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The Dynamics of Land Use Change and Its Impacts on Agriculture in Itu Local Government Area of Akwa Ibom State

by

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Abstract

The study assessed the dynamics of land use change and its impacts on agriculture in Itu Local Government Area. The objectives of the study were to: map the land use/cover class inventory of the study area, assess the trend, rate, nature and magnitude of land use change over the periods 1986 and 2013, assess the extent to which land use has affected agriculture, as well as to examine the impact of land use in agricultural lands in the study area. In order to achieve the above objectives, remotely sensed data of Landsat TM 1986 and NigeriaSat-1 2013 of the study area were used. The image was processed using unsupervised classification algorithm and post classification change detection technique in GIS. This was further augmented by personal interviews and an on-site-assessment. The findings of the study revealed that, five dominant land use categories of open water, swamp forest, bush fallow, compound farmland and built up exist in the study area. The study revealed that, these land use categories have experienced various form of transformations with the built up pertaining to infrastructure and residential buildings having the highest form of change. It was also found that population growth over the study period changed by 17.18% resulting in a significant increase in agricultural lands 22.14 sq. km. The study identified the loss of swamp forest, decrease crop yields and loss of mean of livelihood as negative impacts on agricultural land use in the study area. Based on these findings, it was recommended that development control laws should be enforced in order to avert negative implications on the increased rate of urbanization.

Keywords: Land use change, Driving force, Agricultural impacts, Change detection, Development.

1. Introduction

Land use by man varies differently due to how he perceives the environment to be useful to his economic and material well-being. Humans have been modifying land to obtain food and other essentials for thousands of years. Yet current rate of magnitude

and intensity of land use changes are driving unprecedented changes in ecosystem and environmental processes at local, regional and global scales. Land use is commonly defined as a series of operations on land carried out by humans with the intention of obtaining products and/or benefits through using land resources. According to Ellis 2013, land use is directly linked to their driving forces, which are factors that influence human, economic and environmental activities.

Land use indicates how people are using the land, whereas land cover indicates the physical land type and can be obtained from the same source. Both types of data are more often obtained from analysis of either satellite images or aerial photograph. Understanding both the land use and land cover of a track of land provides a comprehensive picture of a particular area. This data is a fundamental component of the planning and decision making processes for many communities. This is because it helps them to understand better where to plan for different types of growth and where to preserve; it also helps them to understand the connectivity or fragmentation of various features in the community.

Within the context of land lies the issue of land use/cover mechanisms which induce change in the patterns of land use linked to their driving forces. Geist and Lambin (2001, 2002) grouped land use change drivers into proximate and underlying causes. According to them, proximate causes are immediate actions at the local level, such as agricultural expansion, that originate from intended land use and directly impact forest cover, while underlying driving forces are those that do not intend the use of land immediately, such as human population dynamics or agricultural policies.

In the light of the above, this study seeks to investigate the changing pattern of land use and its impacts on agriculture in Itu L.G.A within the period of 27 years (1986-2013) due to availability of data. The work shall rely on remote sensing data in a GIS environment to map the status of land use change with a view to assessing the rate of changes and impact on agricultural land of Itu L.G.A.

2. Statement of the Problem

All over the world, changes in land use dates back to prehistoric time with direct and indirect consequences of human actions to secure essential resources such as burning of areas to enhance wild game and agriculture, thus resulting in the extensive clearing and management of earth's terrestrial surface. In Nigeria, the story also remains the same as human activities like clearing of forest for vegetation, road construction, overgrazing etc., have taken quite a portion of the vegetation cover; we see that areas with low population density bear little resemblance to the original plant cover (Arome *et al.*, 2012). These are exploited and carried out daily by hundreds of people whose livelihoods depend on forest product and rapid population has led to its over exploitation.

In Oku Iboku, Itu Local Government Area, prior to the establishment of NNMC in 1977, agriculture accounted for most of the major economic activities of the people,

and due to government intervention, large portion of the land was undertaken for the construction of the Paper mill, roads and estate which affected the economic activities of the people putting much pressure on land. The farming system of the people were also affected by reasons of human occupation such as slash and burn agriculture, shifting cultivation, bush fallow and infrastructures etc. These activities made the land use cover of the area to be in the state of flux because the area was typically rural and are largely dependent on the land.

However, the method of land preparation, cropping system, intensity of land usage, soil fertility, and the fallow period are all factors which either influence or being influenced by land use cover change, thus explaining the dynamics which still require further investigation. This study assesses the pattern of land use/cover change, and its impacts on agriculture in Itu L.G.A from 1986 to 2013. The work uses GIS and remote sensing data to map the status of land use/cover change with a view to assessing the rate of changes and impact on agricultural land of the area. A study of this nature gives a better understanding of land cover change and its driving forces, which will also assist to proffer measures to counter the negative effects of land cover change for the benefit of the entire public and also guide researchers and policy makers to make decisions, which stimulate sustainable environment.

3. Aim and Objectives

The study aims at examining land use change and its consequences on agriculture in Itu between 1986-2013 using remote sensing data and GIS techniques.

To achieve this aim, the following objectives are set:

- (i) To carry out land use cover inventory between 1986 and 2013
- (ii) To map the land use cover of the area
- (iii) The assess the trend and magnitude of change
- (iv) To assess the impact of the change on agriculture.

4. Materials and Methods

To achieve the objectives of the study, a combination of datasets from secondary and primary sources were collected and utilized.

4.1 Remote sensing Data

Landsat satellite image of 1986 were acquired from the Global Land Cover Facility (GLCF), an Earth Science Data Interface, while the 2013 images of NigeriaSat-1 were obtained from the National Centre for Remote Sensing (NCRS), Jos. Vegetation and land use/cover map of the study area for 1988 was acquired from the Cross River Basin Development Authority (CRBDA). For data capture in GIS, the maps were obtained in analogue 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. To achieve this, the features were re-projected to World Geodetic System (WGS) 1984 Universal Transverse

Mercator (UTM) zone 32. The choice of using UTM is based on the fact that the satellite images that were acquired later during the data collection stage were all on UTM coordinate system.

The satellite images were processed using unsupervised classification algorithm and post classification techniques in ArcGIS9.2. The image classification for pattern recognition was used to identify each pixel position with reference to the land use and vegetation. They were then classified into five units namely, Open Water, Swamp Forest, Compound Farmland, Bush Fallow and Built Up. The area calculation of the land use change for the analysis of changes in hectares, percentage, trend and rate of change between 1986 and 2013 was performed. The point by point detection of the land cover was then assessed.

4.2 Instruments for Data Collection

4.2.1 Questionnaire/personal interviews

The questionnaire was structured based on the socio-economic data, accessibility to land and farming activities as well as land use change on agriculture. This was used to acquire ground truth to the changes in land use in the study area. Structured interviews and discussions were held with farmers, and community leaders who were seen as knowledgeable people in the communities. This includes individuals who have been resident in the study area for at least 28 years.

4.2.2 Sampling Procedure

In order to obtain socio-economic data from households in the study area, a household survey was conducted. Itu is made up of 87 villages with 5 clans. Using the table of random numbers, ten (10) villages were selected: The villages include; Ekritam II, Ikot Ebido, Mbribit Itam, Nung Ukot, Ikot Obio Enang, Mbak, Afaha Ube, Ikot Ebom, Ayadehe and Oku Iboku. In administering questionnaire, households were chosen at five- five interval to be able to go round the entire village of that area. In determining the sample size however, Yamane (1967) formula for finite population was used to derived the number of questionnaire to be administered, hence using the table of random numbers 10 percent ($n = 400$) was considered appropriate. Based on this, a total of 400 questionnaires were administered.

$$n = N (I = N(e)^2)$$

Where N = Present Population
e = The significant level (0.05)
I = Constant

5. Results

5.1 Study Area

The study area for this work is Itu L.G.A of Akwa Ibom State. The area is approximately located between latitudes 5°0' and 5°5' North of the equator and longitudes 8°0' and 8°5' East of the Greenwich meridian. The area lies to the western bank of the Cross River State.

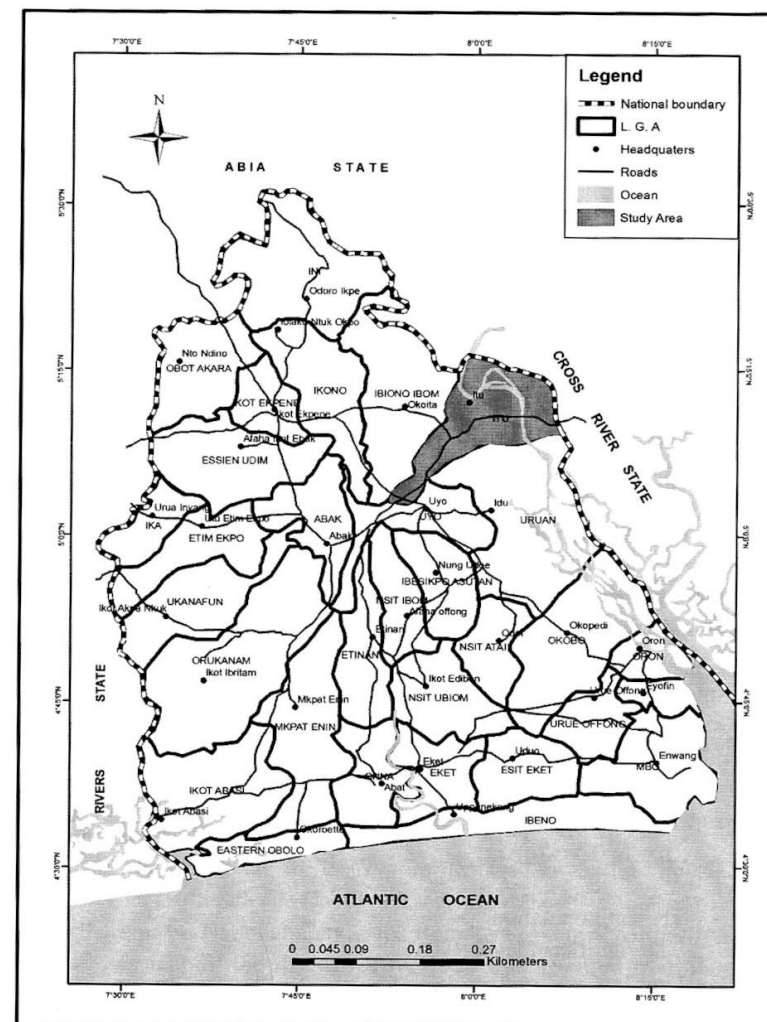


Figure 1: Location of Itu on the map of Akwa Ibom State.

Source: Akwa Ibom State Ministry of Lands and Town Planning, Uyo

5.2 Land use change inventory

In order to capture changes that have occurred in the area, the data generated from the analysis have been summarized in table1 for clarity. Table 2 also indicate the land use cover status of the study area for the year 1986 and 2013 respectively. Based on the land use change statistics between the base year 1986 and 2013, it was clear that during the 27year period, there was a little decrease of -4.34 sq.km in the area of open water. This however, represented 18.8% of the total change and at the rate of 0.16 sq.km per year. This further represented a minimal rate of change within the study area. Swamp forest increased by a total of -8. 41sq.km between 1986 and 2013, hence the rate of decrease was 0.31 sq.km per year. Consequently, bush fallow decreased by a total of 1.20 sq.km and at the rate of 0.044 sq.km per year.

Table 1: Land Use Change Class Inventory

S/N	Classes	1986(km)	2013 (km)	Change (km)	Change (%)	Change/yr (km)
1	Open water	16.99	21.33	-4.34	18.8	0.16
2	Swamp forest	78.35	86.76	-8.41	36.58	0.31
3	Bush fallow	77.16	75.96	1.20	5.22	0.044
4	Compound farmland	57.44	52.35	5.09	22.14	0.18
5	Built up	32.16	28.24	3.92	17.18	0.15
	Total	262.10	264.64	22.99	100	

Source: Researchers analysis

Equally, compound farmland increased by 5.09 sq.km and at the rate of 0.18 sq.km per year. On the other hand, built up increased by 3.95 sq.km within the study area period, representing 0.15 sq.km per year. The reason for the reduction of open water and fresh water was due to deforestation for timber, logs and firewood. The little increase in bush fallow was as a result of conscious effort by some communities and farm owners to regenerate soil fertility and forest, while compound farmland increased due to clearing and deforestation of forest as people moved into their lands to build residential and commercial buildings. Therefore, built up areas also increased due to construction and developmental purposes.

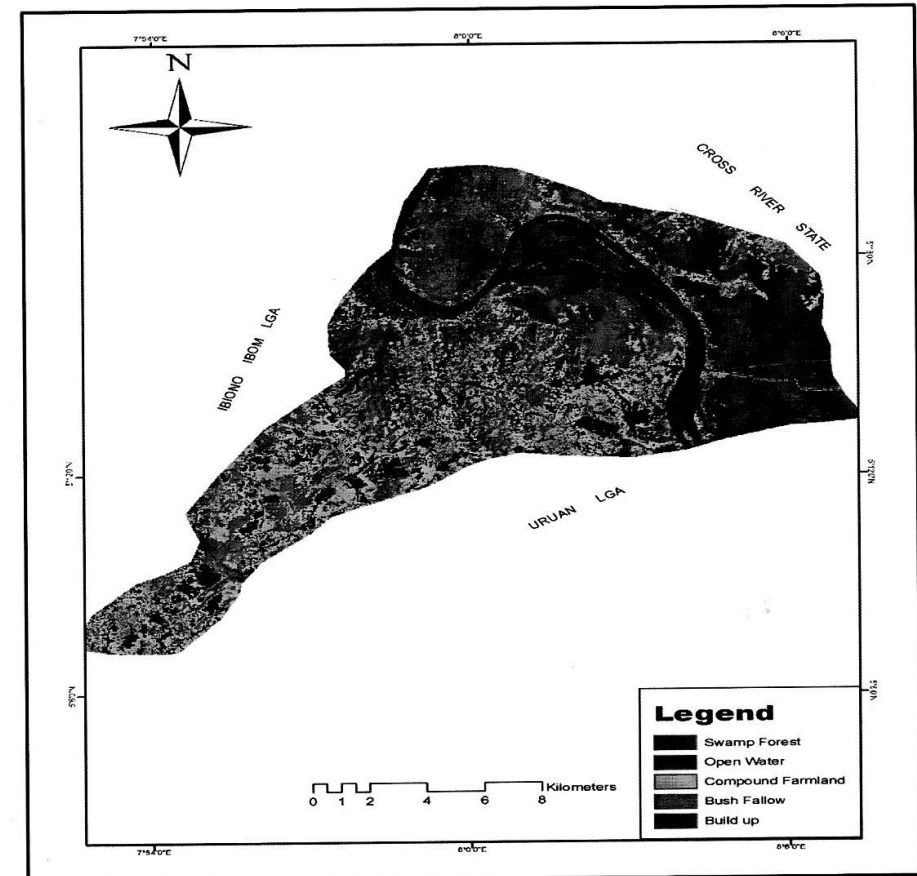


Figure 2: Land Use Cover Status of the Study Area for 1986

Source: Researchers reproduced using Erdas Imagine from Landsat Thematic Mapping

forest changed to -673.94 hectares representing 31.64% decrease at 14.87% annual rate of change. Bush fallow changed to 120.63 hectares representing 5.99% increase 2.67% rate of annual change. It was also revealed from the analysis that compound farmland changed by 508.41 hectares representing 23.87% increase at 1.12% annual rate of change while built-up assumed a change of 391.92 hectares representing 18.40% increase at the rate of 8.64% change annually.

Table 2: Land Use Cover Change: Magnitude, Trend and Rate of Direction.

S/N	Land cover classes	1986 land cover in hectares	2013 land cover in hectares	Change in hectares	% change	% Annual rate of change	Change per year in hectares	Direction of change
1	Open water	1693.32	2128.31	-434.99	20.42	9.58	16.1	Decrease
2	Swamp forest	7983.09	8657.03	-673.94	31.64	14.87	24.96	Decrease
3	Bush fallow	7700.08	7579.45	120.63	5.66	2.67	280.72	Increase
4	Compound farmland	5732.42	5224.01	508.41	23.87	1.12	212.31	Increase
5	Built up	3209.74	2817.82	391.92	18.40	8.64	118.87	Increase
	Total	26318.65	26406.62	2129.89	100	36.88		

Source: Researchers Analysis

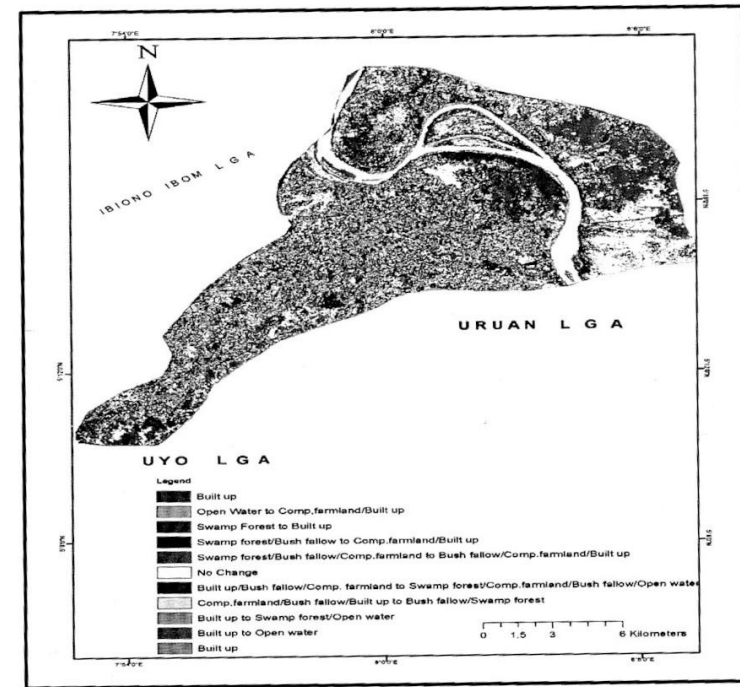


Figure 4: Land Use Cover Status of the Study Area between (1986-2013)

Source: Researcher's reproduced using Erdas Imagine from Landsat Thematic Mapping 1986

5.4 Impact of Land Use Change on Agriculture

The study identified through the questionnaire administered that, the provision of large area for cultivation, extinction of flora and fauna, alteration of ecosystem, loss of soil nutrient, poor agricultural yield and erosion of farmland are the various implications of land use change cover on agriculture. Table 4.5 shows the total and percentage change of land use on agriculture as responded by household in the study area.

Table 4.5: Impact of Land Use Change to Agriculture.

S/N	Item	S.A %	A	%	U	%	D	%	S.D	%	Total
1.	To what extent do you agree that the current Land Use Change have affected agriculture?	247	61.75	98	24.5	35	8.75	25	6.25	0	400
2.	Has Infrastructure leads to the loss of farmland?	280	65.0	75	18.75	20	5.00	35	8.75	10	400

3.	Has they been decreased in crop yield?	131	32.79	139	34.75	51	12.75	54	13.5	25	6.25	400
4.	Have Land Use Cover Change pose losses to means of livelihood?	205	51.25	111	27.75	56	14.00	28	7.00	0	0	400

Source: Researchers Analysis

Key: S.A = Strongly Agree

A = Agree

U = Undecided

D = Disagree

S.D = Strongly Disagree

It was gathered from the questionnaire that, 61.75% of the respondents strongly agreed that the current land use had affected agriculture in the study area. Only 24.5% agreed, while 8.75% and 6.25% respondents were undecided and disagreed respectively. Agricultural production was further challenged by decreasing crop yields in the study area. Therefore, about 67.54. % of the households strongly confirmed that they have been experiencing a reduction in crop yields, while 12.75% were undecided and 19.75% were against decrease crop yield. But the extent of such decrease could not be evaluated. This reduction according to the household is as the result of reduced fertility of the soil and degradation of farm space arising from intensive cultivation of the remaining farmlands to feed the immediate needs of the increasing population.

The households also noted that, the diminishing land area available for agriculture has led to the reduction of land fallow which used to be 5-15 years, to 1-3 years, hence the continuous cropping on available land in order to feed the growing population in the study area. As a result of these, the lands were depleted of nutrients and became less productive. This further posed a consideration threat to food security in the study area, as majority of the rural dwellers were net food buyers and spend a large part of their disposable income on food.

Furthermore, 51.25% of respondent strongly agreed to the effect of land use on agriculture as it posed a loss to their means of livelihood. Only about 27.75% of the respondents agreed while 12.75% was undecided and 19.75% respondent disagreed. Some of the households interviewed noted that, as population and economic development increased, their farmlands were lost, lthough, some still had farmlands. According to some of the respondents, this loss of farmland forces them to abandon their occupation, thereby inducing falling income and joblessness. These aspects point down to Oku-Iboku area were many farmers and fishermen took to commercial motor-cyclist as the result of the closure of the paper mill in the area.

The loss of agriculture creates different levels of impacts among the family members. For the family heads of the households who is the owner of the land, loss of land means the loss of socio-economic security while among children it is the loss of

ancestral property. Women who can play an active role and can contribute in a major way to agricultural produce, will be left with no work except routine household jobs.

6. Discussion of Findings

This study revealed that changes in land use categories have led to the loss of the swamp forest in the area thereby putting the natural environment into extinction, and also lead to alteration of wildlife habitat which may result in loss or near extinction of wildlife in their natural environment. The reduction in swamp forest was as a result of exploitation of timber, logs and firewood. The increase in compound farmland resulted from clearing of bush and reclamation of lands by government to construct roads and other infrastructure. This, however, made land owners and buyers to build on those lands because of its accessibility to roads and others. Furthermore, the findings in the study indicate that, land use has impacted negatively on agricultural lands in the study area. As a result, this has reduced the spatial extent of agricultural lands and fragmented them into smaller sizes. Therefore, the continuous loss of agricultural land due to the increase population poses a threat to food availability, production and sustainable agriculture in the study area. Other negative impact includes decreased crop yields and a loss of means of livelihood from agricultural sources.

7. Conclusion and Recommendations

In conclusion, the study sought to capture land use change and its impact on agriculture in the study area, using remote sensing and GIS technology. It has also provided the basis for land use/cover planning in the area. From the land use change analysis, it has been confirmed that land use has been in a state of flux manifesting as modification and/or conversion from natural forest to other land covers. These mainly may be induced by anthropogenic activities, such as deforestation, bush burning, farming practices and urbanization due to population expansion etc. as the underlying force of change. It is revealed from the study that the changes are on a faster rate and that this trend is likely to continue at a faster rate if the related agencies are not taking advantage of the availability of remote sensing data and GIS technology in understanding land cover change and the associated driving forces in the study area.

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