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Impact of Land Use Change Drivers on Socio-Economic Activities in Ikpa River Basin, Akwa Ibom State, Nigeria

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ABSTRACT

This study examined the impact of land-use change drivers on socioeconomic activities in the Ikpa River Basin, Akwa Ibom State. This was done by assessing and mapping the extent of land-use change as well as examining the drivers of change in socio-economic activities in the study area. The use of systematic random sampling was employed for data collection. Data was collected on socioeconomic status, land-use change, and drivers of socioeconomic activities. This was analyzed using remotely sensed data between 1986 and 2018 processed with an unsupervised classification algorithm in Erdas Imagine to detect changes in the ArcGIS 9.2 environment. Survey results were represented in percentages, charts, and figures. The result of the land use identified five land use classes. These include Open water, Swamp Forest, Bush fallow, Compound farmland, and Built-up. A reduction was found in the area of Open Water by 6.79% per year, Swamp Forest decreased by 23.13 % and Bush Fallow decreased by 21.52%, while significant increases were observed in the area of Compound Farmland by 3.11% and Built-Up area at 47.32%, change due to socio-economic activities. Also, the survey results identified increases in the number of infrastructures, industries, agriculture, and lumbering as key drivers of land-use change in the area. On one hand, the drivers have provided many homes, eased movements, employment, etc., while the environment has been significantly altered affecting mostly agricultural lands. Based on these findings, the study recommends efficient steps toward improving agricultural land productivity will help. Also, control laws should be enforced to avert the incessant rate of deforestation as well as regulate proper urban planning for socio-economics activities. This will ensure efficient planning and management of land use in the area.

Keywords: Land, Land use change, Socio-economic activities, Driving force, and Change assessment

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1. INTRODUCTION

Land use has altered the natural environment and threatened biodiversity in the last five decades. These changes are a result of human activities such as deforestation, urbanization, agriculture intensification, and subsequent land degradation (Agarwal **et al**. 2002; Hwang **et al**. 2015). The impact of human activities on land has increased rapidly, altering forest cover and eventually affecting the earth's biodiversity, nutrient, hydrological cycles, and climate change (IPCC, 2007; Horwitz and Finlayson, 2011). The causes and consequences of human-induced environmental changes have impacted negatively the livelihood of inhabitants. Even though they are not distributed evenly over the earth, certain regions where their impacts are and short-term sustainability of man-environmental relationships (Lambin and Meyfroidt, 2011).Land is very critical to human existence, as it provides necessities such as food, shelter, and clothing to man.

It is a habitat for various species of plants and animals. It serves as a watershed, houses the structures for industrial, residential, commercial, and transportation purposes, and provides ground for agricultural activities. Therefore, the utilization of land plays a critical role in the harmonious relationship between man and its environment. Lambin and Meyfroidt (2010) opined that the extent to which land is used depends on the land cover type, which borders on how the biophysical attributes of the land are composed, utilized, and managed to satisfy the intent of the user. This, therefore, leads to the alteration of the original land cover type leading to the decline in natural resources and climate change (Foley, 2005; Turner **et al.** 2007).

Subsequently, land-use changes are driven by factors like biophysical and socioeconomic impacts (Briassoulis (2020); Sakayarote and Shrestha, 2017). Furthermore, these drivers are also classified as direct or proximate and indirect or underlying causes. Proximate causes are the activities and actions of people that directly affect land use to fulfill their immediate needs like farming, building, etc. While the underlying causes are often external and beyond the control of local communities and are fundamental socioeconomic and political processes that push proximate causes into immediate action on land use (Lambin **et al**. 2003). In general, socio-economic drivers such as agricultural expansion, industrialization, urbanization, and population growth to technological advancement are known to be the most common contributing forces to intense land-use change on a global scale than the physical drivers (Desalegn **et al**. 2014).

Ikpa Basin area is an ecosystem that offers goods and services to the surrounding environment. Although, the interior areas are largely rural and the main economic activities of the people are predominantly farming, hunting, fishing, and trading. However, they have been serious land-use changes as a result of socio-economic activities such as agricultural expansion and infrastructural development in the area, as these land uses have threatened the ecosystem leading to biodiversity losses, food insecurity, and climate change. More so, these activities have affected the natural flow of the rivers due to road expansion, with its attendant land degradation. Therefore, understanding the interactions between humans and the environment in the context of socio-economic drivers of land-use change is quite important to unravel the complex interface of anthropogenic activities and natural factors as well as the conservation of forests, and another ecosystem for sustainable development. In Akwa Ibom State, many studies on land-use change have been carried out in the last two decades (Ituen, 2015; Ntuk, Ituen, and Koffi, 2017; Okon, Wilcox, and Ituen, 2018). These studies reveal that land-use change is driven by many factors including biophysical, socio-economic, cultural, and technological features, with a serious impact on agricultural lands and the inhabitant of the environment.

Most of these studies centered around the impact of the land-use drivers, socio-economic forces, and their corresponding impact on agricultural practices. For instance, Ntuk, Ituen, and Koffi (2017) study on land cover change and the associated socio-economic driving forces in Uruan Local Government revealed natural increment, urbanization, and bush fallow as the main drivers of land cover change. Okon, Ituen, and Wilcox (2018) investigated the dynamics of land use /cover change and its consequences on agriculture in Itu LGA, where population increase, low crop yield, and industrialization were found to impact negatively on agriculture.

Considering the above studies, there is an important component of this knowledge frontier that has not been fully researched which is the impact of these land-use change drivers on the socio-economic activities of the people within the environment. Also, the study of land-use change in a land system such as a basin, with a whole or specific surface features defined by one or more processes, helped to enhance this study. Because of these, the study seeks to assess if there is a significant effect of land use drivers on socio-economic activities in the Ikpa River Basin in the last thirty-two years (1986 to 2018). Remote sensing data, GIS, and field surveys were used to map and examine the rate of changes and impact on the socio-economic activities in the Ikpa Basin. This study enhances the current knowledge frontiers by providing accurate real-time statistical data for policymakers and research purposes, as the wider debates on land changes continue to evolve.

This study incorporated the concept of land use rent and sustainable livelihood. Land-use changes are supported by a complex interaction of factors combining environmental, cultural factors, and economic activities that vary from different geographical locations (Ellis and Ramancutty 2013). The theory of land-use change led by Heinrich on Thunen (1990) dates back to the 19th century. He developed the model of land use theory in 1826 from his practical experience in an agrarian community in Western Germany where he assumes using of cropping zone and distance to market as factors influencing land-use change. Von Thunen used two key values; land rent and intensity. The land rent was understood as profit from land seen as a factor and mean of production and intensity of production implies labor force needed per one hectare. Von Thünen added that most of the factors that influence the structure and intensity of agricultural production depend on the geographical location of any piece of land. However, this school of thought that was mainly based on spatial economic does not consider biophysical and socio-economic factors affecting land use patterns. Other factors like population densities have been backed by various scientists (Boserup 1965; Thuita and Wilson, 2017). Furthermore, it is noted that several other drivers like urbanization, industrialization, wood extraction, soil fertility, and policies affect land use and land cover change (Ntuk and Ituen, 2017; Okon et al. 2018).

The concept of livelihood is also applicable in this study as it focuses on the general well-being of the inhabitants as most of these drivers either positively or negatively impact people’s source of living. Livelihood explains the totality of means by which people secure a living or acquire the requirement for survival and satisfaction of needs evolved through production, trade, and movement of goods and services. Available studies have used the sustainable livelihood approach (SLA) such as the Harvard Humanitarian Initiative (2016) to analyze rural livelihoods. The approach states that livelihood lies within a vulnerability context, livelihood capitals or assets influenced by recognized structures and processes to pursue distinct livelihood strategies. The application of these two concepts has provided an understanding of what exists between likelihood changes resulting from proximate land use at any given time. This will guide people on planning strategies so as not to be overwhelmed by shocks or loss of livelihood in the area.

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1.1 Aim and Objectives

The study aimed at examining the impact of land use change drivers and how it has impacted on socioeconomic activities in Ikpa River Basin of Akwa Ibom State between 1986 and 2018 using remote sensing data, GIS techniques and statistical survey. This study set out to;

i. assess and map the extent of land use changes within the span of 32 years,
ii. investigate the effects of drivers of land use change on socioeconomic activities in the study area.

2. STUDY AREA

Ikpa River basin is a major tributary of Cross River, found in the Northeast of Akwa Ibom State, in Nigeria. It cuts across Ini, Ikono, Ibiono Ibom, Itu, Uruan and Uyo LGA, (Figure 1). Ikpa Basin is one of the three basins in the State, located between latitudes $5°0^{1}3.801^{II}$ and $5°16^{1}49.129^{I1}$ North of the Equator and longitude $7°46^{1}34.9^{II}$ and $8°3^{1}11.9^{I1}$, East of Greenwich Meridian. It is dendritic, pear-shaped with a natural river and a homogenous geologic formation which occupies the total land area of 358.92km^2 Ezemonye et al. (2017).

Figure 1: The Akwa Ibom Map Showing Ikpa River Basin Area
Source: Ministry of Lands and Town Planning, Uyo.

The climate of the area is the same as the climate of Akwa Ibom State and Nigeria lying within the tropical zone. The area enjoys both rainy and dry seasons, as the wet period lasts between the months of April to November with its peak in July. While the geology of the basin is underlain by coastal plains sands of tertiary and quaternary rocks of sedimentary origin (Udosen, 2012; Umo, 2014), the relief of the basin varies from one location to another. However, analysis using United State Geological Survey (USGS DEM, 2016) and ArcGIS software indicate that the highest elevation (483 meters) is in a town of Obotme, Ini Local Government Area, where the Ikpa River originated and flows North-south to South-west direction into the Cross River. Originally, the area belonged to the vegetation belt of the tropical rainforest, but due to prolonged human activities and resources exploitation, the vegetation cover has been removed, and the land left with secondary forest, bush fallow and grasses (Ituen, 2010).

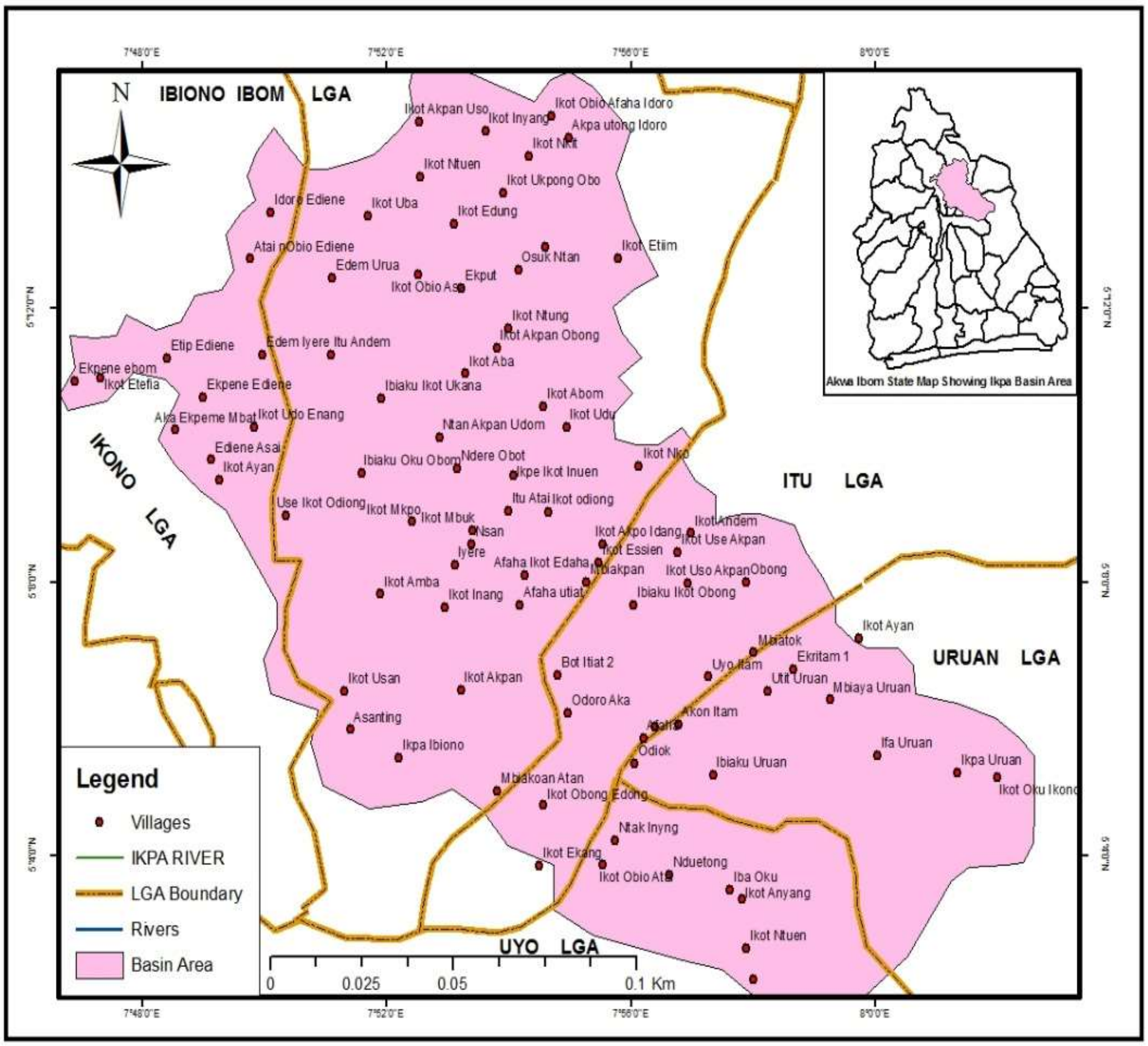

Figure 2: The Ikpa River Basin Area Map
Source: Ministry of Lands and Town Planning, Uyo.

3. MATERIALS AND METHODS

The study is broadly divided into two main parts, which are the remote sensing aspect and the statistical survey-based land-use change assessments. These two approaches were guided by the general objectives of the study, with a well-defined study area. Landsat images together with the existing political and vegetation maps were gathered and processed. The statistical survey of the LUC with their socio-economic drivers was also carried out. The effects of the observed land-use changes on the socio-economic aspect of the people living in the area were assessed.

3.1. Remote Sensing

(a) Data acquisition and Processing

Landsat satellite images of 1986, 2003, and NigeriaSat-1 images of 2018 were acquired and used for the study. The 2003 and 2018 images were obtained from the National Centre for Remote Sensing (NCRS) Jos, with a resolution of 32 by 32mm. Figure 3 shows the steps involved in image processing and change detection analysis. With the aid of ERDAS Imagine 9.2 software, the different bands of the satellite images for each year of study were layer-stacked. This was done to ensure that the datasets were ready for additional processing and analysis.

The different composite bands used in this study are band layers 6-5-3 especially to obtain a high-resolution image for the 2018 image**.** The satellite images were processed using an unsupervised classification algorithm and post-classification techniques in ArcGIS9.2. The image classification for pattern recognition was used to identify each pixel position regarding the land use and vegetation.

The steps involved in image processing firstly include a definition of the five land uses namely, (Open Water, Swamp Forest, Compound Farmland, Bush Fallow, and Built-Up) data acquisition, data enhancement, processing, and integration. The area calculation of the land-use change for the analysis of changes in hectares, percentage, trend, and rate of change between 1986 and 2018 was performed. For data capture in GIS, the maps were obtained in analog format and converted to an image data source in ArcGIS 9.2 software for georeferencing and digitization. Furthermore, it was necessary to re-project the digitized features to a common projection and coordinate system.

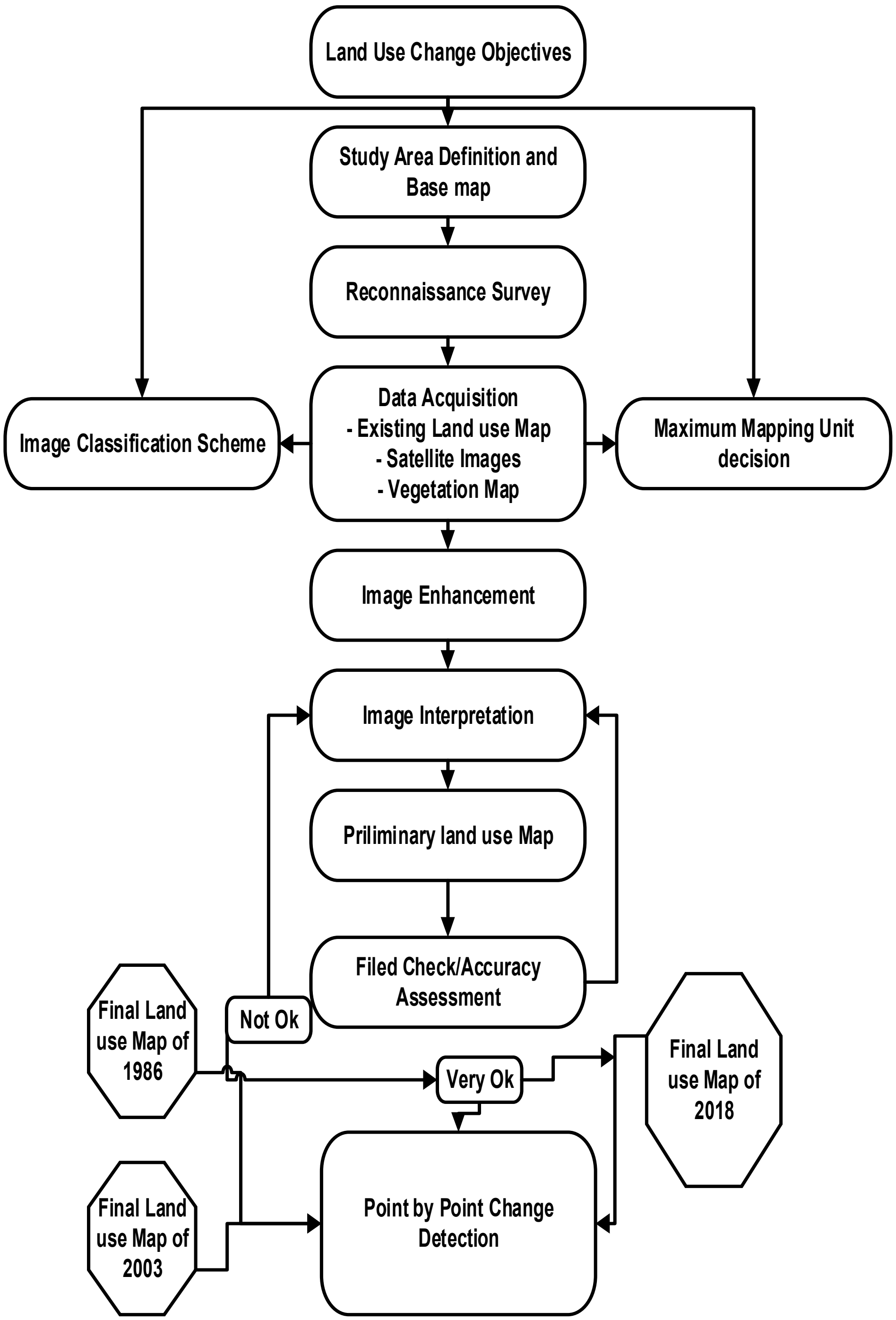

Figure: 3. Schema for Image Processing
Source: After Ituen (2015)

(b) Image Enhancement

Spectral enhancement also known as image sharpening was applied in the modifying of values of pixels in a particular image to enhance or improve certain important features above others. It helps to improve image resolution and enhance the quality of the satellite imageries to aid easy identification of pixels of land use and bare lands for visual interpretation.

(c). Clipping

This is also called sub-setting or delineating the Area of Interest (AOI). Ikpa basin which is the Area of Interest was delineated and identified by creating a polygon shapefile for each year of study with the same spatial reference and was overlaid on the images in Erdas 9.2. Clipping helps to focus on the particular area of interest and ignore unnecessary information in the full satellite imageries. d. Image Classification Scheme: The pixel-oriented classification with maximum likelihood method was used because it delivers better results than the minimum distance method. It also categorizes each pixel of an image into one of the various land use classes or themes. Given this, an unsupervised classification was adopted in the study. However, reference was made to the land use and vegetation classification scheme of the CRBDA. Five land use classes were used. These are open water, swamp forest, compound farmland, bush fallow, and built-up (residential houses, commercial and industrial buildings, transport facilities) as it was impossible to make a further distinction.

(d) Area Calculation and Rate of Change

The total area of the study location for the clipped and analyzed image were calculated in square kilometers (km) with the help of ERDAS Imagine 9.2 in other to quantify the size or spatial extent of changes that have occurred over time. f. Accuracy Assessment: The major reason for accuracy assessment is to evaluate the accuracy of the classification process such as the land use cover maps extracted from the satellite data. However, the 1986 classified image was compared with that of the land use and vegetation map published by the CRBDA in 1986. Furthermore, a field check was undertaken on the 2003 and 2018 classified images. These methods proved very reliable in generating valid land use cover categories for the study.

3.2. Sample Size and sampling Procedures

A household survey was conducted using structured questionnaires, and interviews with community leaders, farmers, and individuals who had lived for about 32 years in the area. Information got includes occupation, type of building, size of farm holding, type of agriculture, nature of agriculture, access to roads, the extent of wood extraction, and uses of wood. Ikpa Basin as shown in Figure 1 is made up of Ninety (90) villages. Because of the similarity of the biophysical characteristics among the villages, 20 villages were systematically selected for sampling. In each selected village, 20 households were as well visited for data collection, as such resulting in a total of 400 households. To give equal coverage of respondents in each selected village, systematic random sampling procedures were used at five regular intervals after fixing the origin at Ikot Mbang market square to administer the questionnaire.

The infinite population sampling formula was used in determining the sample size because the population size is infinite or cannot be estimated accurately (Godden, 2004). Thus, Godden's formula was used in this case, and a sample size of 400 respondents was chosen. The total sample size was equally divided among the twenty sample villages. Collected data were used to analyze potential driving forces resulting in the land-use change in the area. The total and percentages were then plotted using a bar chart to show the percentage increase or decrease of change that has taken place, and the result was interpreted.

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(a). Analysis and Interpretation of Questionnaire:
This part of the analysis relied on survey questionnaires, the collected data were analyzed by the use of Excel, and the results were summarized and presented quantitatively in percentage distributions, figures, charts, and tables. Collected data were coded in this pattern, a=1, b=3, c=7 and d=9 according to their order of increasing importance. The total and percentages were then plotted using tables and bar charts to show the percentage increase or decrease of change that has taken place, and the result was interpreted.

(b). Statistical Analysis
Following the completion of data collection, data were cleaned, coded, summarized, and entered into SPSS 17.0 software program for analysis. The specific quantitative method of analysis employed in this study is the multiple regression model which enabled us to establish the effect of land use drivers on the socio-economic variables.

4. RESULTS AND DISCUSSION.

4.1 (a) Land Use Inventory and Change Assessment
In this section, the results of the image analysis and change detection for the period of 1986 to 2003 and 2003 to 2018 are presented. However, to capture changes that have occurred in the area, the data generated from the analysis have been summarized in Table 1 for clarity. Table 1, the 17 years from 1986 to 2003, shows a 4.32 sq. km decrease in Open Water, which represents about 5.51 percent of the total change at the rate of 0.25 sq. km per year. This land use substantially decreased by 6.79 percent from the period of 2003 to 2018, which means that the land use subsequently decreased as a result of the expansion of roads and bridges built across the river in the area.

Table 1: Land use inventory (1986 to 2003) and (2003 to 2018)

					1986 - 2003			2003 - 2018		
S/N	Classes	1986(Km)^2	2003(km)^2	2018(km)^2	Change (km)^2	Change(%)	Change/ yr (km)^2	Change (km)^2	Change (%)	Change/ yr (km)^2
1	Open water	40.4	37.1	34.84	-4.32	-5.51	-0.25	-2.26	-6.79	-0.15
2	Compound farmland	64.14	80.65	82.08	16.5	21.04	0.97	1.43	3.11	0.09
3	Built up	54.24	63.88	85.67	34.46	43.95	2.02	21.79	47.32	1.45
4	Swamp forest	102.28	94.86	84.21	-7.41	-9.45	-0.44	-10.65	-23.13	-0.71
5	Bush fallow	97.75	82.03	72.12	-15.72	-20.05	-0.92	-9.91	-21.52	-0.66
	Total	**358.92**	**358.82**	**358.92**	**78.41**	**100**		**46.04**	**100**	

Source: Researchers analysis (2019)

The area of compound farmland shows an increase of 21.04% change from1986-2003 and 3.11% change between the 2003 and 2018 period. Also, the built-up area shows a significant increase of 43.95% change during the 17year period, which enormously increased to 47.32% change between the years 2003 and 2018. The significant increase in compound farmland and built-up areas exceptionally shows the socio-economic activities occurring in the study.

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This area is covered with the estate of residential and commercial buildings, road expansion, and small-scale industries. This tremendous increase has affected the natural ecosystem of the basin area thereby threatening biodiversity, food security, health, lives, and properties of the inhabitant in the study. For the swamp forest, the study revealed a significant decrease of 7.41 sq. km, representing a 9.45% change between 1986 and 2003. This further significantly decreased by a total of 23.13% between 2003 and 2018.

This implies that the decrease in the swamp forest results from continuous deforestation of the area, a trending issue in the environment in the 21st century. This is due to the exploitation of trees for logging, building, and construction, firewood, and charcoal selling in the study. These, as obtained from the questionnaire occur on daily/monthly bases which have contributed to environmental degradation. Another decrease was experienced in the area covered by bush fallow. Table 1 shows that bush fallow reduced by 20.0% change between 1986 and 2003, followed by a 21.52% decrease between the 2003 and 2018 period. The decrease results from the clearing of forests for agricultural expansion, construction of new roads in rural areas, as well as family increase (more mouths to feed) resulting in its shrinkage every year. This aspect reflects the last stages of Boserup's theory of annual cropping and mixed-cropping, where clearing forests every year and planting the same crops in the same plot of land will eventually reduce yield. The images of the study area for the year 1986, 2003 and 2018 are also presented

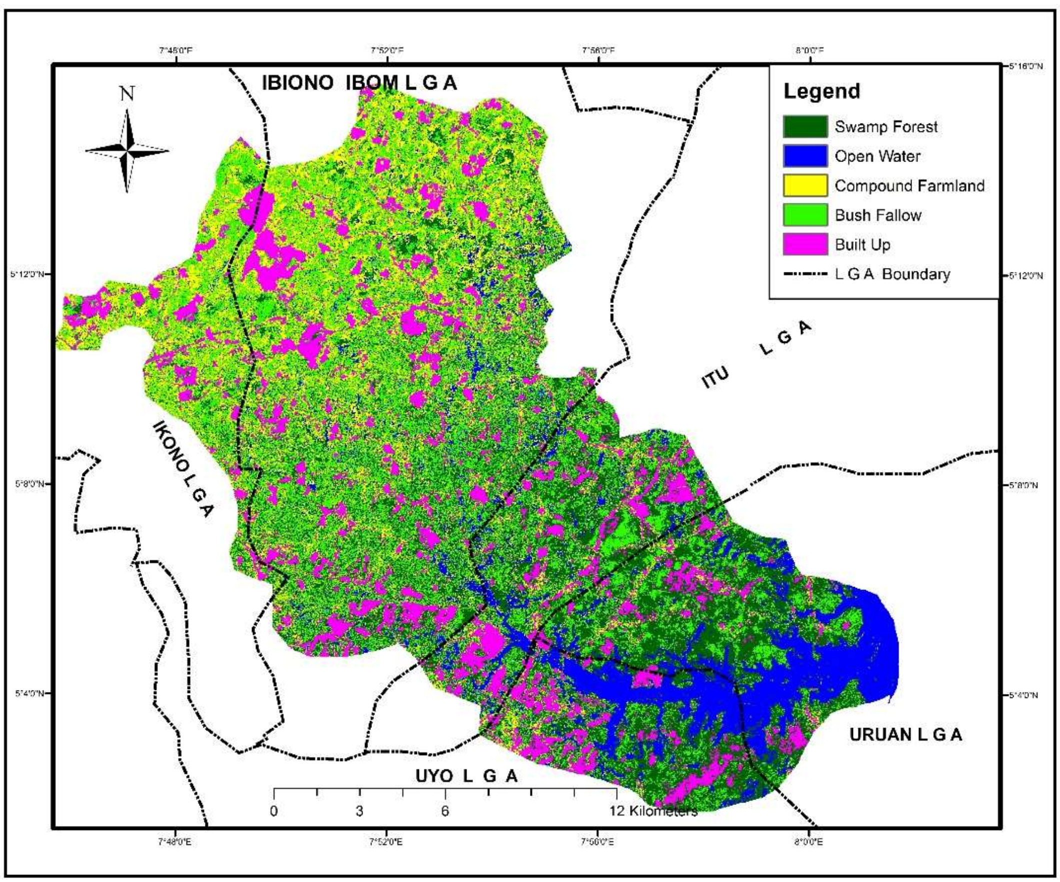

Figure 4: Land Use Status of the Study Area for 1986

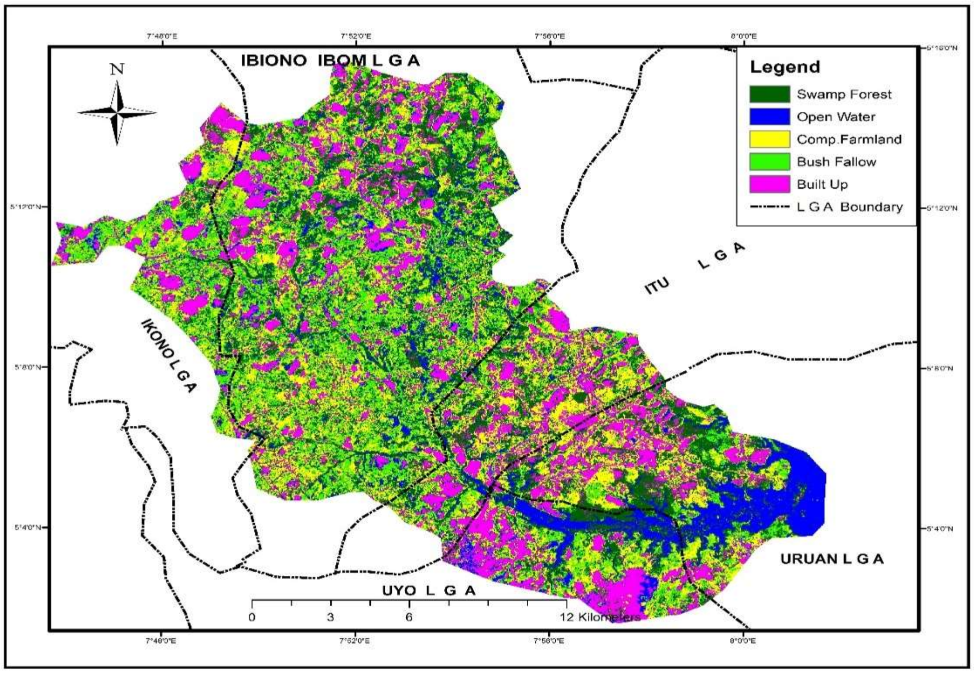

Figure 5: Land Use Status of the Study Area for 2003

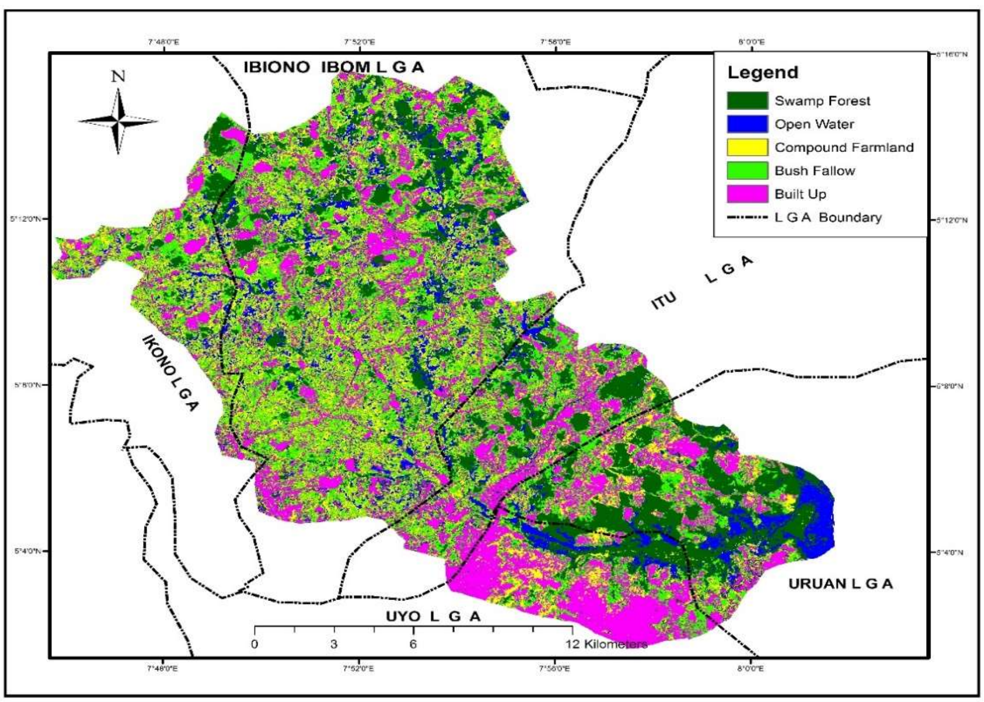

Figure 5: Land Use Status of the Study Area for 2018

(b) Assessment of Trends and Magnitude of Land Use Change

Following the inventory results obtained, Table 2 presents the overall land-use statistics between the base year, 1986 and 2018, to assess the nature of change for the 32 years.

Table 2: Land use trends and magnitude of change (1986-2018)

S/N	Classes	$1986(km)^2$	$2018(km)^2$	Change $(km)^2$	Change (%)	Change/ yr. $(km)^2$	Direction of change
1	**Open water**	40.3	34.84	-5.56	-5.64	-0.17	**Decrease**
2	**Compound farmland**	64.14	82.08	17.83	18.1	0.55	**Increase**
3	**Built up**	54.24	85.67	31.43	31.91	0.98	**Increase**
4	**Swamp forest**	102.28	84.21	-18.02	-18.29	-0.56	**Decrease**
5	**Bush fallow**	97.75	72.12	-25.63	-26.02	-0.8	**Decrease**
	Total	**358.92**	**358.92**	**98.47**	**100**		

Source: Researchers analysis (2019).

Table 2 shows significant changes in land use classes observed for the 32 years. There was a 5.64 % decrease in Open Water with a 0.17 sq. km annual rate of change. Changes observed were; an 18.10% increase in Compound Farmland at 0.55 sq. km, a rate of change and 31.91% increase in Built-Up at the annual rate of 0.98 sq. km, 18.29% decrease in Swamp Forest with an annual rate of change of 0.56 sq. km, 26.02% decreased in Bush fallow with a 0.80 sq. km rate of annual change. These classes show significant land-use changes happening in the area, especially areas covered by Open Water, Compound Farmland, and Built-Up. These classes have gained significantly from Swamp Forest and Bush Fallow. The reasons are similar to those observed in Figure 6 for the recent period. Figure 7 shows the comparison of the land-use area covered in kilometers, which reveals a significant increase in Open Water, Compound Farmland, and Built-Up at the expense of a decrease in Swamp Forest and Bush Fallow. These facts revealed by the satellite images are the driver of such land-use transformation. Thus, this inventory will assist in curbing the massively land use in the area guided by proper measures for sustainable land practices.

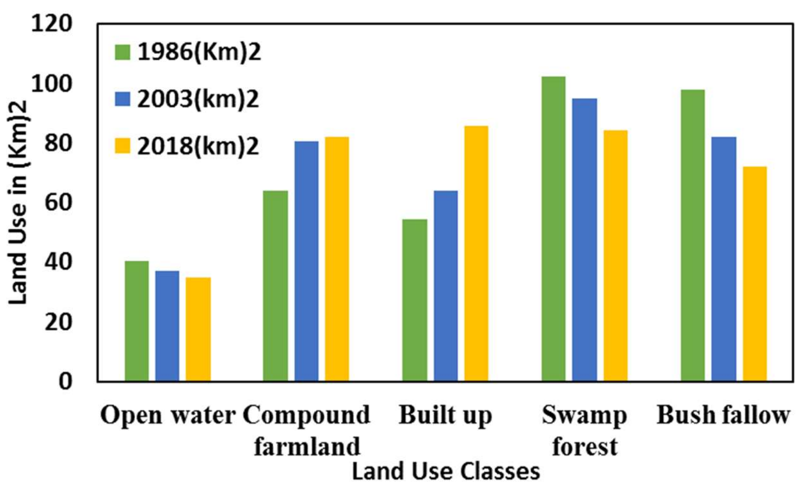

Figure 7: Graph showing comparison of classified land use change of 1986, 2003 and 2018 imagery of Ikpa Area.
Source: Researchers Analysis (2019)

(c) Point Change Detection

Point Change detection examines the transformation of one land cover type to another. Table 3, therefore, presents the change detection for five land cover types in a matrix form.

Table 3: Land Use Change Matrix (km²)

S/N	1986 \ 2018	Open water	Compound farmland	Built up	Swamp forest	Bush fallow
1	Open water	No change		3.96	28.37	
2	Compound farmland		No change	54.9		11.9
3	Built up		2.5	No change		0.41
4	Swamp forest		0.6		No change	30.31
5	Bush fallow		31.16	44.32		No change

Source: Researchers analysis (2019)

The matrix indicates the actual size in square kilometers by which one land-use type in 1986 changes to another in 2018 due to several climatic and socio-economic factors. Figure 8 presents the change detection map for the study area, and the changes for each land cover type are described in detail.

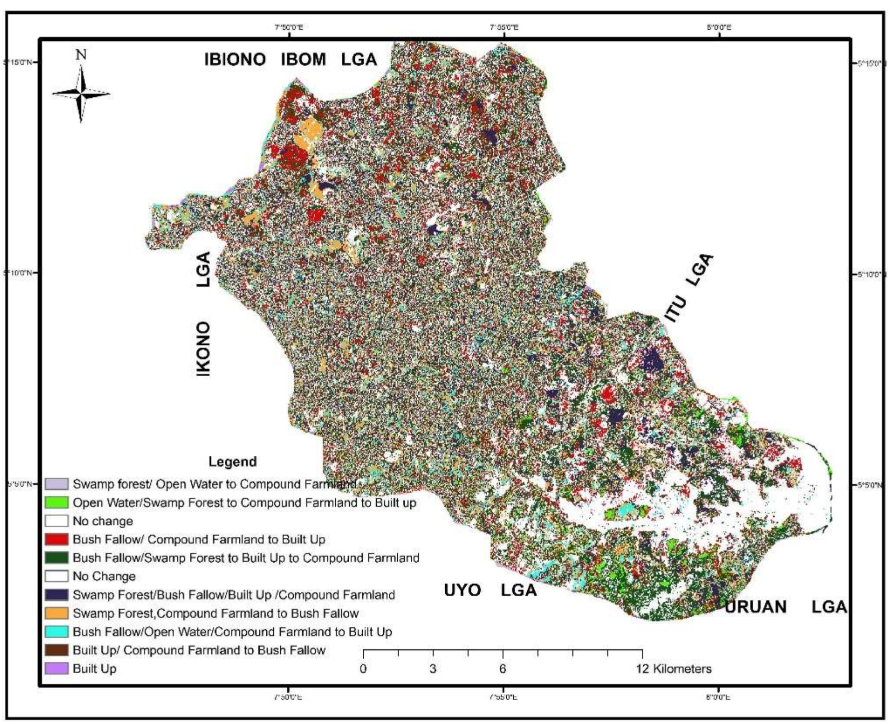

Figure 8: Land Use Change Detection From 1986 To 2018
Source: Researchers reproduced using Erdas Imagine from Landsat Thematic Mapping (2019).

4.2 Land Use Change Drivers and Socio-economic Effects

A field survey was carried out in the study area for community leaders, heads of households, village heads, and elders who have lived in the area for about 30 years and above. Questionnaire responses on the socio-economic drivers of land-use change centered on; infrastructure, agriculture, and lumbering.

(a) Infrastructural distribution

The use of land for infrastructures changes the land cover significantly. The infrastructures considered in this study include; housing, roads, markets, schools, and churches.

i. Housing

Housing being one of the key drivers of land use change, was assessed in terms of the quantity and quality of the houses in the area. Figure 9 presents the distribution of houses for the years under review. In this study, only the recent period is mainly discussed as other details are shown precisely on the chart for easy understanding.

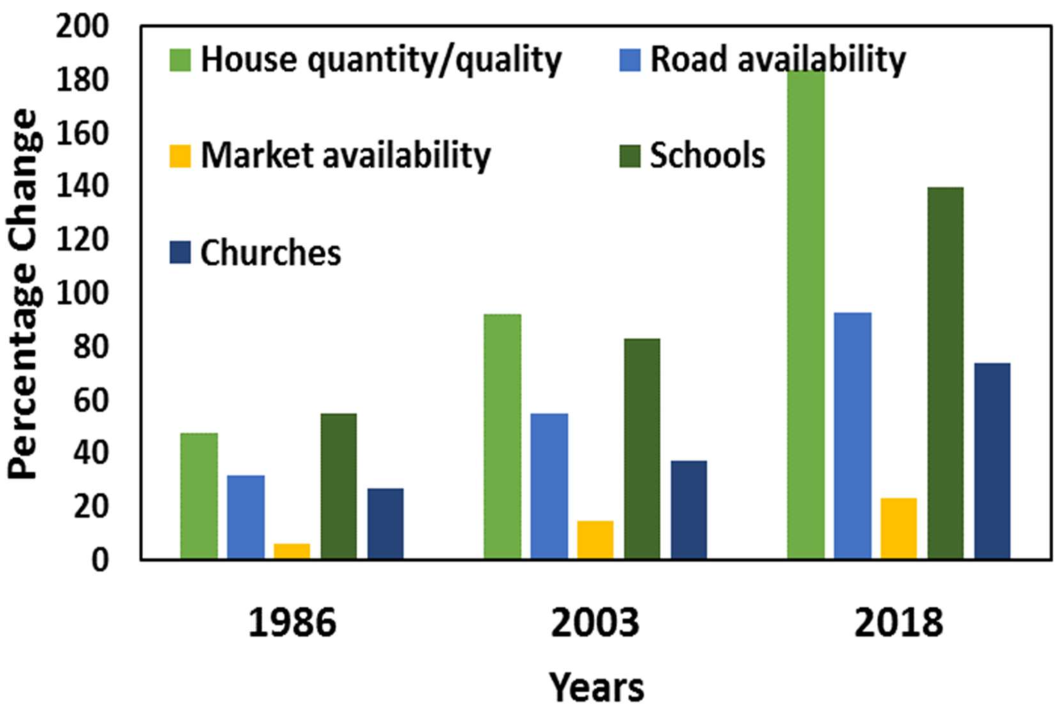

Figure 9: Infrastructural distribution

An overall increase of 184% in housing for the 32 years is shown in figure 9. The increases in the second range of the years were observed around: Ikot Ntuen, and Nduetong Oku in Uyo Local Government Ikot Ekang, in Itu Local Government, and Ikot Mbang, in Ibiono Ibom, all within the Uyo Capital City Development Authority. The remarkable changes are attributed to urbanization being extended to these areas, as people gradually move from the city center to the outskirt of the town where the cost of acquiring a property is relatively cheap. The marginal increases were also found in the remaining part of the study area, as some of the villages are still located in interior areas.

The result indicates that; the changes to the modern houses are associated with recent socio-economic activities and the quest to improve the living standards of the inhabitants. Also, the rapid increase in population, has resulted in the expansion of built-up, and conversion of houses into story buildings for residential and commercial purposes. The change in quantity and quality have so much impact on the land area of the study as a large space area is used for the construction of these modern houses with a fence and soak away pit the building.

ii. Road

Also, figure 9 presents the distribution of roads in the area. It is shown that the number of the road increased significantly by 56%, with a 40% increase in the quality of roads, which means that most of the road earlier created was later constructed and expanded in the urban areas. Some of the roads in interior villages were expanded, these include the dualization of the Calabar-Itu road and Uyo-Ikot Ekpene roads. New roads have also been constructed in other communities as intervention projects by government agencies. This is revealed by the overall 100% increase in the number of roads, and about 80% increase in the quality of roads in the area. Through the availability of good roads, accessibility, and urban proximity, enormous opportunities in the area have evolved. It has changed the rural appearance of the area to a busy urban city and its immediate surroundings.

(iii) Schools and churches

Figure 9 presents the distribution of churches and schools in different years in the area. Figure 9 also reveals that there was a 140% increase in the number of schools for the 32 years. Much of this increase occurred in the second range of the study years with an 82% increase as compared to the 55% increase in the first range of the years. This increase in the number of schools could be attributed to the proliferation of private schools, though some were of mushroom types in the study area. The government's drive for school expansion has also contributed to this growth. The influx of people residing along the new roads in the area has also increased as well as commercial activities.
The bar chart also shows the number of churches in the area. A cumulative increase of about 74% in the 32 years study period was observed. These changes follow similar trends with the infrastructural expansion, especially the new roads and the dualization of the existing roads. Also, with the population increase, the expansion of churches to occupy the influx of worshippers has led to the expansion of building into large space areas. These have further added enormous pressure on land use and its associated land cover changes in the area.

(iv) Market

Figure 9 reflects the increased number of the market in the area. From the plot, the overall year showed a 23% increase in the number of markets. Though there were markets in the first range showing almost the 15% equal in the number and sales but later increased with 8% in the second range. The increase is a result of road construction which helps in the opening up of the new area to ease movement for trade and as well reduced the cost of transportation. The availability of the market provides the enabling environment for trading in agricultural produce, especially, perishable goods, and the transportation of goods from the farm to the market. These markets are categorized as daily, weekly, morning, and evening which boosts the frequency of sales in the entire study area. Despite this, the expansion of markets into most agricultural lands as a result of road expansion has affected the land use of the area, which has altered the entire ecosystem of the basin area.

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(b) Agriculture

Agricultural land-use practices are the major driver of land-use change, as this sector remains the main source of livelihood for the people within the study area. Figure 10 shows the sizes of farmlands in the area, with a general decrease in the size of farm holding. A 23% reduction was observed in the first 17 years and a further 47% decrease in the last 15 years, with a total of 59% decrease in the size of farm holding for the 32 years study period.

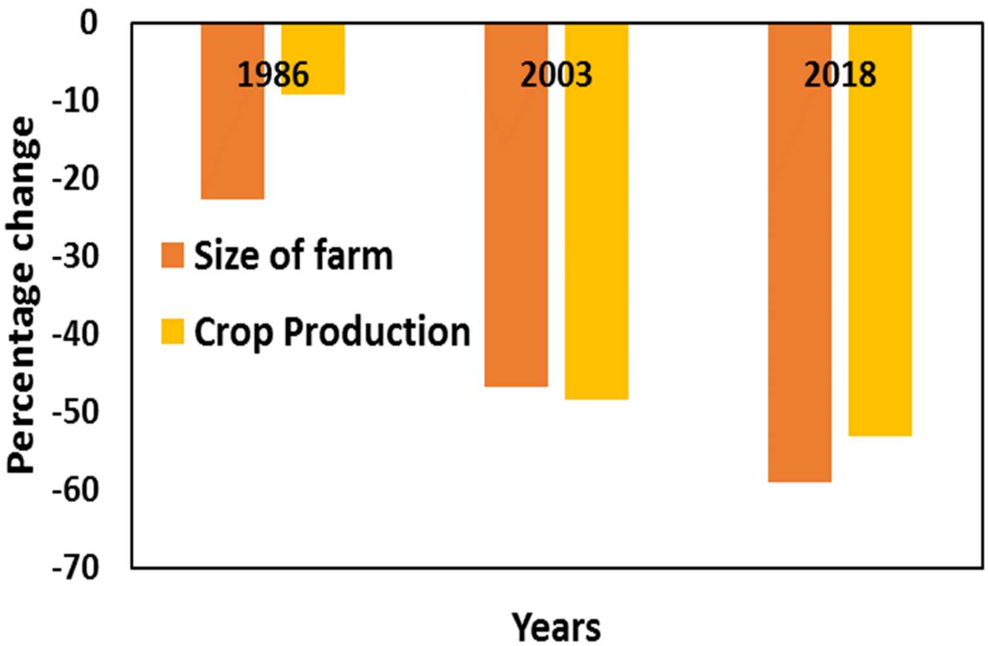

Figure 10: Size of Farm Holding

The decrease in farm holding in the area is attributed to the expansion of the infrastructure as earlier highlighted in figure 9. Mainly, road construction into new areas such as Ikot Ntuen, Ikot Akang, Ikot Ebom, Akpa Usung Idoro, Ibiaku Uruan, Ikot Andem, Ediene, and Mbiatok has taken told of a large expanse of agricultural farmlands thereby resulting into shrinkage of farm sizes. The decrease of land in the study area has resulted in an intensification of agriculture in the remaining forest area as mostly found in the interior villages and a lack of fallow, hence resulting in a decline in land productivity due to deterioration of soil fertility.

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(c) Lumbering
Lumbering results from deforestation of an area for one or more land uses. Figure 11 shows the changes in the size of the forest and the extent of logging.

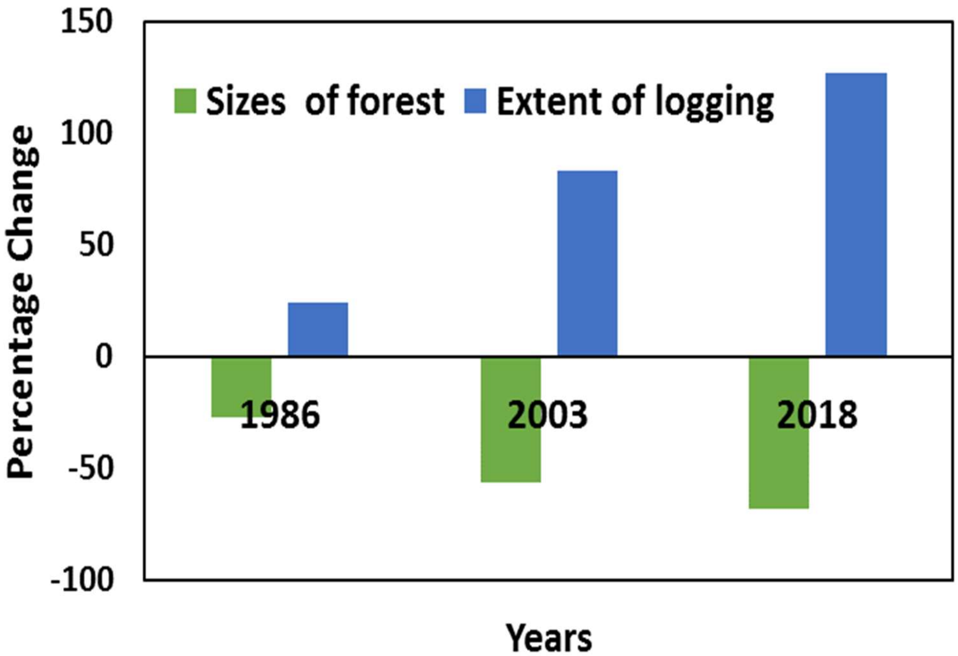

Figure 11: Lumbering Activities

From the chart, figure 11 shows an enormous decrease of 70% change of the size of forest and 130% change of extent of exploitation occurred in the first range. The increase here was due to government intervention to create and expand roads for development in the area, but was later left without construction. In the overall, an increase of 127% change of extent of wood extraction was observed in the 32 years of study. The decrease in the size of forest in associated with deforestation of woods for timber and firewood which still remains the main source of energy among respondents in the study area. The increase is due to the high cost of electricity, petrol and kerosene, making most people in both urban and rural areas continued to rely on fuelwood as their main domestic energy source. This has resulted in continued land use change, especially in the form of deforestation due to over-dependence on fuelwood by the majority of rural and urban dwellers in the area.

5. CONCLUSION/RECOMMENDATIONS.

In summary, the Ikpa basin area has various potential to generate fertile land and natural vegetation. There is a land-use change in the area, owing to population growth and socio-economic factors to meet people's needs. Although these drivers have helped improved housing quality, ease of movement, and other social structures, there is a significant impact of these drivers leading to shrinkages of farm sizes, decreased food availability, insecurity, and joblessness in the area. The study indicates that the changes are at a faster rate, and therefore recommends monitoring the past and present land-use dynamics. Also, a combination of remote sensing data, GIS, and survey analysis has proven to be effective tools for environmental monitoring. Also, regular auditing of land-use change by relevant authorities will provide adequate data for restructuring residential and commercial buildings in the area. Proactive measures for afforestation and planned regenerative agriculture will curb land degradation. These will encourage long-term economic development, conservation of biodiversity, and a sustainable ecosystem.

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