Urban Expansion: A Threat to Agricultural Land and Food Security in Ekiti State, Nigeria

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ABSTRACT

This study aims at evaluating the role of Geo-spatial techniques in addressing the issue of urban expansion and growth as a threat to agricultural land uses and food security in Ekiti State. The challenges of reduction in agricultural lands due to population increase and physical development of our urban centres (provision of infrastructure) has put adverse effect/ threat to food security in Ekiti State especially in urban areas of the state. The uncontrolled rural-urban migration due to socio-economic development has made it imperative to address the problem of reduction in agricultural lands in the study area. Also, the issue of rapid urban development without appropriate attention given to the importance of food security with persistent deteriorating infrastructure for urban food processing has led to rapid price changes, in food and other agricultural products. This study, therefore, attempts to use remote sensing integrated into Geographic Information System technologies to provide powerful tools for mapping and detecting changes in land use and land cover using Ekiti State as a case study. The digital image processing techniques of remote sensing (RS) was employed to enable speedy, accurate and objective interpretation of the multispectral data used for the study, in order to understand the extent , rate and the magnitude of land use and land cover dynamics in the study area. The study reveals that agricultural land and natural vegetation have the highest change .Much of these land areas were converted to built-up areas for the three study epochs (2003, 2013 and 2023). The study concludes that there is a progressive encroachment of built- up areas on agricultural land in the study area, thereby resulting in significant environmental changes that threatens food security.

Keywords: Agricultural land, Food-Security, GIS and Remote Sensing, Urban Growth and Urbanisation

INTRODUCTION

The global population continue to rise in billions with the greatest number coming from the developing countries like Nigeria (FAO,2009; Dalil et al., 2013). Nigeria as a nation is growing fast in population, thus there is a competition for survival that forced people to migrate from country land to town lands that led to urbanization. This poses a significant effect on citizens' access to food due to competing uses in the land resources of the nation which is a fixed asset put at 923,768 square kilometers(NIS,2021).This increase is not a new trend for it was postulated by Malthus three century's ago (Owoo,2020) . Thus, increase in population and consumption growth poses a major threat to food production and that if the population growth increases, increase in urbanization will continue to threaten agricultural production. Thus, urban expansion owing to population increase in Nigeria will continue to put much pressure on land due to competing uses of the land resources thus impacting the land use changes in the study area as most of the agricultural lands are converted to other uses such as industries, schools, roads and other infrastructural facilities. Ayedogbon et al.,(2022) commented that National Bureau of Statistics (NBS,2020) gave the records of the rate of urban growth in Nigeria as it ranges from 2.2% in 1990 to 3.3% in 2020. According to statistic from United Nation Population Division(2010)which states that by 2050 the population growth will double the amount of the global demand for food in sub-saharan Africa even if fertility rates were to decline from their current levels, populations projection is to double, with attendant implications for food security.

The Food and Agricultural Organization also identifies population growth as a critical determinant of food

security and it is therefore not surprising that with the observed large increases in the country's population Nigeria faces a crisis in terms of access to agricultural land to produce food for its populace. Nigeria's population is estimated to be approximately 198 million, making it the most populous country in Africa and the seventh most populous country in the world (FAO,2013;Owoo, 2020).

Nigerian main agricultural activities and production systems face a lot of challenges such as increase in population growth, climate change and development of human settlements, especially in the urban areas of the country a result of high birth rate and rural-urban migration; thus making the urbanization process of settlements an unprecedented and inevitable phenomenon (Dalil et al., 2013).These challenges contribute significantly to the country's economy, under employment and food security(FAO,2020b; World Bank,2020).

The Food and Agriculture organization of the United Nations (FAO) defines food security as a situation that exist when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO,2008). This definition comprises four key dimensions to household food security: accessibility, availability, safety and stability; and these four keys can only be meaningful and sustainable when land for food production is available for use in larger quantity in the country). Agricultural planning and development is important in Nigeria, for it contributes to food security and livelihood by providing a range of agricultural products and supporting rural livelihoods through farming, fishing and livestock rearing(FAO,2018)

Popoola (2016) lamented on forest declining that over 400,000 hectares of land were destroyed by the public for physical development activities in urban areas of Nigeria; and that over 14 million hectares of land were converted to various land uses with diverse effect on agricultural land between 1990 and 2020 (Adegboyega and Ogunlade,2019). For instance, Ajoda new town, Ibadan, Land Mark University, Omu-aran, Dangote Cement Factory at Obajana (Kogi State, and Ibese near Ilaro (Ogun State), JABU at Ikeji-Arakeji,Osun State, Shagari Villages in Akure. Likewise in Ekiti State, education is the most viable industry for the people are in the fore front of educational development which could have a detrimental effect on the land use and land cover of the area as we have 541 Public Primary School,74 Private Primary School,141 Public Secondary School,I8 registered Private Secondary School, ABUAD,EKSU and FPA, Ado-Ekiti, FUOYE, at Oye and Ikole-Ekiti, and Ekiti State Polytechnic, Isan-Ekiti. Aside this, land was acquired for Cargo Air Port, Federal Housing Authority , and that of Ekiti State Housing Corporation (Okeila and Irewolede), and Ifaki (Ekiti State Diary,2023) all these schools acquired not fewer hectares of land for their use and have taken the little land which were meant for farm work before from the rightful owner and are converted for other uses in the study area.

DATA AND METHODS

The study area

The study area is Ekiti State , Nigeria. It lies between latitudes $07^0$15' and 08^0 5' north of the Equator and between longitudes 04^0 45' and 05^0 45' east of the Greenwich Meridian. Ekiti State is bounded in the north by Kwara State, in the north east by Kogi State, in the west by Osun State and in the south and south east by Ondo State (Fig 1) Ekiti State has sixteen Local Government Areas (Fig 2).

The land form (relief) of Ekiti State is most gently undulating landscape rock outcrops, that is, it is referred to as Western upland of Nigeria. This major landform in Ekiti land oftentimes serve as a determinant factor for its use whether for economic activities such as forest exploitation or agriculture (Adegboyega,2014). Ekiti State enjoys the humid tropical climate of distinct wet and dry seasons. The seasons are determined by the movement of the Inter-Tropical Discontinuity (ITD). The wet season spreads between April and October with the tropical maritime (mT) air mass originating from the Atlantic Ocean. The dry season spread between November and March with the Tropical Continental (cT) air mass originating from the Sahara desert. The temperature ranges from 26^0C to 30^0c with the annual temperature of 27^0C owing to the climate change experienced in the recent time.

The vegetation of Ekiti State is classified into two viz: the north and the south vegetation with its spatial

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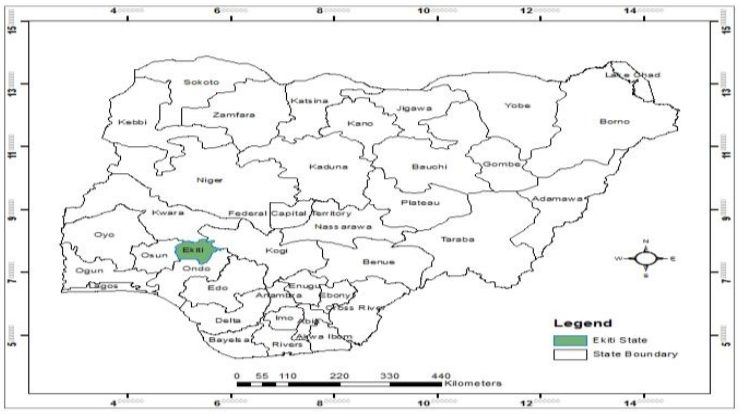
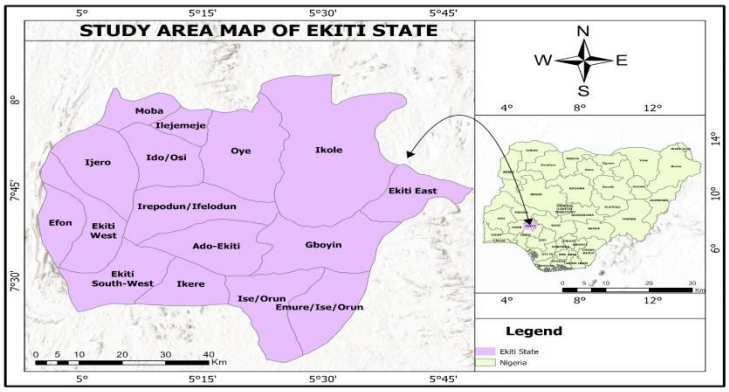
distribution that varies with fascinating scenery. The south falls in to the tropical low land rainforest zone of Nigeria and it is characterized by the assemblage of plant physiognomy The north vegetation is Guinea-savannah woodland that forms fairly close canopies with grasses like Ghamba grass species such as *Andropogon spp. and Hyparriheria spp,* The tree species include locus bean and shear butter trees (Adebayo, 2004)

Fig.1. Map of Nigeria showing Ekiti State.



Source: Office of the Surveyor-General, Ekiti State,2024.

Fig.2: Map of Ekiti State showing the 16 LGA



Source: ArcGIS PRO, 2024

Data Collection

The data used for the study is secondary source using Landsat satellite imagery obtained from United State Geological Survey (USGS) Earth explorer covering three epochs (2003, 2013, and 2023) for the Land Use Land Cover (LULC) analysis for Ekiti State, Nigeria. The approach includes data collection, and preprocessing that is, remote sensing integrated into GIS. This was geo-referenced to World Geodetic Survey (WGS) 84 on Clarke, 1880.

This methodology provides a systematic approach for analyzing the Land Use Land Cover changes in Ekiti State, Nigeria, over an interval of 10-year period. The use of satellite imagery, supervised classification, and post-classification change detection allows for an accurate assessment of the spatial and temporal dynamics of land cover changes in the study area.

Data Analysis

Land Cover Classification

The acquired satellite images were preprocessed to ensure they were suitable for the analysis. The

preprocessing steps included: **Geometric Correction**: Ensuring that the satellite images are correctly aligned with the Earth's surface, **Radiometric Correction**: Adjusting for sensor errors and atmospheric conditions to improve the accuracy of pixel values, **Sub setting**: Cropping the images to cover only the boundaries of Ekiti State, **Cloud Removal**: this was necessitated, using cloud masking techniques to remove areas of cloud cover from the imagery to have perfect map of the study area.

Supervised classification was used to categorize the land cover types within the study area for the years 2003, 2013, and 2023. The classification was based on the following LULC classes: Developed/Built-up area, Forest land, Bare land, Water bodies.

The image got were processed, classified using USGS Earth explorer and ARCGIS 10.8. The Shape file acquired for Ekiti State was in World Geodetic Survey(WGS84) and downloaded from the GIS laboratory. The shape file acquired were in WGS 84 coordinate system by selecting Nigeria as a country and Ekiti State as administrative level 1.Cloud Masking technique was used to extract Landsat Imagery of the study area by overlaying the shape file of the study area and each of the scene was finally clipped out to form a new raster layer that perfectly depicted the study area while other parts of the image were removed to have a perfect study area map. To assess the changes in LULC over the 10 years (2003, 2013, and 2023), satellite imagery from the Landsat missions was acquired, **2003**: Landsat 7 Enhanced Thematic Mapper Plus (ETM+), **2013**: Landsat 7 Enhanced Thematic Mapper Plus (ETM+), **2023**: Landsat 8 OLI and TIRS.

The image was clipped out before processing files that was eventually used for maximum likelihood classification in ARCGIS 10.8 software. Bands of different colors 5-4-3-2-1 were combined before processing out the final map. EMV 5.3 was used for land use and land cover LULC classification accuracy assessment to classify image of each year i.e the three epochs, 2003, 2013 and 2023 to another data source for accuracy. The accuracy assessment enables us to understand how accurate the product is in the real world. With overall accuracy test carried out good result was obtained.

RESULTS AND DISCUSSION

Results

The result of the study were presented in maps and tables to identify the change detection (change extent and the rate of changes) at different epochs. The positive (+) sign indicates increase while the negative (-) sign indicates decrease in the changes considering the classification of the classes according to Anderson, 1976 and USGS Land Use and Land Cover Maps Ekiti State, Southwestern Nigeria. Ekiti State boundary was obtained from Nigeria's administrative boundary layers shapefiles. In other to assess the changes in Land Use and Land Cover (LULC) over the 10 year

Table 1: Satellite Images of 2023, 2013, and 2003 Characteristics. (USGS: 2023, 2013 and 2003).

S/N	Date	Source	Satellite Type	Sensor	Path/Row	Band	Resolution
1	O3/01/2003	USGS	Landsat 7	Enhanced Thematic Mapper Plus (ETM+)	190/053	1-5	30m
2	01/01/2013	USGS	Landsat 7	Enhanced Thematic Mapper Plus (ETM+)	190/053	1-5	30m
3	23/01/2023	USGS	Landsat 8	OLI and TIRS (C2 L2)	190/053	1-5	30m

Source: Author’s field work, 2023

interval (2003, 2013, and 2023), satellite imagery from the Landsat missions was acquired, **2003**: Landsat 7 Enhanced Thematic Mapper Plus (ETM+), **2013**: Landsat 7 Enhanced Thematic Mapper Plus (ETM+), **2023**: Landsat 8 OLI and TIRS.

The United States Geological Survey (USGS) Earth Explorer platform obtained the images. Each dataset was selected for the same season (preferably dry season) to minimize the effects of seasonal variation on land cover.

Discussion

The results of the classified LULC maps and change detection were analyzed using spatial and statistical techniques. The analysis was carried out using the tool ArcGIS Pro for spatial analysis, mapping, and overlay operations. The discussion of the result based more on impact of built-up areas on the agricultural land and forestland in the study area owing to the anthropogenic activities that pave way for physical development to satisfy the interest of the teeming population. Yet, the negative impact affect food production in the area as many of the arable agricultural land were no longer available for commoners and subsistent farmers to use, thus, affecting the hike in price of food stuffs and raw materials .For instance, the price of a bag of local rice sold for twenty thousand naira before in the market ,is doubled the price now thus, making it unbearable for the common man and consequently making the peasant farmers poorer and poorer.

- **Statistical Analysis**: Descriptive statistics were used to quantify the changes in LULC classes. Trends and patterns in land cover change were analyzed to identify major drivers of change, such as urbanization, deforestation, and agricultural expansion.

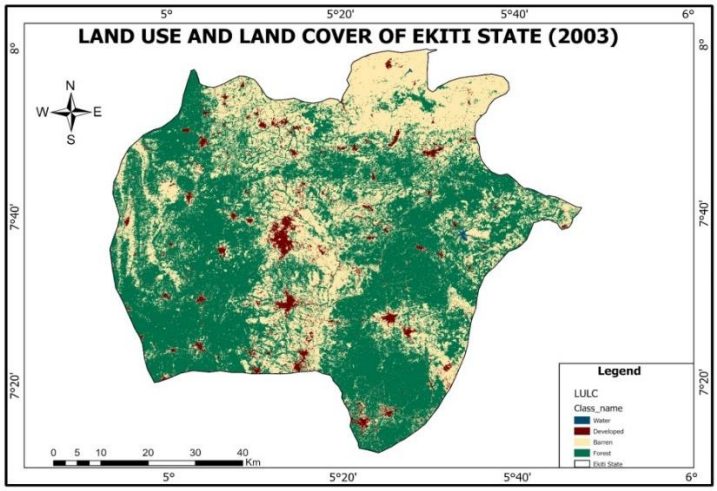
Table 2: The Land Use /Land Cover Statistics of 2023, 2013and 2003.

Land Cover	Area(km^2) 2023	Percentage (%) 2023	Area(km^2) 2013	Percentage (%) 2013	Area(km^2) 2003	Percentage (%) 2003
Developed/ Built-up	539.9149	10.30	1902.048	7.03	185.9386	3.5
Forest/ Vegetation	2941.865	56.13	365.7159	57.75	3031.817	57.86
Bare Land	1726.891	32.9	3003.106	36.6	2016.864	38.49
Water Bodies	32.06073	0.61	28.54124	0.54	4.828204	0.09
TOTAL	**5,240.7 km^2**	**100%**	**5,199.7 km^2**	**100%**	**5,239.4 km^2**	**100%**

Source: Author's field work, 2023

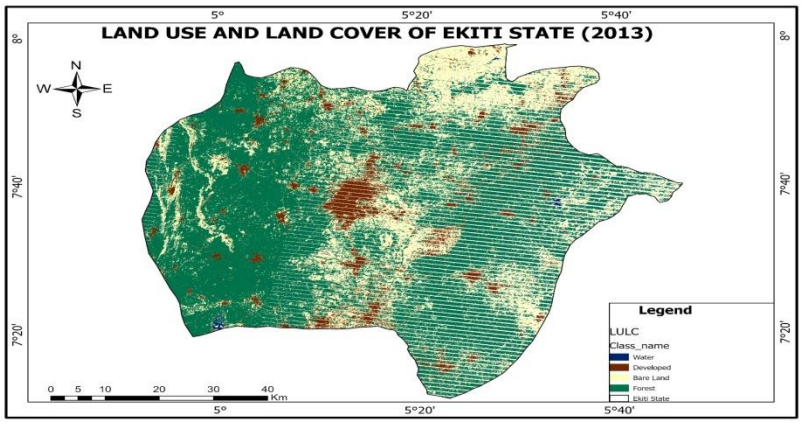
The satellite images for the three-time periods are presented in Figures 1, 2, 3 and fig.4.

Figure 1: LULC of 2003



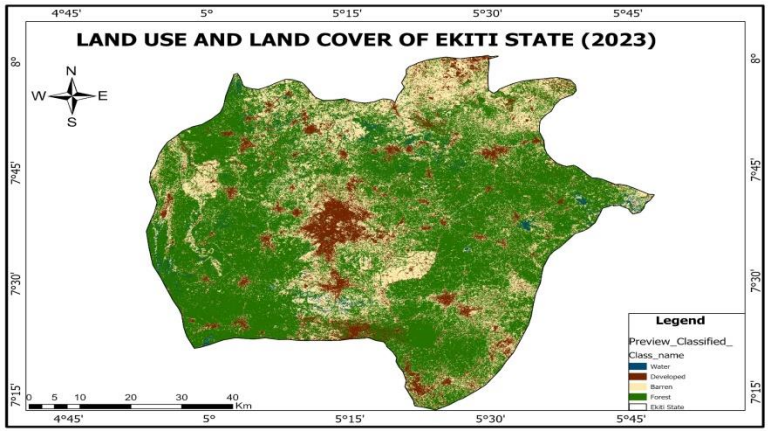
Source: Image Analysis of Landsat Satellite Imagery, 2023

Figure 2: LULC of 2013



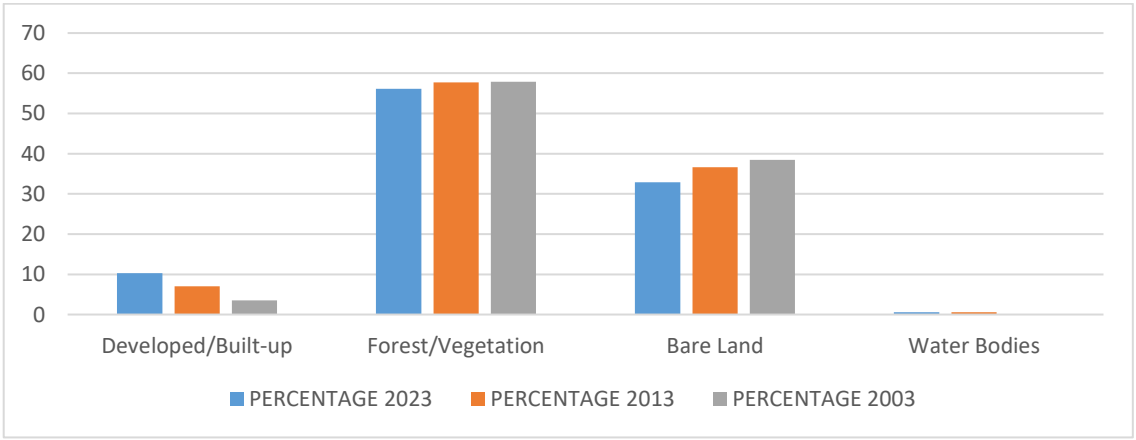
Source: Image Analysis of Landsat Satellite Imagery, 2023

Figure 3: LULC of 2023



Source: Image Analysis of Landsat Satellite Imagery, 2023

Fig 4. Barchart showing the percentage difference for the different epochs



Source: Author's field work, 2023

CONCLUSION AND RECOMMENDATIONS

Conclusion

In general, the study illustrated the potentials of geospatial techniques for understanding the threat of urban expansion evolved greatly over time and space in the continual expansion of Built Up area (BU) on

agricultural land as a result of change detection in Land Use and Land Cover of Ekiti State. The creation of the State in 1996 had remarkable effect on the growth of Built Up area (BU), hence the utilisation of Forest Land (FL) and Range Land (RL) and Agricultural Land (AL) for developments. It is remarkable that Built Up area (BU) increased from 2003(3.5%) to 2023(10.3%) which is by 6.8% ; this implies that as more physical developments take place through founding of schools, LG Secretariats and other infrastructures in the state as witnessed in the last few decades, such development threatens lands that could be used for planting arable crops that are converted to another use. This eventually have negative impact on food production as discussed.

And for food security to take proper shape in Nigeria, bearing in mind that Ekiti State, the study area, is an agrarian community, what happened in other parts of the country must be emplaced. For instance, in support of the Nigerian Government's commitment to increasing food supply, the National Space Research and Development Agency (NASRDA) carried out a project to develop a Fadama (wetland) Land Information Management System (FLIMS) in collaboration with the Satellite Application Centre of South Africa with the aim of assisting in the enhancement of Fadama based rice cultivation. Using NigeriaSat-1 images, the result of the project shows that about 3 million Hectares of Fadama land is available for rice production in Nigeria , thus contributing significantly to food security in the country(Kufoniyi,2022).

Recommendations

The geospatial techniques used (Remote Sensing integrated into Geographic Information System) in this study was used in data collection, data analysis and land use modelling for monitoring land use changes in Ekiti State in view of the fact that change is a continuous process. The followings are thus recommended:

1. Now that Ekiti State is establishing Geospatial Data Centre (EKGIS), it is a welcome development in the state and as such the state government should map out all the Local Government areas of the state to give room for proper charting to monitor the sixteen Local Government areas of the state as in this study. The data and maps should be updated from time to time to improve land use planning in the state.

2. The application/ use of remote sensing in the study would help to confirm and verify land farm viability of over 20,000 hectares of farmland and verified land fallowness by checking for cultivation of land for up to 3 previous seasons in each LGA, consequently the identified suitable land for organic farming would be achieved and be cost -effective for the citizens.

3. The State Government should encourage in agriculture by providing land for farm settlements, seeing to the food security challenges by finding lasting solutions to farmers and herders conflict as well as providing farm inputs and financial support to farmers.

4. Urban agriculture should be encouraged and practised in our urban areas with no bush left unused(fallow) for farming activities to avert food insecurity in the state and in Nigeria at large.

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