Assessment of the Effect of Anthropogenic Activities on Forest Resources in Kwande Local Government Area, Benue State, Nigeria

PRISCILLA MNENA AGBER[1], TERWASE SHABU[2], DANIEL PEVERGA DAM[3], MONDAY AKPEGI ONAH[4], JOSHUA ORODUEN AHILE[5]

[1, 2, 3, 4, 5]*Department of Geography, Benue State University, Makurdi*

Abstract- ***This study assessed the effect of anthropogenic activities on forest resources in Kwande Local Government Area (LGA), Benue State, from 2004 to 2024. The study identified the major forest resources, evaluated changes in resources and forest cover, and examined the socio-economic drivers of deforestation. The study population consists of residents and forests of Kwande LGA, estimated at 359,000 people in 2024. A sample size of approximately 400 was determined using the Taro Yamane formula. Data collection involved questionnaire surveys, field observations, and remote sensing. Data analysis used quantitative methods, descriptive statistics, and GIS and remote sensing for forest cover change analysis over 30 years. The findings reveal a significant reliance on forest resources, with 55.6% of respondents using them daily, particularly non-timber products (30.5%) and fuelwood (29.9%). Over the 30 years, the forest cover in Kwande LGA declined by 58.61%, from 937.78 km² in 2004 to 388.05 km² in 2024, while farmland expanded by 531.78 km². Deforestation was predominantly driven by agricultural activities (60.2%), logging (10.2%), and fuelwood collection (75.4%). Wildlife populations showed the most significant decline (49.7%), with 75.4% of respondents observing reduced species diversity. Ecological consequences included habitat loss (55.6%) and decreased water quality (24.6%). The study concludes that agricultural expansion and logging are major contributors to forest resource depletion, intensifying biodiversity loss, and ecological degradation. The study recommends that sustainable agricultural practices, reforestation programmes, and enhanced environmental education are essential for addressing the pressures on forest resources.***

Indexed Terms- ***Anthropogenic Activities; Forest Resources; Deforestation: Change***

I. INTRODUCTION

Forests are one of the planet's most valuable natural resources, providing a wide array of ecological, economic, and social benefits. Covering approximately 31% of the world's land area, forests play a crucial role in maintaining global biodiversity, regulating climate, and supporting millions of livelihoods (FAO, 2020). They act as carbon sinks, absorbing about 2.6 billion tonnes of carbon dioxide annually, mitigating climate change's effects (Pan et al., 2011). Forests are extensive areas defined by dense woodland, non-woody vegetation, and diverse plant and animal communities. Tropical rainforests, often called "the lungs of the planet," are the world's most essential storehouse of biodiversity (Orobator, Ekpenkhio, & Jideonwo, 2020). Forest resources encompass all-natural products and ecological services provided by forests, including timber, non-timber forest products (NTFPs) like fruits, nuts, and medicinal plants, as well as critical ecosystem services such as carbon sequestration, biodiversity habitat, water regulation, and soil conservation (FAO, 2020; WWF, 2021). These resources are vital for environmental health, economic activities, and the livelihoods of millions globally (FAO, 2020; Pan et al., 2011).

Home to 80% of terrestrial biodiversity, forests host plant and animal species (WWF, 2021). Despite their significance, forests face severe threats from various human activities such as deforestation driven by agricultural expansion, logging, and infrastructure development. Between 1990 and 2020, the world lost

approximately 420 million hectares of forest, primarily in tropical regions (FAO, 2020), leading to diminished biodiversity, exacerbated climate change, and disrupted livelihoods for indigenous and local communities.

Anthropogenic activities are human actions that alter the natural environment, driving significant environmental changes that affect ecosystems and biodiversity at various scales. Major anthropogenic activities impacting forest resources include agricultural expansion, logging, urbanization, infrastructure development, mining, fire, and grazing. These activities have multifaceted impacts that vary across regions and timescales (IUCN, 2021). Key impacts include biodiversity loss, climate change, soil erosion and degradation, water cycle disruption, and livelihoods. Deforestation and forest degradation in biodiversity hotspots result in habitat loss, endangering plant and animal species.

In Nigeria, several species have become threatened due to habitat destruction, contributing to increased atmospheric carbon dioxide levels and exacerbating global warming. Forests regulate the water cycle by maintaining the balance between groundwater recharge and surface runoff, implying that deforestation can alter hydrological patterns, affecting water availability and quality. Many rural communities depend on forests for their livelihoods, including food, medicine, and income from forest products. The degradation of forest resources directly impacts their well-being and economic stability (Nwoboshi, 2000).

Nigeria, once richly endowed with forest resources, has experienced significant deforestation over the past few decades. The country’s forest cover has dwindled from an estimated 19 million hectares in 1970 to less than 10 million hectares in 2000 (Nwoboshi, 2000). Recently, FAO (2020) reported that Nigeria's deforestation rate is alarmingly high, estimated at 3.7% per annum, one of the highest in the world. Similar to global trends, this reduction is attributed to factors like agricultural expansion, logging, and urbanization, leading to severe implications for biodiversity, climate change, and local communities reliant on forest resources. Efforts to manage and conserve Nigeria's forests are often hampered by weak enforcement of environmental regulations, inadequate funding, and conflicts over land use (Nwoboshi, 2000).

Considering the critical role forests play in ecological sustainability and human survival, their conservation and protection are not just important but essential. Numerous studies have examined the impact of human activities on forest resources globally and within Nigeria. For example, Orobator, Ekpenkhio, & Jideonwo (2020) noted that forest loss and depletion are now recognized as major environmental issues driven by pervasive and increasing human activities. Studies by Mmom and colleagues (Mmom & Mbee, 2013; Mmom & Arokoyu, 2009; Aremu, Osayimwen, & Emelue, 2009; Mmom, 2007) revealed a lack of documented data on anthropogenic activities and declining forest resources in Edo State. Empirical studies on deforestation in Benue State indicate a significant loss of forest cover due to agricultural expansion, logging, and infrastructural development. For instance, Ambe (2019) highlights that 70% of forest loss in the region is attributable to the conversion of forest land to agricultural use. This is exacerbated by the increasing demand for food and fuelwood. Studies such as that by Obioha (2017) show a direct correlation between anthropogenic activities and biodiversity loss in Benue State. The study recorded a 45% decline in wildlife species over two decades due to habitat destruction from logging and farming activities. This decline negatively impacts the ecosystem services provided by these forests. Agbede (2020) underscores the impact of deforestation on local climate patterns. The study found that the reduction in forest cover has contributed to increased temperatures and altered rainfall patterns in Benue State, exacerbating the effects of climate change and further stressing the forest resources. A study conducted by Adejo et al. (2018) examined the relationship between deforestation and soil erosion in Benue State. The findings indicate that areas with high rates of deforestation experience severe soil erosion and degradation, leading to reduced agricultural productivity and loss of soil fertility. Research by Ekong (2016) delves into the socio-economic impacts of forest degradation in Benue State. The study found that forest-dependent communities face increased poverty levels as their primary sources of income, such

as timber and non-timber forest products, diminish due to overexploitation and deforestation.

Adia et al. (2018) investigated the effect of human activities on Yandev Forest Plantation in Gboko, Benue State, and Sorkwagh (2012) reported extensive deforestation and degradation of forest reserves and plantations established during the colonial era due to increased farmland demand and urban expansion in Benue State. These existing studies provide extensive evidence on deforestation and its drivers in Benue State but lack specific focus on the impact of these anthropogenic activities on forest resources in Kwande LGA. Also, there is a research gap in understanding the local socio-economic and ecological impacts of deforestation in Kwande LGA, which is crucial for tailored conservation and management strategies.

Regrettably, the Benue State government appears indifferent as its forestland continues to diminish yearly due to human encroachment. There is a lack of records on the current status of forest plantations, species diversity, and abundance, particularly in Kwande LGA. The extent of deforestation and the impact of human activities on these forests are also unknown. This study aims to provide essential data for the proper planning and sustainable management of the Kwande forest, addressing these critical gaps in knowledge. Furthermore, Benue State, known for its agricultural productivity and diverse ecological zones, includes forested areas integral to the local economy and environment. In Kwande Local Government Area, Benue State, Nigeria, forests are integral to the local ecosystem and cultural heritage. The local government is blessed with a number of forest cover namely: Achor, Aondo-Akaa, Mbagba, Ikyogen forest reserve, Anwase and Nyiev forests. They are found mainly in the southern parts of the LGA along rivers and streams and mountains. Achor Forest is known for its dense vegetation and rich biodiversity. It provides habitat for various wildlife species and is an important source of medicinal plants for local communities. While Aondo-Akaa Forest is significant for its cultural and spiritual value to the local people. It is believed to be a sacred forest, and traditional rituals are often performed. The forest is also home to several species of trees that are unique to the region. Mbagba Forest is characterized by its extensive coverage and the presence of several streams that flow through it. It is crucial for water regulation in the area and supports agricultural activities by providing a source of irrigation. Ikyogen Forest is known for its tall, dense trees and diverse flora. It serves as a carbon sink and plays a vital role in mitigating climate change effects in the region. The forest also supports local livelihoods through the collection of non-timber forest products. Nyiev Forest is noted for its unique tree species and the presence of endangered wildlife. Conservation efforts are in place to protect the biodiversity of this forest. It is also a popular spot for eco-tourism and educational research. These forests not only contribute to the ecological balance of the area but also hold significant cultural, economic, and environmental importance for the local communities in Kwande Local Government Area. These forests provide timber and non-timber Forest Products (NTFPs) and support biodiversity. However, like other parts of Nigeria, Benue State, and specifically Kwande Local Government Area, face significant challenges in forest management due to anthropogenic pressures. Activities such as logging, slash-and-burn agriculture, and overgrazing threaten forest resources, resulting in soil erosion, biodiversity loss, and reduced availability of forest products. Observations suggest these impacts are particularly pronounced in Kwande Local Government Area, where forests play a crucial role in the livelihoods of rural communities and the local economy. However, these impacts have not been empirically investigated and documented to inform sustainable forest conservation and protection policies.

Given the profound and far-reaching implications of anthropogenic activities on biodiversity, climate regulation, and local livelihoods in Kwande LGA, it is essential to understand the extent of these effects. This understanding is crucial for developing effective conservation strategies and sustainable management practices to protect and restore forest resources in the area. Hence, this study aims to evaluate the impact of anthropogenic activities on forest resources in Kwande Local Government Area, Benue State.

II. MATERIALS AND METHODS

Study Area

Kwande Local Government Area (LGA) is situated in Benue State, Nigeria. Kwande LGA is located towards

the southeastern part of Benue State. It shares boundaries with Vandeikya and Konshisha LGAs to the north, Cross River State to the south, Ushongo LGA to the west, and the Republic of Cameroon to the east. Kwande is approximately situated between latitudes 6°30'N and 7°00'N and longitudes 9°00'E and 9°30'E (Figure 1). Kwande Local Government Area experiences a tropical climate marked by distinct wet (April–October) and dry (November–March) seasons, with average annual rainfall between 1,200 mm and 2,000 mm and temperatures ranging from 20°C to 35°C. The savanna vegetation in this area consists of species like *Afzelia africana*, *Parkia biglobosa*, and various grasses, while its riverbanks support arable farming and are densely vegetated. However, deforestation due to agriculture, logging, and fuelwood extraction has led to biodiversity loss and ecosystem degradation. The area's relief features low-lying, gently undulating terrain with braided rivers like the Katsina-Ala and its tributaries forming extensive floodplains. Geologically, it lies on basement complex rocks rich in minerals, with fertile alluvial soils supporting intensive agriculture near riverbanks. Human settlements are largely agrarian, relying on subsistence farming, though unsustainable land use practices threaten forest and soil health.

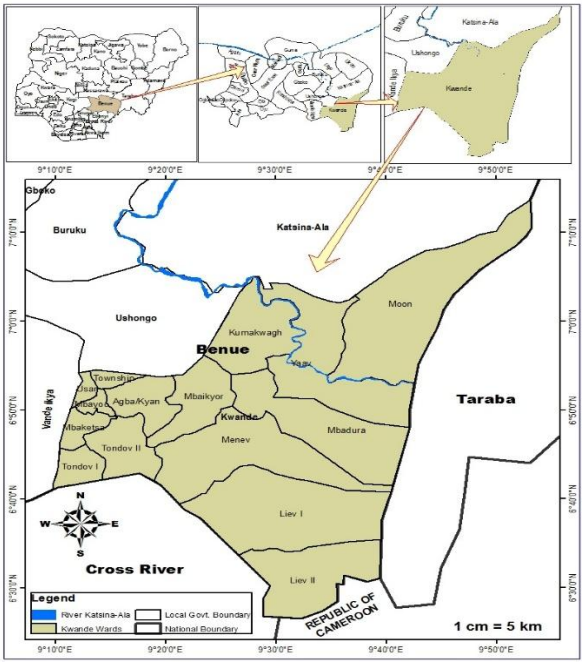


Figure 1: Kwande Local Government Area

Methods

The study population comprises forests and residents of Kwande LGA involved in forest-related activities like farming, logging, and hunting, with an estimated human population of 359,000 in 2022. The sample size was determined using Taro Yamane's formula, with a 5% margin of error, resulting in approximately 400 respondents. A multistage sampling technique was used, starting with the purposive selection of eight forested villages to ensure spatial representation. Within each village, simple random sampling was applied to select respondents, ensuring diverse socio-economic coverage. Data collection methods included structured questionnaires for quantitative data, field observations for ecological validation, and remote sensing for spatial and temporal changes. Satellite imagery for the years 2004, 2014, and 2024 was acquired to analyse changes in forest cover. These images underwent pre-processing like geometric and atmospheric correction to ensure accuracy. Land cover classification using GIS was categorised forest and non-forest features using supervised or unsupervised methods. Change detection analysis was used to track forest cover variations over time. Finally, spatial analysis and visualisation through GIS were used to interpret trends in deforestation, forest degradation, and biodiversity loss across Kwande LGA.

III. RESULTS AND DISCUSSION

Demographic and Socioeconomic Characteristics of Respondents

The result of the demographic and socioeconomic characteristics of respondents is presented in Table 1. The socio-demographic characteristics of respondents in Kwande Local Government Area reveal significant patterns that influence forest resource utilisation. Gender distribution shows a male dominance, with 65.5% male and 34.5% female, reflecting the traditional gender roles in labour-intensive activities such as farming, logging, and charcoal production. The age distribution indicates that the majority (69.8%) of respondents fall within the 41–63 age group, followed by 20.1% aged 64–86, and only 10.2% aged 18–40, suggesting that middle-aged individuals are the primary actors in forest exploitation. Marital status data show that 61.2% of respondents are married, 17.0% are single, 12.4% are divorced/separated, and 9.4% are widowed, pointing

to the significant role of married individuals in land and forest-use activities, likely due to household economic responsibilities. In terms of household size, 45.9% of respondents have 6–10 members, 29.2% have 11–15, 20.1% have 1–5, and 4.8% have more than 15 members, indicating high household dependency on forest resources for fuelwood, land, and other needs.

Table 1: Demographic and Socioeconomic Characteristics of Respondents

Variable	Frequency	Percentage
Sex		
Male	258	65.5
Female	136	34.5
Age		
18 – 40	40	10.2
41 – 63	275	69.8
64 – 86	79	20.1
Marital Status		
Single	67	17.0
Married	241	61.2
Divorced/separated	49	12.4
Widow	37	9.4
Household Size		
1-5	79	20.1
6-10	181	45.9
11-15	115	29.2
16 and above	19	4.8
Educational Qualification		
No formal Education	57	14.5
First School Leaving Certificate	61	15.5
Senior Secondary School Certificate	96	24.4
Diploma/Nigerian Certificate of Education	98	24.9
Graduate/Postgraduate Degree	82	20.8
Primary Occupation		
Farming	214	54.3
Logging	39	9.9
Trading	86	21.8
Hunting	12	3.1
Others	43	10.9
Income		
N50,000.00 - N 250,000.00	41	10.4
N 250,001.00 - N 550,000.00	96	24.4
N 550,001.00 - N 750,000.00	159	40.4
N 750,001.00 - N 1,000,000.00	98	24.9
Total	394	100.0

Source: Researcher's Field Survey, 2024

Educational qualification among respondents shows that 24.4% have secondary education, 24.9% hold a diploma/NCE, 20.8% possess graduate/postgraduate degrees, while 15.5% have only basic education and 14.5% have no formal education, highlighting moderate literacy levels that may affect knowledge of sustainable forest management practices. The occupational distribution reveals that 54.3% of respondents are farmers, 21.8% are traders, 9.9% are loggers, 3.1% are hunters, and 10.9% engage in other occupations, reflecting heavy reliance on land and forest-based livelihoods. Regarding household income, 40.4% of respondents earn between N550,001 and N750,000 annually, while only 10.4% earn between N50,000 and N250,000, indicating a predominance of middle-income earners whose economic activities may drive forest exploitation. The data also show a notable 14.5% of respondents without formal education and a considerable 29.2% with household sizes of 11–15 members, reinforcing the socio-economic pressures contributing to forest degradation. Additionally, the low engagement of the 18–40 age group may reflect rural-urban migration trends or declining interest in traditional forest-dependent occupations among youths.

Major Forest Resources in Kwande LGA

The result here presents the distribution, types, and usage frequency of forest resources based on data collected from the communities. Table 2 shows that non-timber forest products (NTFPs), including fruits and medicinal plants, are the most common, accounting for 30.5% of the total, followed closely by fuelwood at 29.9%, timber at 20.3%, and wildlife at 19.3%, out of a total frequency of 394. These figures highlight a significant dependence on forest resources for subsistence, energy, construction, and traditional practices. Further disaggregation in Table 3 reveals that within the NTFP category, medicinal herbs are the most frequently exploited (40.4%), followed by fruits (30.5%), nuts/seeds (19.5%), and fibres such as bamboo (9.6%), indicating a strong reliance on forest products for health, food, and income generation. Table 4 captures the frequency of forest resource use, where daily exploitation is predominant, with 219 respondents (55.6%) indicating daily use, 76 (19.3%) monthly, 58 (14.7%) weekly and only 41 (10.4%) rarely using forest resources. This high rate of daily exploitation underscores the urgent need for sustainable forest management, especially given the pressure on medicinal plants and fuelwood. The patterns observed suggest that local communities are highly dependent on forests, not only for immediate needs but also for livelihood sustenance. Overall, the findings call for the implementation of sustainable resource utilisation strategies and the promotion of alternative sources of income and energy to safeguard the ecological balance of forest ecosystems in Kwande LGA.

Table 2: Common Forest Resources in Kwande LGA

Forest Resources	Frequency	Percentage
Timber	80	20.3
Non-timber forest products (Fruits, medicinal plants)	120	30.5
Wildlife	76	19.3
Fuelwood	118	29.9
Total	394	100.0

Source: Researcher's Field Survey, 2024

Table 3: Most Frequently Exploited non-timber forest products (NTFPs)

Non-timber forest products	Frequency	Percentage
Fruits	120	30.5
Medicinal herbs	159	40.4
Nuts/seeds	77	19.5
Fibers (e.g., bamboo)	38	9.6
Total	394	100.0

Source: Researcher's Field Survey, 2024

Table 4: Frequency of use of forest resources for daily needs

Frequency of use of forest resources exploitation	Frequency	Percentage
Daily	219	55.6
Weekly	58	14.7
Monthly	76	19.3
Rarely	41	10.4
Total	394	100.0

Source: Researcher's Field Survey, 2024

Extent of changes in resources between 2004 and 2024

Between 2004 and 2024, the perception of forest resource availability in Kwande LGA indicates a

substantial decline, with 60.9% of respondents reporting a significant reduction and 24.6% reporting somewhat reduced availability. Only 9.6% perceived no change, while 4.8% observed a slight increase, based on responses from 394 participants (Table 5). Regarding forest resources with the greatest perceived decline, wildlife ranked highest at 49.7%, followed by timber at 19.8%, medicinal plants at 14.7%, fuelwood at 10.4%, and non-timber forest products (NTFPs) at 5.3% (Table 6). These statistics reflect a broad concern over deforestation and biodiversity loss in the area. A significant 75.4% of respondents also perceived a notable decline in wildlife species diversity over the two decades, while 19.8% reported a slight decrease, and only 4.8% perceived no change (Table 7). The combined findings suggest unsustainable use and degradation of forest resources, particularly affecting wildlife. The data highlights the urgency for conservation strategies to mitigate further environmental losses. The consistency across tables emphasises growing human pressures on forest ecosystems in Kwande LGA.

Table 5: Perception of Availability of Forest Resources between 2004 and 2024

Status of Forest Resources	Frequency	Percentage
Significantly reduced	240	60.9
Somewhat reduced	97	24.6
No change	38	9.6
Somewhat increased	19	4.8
Total	394	100.0

Source: Researcher's Field Survey, 2024

Table 6: Forest Resources with the Perceived Greatest Decline Rate in between 2004 and 2024

Forest Resources	Frequency	Percentage
Timber	78	19.8
Wildlife	196	49.7
Medicinal plants	58	14.7
Fuelwood	41	10.4
Non-timber forest products (NTFPs)	21	5.3
Total	394	100.0

Source: Researcher's Field Survey, 2024

Table 7: Perceived extent of changes in the diversity of wildlife species between 2004 and 2024

Degree of Changes	Frequency	Percentage
Yes, a significant decrease	297	75.4
Yes, a slight decrease	78	19.8
No change	19	4.8
Total	394	100.0

Source: Researcher's Field Survey, 2024

Extent of changes in forest cover between 2004 and 2024

The results of the extent of changes in forest cover between 2004 and 2024 is presented in Table 8 and Figure 2. The result shows that between 2004 and 2024, forest cover in Kwande LGA reduced significantly from 937.78 km² (34.23%) to 388.05 km² (14.16%), resulting in a net loss of 549.73 km² or 58.61% of the 2004 forest area. Farmland increased markedly from 1766.48 km² (64.47%) in 2004 to 2298.26 km² (83.88%) in 2024, indicating a net gain of 531.78 km². Built-up areas expanded from 6.17 km² (0.23%) in 2004 to 23.73 km² (0.87%) in 2024, marking a net increase of 17.56 km². Rock outcrops slightly fluctuated across the years: 15.35 km² (0.56%) in 2004, 11.52 km² (0.42%) in 2014, and 14.74 km² (0.54%) in 2024.

Water bodies also showed minor variation, covering 14.26 km² (0.52%) in 2004, 12.91 km² (0.47%) in 2014, and 15.55 km² (0.57%) in 2024. Spatially, forest cover in 2004 was dominant and relatively intact, concentrated particularly near water bodies and sparsely interspersed with farmland and built-up areas. The land use/land cover (LULC) configuration in 2004 revealed limited human interference, with built-up areas forming minor clusters and farmland being sparsely distributed. Rock outcrops and water bodies were stable in distribution and size, with water bodies primarily aligned along river systems.

By 2014, forest cover was still dominant but showed clear signs of fragmentation, especially near growing built-up areas and expanding farmland zones. Farmland encroached on forest areas, while built-up areas became more prominent, expanding outward from existing clusters. Rock outcrop/bare surface and

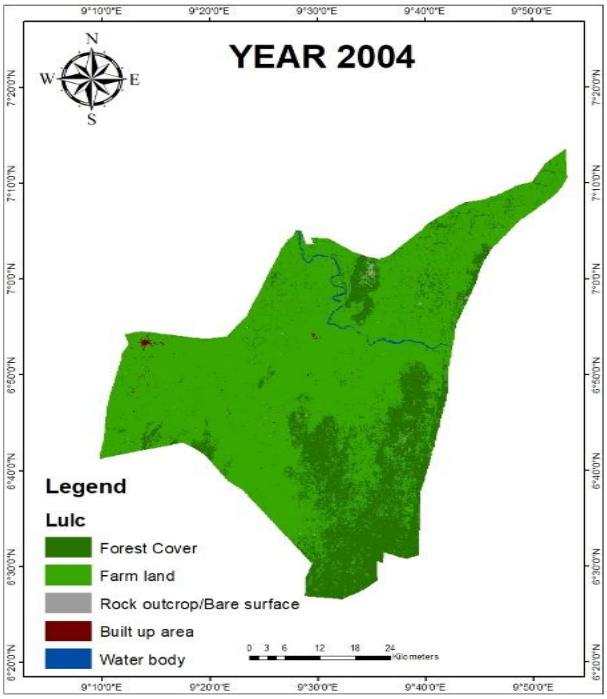
water bodies experienced minimal spatial changes, reflecting stable non-arable terrain and persistent hydrological features. The 2024 spatial analysis revealed a further reduction in forest cover, with forested areas increasingly fragmented and concentrated away from intensively farmed and urbanised zones.

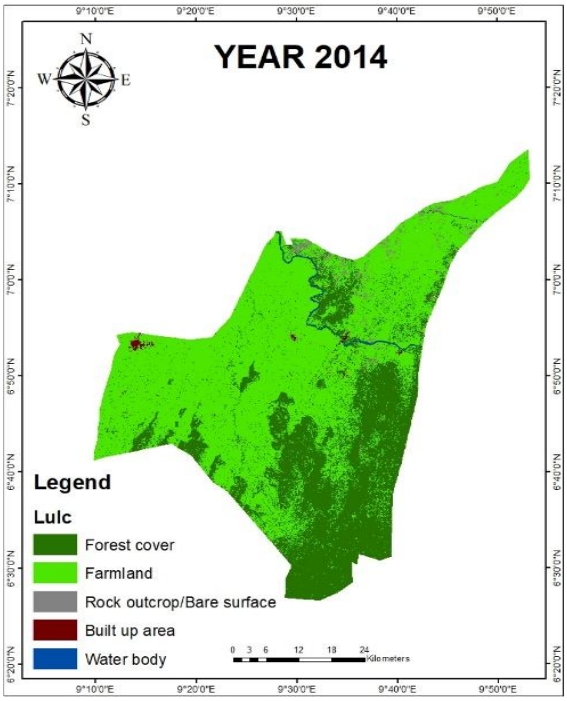
Farmland visibly extended across previously forested territories, and built-up areas expanded notably, signifying intensified human activities. While rock outcrops remained unchanged and water bodies retained spatial stability, the forest-to-farmland transition continued to dominate the LULC shift. Overall, the 30-year trend highlights the extensive transformation of Kwande LGA's landscape, driven primarily by agricultural expansion and moderate urbanisation.

Table 8: Landuse Land Cover Change over Kwande LGA, Benue State Nigeria

Landuse Land Cover Class	2004		2014		2024	
	Area (km^2)	%	Area_km2	%	Area_m2	%
Forest cover	937.78	34.23	670.91	24.49	388.05	14.16
Farmland	1766.48	64.47	2031.47	74.14	2298.26	83.88
Built-up area	6.17	0.23	13.60	0.50	23.73	0.87
Rock outcrop/Rock outcrop	15.35	0.56	11.52	0.42	14.74	0.54
Water body	14.26	0.52	12.91	0.47	15.55	0.57
Total	2740.05	100.00	2740.40	100.01	2740.33	100.01

Source: Imageries from the USGS, 2024





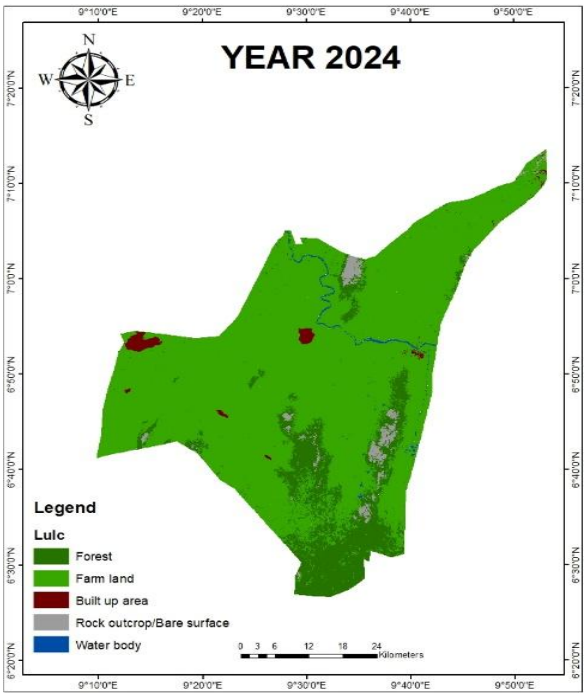


Figure 2: Landuse Land Cover Changes over Kwande Local Government Area in 2004, 2014 and 2024

IV. DISCUSSION

The results provide valuable insights into the exploitation of forest resources, particularly non-timber forest products (NTFPs), and their impact on local livelihoods. The findings indicate that NTFPs, including fruits and medicinal plants, are the most frequently exploited resources. This high dependency on forest resources for daily needs underscores the critical role these products play in the subsistence and economic activities of the local communities. These results align with previous empirical studies conducted in Nigeria. For instance, a study by Jimoh et al. (2013) observed that rural households in Nigeria derived up to 80% of their incomes from the sales of NTFPs, suggesting the significant economic contribution of these resources to local livelihoods. Similarly, research by Unongo et al. (2019) assessed the effects of forest resource exploitation and utilization on the livelihoods of rural households in Benue State. In another study, Inoni (2009) examined the effects of forest resource exploitation on the economic well-being of rural households in Delta State, Nigeria, and found that while initially supporting other livelihood activities, NTFP extraction is rapidly becoming a mainstream income source. This is consistent with the current study's finding that a majority of respondents exploit forest resources daily, suggesting a high level of dependency likely driven by subsistence needs such as firewood, food, and medicinal plants. However, variations exist when considering the types of NTFPs exploited. While the current study identified medicinal herbs as the most frequently exploited NTFPs in Kwande LGA, accounting for 40.4%, other studies have highlighted different primary NTFPs in various regions. For example, a study by Olaniyi & Isitor (2016) in Akure metropolis, Nigeria, evaluated the potential and challenges of marketing NTFPs and found that certain products, such as bushmeat and wild fruits, were more prevalent in that area. These variations may be attributed to regional differences in forest composition, cultural practices, and market demands.

The current study's findings on the significant decline in forest resources and wildlife diversity in Kwande LGA between 2004 and 2024 align with several empirical studies in Nigeria and West Africa. For instance, a study by Akinyemi (2013) analyzed deforestation patterns in Nigeria's Niger Delta region (1987-2013) and reported substantial forest loss, attributing it to factors such as agricultural expansion and urbanization. The findings of this study are also consistent with the empirical study by Onyekuru and Marchant (2016) in several key areas, particularly regarding the impact of environmental changes on forest resources and livelihoods. Both studies highlight the significant role of climate and human activities in shaping forest ecosystems and the socio-economic conditions of dependent communities. A major area of agreement between the studies is the impact of environmental changes on forest resource availability. The current study reveals that 60.9% of respondents perceive a significant reduction in forest resources between 2004 and 2024, with an additional 24.6% noting a somewhat reduced availability. This supports the findings of Onyekuru and Marchant (2016), who suggest that changing climatic conditions, particularly rainfall patterns, significantly influence forest-based income and resource availability. Their study underscores the importance of rainfall in sustaining tropical forest productivity, suggesting that increased precipitation during certain seasons boosts household net revenue, while reduced or misaligned precipitation negatively affects income. Similarly, the current study’s findings indicate that deforestation,

logging, agricultural expansion, and urbanization have contributed to the degradation of forest resources, demonstrating the growing vulnerability of these ecosystems.

Another point of convergence is the socio-economic impact of declining forest resources. Onyekuru and Marchant (2016) found that forest-dependent households derive an average annual income of $3,380 from forest resources, with key socio-economic factors such as education level, transportation access, and river flow significantly influencing net revenue. The current study further reinforces this by demonstrating that deforestation has led to the depletion of essential forest resources, particularly wildlife (49.7%), timber (19.8%), and medicinal plants (14.7%). This decline suggests a direct economic impact on rural households reliant on these resources for income, sustenance, and traditional medicine. The loss of wildlife, identified as the most significantly declining resource, may also indicate a disruption of hunting practices, which are crucial for some livelihoods. However, variations exist between the studies in terms of their methodological approaches and specific focus areas. While Onyekuru and Marchant (2016) utilized the Ricardian model to quantify climate change impacts on forest resource use across Nigeria's ecological regions, the current study relies on perception-based surveys within Kwande LGA to assess changes in forest resources over two decades. The former study provides quantitative estimates of how climate variables, particularly temperature and precipitation, affect net revenue, while the latter focuses on community perceptions of resource depletion and biodiversity loss. Also, Onyekuru and Marchant (2016) emphasize climate change as a key driver of resource depletion, whereas the current study attributes forest decline to a combination of human activities, including logging, agricultural expansion, and urbanization, with less emphasis on climate variability.

Another point of variation is the resilience of forest ecosystems to climate change. Onyekuru and Marchant (2016) suggest that tropical forests exhibit some resilience, as further increases in temperature or decreases in precipitation beyond a certain threshold do not significantly alter net revenue. Conversely, the current study implies a continuous decline in forest resources, with only 4.8% of respondents perceiving any increase in forest cover, suggesting that conservation and afforestation efforts have had minimal impact. The stark decline in wildlife diversity, as perceived by 75.4% of respondents, further indicates that forest ecosystems in Kwande LGA are under severe pressure, with minimal signs of recovery or resilience. Overall, while both studies highlight the pressing issue of forest degradation and its socio-economic consequences, they differ in their emphasis on climate change versus direct human activities as primary drivers of resource depletion. The current study calls for urgent policy interventions to mitigate deforestation and biodiversity loss, aligning with the broader implications of Onyekuru and Marchant (2016), which emphasize the need for strategies to regulate water supply and mitigate climate change impacts on forest-dependent livelihoods.

In addition, the findings of the current study agree with the empirical study by Olajuyigbe et al. (2023) in demonstrating significant forest resource depletion over time due to deforestation and anthropogenic activities. Both studies highlight deforestation as a primary driver of environmental degradation, with the current study specifically linking this decline to logging, agricultural expansion, and urbanization in Kwande LGA. Similarly, Olajuyigbe et al. (2023) observed a substantial reduction in forest cover across five reserves in Oyo State over three decades, reinforcing the trend of widespread forest loss in Nigeria. Additionally, both studies emphasize the urgent need for conservation efforts and policy interventions to restore and protect forest ecosystems. However, while Olajuyigbe et al. (2023) relied on remote sensing data to assess forest cover loss quantitatively, the current study is based on community perceptions, offering a socio-ecological perspective on resource availability. Another key variation is that the current study provides specific insights into the decline of different forest resources, particularly wildlife, timber, medicinal plants, and fuelwood, whereas Olajuyigbe et al. (2023) focused primarily on overall forest cover reduction. The decline in wildlife species diversity reported in the current study further complements the findings of Olajuyigbe et al. (2023), who emphasized the loss of ecosystem services, including biodiversity

conservation. Moreover, while Olajuyigbe et al. (2023) stress the role of deforestation in reducing carbon sequestration capacity, the current study highlights its direct impact on local livelihoods and biodiversity. The slight perception of resource stability or increase among a small fraction of respondents in the current study suggests localized afforestation efforts, which were not addressed in Olajuyigbe et al. (2023). Despite differences in methodology and focus, both studies collectively reinforce the necessity for immediate conservation strategies to mitigate forest degradation and biodiversity loss.

CONCLUSION

Based on the findings, the study concludes that anthropogenic activities, primarily agricultural expansion and logging, have significantly contributed to the depletion of forest resources in Kwande LGA, leading to a marked reduction in forest cover and a decline in local biodiversity. The heavy reliance on forest resources for subsistence and economic activities, such as fuelwood collection and medicinal plant use, exacerbates the pressure on forests, further intensifying ecological degradation. The study, therefore, recommends sustainable forest management practices and conservation efforts to mitigate the adverse effects of deforestation on both the environment and local livelihoods.

REFERENCES

[1] Adejo, S. A., Agada, A. S., & Omojola, A. S. (2018). Impact of deforestation on soil erosion and degradation in Benue State, Nigeria. *Journal of Environmental Management,* 215, 320-330.

[2] Agbede, O. O. (2020). The influence of deforestation on climate change in Benue State, Nigeria, *Climate Research*, 75(1), 65-78.

[3] Akinyemi, F. O. (2013). An assessment of land-use change in the Niger Delta. *International Journal of Remote Sensing*, 34(24), 8669–8683.

[4] Ambe, C. B. (2019). Agricultural expansion and deforestation: Implications for forest cover in Benue State, Nigeria. *Agricultural and Forest Meteorology*, 276, 107631.

[5] Aremu, A. O., Osayimwen, V. O., & Emelue, G. U. (2009). *Assessment of deforestation and forest degradation in Edo State, Nigeria*. Journal of Forestry Research and Management, 6, 1–10.

[6] Food and Agriculture Organization. (2020). *Global forest resources assessment 2020: Main report*. FAO.

[7] Inoni, O. E. (2009). Effects of forest resources exploitation on the economic well-being of rural households in Delta State, Nigeria. *Journal of Agriculture and Social Research (JASR)*, 9(2), 114-127.

[8] International Union for Conservation of Nature. (2021). *The IUCN red list of threatened species*. Version 2021-3. https://www.iucnredlist.org

[9] Jimoh, S. O., Akinmoladun, O. F., & Akinmoladun, F. O. (2013). Non-timber forest products and their contribution to households' income in Nigeria. *Ecological Processes*, 2(1), 1-9.

[10] Mmom, P. C. (2007). *Urbanization and its implications for sustainable development in the Niger Delta region of Nigeria*. Journal of Human Ecology, 23(2), 123–130.

[11] Mmom, P. C., & Arokoyu, S. B. (2009). *Urban expansion and loss of agricultural land in Port Harcourt metropolis, Nigeria*. Research Journal of Environmental and Earth Sciences, 1(2), 77–83.

[12] Mmom, P. C., & Mbee, A. G. (2013). *Monitoring land use/land cover change in the Niger Delta, Nigeria: The application of remote sensing and GIS*. African Journal of Environmental Science and Technology, 7(6), 489–497.

[13] Nwoboshi, L. C. (2000). *The nutrient factor in sustainable forestry*. Ibadan: Ibadan University Press.

[14] Olajuyigbe, S. O., Agwu, O. P., & Ezekiel, I. A. (2023). Comparative analysis of forest cover change in selected forest reserves in Oyo State, Nigeria. *Ethiopian Journal of Environmental Studies & Management, 16*(3), 337–348.

[15] Olaniyi, O. A., & Isitor, S. U. (2016). Marketing of non-timber forest products in Nigeria: A case of Akure metropolis. *Journal of Agriculture and Social Research (JASR)*, 16(1), 1-10.

[16] Onyekuru, N. A., & Marchant, R. (2016). Assessing the economic impact of climate

change on forest resource use in Nigeria: A Ricardian approach. *Agricultural and Forest Meteorology, 220*, 10–20.

[17] Orobator, P. O., Ekpenkhio, E., & Jideonwo, I. C. (2020). Anthropogenic activities and depletion of forest resources in Udo, Edo State, Nigeria. *Journal of Environmental Sciences*, 20(1), 50-63.

[18] Pan, Y., Birdsey, R. A., Fang, J., Houghton, R., Kauppi, P. E., Kurz, W. A., & Hayes, D. (2011). A large and persistent carbon sink in the world's forests. Science, 333(6045), 988-993.

[19] Unongo, E. A., Musa, M. W., & Akinola, M. O. (2019). Assessment of effects of forest resources exploitation and utilization activities on the livelihood of rural households in Benue State, Nigeria. *International Journal of Research and Innovation in Social Science (IJRISS), 3*(5), 332.

[20] World Wide Fund for Nature. (2021). Living Planet Report 2020: Bending the curve of biodiversity loss. WWF. https://wwf.panda.org/knowledge_hub/all_publications/living_planet_report_2020/