SPC Journal of Social Sciences, 5 (1) (2024) 1-9

SPC Journal of Social Sciences

Website: www.sciencepubco.com/index.php/JSC

Research paper

Analysis of Urban Expansion and Land Use and Land Cover Dynamics of Ado-Ekiti Local Government of Ekiti State, Nigeria

Idowu Adewale Ogunlade [1]*; Abiodun Johnson Olatunji [1]; Emmanuel Rotimi Adegboyega [1]; Abiodun Reinhard Oni [1]

[1]Department of Geography and Planning Science, Ekiti State University, Ado-Ekiti, Nigeria
**Corresponding author E-mail:idowuogunlade@gmail.com*

Abstract

This study examined the pattern of Land Use and Land Cover Change (LULCC) in Ado-Ekiti being the only town and headquarters of Ado-Ekiti Local Government as well as the capital of Ekiti State, Nigeria for thirty-six years between 1985 and 2021 using Remote Sensing and Geographical Information System techniques covering four epochs. Seven Land Use and Land Cover (LULC) classes including Agricultural Land (AL), Barren Land (BL), Built Up Area (BU), Forest Land (FL), Range Land (RL), Water Body (WB) and Wet Land (WL) were identified in Ado-Ekiti Local Government based on USGS/Anderson's classification model. Landsat 5 TM, Landsat 7 ETM+ and Landsat 8 OLI and TIRS images were acquired for the supervised digital image classification using Arc GIS 10.8, ENVI 8.3 and DIVA GIS software. The results obtained showed that between1985 to 2021 Built Up Area (BU) increased by about 80.98%, that is, by about five times. There was decline in Forest Land (FL), Water Body (WB) and Wet Land (WL) but increase in Agricultural Land (AL), Barren Land (BL) and Range Land (RL). After the presentation of the results, recommendations were made on the need for continuous collection, analysis, interpretation and updating of data in the study area to monitor developments in order to aid quick response in decision making by appropriate authorities.

Keywords: *Geographic Information System (GIS); Land Satellite (Landsat); Land Use Land Cover Change (LULCC); Remote Sensing (RS); United States Geological Survey (USGS).*

1. Introduction

As a result of competition for survival, man has been forced to leave the countryside for the cities, which has led to a rise in urbanisation, a consequent shortage of available dwellings and a quick development of existing cities (Desai, Patil, Mahale and Umrikar, 2009). The LULCC is an ecological phenomenon that has both local and global implications (Agarwal, Green, Grove, Evan and Schweik, 2002). Globally and over a long period, nearly 1.2 million km^2 of forest and woodland and 5.6 million km^2 of grassland and pasture have been converted to other uses during the last three centuries (Ramankutty and Foley,1999). Humans have transformed significant portion of the Earth's land surface: 10% to 15% currently is dominated by agricultural row crops or urban-industrial areas, and 6% to 8% is pasture (Vitousek, Mooney, Lubchenco and Melillo, 1997).

Turner II and Meyer (1994) remarks that during the last 300 years, the scales, rates and kinds of environmental change have been very significant as humanity has passed through era of rapid population growth and the development of fossil fuel-based industrial society. Bernstein (1994) agrees that with increase in population in a place, industrial development come up which in turn exert pressure on the surrounding ecosystem.

Due to intense demographic pressure, land is becoming more valuable and scarce. Humans have been transforming the landscape for thousands of years in pursuit of food and other necessities (Zubair, 2006). The greatest regional human disruption to the environment in the 20th century was the alteration of LULC, which has become a worldwide phenomenon (Ademiluyi, Okude and Akanni, 2008). Food and water security for the expanding population as well as concerns arising from climate change are essential for achieving equitable growth and development across a wide range of fields and industries (Ramakrishna, 1998).

The pace of urbanisation is dependent on the complexity of the interaction among the driving factors like population/income, technology, politics/society/economics/culture (Geist and Lambin, 2002).

Comparatively, the situation in developing economies appears to be population driven whereas in developed economies the driving force of change is a complex mix of all factors with technology at the core (Lambin, Turner II, Geist, Agboola, Angelsen, Bruce, Coomes, Dirzo, Fischer, Folke, George, Homewood, Imbernon, Leemans, Li, Moran, Mortimore, Ramakrishna, Richards, Skanes, Steffen, Stone, Svedin, Veldkamp, Vogel, and Xu, 2001; Ujoh, Kwabe and Ifatimehin, 2010).

On the consequences of LULCC, several researchers have focused on LULC studies because of their adverse effects on ecology of the area and vegetation (Martinuzzi, Gould and Gonzalez, 2007; Sudhira, Ramachandra and Jagadish, 2004).

Several researches have shown that unplanned changes in land use due to urbanisation have become a major problem (Balogun, Adeyewa, Balogun and Morakinyo, 2011). LULCC is a major source of habitat loss, ecosystem alteration and biodiversity change in forest dominated landscapes.

Since the creation of Ekiti State in 1996, Ado-Ekiti as the state capital has undergone population growth, city expansion and other developmental activities, all of which have resulted in land cover modification. The rising demographic pressure and the human activities that go along with it, which have caused severe environmental stress and ecological instability, have made it necessary to pay more attention to the management in recent years.

The natural and socio-economic factors that affect LULC in the Local Government need a thorough examination of the causes, mode and pace. Therefore, the main aim of this study is to analyse the status of LULC of Ado-Ekiti Local Government between 1985 and 2021, with a view to see the changes that have taken place over thirty six years period, using Remote Sensing and GIS techniques.

The specific objectives include to: identify the various Land Use and Land Cover types; determine the location, pattern and trend of land use and land cover types; explain the cause of the pattern observed and make appropriate recommendations.

The study classification is based on the United States Geological Surveys /Anderson's Land Use and Land Cover Classification System for use with Remote Sensor Data Scheme at Level I.

2. Study area and data description

2.1. The study area

The study area is Ado-Ekiti Local Government of Ekiti State made up of only one town, Ado-Ekiti but many farm settlements such as Odo, Igirigiri, Ago Ologunja, Kajola, Ategbado, Aso Ayegunle, Ago Araromi, Bolorunduro, Ilokun/Irasa, Aba Igbira, Aba Fulani, Itanla/Housing Estate, Oke Aso, Olokemeji, Ilamuo, Ago Aduloju, Igimo-Kogo, Ago-Aso, Emirin, Erifun,Temidire, Esunmo, Ureje and so on . The Local Government is located between latitudes 7°35' and 7°47' North of the equator and longitudes 5°11' and 5°16' East of the Greenwich meridian. It has a total land area of about 32,212 hectares and it is bounded in the North and West by Irepodun/ Ifelodun Local Government Area and East and South by Aiyekire, Ikere and Ekiti South West Local Government Areas of Ekiti State (Government of Ekiti State Website, 2023).

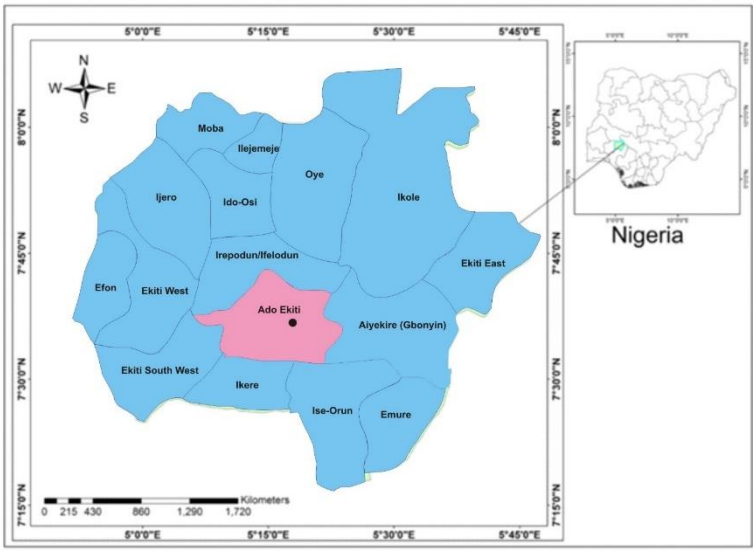

Fig. 1: Map of Ekiti State, Nigeria Showing the Location of Ado-Ekiti Local Government Area. Source: Image Analysis of Landsat Satellite Imagery, 2024.

2.2. Climate, vegetation and geomorphology

Ado-Ekiti Local Government is in the humid equatorial rain forest zone as presented in Koppen-Geiger Climate classification, based on seasonal precipitation and temperature (Kottek, Grieser, Beck, Rudolf and Rubel, 2006). The study area is mainly an upland zone, rising over 250 meters above the mean sea level .The average rainfall is about 1,334 mm with double maxima rainfall with a mid-year break in August and with a mean temperature of 27°C. It is generally an undulating part of the country with a characteristic landscape that consists of old plains broken by steep-sided out-crops that may occur singularly, in groups or ridges (Wikipedia, 2019).

2.3. Data description

Table.1: Data Types, Sources and Characteristics

S/N	Sensor/Data Type	Capture Date	Spatial Resolution/Scale	Spectral Resolution
1.	Landsat 5 Thematic Map (TM)	11/12/1984	30m	7 Bands
2.	Landsat 7 Enhanced Thematic Map Plus (ETM+)	13/11/2000	30m	8 Bands
3	Landsat-8OLI and TIRS	17/12/2015	30m	11Bands
4	Landsat-8OLI and TIRS	12/11/2020	30m	11Bands

Source: USGS Earth Resources Observation and Science Center, 2024; Field Survey, 2024.

3. Research methodology

3.1. Introduction

The data used in the study included only secondary data. This is because the downloaded Landsat satellite images obtained directly from the USGS Earth Explorer Website (https://landsat.usgs.gov/) were already geo-referenced to WGS 84 (World Geodetic System 84) Geographic Coordinate Reference System standard.
Landsat Images covering 4 periods and spanning 36 years were acquired for analysis. The choice of images included cloud-free analysable ones with minimal scanlines acquired during fairly dry months of November and December. The cloud cover was further corrected with toolbox Arc Map 10.8. Images obtained were more or less captured at the same time of the year because of seasonal variability.
The study period covered the pre-existence and strategic existence of Ado-Ekiti as capital city of Ekiti State which was created in October 1996. Three different optical sensors Landsat-5 Thematic Map (TM), Landsat-7 Enhanced Thematic Map Plus (ETM+) and Landsat-8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) images was employed for four period 1985, 2000, 2015 and 2021.

3.2. Image processing and classification

The software and website utilised in the processing and classification of the images using 4 periods included: DIVA GIS World Data; USGS Earth Explorer Website; Arc GIS 10.8; Envi 5.3.
DIVA GIS World Data: Shapefile for Ado-Ekiti Local Government Area (LGA) was downloaded from the GIS lab. The shapefile acquired from the platform was in WGS 84 coordinate system. The download was done by selecting Nigeria as the country and then the administrative area at level one being Ekiti State. Ado-Ekiti LGA was thereafter selected for level two
To extract the Landsat image of the study area, a process known as masking under extraction was used, which involved overlaying the shapefile of the study area on each of the scenes and finally clipping out 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. The clipping method in Arc Map 10.8 was used to clip out the study area from the satellite image before processing.
USGS Earth Explorer website accessed through Google: It involved logging in to register and create an account with user name and password to download Landsat 5 TM, 7 ETM+ and 8 OLI and TIRS images .The downloaded Landsat images were already georeferenced to WGS 84 coordinate system. Landsat 5 TM, 7 ETM+ and 8 OLI and TIRS data are multi-spectral with seven or more different colour bands but only seven of the bands were used in the study.
Arc GIS 10.8: Supervised classification as opposed to unsupervised was used for image classification in the study. Twenty-five training samples were picked for each LULC category to create a signature file that was eventually used for maximum likelihood classification in Arc map 10.8.
It is important to note that 5-4-3 band combination was selected for RGB colour composite Landsat 8 and 4-3-2 band combination was selected for RGB colour composite Landsat 5 and 7 in the software for the processing until the final map was ready.
Envi 5.3: This was employed for the Land Use and Land Cover classification accuracy assessment (confusion matrix) by comparing classified image of each LULC in 1985, 2000, 2015 and 2021 to another data source considered accurate. Accuracy assessment helps to understand how accurately the maps match the values of the real world. Various algorithms' accuracy were evaluated using metrics obtained from an error matrix but Overall Accuracy (OA) was the emphasis here. OA= Total number of samples correctly classified divided by the total number of samples considered for the accuracy assessment expressed in percentages. OA = Tnscc/Tnscaa * 100.

4. Discussion of results and accuracy

4.1. Introduction

The analysis involves the presentation of data collected in figures and tables. LULC types were analysed, mapped and presented in the form of maps and tables. Three different satellite images acquired in 1985, 2000, 2015 and 2021 within the same season of the year were classified to see the LULCC over the years.
The results of the study of the Land Use and Land Cover Change of Ado-Ekiti Local Government from 1985 to 2021 were presented in maps and tables to: identify the various Land Use and Land Cover types; determine the location, pattern and trend of LULCC; explain the cause of pattern observed and make appropriate recommendations.
The seven main categories of LULC discovered in the analysis included Agricultural Land (AL), Barren Land (BL), Built Up Areas (BU), Forest Land (FL), Range Land (RL), Water Body (WB) and Wet Land (WL).
Each category is represented by a different colour based on USGS/Anderson classification system.

4.2. Discussion of results

Discussion of the results focuses more on the Built Up Area (BU), Agricultural Land (AL) and Forest Land (FL). This is due to the fact that they seemed to be the most significant imprint of anthropogenic activities in the study area.

Table 2: Land Use and Land Cover Area Statistics for Ado-Ekiti Local Government from 1985 to 2021

	1985		2000		2015		2021	
LULC	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
Agricutural Land (AL)	3,324	10.32	5,994	18.61	5,868	18.22	4,686	14.55
Barren Land(BL)	3,807	11.82	2,476	7.69	4,758	14.77	4,000	12.42
Built Up Area(BU)	952	2.96	1,077	3.34	3,454	10.72	5,006	15.54
Forest Land(FL)	8,179	25.39	6,969	21.63	5,804	18.02	5,187	16.10
Range Land(RL)	10,227	31.75	8,878	27.56	3,578	11.11	10,307	32.00
Water Body(WB)	31	0.09	18	0.06	17	0.05	16	0.05
Wet Land(WL)	5,692	18.29	6,799	21.11	8,731	27.10	3,007	9.33
Total	32,212	100	32,212	100.00	32,212	100.00	32,212	100.00

Source: Image Analysis of Landsat Satellite Imagery, 2024.

Table 3: Land Use and Land Cover Change Statistics for Ado-Ekiti Local Government from 1985 to 2021

	1985-2000			2000-2015			2015-2021		
LULC	Ca in Ha	Ce (%)	Cr (%)	Ca in Ha	Ce (%)	Cr (%)	Ca in Ha	Ce (%)	Cr (%)
Agricutural Land (AL)	+2,670	+80.32	+5.02	-126	-2.10	-0.13	-1,182	-20.14	-2.87
Barren Land(BL)	-1,334	-35.04	-2.19	+2,282	+92.16	+5.76	-758	-15.93	-2.27
Built Up Area(BU)	+125	+13.13	+0.82	+2,377	+220.7	+13.79	+1,552	+44.95	+6.41
Forest Land(FL)	-1,210	-14.80	-0.93	-1,165	-16.71	-1.04	-617	-10.63	-1.52
Range Land(RL)	-1,349	-13.19	-0.82	-5,300	-59.70	-3.73	+6,729	+188.06	+26.86
Water Body (WB)	-13	-41.93	-2.62	-1	-5.55	-0.35	-1	-5.88	-0.84
Wet Land(WL)	+1,107	+19.45	+7.46	+1,932	+28.41	+1.77	-5,724	-65.56	-9.36

Source: Image Analysis of Landsat Satellite Imagery, 2024

Where Ca is Change Area
Ce is Change Extent
Cr is Change Rate
Ha is Hectares

In discussing results, the percentage increase of Land Use and Land Cover type of the Local Government Areas was indicated with a plus sign (+) while percentage decrease was indicated with a minus sign (-). Please see table 3
Aside percentages and area in hectares, the Change Rate (Cr) is also discussed. The Cr measures the average rate of Land Use and Land Cover Change by type, per year within a given period: 1985 to 2000, 2000 to 2015 and 2015 to 2021.
Built Up Area (BU):
For the 36 years studied, Built Up Area (BU) increased by about 80.98%, that is, about five times from 2.96% (952 Ha) in 1985 to 15.54% (5,006 Ha) in 2021(Table 2)
BU had positive change though the 4 epochs from 2.96% (952 Ha) in 1985 to 3.34% (1,077 Ha) in 2000, to 10.72% (3,453 Ha) in 2015 and to 15.54% (5,006 Ha) in 2021.
Built Up Area (BU) increased by average of +0.82 % per year between 1985 to 2000 but increased by average of +13.79% between 2000 and 2015, only to reduce to average growth rate of +6.41% between 2015 and 2021(Please see Cr in Table 3)
The growth rate of BU in Ado-Ekiti Local Government Area was fastest between 2000 and 2015 when change rate (growth rate) peaked at +13.79%. This was as a result of immediate need for expansion due to Ekiti State creation as well as siting of the State capital in Ado-Ekiti from October 1996.
Agricultural Land (AL):
For the 36 year period between 1985 and 2021, Agricultural Land (AL) increased marginally from 10.32% (3,324 Ha) in 1985 to 14.55 % (4,686 Ha) in 2021. The AL expansion especially at the several farm settlements within the Local Government was to meet the food supply to the increased population.
Agricultural Land (AL) in area statistics increased from 10.32% (3,324 Ha) in 1985 to 18.61% (5,994 Ha) in 2000, but reduced to 18.22% (5,868 Ha) in 2015 and a further reduction to 14.55 % (4,686 Ha) in 2021 (Table 2)
From the average annual change rate point of view, Agricultural Land (AL) reduced from +5.02% growth rate between 1985 and 2000 to -0.13% between 2000 and 2015 and even further down to -2.87 % between 2015 and 2021.
The growth rate of AL in Ado-Ekiti Local Government Area was fastest between 1985 and 2000 when change rate (growth rate) peaked at +5.02%.
Forest Land (FL):
For the 36 year period between 1985 and 2021, Forest Land (FL) decreased from 25.39% (8.179 Ha) in 1985 to 16.10% (5,187 Ha).
Forest Land (FL) in area statistics showed continuous reduction from 25.39% (8.179 Ha) to 21.63% (6,969 Ha) to 18.02% (5,804 Ha) to 16.10% (5,187 Ha) from 1985 to 2000 to 2015 and to 2021 respectively (Table 2)
From the average annual change rate point of view, Forest Land (FL) changed at an increasing decline from -0.93 % between 1985 and 2000 to -1.04% between 2000 and 2015 and even further down to -1.57 % between 2015 and 2021.The continuous decrease in FL due to increased population over the study period was to give way specifically for expansion of BU and AL in order to meet the housing and food supply.

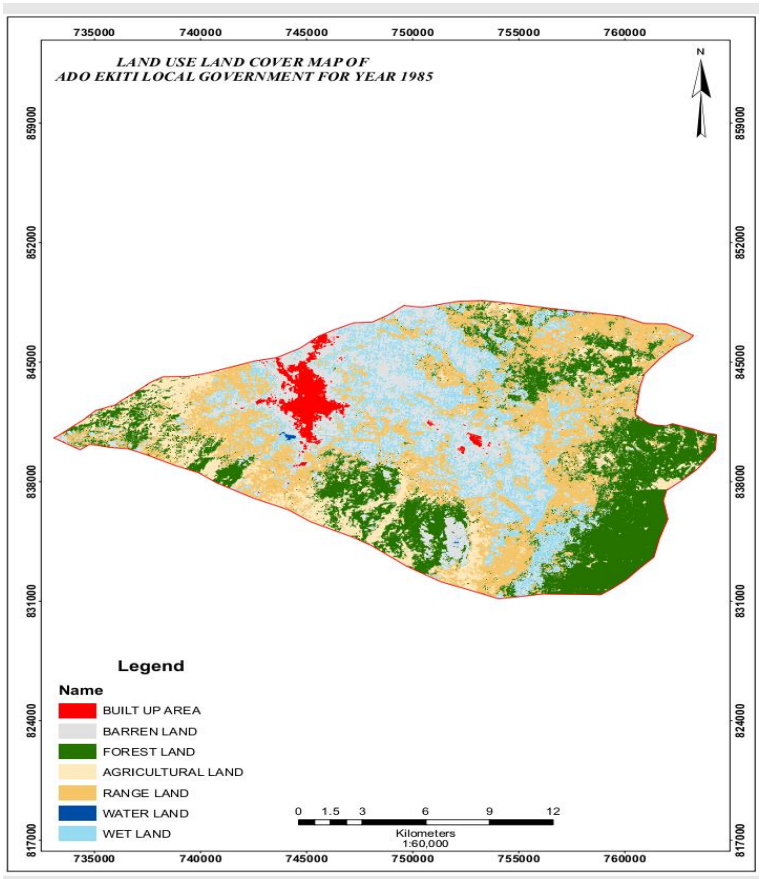

Fig.2: Land Use and Land Cover Map of Ado-Ekiti Local Government for Year 1985. Source: Image Analysis of Landsat Satellite Imagery, 2024.

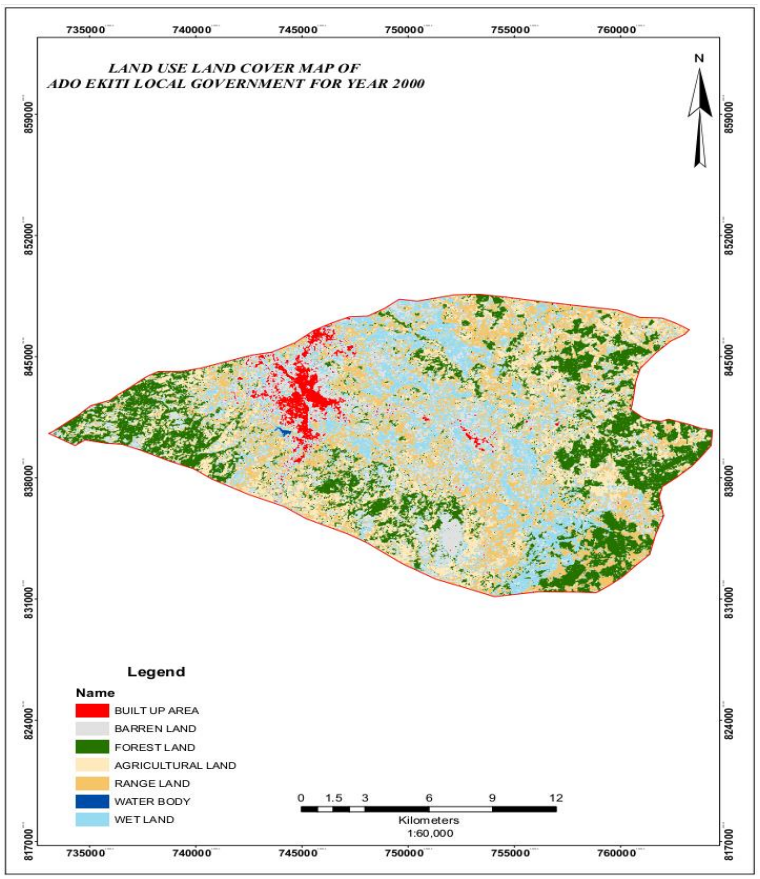

Fig. 3: Land Use and Land Cover Map of Ado-Ekiti Local Government for Year 2000. Source: Image Analysis of Landsat Satellite Imagery, 2024.

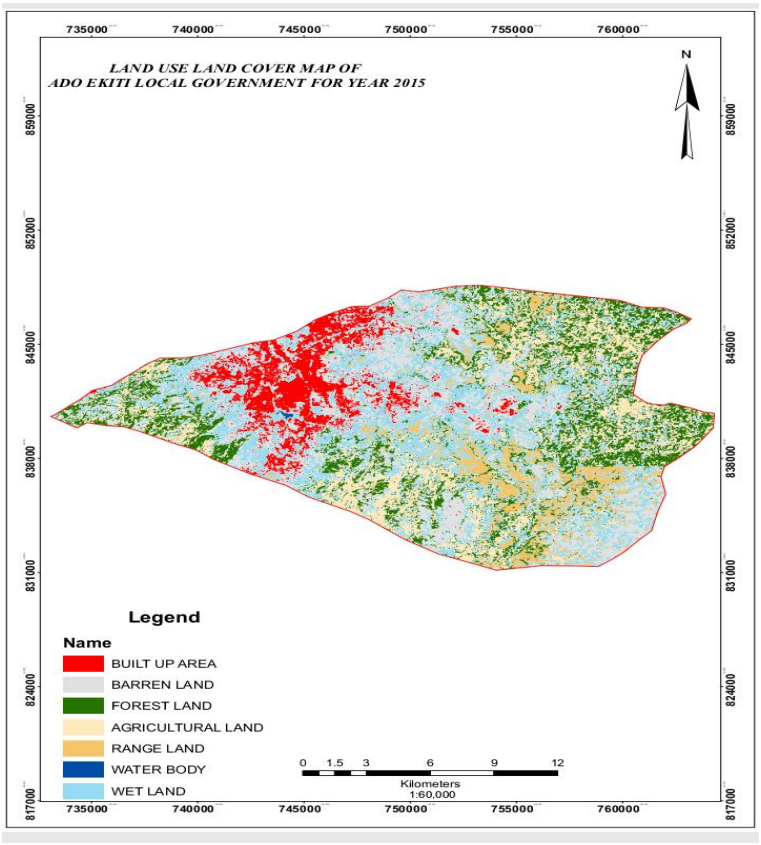

Fig. 4: Land Use and Land Cover Map of Ado-Ekiti Local Government for Year 2015. Source: Image Analysis of Landsat Satellite Imagery, 2024.

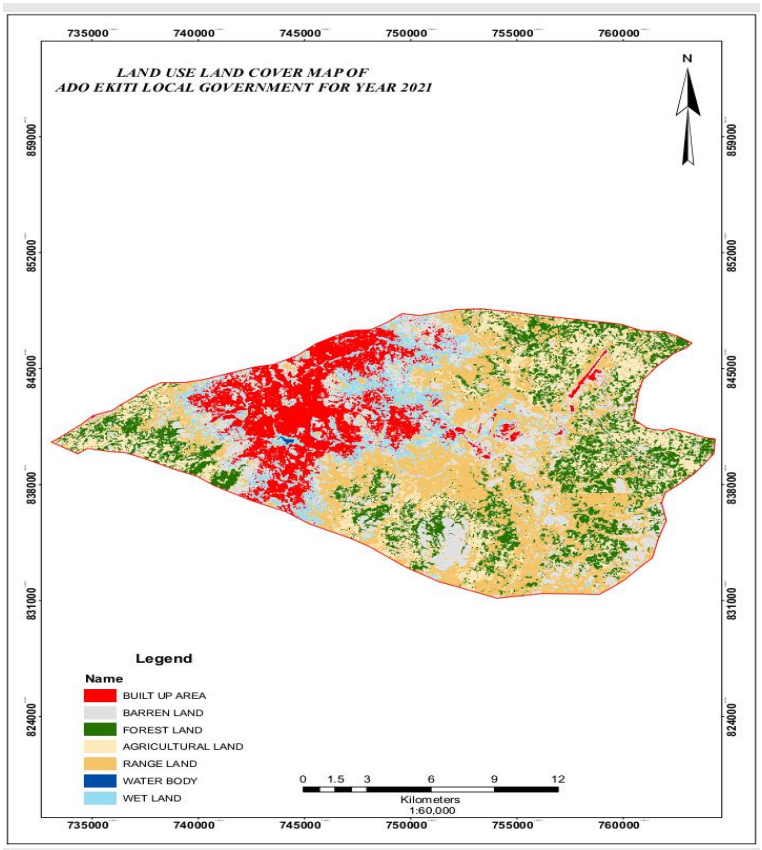

Fig. 5: Land Use and Land Cover Map of Ado-Ekiti Local Government for Year 2021. Source: Image Analysis of Landsat Satellite Imagery, 2024.

4.3. Confusion matrix

A confusion matrix (or error matrix) is usually used as the quantitative method of characterising image classification accuracy. It is a table that shows correspondence between the classification result and a reference image. Foody (2002) recommended an 85% target for user's, producer's, and overall accuracies derived from the error matrix. The results of this confusion matrix showed a range from 86% to

96% which means that the image classification was accurately done. Please find below the confusion matrix of the Local Government Area for the 4 periods:

Table 4: Ado-Ekiti Local Government Confusion Matrix Accuracy for Year 1985

OBJECT ID	CLASS VALUE	PREDICT	(BU)	(AL)	(RL)	(FL)	(WB)	(WL)	(BL)	GROUND TRUTH
1	1	BUILT UP AREA (BU)	21	0	0	0	0	0	0	21
2	61	AGRICULTURAL LAND (AL)	0	20	1	0	0	0	0	21
3	115	RANGE LAND (RL)	0	0	17	0	0	3	0	20
4	154	FOREST LAND (FL)	0	0	0	20	0	0	0	20
5	229	WATER BODY (WB)	0	0	0	0	17	0	0	17
6	243	WET LAND (WL)	0	0	2	0	1	12	7	22
7	269	BARREN LAND (BL)	0	0	0	0	1	5	13	19
		TOTAL	21	20	20	20	19	20	20	140
	ACCURACY IS 86%	120	86							

Source: Author's Field Survey and Analysis, 2024.

Table 5: Ado-Ekiti Local Government Confusion Matrix Accuracy for Year 2000

OBJECT ID	CLASS VALUE	PREDICT	(BU)	(AL)	(RL)	(FL)	(WB)	(WL)	(BL)	GROUND TRUTH
1	1	BUILT UP AREA (BU)	20	0	0	0	0	2	0	22
2	132	AGRICULTURAL LAND (AL)	0	16	0	0	0	0	0	16
3	209	RANGE LAND (RL)	0	3	18	0	0	2	1	24
4	286	FOREST LAND (FL)	0	1	0	20	0	0	0	21
5	336	WATER BODY (WB)	0	0	0	0	19	0	0	19
6	355	WET LAND (WL)	0	0	2	0	1	16	1	20
7	385	BARREN LAND (BL)	1	0	0	0	0	0	18	18
		TOTAL	20	20	20	20	20	20	20	140
	ACCURACY IS 91%	127	91							

Source: Author's Field Survey and Analysis, 2024.

Table 6: Ado-Ekiti Local Government Confusion Matrix Accuracy for Year 2015

OBJECT ID	CLASS VALUE	PREDICT	(BU)	(AL)	(RL)	(FL)	(WB)	(WL)	(BL)	GROUND TRUTH
1	1	BUILT UP AREA (BU)	20	0	0	0	0	0	0	20
2	84	AGRICULTURAL LAND (AL)	0	20	0	0	0	0	0	20
3	185	RANGE LAND (RL)	0	0	20	0	0	2	0	22
4	233	FOREST LAND (FL)	0	0	0	19	0	0	0	19
5	276	WATER BODY (WB)	0	0	0	0	19	0	0	19
6	295	WET LAND (WL)	0	0	0	0	1	18	1	20
7	335	BARREN LAND (BL)	0	0	0	1	0	1	19	21
		TOTAL	20	20	20	20	20	21	20	141
	ACCURACY IS 96%	135	96							

Source: Author's Field Survey and Analysis, 2024.

Table 7: Ado-Ekiti Local Government Confusion Matrix Accuracy for Year 2021

OBJECT ID	CLASS VALUE	PREDICT	(BU)	(AL)	(RL)	(FL)	(WB)	(WL)	(BL)	GROUND TRUTH
1	1	BUILT UP AREA (BU)	21	0	0	0	0	0	0	21
2	61	AGRICULTURAL LAND (AL)	0	20	1	0	0	0	0	21
3	115	RANGE LAND (RL)	0	0	17	0	0	3	0	20
4	154	FOREST LAND (FL)	0	0	0	20	0	0	0	20
5	229	WATER BODY (WB)	0	0	0	0	17	0	0	17
6	243	WET LAND (WL)	0	0	2	0	1	12	7	22
7	269	BARREN LAND (BL)	0	0	0	0	1	5	13	19
		TOTAL	21	20	20	20	19	20	20	140
	ACCURACY IS 86%	120	86							

Source: Author's Field Survey and Analysis, 2024.

5.1. Recommendation

The role of RS and GIS in this study is clearly seen as important in data collection, processing, analysis, presentation and modeling in LULC. They are tools that can be used in monitoring LULCC in Ado-Ekiti Local Government in view of the fact that change is a continuous process. Specific recommendations are as presented below:

1) The recently established Ekiti State Geospatial Data Centre is a welcome development. It should commence LULCC studies in the remaining fifteen Local Government areas of the State that could not be covered in this study. The data and maps should be updated from time to time to improve land use planning by the Local Government and the State Government.
2) The State Government and the Local Government Council should endeavour to focus on the Forest Land (FL) that has been on a consistent decline over the 36 years of the study. Forest Plantation projects should be encouraged across all the farm settlements in the Local Government Area and the activities of illegal lumbering and deforestation should be discouraged.
3) The Local Government Council and the State Government should encourage agriculture in the farm settlements, seeing to the security challenges by finding lasting solutions to farmers/herders conflict as well as providing farm inputs and financial support to farmers.

5.2. Conclusion

In general, the study illustrated the potentials of RS and GIS techniques to understand the characteristics and changes in Land Use and Land Cover of Ado-Ekiti Local Government of Ekiti State.
It was clearly seen, through this study that the land use characteristics of Ado-Ekiti Local Government evolved greatly over time and space with continuous expansion of Built Up Area (BU).The creation of the State and siting of capital at Ado-Ekiti in 1996 had remarkable effect on the growth of Built Up Area (BU), hence the utilisation of Forest Land (FL), Range Land (RL) and Agricultural Land (AL) in Urban Expansion. It is remarkable that Built Up Area (BU) increased between 1985 to 2021 by 80.98%.

Acknowledgements

The authors are extremely grateful to the AFRIGIST, Ile Ife, Oyo State, Nigeria for the unquantifiable support in the course of this research work.

Competing interests

Authors have declared that no competing interests exist.

References

[1] Ademiluyi, I.A.; Okude, A. S. and Akanni, C. O. (2008). *An Appraisal of Landuse and Landcover in Nigeria*. African Journal of Agricultural Research. Vol. 3 (9): 581-586.
[2] Agarwal, C.; Green, G. M.; Grove, J. M.; Evans, T. P. and Schweik, C. M. (2002). *A Review and Assessment of Land-Use Change Models: Dynamics of Space, Time, and Human Choice*. General Technical Report NE-297. Newtown Square, Pennsylvania: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 61 pp. https://doi.org/10.2737/NE-GTR-297.
[3] Anderson, J.R.; Hardy, E.E. ; Roach, J.T. and Witmer, R.E. (1976) . A Land Use and Land Cover Classification System for Use with Remote Sensor Data: Geological Survey Professional Paper 964. *A revision of the land use classification system* as *presented in U.S. Geological Survey Circular 671*. United States Government Printing Office, Washington, 1976: 8p. https://doi.org/10.3133/pp964.
[4] Balogun, I.A.; Adeyewa, D.Z.; Balogun, A.A. and Morakinyo, T.E. (2011). Analysis of Urban Expansion and Land Use Changes in Akure, Nigeria Using RS and GIS Techniques. *Journal of Geography and Regional Planning* 4(9): 533-541.
[5] Bernstein, J.D. (1994). *Land Use Consideration in Urban Environmental Management*. World Bank Publishers. Washington D.C. 99p. https://doi.org/10.1596/0-8213-2723-2.
[6] Desai, C.G.; Patil, M.B.; Mahale, V.D. and Umrikar, B. (2009). Application of Remote Sensing and Geographic Information System to Study of Land Use / Land Cover Change. A Case Study of Pune Metropolis. *Advances in Computational Research* 1(2):10-13.
[7] Geist, H. J. and Lambin, E. F. (2002). Proximate Causes and Underlying Driving Forces of Tropical Deforestation. *Bioscienc*e, 52 (2), 143-50. https://doi.org/10.1641/0006-3568(2002)052[0143:PCAUDF]2.0.CO;2.
[8] Government of Ekiti State (2023) .Https://www.ekitistate.gov.ng/about-ekiti/local-government/ado-ekiti/
[9] Kottek, M.; Grieser, J.; Beck, C.; Rudolf, B. and Rubel, F. (2006). World Map of the Koppen –Geiger Climate Classification Updated, Borntraeger, G (Ed),*Meteorologische Zeitschrift, Berlin, Stuttgart* .Vol. 15, No. 3, 259-263. https://doi.org/10.1127/0941-2948/2006/0130.
[10] Lambin, E. F.; Turner, B. L.; Geist, H. J.; Agboola, S. B.; Angelsen, A.; Bruce, J. W.; Coomes, O. T.; Dirzo, R.; Fischer, G.; Folke, C.; George, P. S.; Homewood, K.; Imbernon, J.; Leemans, R.; Li, X.; Moran, E. F.; Mortimore, M.; Ramakrishna, P.S.; Richards, J. F.; Skanes, H.; Steffen, W.; Stone, G. D.; Svedin, U.; Veldkamp, T. A.; Vogel, C. and Xu, J. (2001). The Causes of Land Use and Land Cover Change: Moving Beyond the Myths. *Global Environmental Change*11 (4), 261-269 pp. Elsevier Science Ltd. https://doi.org/10.1016/S0959-3780(01)00007-3.
[11] Martinuzzi, S.; Gould, W.A. and Gonzalez, O.M.R. (2007). Land Development, Land Use and Urban Sprawl in Puerto Rico, Integrating Remote Sensing and Population Census Data, *Landscape and Urban Planning*, vol. 79, no. 3-4, pp.288–297.https://doi.org/10.1016/j.landurbplan.2006.02.014.
[12] Ramakrishna, P.S. (1998) .Sustainable Development, Climate Change and Tropical Rain Forest Landscape. *Climatic Change*.39:583–600. https://doi.org/10.1023/A:1005398606125.
[13] Ramankutty, N. and Foley, J.A. (1999). Estimating Historical Changes in Global Land Cover: Croplands from 1700 to 1992, *Global Biogeochemical Cycles*, 13(4), 997-1027. https://doi.org/10.1029/1999GB900046.
[14] Sudhira, H. S.; Ramachandra, T. V. and Jagadish, K. S. (2004). Urban Sprawl: Metrics, Dynamics and Modelling Using GIS, *International Journal of Applied Earth Observation and Geoinformation*, vol. 5, no. 1, pp. 29–39, 2004. https://doi.org/10.1016/j.jag.2003.08.002.
[15] Turner, B.L. II. and Meyer, B.L. (1994). *Global Land Use and Land Cover Change: An Overview in Changes in Land Use and Land Cover: A Global Perspective*,(Eds.) Meyer, W.B. and Turner, B.L.II.: Cambridge University Press. pp. 3-10.
[16] Ujoh, F.; Kwabe, I. D. and Ifatimehin, O. O. (2010) .Understanding Urban Sprawl in the Federal Capital City, Abuja: Towards Sustainable Urbanization in Nigeria. *Journal of Geography and Regional Planning* 3 (5), 106-113.
[17] Vitousek, P. M.; Mooney, H. A.; Lubchenco, J.; Melillo, J. M. (1997). Human Domination of Earth's Ecosystems. *Science*. 277(15 July): 494–499. https://doi.org/10.1126/science.277.5325.494.

[18] Wikipedia (2019). https://en.wikipedia.org/wiki/Ekiti_State.
[19] Zubair, A.O. (2006) .*Change Detection in Land Use and Land Cover Using Remote Sensing Data and GIS (A Case Study of Ilorin and its Environs in Kwara State)*, Unpublished M.Sc Thesis, Department of Geography, University of Ibadan, Nigeria. p1.