

SPATIO-TEMPORAL ASSESSMENT OF POPULATION GROWTH ON LANDUSE CHANGES IN OBUDU, CROSS RIVER STATE, NIGERIA

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ABSTRACT: The study examined the impact of population growth on land use changes in Obudu, Nigeria. The main problem that elicited interest in this study include the rapid increase in human population in the study area and the attendant effect of land use transformation and other environmental related problems of population growth and land use changes. The main objectives of the study include: to investigate population related land use changes in the study area, to identify the factors that governed land use changes and the classes of different land uses during the period under study and to ascertain the extent and trend of population growth and land use changes in the study area. Data for the study were collected from National Population Commission (NPC), the United States Geological Survey Agency, the Cross-River State Ministry of Land and Survey and the Cross-River Basin Development Authority. Simple random sampling technique was employed in the administration of questionnaire on 120 respondents from the ten wards of the study area. Three sets of remotely sensed data were used to measure the land use/land cover changes during the periods 1986 – 2013. The results confirmed a strong relationship between population growth and land use changes in Obudu. Furthermore, the result had shown that between 1986 and 2013 there was steady increase in population and this resulted to land use changes which triggered other environmental problems in the study area. The work concludes by recommending that government through the Town Planning and Development Control should be meticulous in their work, zoning regulations should be put in place and concerned agencies should ensure compliance by developers on the land and other land related activities.

Keywords: Population growth, land use changes, GIS, remote sensing, Obudu

Introduction

Man has brought in changes to land use and land cover in the world mainly through growth in population and urbanization. In recent times, population growth has contributed a serious problem both in the rural and urban areas with high demands for agricultural, institutional, residential, industrial, commercial and recreational purposes. Rapidly increasing human populations have brought about extensive land use changes throughout the world. Land is generally required for various uses in the society. It is a major factor of production and a vital element in the socioeconomic development of any country (Federal Ministry of Housing and Urban Development (FMHUDS), 2006). Changes in land use are caused by multiple interacting direct drivers such as climate change, introductions of alien invasive species among others which in turn are controlled by indirect drivers such as demographic, economic or cultural changes (Millennium Ecosystem Assessment, 2003). Thus as nations grow in size and rural areas become urban centres and later to large metropolitan areas, there is always increased competition as well as demand for land for different purposes.

Historically, the driving force for most of land use changes is population growth (Ramankutty & Foley, 1999). Population growth is often used as a proxy for land use change (Kok, 2004), but at lower scales, a set of complex drivers are important too. Increasing demand on food as a result of population growth has created more pressure on land resources (Maksym and Zhang, 2008). Objectives for land use change vary between the developed and developing countries. In developed countries, land use change is based on economic reasons such as large scale farming or urban development and an increasing need to conserve biodiversity and environmental quality for current and future generations (Bouma, Varallyey and Batjes, 1998) whereas in the developing countries, rapid population growth, poverty and the economic situations are the main driving factors (Lambin, Geist and Lepers, 2003, Ramankutty & Foley, 1999).

Landuse refers to the various activities carried out by humans to exploit the landscape, such as agriculture, urban development, grazing, logging and mining (Ellis, 2011). Land use change is a process by which human activities transform the landscape and it is a central issue in global environmental change. For example, open or forested space could turn to built up area. Land use change is therefore intricately related to both economic development and the ecological characteristics of the landscape (Derfries, Foley & Asner, 2004). Land use changes can therefore be caused by multiple driving forces that control some environmental, social and economic variables. These driving forces can contain any factor which influences human activities

including local culture, economic and financial matters, environmental circumstances (i.e. greenness, land quality, terrain situation, water availability and accessibility to recreation), current land policy and development plans as well as the incentives between these controlling variables.

The total population of Nigeria as at March, 2006 was 140,603,542 (made up of 71,709,859 males and 68,293,683 females) which translated to an annual growth rate of 3.2 percent over the 1991 census figure of 89 million (Federal Government Official Gazette, 2007). The implication of this huge human population and growth is obvious. The population growth rate is critical. Cross River State is not an exception in the global country population surge. In 1991, the state had a population of 1,911,569 inhabitants and this increased to 2,892,988 people by 2006 (National Population Commission, 2007). National Population Commission estimate indicates that at 2.8 percent growth rate, the state will have a population of 4,258,437 by 2020. This rapid rate of population growth is also reflected in Obudu, one of the fastest growing local government area in Cross River State. Oko and Okpiliya (2019) reported that in the past two decades, Obudu has witnessed rapid increase in population which has led to alteration and alteration of several land uses and land covers. These land use alteration and alternation have impacted negatively on the spatio-temporal land cover features such as urban green areas, massive deforestation, grass among other ecosystems which are currently giving way for the construction of new roads, new residential buildings, airports, cottage industries, markets, schools, dams etc. These phenomena have triggered conspicuous land use changes.

These development in conjunction with the high influx of people into Obudu and the suburbs of improved kindergarten, primary, secondary and post secondary education, commercial activities, recreation etc. The unique characteristics Obudu and its location as a buffer zone to the popular Obudu cattle ranch and resort the tourism destination of Cross River State.

It is however important to carry out land use and land cover mapping and analyses of population growth trend of a particular place periodically. These will provide information on the population and how the landscape is changing, how the changes have occurred and where the changes are taking place. Studies on population growth and land use change provide vital information on the state of the environment and development trends.

The aim of this study is to examine the spatio-temporal trend of population growth on land use changes in Obudu, Nigeria between 1986 and 2013. To achieve the objectives of the study, the following specific objectives were generated;

- To investigate (determine) the population related land use changes in Obudu
- To identify possible factors that governed land use change and the distribution of different land uses during specific period of time
- To ascertain the extent and trend of population growth and land use changes within the study area.

Study area

The study area (Obudu) lies between latitudes 6°22' and 6°43' North of the equator and longitudes 8°53' to 9°14' East of the Greenwich Meridian with a total land area of about 1200km². The area is located at the Northern Senatorial District of Cross River State, Nigeria. With a projected population of about based on the 2006 census at a growth rate of 3.0 percent (Oko and Okpiliya, 2019) (Figure 1), Obudu is bounded by Benue State to the North, Boki Local Government Area of Cross River State to the South, Obanliku to the East and Bekwarra and Ogoja Local Government Areas to the West respectively (CR-SEEDS, 2007). Obudu lies within the tropical humid climate with wet and dry seasons with mean annual temperature of between 15°C and 16°C and mean annual rainfall of 1300mm – 2000mm per annum (Oko and Okpiliya, 2019). The area is surrounded and crisscrossed by hills and mountains which is responsible for the mild climate of the area. Obudu is underlain by basement complex rocks that mark the western end of the foothills of the Cameroon Mountains.

In terms of vegetation, Obudu is located in the Southern Guinea Savanna zone where vegetation generally is a mixture of lower montane grassland and moist forests with some patches of savanna grassland and deciduous forests which indicate a sustained human interference culminating into rapid land use changes. The economy is majorly agrarian with farming as the predominant economic activities. Over 75 percent of the residents are involved in various facets of agriculture at subsistence levels.

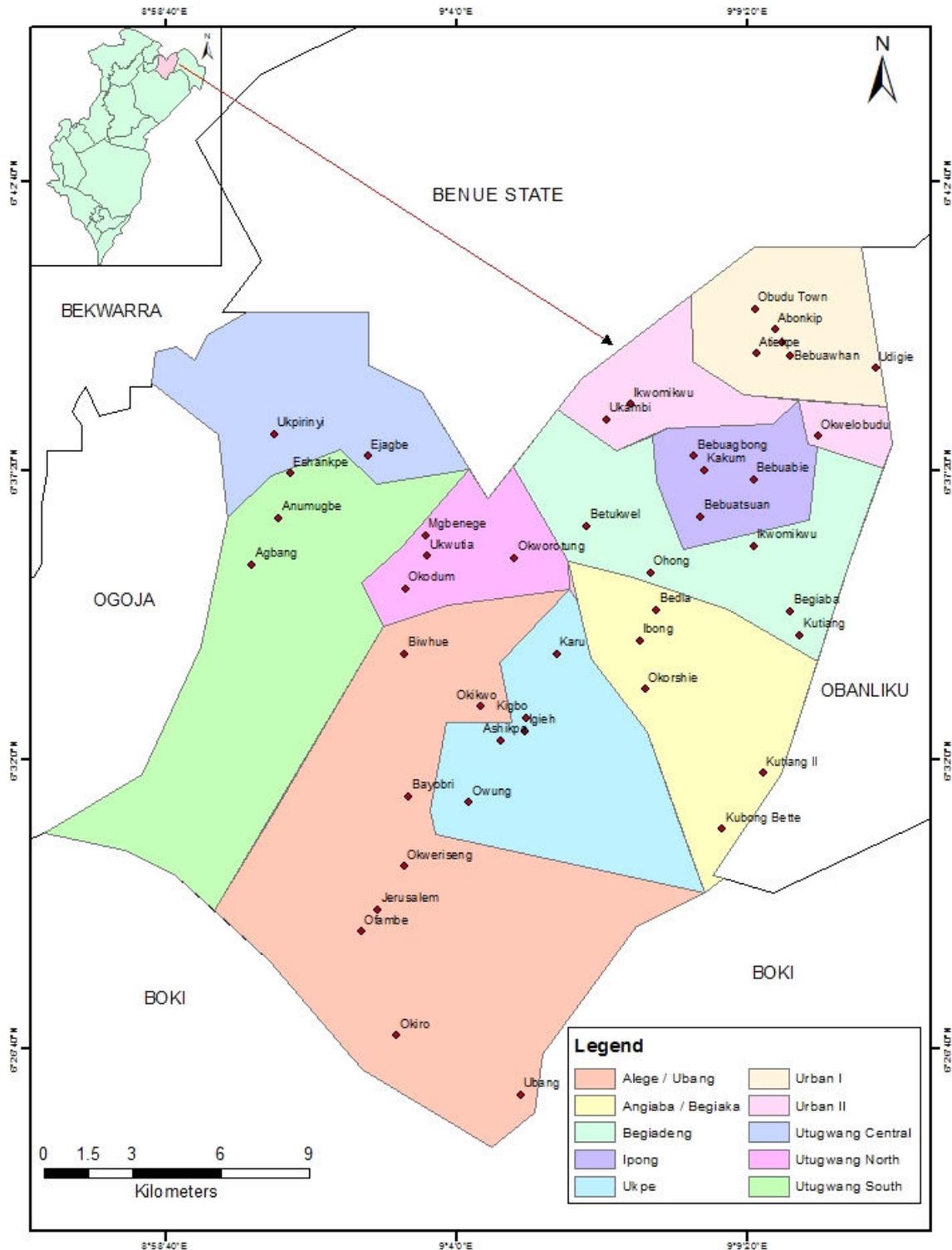


FIG.1: Obudu Local Government Area showing ten (10) Council Wards

Map projection:
UTM Zone 32NWGS 84

Data Source:
CRSFC, GIS Unit.

Materials and methods

The spatial data acquisition techniques employed in this study were the Landsat Thematic Map (TM) of 1986 and Enhanced Thematic Map (ETM+) of 2000 and 2013. The three images were obtained from the United States Geological Survey (USGS) each with a spatial resolution of approximately 28.5km². In addition, an existing landuse map of 1982 and large scale aerial photographs of 2000 of the area were acquired from Cross River State Ministry of Lands and Surveys and used. Ground truthing was carried out in order to ascertain the accuracy of the land use data of 2013 generated by the satellite images and complemented by randomly selected Global Positioning Systems that were used for the accuracy assessment of the 2013 land use data. Furthermore, multiple-choice questionnaire fashioned to meet the objectives of the study were used to carry out the investigation on the impact of population growth on land use changes in Obudu. Personal observation and interview were made to supplement the data in the questionnaire. The instrument was administered on twelve (12) respondents randomly sampled from each of the ten political wards of the study area, hence a total of 120 respondents were used.

Information on the population census data of Obudu was obtained from National Population Commission Office, Calabar (NPC, 2007). The population growth trend of Obudu from 1986 to 2013 is shown in Table 1.

Table 1: Trend in population growth of Obudu from 1986 to 2013

S/N	Year	Population figures
1	1986	72,820
2	1987	75,077
3	1988	77,404
4	1989	79,804
5	1990	82,278
6	1991	84,799
7	1992	88,530
8	1993	92,425
9	1994	96,492
10	1995	100,738
11	1996	105,170
12	1997	109,797
13	1998	114,628
14	1999	119,672
15	2000	124,938
16	2001	130,435
17	2002	136,174
18	2003	142,166
19	2004	148,421
20	2005	154,951
21	2006	161,457
22	2007	165,978
23	2008	170,625
24	2009	175,403
25	2010	180,314
26	2011	185,363
27	2012	190,553
28	2013	195,888

Source: *National Population Commission 2007*

Statistical analysis was used to define the spatial and temporal variation and changes in the various land uses of the period under study. In all, eight categories of land use types were identified from the total areal coverage of 47,993.38m² in the study area. The landuse types/cover for the period under study is shown in Table 2.

Table 2: Landuse types/classes in Obudu LGA between 1986 to 2013

S/N	Class name	1986 (Area in Ha)	2000 (Area in Ha)	2013 (Area in Ha)
1.	Mature forest	7834.27	6270.95	3602.28
2.	Bush fallow with trees	7519.95	7884.59	8223.77
3.	Bush fallow	4805.73	5150.09	4776.32
4.	Secondary forest	6124.77	6077.39	5210.82
5.	Freshwater swamp grassland	5185.17	6083.51	7023.51

6.	Mountain grassland	6610.14	6085.73	5597.02
7.	Farmland	7466.31	6747.86	6636.19
8.	Built-up/bareland	2447.04	3693.26	6423.46
	Total	47993.38	47993.38	47933.38

Source: Author’s fieldwork, 2014

Results and discussion

Table 3: Associated problems of landuse changes in Obudu LGA

S/N	Options	Frequency	Percentages
1.	Erection of buildings	36	30
2.	Increase in land value	30	25
3.	Increasing land dispute	24	20
4.	Erosion	18	15
5.	Others	12	10
	Total	120	100

Source: Author’s fieldwork, 2014

Table 3 shows that 36 respondents representing 30% indicated that the problem associated with land use change in Obudu is erection of buildings, 30 respondents representing 25% reported that increase in land value is the problem associated with land use change in Obudu, 24 respondents representing 20% said that increase in land disputes is the associated problem of land use change in Obudu, 18 respondents representing 15% were of the view that increase in land value is one of the problems associated with land use change in the study area while 12 respondents representing 10% maintained that other problems such as road construction, waste disposal, flooding and pollution,landdisputess etc. are the problems associated with land use change in Obudu. The findings with regards to increase in land dispute is in agreement with Uyang, Nwagbara and Undelikwo (2013) who carried out a study on communal land conflict and food security in Obudu Local Government Area of Cross River State and found out that one of the causes of communal land conflict in Obudu was due largely to rapid increase in population struggling over land that is inelastic is supply.

Table 4: The most significant evidence of population growth in Obudu

S/N	Options	Frequency	Percentage
1.	Traffic congestion on the streets and roads	42	35
2.	Rising out of land	30	25
3.	Landuse conversion	24	20
4.	Crime rates	14	11.7
5.	Others	10	8.3
	Total	120	100

Source: Author’s fieldwork, 2014

The responses on the most significant evidence of population growth in Obudu is presented in Table 4. From the table, it can be seen that out of 120 respondents sampled, 42 respondents representing 35% said the most significant evidence of population growth is traffic congestion on the streets and roads in Obudu; 30 respondents representing 25% reported that rising cost of land is the most significant evidence of population growth in Calabar, 24 respondents representing 20% upheld that landuse conversion is the most significant evidence of population growth, 14 respondents representing 11.7% reported that increase in crimes is the most significant evidence of population growth in Calabar while 10 respondents representing 8.3% said other issues ranging from lack of accommodation, high rent charges, poverty and rising cost of living are the most significant evidence of population growth in Obudu.

Table 5: Responses as to which areas in Obudu has been affected as a result of landuse changes

Option	Frequency	Percentage
Obudu urban I and II	6	5
Allege/Ubang and Ukpe	3	2.5
Utugwang North, Central and South	4	3.3
Angiaba/Begiaka	2	1.7
Ipong and Begiading	3	2.5
All of the above	102	85.0
Total	120	100

Source: Author’s fieldwork, 2014

Table 5 shows that 6 respondents representing 5% said that Obudu Urban I and II axis is the area mostly affected as a result of land use change in the study area, 3 respondents representing 2.5% reported that

Alege/Ubang and Ukpe is the major part affected due to land use change in Obudu, on the other hand 4 respondents representing 3.3% were of the view that Utugwang North, Central and South is being affected by land use change, 2 respondents representing 1.7% held that Agiba/Begiaka is affected by land use change, another 3 respondents representing 2.5% said that Ipong and Begiading is most affected by land use change in the study area while 102 respondents representing 85% noted that all the listed areas in Table 5 have been largely affected by the problem of land use change in Obudu. The implication of this is that the entire parts of Obudu are affected in one way or the other due to land use changes. This finding corroborates with Folasade and Olatunde (2014) and Akinbola (2003) who reported that land is the pivot of man’s absolute existence and stressed that through the past, in the present and through the foreseeable future, land continues to be the foundation of man’s food supply chain and a vital recurrent and capital resource of any nation.

Table 6: The environmental consequences of land use change in Obudu

Option	Frequency	Percentage
Deforestation	40	33.3
Land fragmentation	36	30
Erosion	24	20
Biodiversity loss	12	10
Others	8	6.7
Total	120	100

Source: Author’s fieldwork, 2014

Table 6 indicates that 40 respondents representing 33.3% said that high rates of deforestation within Obudu is the major environmental consequence of land use change in the area, 36 respondents representing 30% reported that incidences of land fragmentation is the major environmental consequence of land use change in the study area, 12 respondents representing 10% said that biodiversity loss is an environmental consequence of land use change while 8 respondents representing 6.7% were of the opinion that other environmental consequences of land use change in the study area include pollution, indiscriminate dumping of wastes, flooding and urban heat island.

Table 7: The positive impact of land use change in Obudu

Options	Frequency	Percentage
Urbanization	30	25
Industrialization	28	23.3
Increased commercial activities	34	28.3
Immigration	10	8.3
Flourishing land rent markets	18	15
Total	120	100

Source: Author’s fieldwork, 2014

Table 7 depicts the 120 responses in respect of the positive impacts of land use change in Obudu. In the table, 30 respondents representing 25% said that the positive impact of land use change in the study area is urbanization, 28 respondents representing 23.3% reported that industrialization is the positive impact of land use change in Obudu, 34 respondents representing 28.3% said that the positive impact of land use change in Obudu is increased commercial activities, 10 respondents representing 8.3% on the other hand were of the view that immigration into Obudu is the positive impact of land use change in the area while 18 respondents representing 15% said that flourishing land rent market is the positive impact of land use change in the study area.

The results of the statistical analysis from the computation of the three satellite images (1986, 2000 and 2013) produced eight classes of land uses as shown in Table 2. The land use/cover maps are shown in figures 2, 3 and 4. These maps depict the spatial land mass of Obudu as there were in 1986, 2000 and 2013. There was a major increase in the built-up/bareland from 1986 to 2000 and as well from 2000 to 2013 as reflected on the maps. These gains in built-up/barelands were actually at the expense of other land use types (Mature forest, bush fallow with trees, bush fallow, secondary forest, fresh water swamp grassland, mountain grassland and farmland).

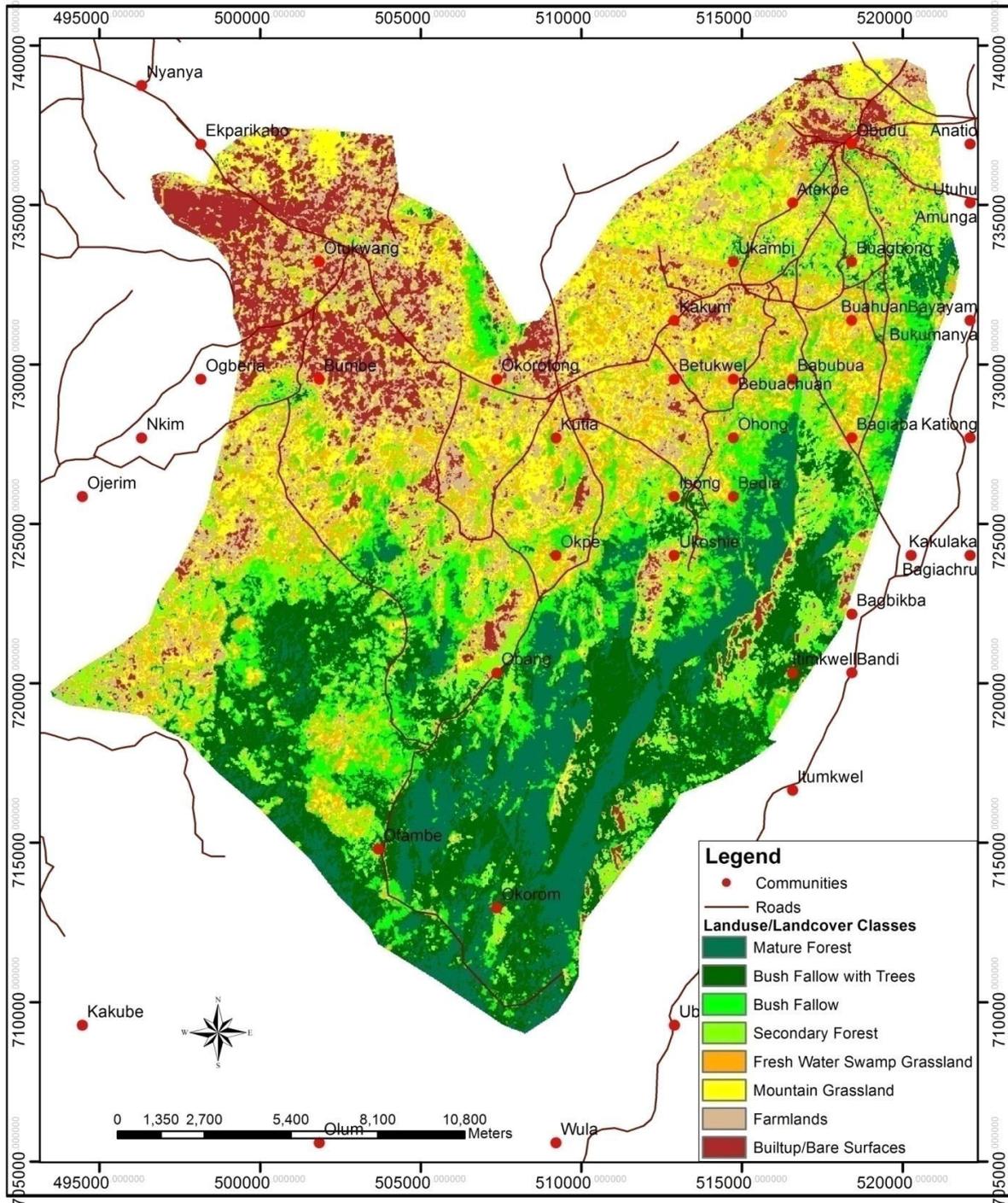
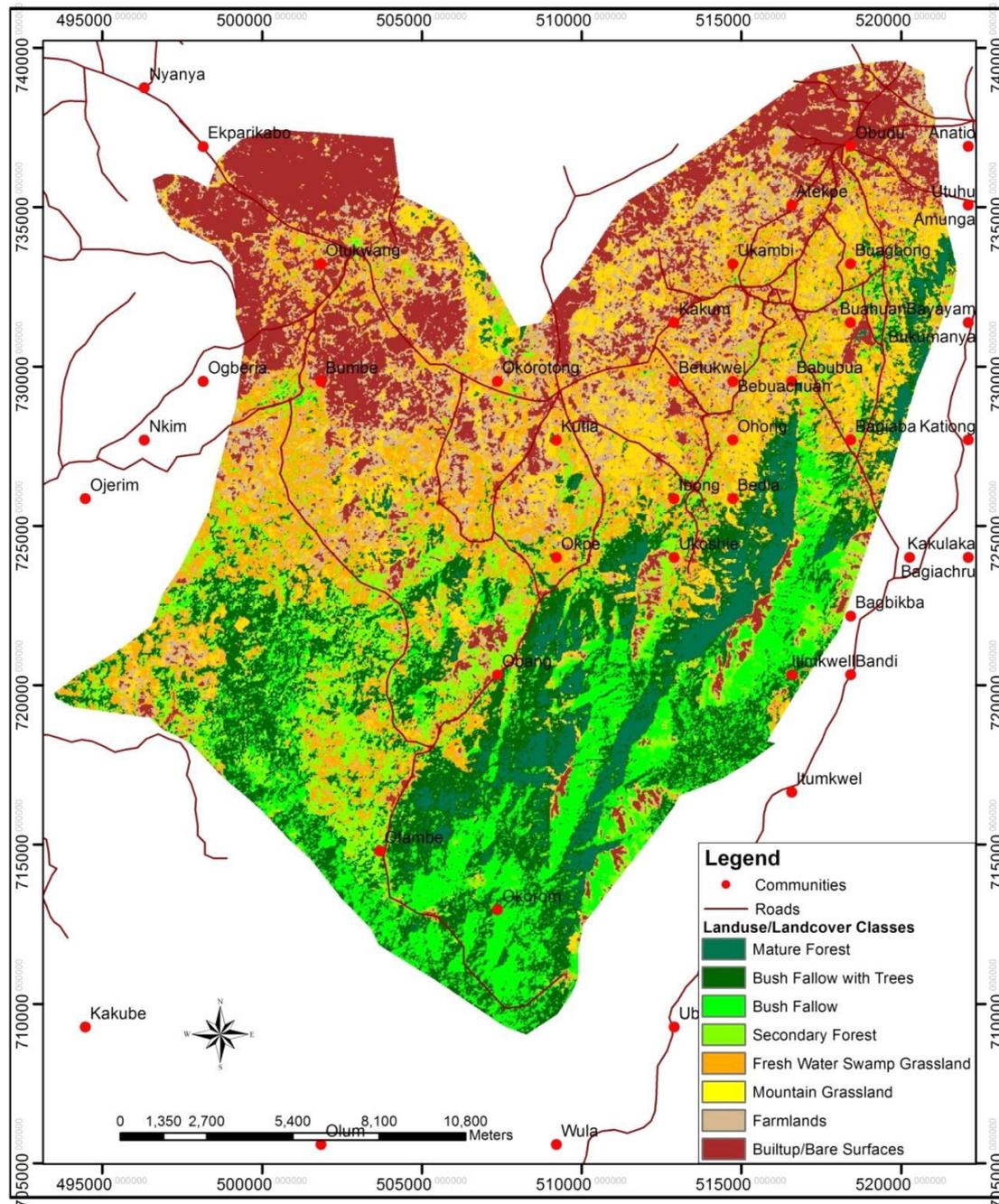


Figure 2: Landuse map of Obudu as at 1986 derived from Landsat (TM)
 Source: Author's fieldwork, 2014



Figure

4: Landuse map of Obudu as at 2013 derived from Landsat (ETM+)

Source: Author’s fieldwork, 2014

The changes that occurred in the land use types/classes in the study area within the three epochs (1986, 2000 and 2013) are captured in tables 8, 9 and 10. From the reference baseline of 1986, out of a total areal extent of 47993.38Ha, the mature forest, bush fallow with trees, bush fallow, secondary forest, fresh water swamp grassland, mountain grassland farm land and built-up/bareland were 7834.27ha (16.3%), 7519.95ha (15.6%), 4805.73ha (10%), 6124.77ha (12.7%), 5185.17ha (10.8%), 6610.14ha (13.7%), 7466.31ha (15.5%), 2447.04 (15%) as shown on the table 8.

From table 9, there was a decrease of mature forest from 16.3% in 1986 to 13% in 2000 representing about 9% loss of mature forest while in the same period there was an increase in built-up area from 5% in 1986 to 3693.26ha (7.6%) in 2000 amounting to about 3% gain in the built-up area in Obudu. A similar trend was equally witnessed from 2000 to 2013 as shown in Table 10.. Within the period, the built-up area increased from 3693.26ha to 6423.46ha in 2013. On the other hand, secondary forest, mountain grassland and farmland decreased from 6124.77ha, 6610.14ha and 7466.31ha in 1986 to 5210.82ha, 5597.02ha and 6636.19ha in 2013 respectively.

Table 8: Areal extent of landuse category in Obudu in 1986

S/N	Landuse category	Areal extent (ha)	Percentage
1.	Mature forest	7834.27	16.3
2.	Bush fallow with trees	7519.95	15.6
3.	Bush fallow	4805.73	10.0
4.	Secondary forest	6124.77	12.7
5.	Fresh water swamp forest grassland	5185.17	10.8
6.	Mountain grassland	6610.14	13.7
7.	Farmland	7466.31	15.5
8.	Built-up/bareland	2447.64	5.0
	Total	47993.38	100

Table 9: Areal extent of landuse category in Obudu in 2000

S/N	Landuse category	Areal extent (ha)	Percentage
1.	Mature forest	6270.95	13.0
2.	Bush fallow with trees	7884.59	16.4
3.	Bush fallow	5150.09	10.7
4.	Secondary forest	6077.39	12.6
5.	Fresh water swamp forest grassland	6083.51	12.6
6.	Mountain grassland	6085.73	12.6
7.	Farmland	6747.86	14.0
8.	Built-up/bareland	3693.26	7.6
	Total	47993.38	100

Table 10: Areal extent of landuse category in Obudu in 2013

S/N	Landuse category	Areal extent (ha)	Percentage
1.	Mature forest	3602.28	7.5
2.	Bush fallow with trees	8223.77	17.1
3.	Bush fallow	4776.32	9.9
4.	Secondary forest	5210.82	10.08
5.	Fresh water swamp forest grassland	7023.51	14.6
6.	Mountain grassland	5597.02	11.6
7.	Farmland	6636.19	13.8
8.	Built-up/bareland	6423.46	13.4
	Total	47993.38	100

Relationship between population growth and landuse/cover change

Table 11: Population growth and land use changes in Obudu

Year	Population	Areal/extent of built-up area (ha)
1986	72,820	2447.04
2000	124,938	3693.26
2013	195,888	6423.46

The population data of Obudu as supplied by National Population Commission, Calabar office was projected from 1986 to 2013 and presented in Table 1. Table 11 shows the three time periods of projected population in the study area and the corresponding amount of increase in built-up area. Clearly, the impact of population growth is reflected in the attendant areal expansion of the built-up/bareland in Obudu at the expense of other land use types (mature forest, bush fallow with trees, bush fallow, secondary forest, fresh water swamp grassland, mountain grassland and farmland). This finding is in agreement with earlier works of Njingbwen and Njungbwen (2011) who carried out a study on urban expansion and loss of agricultural land in Uyo urban area of Akwa Ibom State and observed continuous increase in built up area of the expense of agricultural land.

Conclusion

This research focused on the spatio – temporal analyses of population growth on land use changes in Obudu, Nigeria. It is indubitable that almost every facet of development is affected by population growth and this has impacted overly on land uses in Obudu. The study has established that rapid population growth in the study area has influenced land use changes between 1986 and 2013. In addition, the study has shown that rapid increase in

population relying on a limited land space has created enormous demands for land for different purposes in the study area vis-à-vis population dynamics overtime.

Moreso, major changes in land use/land cover during this period influenced by population growth showed an increase in built-up areas at the expense of mature forest, bush fallow with trees, bush fallow, secondary forest among other land use categories.

Recommendations

Based on the findings of this study, the following suggestions are germane in improving the problems of land use changes as orchestrated by rapid population growth in Obudu:

- It is absolutely necessary for the government through town planning and development control department to be meticulous in land allocation and registration.
- For improved, sustainable land use practices and even development to be achieved in Obudu, there is need for compliance by all stakeholders on land use planning and management of the state government.
- Furthermore, Obudu master plan should be strictly followed in the creation of residential, institutional, commercial, industrial and other development needs.
- Zoning regulations which are used by local government authorities should be adopted in the study area and followed strictly.

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