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Research Article

LAND USE AND LAND COVER CHANGE IN IKWERRE LOCAL GOVERNMENT AREA OF RIVERS STATE: IMPACTS AND CHALLENGES FROM 1987 TO 2020"

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Abstract

This study examined landuse and land cover change in Ikwerre Local Government Area of Rivers State. It adopted the cross-sectional research design, utilizing satellite images (19872020) and questionnaire for socio-economic data from 210 randomly selected households from seven communities (Aluu, Ubima, Elele, Igwuruta, Ozuoha, Isiokpo and Omagwa). Three research questions and three objectives guided the study. Satellite image classification and analysis was done with the RS and GIS tools of Landsat TM 1986, ETM image and ASTER. The main findings of the study are: crop cultivation, plantation agriculture, residential, institutional, commercial, transportation and recreational infrastructures are the main landuse activities in the area; there is significant relationship between landuse and land-cover change, as the former leads to the later; there is significant difference in rate of land-cover change from1987-2020. While there is constant increase in rate of expansion of residential built-up at 9.3% (1987-1997) and 15.4% (2007-2020); plantations grew at 2% (1987-1997) and declined at 1.36% (20072020); there is also a steady decline in land-cover for crop cultivation, institutional and recreational infrastructures. Finally, change in landuse and land-cover pose some social and environmental challenges on the people e.g. loss of forested lands, biodiversity, sacred grooves, wet lands; and decline in farmers' income. In order to reduce the problem, the study recommended for the establishment of high rise residential and commercial buildings; and the diversification of the area's economy into secondary activities and services.

Keywords: land-use, land-cover, change, forest and biodiversity loss

INTRODUCTION

Land use and land cover change in any geographic space are interjectionally related with the former defining the latter‟s quality and extent or coverage. It is also interesting to state here that the quality and quantity of available resources (forest, water and soil) are strongly linked to land cover and patterns of land use within a location.

As a geographic entity, land possesses certain basic characteristics which define its value and use. These features include its size, shape, form/nature (low land, wetland, marshy, highland, hilly and mountainous), fertility, strength and carrying capacity, texture and structure, erosivity and permeability, nature of bedrock, microbial and physiochemical properties. Thus, in geographic lexicon, the intrinsic qualities of land often result to three

dimensional interpretations or descriptions: absolute land, relative land and relational land. It is pertinent to note that these three views of land as „a space" upon which development occurs, is a function of the inter-play of other factors such as choice, need and opportunity; location, potentials, size and form; time, demand and cost; culture, government policy and tax (Rex, 2016; Cox, 2016; Ukpere, 2005).

These factors constitute the driving force which often dictates the use of land in any location and rate of land cover change. Basically, all man"s land use activities in any space result to land cover change of that area. The dangers of continuous land cover change due to intensification of land use activities often results to loss of forests, grasslands and scrubs and biological species across the globe. It also exposes the land area to the forces of weathering, denudation, and erosional activities. The long term impact of change in land cover is climate change and global warming and its related problems (Rex, 2016; Pavloh, 2014; Ukpere, 2005).

Over here in Nigeria and Rivers State in particular, land cover change (LC) is on the increase. This is primarily due to high rate of land use (LU) activities going on (mostly in the urban centres and urban-fringes). Urbanization processes causes the disappearance of urban green areas and wet lands which hitherto serves as reservoirs for urban flood water. Hence, urbanization and industrialization although propel development on space, is also associated with some negative effects such as loss of good vegetative cover (forest cover), shortage of farmlands and recreation grounds, ecosystem destabilization and loss of biological species. At the rural regions, the commonest land use activities that often result to land cover change over a space of time include land clearing for agricultural activities, residential buildings, institutional establishments, (schools, hospitals), the forceful taking-over of rural lands by the Federal and Sates governments for the establishments of specific projects and programmes. Most time, these programmes do not have direct benefits to the rural people while in other instances, are abandoned to waste away due to lack of continuity. Thus, the rate of land cover change due to land use is on the high side even at the rural regions (Adediji, 2017; Ogonor, 2016; Ukpere, 2005; Carr, 2004).

Again, some of the major challenges facing soil, forest and water (land resources) management across the globe especially among developing countries including Nigeria of which the study area is part of, include unsustainable natural resources utilization and management, agricultural expansion and forest lost associated with high rate of deforestation resulting from timber exploitation, urbanization, and agriculture related activities (Ajoku, 2014; Clark, 2010). Increase demand for land for residential building projects, urban encroachment into rural lands and especially, expansion and intensification of agricultural production has had significant impact on available land in the study area. The dense forests of the area are fast disappearing. This study is therefore directed to ascertain land use (LU) and land cover change in the area from 1987-2020. The study is therefore poised to address the following research questions:

1. What are the main land use activities in the area?
2. Is there any significant relationship between land use (LU) and land cover (LC) change in the area?

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3. Is there any significant difference in rate of land use and land cover change over the period under study?

Aim and Objectives of the Study

The study was aimed at examining the rate of land use and land cover change in the area from 1987-2020. To achieve the above stated aim, the following specific objectives guided the study. To:

1. Ascertain the main land use activities in the area.

2. Determine if there is any significant relationship between land use and land cover change in the area.

3. Find out if there is any significant difference in rate of land use and land cover change during the period.

The Study Area

Ikwerre Local Government Area is located within latitudes $4^0 55'$ and $5^0 15'$ N and between longitudes $6^0 40'$ and $6^0 55'$ E (see the images/figures). It is approximately 1,099 km^2 with a fairly flat topography and few surface streams which drains the area downstream into the freshwater swamps and then to the tributaries of the Sombeiro and New Calabar rivers. There are twelve (12) autonomous communities in the area with a projected population of 216,454 as at 2010 and

298,149 in 2019 (NPC, 2006; Ukpere, 2007). It shares boundaries with Imo State at its north,

Emohua Local Government Area in the West, Etche Local Government Area in the East, Obio/Akpor Local Government Area in the south. Its tropical rainforest vegetation is under serious threat due to high rate of deforestation.

CONCEPTUAL CLARIFICATIONS AND THEORETICAL FRAMEWORK

The Concept of land use refers to the various ways by which land in any given location is being put into use by the residents or population of such place. Land use represents a functional relationship between the existing population of the area and available land. It is been influenced by changes in technology, state policy, economic, demographic and cultural values (Ukpere, 2005). On the other hand, land cover as a concept, is used to describe the actual land mass of the area covered by different land use types. And a change in land cover means a change that is brought about by the different land use forms within a geographic space. Two concepts of change occur on space: conversion and modification. Turner (1999) and Skole (1999) cited in Ajoku (2014), opined that land cover modification involves alterations of structure or function without a whole change from one form to another. While land covers conversion imply conversion of the existing use of land to another form in order to meet up certain defined or desired goals.

It is important to state here that land use types vary across space. However, the existence of any form of land use in any location is a function of size and characteristics of the population, technology at disposal, size and biophysical characteristics of the land, certain socio-economics and cultural factors. Thus, the remote causes of land use change explains how the people of any location make land use decisions and the interactions between the various factors in certain contents which influences decision making on land use. This decision making of

course, is influenced by certain local, regional and global factors (Ajoku 2014; Ukpere 2005). Also, Larry and Jones (2015); Parrson (2016) and Mmom and Fred-Nwagwu (2013) opined that "proximate or direct causes of land use change constitute human activities or immediate actions that originate from intended land use and directly affect land cover".

Schools of Thought (Theories) on Deforestation and Land Cover Change

Carr (2004) postulated that the broad factors of demographic, socio-economic, technological, political and environmental are often the main prevailing factors causing forest lost and land cover change. Hence, there are two main schools of thoughts (debates) on the causes of forest loss and land cover change:

(a) Single-factor causation
(b) Irreducible complex factors

(a) Single-factor causation

Proponents of this debate argued that deforestation is caused by a single factor e.g. the role of shifting cultivation or growth in population of the area. This forces increase pressure on forest lands thereby forcing a change in land cover of the area (Carr, 2004).

(b) Irreducible complex factors

This school of thought is of the opinion that the causes of deforestation are irreducibly complex. That is, several factors are responsible for forest lost or land cover change. For instance, increase in human population leads to increase pressure and competition for the use of land and resources of an area. Again, deforestation is caused not just by a single factor rather by the combine factors of population pressure, economic stagnation, social and technological conditions (Mmom & Fred Nwagwu, 2013).

RESEARCH METHODOLOGY Research Design, Data types, Sample and Sampling Technique; and Methods of Data collection and Analysis

The study made used of cross-sectional research design utilizing both primary and secondary sources of data. The primary data were generated through the use of satellite images of the area (1987-2020) and 210 copies of socio-economic questionnaire used to gather certain social data from 210 respondents randomly selected from seven communities (Aluu, Ubima, Elele, Igwuruta, Ozuoha, Isiokpo and Omagwa). GPS coordinates of the place were randomly picked in order to aid ground routing for satellite coverage and data acquisition. The systematic sampling technique was used to systematically arrange or organized the data and satellite images into four epochs ranging from 1987-2020.

Remote Sensing Data Collection and Image Processing Procedure and Analysis

Landsat satellite remote sensing data collection pre-processing was carried out using ground routing with GPS for coordinates, Landsat TM of 1986, 1989, 2003 and Landsat ETM images, for 2013 and Universal Traverse Marcator (WGS 84) for 2008, 2010, 2015 advance space borne thermal emission and reflection radiometer

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(ASTER) and other platforms such as the 2002 JICA and the United States Geological Services land use maps processing system were utilized to gather spatial data and images of land cover change, as demonstrated by Larry and Jones (2015). Landsat satellite imageries for four Epochs: 1987, 1997, 2007 and 2020 of Ikwerre Local Government Area Rivers State, were acquired from the United States Geological Survey Landsat. These were analyzed using suitable Remote sensing and GIS soft wares. Landsat has the ability to measure and monitor tropical forests and other land use at a high spatial and spectral resolution. It contains six spectral bands of spatial resolution of 30m x 30m, one panchromatic band of 15m x 15m and one thermal band of resolution of 60m x 60, thick vegetation; and the description of each of the classes according to Anderson et al. (2001) is shown. The images were layer stack using the Erdas image 9.2 software, and there after classified. The percentage of wetland lost to other land use was also computed using ArcGIS 10.5 software.

RESULT AND DISCUSSION

Table 4.1: Main Land use activities in the area

1.	Agricultural cultivation crop and (food Plantations)
2.	Residential buildings
3.	Commercial Activities
4.	Road Construction /transportation
5.	Industrial development
6.	Institutional Developments
7.	Recreational

Source: Researchers‟ field work, 2020

Land Use and Land Cover Distribution in the Area

The static land use-land cover distribution for each study year as derived from the satellite images (maps) are presented in the table below.

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Table 4.2: Land use and land cover trend (1987, 1997, 2007 and 2020)

Landuse/ Land Cover Categories	1987		1997		2007		2020	
	Area (ha.)	Area (%)	Area (ha.)	Area (%)	Area (ha.)	Area (%)	Area (ha.)	Area (%)
Plantation	15433.67	12.56 %	18000.36	14.65 %	212374.33	17.40 %	19703.79	16.04
Settlement	10323.20	8.40%	21684.767	17.65 %	35934.76	29.26 %	54840.43	44.65
Cultivation	45606.47	37.13 %	38006.513	30.94 %	30214.66	24.60 %	23214.66	18. 90
Vegetation	39551.76	32.20 %	34959.34	28.46 %	25593.53	20.84 %	18171.06	14.80
Water bodies	5870.30	4.78%	5000.3	4.07%	4807.75	3.91%	3900.72	3.17
Marshes	6046.21	4.92	5180.33	4.22%	4906.58	3.99	3000.95	2.44
Total	**122831.61**	**100%**	**122831.61**	**100%**	**122831.61**	**100%**	**122831.61**	**100 %**

Source: Authors‟ field work; generated automatically from the land cover map of the area, 2020 The figures presented in the table above represents the static area of each land use land/cover category for each study year. The total classified study area is about 122831.61 hectares. By 1987, most of the area was pristine and undeveloped. About 4.9% of total area was marshes, 4.78% were water bodies and 32.20% of the total area was forest. Human settlements (built-up areas) make up 8.40% of the total area. Cultivation occupied the highest in the study area (37.13%) seconded by vegetation (forested areas) 32.20%. This was due to the fact that as at that time, the population of the area was low and there was and there was enough land for cultivation and agricultural activities. Also, the percentage of forested/shrub /wetland is changing to the other forms of land covers.

In 1997, marshes occupied 4.22%, water body 4.07%, cultivation 30.94%, vegetation 28.46%, and settlement occupying 17.65%. It is important to state here that cultivation reduced because of increase in population and the need to build more houses. In 2007, marshes occupied 3.99%, water bodies occupying 3.91%, cultivation 24.60%, vegetation 20.84%, and settlement occupying 29.26%. The analysis thus shows that while there is a gradual increase in built-up area (settlement), size of plantations increased between 1987 and 2007, cultivation, marshes

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vegetation, and water bodies reduced in terms of spatial extent over time. By the end of August 2020, marshes occupied 2.44 %, water bodies occupying 3.17%, cultivation 18.90%, vegetation 14.80%, and settlement occupying 44.65%, thereby occupying the highest landuse.

Image classification was based on Anderson et al, (2001) system as interpreted in the table below.

Table 4.3: Landuse/Land cover Classification Scheme

S/NO	Land use Types	Description	Appearance Colour
1	Vegetation	Thick forest, derived forest, mixed forest lands, palms, shrubs, herbs , vegetable land and others	Dark Red
2	Built up Area	Residential, commercial and services, industrial, transportation, roads	Cyan
3	Marshes	low-lying areas, marshy land, swamps	Deep Red
4	Water bodies	Rivers, permanent open water, lakes, ponds, reservoirs, etc	Dark Blue
5	Cultivation	Agricultural area, crop fields, fallows lands.	Light Green

Source: Adapted from Anderson et al, 2001

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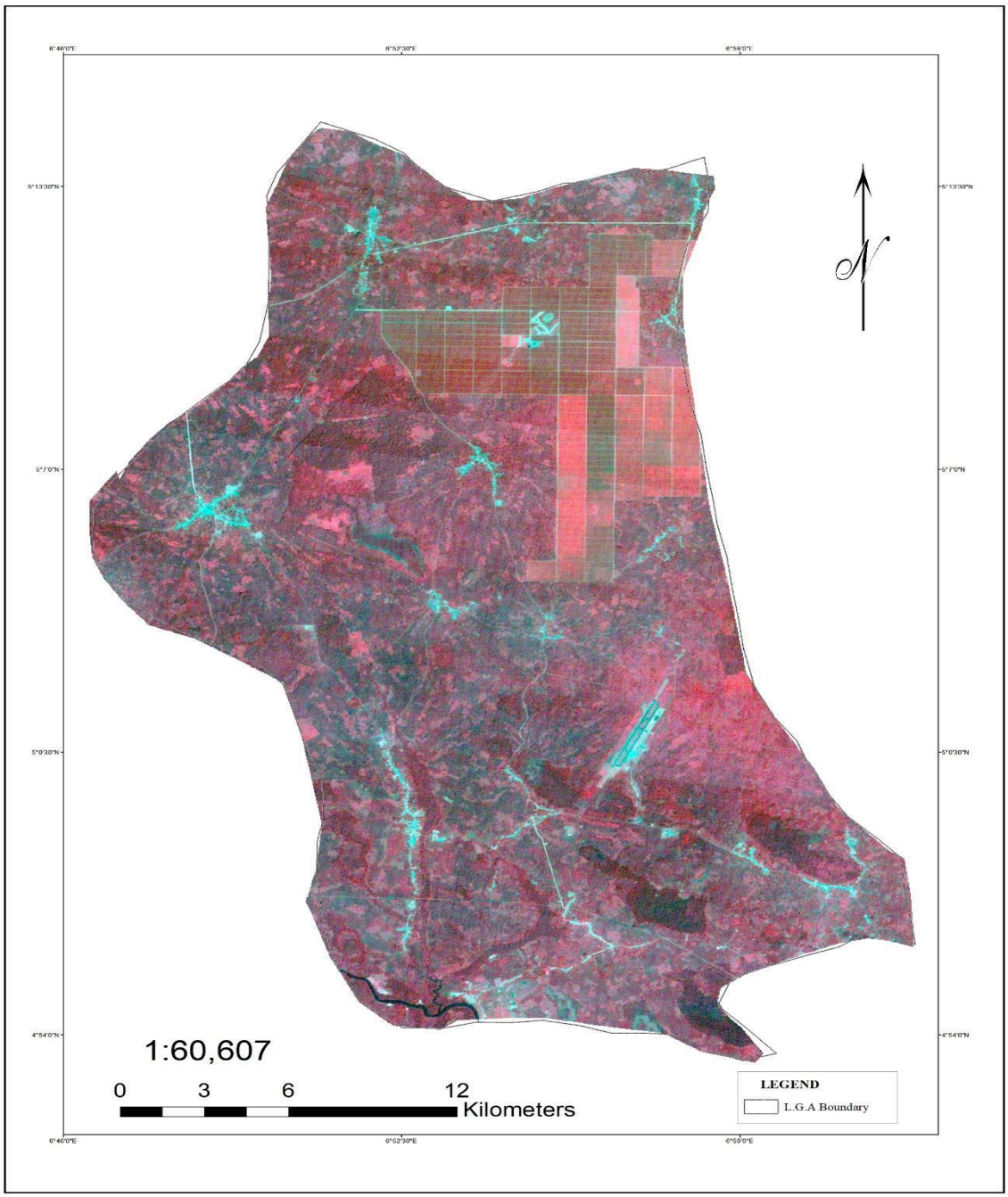

Figure 1: 1987 Satellite image of Ikwerre L.G.A.

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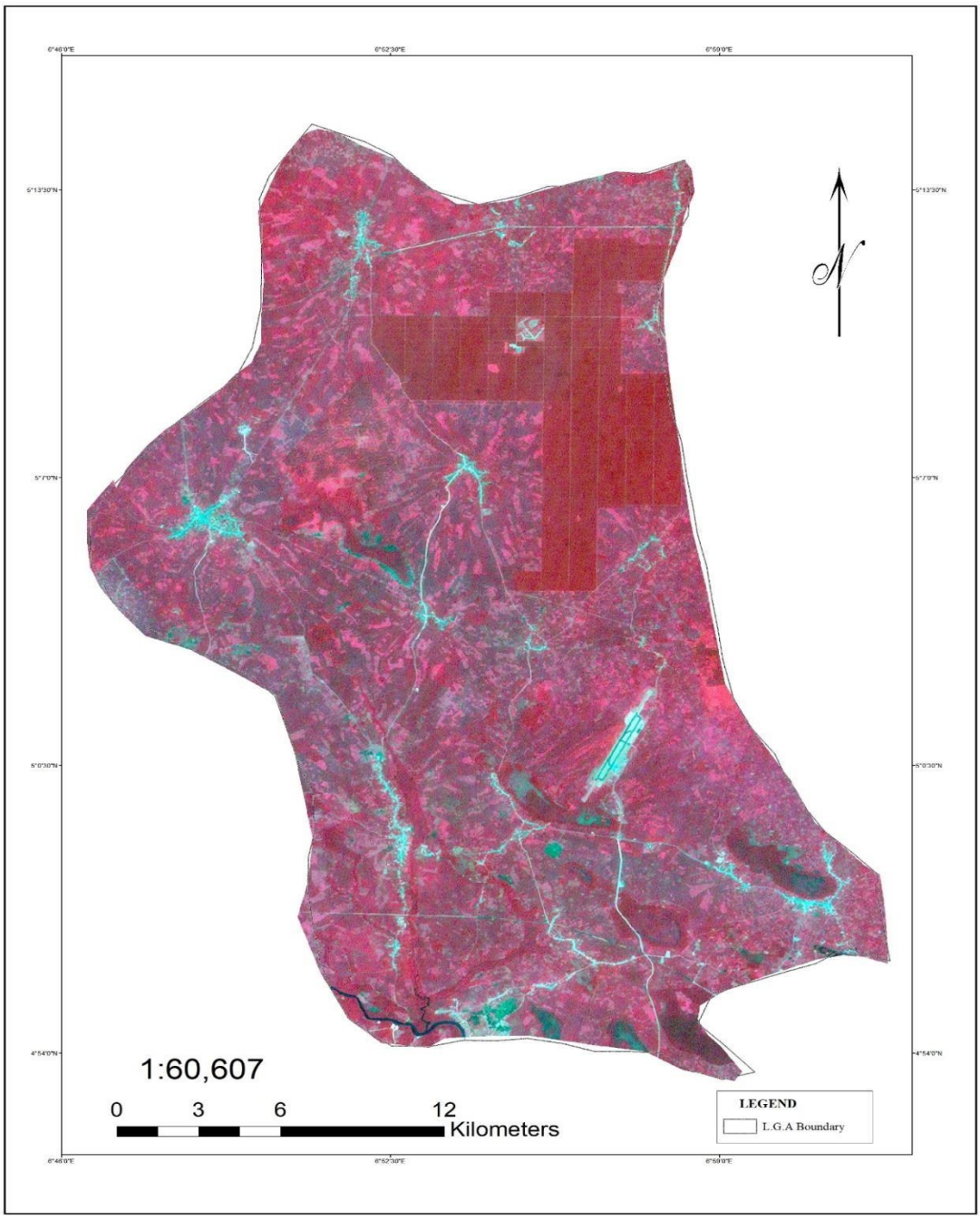

Figure 2: 1997 Satellite image of Ikwerre L.G.A.

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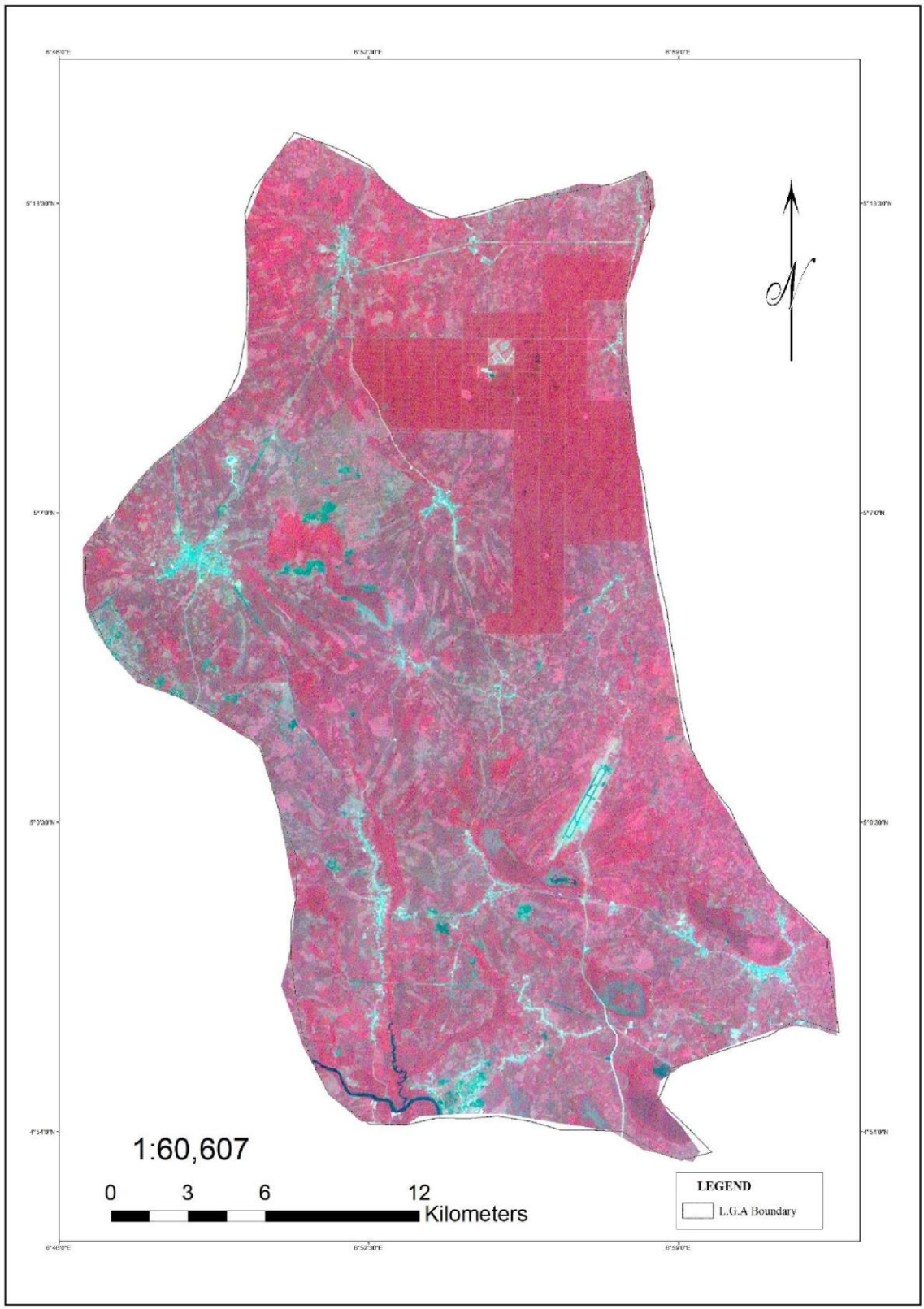

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Figure 3:2007 Satellite image of Ikwerre L.G.A.

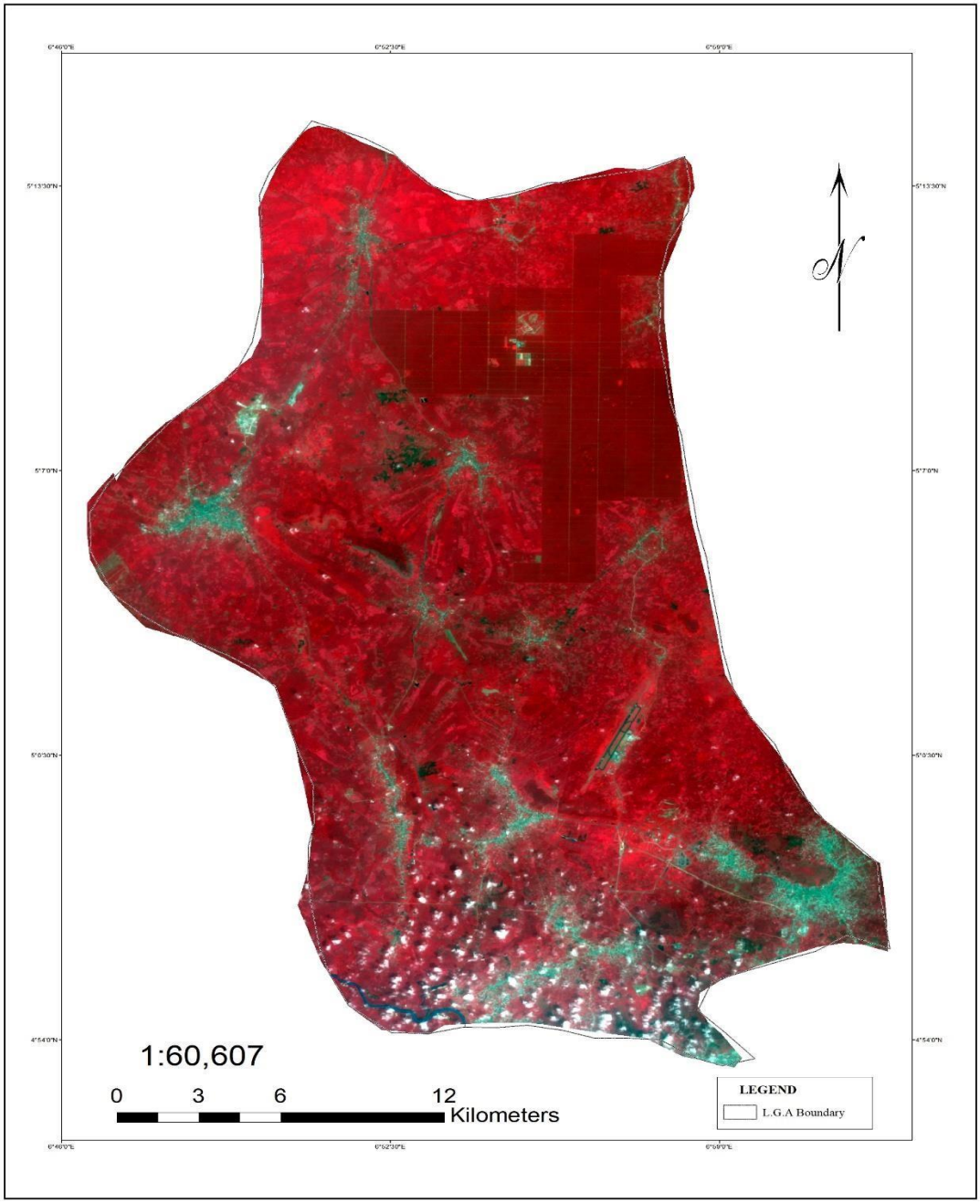

Figure 4: 2020 Satellite image of Ikwerre L.G.A.

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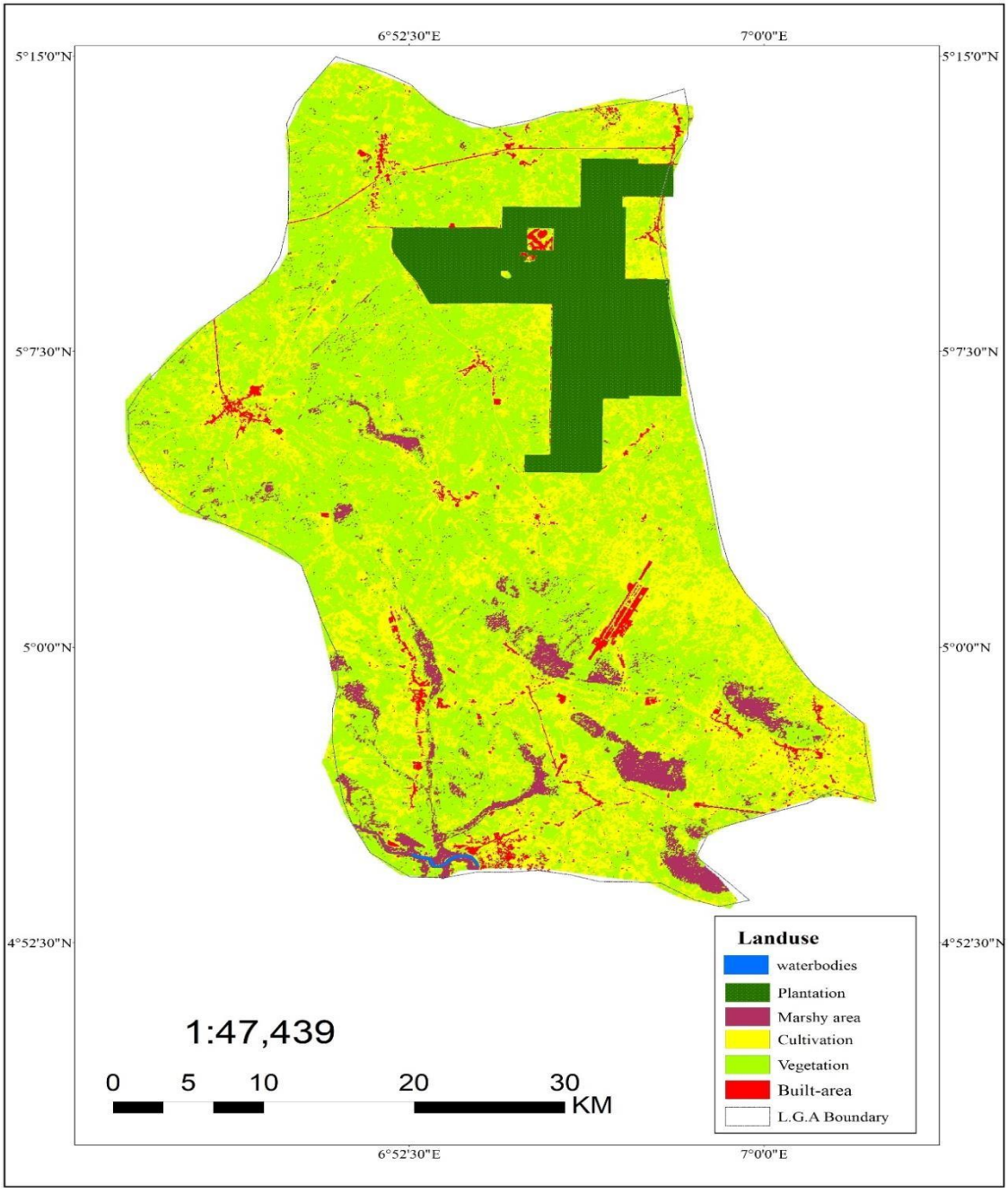

Figure 5: 1987 Classified landuse image of Ikwerre L.G.A.

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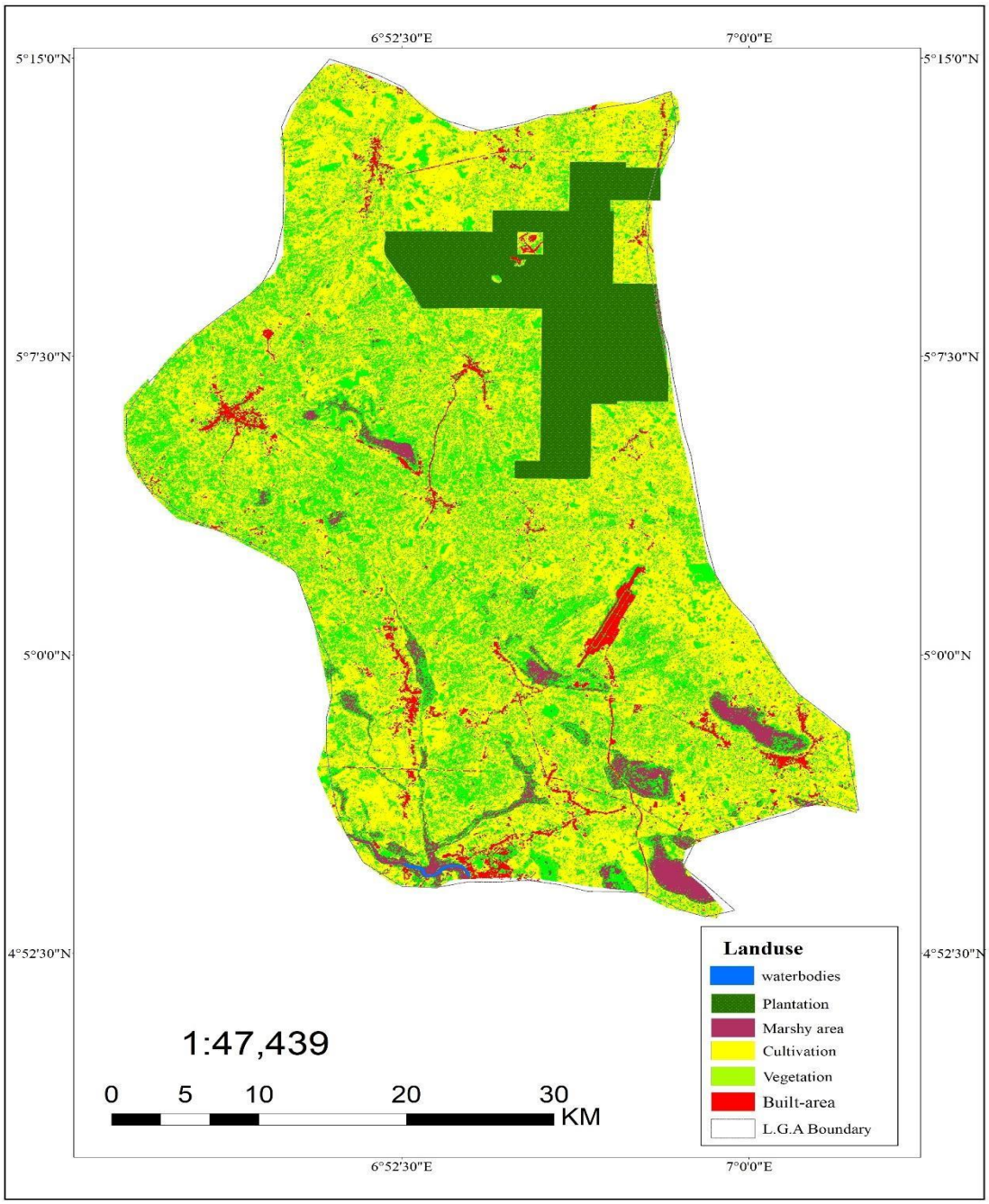

Figure 6: 1997 Classified landuse image of Ikwerre L.G.A.

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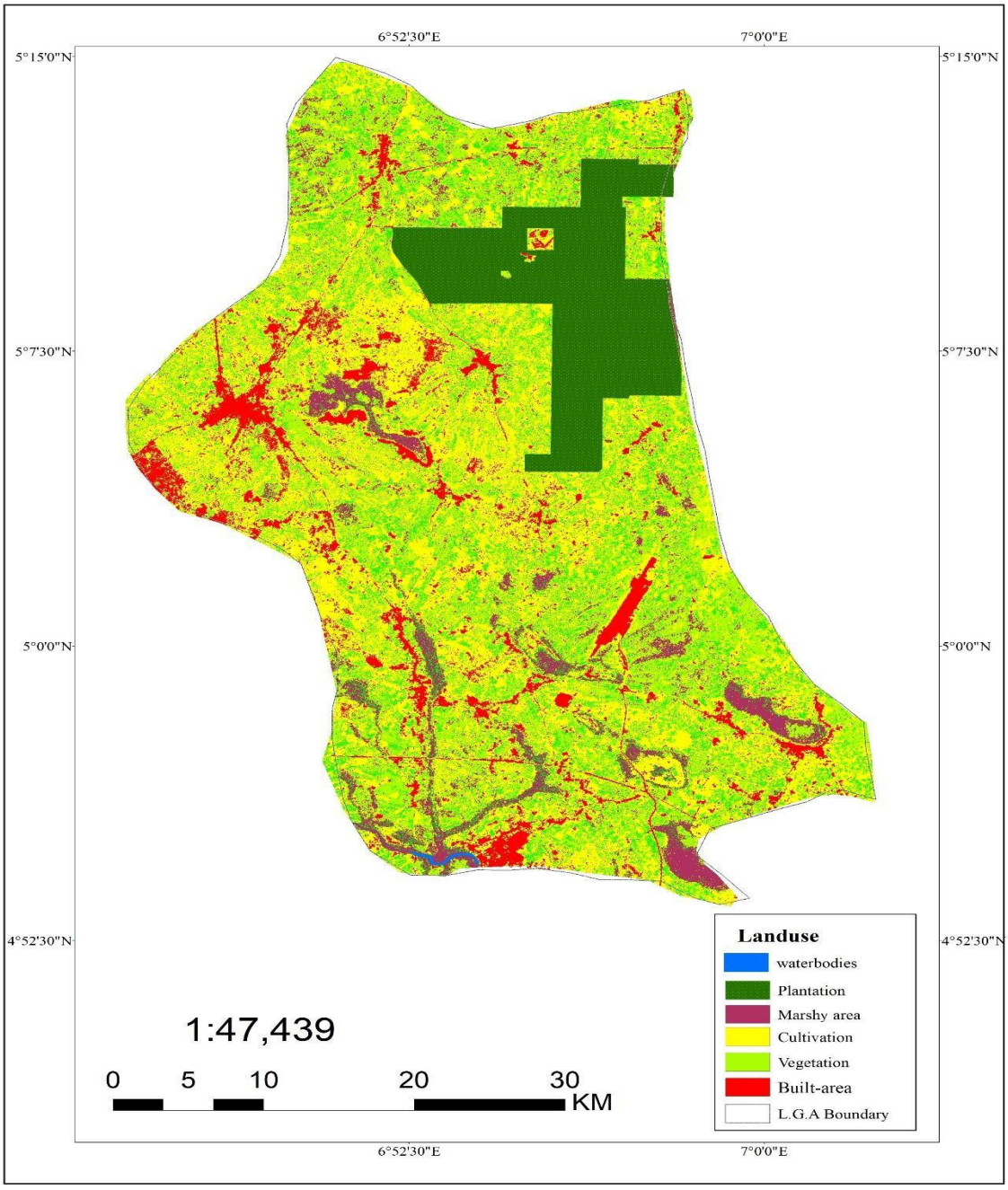

Figure 7: 2007 Classified landuse image of Ikwerre L.G.A.

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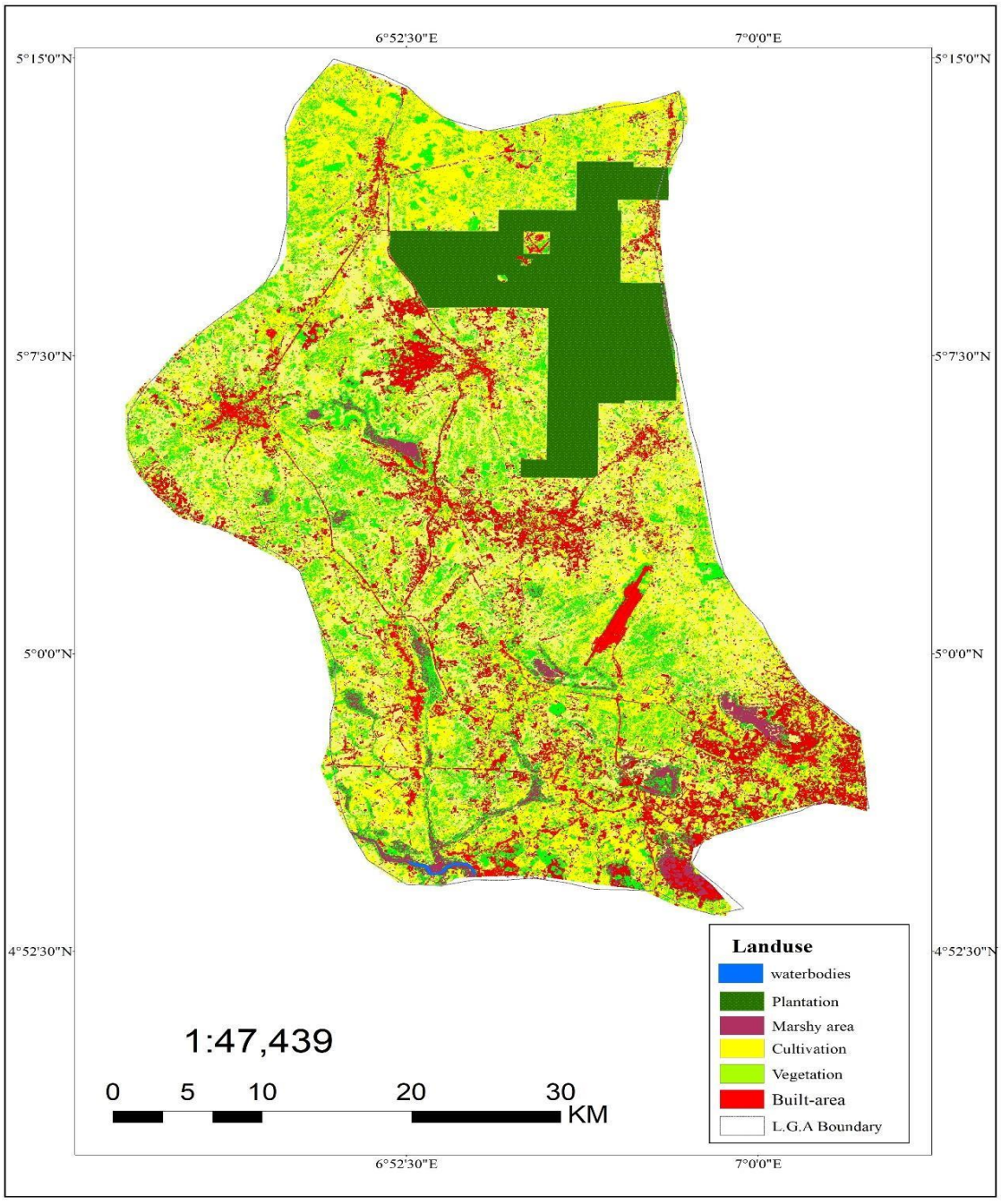

Figure 8: 2020 Classified landuse image of Ikwerre L.G.A.

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A lot of human actions have led to change in land use across the area. These activities include expansion of rural settlements, urban sprawl and encroachment into rural lands, tilling for crop production, and oil palm plantations, and transportation system. Urbanization is a major cause of landuse. With increased in population, more areas are being extended for human activities.

It is pertinent to note here that strict adherence to basic principles was carefully followed. Thus, digital classification of land cover changes is significantly useful in identifying and labeling of the land cover classes. Time series data are essential in determination of the classes. The resolution of the images matters a lot for appropriate classification of the wetland uses and cover. The Thematic maps produced portray the diverse ways in which small landuse are utilized.

Discussion of Findings Based on the Set-Objectives

Objective one was aimed at ascertaining the main forms of land use activities in the study area. Findings from the field survey and responses from the respondents through the use of the questionnaire revealed the following land use activities: agricultural activities (food crop cultivations and oil palms, rubber plantations); residential building projects; commercial activities; institutional developments; industrial activities; and transportation activities. Thus, objective one was actualized, and it is in line with the findings of Ajoku (2014) on land use activities in the area and also in line with the works of Ukpere (2005) on pattern of land use within and around Port Harcourt and adjoining areas.

Objective two was actualize because the analysis was able to establish that there is significant relationship between land use and land cover change in the area. In other words, our findings revealed that land use intensification leads to land cover change. The satellite images of the area from 1987 to 2020 showed that there is a gradual disappearance of the natural vegetation of the area especially within the southern part where there is an evidence of outward expansion of the original built-up area (settlements). This southern part is closer to Port Harcourt hence, there is high demand for land for residential, institutional and commercial purposes (see Sat image/ fig 14). That is to say, intensification of land use activities has forced a drastic change in the land cover of the area which is now wearing a new look due to the expansion (outward growth) of settlements in the area.

Objective three aimed at finding out if there is any significant difference or variation in rate of land cover change during the period under review. Findings revealed that there is significant spatial difference in rate of land cover change in the area from 1987-2020 (see tables below).

Table 4.4: Rate of Change of land use/land cover of the area (1987-1997)

Land use/land cover Category	1987 (ha)	%	1997 (ha)	%	diff (%)

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Plantation	15433.67	12.7	18000.36	14.7	2
Built-up areas	10323.20	8.4	21684.8	17.7	9.3
Crop Cultivation	45606.5	37.1	38006.5	30.9	-6.2
Water bodies	5870.3	4.8	5000.3	4.07	-0.73
Forest lands	3955.76	32.20	34959.34	28.5	-3.7
Marshes	6046.21	4.92	5180.33	4.22	-0.7
Total	**122831.61**	**100%**	**122831.61**	**100%**	

Source: Deduced from the land cover map of the Area (1987-1997)

From table 4.4 above while there is increase in rate of percentage change in plantations from 1987 to 1997 at 2%, and 9.3% for built-up areas (settlements); there was a decrease (constant reduction or decline) in the size of cultivated areas at -6.2%, water bodies (-0.73%), vegetation or forest lands (-3.7%), and marshes (-0.7%). The land cover area for plantations and built-up areas increase due to certain reasons:

- Increase in population leads to increase demand for housing accommodations
- Increase in housing demands is associated with increased demand for land for building projects plus settlement expansion.
- Population-land use pressure in the area is associated with its proximity to Port Harcourt.
- Changing economic conditions and increase in number of persons investing into oil palm plantations viz-a vis the presence of SIAT/Rison palm estates in the area.

Table 4.5: Rate of Change in Landuse/Land cover in the Area (2007-2020)

Landuse/land Cover type	**2007 (ha)**	**%**	**2020 (ha)**	**%**	**diff (%)**
Plantations	212374.33	17.4	19703.8	16.04	-1.36
Built-up areas	35934.76	29.3	54840.43	44.7	15.4
Crop cultivations	30214.7	24.6	23214.7	18.90	-5.7
Water bodies	4807.75	3.9%	3900.72	3.17	-0.73
Forest lands	2559.3	20.84	18171.06	14.8	-6.04
Marshes	4906.5	3.99	300.95	2.44	-1.55
Total	**122831.61**	**100%**	**122831.61**	**100%**	

Source: Deduced from the land cover map of the area 2007 – 2020

From table 4.5 above, except built-up areas which increased by 15.4% from 2006 to 2020 in the area, all the rest including plantations decline gradually. The reason for this decrease for the plantations (-.36%) is due to the fact that many of the already existing plantations were either cut-down for housing developments or to give way for road constructions. Also, cultivated lands decreased at the rate of (-5.7%), water bodies decreased by -0.73%, forestlands -6.04%, marshes -1.55%.

CONCLUSION AND RECOMMENDATION Conclusion

This study has been able to establish the presents of certain land use activities causing land cover change in the area. Hence, there is significant relationship between land use and land cover change. In terms of rate of land cover change arising from land use activities, there is a constant growth rate of 9.3% (between 1987 and 1997) and 15.4% (between 2007 and 2020) for built-up areas; 2% for plantations (between 1987 to 1997) but decline at -1.36% (between 2007 to 1997). There is a steady decline in total land cover for crop cultivation (-6.2%) between 1987 to 1997 and -5.7% between 2007 and 2020; water bodies -0.73% between 1987 and 1997 and between 2007 and 2020; forest lands is also diminishing, between 2007 and 2020; and finally, marshes and wetlands is also disappearing; it was -0.7% between 1987 and 1997, and -1.55% between 2007 and 2020.

Recommendation

Arising from the findings of this study, the researcher hereby recommends that:

1. Adoption of policies that will promote the establishment of high rise residential and commercial buildings in order to promote the doctrine of space maximization rather than building shanties and wagon houses.
2. Adoption of measures to promote afforestation programme, protection of wetlands and marshes; proper planning and development control initiatives.
3. Diversification of the economy of the area to include services and nor-land dependent ventures (primary activities like farming, lumbering).

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