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RESEARCH ARTICLE

SPATIO-TEMPORAL ANALYSIS OF FOREST COVER DYNAMICS (1987-2024) AND ITS IMPLICATIONS FOR CONSERVATION IN OVIA SOUTH-WEST, EDO STATE, NIGERIA

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Abstract

Forests are critical global assets supporting biodiversity, ecosystem services, and millions of livelihoods, yet they face severe threats from anthropogenic pressure. This is particularly acute in the Niger Delta region of Nigeria, where quantitative data on long-term forest cover dynamics is sparse. This study employed Remote Sensing (RS) and Geographic Information Systems (GIS) to assess spatio-temporal changes in forest cover in Ovia South-West Local Government Area, Edo State, over a 37-year period (1987–2024). Landsat 5 TM (1987) and Landsat 8 OLI/TIRS (2024) imageries were classified into four land-use classes: Forest, Disturbed Forest, Farmland, and Built-up Area. The analysis revealed a severe and rapid decline in pristine forest cover. The area under natural Forest plummeted from 202,031.28 hectares (76.95%) in 1987 to 110,449.55 hectares (42.07%) in 2024, representing a loss of 91,581.73 hectares or 50% of its original extent. Concurrently, Disturbed Forest increased by 106%, and Farmland expanded by 278%, indicating that agricultural expansion is the predominant driver of deforestation and forest degradation in the area. The study concludes that the region is experiencing an unsustainable land-use transition, with high-value natural forests being rapidly converted to farmland and degraded woodlands. This establishes a critical baseline for conservation, underscoring the urgent need for targeted interventions, including sustainable agricultural intensification and the integration of geospatial data into land-use planning to guide forest restoration and policy formulation.

Keywords: Deforestation, land use change, remote sensing, GIS,and forest degradation.

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1.0. INTRODUCTION

Forests, woodlands, and trees have historically provided essential resources for human survival, including land for settlement and agriculture, raw materials for construction, woody biomass for energy and fuel, and direct sources of food (Williams, 2003). Before the Industrial Revolution, forests were central to sustaining human populations. The transformation of forested landscapes into arable land played a foundational role in the spread of the agricultural revolution (Williams, 2003). Globally, forests cover about 4 billion hectares, or 30% of the Earth's land surface, providing critical goods such as fuel, food, and shelter (Bore, 2014). According to the Food and Agriculture Organisation (FAO), (2016), approximately 1 billion people living in extreme poverty depend on forests for part of their income.

In Sub-Saharan Africa, forest resources are essential for the livelihoods of rural populations. An estimated two-thirds of the region's 600 million people rely on forest products for survival or as a significant source of income from both wood and non-timber forest products (NTFPs) (Olujobi, 2015; Olujobi & Olajuyigbe, 2020). Today, forests remain critical global assets, providing vital ecosystem services, supporting biodiversity, and underpinning the livelihoods of millions (FAO, 2020). Forest ecosystems serve as the primary biological infrastructure for the regulation of the Earth's hydrological and climatic systems (Bonan, 2008).

While forest-resource pressure was relatively low during the colonial era due to smaller populations and less land use competition, this dynamic has drastically changed. Rapid population growth and increasing demand for forest goods have transformed natural vegetation, altered traditional livelihood systems and created new challenges for forest conservation. In Nigeria, rapid anthropogenic pressures have led to significant forest degradation (Akinwumiju et al., 2021). In regions experiencing rapid Land Use and Land Cover (LULC) changes, such as the Niger Delta, the removal of forest cover has been identified as a critical driver of environmental instability and biodiversity loss (Egbinola et al., 2017).

This study as shown in Figure 1, focuses on Ovia South-West Local Government Area of Edo State, a region within Nigeria's biodiverse Niger Delta. Despite its ecological importance, quantifiable data on long-term forest cover change here is sparse. This paper addresses this gap by employing Remote Sensing (RS) and Geographic Information Systems (GIS) to map and quantify forest cover changes over 37 years (1987-2024). The primary objective is to establish a baseline of change, identifying the rate, pattern, and spatial distribution of forest loss and degradation to inform targeted conservation and sustainable land-use planning (Anderson et al., 2020).

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Figure 1: Edo State showing Ovia South West LGA

2.0. CONCEPTUAL REVIEW

The assessment is grounded in the concept of Land Use/Land Cover (LULC) Change as a critical indicator of environmental health and human pressure. The study aligns with the Complex Adaptive Systems theory, viewing the landscape as an emergent property of interactions between biophysical elements and human socio-economic drivers (Lambin et al., 2003). Furthermore, it engages with global discourse on Sustainable Forest Management (SFM), which emphasises the need for robust, spatially explicit data for effective policy formulation.

Historically, the relationship between economic development and deforestation has been profound, with agricultural expansion being a primary driver of forest clearance since the advent of farming (Moe & Liu, 2016). This pattern has continued into the modern era, with industrial demand and commercial agriculture causing severe deforestation, particularly in tropical regions (Olujobi & Olajuyigbe, 2020). While some regions like Europe and North America have seen forest recovery, many developing nations, especially in Africa and Asia, continue to experience high rates of forest loss and degradation due to factors like agricultural expansion, fuelwood collection, and illegal logging (Hosonuma et al., 2012; Kissinger et al., 2012).

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To effectively monitor these dynamic changes, Remote Sensing (RS) and Geographic Information Systems (GIS) have become indispensable tools. They provide systematic, cost-effective, and temporally repetitive data crucial for analysing Land Use and Land Cover (LULC) change (Kumar et al., 2010; Wasonga, 2009). The review synthesises empirical work, such as Suleiman et al. (2017) in Nigeria and Atesoglu & Tunay (2010) in Turkey, demonstrating the efficacy of RS/GIS for monitoring forest dynamics and identifying drivers, such as agricultural expansion and illegal logging. Accurate and frequently updated spatial information from these technologies is essential for informed decision-making, conservation planning, and understanding the socio-economic and environmental drivers of forest change (Panigrahy et al., 2010; Reddy et al., 2013).

3.0. MATERIALS AND METHODS

3.1. Data Sets

The Landsat 5 TM (1987) and Landsat 8 OLI/TIRS (2024) satellite imageries (30m / 30 m resolution) were acquired from USGS. An administrative map of Edo State was used for boundary extraction.

3.2. Pre-processing and Analysis:

Images were pansharpened, radiometrically corrected, and masked to the study area in ERDAS Imagine 10.5. Supervised classification with the Maximum Likelihood algorithm was performed to derive four LULC classes: Forest, Disturbed Forest, Farmland, and Built-up Area. Training samples were validated using GPS ground truthing and Google Earth imagery. Post-classification change detection was conducted to quantify gains and losses between 1987 and 2024. Areal computations (hectares) and percentage changes were calculated within a GIS environment.

4.0. PRESENTATION OF RESULT AND DISCUSSIONS

4.1. Forest Mapping and Changes in Ovia South West LGA

In mapping forested areas in Ovia South West local government area of Edo state, the land use cover (LUC) analysis carried out using remote sensing (RS) and geographic information system (GIS) revealed that four land cover classes (forest, disturbed forest, farmlands and builtup) were clearly demarcated as shown in the Table 1 and Figures 2 and 3 of which two - forest and disturbed forest represented the forested areas in the study area. From the RS and GIS analysis, it was revealed that in 1987, forest occupied 202031.28 hectares (76.95%) of the total land mass of the Ovia south west while disturbed forest occupied 35393.79 hectares (13.48%). Combining the two together, the forested area as at 1987 was about 237425.07 hectares (90.43%) of the total area.

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Also in 2024, forest had reduced to 110449.55 hectares (42.07%) of the total land mass while disturbed forest had increased to 72960.75 hectares (13.48%). Combining the two together, the forested area as at 1987 was about 237425.07 hectares (90.43%) of the total area. On the overall, it was discovered that the natural forest was lost -91,581.73 hectares (50%) of it status in 1987 to other land cover classes including disturbed forest, while the disturbed forest gained 37,566.96 hectares (20.51%) from the lost forest cover, and the remaining 29.49% shared by farmland and builtup area, with farmland taking the highest (27.51%).

Table 1: Extent of Forest Cover & other Land Cover Changes between 1987 & 2024

Land Use Cover	Spatial Coverage in Hectares 1987	%	2024	%	Change bw 1987 & 2024	% Change
Forest	202031.28	76.95	110449.55	42.07	-91,581.73	50
Disturbed Forest	35393.79	13.48	72960.75	27.80	37,566.96	20.51
Farmland	18102.14	6.90	68487.48	26.08	50,385.30	27.51
Builtup	7005.45	2.67	10634.88	4.05	3,629.43	1.98
Total	262532.66	100	262532.66	100		100

Source: Researcher's Compilation from 1987 & 2024 Imagery, (2025).

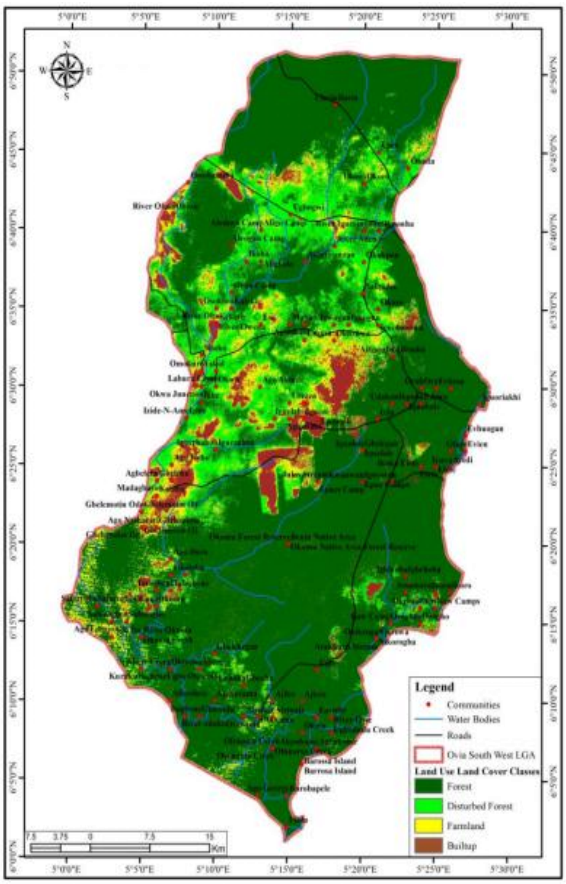

Fig.2: 1987 Image of Ovia SW: Forested Areas

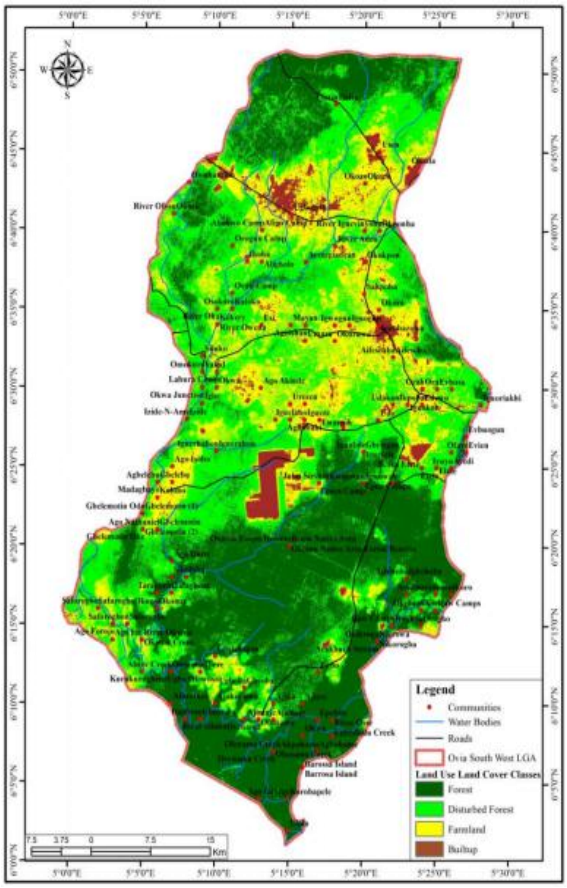

Fig.3: 2024 Image of Ovia SW: Forested Areas

Source: Extracted from Landsat satellite imagery of 1987 & 2024

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The analysis revealed a severe decline in pristine Forest cover from 202,031.28 hectares (76.95%) in 1987 to 110,449.55 hectares (42.07%) in 2024, an absolute loss of 91,581.73 hectares (50% of its 1987 extent). Concurrently, Disturbed Forest increased by 37,566.96 hectares (+106%), and Farmland expanded dramatically by 50,385.30 hectares (+278%). Built-up area growth was modest (1.98% of total change). The net forested area (Forest + Disturbed Forest) shrank from 90.43% to 69.87% of the LGA.

4.2. Discussion

The finding highlights a severe decline in the forest resource base of Ovia South West LGA. In 1987, the combined forested area categorized as natural forest and disturbed forest covered an overwhelming 90.43% of the total land mass. However, the subsequent 37 years witnessed a massive shift in land use, fundamentally altering the environmental landscape (Turner *et al*., 2020). This contradict Umo et al 2018 report of143533 meter square (11.3 percent) of scatter forest and 280251 meter square (22 percent) for secondary forest and scatter farmland within the gully vulnerable region of Eniong Offot area of Uyo, South-south Nigeria.

The most concerned is the 50 percent loss of the natural forest (a decrease of 91,581.73 hectares). This natural forest represents the high-value ecological component, providing premium timber, a stable habitat for biodiversity, and a diverse range of high-quality Non-Timber Forest Products (NTFPs). In line with Farrington et al., (1999) this dramatic reduction signifies that the most valuable and biodiverse forest assets that underpin certain traditional livelihoods are now becoming scarce and fragmented.

Concurrently, the upsurge in disturbed forest by 37,566.96 hectares, increasing its share to 27.80% of the total land, suggest that the process of forest loss is characterised primarily by degradation and fragmentation. Activities such as selective logging, intensive fuelwood harvesting, and short-fallow cultivation methods lead to the transition from a natural to a disturbed state. Just like Nechyba & Walsh (2004), this shift is highly significant for livelihoods, as disturbed forests yield lower-quality resources, require greater labour investment, and offer less reliable returns, thereby increasing the vulnerability of communities relying on these degraded resources. By analyzing the destination of the lost forest cover, the data clearly identifies the dominant pressures on the resource base. The total loss from the natural forest was redirected primarily into two categories: disturbed forest and farmland, with the latter representing the single largest gain. Farmland expanded significantly, gaining 50,385.30 hectares, which translates to 27.51% of the total land cover change.

This finding is crucial as it links forest loss directly to agricultural livelihood strategies. The significant expansion of farmland into previously forested areas strongly indicates that the primary driver of deforestation in Ovia South West LGA is extractive agricultural practice,

likely driven by population growth and the need for new land to sustain subsistence or cash crop production. This dependency on land expansion suggests that current farming techniques may not be sufficiently intensive or sustainable, necessitating continuous encroachment into the forest frontier. In contrast, the contribution of the built-up area to the overall land cover change was minimal (1.98 percent). This suggests that the decline in forest resources is less about intensive urbanisation spreading from major cities and more about rural resource pressure and the struggle to sustain livelihoods through low-technology agricultural methods.

The data from Ovia South West LGA presents a clear picture of unsustainability. The forest resource which the backbone for numerous local livelihoods, is not merely shrinking; its ecological quality is rapidly degrading from a natural state to a disturbed one. The dominant underlying pressure is the expansion of farmland, signaling that the current model of agricultural expansion is directly competing with forest conservation. If this trend continues, the traditional forest and agricultural livelihoods will face irreversible mishap due to resource exhaustion, as earlier stated by Farrington et al., 1999). Underscoring the urgent need for forest restoration and the introduction of sustainable, non-extractive livelihood alternatives within the studied Local Government Area is necessary in collaboration with the Umo *et al.* (2018) notion that land use change are clear indicator of prolonged anthropogenic pressure. .

5.0. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The study conclusively maps and quantifies a severe and rapid deforestation crisis in Ovia South-West LGA. Nearly half of the natural forest has been lost in 37 years, primarily converted to farmland and degraded forest. This establishes a critical baseline, revealing hotspots of change and underscoring the urgency for intervention.

5.2. Recommendations

i. The identified zones of intense forest loss and fragmentation should be prioritized for immediate conservation action and restoration projects.
ii. Government and NGOs must promote Sustainable Agricultural Intensification (SAI) practices to reduce the need for forest-frontier expansion.
iii. Future land-use planning must integrate these geospatial findings to create legally binding green corridors and protected area buffers.

Conflict of Interest

The authors declare that no conflict of interest exist in this manuscript.

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