

## **Examination of Agricultural Land Use Change to Other Land Uses in Umuahia, Abia State**

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### **Abstract**

**T**his study examined the agricultural land use change to other land uses between 2002 and 2015 in Umuahia, Abia State. Data was acquired from both primary and secondary sources. The primary data include images sourced from the Landsat7 and 8 satellite series amongst others. Secondary data include topographic map sheet, population data, and administrative map of Umuahia. Tools employed include: a computer unit, GIS software such as ARCGIS 10.2, and GPS device. After the acquisition of the various Lands at data sets required for this study, the data sets were digitally processed using the following methods; scanning, geo-referencing, digitizing, image re-sampling, image sub-mapping, image enhancement, signature development and image classification. Spatial analytical techniques employed in this study are Area analysis of the resulting land use types for each study year and the Overlay Operations. The findings showed that between 2002 and 2010, agricultural land decreased by -4920.80ha while the built-up area, bare surface and water body increased by 2573.51ha, 2345.62ha and 1.67ha respectively. From 2010 – 2015, agricultural land also decreased with -3821.50ha while the built-up area, bare surface and water body increased by 1200.95ha, 2614.19ha and 6.36ha respectively. These findings showed a continuous reduction in total area of the agricultural land throughout the period. This study recommends that the government should ensure that land use planning is instituted and implemented religiously by the relevant bodies, amongst others. This will help to ensure that agricultural land use is sustained in the city.

**Keywords:** *Examination, Agriculture, Land use change, Umuahia, Abia State*

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### **Background to the Study**

God's introduction of man into the earth is the genesis and origin of conflicts, and environmental problems. This is because the activities of man do not take place in isolation. Man's desperate quest for improved survival and control over his environment has induced and increased exploitation, exploration and alternation of his surrounding land. Since time immemorial, man has been altering the land cover through different activities such as clearing of vegetal covers and patches of the land for various purposes.

Nature can no longer continue its cycle due to over encroachment by man into the environment. Presently, there is a decrease in farming activities as a result of the continuous conversion of farmlands into other developmental purposes. While the grasslands becomes victim of animal rearing, the forests falls victim of lumbering leading to desert encroachment, as well as soil erosion. Man has been modifying land to obtain food and other essentials for thousands of years, but current rates, extents and intensities of land use and land cover change are far greater than ever in history, driving unprecedented changes in ecosystems and environmental processes at local, regional and global scales. These land uses exert pressure on the seemingly finite land resources in urban centres. Thus land is fast becoming a critical resource, its demand remain a fundamental issue of both academic and policy discourse (Ejaro and Abdullahi, 2013).

Ifatimehin and Ufuah (2006) and Rimal (2011) asserts that, the change in land cover occurs even in the absence of human activities through natural processes whereas land use conversion is the manipulation of land cover by humans for multiple purposes such as; food, shelter, fuel wood, timber, fodder, medicine, raw materials and recreation. Since the early 1980s, vast transformation have occurred in the land use and land cover patterns as evidenced by persistence expansion in built-up areas, decrease in natural woodland and grassland in the world (Xiaomei and Ronging, 1999). This development has increased drastically in the last fifteen years as a result of continual influence of human, cultural, social and economic activities (Lambin, Geist, and Lepers, 2003), and its impact on any geographical location cannot be overemphasized. It will be noticed that cities such as Umuahia have changed from small, isolated populated centers to large, interconnected economic, physical and environmental features (Ujoh, Ifatimehin and Baba, 2011).

The percentage of world population in urban areas is nearly 50% (Eludoyin, Wokocha and Ayolagha, 2011) as against 15% 100 years ago (United State Geological Survey, 1999). This increase in population has propelled urbanization which now causes increasing pressure on land in the cities of Nigeria especially in the capital cities which Umuahia is inclusive. Due to poorly planned human interference, many of the African countries have experienced untold environmental degradation and ecological deterioration in the past century, with little or no real solution to alleviate many of these concerns (Ejaro and Abdullahi, 2013).

As all nations plan to overcome the problems of haphazard, uncontrolled development, loss of prime agricultural land, destruction of important wetlands and loss of fish, wildlife habitats and deteriorating environmental quality, the knowledge about land use and land

cover change has become increasingly important (James, Ernest, John, Richard, 2001). To this effect, Read and Lam (2001) emphasized the importance of information on what changes occur, where and when they occur, the rates at which they occur, and the socioeconomic and physical forces that drive those changes as well as their impacts.

Therefore, viewing the earth from space has become imperative in understanding the influence of man's activities on his natural resource base over time as data from earth sensing satellites over the past years have played vital role in mapping the earth's features and infrastructure, managing natural resources and studying environmental changes. As a widely recognized effective tool for planning and decision making due to its ability to provide a medium for integration of spatial and non - spatial data, Geographic Information System (GIS) was utilized in examining the agricultural land use change in Umuahia from 2002 - 2015.

### **Research Problem**

Uncontrolled human activities have led to significant modification of the natural biodiversity in the world (Adefioye, 2013). In Umuahia, there has also being a substantial change in land uses especially agricultural land (from 31.65km<sup>2</sup> to 25.96km<sup>2</sup>) to other land uses (Ujoh, Ifatimehin, & Baba, 2011). Such expansions have included both planned and unplanned development. Unfortunately, in both cases, development is at the expense of agricultural lands and green spaces.

This development causes decline in agricultural activities, deforestation, climate change and conversion of agricultural land to other uses amongst others (Rilwani and Gbakeji, 2009). According to Ujoh *et. al;* (2011), Umuahia is a city known for agricultural activities, but recent development indicates that residential, institutional and commercial developments have taken over agricultural land in the area. These leads to the shortage of arable land, decline in agricultural yield, loss of biodiversity and ecosystem functioning (Rilwani and Gbakeji, 2009).

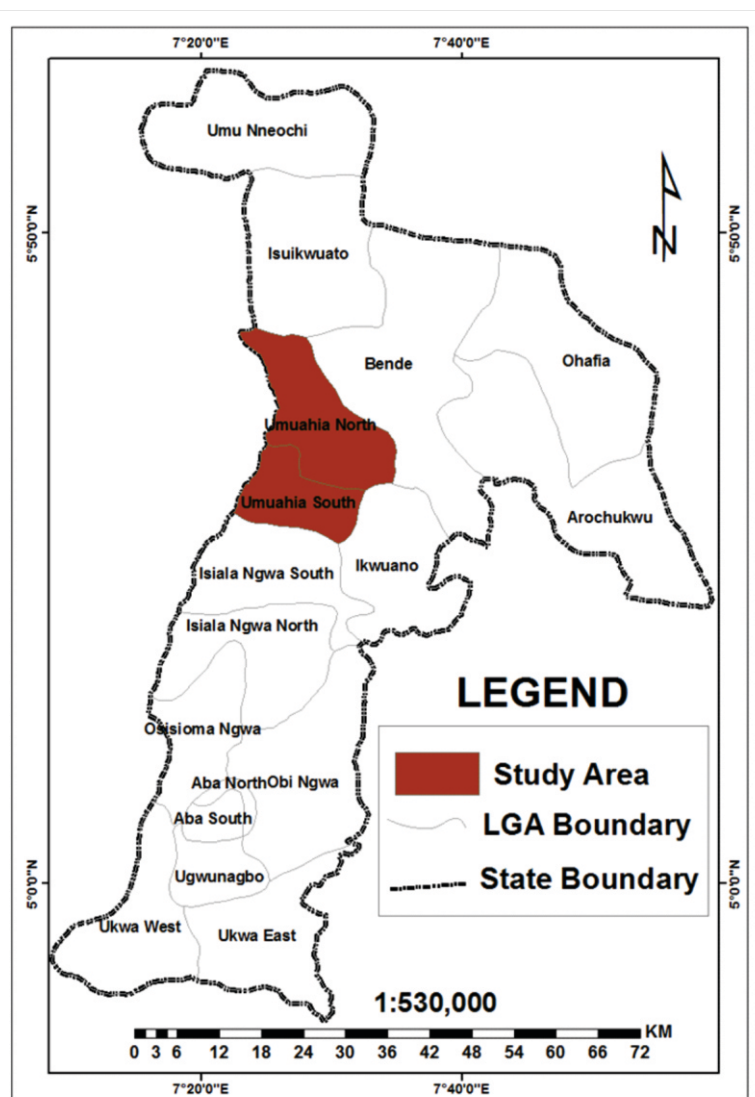
Foody (2003) observed that, land use and land cover change is one of the most important variable of environmental change and abuse of it represents the largest threat to ecological systems and their services. The increasing rate of land use change to other uses as witnessed in Umuahia lately may result to ecosystem disequilibrium if it is not controlled. To this end, this study examined the agricultural land use change in Umuahia from 2002 - 2015. As Lambin, Geist & Lepers (2003) stated, "in order to use land optimally, it is not only necessary to have the information on existing land use and land cover but also to have the capability to monitor the changes in the land use resulting from both changing demands of increasing population and natural forces that act to alter and shape the landscape".

Accordingly, several studies relating to land use change abound within and around Umuahia (Okaji Okpara, & Olawoye, 2001; Rimal 2011, Ifatimehin and Ufuah, 2006, Onweremadu, Osuji, Eshett, Okpara, & Ibeawuchi, 2007, Ujoh *et. al;* 2011), but most of the works done within Umuahia are basically on Umuahia North and with little interest on

agricultural land use change to other uses. Therefore, there is the need to carry out a comprehensive study that will encompass agricultural land use change in both Umuahia North and South. It is on this premise that this study examined the agricultural land use change in Umuahia between 2002 and 2015.

### Study Area

Umuahia is the capital city and the administrative heartbeat of Abia State. Geopolitically, it is located in Abia central in the southeastern part of Nigeria. The city lies along the rail road that is between Port-Harcourt in the south to Enugu city in its north. It is located on latitude 5°00'N - 5°50'N and longitude of 7°20'E - 7°40'E. It is bounded in the North-East by Bende LGA, in the South by Isiala-Ngwa North LGA, in the South-East by Ikwuano LGA and in the West by Imo State (See fig.1).



**Fig. 1: Map of Abia State showing the study area.**

**Source:** Researcher's Fieldwork 2016

### Method of Study

This study adopted a descriptive research method in which a number of techniques such as Geographic Information System (GIS), satellite remote sensing and conventional field survey were integrated. The population of the study constitutes the land uses in Umuahia North and South Local Government Areas. These land uses include agricultural land, built-up areas, bare surfaces and water bodies.

Data for this study was acquired from both primary and secondary sources. The primary data include images sourced from the Landsat7 and 8 satellite series. Landsat7 Enhanced Thematic Mapper Plus (L7 ETM+) satellite images of epochs; 2002 and 2010, and Landsat8 operational land imager (OLI) satellite image of 2015 covering the study area was sourced from the United State Geological Survey (USGS). See Table 1 for the characteristics of these satellite images.

**Table 1: Satellite imageries and characteristics**

S/N	Data Type	Year	Resolution	Source
1	L7ETM+	2002	30M	USGS
2	L7ETM+	2010	30M	USGS
3	OLI	2015	30M	USGS

Secondary data used in this study include topographic map sheet, population data, and administrative map of Umuahia. Information on the physical and socio-economic variable of the city was obtained from the State Ministry of Environment and from the Umuahia Capital Development Authority as well as historical records gotten mostly from relevant sources.

The geo-referencing properties of 2002, 2010 and 2015 are all the same with equal resolution of 30m. Spatial Reference is WGS 1984\_UTM\_ZONE 32N. Materials and tools that were employed in this study include: a computer unit with necessary properties for image processing, Geographic Information System software such as ARCGIS 10.2, and GPS device. Administrative map of the study area was also used in image classification. After the acquisition of the various Landsat datasets required for this study, the data sets were digitally processed using the following methods; scanning, geo-referencing, digitizing, image re-sampling, image sub-mapping, image enhancement, generation of training sites (signature development) and image classification. Real world features were represented in the images using different colour domain, green for agriculture, blue for water body, red for built-up area, and ash for bare surface.

Spatial analytical techniques employed in this study are Area analysis of the resulting land use types for each study year and the Overlay Operations. These methods were adopted from Abate (2011) in his study of evaluating the land use and land cover dynamics in Borena Woreda of South Wollo highlands, Ethiopia and by Enaruvbe and Atedhor (2015) in their study of spatial analysis of Agricultural Land Use Change in Asaba Southern Nigeria.

## Results

The findings of this study are presented in form of maps, charts and statistical tables. They include the state, change and rate of land use of each class.

### Land Use Distribution

The state of land use distribution for each study year as derived from the satellite images are presented in Table 2

**Table 2: Land Use Distribution of 2002, 2010 and 2015**

Land Use Categories	2002		2010		2015	
	AREA (Ha.)	AREA (%)	AREA (Ha.)	AREA (%)	AREA (Ha.)	AREA (%)
Agricultural Land	34056.4	88.5	29135.60	75.7	25314.10	65.8
Bare Surface	1245.48	3.2	3591.10	9.3	6205.29	16.1
Built- up Area	3091.5	8.0	5665.01	14.7	6865.97	17.8
Water Body	103.58	0.3	105.25	0.3	111.60	0.3
<b>TOTAL</b>	<b>38496.96</b>	<b>100.00</b>	<b>38496..96</b>	<b>100.00</b>	<b>38496.96</b>	<b>100.00</b>

**Source:** Researchers Fieldwork

In 2002 (Table 2), water body occupied the least class with just 103.58ha of the total classes while the Agricultural land occupied the largest area by 34056.4ha. This could be as a result of low population and high level of agricultural dependence. Fig. 2 shows the 2002 land use image of the study area while Fig. 3 is a bar chart showing area in hectares of land use categories in 2002.

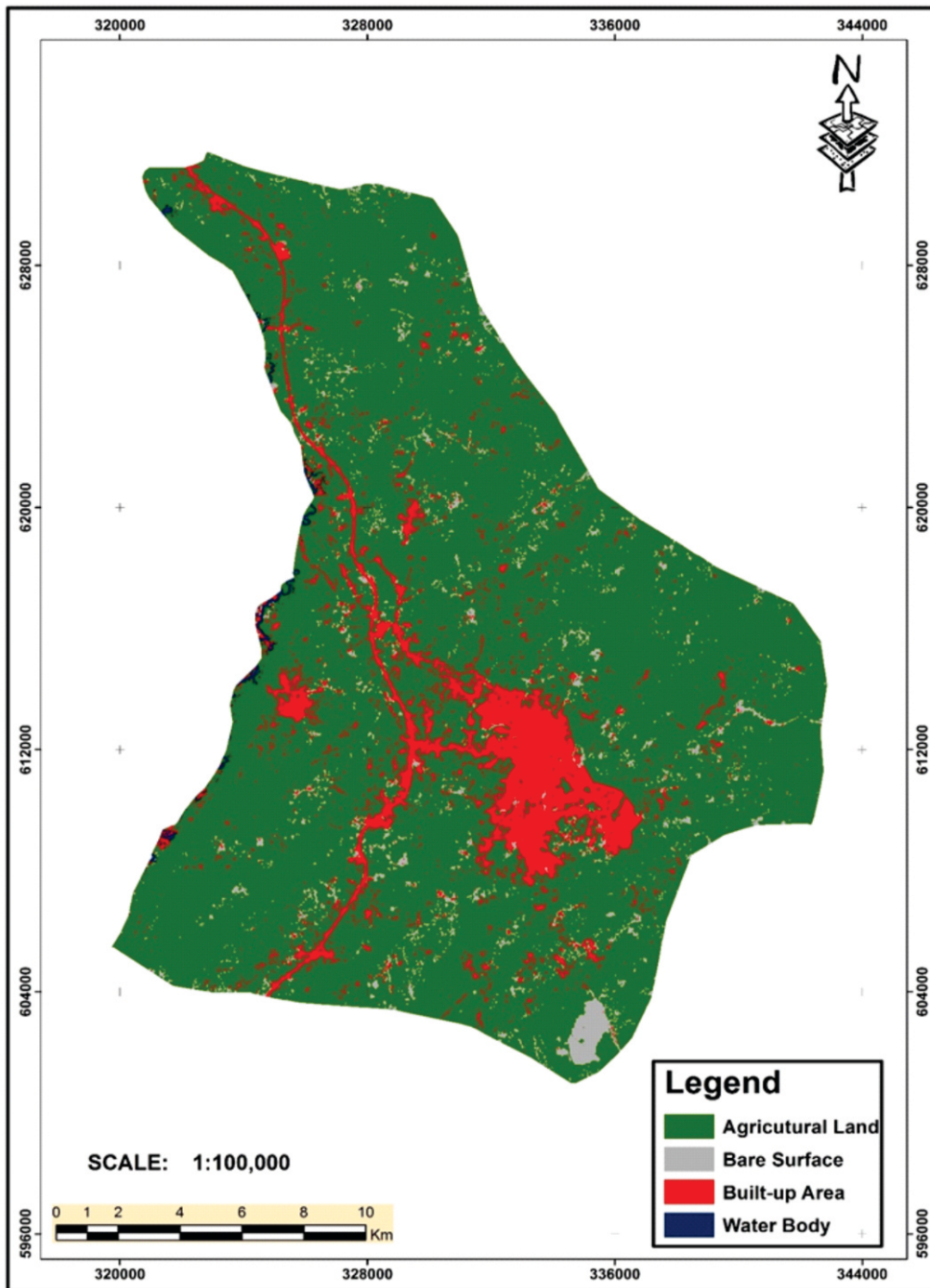
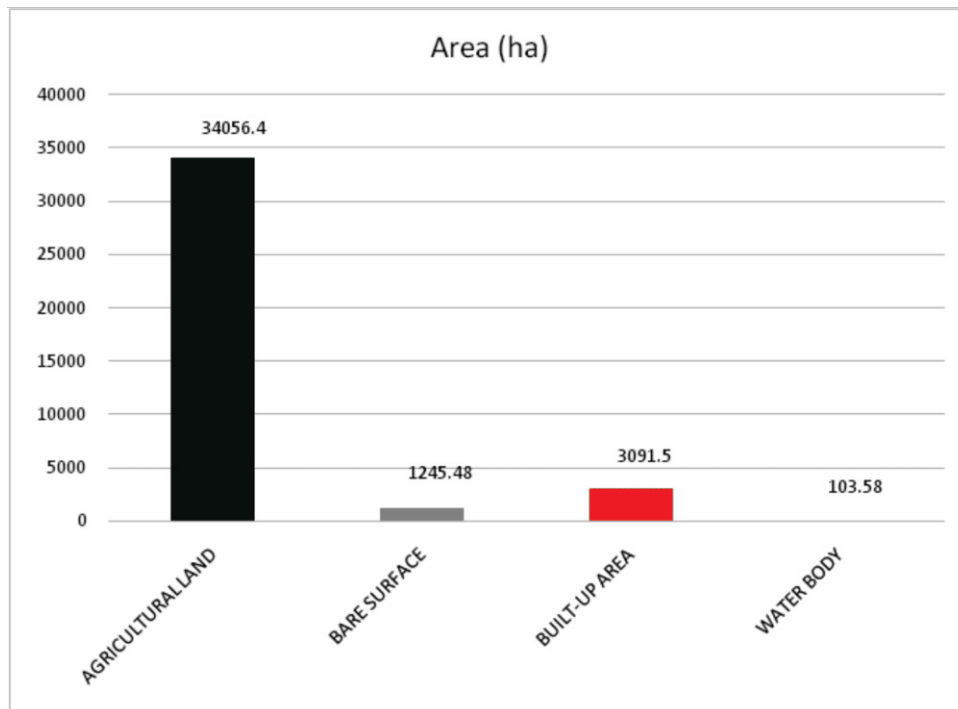


Fig. 2: 2002 Land use image of Umuhia north and Umuhia South LGAs



**Fig. 3: Bar chart showing area in hectares of land use categories in 2002**

In 2010, Water Body had a slight increase with 105.25ha, bare surface increased to 3591.10ha alongside with Built-up area, which also increases by 5665.01ha of the total class while Agricultural land depreciates to 29135.60ha of the total class. The pattern of land use distribution in 2010 showed an increase in built-up areas and bare surfaces which is about 14.7% and 9.3% as against 8.0% and 3.2% respectively in 2002. Agricultural land has been on a continuous reduction since 2002 when it occupied 88.5% by occupying 75.7% of the total area in 2010. Still, water body maintains the least position in the classes with 0.3% of the total class. Fig. 4 shows the 2010 land use image of the study area while Fig. 5 is a bar chart showing area in hectares of land use categories in 2010.



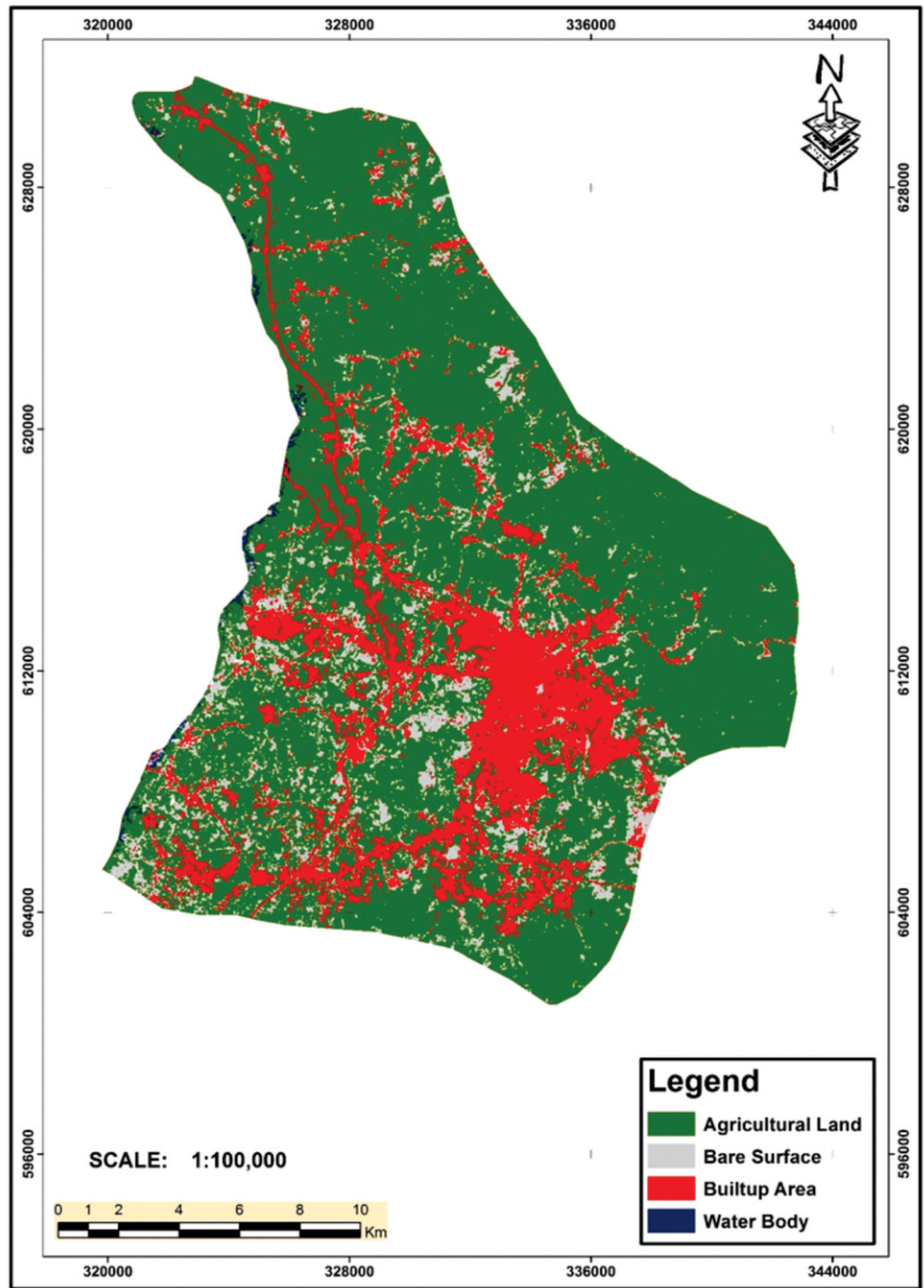
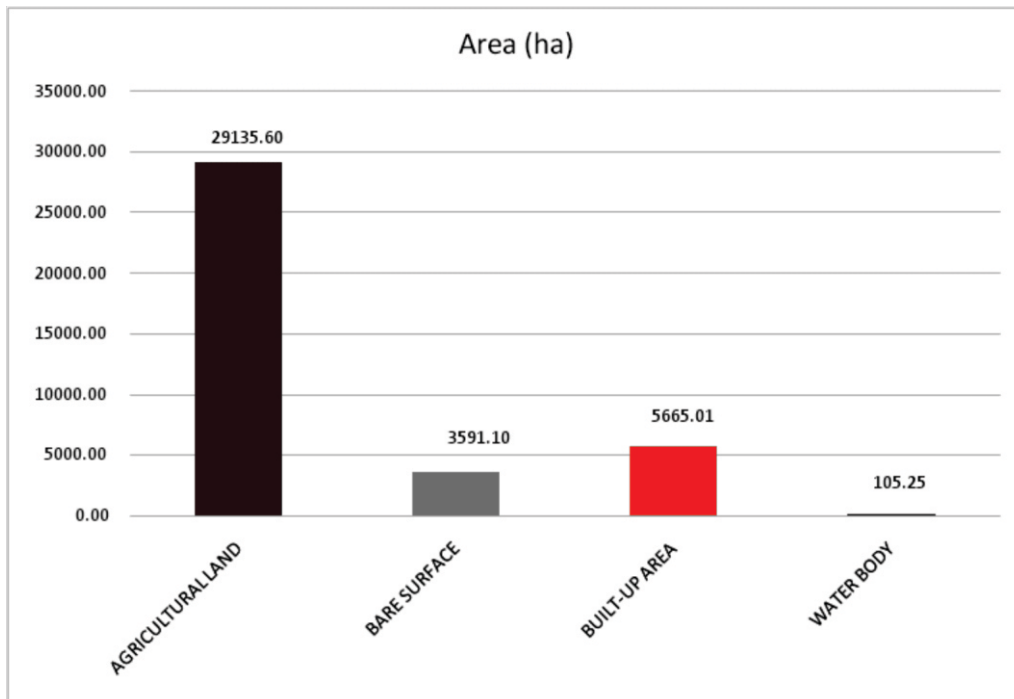


Fig. 4: 2010 Land use image of Umuahia North and Umuahia South LGAs



**Fig. 5: Bar chart showing area in hectares of land use categories in 2010**

The pattern of land use land cover distribution in 2015 followed the pattern in 2010. Bare surface and Built-up area occupied 6205.29ha and 6865.97ha respectively of the total land while Agricultural land takes up 25314.10ha another drop in the area covered in 2002. Also, water body maintained the least position in the classes with 111.60ha. Fig. 6 shows the 2015 land use image of the study area while Fig. 7 is a bar chart showing area in hectares of land use categories in 2015

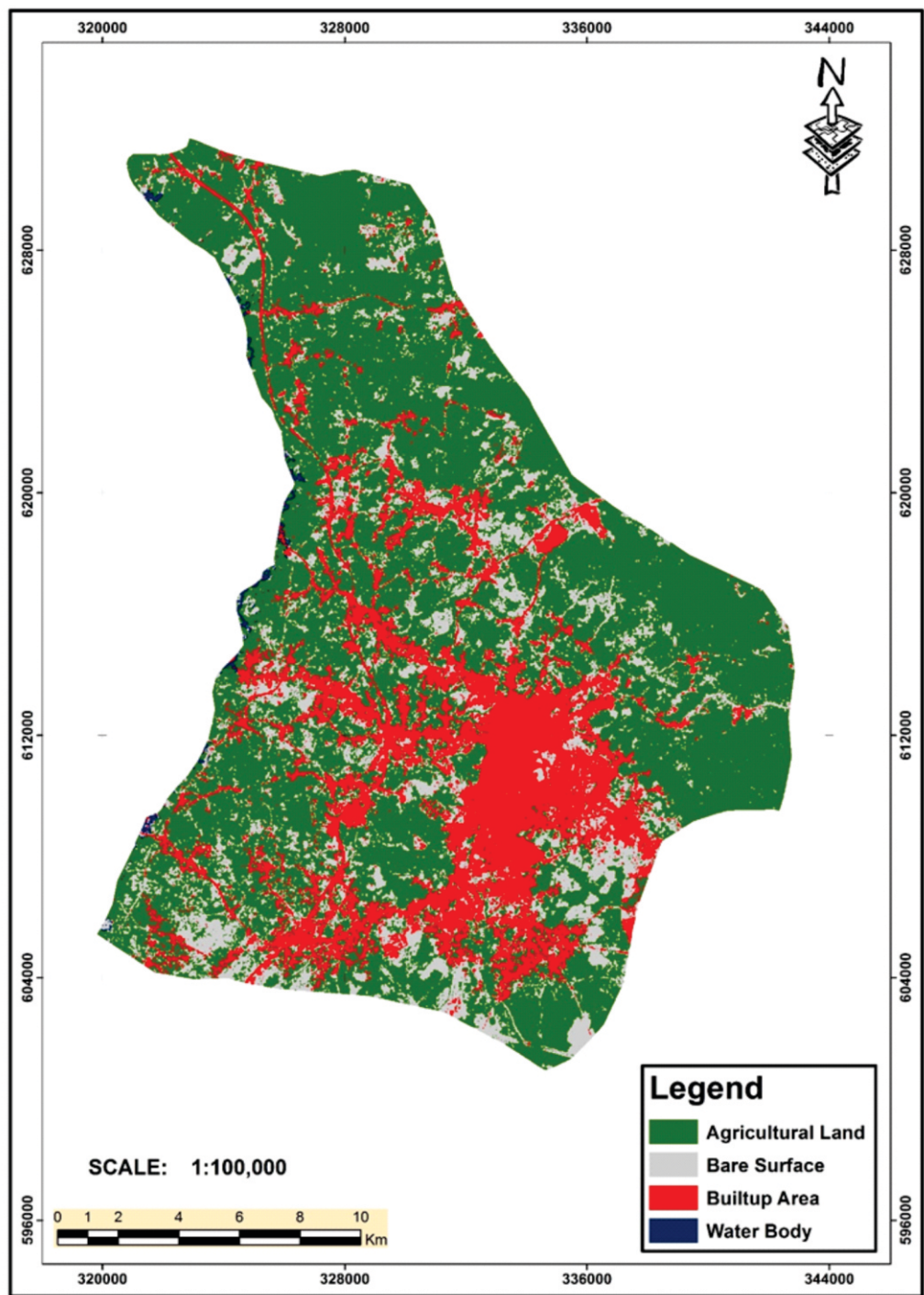


Fig. 6: 2015 Land use image of Umuahia North and Umuahia South LGAs

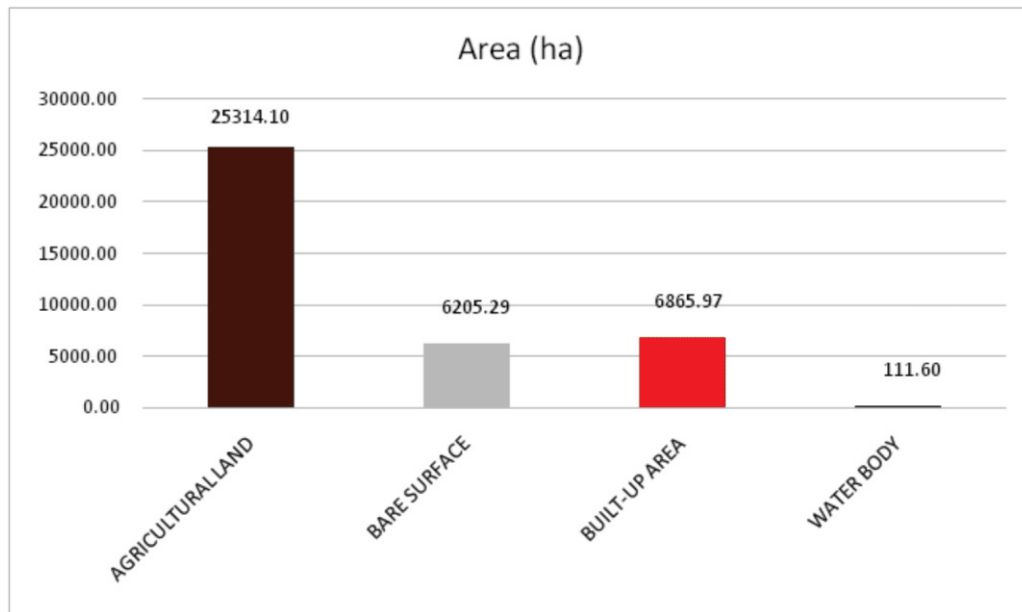


Fig. 7: Bar chart showing area in hectares of land use categories in 2015

#### Land Use Change, Rate and Magnitude

The land use change, rate and magnitude for the study area are shown in Table 3

Table 3: Land Use Change, Rate and Magnitude:

LAND USE CATEGORIES	2002	2010	CHANGE (Ha)	CHANGE (%)	2010	2015	CHANGE (Ha)	CHANGE (%)	ANNUAL RATE OF CHANGE	
	AREA (Ha.)	AREA (Ha.)			AREA (Ha.)	AREA (Ha.)			2002/2010	2010/2015
AGRICULTURAL LAND	34056.4	29135.60	-4920.80	-50.00	29135.60	25314.10	-3821.50	-50.00	-4.00	-2.50
BARE SURFACE	1245.48	3591.10	2345.62	23.83	3591.10	6205.29	2614.19	34.20	1.91	1.71
BUILT-UP AREA	3091.5	5665.01	2573.51	26.15	5665.01	6865.97	1200.95	15.71	2.09	0.79
WATER BODY	103.58	105.25	1.67	0.02	105.25	111.60	6.36	0.08	0.00	0.00

Table 3 depicts a negative change in agricultural land, while other land uses had positive changes (increased values). These may be as a result of several factors but the major ones are urbanization and population dynamics. This situation has increased land consumption rate in the region between 2010 and 2015. As evidenced in Table 3, between 2002 and 2010, built-up area and bare surface in the region increased by 26% and 24% respectively, water body by 0.02% while agricultural land decreased by 50%. The period between 2010 and 2015 witnessed built-up area and bare surface increasing by 16% and 34% respectively and water body by 0.08% while agricultural land still decreased.

Also significant changes were observed concerning the annual rate of change in agricultural land from -4.00 between 2002 and 2010 to -2.50 in 2010 and 2015. During this period, built-up area and bare surface had 2.09 and 1.91 in 2002 and 2010 while values of 0.79 and 1.71 were obtained in 2010 and 2015 respectively. The gain and loss in agricultural land between the years under study is shown in Tables 4 and 5.

**Table 4: Gain and Loss in Agricultural Land between 2002 and 2010**

Land Use/Land Cover Categories	Total Gain (Ha)	Annual Gain (Ha)	Total Loss (Ha)	Annual Loss (Ha)
Agricultural Land	-	-	4920.80	615.1

**Source:** Researcher's Fieldwork

**Table 5: Gain and Loss in Agricultural Land between 2010 and 2015**

Land Use/Land Cover Categories	Total Gain (Ha)	Annual Gain (Ha)	Total Loss (Ha)	Annual Loss (Ha)
Agricultural Land	-	-	3821.50	764.3

**Source:** Researcher's Fieldwork

Tables 4 and 5 showed that agricultural land is seriously losing its place in Umuahia. Should human quest for improved survival, more development and advancement continue unabated, agricultural land in the area would be under serious threat. Agricultural yield over the study years are shown in Table 6.

**Table 6: Agricultural Yield over the Study Years**

Agricultural Produce		Yield (tons)		
		Year 2002	Year 2010	Year 2015
1.	Cassava	0.382	0.222	0.091
2.	Yam	427	334	241
3.	Maize	786	704	332
4.	Rice	1846.3	1136.6	332.4
5.	Cocoa	2010	1754	1754
6.	Oil Palm	1157	1109	1201
	<b>Total</b>	<b>6227</b>	<b>5038</b>	<b>3851</b>

**Source:** State Ministry of Agriculture

Based on yield performance as observed in Table 6, it is seen that agricultural yield in the year 2002 was 6227 tons with available land for agricultural use at 34056.4 ha. In the year 2010, yield stood at 5038 tons with available land for agricultural use at 29135.60 ha. Also in 2015, yield stood at 3851 tons with agricultural land use at 25314.10 ha. This situation as it can be seen in fig. 8 and 9 indicate that as the year goes by, land availability for agricultural uses in the study area depreciates and as it depreciates so does the agricultural yield in the study area depreciates. This depreciation in the agricultural yield affects negatively on the income accruable to the farmers in the area and the region at large.

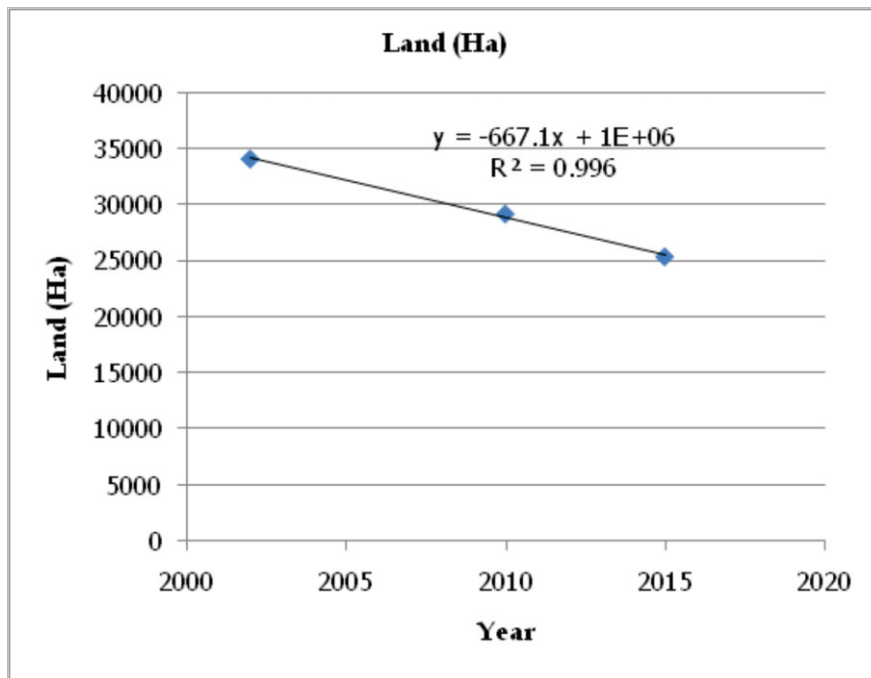


Fig. 8: Line graph showing Agricultural land over the study years

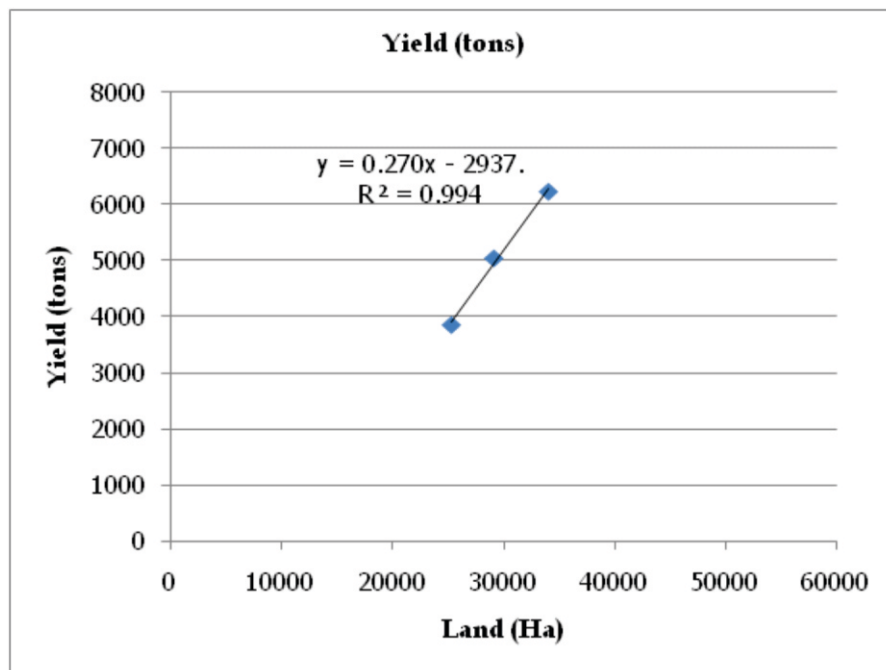
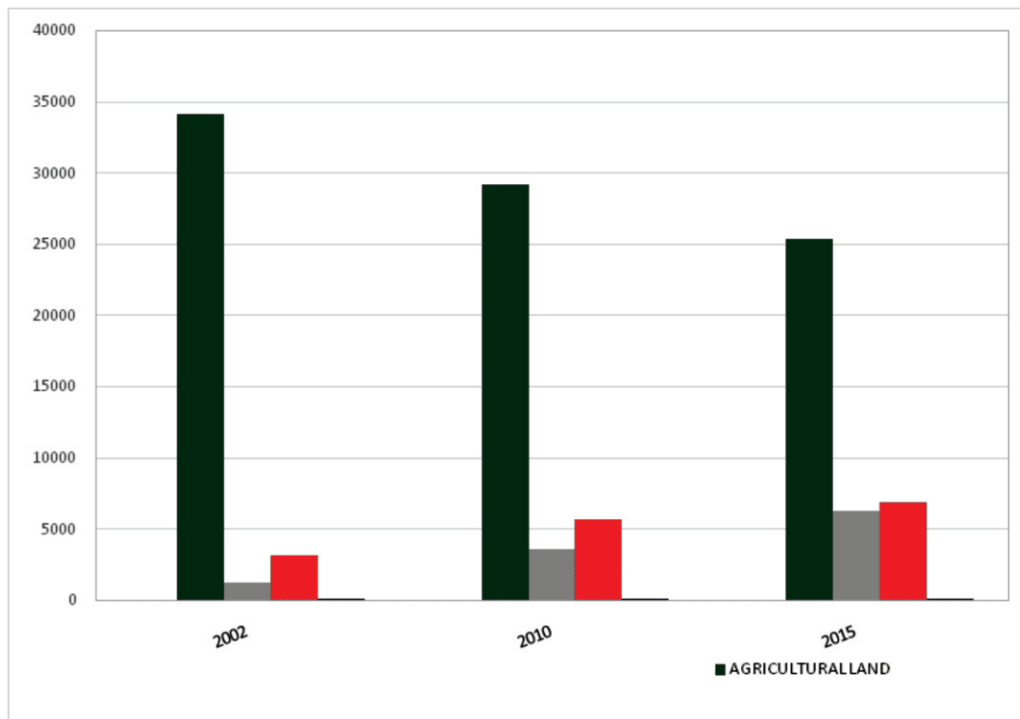


Fig. 9: Line Graph showing yield over Agricultural land

To this end, the loss of agricultural land amongst others has reduced the potential for food production and aggravates food shortages resulting in food insecurity. Also it leads to a reduction in per capita agricultural production and income accruing to farmers. In some

areas, the lack of opportunities has turned once-viable communities into ghost towns. It has intensified income segregation and economic disparities between urban and suburban communities. Fig.10 shows the agricultural land area in the years under study that is 2002, 2010 and 2015.



**Fig. 10: Bar chart of Agricultural Land Area (Ha) in 2002, 2010 and 2015**

### Conclusion

Environmental change is an inevitable natural process. However, rapid environmental changes, caused by anthropogenic activities, can lead to several negative consequences including deforestation, climate change, extinction of plant and animal species, distortion of hydrological cycle and food shortages. Consequently, monitoring the rate and pattern of environmental change is an important component of environmental planning and management. This study examined the conversion of agricultural land use to other uses in Umuahia. The results revealed that urban development as well as population growth has resulted in the decline in agricultural land from -4920.80ha between 2002 and 2010 to -3821.50ha between 2010 and 2015 in the study area. This signifies a reduction in land availability for agricultural activities in the area during the period of study. This finding portends dwindling interest in agricultural production which requires policy intervention aimed at protecting agricultural land against urban encroachment.

## Recommendations

To ameliorate the rate at which agricultural land is lost to other land uses, the following recommendations are suggested;

1. Government should ensure that land use planning is instituted and implemented religiously by the relevant bodies. This will help to ensure that agricultural land use is sustained in the city.
2. Urban growth boundaries should be demarcated by adopting the use of a green belt area around the city. This will enhance the aesthetic value of the environment and also serve to slow down the rate of agricultural land use conversion.
3. Policymakers should seek for more policies that will encourage agriculture and mitigate the impact of agricultural land use change in the study area.
4. Urban planners and environmental managers should be encouraged to use remote sensing and Geographic Information System in planning, management, and in making various environmental decisions.

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