

Deforestation and Its Implications for Environmental Sustainability in Nasarawa State, Nigeria

ABDULLAHI YUSUF AGWAI¹, ELIAS NAPOLEON GYOBE Ph.D², AND ADAMU SULEIMAN OGAIH³

^{1,2,3}Department of Geography Federal University Lafia Nasarawa State & Department of Geography Nasarawa State University Keffi.

¹<https://orcid.org/0009-0001-8294-6451>

*Corresponding Author: ABDULLAHI YUSUF AGWAI

DOI: <https://doi.org/10.5281/zenodo.22021608>

Article History	Abstract
Original Research Article	<i>Deforestation remains a major environmental challenge threatening forest resources and environmental sustainability in Nasarawa State, Nigeria. This study examined the major drivers of deforestation and assessed its implications for environmental sustainability in the state. The study was anchored on the Environmental Kuznets Curve (EKC) Theory, which explains the relationship between socioeconomic development and environmental degradation. A descriptive survey design was adopted, with 384 questionnaires administered to respondents selected from Akwanga, Karu and Lafia Local Government Areas representing the three senatorial zones of the state. Of these, 374 questionnaires were successfully retrieved and analyzed using frequency counts and percentages. The findings revealed that timber harvesting was the leading driver of deforestation (85%), followed by settlement expansion and agricultural expansion (81% each), charcoal production (78%), fuel-wood collection (72%), population growth and mining activities (70% each), while bush burning recorded the lowest agreement (53%). The study further found that deforestation has substantial implications for environmental sustainability, particularly loss of biodiversity (83%), increased environmental temperature (80%), loss of carbon storage and reduction in vegetation cover (71% each), loss of ecosystem services and increased soil erosion (69% each), and deterioration of water resources (65%). The study recommends sustainable land-use and forest-resource management practices among farmers and forest-dependent communities, alongside strengthened forest protection, environmental regulation, reforestation and forest-restoration programs by the Nasarawa State Government.</i> Keywords: Deforestation, Environmental Sustainability, Forest Resources, Land-Use Change, and Timber Harvesting.
Received: 17-06-2026	
Accepted: 24-07-2026	
Published: 20-08-2026	
Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited. Citation: A., Y., Agwai, E., N., Globe & A., S., Ogah. (2026). Deforestation and its implications for environmental sustainability in Nasarawa State, Nigeria. UKR Journal of Multidisciplinary Studies, 2(8), 188-196.	

Introduction

Forests are among the most important components of the global environment because they regulate climate, conserve biodiversity, protect soils and water resources, store carbon, and provide food, energy and other livelihood resources to millions of people. Despite these ecological and socioeconomic functions, forest ecosystems continue to experience considerable pressure from agricultural expansion, logging, infrastructure development, settlement expansion, mining, fuel-wood collection and other human activities. The Global Forest Resources Assessment 2025 indicates that forests currently cover about 4.14 billion hectares, approximately one-third of the world's land area,

while deforestation has slowed globally compared with previous decades but remains a major environmental concern (FAO, 2025). Deforestation is particularly problematic because the removal of forest vegetation simultaneously reduces carbon storage, disrupts ecological processes, increases soil exposure to erosion, diminishes biodiversity and weakens the capacity of ecosystems to provide essential services. Thus, controlling forest loss is central to achieving environmental sustainability and the Sustainable Development Goals relating to climate action, biodiversity, land degradation and sustainable resource management.

Recent evidence further demonstrates that the environmental implications of deforestation extend beyond the immediate loss of trees. Abera et al. (2024), found that approximately 18% of Africa's montane forests, equivalent to about 7.4 million hectares, were lost between 2003 and 2022, with deforestation amplifying warming and changes in cloud formation in African mountain ecosystems. Similarly, Masolele et al. (2024) demonstrated that forest loss across Africa is strongly associated with land-use conversion, with small-scale cropland identified as a dominant driver in many areas. Their continental-scale assessment emphasizes that the consequences of forest conversion vary spatially and that understanding the land uses replacing forests is important for effective environmental planning. In addition, recent research indicates that African forests remain important carbon sinks, but continuing forest loss is undermining their capacity to offset greenhouse-gas emissions.

The situation is particularly critical in Africa, where forests support the livelihoods of rural populations through agriculture, fuelwood, construction materials, food, medicine and other non-timber forest products. At the same time, population growth, agricultural expansion, urbanization, commercial exploitation of forest resources and weak institutional enforcement have intensified pressure on forest ecosystems. 30 African countries over the period 2004–2021, found that natural-resource extraction can reduce environmental sustainability, particularly where institutional capacity is weak Manu et al. (2024). Evidence from West Africa (Togo, Benin, Nigeria and Cameroon) also shows that even relatively small forest patches are increasingly vulnerable. Forest patches reported substantial annual losses of primary forest patches and warned that continued deforestation could seriously undermine their capacity to provide ecosystem services. Consequently, the sustainability of African forests requires approaches that simultaneously address the ecological consequences of forest loss and the socioeconomic activities that drive dependence on forest resources Wingate et al. (2024).

In Nigeria, the problem of deforestation has become increasingly important because forests are being converted to agricultural land and settlements and exploited for timber, fuel-wood and other resources. Nigeria's rapidly growing population and dependence on land-based livelihoods have increased demand for forest resources, while illegal logging, agricultural expansion, mining and infrastructure development have contributed to forest degradation. Recent national-level research using satellite-based techniques confirms that rapid deforestation presents serious environmental challenges in Nigeria, particularly through biodiversity loss and the degradation of ecosystem

services (Alage et al., 2025). Similarly, Oloyede et al. (2025) demonstrated a relationship between extensive forest destruction and increasing environmental temperatures in southwestern Nigeria, illustrating how forest removal can contribute to local environmental changes. The environmental governance dimension is equally important. Mike and Lugard (2025) identify illegal logging, destructive mining, agricultural expansion and uncontrolled infrastructural development among activities threatening Nigerian forests and argue for stronger and more participatory forest governance.

The problem is also evident in the North-Central geopolitical zone of Nigeria, where the forest environment is characterized largely by Guinea Savanna vegetation and where agriculture, fuel-wood collection, settlement expansion, commercial exploitation of trees and other land-use activities exert increasing pressure on vegetation resources. The region's position as an important agricultural zone makes the relationship between forest resources and environmental sustainability particularly significant. Forest clearance may create additional farmland in the short term, but persistent removal of vegetation can expose soils to erosion, reduce soil organic matter, alter local microclimatic conditions, reduce biodiversity and undermine the ecological functions upon which agricultural production depends. Recent research in neighboring North-Central areas provides evidence of the wider ecological consequences of deforestation. For example, research in the Mubi region of northeastern Nigeria found substantial changes in vegetation cover associated with ecological and food-security implications, reinforcing the connection between forest loss, land resources and rural livelihoods (Gadiga & Peter, 2025). Within this regional context, Nasarawa State presents an important case for investigating deforestation and environmental sustainability. The state is located within Nigeria's North-Central region and contains extensive areas of Guinea Savanna vegetation, agricultural landscapes and gazetted forest reserves. Increasing population pressure, agricultural expansion, fuel-wood harvesting, settlement development and other human activities have transformed parts of the state's forest landscapes. Particularly important recent evidence is provided by Chunwate et al. (2025), who examined forest-cover and land-use trajectories in three gazetted forest reserves in Nasarawa State from 1966 to 2020. Their findings revealed substantial forest losses across the reserves: Risha Forest Reserve lost 88% of its forest cover, Doma Forest Reserve lost 83%, while Odu Forest Reserve recorded a 55% loss and retained 45% forest cover by 2020. Recent research has also highlighted that the problem in Nasarawa State is not simply a historical pattern of forest-cover reduction but an ongoing interaction between human activities, livelihoods and forest governance. Similarly,

Sylvester et al. (2024) reported substantial vegetation loss in Doma Local Government Area over the 1992–2022 period, demonstrating the continuing transformation of forest and vegetation resources at the local level. More recent evidence from Agudu Forest Reserve in Lafia Local Government Area identifies agricultural expansion, fuelwood extraction and weak governance as important drivers of forest decline, further demonstrating the continuing pressure on Nasarawa's forest resources. These studies collectively indicate that forest loss in Nasarawa State has ecological, socioeconomic and institutional dimensions that require integrated investigation. Despite these contributions, existing studies in Nasarawa State have largely concentrated on forest-cover change, individual forest reserves, specific local government areas, or the drivers of forest degradation. Comparatively less attention has been given to the broader implications of deforestation for environmental sustainability across Nasarawa State as a whole, particularly by examining how forest loss affects biodiversity, soil and water resources, climate regulation, land productivity and the capacity of local ecosystems to sustain human activities. The recent evidence of extensive forest-cover decline in Doma, Risha and Odu reserves further suggests that the environmental consequences of continued deforestation may extend beyond individual reserves and affect the wider ecological sustainability of the state. Therefore, there is a need for a broader state-level assessment that moves beyond simply measuring forest loss to examining its implications for environmental sustainability. It is against this background, this study investigates deforestation and its implications for environmental sustainability in Nasarawa State, Nigeria.

Objectives of the Study

- i. To examine the major drivers of deforestation in Nasarawa State, Nigeria.
- ii. To assess the implications of deforestation for environmental sustainability in Nasarawa State.

Empirical Literature Review **Drivers of Deforestation**

Denton, Arko, and Ampomah (2024), in a scoping assessment of environmental degradation in West Africa, examined major degradation processes including deforestation, soil degradation, water pollution and biodiversity loss. Their review identified agricultural expansion, logging, mining and weak environmental governance as interconnected drivers of forest and environmental degradation in West African countries, including Nigeria. The authors emphasized that the drivers of degradation are closely connected to livelihood activities and institutional weaknesses, requiring integrated rather than sector-specific interventions. Although the study provides a useful regional understanding of the causes of

deforestation, its broad West African scope limits its ability to explain the relative importance of these drivers within Nasarawa State.

Sartor, Salis, Pinardi, Saracik, & Meo (2024) investigated the use of satellite imagery and deep-learning techniques for monitoring deforestation in Côte d'Ivoire. Using Sentinel-1 and Sentinel-2 imagery, the researchers developed forest/non-forest classification approaches for identifying areas affected by forest clearance. The study demonstrated that remotely sensed data can effectively identify and quantify forest disturbance, particularly in areas where conventional field-based monitoring is difficult. Although the research was conducted outside Nigeria, its methodological contribution is relevant to the present study because it demonstrates the usefulness of geospatial technologies for assessing the extent and spatial distribution of deforestation. However, the study concentrated primarily on the technical detection of forest loss rather than the socioeconomic factors responsible for deforestation.

Rotowa and Egbewole (2025) examined human activities and livelihood dependence as drivers of deforestation in Agudu Forest Reserve, Lafia Local Government Area, Nasarawa State. Using questionnaires, field observations and photographic evidence, the researchers investigated activities responsible for forest decline. The study identified agricultural expansion, fuelwood extraction and weak forest governance as important drivers of deforestation. The findings further indicated that local dependence on forest resources contributes significantly to continued forest exploitation. The study is highly relevant to the present research because it provides recent evidence from Nasarawa State and directly connects forest degradation with human livelihood activities. Nevertheless, its focus on one forest reserve and a relatively small number of respondents limits the extent to which its findings can be generalized to the whole state.

Implications of Deforestation for Environmental Sustainability

Jahel and Lambin (2024) examined interventions aimed at reversing degradation in African social-ecological systems. Their study demonstrated that successful restoration initiatives depend heavily on locally driven institutions, appropriate incentives, strong social arrangements and sustained community participation. The researchers emphasized that environmental degradation is not simply an ecological problem but is closely connected with socioeconomic conditions and governance. Their findings are relevant to deforestation because interventions that fail to address the livelihood dependence of local populations may have limited long-term effectiveness. However, the study examined environmental restoration across different

African contexts rather than specifically measuring the environmental consequences of deforestation in Nasarawa State.

Olunusi (2024) examined environmental sustainability trends in Nigeria and found increasing deforestation alongside agricultural expansion over the 1991–2020 period. The study's findings suggest that continued conversion of forest resources is inconsistent with long-term environmental sustainability, particularly when agricultural expansion occurs without adequate environmental safeguards. The study provides important evidence of the national relationship between land-use change and environmental sustainability. Nevertheless, because it relied on national time-series data, it did not examine specific environmental consequences such as biodiversity decline, soil degradation or changes in local climatic conditions at the state level.

Abimbola, Adewumi, and Abubakar (2025) examined vegetation change and land-surface temperature in Lafia, Nasarawa State, using remote sensing and GIS techniques. The study found that rapid urban expansion was accompanied by significant vegetation decline and increasing land-surface temperatures, contributing to urban heat-island conditions. Although the study focused on urbanization rather than deforestation specifically, its findings demonstrate an important environmental consequence of vegetation removal within Nasarawa State: declining vegetation cover can contribute to increased surface temperatures and reduced environmental comfort. The study, however, was restricted to Lafia urban areas and did not investigate the wider environmental implications of forest loss across the state.

Theoretical Framework

Environmental Kuznets Curve (EKC) Theory

The study is anchored on the Environmental Kuznets Curve (EKC) Theory, developed from the works of Grossman and Krueger (1991, 1995). The theory explains the relationship between economic activities and environmental degradation, proposing that environmental degradation tends to increase during the early stages of economic development as human activities and resource exploitation intensify. However, beyond a certain level of development, environmental degradation may decline as improved technologies, stronger environmental regulations, environmental awareness, and sustainable resource-management practices are adopted.

The EKC Theory is relevant to this study because deforestation in Nasarawa State is closely associated with socioeconomic activities such as agricultural expansion, fuel-wood collection, logging, settlement expansion and other forms of forest-resource exploitation. These activities

increase pressure on forest resources and can result in the conversion and degradation of forested areas. Thus, the theory provides a basis for examining the major human activities responsible for driving deforestation in Nasarawa State, which corresponds to the first objective of the study. The theory is also relevant to the second objective, which assesses the implications of deforestation for environmental sustainability. Continued forest removal can contribute to biodiversity loss, soil degradation, reduced carbon sequestration, disruption of water regulation and changes in local climatic conditions. These consequences represent forms of environmental degradation associated with unsustainable resource exploitation. The EKC further suggests that improved environmental governance, sustainable agricultural practices, alternative energy sources, reforestation, public environmental awareness and effective enforcement of forest regulations can reduce environmental degradation. Therefore, the EKC Theory provides an appropriate framework for understanding the relationship between socioeconomic activities, deforestation and environmental sustainability in Nasarawa State. In the context of this study, increasing pressure from agricultural activities, fuel-wood demand, logging, settlement expansion and other resource-dependent activities is expected to contribute to forest loss, while effective environmental management and sustainable resource-use practices can help reduce deforestation and its adverse environmental consequences. The theory therefore provides a direct theoretical foundation for examining the drivers of deforestation and its implications for environmental sustainability in Nasarawa State.

Methodology

The study was conducted in Nasarawa State, Nigeria, located in the North-Central geopolitical zone of the country. The state covers approximately 27,137 km² and is predominantly characterized by Guinea Savanna vegetation. However, agricultural expansion, logging, fuel-wood collection, charcoal production, settlement development, bush burning and other human activities have contributed to the modification and degradation of forest resources, making the state suitable for examining the drivers of deforestation and their implications for environmental sustainability. The study adopted a descriptive survey research design. The target population comprised adult residents, particularly farmers, forest-resource users, community leaders and other residents with knowledge of forest use and land-use changes. A multistage sampling procedure was adopted. Three Local Government Areas (LGAs) were purposively selected to represent the three senatorial zones of Nasarawa State: Akwanga LGA from Nasarawa North, Karu LGA from Nasarawa West and Lafia LGA from Nasarawa South. The selected LGAs were

considered appropriate because of their agricultural activities, population growth, settlement expansion and pressure on forest resources. Based on the 2026 population estimates of World Population Review, Akwanga LGA has a population of 192,628, Karu LGA has 372,074, and Lafia LGA has 567,694, giving a combined population of 1,132,396 (World Population Review, 2026). Using the Krejcie and Morgan (1970) sample size determination table, a sample size of 384 respondents was adopted. The sample was proportionately distributed according to the population of the selected LGAs, resulting in 65 respondents from Akwanga, 126 from Karu and 193 from Lafia. A total of 384 questionnaires were administered, out of which 374 were successfully retrieved, representing a 97.4% retrieval rate. The 374 valid responses were used for the analysis. Both primary and secondary data were used. Primary data were collected through a structured questionnaire, while secondary data were obtained from relevant peer-reviewed journal articles, government publications, forestry and environmental reports, books and other relevant documents. The questionnaire contained sections covering major drivers of deforestation and the implications of deforestation for environmental

sustainability. The substantive items were measured using a four-point Likert scale comprising Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The collected data were coded and analyzed using frequency counts and percentages and presented in tables. For the first objective, frequencies and percentages were used to identify the major drivers of deforestation, including agricultural expansion, logging, fuel-wood collection, charcoal production, settlement expansion, bush burning, mining and other forest-resource exploitation activities. For the second objective, frequencies and percentages were used to assess the implications of deforestation for environmental sustainability, particularly biodiversity loss, soil degradation, erosion, reduction in vegetation cover, increased environmental temperature, loss of carbon storage, deterioration of water resources and loss of ecosystem services. The analysis was based on the 374 successfully retrieved questionnaires. Participation was voluntary, and information obtained from respondents was treated confidentially and used strictly for academic purposes.

Data Presentation

Table 1: Major Drivers of Deforestation in Nasarawa State (n = 374)

Major Drivers	SA	A	D	SD	Total
Agricultural expansion	154 (41%)	150 (40%)	50 (13%)	20 (6%)	374 (100%)
Timber harvesting	166 (44%)	154 (41%)	48 (13%)	6 (2%)	374 (100%)
Fuel-wood collection	148 (40%)	120 (32%)	80 (21%)	26 (7%)	374 (100%)
Charcoal production	152 (41%)	138 (37%)	62 (16%)	22 (6%)	374 (100%)
Settlement expansion	180 (48%)	122 (33%)	60 (16%)	12 (3%)	374 (100%)
Bush burning	100 (27%)	97 (26%)	100 (27%)	77 (20%)	374 (100%)
Mining activities	144 (38%)	120 (32%)	92 (25%)	18 (5%)	374 (100%)
Population growth	160 (43%)	100 (27%)	70 (19%)	44 (11%)	374 (100%)

Table 1 presents respondents' perceptions of the major drivers of deforestation in Nasarawa State based on 374 respondents. The results show that timber harvesting was identified as the most prominent driver, with 166 (44%) respondents strongly agreeing and 154 (41%) agreeing, giving a combined agreement of 85%. This was followed by settlement expansion, for which 180 (48%) strongly agreed and 122 (33%) agreed, representing 81% combined agreement. Agricultural expansion was also considered a major driver, with 154 (41%) strongly agreeing and 150 (40%) agreeing, giving 81% combined agreement. Similarly, charcoal production recorded 152 (41%) strongly agreeing and 138 (37%) agreeing, representing 78% agreement, while fuelwood collection recorded 148 (40%)

strongly agreeing and 120 (32%) agreeing, giving 72% combined agreement. Population growth was identified by 70% of respondents, comprising 160 (43%) who strongly agreed and 100 (27%) who agreed. Mining activities recorded 144 (38%) strong agreement and 120 (32%) agreement, representing 70% combined agreement. In contrast, bush burning received the lowest level of agreement among the listed drivers, with 100 (27%) respondents strongly agreeing and 97 (26%) agreeing, giving a combined agreement of 53%. However, the relatively high proportion of respondents who disagreed (27%) or strongly disagreed (20%) indicates that respondents had more varied views about the importance of bush burning as a major driver. Overall, the findings

indicate that timber harvesting, settlement expansion and agricultural expansion were the most prominent perceived drivers of deforestation in Nasarawa State, while bush burning was the least strongly supported. The results suggest that both direct forest-resource exploitation and land-use conversion associated with socioeconomic development are important contributors to deforestation in the study area.

The finding on population growth (70%) is in agreement with Chunwate et al. (2025), who identified population growth as an important indirect driver of forest change in Nasarawa State. Their study showed that population increase creates greater demand for farmland, housing,

timber and other forest resources, thereby intensifying pressure on remaining forests.

Further support comes from Rotowa and Egbewole (2025), who investigated human activities and livelihood dependence as drivers of deforestation in Agudu Forest Reserve, Lafia LGA, Nasarawa State. Their study identified agricultural expansion and fuel-wood extraction among the major activities contributing to forest decline. This finding is particularly relevant to the present study because Lafia is one of the selected LGAs, thereby providing local evidence that livelihood activities and dependence on forest resources contribute substantially to deforestation.

Table 2: Implications of Deforestation for Environmental Sustainability (n = 374)

Environmental Implications	SA	A	D	SD	Total
Loss of biodiversity	166 (44%)	144 (39%)	50 (13%)	14 (4%)	374 (100%)
Increased soil erosion	140 (37%)	120 (32%)	74 (20%)	40 (11%)	374 (100%)
Reduction in vegetation cover	154 (41%)	112 (30%)	68 (18%)	40 (11%)	374 (100%)
Increased environmental temperature	170 (45%)	130 (35%)	44 (12%)	30 (8%)	374 (100%)
Loss of carbon storage	124 (33%)	140 (38%)	60 (16%)	50 (13%)	374 (100%)
Deterioration of water resources	120 (32%)	124 (33%)	58 (16%)	72 (19%)	374 (100%)
Loss of ecosystem services	132 (35%)	128 (34%)	80 (22%)	34 (9%)	374 (100%)

Table 2 presents respondents' perceptions of the implications of deforestation for environmental sustainability in Nasarawa State. The findings indicate that loss of biodiversity was the most strongly identified implication, with 166 (44%) respondents strongly agreeing and 144 (39%) agreeing, giving a combined agreement of 83%. This was followed by increased environmental temperature, with 170 (45%) strongly agreeing and 130 (35%) agreeing, representing 80% combined agreement. Similarly, loss of carbon storage recorded 124 (33%) respondents who strongly agreed and 140 (38%) who agreed, giving 71% combined agreement. Reduction in vegetation cover was also highly reported, with 154 (41%) strongly agreeing and 112 (30%) agreeing, representing 71% agreement. Loss of ecosystem services recorded 132 (35%) strong agreement and 128 (34%) agreement, giving a combined agreement of 69%. The results further show that deterioration of water resources was identified by 65% of respondents, comprising 120 (32%) who strongly agreed and 124 (33%) who agreed. Increased soil erosion recorded the lowest level of combined agreement, although it remained substantial, with 140 (37%) strongly agreeing and 120 (32%) agreeing, representing 69%. The findings demonstrate that respondents perceived deforestation as having considerable negative implications for environmental sustainability, particularly through biodiversity loss, increased environmental temperature,

reduction in vegetation cover, loss of carbon storage and deterioration of ecosystem services and water resources.

The finding that loss of biodiversity was the most prominent implication of deforestation (83% combined agreement) is consistent with the findings of Chunwate et al. (2025), who examined changes in gazetted forest reserves in Nasarawa State. Their study reported that forest degradation and changes in forest cover have important ecological consequences, including the loss and fragmentation of habitats that support biodiversity. The researchers emphasized that continued forest disturbance threatens the ecological functions and conservation value of forest reserves in the state. This supports the present finding that biodiversity loss represents a major environmental consequence of deforestation.

The high proportion of respondents who associated deforestation with increased environmental temperature (80%) is supported by Abimbola et al. (2025), who investigated vegetation change and land-surface temperature in Lafia, Nasarawa State. Their remote-sensing analysis showed that declining vegetation cover associated with urban expansion was accompanied by increasing land-surface temperatures. Their findings demonstrate that the removal of vegetation can contribute to increased surface temperatures, thereby supporting the present respondents' perception of increased environmental temperature as an important consequence of vegetation loss.

Table 3: Summary of Major Findings According to the Study Objectives

Objective	Major Finding	Evidence
Objective 1: Examine the major drivers of deforestation	Timber harvesting was the leading perceived driver of deforestation (85%), followed by settlement expansion (81%), agricultural expansion (81%), charcoal production (78%), fuelwood collection (72%), population growth (70%), mining activities (70%), and bush burning (53%).	Table 1
Objective 2: Assess implications for environmental sustainability	Loss of biodiversity was the most prominent perceived implication (83%), followed by increased environmental temperature (80%), loss of carbon storage (71%), reduction in vegetation cover (71%), loss of ecosystem services (69%), increased soil erosion (69%), and deterioration of water resources (65%).	Table 2

Discussion of Findings

Drivers of Deforestation

The study revealed that timber harvesting was the leading driver of deforestation in Nasarawa State, with 85% of respondents agreeing, followed by settlement expansion and agricultural expansion, each with 81% agreement. Charcoal production (78%), fuelwood collection (72%), population growth (70%) and mining activities (70%) were also identified as important drivers. Bush Burning recorded the lowest level of agreement (53%). These findings are consistent with Chunwate et al. (2025), who identified lumbering, agricultural expansion, fuelwood collection and charcoal production as important drivers of forest change in Nasarawa State. Rotowa and Egbewole (2026) similarly identified agricultural expansion and fuelwood extraction as important contributors to forest decline in Agudu Forest Reserve, Lafia LGA. The findings are also consistent with the Environmental Kuznets Curve (EKC) Theory. The theory suggests that environmental degradation may increase during the early stages of socioeconomic development as economic and livelihood activities expand. In Nasarawa State, increasing demand for farmland, timber, household energy, residential land and mineral resources has intensified pressure on forests. Thus, the high levels of agreement recorded for timber harvesting, agricultural expansion, settlement expansion and energy-related forest exploitation demonstrate how socioeconomic activities can generate environmental degradation. The finding supports the EKC proposition that increasing human economic activities, without adequate environmental regulation and sustainable practices, can accelerate environmental degradation.

Implications for Environmental Sustainability

The study found that loss of biodiversity was the most prominent implication of deforestation, with 83% of respondents agreeing, followed by increased environmental temperature (80%), loss of carbon storage (71%), reduction in vegetation cover (71%), loss of ecosystem services (69%), increased soil erosion (69%) and deterioration of water resources (65%). These findings are supported by

Chunwate et al. (2025), who reported important ecological consequences of forest-cover changes in Nasarawa State, including habitat degradation. Abimbola et al. (2025) also found that declining vegetation cover in Lafia was associated with increasing land-surface temperatures. From the perspective of the EKC Theory, these findings demonstrate the environmental costs of increasing socioeconomic pressure on natural resources. Continued forest exploitation reduces vegetation cover and consequently affects biodiversity, carbon storage, soil protection, water regulation and temperature moderation. The theory further suggests that such degradation can be reduced when environmental awareness, improved technology, effective regulations and sustainable resource-management practices increase alongside socioeconomic development.

Conclusion

The study examined the major drivers of deforestation and its implications for environmental sustainability in Nasarawa State, Nigeria. The findings revealed that timber harvesting, settlement expansion and agricultural expansion were the most prominent drivers of deforestation, while charcoal production, fuelwood collection, population growth and mining activities also contributed substantially. The study further established that deforestation has significant implications for environmental sustainability, particularly through biodiversity loss, increased environmental temperature, reduction in vegetation cover, loss of carbon storage, soil erosion, deterioration of water resources and loss of ecosystem services. The findings confirm that continued socioeconomic pressure on forest resources is contributing to environmental degradation in the state, emphasizing the need for sustainable forest-resource management and stronger environmental governance.

Recommendations

- Farmers and forest-dependent communities should adopt sustainable land-use and forest-resource practices, including agroforestry, controlled tree harvesting, reduced dependence on fuel-wood and

charcoal, and tree planting on farms and degraded lands. This will reduce pressure on natural forests while allowing households to continue benefiting from land and forest resources.

- ii. The government should strengthen forest protection and environmental regulations by improving monitoring of timber harvesting, settlement expansion, agricultural encroachment and mining activities, while expanding reforestation and forest-restoration programmes. Effective enforcement should be complemented by alternative livelihood and energy programmes to reduce communities' dependence on natural forests.

References

1. Abimbola, O. J., Adewumi, T., & Abubakar, M. (2025). Dynamics of urban heat island in Lafia, Nasarawa State of Nigeria: A remote sensing analysis of land surface temperature, urban development and vegetation change. *arXiv*
2. Alage, I. L., Tan, Y., Akande, A. W., & Suprijanto, A. (2025). Advanced characterization of deforestation frontiers in Nigeria utilizing deep learning and Bayesian approaches with Sentinel-1 SAR imagery. *Geocarto International*, 40(1).
3. Abera, T. A., Heiskanen, J., Maeda, E. E., et al. (2024). Deforestation amplifies climate change effects on warming and cloud level rise in African montane forests. *Nature Communications*, 15, 6992.
4. Chunwate, B. T., Marchant, R. A., Jew, E. K. K., & Stringer, L. C. (2025). Forest cover and land use change trajectories within gazetted forest reserves in Nasarawa State, North Central Nigeria (1966–2020). *Trees, Forests and People*, 21, 100963.
5. Chunwate, B. T., Marchant, R. A., Jew, E. K. K., & Stringer, L. C. (2025). Understanding local perspectives on the trajectory and drivers of gazetted forest reserve change in Nasarawa State, North Central Nigeria. *Land*, 14(7), 1450.
6. Denton, F., Arko, T., & Ampomah, G. (2024). Scoping study: Reversing environmental degradation in Africa and Asia (West Africa). *United Nations University*.
7. Food and Agriculture Organization of the United Nations. (2025). Global forest resources assessment: *Global forest sector outlook*. FAO.
8. Gadiga, B. L., & Peter, Y. (2025). The impacts of deforestation on the ecology and food security in the Mubi Region of Adamawa State. *IRES PUB Journal of Environmental & Material Sciences*, 4(3), 1–13.
9. Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement. *National Bureau of Economic Research Working Paper Series*, No. 3914.
10. Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *The Quarterly Journal of Economics*, 110(2), 353–377.
11. Jahel, C., & Lambin, E. F. (2024). Reversing degradation of social–ecological systems: Explaining the outcomes of interventions in Africa. *Sustainability Science*, 20(2), 439–468.
12. Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610.
13. Mike, J. H., & Lugard, S. B. (2025). Fading forests, encroaching sands: A critique of Nigeria's environmental laws on deforestation. *AUN Journal of Law*, 1(1).
14. Manu, E. K., Chen, G. S., Hoang, N., & Leu, S. (2024). Natural resource extraction and environmental sustainability in Africa: The role of voice and accountability. *Sustainable Development*, 32(6), 6104–6119.
15. Masolele, R. N., Marcos, D., De Sy, V., Abu, I.-O., Verbesselt, J., Reiche, J., et al. (2024). Mapping the diversity of land uses following deforestation across Africa. *Scientific Reports*, 14, 1681.
16. Olunusi, B. O. (2024). Assessing the impact of agricultural practices on environmental sustainability in Nigeria. *Journal of Applied Life Sciences and Environment*, 57(3), 403–420.
17. Oloyede, J. O., Okimiji, O. P., & Oloketuyi, A. J. (2025). Massive destruction of tropical rain forest and its soaring effect on environmental temperature in southwest Nigeria. *Discover Global Society*, 3, 110.
18. Rotowa, O. J., & Egbewole, Z. T. (2025). Human activities and livelihood dependence as drivers of deforestation in Agudu Forest Reserve. *International Journal of Forestry and Agriculture*, 9(4), 346–356.

19. Sartor, G., Salis, M., Pinardi, S., Saracik, O., & Meo, R. (2024). Deep learning tools to support deforestation monitoring in the Ivory Coast using SAR and optical satellite imagery. *International Journal of Applied Earth Observation and Geoinformation*, 144, 104849.
20. Sylvester, E. G., Marcus, N. D., & Ogah, A. T. (2024). Assessing the rate of forest degradation in Doma Local Government Area of Nasarawa State, Nigeria. *Journal of Advanced Science and Optimization Research*, 6(9), 85–93.
21. Wingate, V. R., Curatola Fernández, G. F., & Speranza, C. I. (2024). Small forest patches in West Africa: Mapping how they are changing to better inform their conservation. *Environmental Conservation*, 51(4), 254–262.
22. World Population Review. (2026). Akwanga population 2026. *World Population Review*.
23. World Population Review. (2026). Karu population 2026. *World Population Review*.
24. World Population Review. (2026). Lafia population 2026. *World Population Review*.