FUDMA Journal of Renewable and Atomic Energy (FJoRAE)
ISSN: 3027-2335
Vol. 3 (SI) 2026 Pp 64-74
DOI: https://doi.org/10.33003/fjorae.2026.03SI.76

Geospatial Analysis of Urban Development Extent in Kwara South District, Kwara State

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ABSTRACT
Urban development in Kwara South District, Kwara State are linked to socio-economic and political transformations in recent times, particularly during two key periods: These transformations align with broader trends in post-socialist and rapidly urbanizing regions, where economic restructuring often precipitates the large-scale conversion of agricultural land into built-up areas. This study analyzed the present spatial extent of urban development in Kwara South, taking the direction of development into consideration. Landsat 8 (OLI) imagery of 2024 was obtained from the United States Geological Survey and classified using Maximum Likelihood Classifier (MLC) into five (5) LULC classes; cropland, built up, vegetation, bareland and water bodies. The built-up area which represent urban development was extracted (mapped) and the 'Calculate Geometry Tool' was used to calculate the areas of the selected polygons (in km^2 and corresponding percentage) in each LGA across the study area to determine the spatial extent. The result of this study revealed the spatial extent of urban development to stand at about 9% (527.21km^2), with Offa LGA accounting for more than 33% of the built up areas. Oyun LGA followed with 22%, Irepodun approximately 20% and Ifelodun 12.15%. Conversely, Oke Ero and Isin are the LGAs with least urban development in the study area with 3.57% and 2.29% respectively. The result highlights the significantly spatial extent of urban development in Offa LGA, indicating a higher rate of physical development than all other LGA in the study area. These findings will adequately supports informed planning, particularly in regions undergoing accelerated land use transformations, a pattern common in fast-growing urban areas globally.

Keywords: Urban Development, Urban Land Use, Land Use and Land Cover Change, Urban Planning

1.0. INTRODUCTION

In recent years, the socioeconomic, cultural and environmental conditions of human dwellings have been changing with the technical, technological progress, and innovations creating new opportunities to meet the collective needs of urban population. These continuous unprecedented growth in population, diversified economic activities, and advancement in modern construction techniques and equipments have heightened the rapid conversion of rural / peri-urban lands into urban land use in last few years especially in developing countries like Nigeria, where agricultural lands are being converted into residential, commercial and industrial layouts.(Mohammed, 2015; Alani, 2016). Such conversions resulting in the creation of new urban centres, expansion of existing ones and various adjustments in natural landscapes, are physical products of urbanization which is a universal and dynamic phenomenon that continues to significantly increase built-up areas to accommodate the social and economic development of urban and semi urban centres

(Sharma & Kumar, 2022). The improved changes are reflected by the quality of life, and perceived as urban development.

Urban development may be therefore be viewed as a process of positive changes (quantitative growth and qualitative progress) occurring in a given city (urban area), which takes into account the needs, preferences and hierarchy of values characteristic to this area and its community (Dorota & Daruta, 2016). Isomkwo and Joseph (2019) conceptualized urban development as the conscious or unconscious improvement in the circulatory and transportation, residential, commercial and economic functions of a settlement as a result of an increase in human population. It was further explained as the growth of a settlement into areas that were hitherto uninhabited in order to accommodate growth of human population. According to Ritchie *et al.*, (2024), urban development is a science of managing and directing city growth with respects to the discipline of land utilization planning which explores a very wide range of aspects of the built and social environments. The conceptual models of urban development however often ignore the spatial dimension, which is crucial for understanding human quality of life, food and energy consumption, health, climate, and hunger vulnerabilities.

There are three main components which determine urban development such as driving forces, actors and land itself (Hersperger *et al.,* 2010). The driving forces are forces which interact with actors to shape the land like climate change, human activities, urbanization and population growth. Government policy influences the actors through making decisions (such as land use policy, urban utilities planning, resettlement); Actors may be individuals or groups who own the land (such as land owners and policy makers) and are affected directly; while Land characteristics itself can influence urban development and growth (physical landforms).

Urban development in Kwara South District (KSD), like other parts of Kwara State, is experiencing a mix of growth and challenges. Small and isolated population centres are rapidly transforming into urban areas, without paying adequate attention to patterns, extent and suitability of the land. These as observed in other parts of Nigeria can lead to land conflicts, poor environmental quality, extreme poverty and physical dereliction of infrastructures amongst others (DungGwom et al., 2008).

Urban development in Kwara South is linked to significant impact on livability, environmental degradation, infrastructural strain, land conflicts and socio-economic activities (Ogunbode et al., 2025). Analyzing and understanding the extent, pattern and other dynamics are essential for effective environmental management, sustainable development and informed decision making (Mande et al., 2023).

Several studies have been conducted on urban development in Kwara South. For example, Alani (2016) analyzed land suitability for urban land use focusing on physical criteria and landscape fragmentation. Olabode (2023) examined urban development in some parts of the study area but the research dwelled on the major socio-economical factors of urban development. Similarly, Abdulrahman (2023) assessed urban land use and its dynamics, but the research focused on the impact of urban expansion on agricultural lands. Previously, Mohammed (2015) assessed urban encroachment on agricultural land in Offa LGA. Thus, while previous studies have shed light on these issues, there remains a temporal gap in establishing and understanding the current spatial extent of urban development in Kwara South District, this study attempted to breach that gap by analyzing the spatial extent of urban development in Kwara South District, Kwara State in 2026.

1.1. Study Area

The study area is located between Latitudes $8^\circ\ 05^1$ N – $9^\circ\ 10^1$ N and Longitudes $4^\circ\ 20^1$ E – $5^\circ\ 50^1$ E of Greenwich Meridian with an area extent of about 6084.25 km^2. It is a prominent and fairly homogenous senatorial district in Kwara State sharing boundaries with Kogi and Ekiti States to the east; Osun and Oyo States to the south; Niger State and international boundary with Benin Republic in the north and west respectively. Kwara South Senatorial District comprises of seven Local Government Area; Ekiti, Ifelodun, Irepodun, Isin, Oke –Ero, Offa and Oyun. Figure 1 depicts the map of study area.

The population of Kwara South Senatorial District was projected to 1,210,909 in 2024,using the United Nation's Medium Variant Estimate of natural increase rate (2.5% per annum). The people of KSSD are largely farmers; food and tree crops such as yam, sweet potato, cassava, okro, maize, beans, rice, sorghum, fruits, vegetables, cashew, cocoa, and oranges are widely cultivated. Livestock rearing; especially cattle are kept by the nomadic Fulanis with semi-permanent and sedentary structures in some places. Other livestock such as goats, sheep, poultry, fish farming and bee keeping. Notable trees include Iroko, Opepe, locust bean, akee-aple and Shea butter among others (Mohammed, 2015).

Figure 1: Kwara South Senatorial District

Source: Modified from the Administrative Map of Kwara State (2020)

2.0. MATERIALS AND METHOD

In determining the extent of the urban development in the study area, Maximum Likelihood Classifier (MLC) was used for classifying the Landsat-8 OLI image to identify land use and land cover (LULC) classes in the study area. Training sites were established within the imagery by delineating polygons and saved as signature files which were eventually used in supervised image classification process to generate the LULC map for the study area. The study area was categorized into four distinct classes (Bare surfaces, Built up land, Vegetation, and Water body) based on texture, tone, and color, with each class assigned to pixels during image classification.

Table 1: Land use/Land cover Classification Scheme

Landuse/Land Cover Categories	Description
Cropland	Lands covered with temporary crops followed by harvest period, Crop fields and pastures
Built –up land	Land covered by buildings and other man-made structures. Residential, commercial services, industrial area, mixed urban or built up lands
Vegetation	Land covered with natural vegetation (any plant species)
Bare land	Lands with exposed soil, sand or rocks, strip mines, quarries and gravel pits and has no vegetated cover during any time of the year.
Water Body	Rivers, lakes, streams, reservoirs

Source: Modified from Jensen, 2005

The classified image was reclassified into built-up class (assigned a value of 1) and non-built-up classes (assigned a value of 0). The non-urban areas of the study area were masked out using a vector polygon and only the built-up lands within the urban areas were left as urban built-up lands. The 'Calculate Geometry Tool' was used to calculate the areas of the selected polygons (in km^2 and corresponding percentage) in each LGA across the study area to determine the areal extent

2.1. Accuracy Assessment

The aim of accuracy assessment is to quantitatively assess how effectively the pixels were sampled into the correct land cover classes. Moreover the key emphasis for accuracy assessment pixel selection was on areas that could be clearly identified on both Landsat high resolution image, Google earth and Google Map. A total of 307 points (locations) were created in the classified image of the study area. The Accuracy Assessment Cell was filled according to the best guess of each reference point. Topographic map, Google earth and Google Map were used as reference source to classify the selected points.

Table 2: Land use Land cover Accuracy Assessment

Land use	Built – up	Water body	Agricultural land	Vegetation	Bare land	Total (user)
Built – up	10	0	4	1	1	16
Water body	0	4	1	1	0	6
Cropland	0	1	46	4	1	50
Vegetation	0	1	4	10	0	15
Bare land	0	0	2	0	9	13
Total (producer)	**10**	**6**	**57**	**16**	**11**	**100**

Overall classification Accuracy = 84.6%

Table 2 shows a theoretical confusion matrix (error matrix) of a LULC classification. The columns of the confusion matrix show to which classes the pixels is in the validation set belong (ground truth) and the rows show to which classes the image pixels have been assigned to in the image. The diagonal show the pixels that are classified correctly. Pixels that are not assigned to the proper class do not occur in the diagonal and give an indication of the confusion between the different land-cover classes in the class assignment

3.0. RESULTS AND DISCUSSION

The current extent of urban development in the study area was derived from analysis of satellite images into different land use land cover classes and categorized classified into four; built-up land, vegetation, water body and bare surfaces (Table 2 and Figure 2).

Table 3: Land use/Land cover Classification Scheme 2024

Land use	Area Coverage (km^2)	Percentage
Cropland	3449.76	56.70
Built – up	527.21	8.67
Vegetation	1858.23	30.54
Bare land	242.81	3.99
Water body	6.24	0.10
Total	**6084.25**	**100**

Source: Author's Analysis, 2025

The Land use/Land cover analysis shown in Table 2 and Figure 2 revealed that built-up area is the second least dominant land use with less than 9% (527.21km^2) of the study area, while cropland was the most dominant class covering more than half of the study area (57%). This is followed by vegetation occupying 30% of the total study area. The proportion of land covered by water bodies in the study area is the least (less than 1%).

The result corroborate the findings of Ajala *et al.,* (2023) which revealed the periodic percentage increase of cropland and built – up areas in Kwara State over the past 30 years, and identified agricultural land (cropland) to be the highest land use class in Kwara State with 46% coverage. The socioeconomic survey analysis results also indicated that farming is the second prominent occupation, thus accounting for about 60% coverage by cropland out of the total land use classes in the study area. Alani (2016) also reported vegetation (natural forest) as the second dominant class in the study area, having lost over 30% of its coverage to agricultural activities, lumbering and built – up expansion over the past 40 years. The low proportion of water bodies in spatial extent is also in accordance with the study of Elijah and David (2022).

Built-up area in Kwara South Senatorial District had experienced significant increment over the years, from 4.21% in 2016 (Alani, 2016) to 9% in 2025. This can be attributed to political presence (creation of LGAs and headquarters), establishments of tertiary institutions, increased industrial and commercial activities, expansion of cities and villages, construction of roads and buildings, and the accompanying rise in socioeconomic indices. Influx of people (majorly due to education and employment opportunities) also contribute substantially to population growth and sets off the process of urban development.

Though, the study area is still largely dominated by agricultural activities could be attributed to the favourable climate and soils, which encourage agricultural activities; both crop production and animal husbandry. Built-up coverage is noticeably on the increase as reported by Alani (2016) and Mohammed (2021).

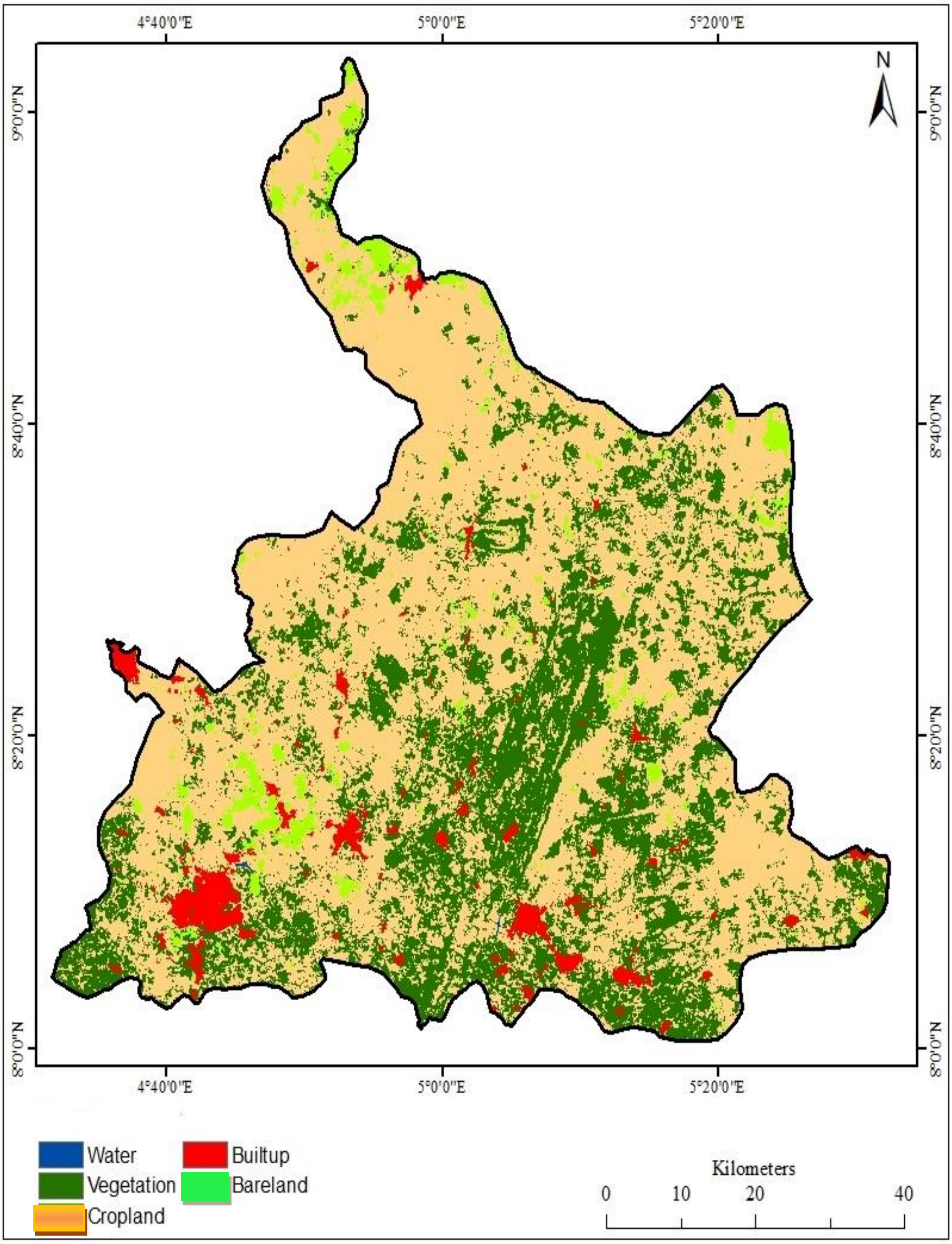

Figure 2: Land use / Land cover of Kwara South District (2025)
Source: Author's Analysis, 2025

To determine the extent of urban development in the study area (area in km²) in 2024, the landuse / land cover map of the study area was extracted to produce a built-up map. Table 4 presents the extent of urban development in the study area according to each LGA.

Table 4: Extent of Urban Development by LGA

LGA	Area in Km^2	Extent of Urban Development	
		Km	%
Ekiti	480	36.23	5.4
Ifelodun	3101	64.14	2.17
Irepodun	737	104.02	14.11
Isin	633	11.07	1.74
Offa	229.50	175.04	76.43
Oke Ero	428	18.87	4.4
Oyun	475.75	117.84	24.76

Source: Author's Analysis, 2025

According to the findings in Table 4.4, the total physical extent of urban development of the study area stands at about 9% (527.21 km^2) of the total land mass of the study area. The urban development extent may still be considered low compared to the total land mass of the study area, but urban extent has significantly increased over the years, from 4.21% in 2016 (Alani, 2016) to the current coverage (9%). The results also revealed Offa LGA accounted for the highest proportion of urban development in the study area with more 33%, while Oyun LGA keenly followed with 22%; Irepodun 19.73 and Ifelodun with 12.15%. Oke Ero and Isin are the LGAs with least urban development in the study area with 3.57% and 2.29% respectively.

This result is in consonance with Timothy et al., (2023) which revealed the extensive urban growth processes in Lokoja, with the total built-up increasing from 1.65% in 2001 to 3.14% 6.04% in 2020; cumulatively from 1.65% 1n 2001 to 10.83% in 2020. Ajala *et al.,* (2023) also revealed the statistic of total built–up area in Kwara State from 25% in 2000 to 30.4% in 2016. It is evident that there have been tremendous changes in percentage of built–up areas in the study area and it is still ongoing.

The observed level of urban development in the study area can be intrinsically linked to the educational and socioeconomic advancement of the south-western states (such as Ekiti, Oyo and Osun) which the study area has been strongly identifying with, despite being situated in North-central geopolitical zone; the political presence (creation of Local Government Area and headquarters), location of tertiary institutions (public and private), tourism resorts, commercial and industrial centres; minerals exploration, agricultural produce, and the proximity to major roads in the study area among others (Mohammed, 2015)

Offa, which is the second largest urban centre in Kwara State witnessed tremendous urban expansion and development since the inception of Offa LGA, Federal Polytechnic, Nigerian Navy School of Health Management, various medium and small scale industries, increased commercial activities due to population influx; fertile soil, ample road network and linkages to the hinterland for agricultural produce. Similarly, Irepodun LGA, with headquarters in Omun Aran is strategically placed as it shares boundary with Ekiti and Osun States; and widely known for both tertiary institutions and tourist centre. Notably among these are the Landmark University, Kwara State College of Education, Oro; Esie National Museum and Monument, Esie, among others. The resulting increase in urban population due to natural birth and rural-urban migration contributes even more as is the case in many developing countries. This is basically due to the economic development that attracts people to urban nuclei for commerce, employment and education.

Major indices of urban development (construction of the residential houses, offices, commercial centres, schools, recreation centres) and population in Kwara South Senatorial District (KSSD) were observed to move from core of the LGAs into peripheries with a lack of physical barriers. These developments were consuming peripheral landscapes (including agricultural lands and forest), stimulating economic, social, political and physical changes,

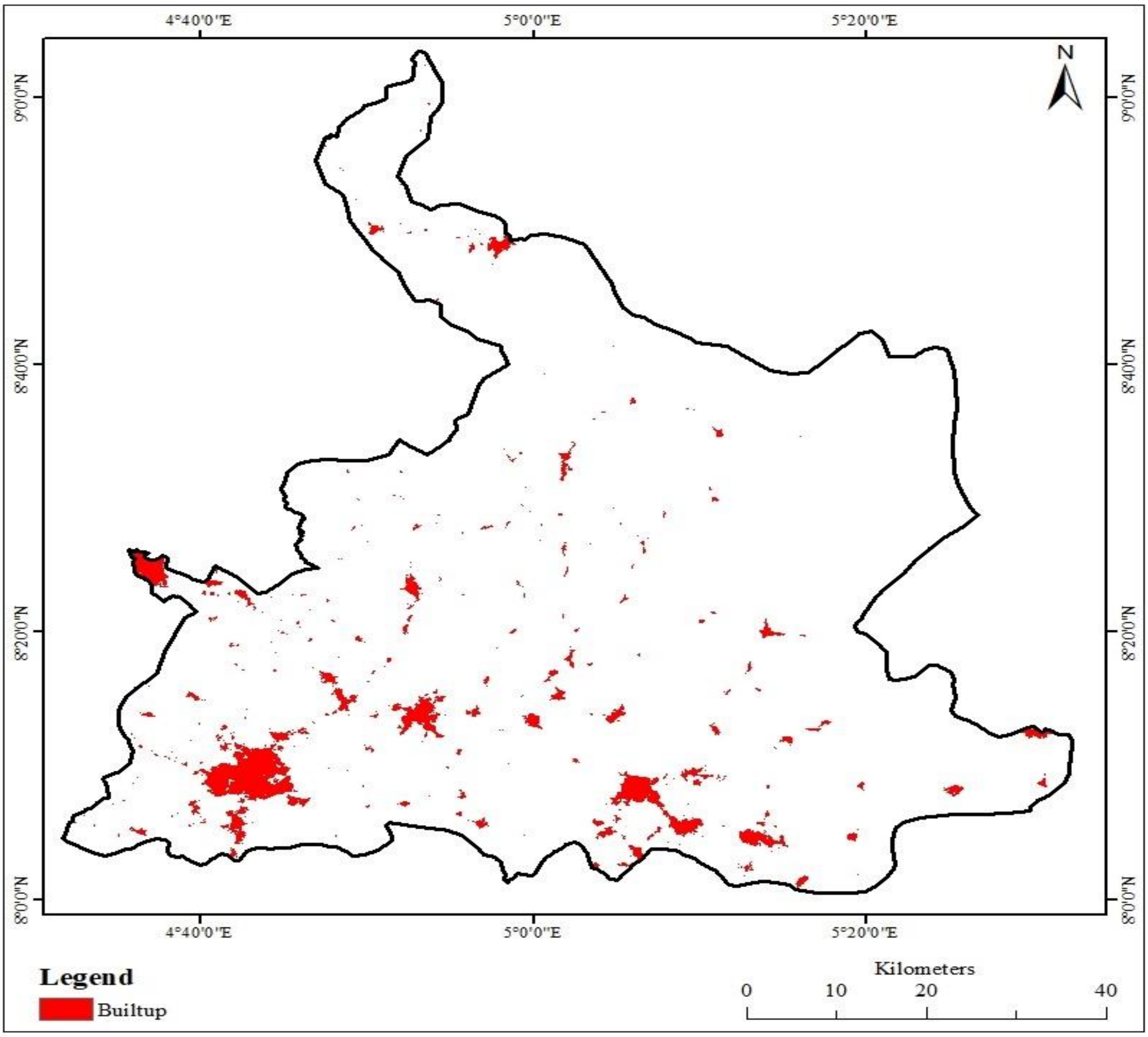

Figure 3: Extent of urban development in Kwara South District
Source: Author's Analysis, 2025

These trends of urban development were in linear (along major roads) and leapfrogging patterns especially in Offa, Ajasse, Oro, Omun-Aran, Share and Idofian to mention few. This creates peri-urban development; a form of urban development that resembles what the sector theory describes as 'axial growth' pushing out from the centre along transportation lines. Hence, it is evident that the agricultural and forested lands which were fragmented by residential and road constructions have increasing potentials for human impacts. Similarly, the conversions of housing accommodations to corporate offices and commercial plazas in the study area are attributed to rapid population increase and urbanization, which forces people out of the metropolis to build their houses and settle at the fringe, coupled with the fact that land price and house rent seems to be cheaper when compared to the city centre. These urban functions had to a certain extent stimulated high population growth that seemed to have culminated in increasing demand for residential and office buildings, commercial outlets, recreation centres and necessary social facilities, thus further increasing urban expansion and development in the recent years. This finding is in agreement with work of Oyeniyi *et al.,* (2025), which revealed that developmental projects in Akure, Nigeria are catalyst for urban development in various forms, by fueling demand for housing for residence and infrastructural needs for investments depending on the accessibility within the urban framework. Mohammed (2021) also observed unprecedented increase in the built up area characterized by building conversions in along the major roads in Offa mostly from residential to various commercial uses like offices, filling station, hotels, and banks, among others. These 'internal restructuring" leads to significant changes in urban land use pattern that stimulate urban development.

4.0. CONCLUSION

This study analyzed the extent of urban development in the study area. Landsat 8 (OLI) imagery of the study area was classified into various land cover and land use using Maximum Likelihood Classifier (MLC). The extent of urban development was mapped and The 'Calculate Geometry Tool' was used to calculate the areas of the selected polygons (in km^2 and corresponding percentage) in each LGA across the study area to determine the areal extent. The land use land cover classification of the study area revealed the physical extent of urban development to stand at about 9% (527.21km^2), with Offa LGA accounting for more than 33% of the built up areas. Oyun LGA followed with 22%, Irepodun approximately 20% and Ifelodun 12.15%. Conversely, Oke Ero and Isin are the LGAs with least urban development in the study area with 3.57% and 2.29% respectively.

The study provided an insight into the spatial extent urban development in Kwara South District, and concluded that the total extent of urban development in the study area stands at 9% (527.21km^2). Offa LGA has the largest portion of urban development in the study area with 33%, while Oyun LGA followed with 22% and Isin LGA has the least urban development with less than 3% of it land mass. It is therefore recommended that the Kwara State Ministry of Housing and Urban Development should re-examine the implementation policy and approach of the master plan of the study area using the GIS-Based Urban Growth Monitoring Tools for the huge potentials of suitable land for urban development discovered in the study area. The unoccupied portion of the study area should be labeled accordingly for befitting activities and the agency should also ensure the effective adherence to the updated master plan.

REFERENCES

Abdulrahman O.T (2024) Monitoring urban growth and landscape fragmentation in Kaduna, Nigeria, using remote sensing approach. *Journal of Degraded and Mining Lands Management*, 12(1), 6757–6769. https://doi.org/10.15243/jdmlm.2024.121.6757

Adewoyin, Y., Mokwenye, E.M. and Ugwu, N.V. (2020). Environmental Ethics, Religious Taboos and the Osun-Oshogbo Grove. *Journal of Cultur-al Heritage Management and Sustainable Deve-opment,* https://doi.org/10.1108/JCHMSD-01- 2020-0019

Ajala,O. N., Adjadeh, T. A., Olaniyan, J. O., and Alori, E. T. (2023). Evaluating the Effect of Land use Land Cover Changes on Land Suitability for Crop Production Using Remote Sensing and GIS. West African Journal of Applied Ecology, 31(2), 11-19.

Alani, A. K (2016*). Geographic Information System (GIS) in Land Suitability Analysis for Urban land use in selected towns of Kwara State.* Unpublished M.Sc Thesis, Department of Geospatial & Space Technology, University of Nairobi

Deliry, S.; Uygucgil, H. GIS-Based land suitability analysis for sustainable urban development: A case study in Eskisehir, Turkey. Int. J. Sci. Eng. 2020, 20, 634–650.

Dengshuai, C., Xiaonan, Y., Xin, L., Huiqiang, F., and Yifang, D (2025). Quantifying urban land expansion using remote sensing data and multi-evaluation indices in the Lower Yellow River, China. *Environmental and Sustainability Indicators* 26, 100643.

Dung-Gwom, J. Y., Hirse, S. O. and Pwat, S. P. (2008). Characteristics and physical implications of slums of Jos, Nigeria. *Journal of Environmental science,* (9) 117-126.

Elhanafy, H. (2023). Guided Organic Growth: A Para-digm Shift in New City Making. E3S Web of Conferences, 418: 01004

Elijah, A. N., and David, E. T (2022) Quantitative Assessment of The Relationship Between Land Use/Land Cover (LULC), Topographic Elevation and Land Surface Temperature (LST) in Ilorin, Nigeria, Remote Sensing Applications: *Society and Environment*. 27(2) 1 – 18.

Haibo, W., Xueshuang, G., Bingbing, W., Chao, D,, and Qiong, C (2021) Urban development analysis using built-up area maps based on multiple high-resolution satellite data. *International Journal of Applied Earth Observation and Geoinformation*. 103. Retrieved 19/12/25 from https://doi.org/10.1016/j.jag.2021.102500

Hersperger, A., Gennaio, M., Verburg, P. H., & Bürgi, M. (2010). Linking Land Change with Driving Forces and Actors: Four Conceptual Models. *Ecology and Society*, *15*(4) 1-17

Isomkwo, A.E., and Dzum, T.J (2019) The Impact of Population Growth on Urban Expansion: An Assessment of Obudu Town in Cross River North Senatorial District, Nigeria. *International Journal of Innovative Research & Development* 8(8) 368 – 378

Imhanfidon, O. J., Innocent, E. B., Aliyu, M., Caleb, O., Ihenacho, N.M., Sanda, D.T., Stephen, M., Nwodo, N., Areh, M., Ernest, A., and Oluyomi, O.H (2023) Geospatial Assessment of the Physical Expansion in Urban Development in Bwari Area Council, Federal Capital Territory, Abuja, Nigeria. *Advances in Social Sciences and Management*. 1(10) 08-29. Retrieved 23/12/2025 from https://hspublishing.org/ASSM/article/view/201/193

Mande, H. K., Olaniyi, A. O., Richard, M., Sule, B., & Abasha, D. (2023). Change in Land Use/Land Cover Using Remotely Sensed Images in Kafanchan Area of Kaduna State, Nigeria. FUDMA Journal of Sciences, 7(6), 227–233. https://doi.org/10.33003/fjs-2023-0706-2120

Mohammed S.A (2015) *Assessment of Urban Encroachment on Agricultural Land in Offa Local Government Area*. Unpublished M.Sc Thesis, Ahmadu Bello University, Zaria, Nigeria

Mohammed S.A (2021) Spatio-Temporal Analysis of Urban Expansion in Offa, Kwara State, Nigeria (1990 - 2014) Ethiopian Journal of Environmental Studies & Management 14(5): 982 – 993, 2021.

Muhammad, R.A., and Amal, A (2019) Detection of Developmentand Density Urban Build-Up Area with Satellite Image Overlay. *International Journal of Environment, Engineering and Education*. 1(2) 40-45. Retrieved 20/12/25 from DOI: https://doi.org/10.5281/zenodo.3369481

Sharma, M., & Kumar, S. (2022). Analysing the spatial patterns and trends of urban growth in Rohtak city, India. *Sustainable Environment*, *8*(1), 1-10. https://doi.org/10.1080/27658511.2022.2051268

Norouzi, Y (2022) Measuring Land Use Changes and Quantifying Urban Expansion Using Remote Sensing and GIS Techniques – A Case Study of Qom, Iran. *Annals of International Society for Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume X-4/W1*. Retrieved on 23/12/25 from https://doi.org/10.5194/isprs-annals-X-4-W1-2022-609-2023.

Olabode, S.A (2023). The communal effects of Islamic Banking in Property Acquisitions in Irepodun LGA, Kwara State. Unpublished MSc Thesis, Bayero University, Nigeria

Ogunbode, T. O., Oyebamiji, V. O., Sanni, D. O., Akinwale, E. O., & Akinluyi, F. O. (2025). Environmental impacts of urban growth and land use changes in tropical cities. *Frontiers in Sustainable Cities*, 6. https://doi.org/10.3389/frsc.2024.1481932

Oyeniyi, M. A., Odunsi, O. M., Rienow, A., & Edler, D. (2025). Spatiotemporal Analysis of Land Use Change and Urban Heat Island Effects in Akure and Osogbo, Nigeria between 2014 and 2023. *Climate*, *13*(4), 68. https://doi.org/10.3390/cli13040068

Ritchie, H., Rodés-Guirao, L., Mathieu, E., Gerber, M., Ortiz-Ospina, E., Hasell, J. And Roser, M. (2024). Population Growth. [online] Our World in Data. Available at: https://ourworldindata.org/population-growth#all-charts.

Zhenfeng, S., Deren, L., and Wenbo, Y (2021) Smart city based on digital twins. *Computational Urban Science* **1**, 4 (2021). https://doi.org/10.1007/s43762-021-00005-y

Timothy, M.V., Ahbdullahi, A.H. and Timothy, A.S (2023) Spatio-temporal Analysis of Urban Growth Pattern in Lokoja, Kogi State, Nigeria. Ethiopian Journal of Environmental Studies & Management 16(5): 614 – 625, 2023 Retrieved on 23/12/2025 from doi: https://ejesm.org/doi/v16i5.7

Oyeniyi, M. A., Odunsi, O. M., Rienow, A., & Edler, D. (2025). Spatiotemporal Analysis of Land Use Change and Urban Heat Island Effects in Akure and Osogbo, Nigeria between 2014 and 2023. *Climate*, *13*(4), 68. https://doi.org/10.3390/cli13040068

Rui, X., Yuji, M., Kun, Q., Jingling, S., Zhi, G., Liu, L., Gang, X., and Limin, J (2024) Urban expansion in highly populous East Asian megacities during 1990–2020: Tokyo, Seoul, Beijing, and Shanghai. *Ecological Informatics,* 83, 102843. 1 – 10. Retrieved on 19/12/2025 from https://www.sciencedirect.com/science/article/pii/S1574954124003856#s0040