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Land Use and Land Cover Change in Kakau Chikun Local Government Area, Kaduna State: The Aftermath of Banditry

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ABSTRACT

In Nigeria, particularly in the Northwest region, banditry has intensified, causing widespread insecurity. States like Kaduna, Katsina, and Zamfara have become hotspots, with bandit groups armed with automatic weapons terrorizing communities, killing, kidnapping, and pillaging resources. The research aimed to examine the effect of banditry on land use and land cover in Chikun LGA, Kaduna State. These disruptions not only threaten safety but also reshape the landscape, leading to changes in land use patterns, abandonment of farmland, and alterations in socio-economic activities. The methodology of research includes primary data, used are satellite imageries (Landsat 7 and Landsat 8, and Landsat 9), and Secondary Data are literature that were sourced from newspapers, journals, and textbooks. The result of the study revealed that in 2023, the land use and land cover had slightly changed from 2014 to 2023. Built-up area occupied 137 km^2, that is 29%, Bare land occupied 51 km^2, that is 11%, Water body covers 3 km^2, that is 1%, while vegetation occupied 100 km^2, that is 21% and Farm land occupied 182 km^2, that is 38%. The study concludes that using Landsat 8 imagery (2014, 2018, 2023) to assess how banditry has altered land use/land cover in the area shows that farmland initially dominated the landscape, while built-up areas and water bodies occupied the smallest shares in Kakau town. By 2023, farmland had declined, and built-up areas had expanded, indicating substantial shifts in land use patterns.

Keywords: landuse; landcover; effect; banditry; chikun and changes

INTRODUCTION

Banditry is a form of organized crime characterized by violence, robbery, and lawlessness, often facilitated by groups known as bandits. It is a global phenomenon that tends to thrive in regions with weak governance, economic disparities, social tensions, and porous borders (Osasona, 2023; Shola, 2022). The criminal activities linked to banditry include extortion, kidnapping, murder, and piracy, which severely undermine security and socio-economic development (Mmahi and Usman, 2023).

In Nigeria, particularly in the Northwest region, banditry has intensified, causing widespread insecurity. States like Kaduna, Katsina, and Zamfara have become hotspots, with bandit groups armed with automatic weapons terrorizing communities, killing, kidnapping, and pillaging resources (Milaham et al., 2022; Olapeju and Peter, 2021). The underlying causes, fragile state institutions, ungoverned spaces, border porousness, arms proliferation, corruption, unemployment, and poverty have contributed to the surge in banditry (Olapeju and Peter, 2021; Ameh and Aliyu, 2023). The situation has led to significant loss of life, displacement, and economic devastation, particularly in rural areas reliant on farming and livestock.

In Kaduna State, the impact is profound, with ongoing attacks hampering farming activities, closing markets, and causing mass migration from affected communities. The violence has severely damaged several rural economies, pushing communities toward collapse. Notable incidents include the kidnapping of the Emir of Kajuru and mass abductions of students, with recent reports highlighting persistent insecurity and community frustration (Ugbomah, Omede, and Philomina, 2022; Sanchi et al., 2022). Residents feel abandoned by government authorities, and tensions have escalated, exemplified by community protests following deadly attacks (Onwaniban, 2020). Kakau in Chikun Local Government Area, a suburb of Kaduna metropolis, has, over the years, experienced significant bandit activities; while many surrounding rural communities sought refuge there, Kakau itself was also under attack, forcing residents to abandon their belongings. Banditry has severely affected farmers and other land users, leading to reduced crop production and heightened food insecurity. The violence has caused widespread land abandonment, resulting in increased fallow land that has become overgrown with vegetation, providing bandits with hiding places.

This situation has expanded ungoverned spaces, forced population movement toward Kaduna city, and driven up food and housing costs. Additionally, bandits exploit these abandoned farmlands to launch attacks even near the Kaduna metropolis, worsening the region's insecurity and instability.

Understanding the influence of banditry on land use and land cover is crucial for devising strategies to mitigate its effects. These disruptions not only threaten safety but also reshape the landscape, leading to changes in land use patterns, abandonment of farmland, and alterations in socio-economic activities. Addressing these impacts can foster more sustainable land management and community resilience in affected areas (Okoli and Abubakar, 2021).

STUDY AREA

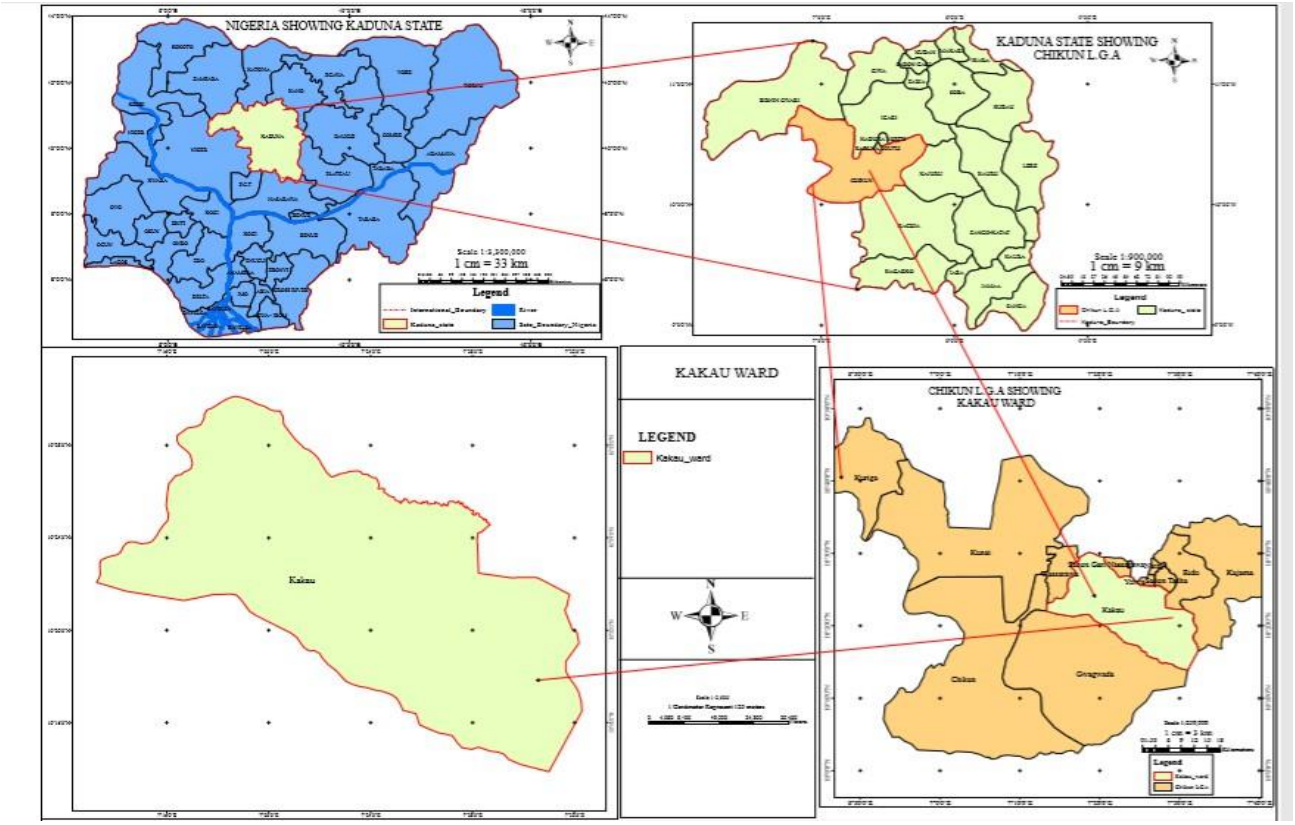

FIGURE 1: Kaduna state map showing the study area.
Source: Field survey, 2025.

GEOGRAPHIC LOCATION

Kakau ward is located in Chikun local government, Kaduna, Nigeria, and it has its geographical coordinates as 10°16' 0" North, 7° 6' 0" East. Kakau shares boundaries with Kachia LGA, Kajuru. L.G.A., Kaduna South LGA, Igabi Local Government Area, Birnin Gwari Local Government Area to the northwest, and Niger State, respectively. (Umaru, et al,2022). The climatic condition of the study area is by no means different from the normal climate experienced in other parts of Chikun LGA. The area witnesses two major seasons, which are the dry season lasting from October to April, while the rainy season commences in May and climaxes in September, and has an average annual temperature of 33 degrees centigrade (Umaru et al, 2022).

The major economic activities of the locals are primarily agriculture-based, with residents engaged in farming a wide variety of crops. In addition to agriculture, other significant economic activities include traditional crafts such as weaving textiles, producing mats, and pottery. These activities sustain the local economy alongside thriving trade in various markets within the area and other social activities in the Kakau community itself (Umaru et. al, 2022).

RESEARCH METHODOLOGY

Data types and Sources

The Data for this study were derived from primary and secondary sources. Primary data used are satellite images (Landsat 7 and Landsat 8, and Landsat 9). The Secondary Data used are other literature, which were sourced from newspapers, journals, textbooks, etc.

TABLE 1: Data types and Sources.

S/N	Types of data	Spatial resolution	Date	Source
1.	Landsat 7	30 meters	2013	United States Geological Survey(USGS)
2.	Landsat 8	30 meters	2018	United States Geological Survey(USGS)
3.	Landsat 9	30 meters	2023	United States Geological Survey(USGS)
4.	SRTM DEM (Digital Elevation Model)	5.4 Kilometer		Climate Hazard Centre

Source: Field survey, 2025.

DATA PROCESSING

Image Processing and Classification

Since the Landsat 8 imagery is digitally processed, that is, they were orthorectified, and there was no need for any geometric and radiometric corrections. However, the images were obtained in different layers, and the layers will be stacked together using ArcGIS 3.18 software; a subset of the study area will be obtained using the QGIS software subset tool.

QGIS software will be used for pixel-based classification. Supervised classification will be performed using a maximum likelihood classifier since it is a land use and land cover classification, which will produce the output raster layer. Supervised classification allows natural spectral clusters to be distinct with a high degree of objectivity.

This method of classification involves the procedure of identifying pixels possessing the same spectral features. QGIS software was used in digitally processing and identifying the spectral clusters on the Landsat images. The maximum likelihood algorithm was used to classify the image and the digital numbers of the pixels grouped with pixels arranged and organized, otherwise known as land cover classes such as built-up area, vegetation, bare surface, etc.

METHOD OF DATA ANALYSIS

Spatial Distribution of Land Use and Land Cover (LULC)

The different LULC categories were quantified using the field calculator in QGIS, which provided their areas in square kilometers to assess the spatial extent of each class. To express these extents as percentages, the total study area was calculated first, and then the area of each LULC class was divided by this total and multiplied by 100. A new attribute field was created using the field calculator to store these percentage values.

Temporal Changes in Land Use and Land Cover (LULC) Patterns

The change in LULC between two selected years was calculated by subtracting the value of the earlier year (A) from that of the later year (B), expressed mathematically as:

$$C=B-A$$

Where C is the magnitude of change, B represents the base year, and A is the reference year. The percentage change (E) was then determined by:

$$E=C/B\times100$$

Where E is the percentage change.

Annual Rate of Land Use Changes

To find the annual rate of change, the magnitude of change was divided by the number of years between the two periods. The formula used is:

$$R=CT$$

Where R is the annual rate of change, C is the magnitude of change, and T is the number of years over which the change occurred.

The maps from the years under study were overlaid to identify the areas most impacted by banditry. This analysis further illustrates how land use and land cover have been affected due to banditry. Additionally, a percentage rate of growth or decline was calculated, focusing primarily on vegetation and farmland, to assess the extent of banditry activity and its major impacts on the physical environment.

RESULTS AND DISCUSSIONS

Identification of Various Land Use and Land Cover of the Study Area

Identifying the various LULC of the study area, using Images derived from Landsat 8 imagery 2014, 2018, and 2023, the boundaries of the study area, ensuring it encompasses the entire area of interest, were observed. Image segmentation was used to partition the remote sensing data into meaningful and homogeneous regions. As shown in Figures 2, Figure 3, and Figure 4.

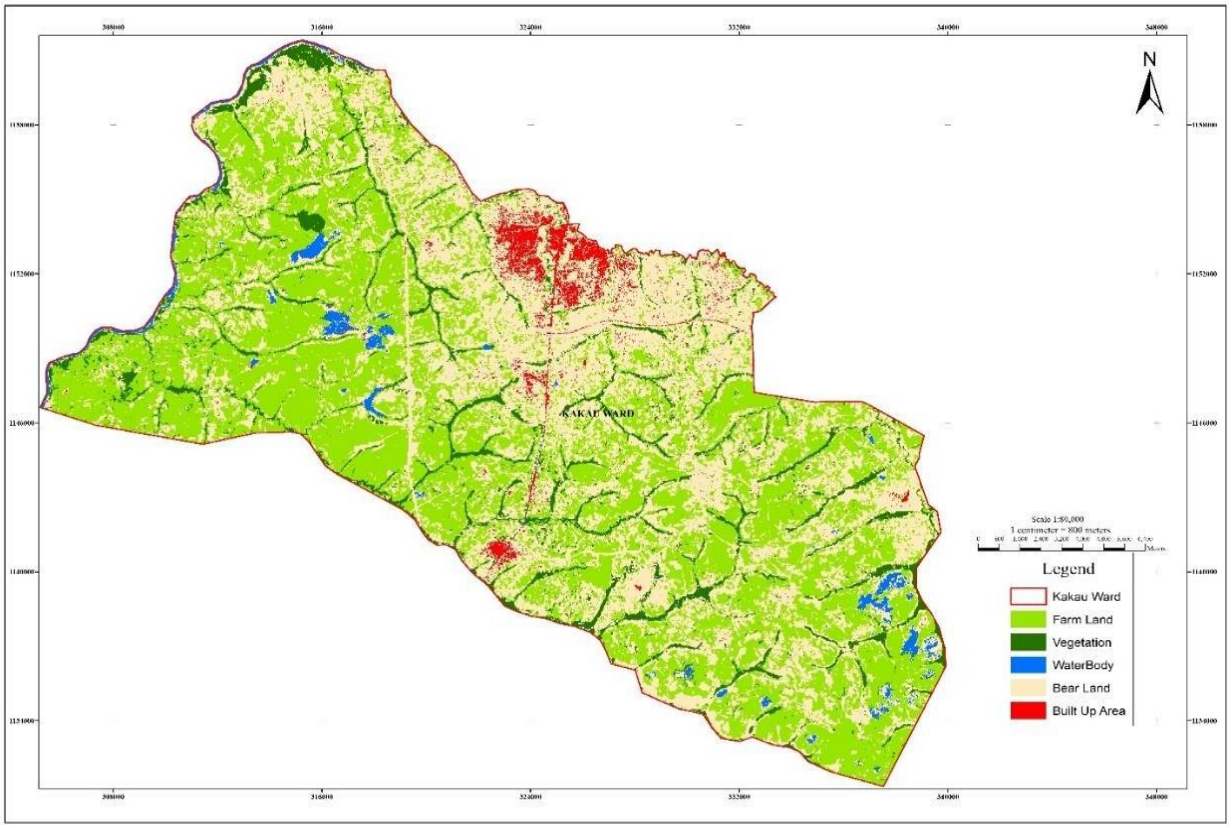

FIGURE 2: Identification of land use and land cover map 2014.
Source: Field survey, 2025.

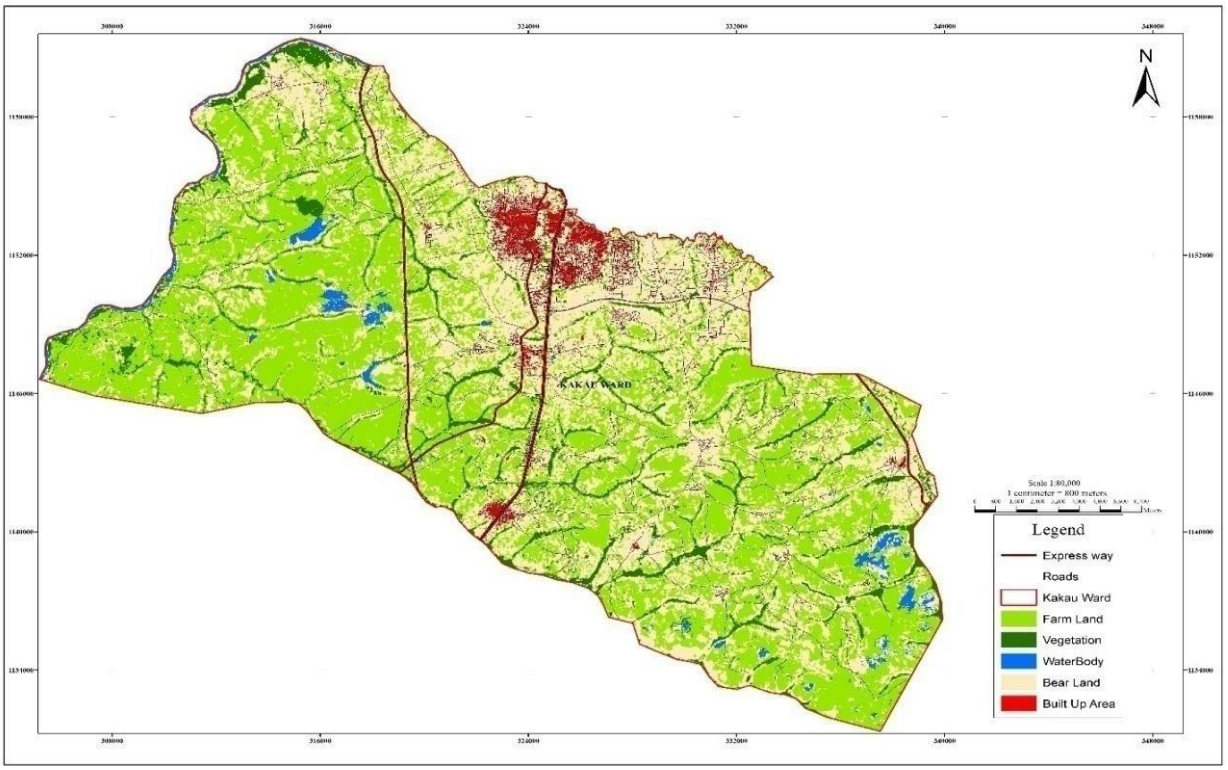

FIGURE 3: Identification of land use and land cover map 2018.
Source: Field survey, 2025.

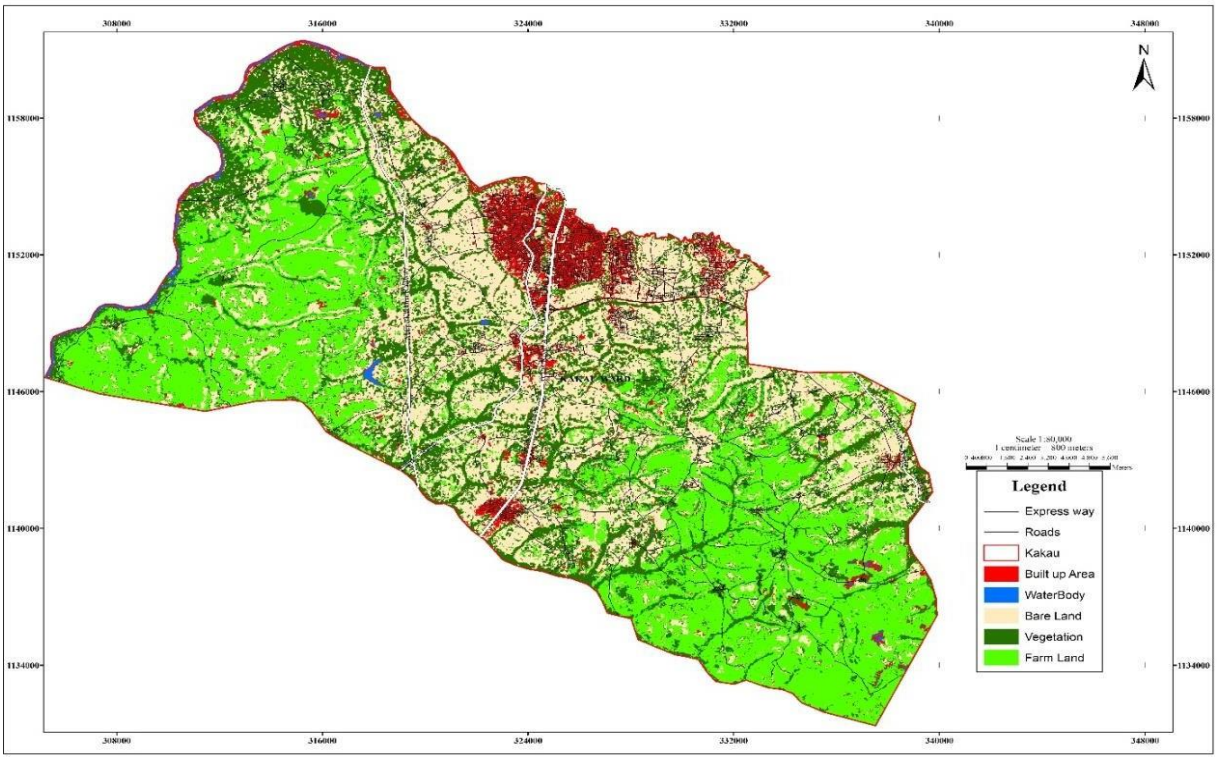

FIGURE 4: Identification of land use and land cover map 2023.
Source: Field survey, 2025.

TABLE 2: Land use and Land cover distribution as of 2014.

LULC 2014	Area	Percentage (%)
Bare Land	195.38	41%
Built-Up Area	9.41	2%
Farm Land	228.39	48%
Vegetation	33.37	7%
Water Body	7.45	2%
Grand Total	**474**	**100%**

Source: Field survey, 2025.

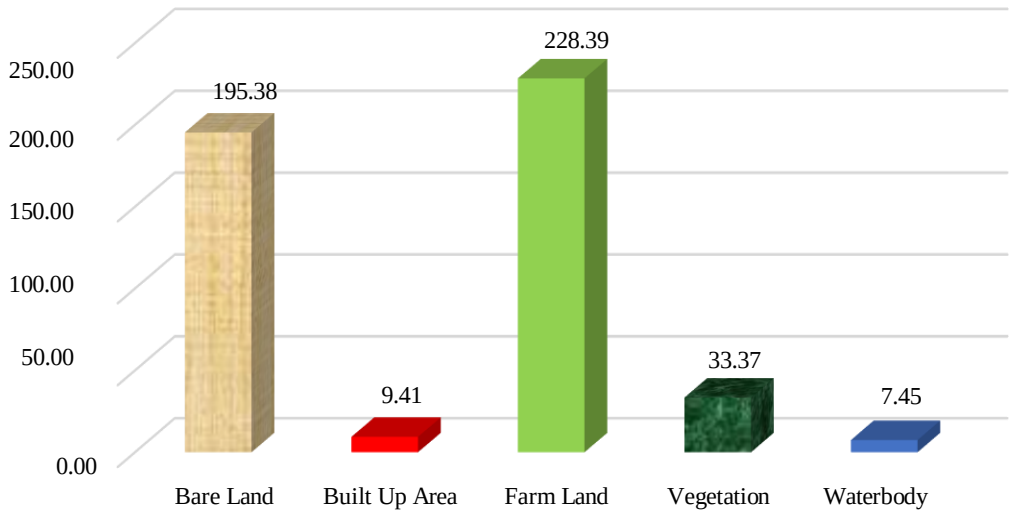

FIGURE 5: Land use and Land cover (2014).
Source: Field survey, 2025.

In 2023, the land use and land cover have slightly changed from 2014 to 2023. Built-up area occupied 137 km^2, which is 29%, Bare land occupied 51 km^2, that is 11%, Water body covers 3 km^2, that is 1%, while vegetation occupied 100 km^2, that is 21% and Farm land occupied 182 km^2, that is 38% as illustrated.

TABLE 3: Land use and Land cover distribution as of 2018.

LULC 2018	Area	Percentage (%)
Bare Land	181.0	38%
Built-up Area	17.9	4%
Farm Land	162.7	34%
Vegetation	109.9	23%
Water body	2.4	1%
Grand Total	**474.0**	**100%**

Source: Field survey, 2025.

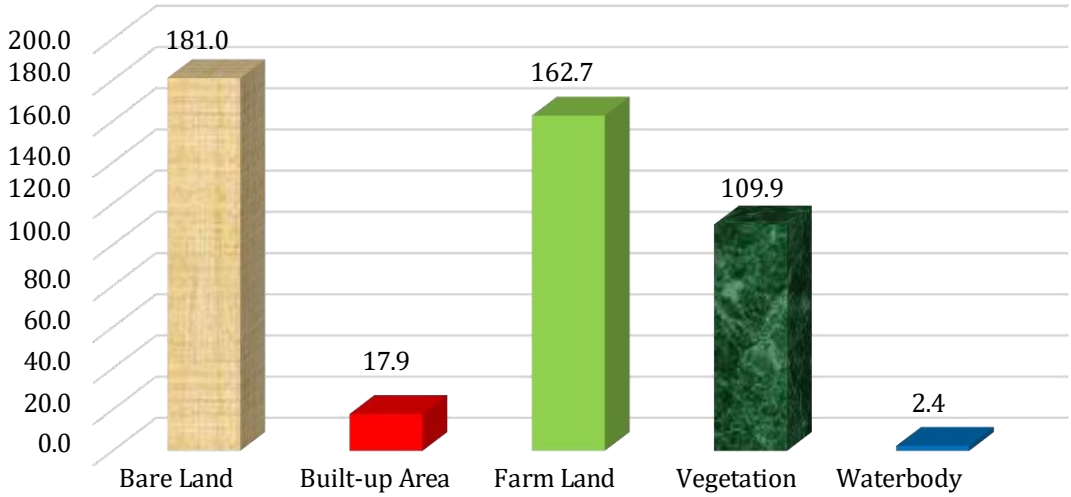

FIGURE 6: Land use and Land cover (2018).
Source: Field survey, 2025.

However, in determining the land use land cover, based on banditry affected, I discovered that the ruler dwellers in the Communities refuse to leave; they reclaim their lands based on heritage. And also, it was observed that the results gotten from the 2014, 2018, and 2023 show the interval of 9.41kmsq, 17.8kmsq, and 28kmsq, which tells us the rate of little increase in built-up area, which has reduced the development of the communities. It shows that they have some minimal development.

TABLE 4: Land use and Land cover distribution as of 2023.

LULC 2023	Area	Percentage (%)
Bare land	158	33%
Built-up Area	28	6%
Farm Land	170	36%
Vegetation	115	24%
Water Body	3	1%
Grand Total	**474**	**100%**

Source: Field survey, 2025.

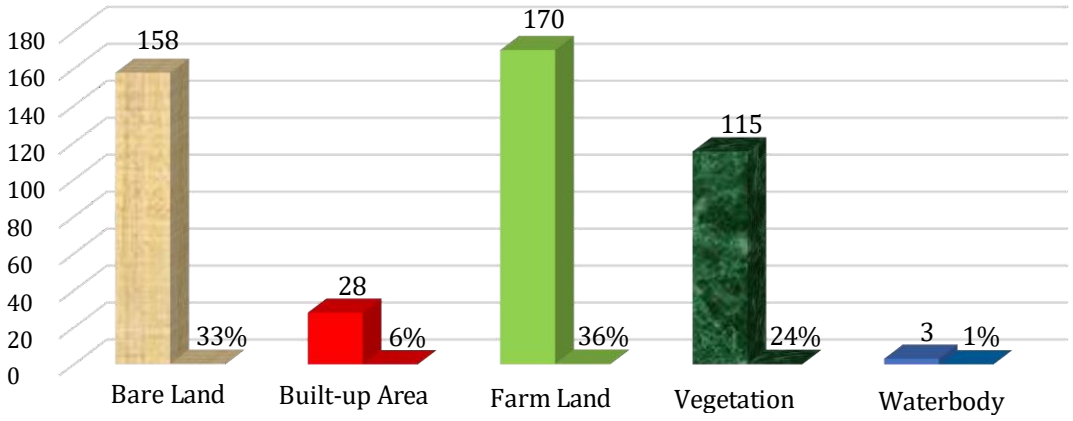

FIGURE 7: Land use and Land cover (2023).
Source: Field survey, 2025.

Rate of Change in the Land Use and Land Cover in the Study Area

Using the Maximum Likelihood Classification method, land use and land cover changes in the study area for 2014, 2018, and 2023 were categorized into five classes.

Figures 2, 5 and Table 5 reveal that in 2014, the majority of the area was farmland, covering 228.39 km^2 (48%), with built-up land occupying just 9.41 km^2 (2%).

TABLE 5: Determine the rate of change in the LULC in the study area due to banditry attacks.

Class Name	LULC 2014	%	LULC 2018	%	LULC 2023	%
Built-up Area	9.41	2%	17.9	4%	28	6%
Water body	7.45	2%	2.4	1%	3	1%
Bare Land	195.38	41%	181	38%	158	33%
Vegetation	33.37	7%	109.9	23%	115	24%
Farm Land	228.39	48%	162.7	34%	170	36%
Total	**474**	**100%**	**474**	**100%**	**474**	**100%**

Source: Field survey, 2025.

Bare land comprised 195.38 km^2 (41%), vegetation covered 33.37 km^2 (7%), and water bodies accounted for 7.45 km^2 (2%), making them the smallest landscape component. The rates of land-use and land-cover change, affected by banditry in the area, provided key insights into the spatial and temporal dynamics of land use and land cover in the study region.

In 2018, the land use and land cover have slightly changed from 2014 to 2018. Bare land occupied 181.0 km^2, which is 38%. Built-up Area occupied 17.9 km^2, which is 4%, Water body covers 2.4 km^2, which is 1%, while vegetation occupied 109.9 square kilometers, which is 23% and Farm land occupied 162.7 km^2, which is 34% as illustrated.

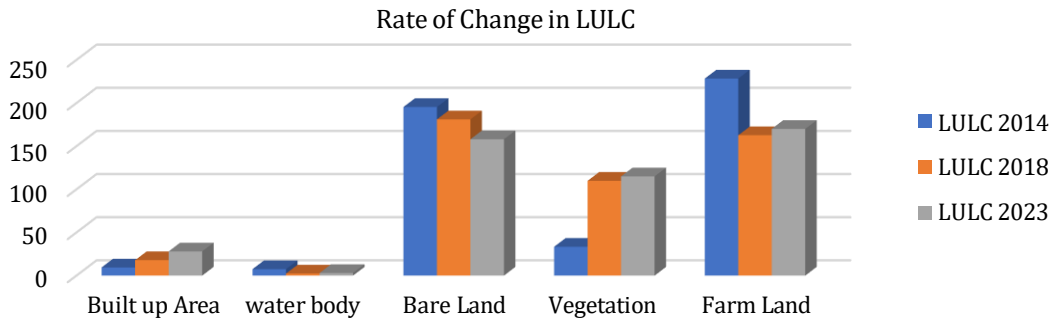

FIGURE 8: Bar graph showing the rate of change in the LULC in the study area.
Source: Field survey, 2025.

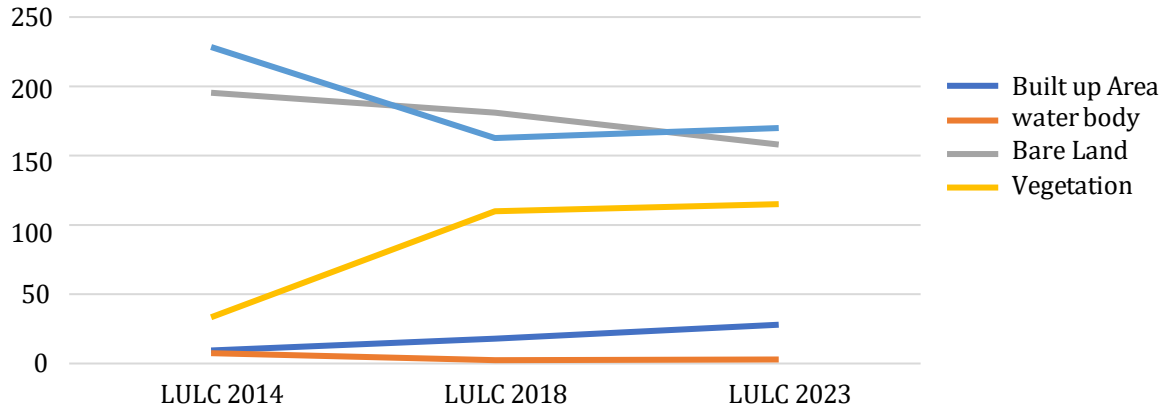

FIGURE 9: Stacked line showing the rate of change in the LULC in the study area.
Source: Field survey, 2025.

According to the analyses above, farm land, vegetation, and bare land are increasing over the period 2014, 2018, and 2023, which has shown how validating banditry has affected these communities, and they are reducing in social and economic activities in this area.

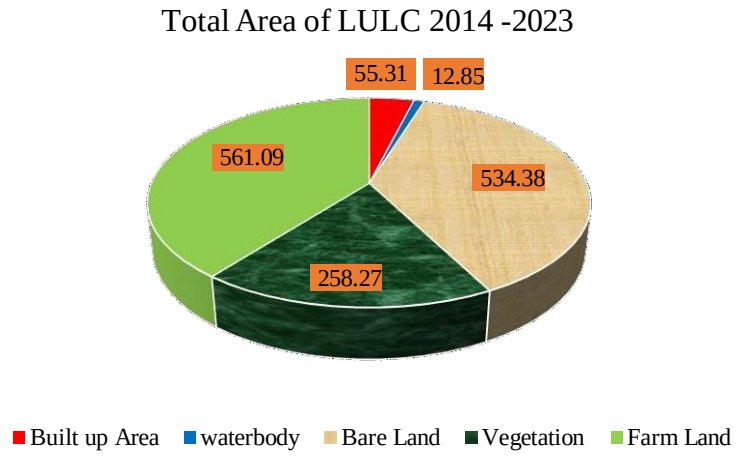

FIGURE 10: Pie chart showing the rate of change in the LULC from 2014 to 2023.
Source: Field survey, 2025.

TABLE 6: Rate of change for LULU from 2014 – 2023.

Class Name	LULC 2014 – 2018		LULC 2018 - 2023		LULC 2014 – 2023	
	Area	%	Area	%	Area	%
Bare land	-14.38	-7.36	-23	-12.70	-37.38	-19.13
Built-Up	8.49	90.22	10.1	56.42	18.59	195.55
Farmland	-65.69	-28.76	7.3	4.48	-58.39	-25.56
Vegetation	76.53	229.33	5.1	4.64	81.63	244.62
Water body	-5.05	-67.78	0.6	25	-4.45	-59.73

Source: Field survey, 2025.

Land use and land cover (LULC) dynamics for 2014, 2018, and 2023 were quantified using post-classification comparison of five thematic classes: farmland, built-up area, bare land, vegetation, and water bodies. As shown in Table 5, in 2014, farmland was the dominant class, occupying 48% of the total area, followed by bare land (41%), vegetation (7%), built-up area (2%), and water bodies (2%). Between 2014 and 2018, farmland declined to 34% (rate of change ≈ −16.4-16.4−16.4), while by 2023 it further reduced to 38% with an additional negative change of about −14.6- 14.6−14.6, indicating a net contraction of agricultural land over the study period. Built-up areas increased from 2% in 2014 to 29% in 2023, with an estimated positive rate of change of approximately 4.6, reflecting progressive urban expansion and conversion of non-urban classes into developed land.

Bare land decreased from 41% in 2014 to 11% in 2023 (rate of change ≈ −9.3-9.3−9.3), suggesting a transition to either vegetated, agricultural, or built-up surfaces. Vegetation cover changed from 7% in 2014 to 21% in 2023 as shown in Figure 4 above, with a positive rate of change of about 20.4, indicating localized gains in natural or semi-natural cover, possibly through regeneration or afforestation processes. Water bodies remained relatively stable at about 2% of the total area across all epochs, with only minor inter-annual fluctuations.

Map and Identify the Areas Affected by Banditry

From 2014 to 2023, land use/land cover analysis was applied to delineate areas with high concentrations of banditry incidents, including Rugar Bawa, Sabon Gida, Kubusu, Rugan Shai, Juji, Unguwar Waira, Jimmu, and Sauna. Kakau recorded a pronounced increase in built-up area, reflecting the relocation of populations from these affected communities. Multi-temporal satellite imagery from the United States Geological Survey (USGS), combined with secondary data, was used to map the impacted areas (Figure 4). High-resolution USGS imagery provided detailed spatial information on the study area, and the resulting LULC maps were overlaid with incident data to isolate the effects of banditry on land cover.

The analysis showed a substantial increase in vegetation and a corresponding decline in farmland within the affected zones. As presented in Table 5, vegetation expanded by approximately 244.62% (81.63 km^2 of the total area), while farmland decreased by about 25.56% (−58.39 km^2). This indicates widespread farmland abandonment and subsequent vegetation regrowth in communities activities, stalled development, and lower church attendance among children due to insecurity. Overall, the findings underscore an urgent need for targeted research, planning, and interventions to mitigate the effects of banditry on land systems and local development.

RECOMMENDATION

Based on the findings and conclusions of this study, several recommendations can be made to address the impact of banditry on land use, land cover, and development in the study area:

I. Strengthen Security Measures: Given the significant impact of banditry on the affected communities, it is crucial to prioritize security measures in the region. Enhanced law enforcement presence, strategic deployment of security personnel, and intelligence-driven operations can help deter banditry attacks and provide a safer environment for community members.

II. Sustainable Land Use Planning: Develop and implement comprehensive land use planning strategies that take into account the changing dynamics caused by banditry. This may involve zoning regulations, conservation efforts, and the promotion of sustainable agricultural practices to balance the needs of development with the preservation of natural resources.

most impacted by banditry. Banditry has therefore exerted marked negative effects on the study area, contributing to reduced agricultural production, weakened social and economic activity, and limited community development.

CONCLUSION

The study used maximum likelihood classification on Landsat 8 imagery (2014, 2018, 2023) to derive five land use/land cover classes: farmland, built-up area, bare land, vegetation, and water. In 2014, farmland (48%) and bare land (41%) dominated, while vegetation and water each covered 7% and 2%, and built-up area accounted for 2%. By 2018, farmland and bare land declined to 34% and 38%, respectively, whereas vegetation increased to 23%, built-up area to 4%, and water decreased to 1%. In 2023, the built-up area expanded sharply to 29%, farmland stabilized at 38%, bare land reduced to 11%, vegetation remained relatively high at 21%, and water persisted at 1%. These results indicate progressive urban growth, a contraction of bare surfaces, and a redistribution between cultivated and vegetated areas, highlighting substantial landscape transformation over the study decade.

In conclusion, using Landsat 8 imagery (2014, 2018, 2023) to assess how banditry has altered land use/land cover in the area shows farmland initially dominated the landscape, while built-up areas and water bodies occupied the smallest shares in Kakau town. By 2023, farmland had declined, and built-up areas had expanded, indicating substantial shifts in land use patterns. The most affected communities, such as Unguwar Waira, Unguwar Jimmu, Unguwar Sauna, Rugar Bawa, Sabon Gida, Kubusu Rugan Shai, and Juji, have experienced reduced socio-economic

III. Economic Revitalization and Development: Support economic revitalization efforts in the affected communities to mitigate the adverse socio-economic impacts of banditry. This can include providing financial assistance, vocational training programs, and access to markets, encouraging entrepreneurship, and attracting investments that can stimulate economic growth and create job opportunities to replace the lost agricultural activities.

IV. Infrastructure Development: Invest in infrastructure development projects, such as road networks, schools, healthcare facilities, and community centers, to improve the overall quality of life in the affected areas. Accessible infrastructure plays a vital role in promoting socio-economic activities, attracting investments, and fostering community resilience.

V. Continuous Monitoring and Research: Maintain an ongoing monitoring system to track changes in land use, land cover, and socio-economic indicators. Regularly update the data and conduct further research to assess the effectiveness of interventions, identify emerging trends, and adapt strategies accordingly.

VI. By implementing these recommendations, it is possible to mitigate the negative impacts of banditry, restore socio-economic activities, and promote sustainable development in the affected communities. The collective efforts of stakeholders, along with the engagement and empowerment of the local population, are crucial in building resilience, fostering security, and creating a brighter future for the study area.

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