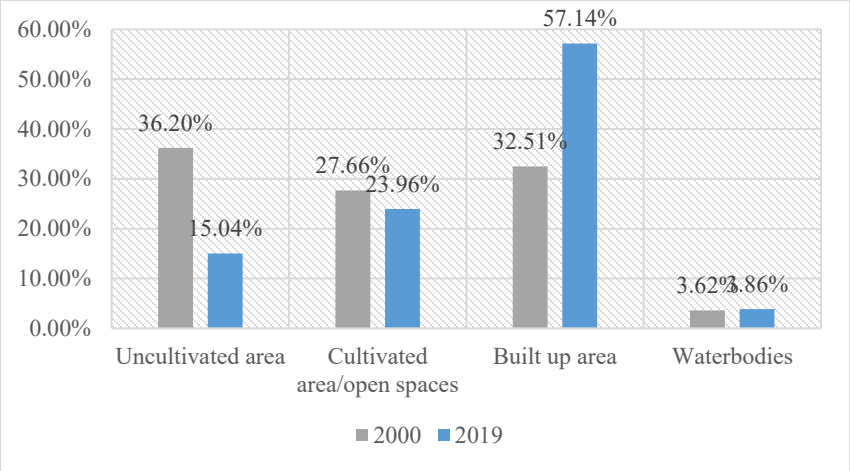


Figure 4: Comparison of area coverage of land uses in 2000 and 2019
Source: Researcher's analysis, 2020

Table 3: Rate of urban expansion in Calabar municipality, between the year of 2000 and 2019

Land Uses	Area Coverage In 2000(Sqkm)	Area Coverage In 2019(Sqkm)	Rate Of Change Between 2000-2019
Uncultivated area/forest	147	61.1	-38.9
Cultivated area/open spaces	112.3	97.3	-2.7
Built up area	132	232	132
Water bodies	14.7	15.7	-84.3
total	406	406.1	306.1

Source: Researcher's analysis 2025

Discussion of Findings

The study sought to examine the impact of urban sprawl on land use at the fringes of Calabar municipality, Cross River State Nigeria. The LULC assessment of the year 2019, 10 years after 2010, as shown on Table 2, Figures 3 and 4, averred that built-up areas increased to 232 sqkm, representing 57 percent of the total coverage. Also, cultivated area/open space, although, experienced an increment in the year 2010 had a decrease in area coverage to 97.3 sqkm, which is 23.96 per cent. In addition, uncultivated areas experienced a further decrease in land use to 61.1 sqkm, representing 15.04 per cent, while water bodies still occupied an area coverage of 15.7 sqkm, that is 3.6 per cent.

In an attempt to assess Land Use Land Cover Rate of Change. It was revealed that land use land cover for uncultivated areas in 2000 covered an area of 147 sqkm (36.21%). And in the year 2019, uncultivated areas covered an area of 61.1 sqkm (15.04%), depicting that the rate of change between 2000 and 2019 is -38.9sqkm, a decrease in uncultivated areas due to increase in urbanization. Cultivated areas in the year 2000 covered an area of 112.3 (27.66%) and in the year 2019, it covered an area of 97.3 sqkm (23.96%), the rate of change between 2000-2019 is -2.7 sqkm showing a reduction in cultivated areas, primarily caused by the increase of land use activities on open spaces. Built up area in the year 2000 covered 132 sqkm (32.51%) and in the year 2019 covered an area of 232 sqkm (57.14%) and the rate of change between 2000-2019 was 132 sqkm, indicating that there is an increase in built up area due to rapid urbanization in the area and the

increase in urban land use. Water bodies in the year 2000 covered an area of 14.7sqkm (3.62%) and in the year 2019 covered an area of 15.7 sqkm (3.86%) and the rate of change between the year 2000-2019 was -84.3 sqkm.

Conclusion and Recommendations

The study sets an overall objective to examine impact of urban expansion on land use at the fringes of Calabar Municipality, Cross River State Nigeria. The study assessed the rate of urban expansion in Calabar Municipality between the year 2000 and 2019 it is noted that there has been an increase in built up area from 2000-2019 due to rapid urbanization, and at the same time a decrease in the rate of forested areas loss particularly to urban development. As a follow up to the study, it is thus recommended that:

- The government should strictly enforce its sustainable urban policies so as to control the urbanization process in the municipality
- Buffer zone should be developed to restrict developers from developing in sensitive environment and help enhance environmental protection
- The government should compensate the locals living in urban centers so as to enhance proper land use management
- The polluter pay principle should be strictly and enforced to evade destruction of natural resources.
- Policies should be implemented to enhance and strengthen the protection of ecologically protected sites in Calabar Municipality following urban expansion and population increase

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