International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(Research Article)

The conversion rate of agricultural lands to urban areas in Oyi local government area, Anambra State Nigeria

Adaobi Eucharia Nkemdirim * and Victor Uchechukwu Nkemdirim

Department of Geography/Planning, Abia State University Uturu, Nigeria.

International Journal of Science and Research Archive, 2025, 15(03), 335-343

Publication history: Received on 24 April 2025; revised on 31 May 2025; accepted on 03 June 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.3.1696

Abstract

Agricultural land in urban areas has a strategic role as a provider of food for the people living in the urban areas, as well as supporting the environment. The important role of the existence of agricultural land in urban areas over the past few decades faces a serious threat, namely the occurrence of agricultural land conversion. This study was carried out with the aim to analyze the trend of agricultural land conversion in urban areas and to find out which of the land use pattern is been affected. The data used in this research is the image classification using different land use classes which are settlement, farm land, forest, bare surface, using ArcGIS 10.4 software, which is dependent on the observable features. The results showed that there are positive changes of identified geographic features among the different classified image of the selected epochs. For the period of 2005 to 2015, it was observed that Settlement gained 1.44km² (5.73%) from other classes making it the only feature that actually increased within this epoch. Then for the period of 2015 to 2022, Bare surface gained about 5.24km² (20.85 %) of its area from other LULC classes, forest gained about 6.44km² (25.64%) of its area from other classes, Settlement gained about 15.09km² (60.09%) additional area from other classes in the study area. While the Negative changes for the period of 2005 to 2015, observed that from the classified images that Bare surface lost about 1.79km² (7.13%) of its area to land use land cover (LULC) classes, farm land lost about15.44km²(61.49%) of its area coverage, Forest lost about 9.31km² (37.08%) the total of its area to other classes in the study area. Between 2015 to 2023, it was observed that farm land was the only class that lost some of its area 1.65km² (6.58%) to other classes.

Keywords: Conversion Rate; Agricultural Lands; Urban Expansion; Classified Images; Epochs

1. Introduction

According to FAO (2014), Agricultural land refers to the share of land that is arable, under permanent crops, and under permanent pastures. Arable land includes land under temporary crops. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee and rubber, while permanent pasture is land used for five or more years for forage, including natural and cultivated crops.

Agricultural land is the land base upon which agriculture is practiced. Typically occurring on farms, agricultural activities are undertaken upon agricultural land to produce agricultural products. Although agricultural land is primarily required for the production of food for human and animal consumption, agricultural activities also include the growing of plants for fiber and fuels (including wood), and for other organically derived products (pharmaceuticals, etc). According to Francis, et. al; (2013), agricultural lands are most affected by rapid urbanization and its functions of demand. Land uses for residential, industry and commercial, civic and culture tend to dominate agricultural lands in the bid for space in the urban place. This dominance tends to deprive farmers of arable land to cultivate thereby reducing agricultural productivity.

* Corresponding author: A. E. Nkemdirim.

The key challenge of the urbanization process is the rapid conversion of large amount of prime agricultural land to urban land uses (mostly residential construction), in the urban periphery. The effect is the unavailability of prime agricultural lands. The consequence is low agricultural productivity, low standard of living and food insecurity. Agricultural lands enhance the quality of life for many. It contributes to green space, wildlife habitat, rural character and access to fresh, high quality, local green produce.

The extent of dependable agricultural land available for agriculture has been declining in recent decades, due to the consumption of agricultural land for urban uses and other non-agricultural uses. This rapid loss of agricultural lands as a result of urban expansion is prevalent throughout the world and much more evident in developing countries Jiang, Deng, and Seto (2013) stated that the urban expansion on agricultural land is associated with both shrinking agricultural land area and a higher level of urban development. The former triggers greater land pressure and the latter indicates increasing off-farm employment opportunities. However, expansion and economic development can lead to rise in the agricultural sector (Wu, fisher, and Pascual., 2011). These have posed additional challenges for the security of food provision and the preservation of natural ecosystems. The nature and magnitude of their relationship directly influence agricultural production and food provision which may have further outcomes on the patterns of a nation's agricultural land (Jiang et. al; 2013).

Furthermore, Ichimura (2003) argued that conversion of agricultural land and forest for urban use and infrastructure is associated with widespread removal of vegetation to support urban ecosystem and put additional pressure on nearby areas that may be even more ecologically sensitive. UN-HABITAT (2010) also affirmed that uncontrolled physical expansion of cities and towns in developing country create an impact on urban environment and economy. This unplanned and uncontrolled development makes provision of housing, roads, water supply, sewers and other public services too expensive. The other impact mentioned on the report was the loss of agricultural land as most cities and town are built on productive agricultural lands.

Oyeleye (2013) believed that the high rate of rural-urban migration in developing countries threatens food security in both urban centres and rural areas. According to him, high numbers of people involved in agricultural activities in rural areas have abandoned agricultural activities as they migrate to the urban centres to seek jobs in manufacturing and processing industries and some into informal activities. Lesser number of people are into agriculture in Nigeria, as more agricultural lands in the suburbs have given way for suburban development and large expanse of lands in rural areas are left uncultivated, as rural areas are more dominated with the aged people who have no strength for agricultural activities. This justifies why importation of food (especially rice, the major Nigeria food) is very high. The prices of all types of foods are very high, which makes it difficult for many poor in the society to afford the three-square meals a day, as recognizes in Nigeria society. Furthermore, Mba, Ude, Ume and Uchegbu (2004) identified several environmental problems which stems from urban expansion with both direct and indirect effects on agricultural land. These problems are classified as ecological, poaching and habitat loss, increasing desertification and soil erosion.

In summary, as much as urban expansion have many positives impacts such as employment opportunities, adequate access to production and distribution of goods and services; commercial and industrial development, increased social amenities and facilities, etc; its impacts on agricultural land are basically negative such as loss of farmland, increased solid waste disposal and land degradation, enclosed surrounding villages to urban territory, over-exploitation of natural resources, and land conflicts among others.

2. Problem Statement

Nigeria, one of the most urbanized countries in Africa with estimated urbanization rate of 3.5% annually has witnessed tremendous urban expansion over the years and is losing about 400,000 hectares of vegetation annually (Adesina, 1999); CIA World Factbook, (2010). According to Oyinloye (2013), the share of urban population out of the total population of Nigeria was less than 7% in 1931 but has continued to escalate over the years. The urbanization rate rose from about 10% in 1952, to 19.2% in 1991, to 43.8% in 2010 and it had reached 50% in 2012. By implication, about 50% of Nigeria now lives in urban areas; while the remaining 50% live in rural areas. The study further stated that there is a direct relationship between the rising urbanization and the rapid growth of cities, and that several factors responsible for the country's rapid growth pattern include natural increase (arising from high birth rate due to improvement in health facilities); rural urban migration; creation of states and local governments, sitting of universities and polytechnics, college of education, commercial centres, industrial centres', tourism resorts etc.

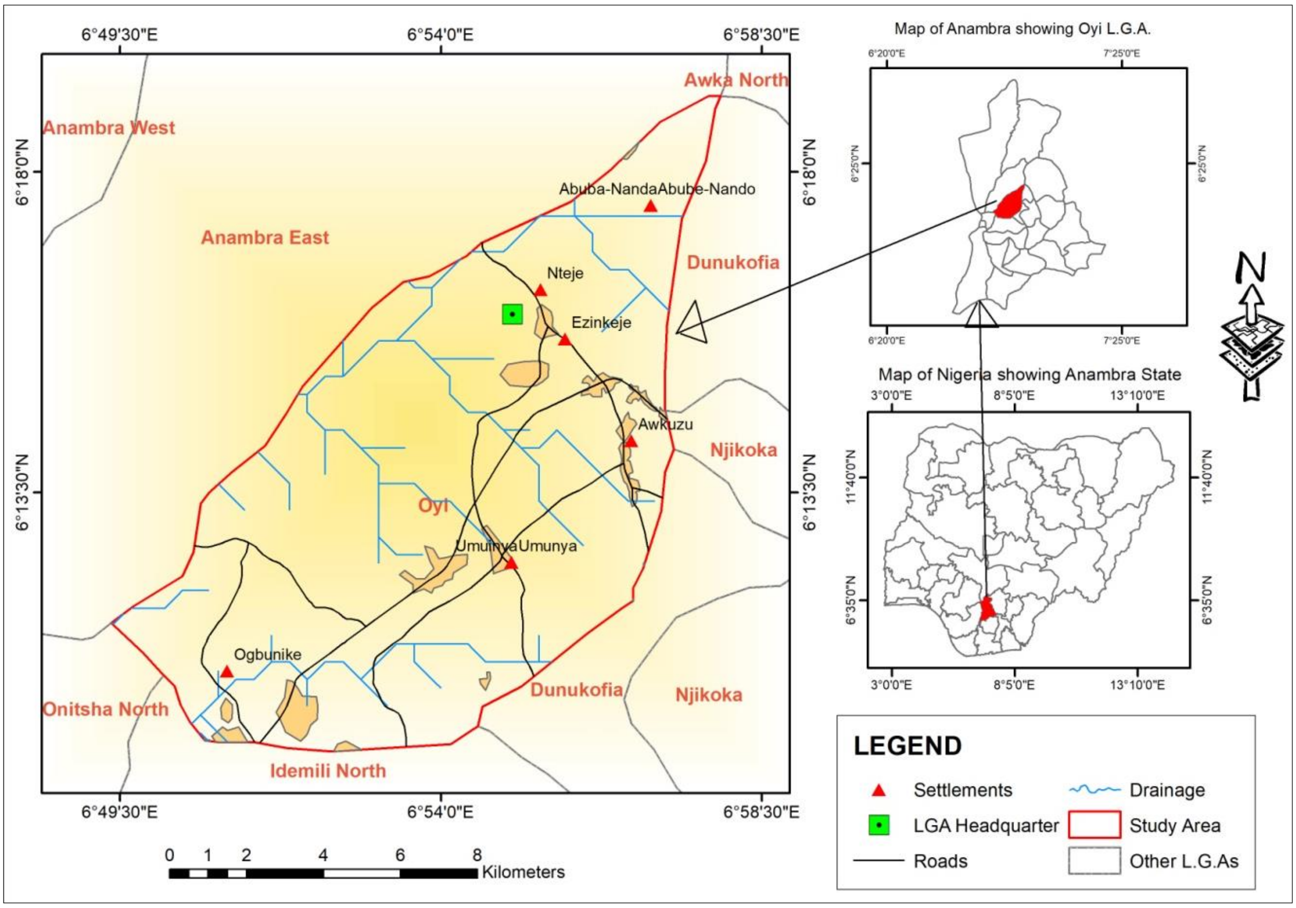
However, up-to-date information that monitors the expansion of Oyi LGA is limited regardless of the changes the area has experienced. Muhammad (1990) studied the process of Peri-Urban Land use conversion in Offia between 1966 and 1986 with the aid of questionnaire survey, the author argued that farmers are the most affected in the Peri-Urban Land use conversion, which is most noticeable in areas near built-up areas and in irregular conversion pattern and distribution.

Oyinloye (2010) studied the spatial growth of Akure, Ondo state using three satellite imageries; Landsat (MSS) of 1972, Landsat (TM) of 1986 and Landsat Enhance Thematic Mapping (ETM) of 2022. The result showed that there has been a rapid conversion of agricultural areas to urban (non-agricultural) land uses. Also, urban expansions of the city have destroyed fertile agricultural land which cannot be recovered as the residential land use continues to spread to and beyond the hitherto distant location relatives to the city core.

These studies motivated the interest to assess urban expansion on agricultural land in Oyi LGA, Anambra state because the sudden transformation of agricultural land in the area has posed a serious threat to food scarcity, high cost of living and a lot of criminal activities. Though, previous attempts have been made to monitor and document the growth of Oyi LGA, but studies that used Remote Sensing and GIS techniques to assess the spatial dimension of urban expansion on agricultural land has been very limited if at all available. Hence, this study will ascertain the extent of agricultural land conversion to urban areas in Oyi LGA between 2005-2022 using Remote Sensing and Geographic Information System (GIS) techniques.

3. Geography of the Area

Oyi local government area (see figure 1) is situated in the south-east geopolitical zone of Nigeria with its headquarter at Nteje, Anambra State. It is situated about 25 kilometers north-east of Onitsha by land route. Its geographical coordinates are Latitude 6^{o} 10’36’’ North and Longitude 6^{o}51’43” East. Oyi has two main seasons, the wet season and dry season with a tropical monsoon climate. It has high temperatures and a lot of rainfall throughout the year.



Source: GIS Laboratory, Abia State University, Uturu – Nigeria.

Figure 1 An insert map of Nigeria showing the study area

The major soils in the area are alluvial and hydromorphic, they are basically underlain by basement complex of pre-cambrian to upper Cambrian period which have strong influence on their morphological characteristics. The soils have high water table with well decomposed organic matter content. The soil encourages agricultural activities (Fawole, 2009). The natural savannah vegetation broadly consists of rainforest and wooden savannah and its well suited for the cultivation of root crops, grains and wide variety of food crops like yam, sweet potatoes, cassava, maize, beans, rice, sorghum, millet, sugarcane, fruits, vegetables, etc. and rearing of livestock such as cattle, goat, and sheep.

Geologically, Anambra was classified into eight geologic formations that include the Benin (Ogwashi-Asaba) formation, Nkporo/Enugu shale, Mamu formation, Ajali sandstone, Nsukka formation, Imo formation, Ameki formation/Nanka sand and Alluvium. The Ameki formation consists of fossiliferous greyish-green sandy clay with calcareous concretion and white clayey sandstones. The Anambra basin covers an area of about 40,000 km with a sedimentary sequence of 9 km in thickness.

4. Methodology

The data used in this research is the image classification using different land use classes which are settlement, farm land, forest, bare surface using ArcGIS 10.4 software, which is dependent on the observable features. The people of the area were equally asked questions on what have been in existence in a given area before and during the research, and how as well as when the change might have taken place. We also made use of statistical representation with different quantified/classified image of different epochs to carry out the comparison in a statistical manner, using graph and table format. This was done with Microsoft excel.

5. Methods of Data Analysis

The acquired satellite images were classified into land use classes which is dependent on the observable features and they are listed below

- Settlement; (these includes built-up areas like residential and commercial features, educational centers, hospitals, industries, motor roads, religious centers)
- Farmlands; (all cultivated areas such as lands and crop fields)
- Bare surface; (all open bare spaces as well as pitches) and
- Forest; (these include fallows, tick riparian as well as tick vegetative cover.

5.1. Statistical representation

Here, we make use of different quantified/classified image of different epochs to carry out the comparison in a statistical manner, using graph and table format. This is being done using software like Microsoft excel. These quantification/classification analyses of these images were carried out using ArcGIS 10.1 which produces the area covered by the identified features in count.

6. Results and Discussions

During this image classification analysis, four geographic features where identified which are settlement, farm land, bare surface and forest and they are used in the classification of the selected images.

Table 1 Area covered by the identified geographic features in the 2005 classified image of the study area

Object ID	LULC Classes	Area Covered			
		Count (pixels)	Square meters (m^2)	Square kilometre (km^2)	Percentage (%)
1	Bare surface	19469	17522100	17.5221	14.44
2	Farm land	21623	35239985	35.239985	29.03
3	Forest	59675	41567530	41.56753	34.25
4	Settlement	34101	27046999	27.046999	22.28
	Grand Total	134868	121376614	121.376614	100.00

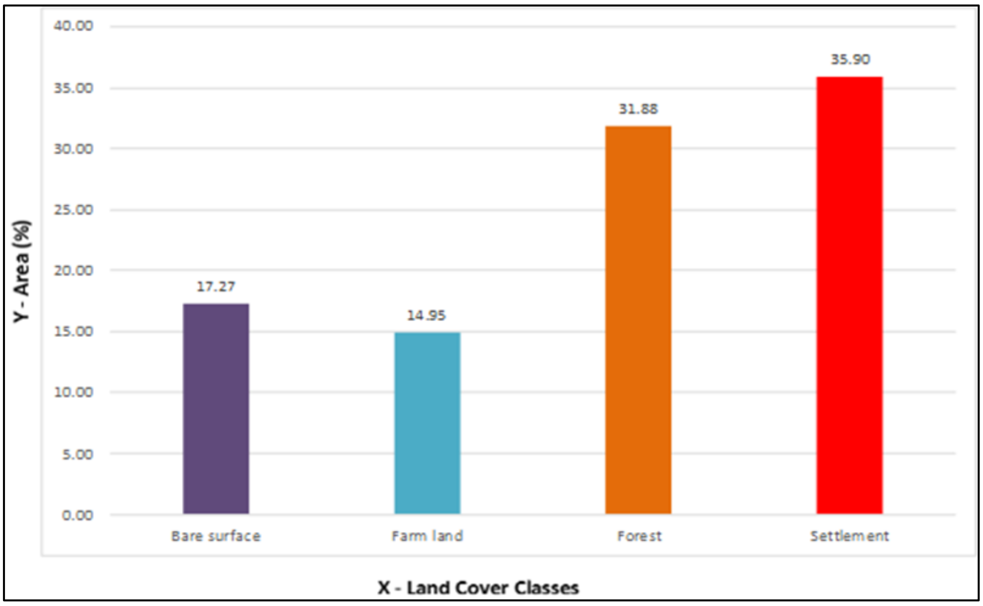


Figure 2 The percentage of quantified geographic features in the 2005 classified image of the study area

Table 2 The area covered by the identified geographic features in the 2015 classified image of the study area

Object ID	**Identified geographic Features**	**Area Covered**			
		Count (pixels)	**Square meters (m^2)**	**Square kilometre (km^2)**	**Percentage (%)**
1	Bare surface	17479	15731100	15.7311	16.34
2	Farm land	21997	19797300	19.7973	20.56
3	Forest	35838	32254200	32.2542	33.50
4	Settlement	31654	28488600	28.4886	29.59
	Grand Total	134868	121376614	96.2712	100.00

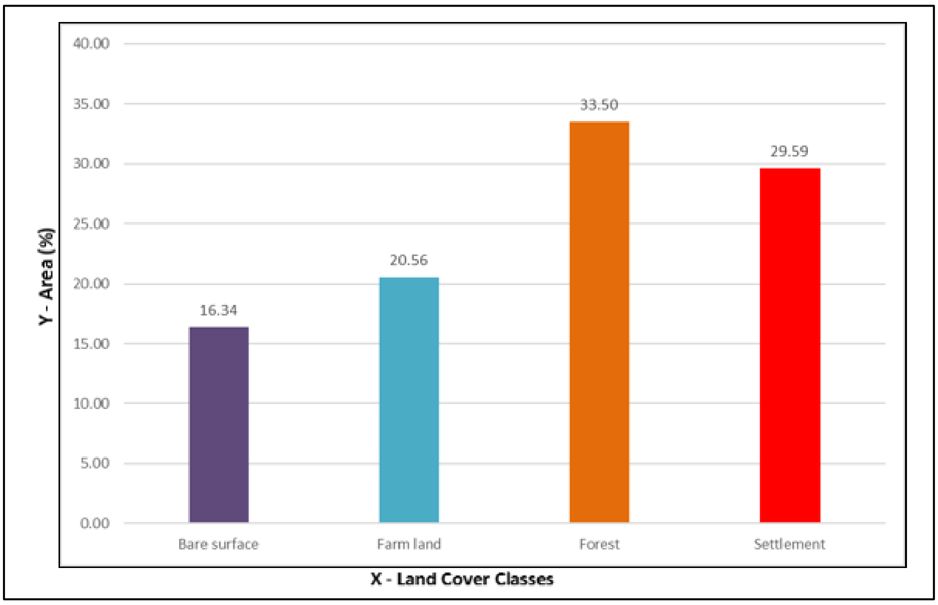


Figure 3 The quantified geographic features in the 2015 classified image of the study area

The classified image of 2015 shows that 16.34% of the study area is covered by bare surface, 20.56% is covered by farmland, 33.50% is covered by forest and 29.59% is covered by settlement. This shows that bare surface increased from 14.44% to 16.34%, farmland decreased from 29.03% to 20.56% and forest also decreased from 34.58% to 33.50%, there is a notable increment in settlement which rose from 22.28% to 29.59% between the year 2005 to 2015. The result is represented in a statistical and graphical format in Table and fig. above.

6.1. Image Classification of 2023

Table 3 Area covered by the identified geographic features in the 2023 classified image of the study area

Object ID	**Identified geographic Features**	**Area Covered**			
		Count (pixels)	**Square meters (m^2)**	**Square kilometre (km^2)**	**Percentage (%)**
1	Bare surface	23297	20967300	20.9673	17.27
2	Farm land	20160	18144000	18.144	14.95
3	Forest	42992	38692800	38.6928	31.88
4	Settlement	48419	43577100	43.5771	35.90
	Grand Total	134868	121381200	121.3812	100.00

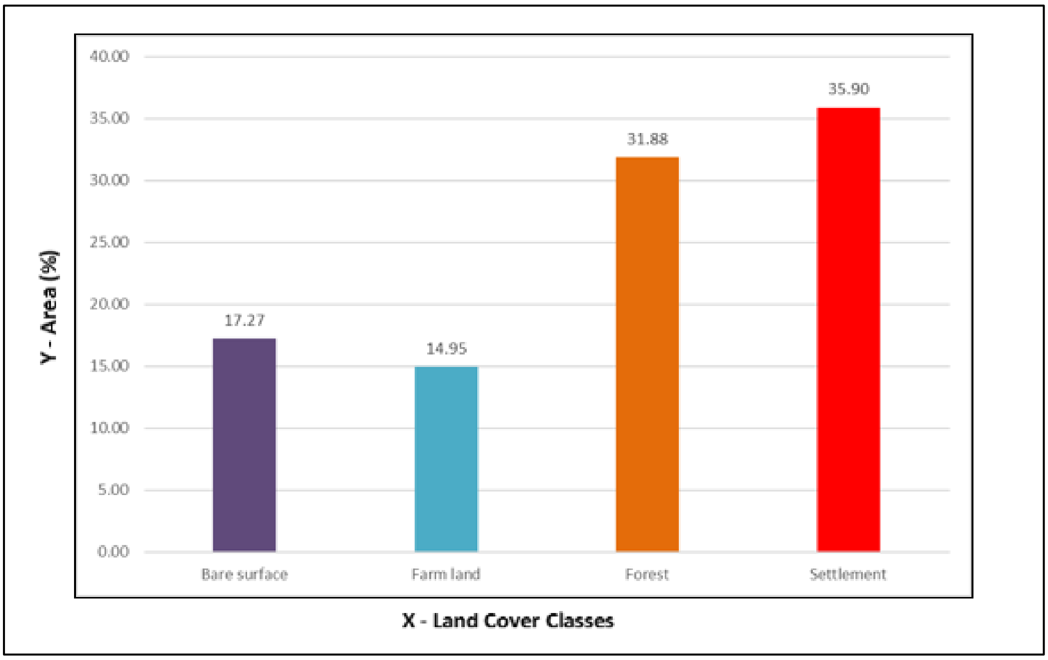


Figure 4 The quantified geographic features in 2023 classified image of the study area

The classified image of 2023 in the Fig. above shows that 17.27% of the study area is covered by bare surface, 14.95% is covered by farm land, 31.88% is covered by forest and 35.90% is covered by settlement. This shows that farmland and forest decreased from 20.56% to 14.95% and 33.50% to 31.88% respectively, while bare surfaces and settlement increased from 16.34% to 17.27% and 29.59% to 35.90% respectively from the year 2015 to 2023. The result is represented in a statistical and graphical format in Table below.

6.2. Classified Images of all epochs and observed changes

An identified geographic feature from all the classified images and the observed changes from all epochs are shown in the table respectively

Table 4 Area covered by the identified geographic features from all the classified images of different epochs (2005 to 2023)

S/N	Geographic Features	Area covered					
		2005 yr. Data		**2015 yr. data**		**2023yr. data**	
		Km²	**%**	**Km²**	**%**	**Km²**	**%**
1	Bare surface	17.5221	14.44	15.7311	16.34	20.9673	17.27
2	Farm land	35.239985	29.03	19.7973	20.56	18.144	14.95
3	Forest	41.56753	34.25	32.2542	33.50	38.6928	31.88
4	Settlement	27.046999	22.28	28.4886	29.59	43.5771	35.90
	Grand total	121.376614	100	96.2712	99.99	121.3812	100

Figure 5 A composite bar chart showing the percentage of quantified geographic features identified for 2005, 2015 and 2023 classified image of the study area

From the year 2005 to 2023, it reveals that Farmland and Forest decreased from 29.03% to 14.95% and 34.25% to 31.88% respectively, while Bare Surface and settlement increased from 14.44% to 17.27% and 22.28% to 35.90% respectively as shown in Table 4 and figure 5 above.

7. Discussion of Data Analysis

From the image classification analysis of 2005, bare surface covers 17.52km², farm land covers 35.23km², forest covers 41.56km² and settlement covers 27.05km² of 121.381km² of the entire study area. For the 2015 classified image, bare surface covered15.73km², farm land covers 19.79km², forest covers 32.25km² and settlement covers 28.48km² of 121.381km² of the study area. For the image classification analysis of 2023, bare surface covers 20.96km², farm land covered18.14km², forest covers 38.69km² and settlement covers 43.57km² of 121.381km² of the study area.

7.1. Negative change of identified geographic features among the different classified images of the selected epochs

For the period of 2005 to 2015, it was observed from the classified images that Bare surface lost about 1.79km² (7.13 %) of its area to land use land cover (LULC) classes, farm land lost about15.44km²(61.49%) of its area coverage, Forest lost about 9.31km²(37.08%) the total of its area to other classes in the study area. Between 2015 to 2023, it was observed that farm land was the only class that lost some of its area 1.65km² (6.58%) to other classes.

7.2. Positive change of identified geographic features among the different classified image of the selected epochs

For the period of 2005 to 2015, it was equally observed that Settlement gained 1.44km^2 (5.73%) from other classes making it the only feature that actually increased within this epoch. Then for the period of 2015 to 2023, Bare surface gained about 5.24km^2 (20.85 %) of its area from other LULC classes, forest gained about 6.44km^2 (25.64%) of it's area from other classes, Settlement gained about 15.09km^2 (60.09%) additional area from other classes in the study area.

8. Conclusion And Recommendation

This study provides insight on the impact of urban expansion of agricultural lands in Oyi Local Government Area, using Remote Sensing and GIS. Attempt was made to capture as accurate as possible the four major land use types in the study area as they change through time. The study used Remote Sensing and GIS as an analytical tool with satellite images used for mapping and quantifying the land use types, rate and extent of urban growth, spatial loss and conversion of agricultural land to other land uses and urban expansion within the study period. As shown from the classified land use classes, land use types had changed significantly over the period under review (2005 - 2023). The statistics indicated that between 2015 – 2023, the growth rate of built-up area occupied the largest share among other land use categories. It shows a rapid decline in forest and farmland. While it is recommended that there is the need to control urban spreading to agricultural land as this will have serious repercussion on food production. Although urban expansion cannot be stopped, with proper management and planning it can be directed in a desirable and sustainable way.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Adesina, F.A; W.O. Siyanbola; D.A. Palermo; L.O. Ojo and A.O. Adegbulugbe (1999). Potentials of agroforestry for climate change mitigation in Nigeria, some preliminary estimates; Global Ecology and Biogeography letters, Vol. 8, 163-173.

[2] Adesina, F.A., (2005) Geoinformation and natural resources exploitation in Africa; United Nation Economic and Social Council, Paper delivered in Fourth meeting of the committee on Development Information, Addis Ababa.

[3] CIA World fact book-www.cia.gov/library/publication/theword factbook/fields/2212.html

[4] Fawole (2007). Constraints to production, Processing and Marketing of sweet-potato in Selected communities in Offia local government Area, Kwara State Nigeria. Journal of Human Ecology, 22(1), pp 23-25.

[5] Food and Agriculture Organization of the United Statistics Division (FAO) (2014). In Max Roser (2015)-land Use in Agriculture. Retrieved from: hppt://ourworldindata.org/data/food-agriculture/land-use-in-agriculture/ on 17th March, 2015.

[6] Francis, Z.N., Romanus, D.D., and Raphael, k.k. (2013). Urbanization and its Impact on Agricultural lands in Growing Cities in Developing Countries: A case study of Tamale in Ghana, Modern Social Science Journal, Vol. 2, pp. 256-287.

[7] Jiang, L; Deng, X and K. Seto, (2013). The Impact of Urban Expansion on Agricultural Land Use intensity in China. Land Use Policy, vol. 35, pp.33-39.

[8] Ichimura M (2003). Urbanization, Urban environment and land use: Challenges and Opportunities. Asia-Pacific forum for Environment and Development Expert Meeting 23 January, 2003, Guilin, China.

[9] Mba, H.C; Ude, BC; Ume, L.C and Uchegbu, B. (Eds) (2004). Management of Environmental Problems and Hazards in Nigeria, Hants: Ashgate Publishing Ltd

[10] Mohammed J.A. (1990). The Process of Peri-urban landuse conversion At Offa Town, Kwara State, Nigeria, unpublished M.Sc. Dissertation. Department of Geography, Ahmadu Bello University, Zaria.

[11] Oyeleye, O.I. (2013). Challenges of Urbanization and urban Growth in Nigeria. American Journal of Sustainable Cities and society Issue2, vol. 1 Jan-Dec 2013.

[12] Oyinloye, M.A. (2010). Spatial Analysis of Urban Growth in Akure, Nigeria. Unpublished PhD Thesis, Department of Urban and Regional Planning, Federal University of Technology, Akure.

[13] Wu, J.J., fisher, M., Pascual, U., (2011). Urbanization and the viability of local Agricultural Economics vol. 87(1), 109-125.

[14] UN-HABITAT (2010). State of the world cities, Bridging the Urban Divide Report 2010/2011. London: Earthscan, USA.