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Impact of Forests Degradation on Rural Household Livelihoods in Central Zone of Taraba State, Nigeria

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ABSTRACT: Forest degradation poses a critical threat to the livelihoods of rural communities in tropical regions, yet empirical evidence linking environmental decline to household-level outcomes remains limited, particularly in understudied ecological zones. This study assesses the impact of forest degradation on rural household livelihoods in the Central Zone of Taraba State, Nigeria, employing a convergent parallel mixed-methods design. Quantitative data from 391 household surveys were integrated with spatial analysis of Landsat imagery (1993–2023) to evaluate land cover change and its socio-economic correlates. Findings reveal that forest degradation driven primarily by agricultural expansion, fuelwood extraction, and weak regulatory enforcement has significantly diminished livelihood security. Key impacts include reduced access to fuelwood and medicinal plants, decreased agricultural productivity, and heightened vulnerability to climate variability. Regression analysis further indicates that forest degradation negatively predicts household livelihood outcomes ($\beta = -0.408$, $p < 0.001$), with female-headed and larger households experiencing heightened vulnerability. Conversely, higher education levels and older household heads correlate with improved resilience. The study

underscores the urgent need for integrated policy interventions that promote sustainable forest management, enhance alternative livelihood options, and strengthen local governance. These findings contribute to the growing discourse on socio-ecological resilience and provide evidence-based insights for sustainable rural development in Nigeria's forest-dependent communities.

Keywords: *Forest Degradation, Livelihood, Rural households*

Introduction

Forests are indispensable to the ecological stability and socio-economic well-being of rural communities worldwide, serving as vital sources of food, fuel, medicine, income, and cultural sustenance (FAO, 2020). In sub-Saharan Africa, approximately 65% of the population relies directly on forests and woodland resources for their livelihoods, with forest products contributing significantly to household income, nutrition, and energy security (Sunderland et al., 2017). Nigeria, despite experiencing one of the highest rates of deforestation in the world, still retains critical forest ecosystems that support millions of rural dwellers, particularly in the biodiverse regions of the Middle Belt and South (Akinsoji et al., 2016). Among these, the Central Zone of Taraba State stands out for its rich and varied forest landscapes, ranging from the montane grasslands of the Mambilla Plateau to the riparian forests along the Benue River which sustain local populations through a multitude of ecosystem services (Mubi, 2010; Tukura et al., 2022).

However, these forest systems are undergoing rapid and severe degradation, driven by a confluence of anthropogenic and environmental pressures. Agricultural expansion, indiscriminate logging, fuelwood extraction, population growth, mining activities, and climate variability collectively contribute to the depletion of forest cover and the deterioration of forest health (Adetoye, 2019; Abubakar & Ibrahim, 2016). In Central Taraba, these drivers are intensified by systemic challenges such as poverty, limited access to alternative livelihoods, weak governance structures, and inadequate enforcement of forest protection laws (Firuza *et al*, 2015). The resulting degradation not only threatens biodiversity and ecological functions such as soil conservation, water regulation, and carbon sequestration, but also undermines the

foundation of rural livelihoods, exacerbating vulnerabilities and diminishing resilience to socio-economic and climatic shocks (May-Tobin, 2011).

The relationship between forest degradation and rural livelihoods is particularly acute in regions where communities are highly dependent on forest resources for daily survival and economic stability. Studies across tropical regions have demonstrated that forest loss correlates strongly with reduced household income, food insecurity, decreased access to medicinal plants, and increased exposure to natural hazards (FAO, 2011; Salim & Ullsten, 1991). In Nigeria, while the ecological dimensions of deforestation have been documented, there remains a significant gap in empirical research linking forest degradation to household-level livelihood outcomes, especially in understudied but ecologically sensitive zones such as Central Taraba. Previous investigations have largely focused on broad-scale land-use changes or singular drivers of deforestation, often neglecting the nuanced ways in which forest decline interacts with household characteristics such as gender, age, education, and family size to shape well-being and adaptive capacity (Chapman et al., 2004; Tagowa & Buba, 2012).

To address this gap, this study undertakes a comprehensive assessment of the impact of forest degradation on rural household livelihoods in the Central Zone of Taraba State, Nigeria. By employing a mixed-methods approach that integrates quantitative household surveys with spatial analysis using remote sensing and GIS, the research aims to provide a holistic and contextually grounded understanding of the forest–livelihood nexus. Specifically, the study is guided by the following objectives:

1. To examine the major perceived causes of forest degradation in Central Taraba, identifying key anthropogenic and environmental drivers as reported by local communities.

2. To evaluate the contributions of forest resources to rural household livelihoods, assessing the economic, nutritional, medicinal, and energy-related roles of forests in daily life.

3. To analyze the impacts of forest degradation on household well-being, focusing on income stability, food security, health, and adaptive capacity to environmental stressors.

4. To identify and assess community-supported strategies for mitigating forest degradation, exploring local perceptions of effective conservation, restoration, and sustainable livelihood interventions.

Through this multi-faceted inquiry, the study seeks to generate robust, evidence-based insights that can inform policy formulation, conservation planning, and sustainable development initiatives. The findings are intended to support stakeholders including government agencies, non-governmental organizations, and community leaders in designing targeted, inclusive, and effective interventions that promote forest resilience while enhancing the livelihoods of forest-dependent communities in Taraba State and similar contexts across West Africa.

Description of Study Area

The study was conducted in the Central Senatorial District of Taraba State, located in northeastern Nigeria. This zone encompasses five Local Government Areas (LGAs): Bali, Gashaka, Gassol, Kurmi, and Sardauna. It spans an area of approximately 32,110.82 km² and is geographically situated between latitudes 6°30'00"N and 8°48'46"N and longitudes 10°01'00"E and 11°50'18"E (Mubi, 2010). The region shares an international boundary with the Republic of Cameroon to the south and is bordered domestically by Adamawa State to the northeast, and the LGAs of Karim-Lamido, Ardo-Kola, Yorro, Wukari, Donga, and Ibi to the north, west, and northwest, respectively. Administratively, the Central Zone represents a critical socio-ecological landscape where forest-dependent rural livelihoods intersect with complex governance and land-use dynamics typical of Nigeria's Middle Belt region (Mustapha, 2006).

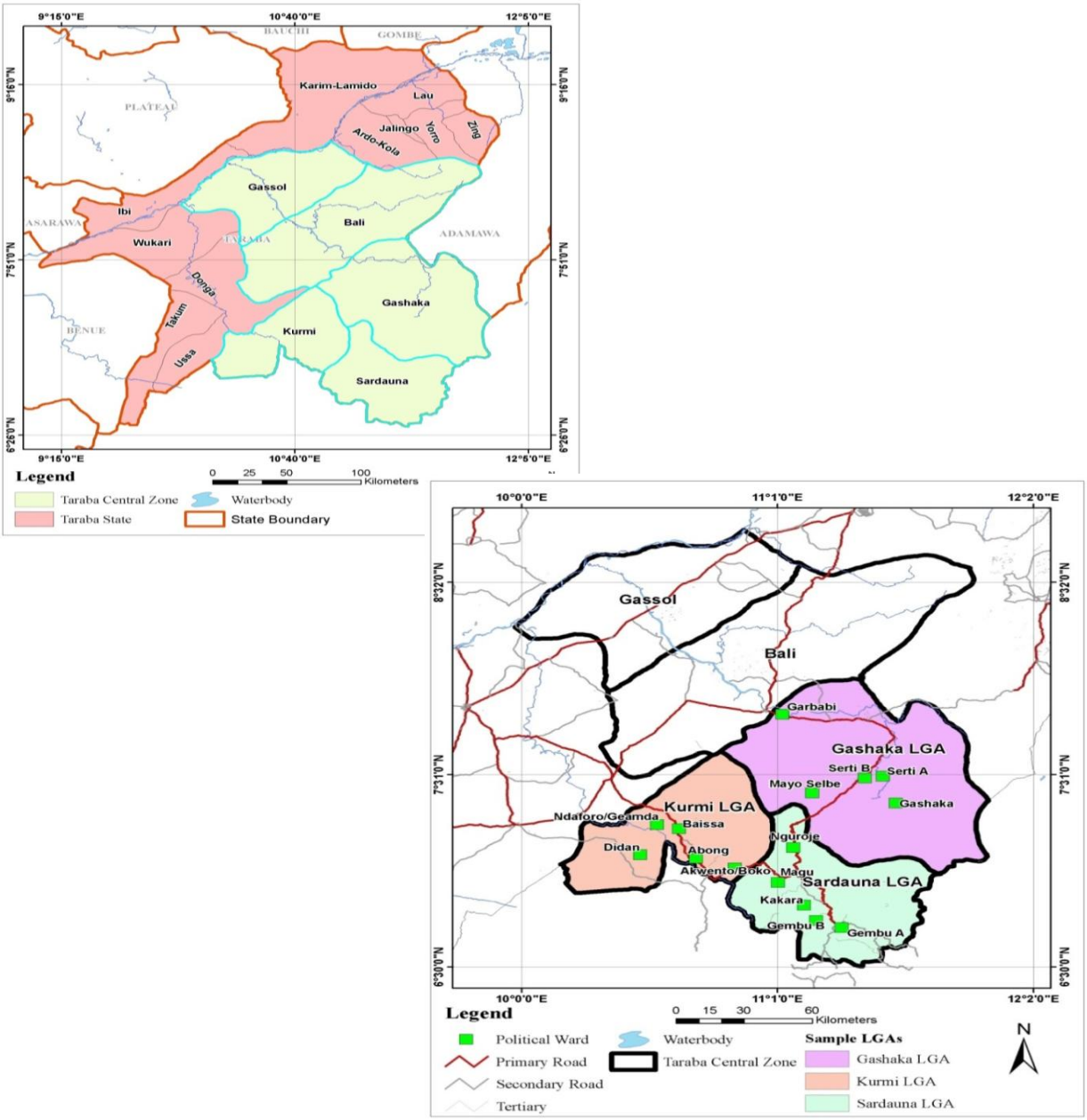

Figure 1: Map of study area.

The study area exhibits pronounced physiographic diversity, encompassing two dominant landforms: the expansive Benue floodplains (locally known as the Muri plains) in the north and the elevated Mambilla Plateau in Sardauna LGA. The plains, with elevations ranging from 240 meters above sea level, consist of undulating highlands, isolated hills, and riparian valleys (Bako et al, 2016). In contrast, the Mambilla Plateau rises to over 1,800 meters, forming one of Nigeria's most significant highland regions (Olaniran, 2002). The region is drained primarily by the

River Benue, which forms a natural northern boundary to Gassol LGA, alongside its tributaries including the River Taraba. This fluvial network is vital for agriculture, domestic use, and ecosystem sustenance.

Climatically, the area experiences a tropical wet and dry climate, classified as Aw under the Köppen-Geiger system (Peel et al., 2007). The wet season typically lasts from April to October, with mean annual rainfall exceeding 1,200 mm in the southern highlands. Temperature regimes vary with altitude; the lowland areas around Bali experience warm to hot conditions year-round (23–40°C), with a slightly cooler period from November to February, whereas the Mambilla Plateau enjoys a more temperate climate (Abubakar & Ibrahim, 2016). Relative humidity fluctuates widely, ranging from 26% to 78% in areas adjacent to the Gashaka-Gumti National Park (Tagowa & Buba, 2012). These climatic gradients significantly influence vegetation patterns, agricultural calendars, and livelihood activities.

The study area hosts a mosaic of vegetation types shaped by altitude, climate, and anthropogenic pressure. The southern and eastern sectors, particularly the Chappal Hills and Fali Mountains in Gashaka and Kurmi LGAs, are characterized by tropical rainforest and moist deciduous forest formations. Chapman et al. (2004) identified distinct riparian forest associations in these areas, including stands dominated by Syzygium guineense var. guineense, Albizia gummifera and Symphonia globulifera, Garcinia smeathmannii. Canopy composition is diverse, featuring species such as Prunus africana, Entandrophragma angolense, and Ficus spp. (Akinsoji et al., 2016).

In contrast, the northern lowlands of Gassol and Bali LGAs are predominated by Sudan savanna woodlands and shrub grasslands, which provide critical grazing resources. The montane grasslands of the Mambilla Plateau represent an afro-alpine ecoregion with unique herbaceous communities and scattered gallery forests (Mubi, 2010). Notably, significant portions of Bali, Gassol, and Sardauna LGAs exhibit over 10% bare or sparsely vegetated land, indicating considerable land cover modification. The presence of the Gashaka-Gumti National Park, one of Nigeria's largest protected areas adds a layer of ecological significance and conservation complexity to the region (Dunn, 2004).

Land use in Central Taraba is predominantly agrarian, with rain-fed and irrigated agriculture practiced extensively in the Benue and Taraba river valleys. Staple crops include maize, sorghum, rice, and yams, while the highlands support temperate crops such as tea and Irish potatoes (Tukura et al., 2022). Livestock rearing, particularly cattle, sheep, and goats, is integral to the local economy, with seasonal transhumance between lowland dry-season grazing areas and upland pastures during the rains.

Forest resources play a multi-functional role in rural livelihoods. Timber extraction especially of high-value species such as Pterocarpus erinaceus (Rosewood) and non-timber forest product (NTFP) collection (e.g., wild honey, medicinal plants, fruits) provide subsistence and cash income (Amadi et al., 2025). However, these activities coexist with escalating deforestation and forest degradation driven by agricultural expansion, fuelwood harvesting, and, in some areas, legal and illegal mining operations. The Ngel Nyake Forest Reserve on the Mambilla Plateau represents one of the few formalized forest plantations in the zone, highlighting ongoing, though limited, afforestation efforts.

Soil types vary considerably across the landscape. Fluvisols dominate riverine floodplains, particularly along the Benue and Taraba valleys, supporting intensive agriculture. Luvisols cover the extensive Benue plains, while Ferrasols are prevalent on the Mambilla Plateau. Leptosols, characterized by shallow depth and high rock content, are found at the foot of the Mambilla Plateau in Gashaka LGA (Tukura et al., 2022).

Geologically, the area comprises eleven distinct units, including Alluvium, Amphibolite, Granite Gneiss, Younger Basalt, and various schist and gneiss formations. Biotite Hemblended Gneiss is the most widespread, covering substantial parts of Bali, Gashaka, and Sardauna LGAs. The distribution of these geological units influences soil fertility, water retention, and land-use suitability, thereby indirectly shaping patterns of agricultural productivity and forest resilience (Tukura et al., 2022).

Central Taraba was selected for this study due to its representative socio-ecological dynamics: it encapsulates the tension between forest conservation and rural

livelihood demands prevalent across Nigeria's forest-savanna transition zone. The co-existence of protected areas, community forests, degraded landscapes, and active agricultural frontiers provides an ideal context for investigating the impacts of forest degradation on household livelihoods. Furthermore, the area's accessibility, demographic diversity, and documented environmental changes make it a pertinent case for generating insights applicable to similar regions in West Africa.

Methodology

This study employed a convergent parallel mixed-methods research design (Creswell & Plano Clark, 2017) to holistically assess the relationship between forest degradation and rural household livelihoods. This approach facilitates methodological triangulation, enhancing the validity and depth of findings by integrating quantitative survey data with qualitative spatial analysis (Johnson & Onwuegbuzie, 2004). The quantitative component involved a cross-sectional household survey, while the qualitative component utilized remote sensing and Geographic Information System (GIS) techniques to analyze land use and land cover (LULC) changes over a 30-year period (1993–2023). Such integrative designs are increasingly adopted in socio-ecological research to capture both human perceptions and biophysical realities (Fischer et al., 2021).

A multi-stage sampling technique was employed to ensure representativeness and logistical feasibility across the rural, forest-dependent communities in Central Taraba. Purposive sampling was first used to select three Local Government Areas (LGAs) with significant forest cover and documented degradation trends (Gashaka, Kurmi, Sardauna). Within each LGA, five wards were randomly selected, followed by the random selection of one village per ward (Table 1). Households were then systematically sampled, with a final sample size of 391 households determined through proportional allocation based on ward-level population data (GRID3, 2023; Raosoft, 2004). This sampling approach is consistent with methods used in similar rural livelihood studies in sub-Saharan Africa (Kumar et al., 2019).

Table 1 Population and Sample Size in some Selected Wards from LGAs

LGA	Ward	Population	Sample size
Sardauna	Kakara	40,494	36
	Gembu A	48,366	43
	Gembu B	51,931	45
	Magu	41,136	36
	Nguroje	70,381	62
Gashaka	Gashaka	9,894	9
	Garbabi	16,116	14
	Mayo selbe	19,719	17
	Serti A	14,998	13
	Serti B	44,070	39
Kurmi	Baissa	33,182	29
	Didan	21,617	19
	Akwento/Boko	8,860	8
	Ndaforo/Geamda	14,272	13
	Abong	9,258	8
Total		434,294	391

Source: Grid3 online data: https://grid3.org/ and Raosoft (2004)

Primary data were collected using a structured household questionnaire administered to household heads. The instrument was designed using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) and covered the following domains:

- Socio-demographic and economic characteristics (age, gender, education, occupation, household size)
- Perceived drivers of forest degradation (agricultural expansion, logging, fuelwood collection, mining, climate change)
- Contribution of forest resources to livelihoods (income, food, medicine, energy, construction)
- Impacts of forest degradation on household well-being (income loss, food insecurity, health, vulnerability)

- Perceived mitigation and adaptation strategies (community forestry, alternative energy, reforestation)

The questionnaire was pre-tested in a non-sampled community to ensure clarity and cultural appropriateness, and adjustments were made based on feedback. The internal consistency of the Likert-scale items was confirmed using Cronbach's alpha (α = 0.87), indicating high reliability (Tavakol & Dennick, 2011).

Secondary data included existing literature, regional reports, and policy documents related to forest management and rural development in Taraba State. Population datasets from GRID3 (2023) and the National Population Commission of Nigeria were used.

Survey data were analyzed using IBM SPSS Statistics Version 28. Descriptive statistics (frequencies, percentages, means, standard deviations) summarized socio-demographic variables and Likert-scale responses. Multiple linear regression was employed to model the relationship between forest degradation and household livelihoods while controlling for key covariates. The regression model was specified as:

$$HLI = \beta0 + \beta1FDI + \beta2HS + \beta3HHA + \beta4HHG + \beta5EDU + \varepsilon$$

Where:

- $\beta0$ is the intercept or constant term.

- $\beta1$, $\beta2$, $\beta3$, $\beta4$, and $\beta5$ are the regression coefficients for the independent variables.

- HLI = Household Livelihood Index (composite measure of income, food security, and access to

basic amenities)

- FDI = Forest Degradation Index (derived from NDVI change and survey indicators)

- HS = Household size

- HHA = Household head age

- HHG = Household head gender (dummy variable: 1 = male, 0 = female)

- EDU = Education level (ordinal scale)

- ε is the error term, representing the random variation in the dependent variable that is not explained by the independent variables.

The use of composite indices (HLI, FDI) follows established practices in livelihood and environmental impact research (Ellis, 2000; Sunderlin et al., 2005). By using a multiple regression model, this research was able to examine the relationships between forest degradation and rural household livelihoods while controlling for other important factors that may influence livelihood outcomes. The results of this analysis provided valuable insights into the impact of forest degradation on rural household livelihoods in Taraba Central, Nigeria, and inform policies aimed at promoting sustainable forest management and improving rural livelihoods.

The study adhered to ethical guidelines for social research. Informed consent was obtained from all participants prior to data collection, and anonymity and confidentiality were strictly maintained. The research protocol was reviewed and approved by the relevant institutional ethics committee, in line with the principles of the Belmont Report (National Commission for the Protection of Human Subjects, 1979).

While the mixed-methods design strengthens the study's validity, some limitations should be acknowledged. Self-reported data may be subject to recall and social desirability biases. Additionally, the use of 30-meter resolution Landsat imagery, while suitable for regional analysis, may not capture fine-scale forest degradation. Future studies could incorporate higher-resolution imagery or participatory mapping to enhance spatial granularity (Zhu et al., 2019).

Results of the Findings

Socio-Economic and Demographic Characteristics of the Respondents

The respondent's socio-economic characteristics, such as gender, age, marital status, household size, educational background, and occupation data is presented in Table 2.

The result of the findings of the study in Table 2 shows that male has the highest frequency of 236 representing 60%, while the female constitutes 155 (40%) of the study population. The respondents with age range between 21 and 30 has the highest number with 182 frequencies representing 47%, followed by 31-40 age range of the respondents with the frequency of 119 and 30% respectively. Next are respondents with age range of 41-50 numbering 66 and 17 by percentage. Respondents of age range between 51 and above are the least with 24 (6%). The marital status of the respondents reveal that the single respondents dominated the rest with 47%, followed by the married respondents with 41%, divorcee 7% and widows 5%.

The household indicates that zero household size numbering 128 or 33% were involved in this research. Household size 1-5 seems to be the highest respondents in this research with 164 frequency and 42%. 83 respondents for the household size 6-10 are the third in this table. Household size 10 and above seems to be the least on this table.

The education portrays that respondents with Secondary School as educational level dominated the list with 203 frequency and 52%, followed by the tertiary education level respondents numbering 118 with 30%, next is respondents with no formal education numbering 42 and 11%. Primary education holders are the least of all with only 28 and 7% respondents.

Lastly the occupation clearly shows that students were the highest respondents for this research with 168 frequency and 43%, followed by farmers with 109 in number and 28% . traders and civil servants appeared to be bracket with 45 frequency each and 12% respectively. 15 artisans representing 4%, then applicants numbering only 9 with 2%. The table also shows that apart from the listed occupation, no any other profession or occupation served as a respondent for this research.

Table 2: Socio-Economic and Demographic Characteristics of the Respondents

S/No.	Socio-Demographic Characteristics	Frequency	Percentage (%)
1	Gender		
	Male	236	60%
	Female	155	40%
	Total	391	100%

2	Age		
	21-30	182	47%
	31-40	119	30%
	41-50	66	17%
	51 and above	24	6%
	Total	391	100%
3	Marital Status		
	Married	161	41%
	Single	183	47%
	Divorced	26	7%
	Widow	21	5%
	Total	391	100%
4	Household Size		
	0	128	33%
	1-5	164	42%
	6-10	83	21%
	10 and above	16	4%
	Total	391	100%
5	Educational Level		
	Tertiary	118	30%
	Secondary	203	52%
	Primary	28	7%
	No formal Education	42	11%
	Total	391	100%
6	Occupation		
	Farming	109	28%
	Student	168	43%
	Trading	45	12%
	Artisan	15	4%
	Civil Servant	45	12%
	Applicant	9	2%
	Others	0	0%
	Total	391	100%

Major Causes of Forest Degradation in Central Taraba Based on respondents View

Concerning the major causes of forest degradation in Taraba Central, factors itemized include agricultural expansion, uncontrolled bush burning, fuelwood collection for domestic use, population growth and urbanization, mining activities (both legal and illegal), climate change effects (e.g., increased droughts), poverty and

lack of alternative livelihoods, Weak enforcement of forest protection laws, conflicts between farmers,, and lack of awareness about the importance of forest conservation. Table 3 shows the perception of respondents on the major causes of degradation in the study area,, with the respondents agreeing with agricultural expansion (mean rating = 4.13), bush burning (mean rating = 4.24), fuelwood collection (mean rating = 4.39), population growth (mean rating = 4.17), mining activities (mean rating = 4.15), climate change (mean rating = 4.05), poverty (mean rating = 4.10), weak enforcement (mean rating = 4.01), conflict (mean rating = 3.98), and lack of awareness (mean rating = 4.08), with a grand mean of 4.53. This finding coincides with the work of (Adetoye, 2019), (Firuza *et al*, 2015), and Meer and Bunde (2018), who found that timber harvesting (deforestation), the process by which a forest is converted to an alternative permanent non-forested land such as agriculture (farming), grazing, or urban development, has remained the single most important problem in forest areas of Nigeria. In a similar study by (Adedoyin, 2019), it was reported that human activities such as farming, hunting, logging, and the collection of non-timber forest products, as well as setting fires, are threats to the continual perpetuation of biological resources (fauna and flora).

Table 3. Major Causes of Forest Degradation in Central Taraba

S/N	Items	N	Mean	SD	Remarks
1	Agricultural expansion for crop farming	391	4.40	.953	Agreed
2	Uncontrolled bush burning	391	4.25	.936	Agreed
3	Fuel wood collection for domestic use	391	4.13	1.016	Agreed
4	Population growth and urban	391	4.17	1.034	Agreed
5	Mining activities (both legal and illegal)	391	4.15	.973	Agreed
6	Climate change effects (e.g., increased droughts)	391	4.05	1.049	Agreed
7	Poverty and lack of alternative livelihoods	391	4.10	1.069	Agreed
8	Weak enforcement of forest protection laws	391	4.01	1.078	Agreed
9	Conflicts between farmers and	391	3.98	1.159	Agreed
10	Lack of awareness about the importance of forest	391	4.08	1.057	Agreed
	Grand Mean		**4.53**		

Impacts of Forest Degradation on Rural Households in Central Taraba

Concerning the Impacts of forest degradation on rural households livelihood's in the study area, factors such as reduced household's access to fuel wood and heating, vulnerability to pests and diseases due to loss of forest cover, negative impacts on household's income, scarcity of medicinal plants, reduction of farmlands productivity due soil erosion, less reliability and poorer quality of water sources, negative impacts on livestock due to reduction of grazing areas, more spending on alternative materials and vulnerability to the impacts of climate change in the study area with the respondents agreeing with all the items of the questionnaire. Table 4 shows the perception of respondents on impact of forest degradation with the respondents agreeing with reduced household's access to fuel wood and heating (mean rating = 4.36), vulnerability to pests and diseases due to loss of forest cover, (mean rating = 4.29), negative impacts on household's income (mean rating = 4.15), scarcity of medicinal plants (mean rating = 4.16), reduction of farmlands productivity due soil erosion, (mean rating = 4.11), less reliability and poorer quality of water sources (mean rating = 4.15), negative impacts on livestock due to reduction of grazing areas (mean rating = 4.05), more spending on alternative materials (mean rating = 3.93), reduced our ability to cope with drought periods (mean rating = 4.05) and vulnerability to the impacts of climate change (mean rating = 4.05) with a grand mean of 4.13. Up to 2 billion people rely on forest products, such as fruits, game meat, fibres, and fuel wood, to meet their basic needs, according to FAO (2011) and May-Tobin (2011). In Africa, fuel wood and charcoal account for 58% of the energy supply; in Latin America and Asia, this percentage is 15% and 11%, respectively, and cannot be disregarded as a potential source of ecosystem disturbance (Salim & Ullsten, 1991). Forest degradation from fuel wood harvesting can be substantial if too many people rely on too few forested areas and the ecosystem services they provide.

Numerous human populations in many tropical biodiversity hotspots depend on diminishing, fragmented forests to meet their needs for fuel wood, agricultural land, and animal protein consumption. However, authorities and conservationists tend to overlook the environmental effects of fuel wood consumption. This is likely due to the fact that this activity is a mysterious and persistent disturbance that is seen as less

significant than other major causes of biodiversity, such as deforestation and forest degradation brought on by changes in land use (Bensel, 2008; Puyravaud, 2010).

Table 4: Impacts of Forest Degradation on Rural Households in Central Taraba

S/N	Items	N	Mean	SD	Remarks
1	Forest degradation has reduced our household's access to fuelwood and heating	391	4.36	.805	Agreed
2	The loss of forest cover has made our crops more vulnerable to pests and diseases	391	4.29	.842	Agreed
3	The decline in forest resources has negatively impacted our household's income.	391	4.15	.965	Agreed
4	Forest loss has made it harder to find medicinal plants we rely on for healthcare	391	4.16	1.043	Agreed
5	Soil erosion due to deforestation has reduced the productivity of our farmland.	391	4.11	.915	Agreed
6	Forest loss has made our water sources less reliable and of poorer quality.	391	4.15	1.005	Agreed
7	Forest degradation has reduced grazing areas, negatively impacting our livestock.	391	4.05	.986	Agreed
8	The loss of forest products has forced us to spend more money on alternative materials.	391	3.93	1.022	Agreed
9	Degradation of forests has reduced our ability to cope with drought periods.	391	4.05	.971	Agreed
10	Forest loss has made our household more vulnerable to the impacts of climate change	391	4.12	.959	Agreed
	Grand Mean		**4.13**		

Contribution of Forests Resources to Livelihood of Rural Households in Central Taraba

Table 5 revealed that with regards to contribution of forest resources to rural household's livelihood in the study area. factors such as significant source of income, provision of fuel wood as a primary source of energy for cooking, fruits and nuts,

medicinal plants, housing and construction needs, Hunting forest animals, wild honey, materials for handicrafts, livestock grazing and contribution to households livelihood were itemized and Table 5 below shows the perception of respondents on the major contributions of forest resouces to rural household livelihood in the study area with the respondents agreeing with all the items of the questionnaire, significant source of income (mean rating = 4.45), provision of fuelwood as our primary source of energy for cooking (mean rating = 4.20), provision of fruits and nuts (mean rating = 4.18), provision of medicinal plants (mean rating = 4.19), housing and construction needs (mean rating = 4.24), Hunting forest animals (mean rating = 4.07), provision of wild honey (mean rating = 4.07), provision of materials for handicrafts (mean rating = 4.89), livestock grazing (mean rating = 3.96) and contribution to households livelihood (mean rating = 4.89), with a grand mean of 4.10. This corroborated with the findings of (Amadi *et al.*, 2025), who reported that the forest products significantly contribute to household income, enhancing rural empowerment of rural communities surrounding the Gashaka-Gumti National Park, Taraba State, Nigeria.

Table 5 Contribution of Forests Resources to Livelihood of Rural Households in Central Taraba

S/N	Items	N	Mean	SD	Remarks
1	Forest resources provide a significant source of income	391	4.45	.752	Agreed
2	We rely on forests for fuelwood as our primary source of energy for cooking	391	4.20	.853	Agreed
3	Forest fruits and nuts contribute substantially to our household's diet.	391	4.18	.950	Agreed
4	We collect medicinal plants from the forest for healthcare needs	391	4.19	.944	Agreed
5	Timber from forests is important for our housing and construction needs.	391	4.24	.949	Agreed
6	Hunting forest animals is a crucial source of protein for our family.	391	4.07	.974	Agreed
7	We gather wild honey from the forest as a food source and for sale	391	4.07	.946	Agreed

8	Forest resources provide materials for handicrafts that we sell for income.	391	3.89	1.032	Agreed
9	Grazing our livestock in forested areas is essential for animal feed.	391	3.96	1.048	Agreed
10	Forest resources contribute more to our livelihood than agricultural activities.	391	3.80	1.187	Agreed
	Grand Mean		**4.10**		

The Strategies for Mitigating Forest Degradation in the Central Taraba

Concerning the mitigation measures to forest degradation in the study area, the factors such implementing stricter penalties for illegal logging, alternative energy sources (e.g., solar, biogas), implementation of reforestation programs, provision of alternative livelihood options, establishment of community-managed forests, educating local communities about sustainable forest management, implementation of forest certification schemes, establishment of protected areas with restricted access, promotion the use of improved cook stoves and used satellite monitoring and technology were itemized and Table 6 shows the perception of respondents on mitigation measures to forest degradation in the study with the respondents agreeing with all the items of the questionnaire, implementing stricter penalties for illegal logging (mean rating = 4.48), alternative energy sources (e.g., solar, biogas) (mean rating = 4.25), implementation of reforestation programs (mean rating = 4.26), provision of alternative livelihood options (mean rating = 4.21), establishment of community-managed forests (mean rating = 4.18), educating local communities about sustainable forest management (mean rating = 4.19), implementation of forest certification schemes (mean rating = 4.01), establishment of protected areas with restricted access (mean rating = 3.96), promotion the use of improved cook stoves (mean rating = 4.12) and used satellite monitoring and technology (mean rating = 4.18) and then the grand mean is 4.13.This finding agrees with Uloko (2017), who reported that rural development policies and the intervention of private institutions in forest areas that can address the development issues and provide cheaper and cleaner alternatives to fuelwood will reduce the forest dependency of local people and thus the pressure on the forest resource. In a similar study by (Uloko, 2017), it was

reported that the government should make provision for an alternative source of employment and ways of improving the living standards of the populace (rural inhabitants).

Table 6: Strategies for Mitigating Forest Degradation in the Central Taraba

S/N	Items	N	Mean	SD	Remarks
1	Implementing stricter penalties for illegal logging would effectively reduce forest degradation	391	4.48	.730	Agreed
2	Providing alternative energy sources (e.g., solar, biogas) would reduce pressure on forests for fuelwood.	391	4.25	.876	Agreed
3	Implementing reforestation programs would significantly help restore degraded forest areas.	391	4.26	.904	Agreed
4	Providing alternative livelihood options would reduce community dependence on forest resources	391	4.21	.889	Agreed
5	Establishing community-managed forests would improve sustainable forest use	391	4.18	.918	Agreed
6	Educating local communities about sustainable forest management would reduce degradation	391	4.19	.934	Agreed
7	Implementing forest certification schemes would promote sustainable timber harvesting.	391	4.01	1.034	Agreed
8	Establishing protected areas with restricted access would effectively conserve forests.	391	3.96	1.041	Agreed
9	Promoting the use of improved cookstoves would reduce demand for fuelwood	391	4.12	.945	Agreed
10	Using satellite monitoring and technology would improve forest protection efforts	391	4.18	.935	Agreed
	Grand Mean		**4.13**		

Multiple Regression Analysis

Model Specification and Theoretical Foundation

The multiple regression analysis was employed to examine the relationship between forest degradation and rural household livelihoods while controlling for other socio-

demographic factors that may influence livelihood outcomes. This statistical approach allows researchers to isolate the specific effect of forest degradation on household livelihoods while holding other variables constant, thereby controlling for confounding variables that might otherwise bias the relationship. The regression model was specified as $HLI = \beta_0 + \beta_1 FDI + \beta_2 HS + \beta_3 HHA + \beta_4 HHG + \beta_5 EDU + \varepsilon$, where HLI represents the Household Livelihood Index (dependent variable), FDI is the Forest Degradation Index, HS is Household Size, HHA is Household Head Age, HHG is Household Head Gender, and EDU represents Educational Level.

Model Performance and Statistical Significance

The multiple regression models demonstrated strong statistical performance as shown in Table 7 with an R value of 0.573, indicating a moderate to strong correlation between the predictor variables collectively and the household livelihood index. The R^2 value of 0.328 demonstrates that 32.8% of the total variation in household livelihood index is explained by the five independent variables in the model, while the adjusted R^2 of 0.319 shows that even after adjusting for the number of predictors, the model still explains 31.9% of the variation. This R^2 value is considered substantial in social science research, particularly for cross-sectional household data where numerous unmeasured factors influence outcomes, suggesting that the selected variables capture the most important determinants of household livelihoods in the study area.

The ANOVA results confirm the overall statistical significance of the model ($F = 37.342$, $p < 0.001$), as can be seen in Table 8 allowing the researcher to reject the null hypothesis that all regression coefficients are zero and confirming that at least one of the predictor variables has a significant relationship with household livelihood index. The highly significant F-test demonstrates that the overall regression model is statistically meaningful and that the combined effect of all predictor variables significantly explains the variation in household livelihood outcomes.

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.573[a]	.328	.319	3.826

[a] Predictors: (Constant), Forest Degradation Index, Gender, Household Age, Educational Level, Household Size

Table 9: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2733.587	5	546.717	37.342
	Residual	5600.490	385	14.547	
	Total	8334.077	390		

[a] Dependent Variable: Household Livelihood Index

[b] Predictors: (Constant), Forest Degradation Index, Gender, Household Age, Educational Level, Household Size

Individual Variable Effects and Interpretation

The Forest Degradation Index emerged as the most significant predictor of household livelihoods, showing a strong negative relationship with the Household Livelihood Index (β = -0.408, p = 0.000). This relationship is highly statistically significant, suggesting that forest degradation has a substantial negative impact on household livelihoods in Central Taraba. For every one-unit increase in the forest degradation index, the household livelihood index decreases by 0.427 units, indicating that areas experiencing severe forest degradation will have substantially lower household livelihood outcomes compared to areas with intact forests.

Gender also showed a significant negative relationship with household livelihood (β = -0.138, p = 0.001), indicating that gender differences significantly explain

variations in household livelihood index. The negative coefficient suggests that female-headed households may experience lower livelihood outcomes compared to male-headed households, with female-headed households having, on average, 1.578 points lower livelihood index scores than male-headed households. This finding likely reflects gender inequality in access to resources, land ownership, and economic opportunities that may disadvantage female-headed households in the study area.

Conversely, the age of household head showed a positive and significant relationship with household livelihood ($\beta = 0.176$, $p = 0.000$), indicating that older household heads tend to have better livelihood outcomes. Each additional year of household head age is associated with a 0.910 increase in livelihood index, possibly due to accumulated experience, assets, social capital, and knowledge over time. Similarly, educational level showed a positive and significant relationship with household livelihood ($\beta = 0.142$, $p = 0.002$), indicating that higher levels of formal education positively influence livelihood outcomes in the study area. For each unit increase in educational level, the household livelihood index increases by 0.814 units, as education enhances human capital, providing access to diverse livelihood opportunities, better resource management skills, and alternative income sources beyond forest dependence.

Finally, household size showed a negative and statistically significant relationship with household livelihood ($\beta = -0.133$, $p = 0.004$), suggesting that larger households tend to have lower livelihood index scores, possibly due to increased pressure on available resources. Each additional household member decreases the livelihood index by 0.752 points, as larger households face greater resource pressure, with more individuals competing for limited forest resources and household income. This comprehensive analysis confirms that forest degradation significantly undermines rural household livelihoods while also revealing the important roles of gender, age, education, and household composition in determining livelihood outcomes in forest-dependent communities.

Table 10 Coefficients

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
	B	Std. Error	Beta		
1 (Constant)	48.763	1.842		26.472	.000
Gender	-1.578	0.462	-0.138	-3.416	.001
Household Age	0.910	0.241	0.176	3.776	.000
Educational Level	0.814	0.255	0.142	3.192	.002
Household Size	-0.752	0.259	-0.133	-2.903	.004
Forest Degradation Index	-0.427	0.044	-0.408	-9.705	.000
[a] Dependent Variable: Household Livelihood Index					

Conclusion

This study has demonstrated that forest degradation in Central Taraba is not merely an ecological crisis, but a profound livelihood emergency. The evidence confirms a strong, significant negative impact on rural households, exacerbating poverty, food insecurity, and vulnerability to climate change. These impacts are not distributed equally; female-headed and larger households face disproportionate burdens. The findings underscore that rural livelihoods are intrinsically linked to forest health. Consequently, sustainable development in the region is unattainable without halting and reversing forest loss. Effective action requires a holistic, multi-sectoral strategy. Moving forward, policies must prioritize community-based forest management, rigorously enforce protection laws, and scale up investments in sustainable alternative livelihoods and clean energy. Integrating these approaches is paramount for building resilient communities and ensuring the long-term conservation of Taraba's vital forest ecosystems.

Recommendations

1. Strengthen Community-Based Forest Management (CBFM): Establish and legally empower Community Forest Management Committees in high-degradation zones to oversee local forest resources. This approach directly addresses the perceived weak enforcement of laws by devolving stewardship to those most impacted, fostering sustainable use and enhancing protection through local monitoring and collective action.
2. Promote and Subsidize Sustainable Alternative Livelihoods (SALs): Develop and fund programs that provide training, start-up capital, and market access for non-forest-dependent income sources, such as agroforestry, beekeeping, and ecotourism. This tackles the root causes of poverty and over-dependence on forest extraction, reducing pressure on ecosystems while improving household income stability.
3. Scale Up Access to Clean and Affordable Energy: Implement targeted programs to distribute improved cookstoves and facilitate community access to solar energy systems or biogas digesters. By providing viable alternatives to fuelwood—a major driver of degradation—this intervention can directly reduce deforestation rates and improve household health and economic savings.
4. Integrate Gender-Responsive and Educational Components into All Interventions: Design all forestry and livelihood programs with specific provisions to support female-headed households, including access to credit, land rights, and targeted training. Concurrently, enhance adult education and environmental awareness campaigns to build human capital, which the study shows is positively correlated with better livelihood outcomes and sustainable practices.
5. Enhance Governance through Integrated Spatial Monitoring and Enforcement: Deploy a participatory GIS-based monitoring system that combines satellite data with ground-truthing by community members to track deforestation hotspots and illegal activities in real-time. Strengthen the capacity of relevant government agencies to act on this intelligence with stricter, consistently applied penalties for violations, thereby improving deterrence and regulatory credibility.

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