URBAN GROWTH ANALYSIS OF IKIRE TOWN, OSUN STATE, NIGERIA BETWEEN 2000 AND 2020

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ABSTRACT

The world is currently experiencing a continuous flow of development, and this development is accelerating urbanization through an evolutionary process. The current problems with urbanization are pervasive in emerging countries where development takes precedence over urban planning. This study examined the urban growth of Ikire town in Osun State, Nigeria between 2000 and 2020 with a view to monitoring its urbanization for a sustainable development. Landsat 7 ETM imageries of year 2000 and 2010 and Landsat 8 OLI/TIRS of year 2020 were the dataset used for the study. Five categories of land use and land cover (LULC) classes were adopted from the processed images. from the attribute and statistical data generated from the classification outcome that was used for post-classification comparison across the years, the extent of urban land use was ascertained. The results showed a remarkable growth in the study area between 2000 and 2020, with its areal extent increasing from 27.418 km^2 (8.9%) in 2000 to 48.500 km^2 (15.7%) in 2020 and a projection of 117.682 km^2 (38%) was estimated into the year 2060. A decreased of the vegetation land cover from 203.198km^2 (65.9%) in 2000 to 175.371km^2 (56.9%) in 2020 was witnessed as a result of this growth. And due to people's need for food and shelter, agriculture land cover grew over the years in this study. Additionally, bare land experienced a slight decline from 19.3% in 2000 to (118.0%) in 2020 which led to continuous development and urban expansion. The study concluded that the built-up area has grown in size over the past 20 years with attendant effects on the surrounding ecosystem.

Keywords: Attitude, Utilization, irrigation technologies

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1 | Introduction

In the modern world, there is a constant flow of development, and this growth in development is a dynamic process that hastens urbanization. The term "urbanization" describes the growth of urban areas with established urban centers that have an impact on the surrounding areas. Urbanization has significantly increased as a global phenomenon over the past century. With the massive influx of people into cities over the past few decades, urban growth has been accelerating (Solon, 2009). According to estimates from the European Environment Agency (2006), over 60% of the world's population will reside in urban areas by 2030. In 2005, more than 50% of people lived in cities. Based on current growth rates, cities are putting heavy pressure on available lands and resources as urban areas grow faster than urban populations themselves (European Environment Agency,

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2006). The environmental effects of urbanization are a trade-off for the cost of population growth in urban areas (Sharma, 2003).

Land use and land cover changes today have a significant impact on our environment. Like in most other parts of the world, West Africa's natural environment is constantly changing. According to Mundia and Aniya (2005), land use change has an impact on the socio-economic circumstances of an area. In recent years, the majority of Nigeria cities have experienced sporadic growth. Nigeria, with a population of 140 million in 2006, is thought to be the most populous country in sub-Saharan Africa, with a complex pattern of habitation growth (Jiboye, 2012). Nigeria, like other developing nations, is facing issues with rapid urbanization and sustainability as a result of rural-to-urban migration (Olaitan, 2012). For instance, housing, infrastructure, and the environment have all been severely impacted by urban growth in Ilorin (Idrees *et.al.,* 2007). Investigating the dynamics of city growth in Ikire is therefore necessary. In Ikire, Osun state, there is currently no current comprehensive documentation on the trend and magnitude of land use pattern dynamics.

It is essential to comprehend and quantify the spatiotemporal dynamics of urban growth in Ikire in order to propose appropriate policies and monitoring strategies and make informed decisions. Due to the establishment of tertiary institutions in the study area, the city has experienced growth and infrastructural development. This study was carried out to evaluate the spatial distribution of land use and cover in the region using remote sensing techniques.

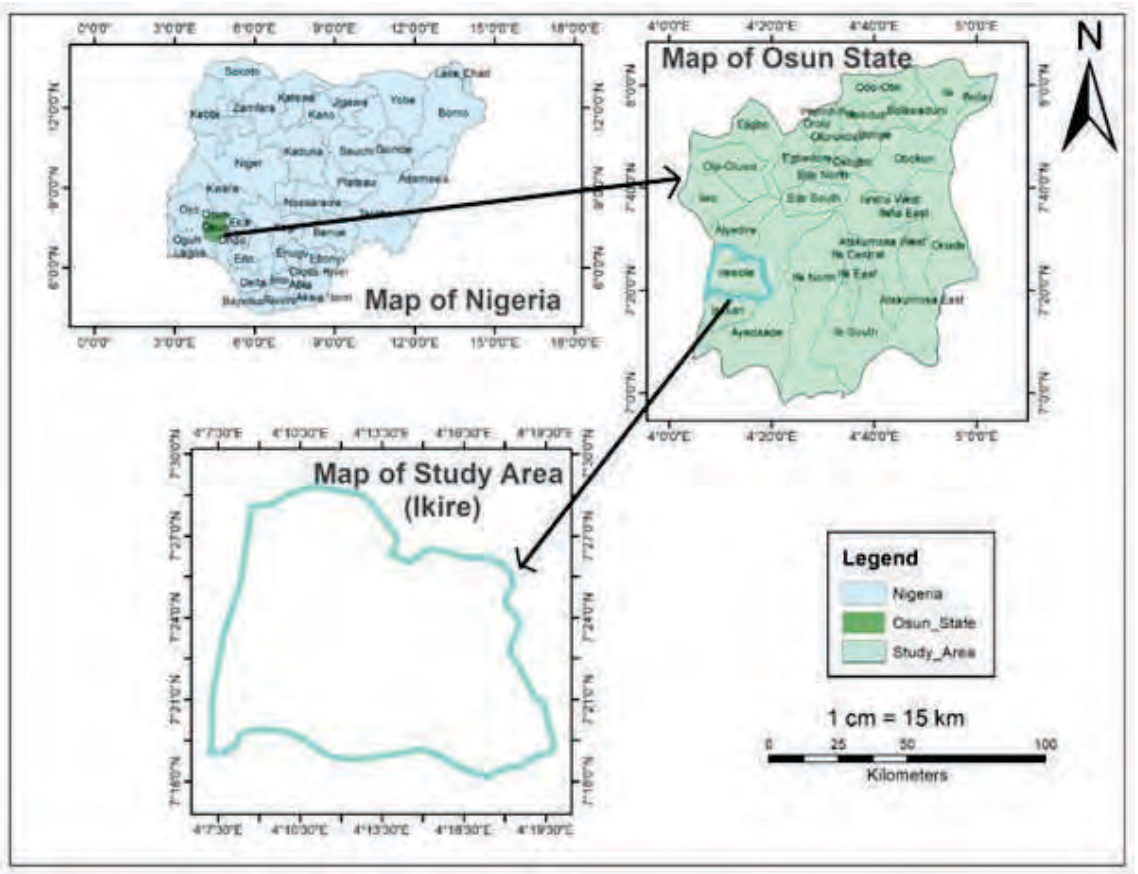

Figure 1 | Map showing the location of the study area
Source: Author's work (2022)

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1.1 | Study Area

The study area, Ikire is located between latitudes of 7°18'N and 7°30'N, and longitude 4°10'E and 4°20'E. It covers about 308 km² with a population of 143,599 according to the 2006 population census. It is delimited in the North-East by Gbongan, in the East by Shasa River and Ife North Local Government, and in the West by Osun and Asejire Rivers . It is also bordered to the North And South by Ayedire and Ayedaade, two additional local government units of the state, (state of Osun structure plans project, 2014). Ikire is known to have high temperatures ranging from 27 to 34 degrees Celsius. With a range of 4°c to 5°c, the average yearly temperature is roughly 27°c. The coldest months are from April to December, which falls in the middle of the rainy and harmattan seasons, respectively. Typically, between January and March, the maximum temperatures are recorded, resulting in warm conditions (State of Osun Structure Plans Project, 2014).

2. | Materials and Methods

The data acquired for the research are shown in Table 1

Table. 1 | Data description

Data	Source	Year	Resolution
LANDSAT (OLI/TIRS)	United States Geological Survey (USGS) (www.earthexplorer.usgs.gov)	2020	30m
LANDSAT (ETM+)	United States Geological Survey (USGS) (www.earthexplorer.usgs.gov)	2010 2000	30m
Administrative Map	Office of the Surveyor General Osogbo, Nigeria		
Worldview Image	Google Earth		1.24m
Ground Coordinates	Author's field work		

The ArcGIS 10.4 software environment's image analysis tool was used to extract pertinent bands from the Landsat pictures and combine them to form a composite image, which was then read to differentiate between the different LULC classes. Geometric and radiometric adjustments were improved through processing of the Landsat data. To improve the resolution of the composite image for precise interpretation, a single high-resolution color image was created by combining a low-resolution band of 30m resolution and a high-resolution panchromatic multispectral imagery band of 15m resolution. The shape file format of the boundary was used to sub-set the improved image into the study area. LULC categories were divided into built-up area, bare terrain, vegetation, agriculture, and water body using the maximum likelihood approach of the supervised image classification algorithm. The "Field Calculator Tool" in ArcGIS 10.4 was used to create LULC maps for every research year. The classified image was compared to the ground coordinates and accuracy assessment parameters were calculated. Post classification processes were carried out by calculating the area of coverage of each land cover type.

3. | Results and Discussion

To evaluate the study area's LULC dynamics, Figures 2 to 4 shows the maps of the LULC types for the years 2000, 2010 and 2020 while Table 2 is a summary of the land use and land cover aerial coverage.

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3.1 | Land use /land cover aerial coverage

To evaluate the spatiotemporal changes of each land use/land cover (LULC) type in the study area, the spatial extent of the LULC types from 2000 to 2020 was calculated and analyzed (Table 2).

Year 2000

From Table 2, in 2000, the vegetation LULC class was the most prevalent. From a total of 308.337 km^2 land area, Vegetation class covered 203.198 km^2 (65.9%) of land. Bare land class followed with 59.568 km^2 (19.3%). The Built Up had 27.418km^2 (8.9%) coverage. Agriculture had a coverage of 14599km^2 (4.7%) The water body had a 3.553km^2 (1.2%) coverage (Figure 3).

Year 2010

In 2010, Vegetation class covered 185.226km^2 (60.1%) of land followed by bare land with

Table 2 | Land Use And Land Cover Areal Coverage

LULC	2000			2010			2020	
CLASS	km^2	%	Δ%	km^2	%	Δ%	km^2	Δ%
Vegetation	203.198	65.9	-5.8	185.226	60.1	-3.2	175.371	56.9
Bare land	59.568	19.3	- 3.5	48.567	15.8	2.2	55.503	18
Built up	27.418	8.9	4.3	40.757	13.2	2.5	48.5	15.7
Agriculture	14.599	4.7	5	29.885	9.7	-1.7	24.652	8
Water body	3.553	1.2	0.1	3.892	1.3	0.1	3.892	1.4

Source: Author's Work (2022)

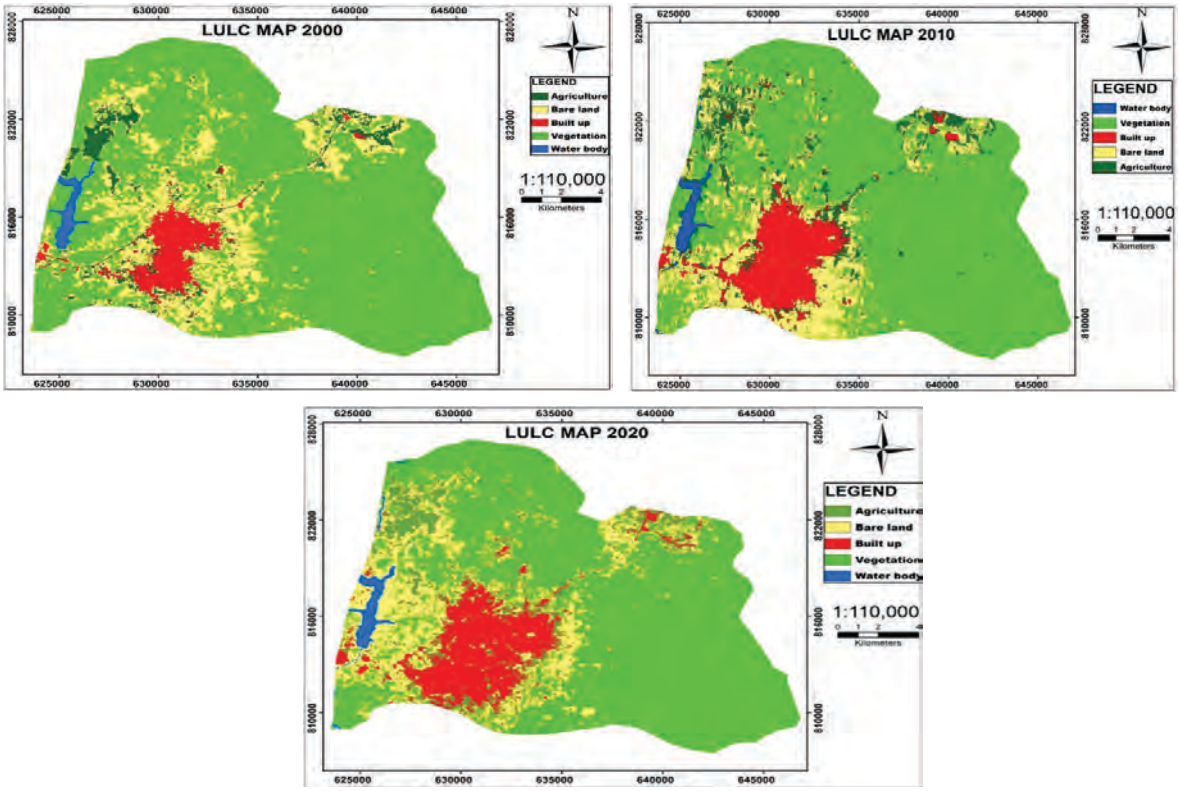

Figure 2 | Land use and Land cover maps of the study period
Source: Author's Work (2022)

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48.567km2 (15.8%), while built-up areas covered 40.757km^2 (13.2%) and Agriculture covered 29.885km^2 (9.7%) and water body covered 1.3% (3.892 km^2) of the total area (Figure 4)

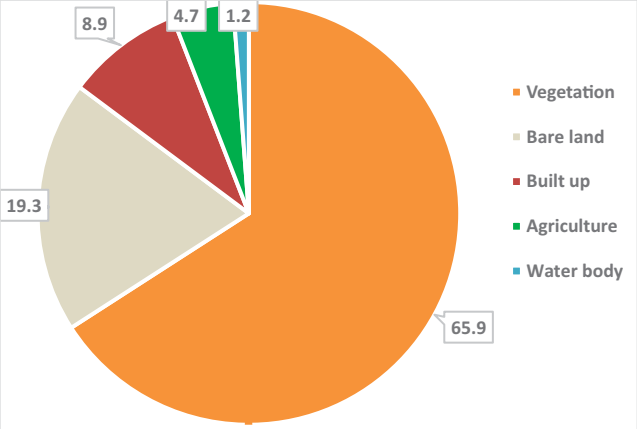

Figure 3 | Land use and Land cover of Ikire in the year 2000

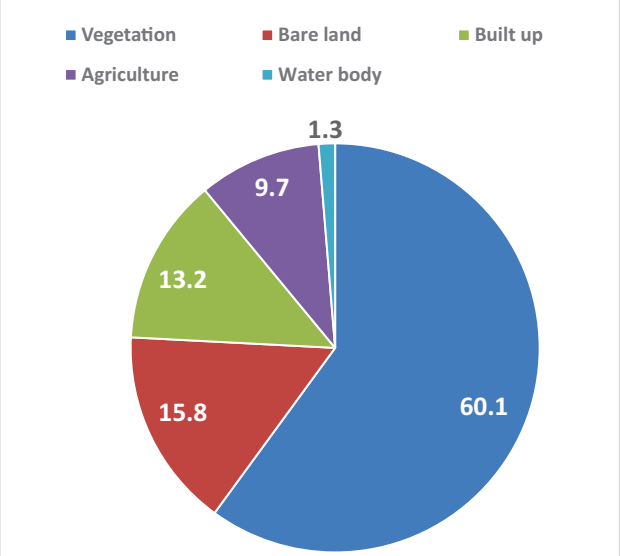

Figure 4 | Land use and Land cover of Ikire in the year 2010

Year 2020

Agriculture accounted for 8.0% (24.652 km2) of Ikire's total area in the year 2020, followed by bare land (18.0% (55.503 km2) and built-up areas (15.7% (48.500 km2), vegetation (56.9% (175.371 km2), and water bodies (1.4% (4.304 km2),

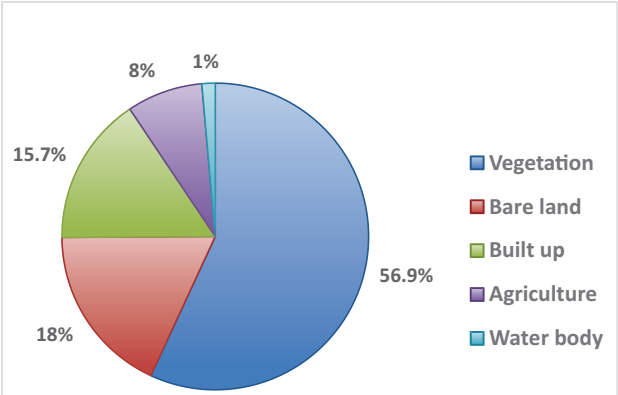

Figure 5 | Land use and Land cover of Ikire in the year 2020

respectively (Figure 5).

3.2 | The overall LULC scenario

The overall LULC scenario (Table 2) for Ikire in 2010 reveals that the built-up areas were developed at the expense of bare land and vegetation. Built-up area increased to 13.2% in 2010 from 8.9% in 2000, which accounts for 8.9% of all LULC distribution in Ikire and a 4.3% increase. This is possibly because of the establishment of a tertiary institution in 2006 which resulted in the development of new residential areas and road system. The number of roads increased significantly as new residential areas were built. The LULC of Ikire's overall scenario for 2020 reveals that the built-up area gradually increased by 2.5% compared to the decade from 2000 to 2010. Built-up area increased to 15.7% in 2020 from its 2010 contribution of 13.2% to the study area's total LULC distribution. This is attributed to further infrastructural development in the study area as a result of the influence of the tertiary institution and its expansion.

3.3 | Trend of LULC

To further evaluate the changes between 2000 and

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2020, the trend of coverage for each LULC type was also examined in the study area.

Bare-land

The trend for the class of bare land cover was calculated for the years 2000, 2010, and 2020, and it showed that it was 19.3% in 2000, 15.8% in 2010, and further inclined to 18.0% in 2020 (Figure 6).

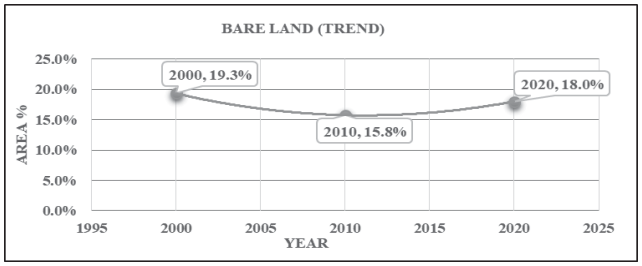

Figure 6 | The trend of bare land from 2000 to 2020)

Agriculture

Between the years 2000 and 2010, agriculture experienced growth, rising from 4.7% to 9.7%, but by the year 2020, it had decreased to 8.0% (Figure 7).

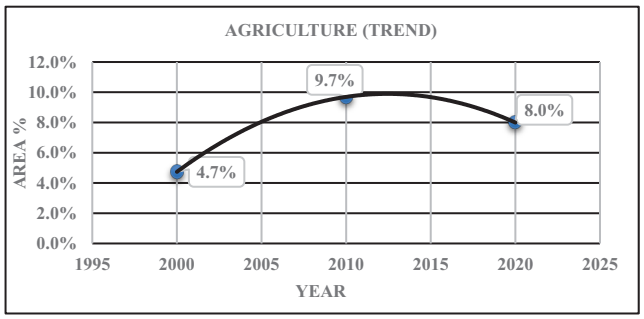

Figure 7 | The trend of Agriculture from 2000 to 2020

Built Environment

Built environment shows that urban development increased between 2000 and 2020, with the area covered increasing from 8.9% in 2000 to 13.2% in 2010 and further to 15.7% in 2020 (Figure 8).

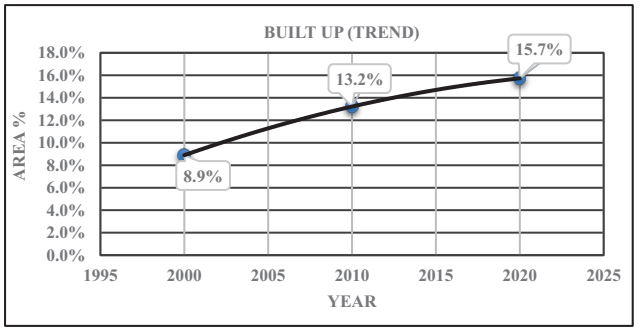

Figure 8 | The trend of Built environmental from 2000 to 2020

Vegetation

Vegetation experienced decrease over the study years. In the year 2000, it was 65.9 % and declined to 60.1 % in 2010, and further decreased to 56.9% in 2020, (Figure 9a).

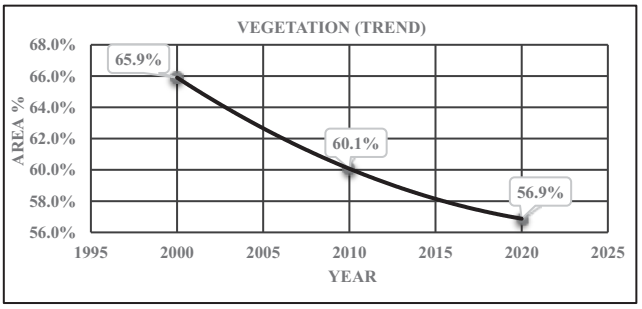

Figure 9a | The trend of Vegetation from 2000 to 2020

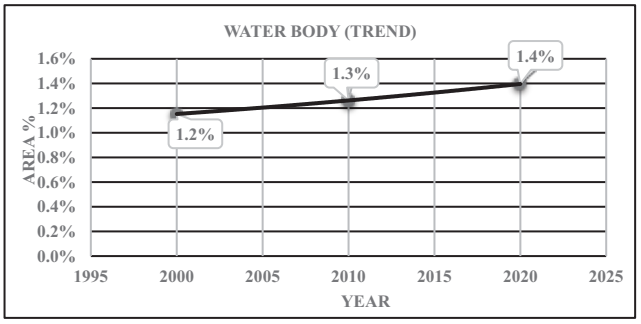

Figure 9b | The trend of Water body from 2000 to 2020

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In 2000, the water body's percentage was 1.2%; this increased to 1.3% in 2010; and then increased again to 1.4% in 2020 (Figure 9b).

According to the trend analyses, the built environment's spatial extent increased continuously from the year 2000 to 2020 (Figure 10), indicating Ikire's continued urban growth and expansion.

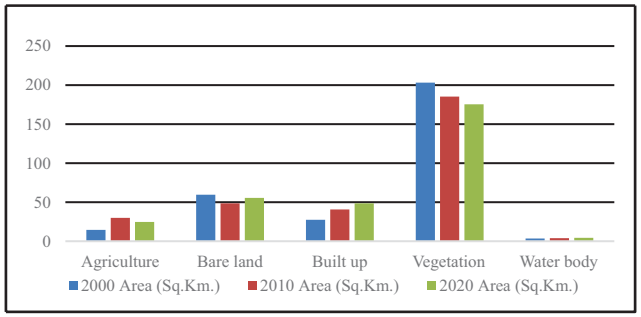

Figure 10 | Trend of Land cover changes in Ikire 2000-2020

3.3 | Estimated Land use in 2060

The projected land-use map for the year 2060 (Table 5) shows a possible spontaneous 22.3% increase in the built-up from 8.9% in 2000 to 38.1% in 2060 of the Land-use class. Vegetation is expected to decrease by 3% from 65.9% (2000) to 47.5% (2060) due to human needs for food and shelter. The Agricultural land is expected to slightly increase by 5% from 4.7% (2000) to 5.0% (2060) as a result of settlement growth and other activities to meet the unlimited demands and needs of mankind. Bare land from the analysis is projected to decrease by 10.1% to 24.126 km^2 (7.9%) of the study area, and lastly water body is expected to have 0.1 increase to 4.526km2 (1.5%) representing the least coverage

Table 5: Predicted Area of Coverage of LULC of Ikire in 2060

LULC Class	2060 (km^2)	Area (%)
Agriculture	**15.511**	**5.0**
Bare land	**24.126**	**7.9**
Built-up	**117.682**	**38.1**
Vegetation	**146.492**	**47.5**
Water body	**4.526**	**1.5**

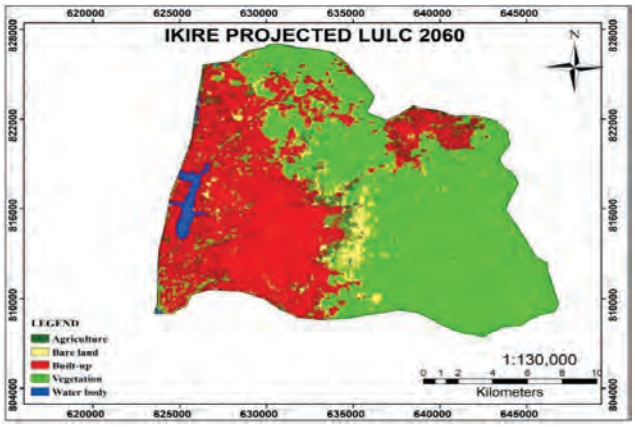

Figure 12 | Expected LULC Map in 2060

Summary

From Table 6, the Land use and Land cover change of Ikire shows decrease in vegetation from 65.9% - 56.9% (2000– 2020) which occurred as a result of increase in population and construction. Bare lands also show slightly decrease from 19.3% -18.0% (2000– 2020) due to growth/ development and increased land demand for constructions. Agriculture increased from 4.7% - 8.0% (2000–2020) due to human needs for food and shelter while water body slightly increased from 1.2% - 1.4% (2000-2020) due to the *Asejire* dam available in the study area. However, built-up has increased significantly from 8.9% - 15.7% (2000– 2020) due to increased settlement expansion and population growth resulting from birth, migration and establishment of tertiary institution in Ikire. Further projection of the Built-up to 2060 shows increase up to 38.2%, signifying future loss of bare land, vegetation and agricultural land in the projected year.

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Table 6: Land use Change of Ikire 2000 – 2060

SPATIAL AREA EXTENT								
YEARS	**2000**		**2010**		**2020**		**2060**	
POPULATION	72,373		159,933		209,368		654,897	
LAND COVER	(Km^2) (%)		(km^2) (%)		(km^2) (%)		(km^2) (%)	
Agriculture	14.599	4.7	29.885	9.7	24.652	8.0	15.511	5.0
Bare land	59.568	19.3	48.567	15.8	55.503	18.0	24.126	7.9
Built up	27.418	8.9	40.757	13.2	48.500	15.7	117.682	38.1
Vegetation	203.198	65.9	185.226	60.1	175.371	56.9	146.492	47.5
Water body	3.553	1.2	3.892	1.3	4.304	1.4	4.526	1.5
TOTAL	308.337	100	308.337	100	308.337	100	308.337	100

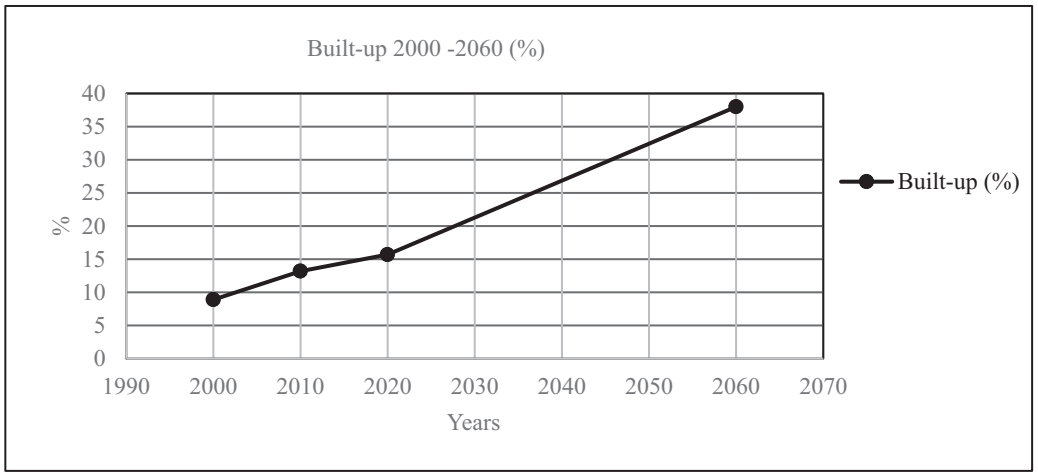

Figure 13: Built-up increase of Ikire from 2000 - 2060

The period of 2000-2010 shows built-up increase of 8%. However, 2010 – 2020 shows built-up increase of 16% while the projected built-up will increase by 38% from 2020 -2060 (Figure 13).

4. | Conclusion

This paper examined urban growth in Ikire with the use of Remote Sensing technology in mapping Land Use Land Cover changes between 2000 and 2020. Five land cover classes namely built-up, agriculture, vegetation, bare land and water body were identified. The analysis showed a rapid growth in built-up land between 2000 and 2020 (8.9% to 15.7%) while the period witnessed a reduction in vegetation (65.9% to 56.9%). It was also observed that the built-up land cover of Ikire by 2060 may likely have appreciated to 38.1%. The growth in built up was prolonging both from urban center to adjoining non-built up areas in all direction. Factor behind development of built-up areas in urban fringes, suburbs and rural areas are, establishment of tertiary Institution, low land price and road networks across the study area. Areas around the tertiary institution were transferred to built-up areas, mostly during the decade of 2000 to 2010. However, urban area is expected to increase more around the tertiary institution in 2060; particularly, in the direction that share boundary

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with Ibadan.

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