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Full Length Research Article

EFFECTS OF BUILT-UP AREAS ON VEGETATION COVER IN CHIKUN LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA

*[1,2]Cletus Musa, [2]Edwin Nyako Gandapa, [2]Isah Shuaibu, [2]Salawu O. Ganiyu

[1]Department of Marine and Coastal Hydrology, Nigeria Hydrological Services Agency, Abuja, Nigeria
[2]Department of Geography, Nigerian Defense Academy, Kaduna, P.M.B. 2109, Kaduna, Kaduna State, Nigeria

*Corresponding Author Email Address: mancle2001@yahoo.com

ABSTRACT

Changes in built-up areas and vegetation cover are inevitable process driven by the short- or long-term human needs. The aim of this study was to assess the effects of built-up area on vegetation cover over 35 years in Chikun Local Government Area. Idrisi TerrSet was used to perform a supervised maximum likelihood classification of the imagery. The results showed that built-up expansion contributed to substantial changes in the vegetation cover, which declined significantly from 3,224 km² (66.34%) in 2007 to 2,998 km² (61.69%) in 2012. While built-up areas increased 278 km² (5.72%) to 317 km² (6.52%) during the same period. The detected trend in vegetation cover indicates a gradual increase to 3,138 km² (64.57%) in 2017 and 3,446 km² (70.91%) in 2022, suggesting potential vegetation restoration efforts or natural regrowth in certain areas. However, juxtaposed with this trend is a noticeable increase in built-up area from 402 km² (8.27%) in 2017 to 415 km² (8.52%) in 2022, likely driven by population growth, urbanization, and infrastructure development. These findings highlight the importance of sustainable land use planning to achieve a balance between development and environmental conservation in the area.

Keywords: Remote sensing, Landsat imagery, Built-up area, Vegetation cover.

INTRODUCTION

Built-up areas around the world are growing and attracting millions of people due to the opportunities they provide to improve livelihoods, such as economic growth and employment, access to services and infrastructure, innovation and technology, efficient land use and connectivity, and improved communication and network. Between 2000 and 2020, the extent of built-up land worldwide grew by about 30%, primarily at the expense of agricultural land, grasslands, and forests (Yuerong *et al*. 2020). In rapidly urbanizing regions such as South Asia, Sub-Saharan Africa, and parts of East Asia, this trend is particularly pronounced. However, if unregulated, global urban land cover could reach 2.3 million km² by 2050, driven by population increase, and leading to widespread and permanent vegetation loss (Chen *et al.,* 2020).

According to the United Nations (2022), the global population reached 8 billion in 2022, with more than 55% of the population living in urban areas, a figure expected to about 70% by 2050. While Nigeria's urban population is further expected to increase to nearly 295 million inhabitants by 2050, making the country Africa's next urban giant (World Bank, 2020).

In Nigeria, built-up areas have been increasing due to rapid population growth, urbanization, economic development, technological advancement, and the proliferation of informal settlements and unregulated expansion, leading to the expansion of cities and towns (Ancha *et al.* 2021). However, these cities have become key social agents of change in an era of unprecedented global urbanization. Beyond outright removal of vegetation cover, built-up expansion leads to habitat fragmentation, reducing contiguous vegetated areas and breaking ecosystems into smaller, isolated patches. This disrupts plant-animal interactions, reduces genetic diversity, and impairs the functionality of vegetation in providing ecosystem services such as carbon sequestration, water purification, and microclimate regulation (Haddad *et al.,* 2015).

Oladipo, Abdullahi, and Adamu (2020) assessed the impact of urbanization on vegetation cover in Kaduna metropolis. The study analyzed satellite imagery of Kaduna metropolis from 2003 to 2019 and revealed a decline in vegetation cover during the study period. The study attributed the decrease to the conversion of green spaces into commercial and residential developments, as well as agricultural land use.

Understanding how built-up areas are distributed and expanding, along with their effects on other biophysical factors, is essential for achieving sustainable urban development and enhancing urban environments. However, there is a significant lack of recent assessments for the study areas, especially considering the size and scale of these local government area. This study therefore, assessed the effects of built-up area on vegetation cover in Chikun LGA.

MATERIALS AND METHODS

Description of the study Area

Chikun is situated in the southern part of Kaduna State and is one of the 23 local government areas within the state. It serves as an administrative division, with its headquarters in the town of Kujama. It is located between Latitude 11˚10'59"N and 11˚25'44"N north of the Equator and Longitude 7˚10'16"E and 7˚35'30"E east of the Prime Meridian (Nwude, 2006). It covers a land area of 4,860sqkm with an estimated population of 372,272 according to the 2006 population census.

The area shares boundaries with Kachia LGA to the south, Kajuru to the east, Kaduna South to the northeast, Igabi to the northeast, Birnin Gwari to the northwest, and Niger State to the west. It consists of 12 subdivisions called Wards (second-order administrative divisions), namely: Chikun, Gwagwada, Kakau, Kujama, Kunai, Kuriga, Narayi, Nassarawa, Rido, Sabon Gari Nassarawa, Sabon Tasha and Yelwa. Chikun LGA experience dry and wet seasons, the dry season runs from November to April of the following year, while the wet season is from May to October. The mean annual rainfall amount in Chikun LGA was between 1,397 and 1,551mm (Danjuma, 2015). The annual mean maximum temperature values range from 30.0ºC - 32.0ºC. The average

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temperature is about 29.3ºC. April is the warmest month with an average temperature of about 22.90°C, while the coldest months are August (20.40ºC °C), September (20.30°C), and December (17.1ºC) (Climate-data.org, 2024). The cold season in the study area has an average temperature of 17ºC (NiMet, 2025). The area is characterized by undulating terrain with Kujama having the highest elevation of about 850 meters above mean sea level. The area is drained by several rivers and streams, including Romi, which serves as a tributary to the river Kaduna in the western part of the local government (Kaduna and Environs, Nigeria, Sheet 1: 100,000). The vegetation cover has been affected adversely by anthropogenic activities such as arable farming, fuelwood harvesting, and the construction of roads and shelters. The vegetation has been largely reduced to grasses, shrubs, and parkland, and with few tall trees, are found mostly along water courses. Some of the tree species are(rice*) Oryza sativa, (*maize*)* *Zea mays, (*guinea corn*) Sorghum bicolor, (*groundnut*) Arachis hypogaea, (*millet*) Pennisetum americanum,* (beans*) Phaseolus vulgaris, (*yam*) Dioscorea spp, (*cassava*) Manihot esculenta, (*cocoa yam*) Colocasia esculenta, (*sugar cane) *Saccharum officinarum, (*soya beans*) Glycine max, (*potatoes*) Ipomoea batatas* (Adewuyi, Daful and Adamu, 2019).

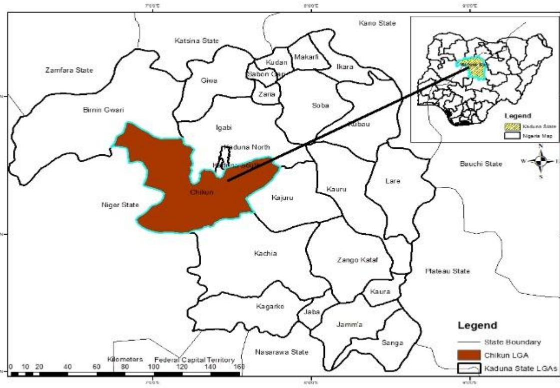

Figure 1 Kaduna State showing the study area.

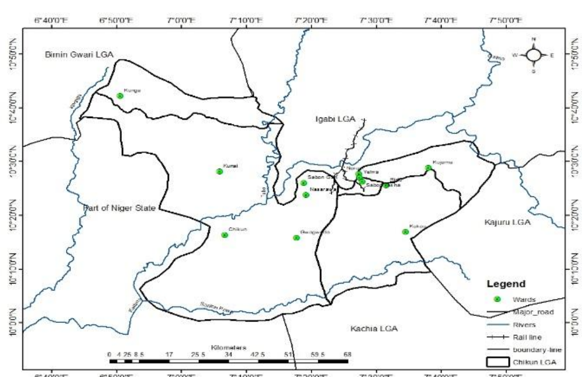

Figure 2: Chikun LGA Physical Features

Data Sources
The study utilized free multi-temporal remotely sensed Landsat datasets. The dataset used consists of Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), and Operational Land Imager (OLI) images. The images were obtained from the United States Geological Survey (USGS) Earth Explorer database, as presented in Table 1 below.

Table 1: Remotely sensed Landsat datasets

Year	Acquisition date	Sensor	Resolution	Path/row	Cloud
1987	1st November, 1987	Landsat-5 (TM)	30m	189/053	<20
1992	6th December,1992	Landsat-5 (TM)	30m	189/053	<20
1997	2nd December, 1997	Landsat-5 (TM)	30m	189/053	<20
2002	13th February, 2002	Landsat-7 (+ETM)	30m	189/053	<20
2007	26th January, 2007	Landsat-7 (+ETM)	30m	189/053	<20
2012	23th November, 2012	Landsat-7 (+ETM)	30m	189/053	<20
2017	29th January, 2017	Landsat-8 (OLI)	30m	189/053	<20
2022	11th January, 2022	Landsat-8 (OLI)	30m	189/053	<20

Source: U.S Geological Survey.

Classified map
Training sites provide the ground truth data necessary for supervised classification algorithms (e.g., Maximum Likelihood, Support Vector Machines, Random Forests). The accuracy of classification heavily depends on the quality and representativeness of the training data, and by utilizing high-resolution Google Earth photographs to construct spectral signatures. The process involved digitizing vector layers consisting different polygons and overlaying them on onto raster datasets representing various land use types. The classified map was segmented into six (6) classes, namely: built-up area, vegetation cover, cultivated area, water body, bare surface, and rock outcrop, using the maximum likelihood supervised classifier of Idrisi TerrSet. The segment maps were polygonised and rasterized in the Idrisi TerrSet environment. The built-up and vegetation cover classes for the eight (8) time periods were extracted from the classified images determine the spatial growth of the local government and changes in vegetal cover. The percentage change between 1987 and 2022 was calculated assuming that the land use in 1987 was 100%. The software was used to extract the statistical coverage of the classes, which was then utilized to compute percentage changes, magnitude of change, and overall trends. The nature of change was determined through the process of map variance.

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Flow Analysis Chat

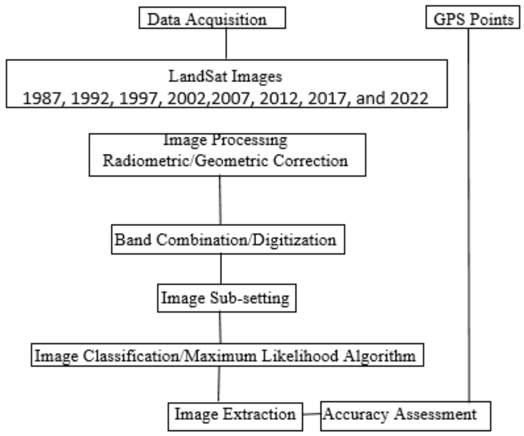

Figure 2A. Flow Chat Analysis

Normalized Differential Vegetation Index (NDVI)
The Normalized Difference Vegetation Index (NDVI) is a widely used remote sensing index for assessing vegetation cover and its health by analyzing satellite or aerial imagery. NDVI is a numerical index calculated from the visible (Red) and near-infrared (NIR) bands of the electromagnetic spectrum, which can be used to monitor vegetation dynamics, land use, and land cover changes.
NDVI formula.

The NDVI is calculated using the following formula: NDVI=(NIR-RED) / (NIR+RED)
Where:

NIR is the reflectance in the near-infrared band.
RED is the reflectance in the red band.

On an NDVI image, vegetated areas generally exhibit high values due to their relatively high near–infrared reflectance and low visible reflectance. In contrast, water has a higher visible reflectance than near-infrared reflectance.
These maps consist of three distinct features as shown in the figures below. The NDVI band may also be combined with other bands of the multispectral image to form a colour composite image, which helps to discriminate different types of vegetation.
High NDVI values (ranging from +0.6 to +1) indicate dense, healthy vegetation, such as forests or crops, because they reflect more near-infrared light and less visible light. Low NDVI values (close to 0 or negative) suggest sparse or no vegetation, such as built-up areas, bare soil, or water bodies.

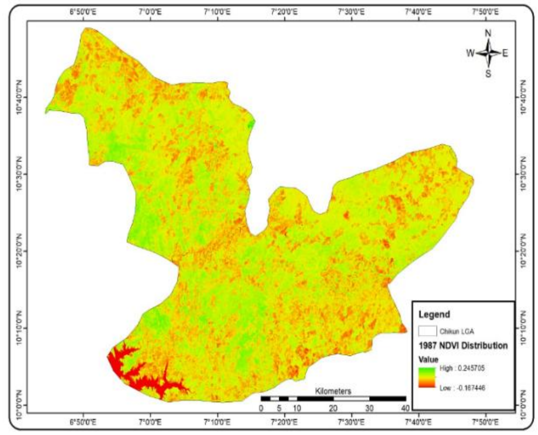

Figure 3: NDVI Map of Greenness Condition January 1987

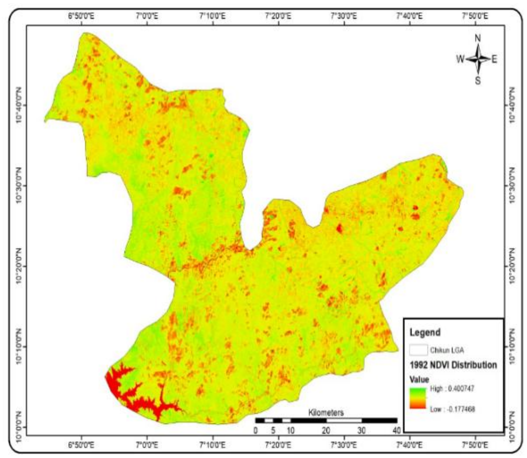

Figure 4: NDVI Map of Greenness Condition December 1992

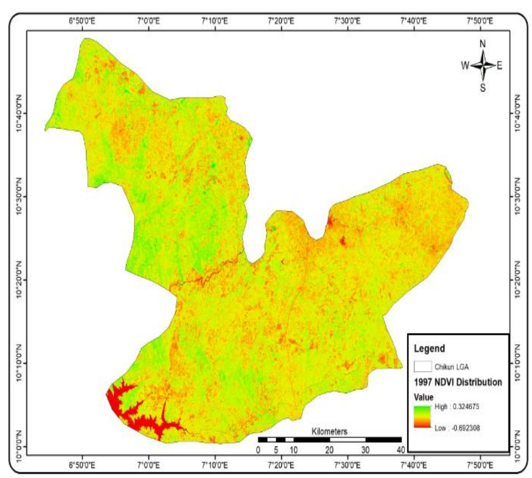

Figure 5: NDVI Map of Greenness Condition February 1997

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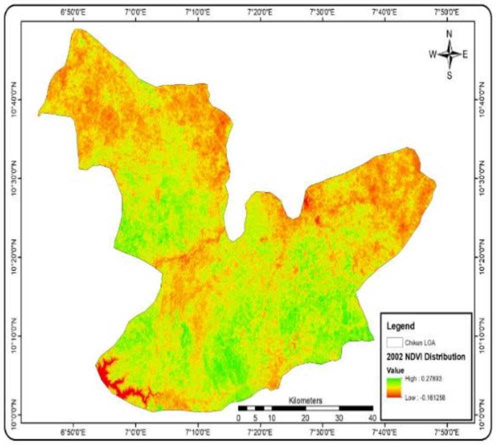

Figure 6. NDVI Map of Greenness Condition February 2002

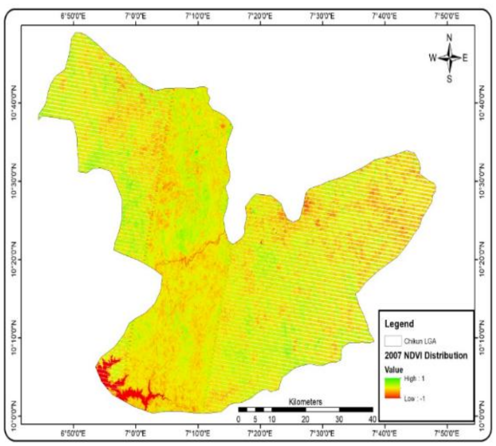

Figure 7: NDVI Map of Greenness Condition January 2007

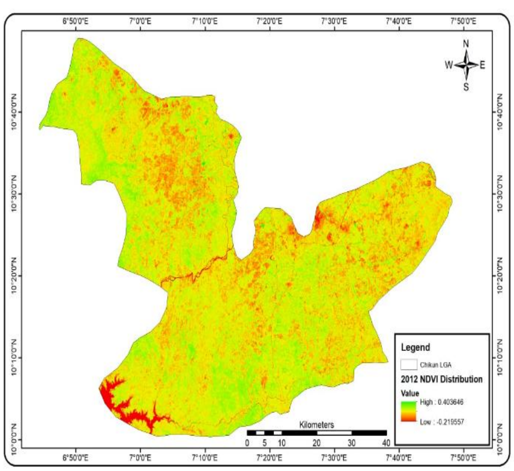

Figure 8: NDVI Map of Greenness Condition November 2012

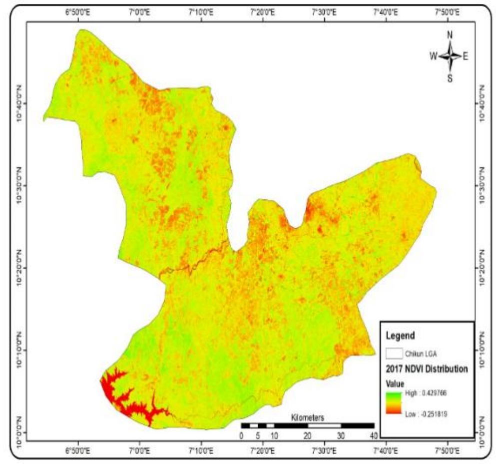

Figure 9: NDVI Map of Greenness Condition January 2017

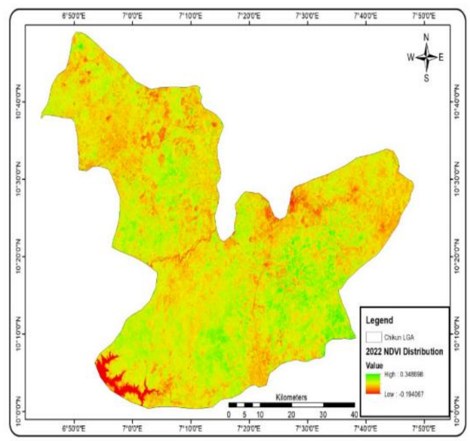

Figure 10: NDVI Map of Greenness Condition January 2022

RESULTS AND DISCUSSION

The outcome of the classified maps of Chikun LGA over the thirty-five (35) years of the study area (1987 - 2022) was generated and presented in Figures 11 to 18, while Table 2 summarizes the total land area for each class across the study area and the corresponding percentage of the total. The map was classified into six classes of built-up areas, vegetation cover, cultivated areas, water bodies, bare surfaces, and rock outcrops.

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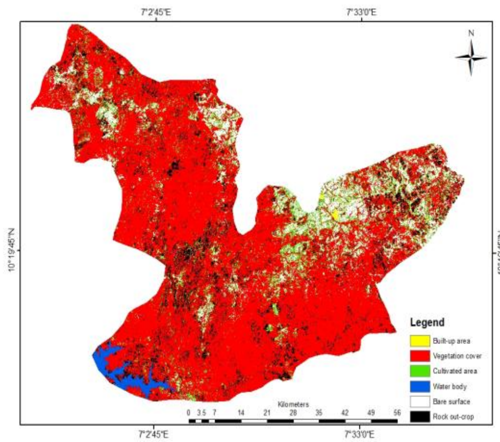

Figure 11: Classified map 1987 of Chikun LGA

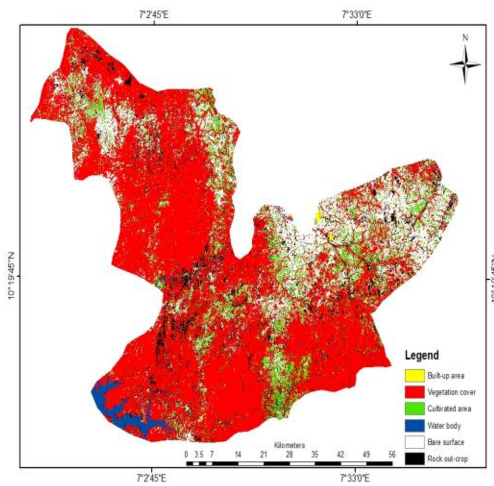

Figure 12: Classified map 1992 of Chikun LGA.

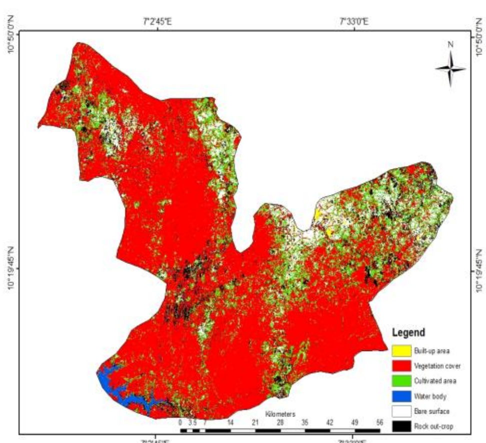

Figure 13: Classified map1997 of Chikun LGA

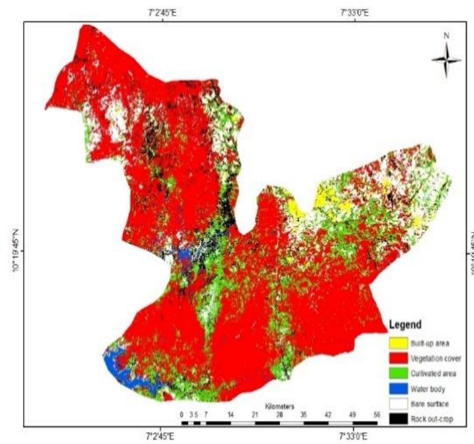

Figure 14: Classified map 2002 of Chikun LGA

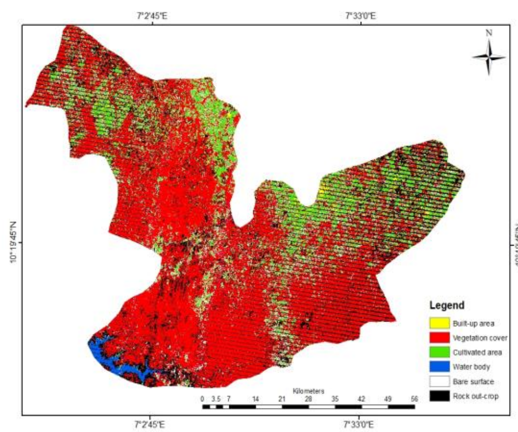

Figure 15: Classified map 2007 of Chikun LGA

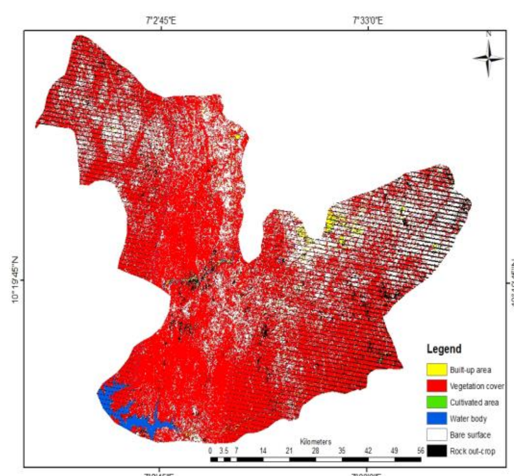

Figure 16: Classified map 2012 of Chikun LGA.

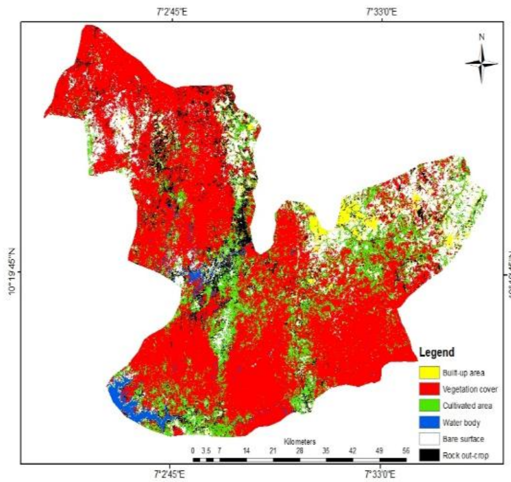

Figure 17: Classified map 2017 of Chikun LGA.

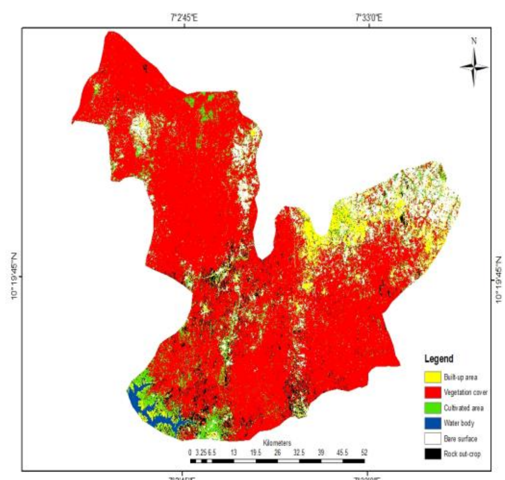

Figure 18: Classified map 2022 of Chikun LGA.

Built-up area

The built-up area in Chikun Local Government Area (LGA) experienced significant growth from 1987 to 2022, as evidenced by the results presented in Table 2. Initially covering only 41 km² (0.84%) in 1987, the built-up area increased steadily, reaching 415 km² (8.54%) by 2022. Notable increases occurred during certain periods, such as from 145 km² (2.98%) in 1997 to 237 km² (4.88%) in 2002, and again from 317 km² (6.52%) in 2012 to 402 km² (8.27%) in 2017. This upward trend in built-up areas indicates a clear shift towards urbanization in the study area, driven primarily by rising demands for housing and infrastructure to support a growing population. This finding agrees with the study by Shehu *et al.* (2020) on the Extent and Rate of Changes in Land use/Landcover Around Kaduna Refining and Petrochemical Company, Chikun Local Government, and found that built-up areas occupied 8.93Km² (6.11%) in 1974, subsequently increasing to 78.62Km² (53.75%) in 2018. Additionally, the finding also aligns with the study by Benedine *et al. (*2017) in their study Geospatial Analysis of Urban Expansion and Its Impact on Vegetation Cover in Kaduna Metropolis, Nigeria, that the increase in built-up area could be attributed to one of the most severe post-crises periods that occurred in the area, which was ethno-religious in nature. The crises prompted the mass movement of people to parts of the metropolis where they felt secure. 3.1. This exerted pressure on the land, leading to an increase in built-up land use at the expense of other land cover types, particularly vegetation.

Vegetation Cover

It was observed that vegetation accounted for 77.47% of the total land area. However, this proportion steadily declined to 74.1% in 1992, 73.05% in 1997, 70.25% in 2002, and 66.34% in 2007, and reached its lowest point of 61.69% in 2012. This downward trend can be attributed to the rapid expansion of built-up areas for residential, commercial, and industrial purposes, as well as the conversion of land for agricultural activities. The clearing of vegetation to make way for built-up development and farmland has led to a significant loss of natural habitats and biodiversity in the study area. This finding is consistent with *et al.* (2020), who studied the extent and rate of changes in land use/landcover around the Kaduna refining and petrochemical company, which found that Vegetation occupied 61.88Km² (42.31%) in 1974 and had reduced to 12.38Km² (8.46%) in 2018. The indiscriminate removal of vegetation cover for built-up areas may result in erosion, air pollution, and increased atmospheric carbon, which in turn contribute to adverse effects such as global warming.

Cultivated Area

The class represented in light green comprised mainly farm areas and arable land, the cultivated land was 253 km² (5.21%) in 1987 and increased to 285 km² (5.86%) in 1992. Although Chikun LGA is an agricultural community, the increase in population growth has contributed to the increase in both rural and urban farming. Cultivated area steadily declined from 431 km² (8.87%) in 1997 to 404 km² (8.31%) in 2002. It further increased to 556 km² (11.44%) in 2007 and decreased to 546 km² (11.24%) in 2012. It also witnessed a steady decrease from 506 km² (10.41%) to 324 km² (6.67%) in 2017 and 2022, respectively. The observed decrease was a result of the conversion of existing farmlands for built-up development purposes. A similar study by Ancha *et al.* (2021) reveals that cultivated land decreased from 433.94 km2 (32.58%) in 1985 to 246.02 km² (18.47%) in 2000. The decline in cultivated land may be attributed to increased rural-urban migration, which reduces the rural population and consequently, leads to a decline in agricultural land use. The decrease in cultivated land and vegetation cover was a result of their transitions to the built-up areas.

Water Body

This category, represented in blue, stands for rivers and streams. The extent of water bodies was 68 km² (1.40%) in 1987, which increased slightly to 74 km² (1.52%) in 1992. However, this trend did not continue, as the area of water bodies decreased significantly to 53 km² (1.09%) in 1997 and further to 27 km² (0.56%) in 2002. There was a notable recovery, with water bodies increasing to 61 km² (1.26%) in 2007, 91 km² (1.87%) in 2012, and reaching 93 km² (1.91%) in 2017. Unfortunately, this positive trend was interrupted by a sudden decrease to 49 km² (1.01%) by 2022. The fluctuation in the water body can be attributed to a combination of factors, including satellite imageries of the area that were captured during the dry season when the rains are completely gone, seasonal rainfall patterns, siltation of parts of Shiroro dam, and runoff channels, it could also be a result of the conversion of

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waterways for built-up development. Consequently, the water body remained relatively unstable, experiencing notable fluctuation throughout the study period, this contrasts with the finding of Sule *et al.* (2023), who reported a progressive decline in water bodies between 1990 and 2020, followed by a slight increase in 2019. The continuous decrease in water surface coverage may be attributed to the encroachment of urban infrastructure into wetland and marshland.

Bare surface

The bare surface, represented in white, encompasses areas characterized by exposed soil, rock, and other non-vegetated surfaces (Figure 11 to 18). The extent of bare surfaces was 524 km² (10.78%) in 1987, increasing to 659 km² (13.56%) in 1992. However, this area decreased to 574 km² (11.81%) in 1997, followed by an increase to 657 km² (13.52%) in 2002. The trend continued with a decrease to 592 km² (12.18%) in 2007, followed by an increase to 766 km² (15.76%) in 2012. Subsequently, there was a steady decline to 582 km² (11.98%) in 2017 and further to 469 km² (9.65%) in 2022. The steady decrease from 2017 to 2022 could be attributed to rural to urban migration caused by insurgency in some parts of the area, which has adversely reduced the conversion of bare surfaces into agricultural land and the development of built-up areas. This result is consistent with the findings of Mbaya *et al.* (2019), who reported that bare surfaces covered about 11% in 1976, increased to about 13% in 1996, and further rose to 17% in 2016. This increase may be attributed to the fact that open spaces are more readily converted to urban development.

Rock outcrop

Rock outcrop category (Figure 11 to 18), represented in black, and the extent of rock outcrops was 209 km² (4.30%) in 1987, but this figure decreased to 158 km² (3.25%) by 1992 and further declined to 107 km² (2.29%) in 1997. There was a slight recovery in 2002, with rock outcrops increasing to 121 km² (2.49%) and further to 149 km² (3.07%) in 2007. However, this was followed by another decline to 142 km² (2.92%) in 2012 and 139 km² (2.86%) in 2017. Notably, rock outcrops increased again to 157 km² (3.32%) in 2022.

Table 2. Detected classified map of Chikun LGA between 1987 and 2022.
Source: Author's Analysis (2024)

Year	1987		1992		1997		2002		2007		2012		2017		2022	
Land cover category	Area (km²)	%	Area (km²)	%	Area (km²)	%	Area (km²)	%	Area (km²)	%	Area (km²)	%	Area (km²)	%	Area (km²)	%
Built-up area	41	0.84	83	1.71	145	2.98	237	4.88	278	5.72	317	6.52	402	8.27	415	8.54
Vegetation cover	3765	77.47	3601	74.1	3550	73.05	3414	70.25	3224	66.34	2998	61.69	3138	64.57	3446	70.91
Cultivated area	253	5.21	285	5.86	431	8.87	404	8.31	556	11.43	546	11.24	506	10.41	324	6.66
Water body	68	1.40	74	1.52	53	1.09	27	0.56	61	1.26	91	1.87	93	1.91	49	1.01
Bare surface	524	10.78	659	13.56	574	11.81	657	13.52	592	12.18	766	15.76	582	11.98	469	9.65
Rock out-crop	209	4.30	158	3.25	107	2.20	121	2.48	149	3.07	142	2.92	139	2.86	157	3.23
Total	4860	100	4860	100	4860	100	4860	100	4860	100	4860	100	4860	100	4860	100

Assessment of classification accuracy of Chikun LGA (1987, 1992, 1997, 2002, 2007, 2012, 2017, and 2022)

The classification accuracy assessment for the eight time periods: 1987, 1992, 1997, 2002, 2007, 2012, 2017, and 2022 in Chikun LGA were 82.66%, 83.60%, 83.62%, 81.30%, 83.13%, 85.41%, 80.00%, and 83.42%, respectively. Additionally, these results indicate a satisfactory level of accuracy, making the classifications suitable for further land cover change detection and analysis. User accuracy across the various land cover categories ranged from 81.81% to 95.43%, while producer accuracy varied between 80.00% and 96.60%, further demonstrating the reliability of the classifications. To assess the overall agreement between the classified maps and reference data, kappa coefficients were computed for each period. The kappa values for 1987, 1992, 1997, 2002, 2007, 2012, 2017, and 2022 were 0.82, 0.801, 0.83, 0.86, 0.84, 0.809, 0.87, and 0.89, respectively. These values fall within the range of strong to almost perfect agreement according to the kappa scale, confirming the robustness and reliability of the classification outputs.

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Table 3. Accuracy assessment of Chikun LGA classified map (1987, 1992, 1997, 2002, 2007, 2012, 2017, and 2022)

	1987		1992		1997		2002		2007		2012		2017		2022	
Class Name	**Producer's Accuracy (%)**	**User's Accuracy (%)**	**Producer's Accuracy (%)**	**User's Accuracy (%)**	**Producer's Accuracy (%)**	**User's Accuracy (%)**	**Producer's Accuracy (%)**	**User's Accuracy (%)**	**Producer's Accuracy (%)**	**User's Accuracy (%)**	**Producer's Accuracy (%)**	**User's Accuracy (%)**	**Producer's Accuracy (%)**	**User's Accuracy (%)**	**Producer's Accuracy (%)**	**User's Accuracy (%)**
Built-up area	85.00	83.21	96.60	88.00	90.43	83.60	81.44	93.30	85.21	91.00	93.70	87.70	80.00	88.80	81.81	90.00
Vegetation cover	91.12	90.55	92.13	90.20	89.00	92.03	87.96	88.96	91.08	92.03	90.62	92.14	90.97	86.63	89.53	90.81
Cultivated area	81.23	84.41	90.00	95.00	91.60	83.30	91.60	86.57	88.80	82.00	88.80	84.72	80.00	85.72	83.63	87.00
Water body	82.61	80.01	83.35	91.43	84.53	89.34	85.72	85.71	83.30	95.43	90.70	87.60	94.72	87.50	83.30	92.23
Bare surface	80.00	88.80	86.60	85.71	87.92	90.90	81.81	81.81	85.63	87.50	89.00	92.31	90.90	83.30	89.59	80.00
Rock out-crop	89.23	90.00	91.30	93.63	81.54	84.53	83.43	86.54	82.92	86.92	84.22	88.95	81.75	83.18	86.00	85.71
Overall classification Accuracy (%)	**82.66**		**80.60**		**81.30**		**83.13**		**85.41**		**88.00**		**83.41**		**86.60**	
Overall Kappa	**0.82**		**0.801**		**0.83**		**0.86**		**0.84**		**0.809**		**0.87**		**0.89**	

Trends in Changes between Built-Up Area and Vegetation Cover (1987 and 2022)

The analysis of built-up area and vegetation cover changes in Chikun Local Government Area (LGA) between 1987 and 2022 highlights significant transformations in the spatial extent of built-up areas and vegetation cover. The table 4 below, presents the trends and variance in these land cover categories over the study period, providing insights into the dynamic interplay between urban development and natural vegetation. The result presents the trends of changes between built-up area and vegetation cover in Chikun LGA from 1987 to 2022. The data indicates that built-up area increased from 41 km² (0.83%) in 1987 to 415 km² (8.52%) in 2022, while vegetation cover decreased from 3,765 km² (77.47%) to 3,446 km² (70.91%) during the same period. This significant divergence highlights the impact of built-up on natural landscapes in the study area.

Vegetation cover was observed to be the dominant land use type, decreasing from 3,765 km² (77.47%) in 1987 to 3,601 km² (74.10%) in 1992, as presented below. This decline indicates the expansion of built-up areas, the removal of vegetation cover, and other developmental activities, which are clear signs of the gradual expansion of Chikun LGA to accommodate more economic and human activities. The gradual increase in built-up areas from 41 km² (0.83%) in 1987 to 83 km² (1.71%) in 1992 began to exert a significant impact on vegetation cover. The study revealed that vegetation covers further decreased to 3,550 km² (73.05%) in 1997 and 3,414 km² (70.25%) in 2002. During this period, there was a notable increase in built-up areas, which expanded from 145 km² (2.98%) in 1997 to 237km² (4.88%) in 2022.

Table 4. Changes in Built-Up Area and Vegetation Cover (1987 and 2022). Source: Author's Analysis (2024)

Year	**1987**	**1992**	**1997**	**2002**	**2007**	**2012**	**2017**	**2022**	**Variance**
Land cover Built-up area Vegetation cover	Area (km²) % 41 . 83 3765 7.47	Area (km²) % 83 1.71 3601 4.10	Area (km²)% 145 2.98 3550 3.05	Area (km²) % 237 4.88 3414 0.25	Area (km²) % 278 5.72 3224 6.34	Area (km²) % 317 6.52 2998 1.69	Area (km²) % 402 8.27 3138 4.57	Area (km²) % 415 8.52 3446 0.91	% 7.69 - 6.56

Table IV presents the trends in changes between built-up area and vegetation cover between 1987 and 2022. The changes focused more on the Built-up area and vegetation cover. In assessing the trend in vegetation cover and built-up area, vegetation cover

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declined significantly to 3,2 declined significantly to 4 km² (66.34%) in declined significantly to declined significantly to 2007 and further to 2,998 km² (61.69%) in 2012. Meanwhile, built-up areas increased significantly, covering an area of 278 km² (5.72%) to 317 km² (6.52%) during the same period. The detected trend in vegetation cover indicates a gradual increase to 3,138 km² (64.57%) in 2017 and 3,446 km² (70.91%) in 2022, suggesting potential vegetation restoration efforts or natural regrowth in certain areas. However, juxtaposed with this trend is a noticeable increase in built-up area from 402 km² (8.27%) in 2017 to 415 km² (8.52%) in 2022, likely driven by built-up and population growth.

The implications of the trends in built-up area and vegetation cover in Chikun LGA underscore the need for sustainable urban planning and land management strategies that balance development with environmental conservation. Policymakers should prioritize the preservation of green spaces, and promote the use of native plant species in landscaping to mitigate the negative impacts of expanding built-up areas on vegetation cover. Additionally, measures should be taken to ensure that built-up expansion occurs in a planned and controlled manner, minimizing the encroachment on sensitive ecological areas.

The variance in the magnitude of change in vegetation cover and built-up area between 1987 and 2022 illustrates how significantly human activities have exploited vegetation cover to meet daily needs without adequate consideration for the natural environment. Between 1987 and 2022, vegetation cover declined by 6.56%, while built-up area expanded, showing a 7.69% increase in their share of the total land area. This magnitude of change reflects a significant shift, with rapid built-up and population growth leading to considerable expansion of built-up areas at the expense of natural vegetation cover. Monitoring these changes through remote sensing or aerial surveys provides valuable insights into the environmental impact of built-up area development and the effectiveness of vegetation cover in Chikun LGA.
These findings are consistent with a study by Gandapa (2018) in Hong LGA, Adamawa State, which found an increase in built-up area with a percentage variance of 1.25 and a decrease in vegetation cover of 19.79 between 1976 and 2009. Furthermore, the finding also aligns with (Narducci *et al.,* 2019), which examined implications of urban growth and farmland loss for ecosystem services in the western United States and found that Population growth and urbanization can drive the conversion of vegetation cover to built-up areas, and altering land use patterns. Similarly, Rahmadi *et al.* (2023) reported that urbanization in coastal areas of Philippines has converted mangrove forests and other natural habitats into built environments, leading to significant ecological consequences. These studies collectively underscore the global trend of built-up leading to the loss of vegetation cover and the urgent need for effective land management strategies to balance development with environmental conservation.

Conclusion
This study assessed the effects of built-up areas on vegetation cover in Chikun LGA. Results revealed a significant reduction in vegetation cover over the study period, largely attributed to the expansion of built-up areas driven by population growth, urbanization, and infrastructure development. This trend highlights the adverse impacts of anthropogenic activities on the environment, particularly biodiversity loss, declining ecological services, and heightened vulnerability to climate change. The study emphasizes the importance of sustainable land-use planning to achieve a balance between development and environmental conservation in the area. A proactive and balanced approach that prioritizes sustainable development, community engagement, and targeted remediation strategies is essential to mitigate the negative impacts and enhance the positive outcomes of urbanization. By integrating these strategies into urban planning, Chikun LGA can work towards a more sustainable and equitable future for all its residents.

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