


Effects of firewood consumption on the biodiversity across the communities in Awka North Local Government Area

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ARTICLE INFO	Abstract
<p>Keywords: <i>Firewood consumption, Biodiversity loss, Ecosystem resilience, Awka North, Sustainable energy.</i></p> <p>©2026 Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International</p> 	<p><i>This study employed a mixed-method research design, integrating quantitative surveys with qualitative focus group discussions and key informant interviews to examine the effects of firewood consumption on biodiversity in Awka North Local Government Area (LGA), Anambra State, Nigeria. Six rural communities were purposively selected, with a sample of 400 residents determined using Taro Yamane's formula and proportionally allocated. Data were collected via structured questionnaires, validated by experts, and pilot-tested for reliability using Cronbach's Alpha. Quantitative data were analyzed using descriptive statistics and Principal Component Analysis (PCA), while qualitative insights contextualized ecological and socio-economic patterns, enabling a comprehensive understanding of how household firewood use impacts biodiversity. According to respondents in Awka North LGA, the use of firewood has a huge effect on biodiversity. 351 respondents (88 percent) reported loss of trees, reducing food and shelter to the wildlife. Three hundred and one respondents (78 percent) reported deforestation that reduced habitat of various species and 302 respondents (76 percent) reported loss of rare plants. Principal Component Analysis (PCA) was used to identify four significant dimensions that explain 94.85 percent of the variance: Component 1 (42.54) - ecosystem resilience and sustainability; Component 2 (26.59) - reduction of species richness; Component 3 (14.32) - extinction of plant species; Component 4 (11.40) - disruption of microclimate. The ANOVA did not reveal any significant difference between communities ($F = 1.163$, $p = 0.34$), meaning that there are no variances in perceptions of all six communities. The researchers found that the use of firewood is always a danger to the biodiversity of all communities, disturbing ecosystem strength, species richness, and equilibrium. To reduce such impacts and to save local biodiversity, it is suggested that sustainable energy options and community-based conservation strategies should be used.</i></p>

Introduction

Firewood is an organic material and this has been a key concern as a renewable, environmentally friendly alternative to conventional fossil fuels. Firewood would be instrumental in achieving the goal of ensuring energy security, reducing greenhouse-gase emissions, and enhancing rural growth in Nigeria, where agriculture is the main economic activity. However the utilization of firewood in the diverse parts of Nigeria is conditioned by the social, economic, environmental, and technological situations. The large agricultural industry of the country provides sufficient raw materials to manufacture firewood, including oilseeds, cassava, sugarcane, and maize (Ali et al., 2023).

In households, firewood is mostly used for heating, cooling, and cooking. These are the main energy consumers. The process of cooking using electricity, sawdust, charcoal firewood, stoves, and ovens also uses a significant amount of energy. According to Khare (2009), slums, squatter settlements, and other low-income regions make up the bulk of urban population in practically all developing country cities. The biofuel consumption habits of such residents are completely different from those of high-income groups. Instead, these metropolitan regions' patterns of biofuel usage are strikingly comparable to those of rural places. There are various ramifications of the impoverished

urban and rural people' overwhelming reliance on non-commercial energy sources. For instance, major ecological balance issues are being caused by the exploitation of vegetative cover (Hartley et al, 2019).

In the majority of rural households in developing nations, firewood is mostly utilized in conventional cook stoves. According to estimates, about half of the world's population uses firewood for a variety of purposes, including lighting, heating, and cooking (Hooper et al, 2018). It is expected that dependency on firewood would increase going forward, particularly in emerging nations. This is a result of an over reliance on wood and charcoal as fuel sources (Derebe et al, 2025). Sub-Saharan Africa is home to 80 percent of the global population that utilizes firewood to cook (FAO, 2019). This is predicted to continue growing and it might even over take gasoline consumption in other parts of the world like Asia and South America. It is estimated that 1 billion individuals (primarily in Africa) will continue to rely on traditional biofuel as an energy source by 2030 (FAO, 2019). Such reliance may lead to a shortage of cooking fuel, in large part due to deforestation. The health risks are also increased among people using traditional cook stoves and those who extensively depend on biofuel.

In Anambra State, the energy consumption patterns of urban and rural communities display significant differences shaped by socio-economic and infrastructural contexts (Chukwuma et al, 2021). Urban areas demonstrate energy behaviors similar to industrialized cities, characterized by high biofuel use for transportation, commercial buildings, household comforts, and leisure activities, reflecting the practices of relatively affluent urban dwellers (Muogbo, 2025a). In contrast, the rural populations and urban slum areas depend primarily on energy to serve domestic purposes, which dictates the demands of the low-income groups (Muogbo et al, 2025). The development of cities has raised housing problems and poor living conditions, putting pressure on transport, energy, water, and health systems (Enemuo & Muief, 2023). Urban and rural disparities in energy requirements indicate the necessity to focus on both the access of marginalized populations to household energy and the environmental sustainability (Muogbo & Obiefoka, 2022). The lack of planning and the inefficient systems of distributing energy introduce ecological pressure; forest resources are being more and more exploited as fuelwood, which poses a threat to the biodiversity and stability of the ecosystem. These results relate socioeconomic disparity, energy consumption, and ecological devastation in Anambra State and indicate that converged policies that foster sustainable energy options and fair distribution are needed by both urban and rural populations (Muogbo, 2025b).

The difference between the two groups is minimal since cooking takes up most of the biofuel consumption used by the poor in both urban and rural regions. Increased incomes, however, lead urban families in most developing nations to consume more biofuels. Most of the energy consumed by low-income households is spent on lighting and cooking, and as much as 60% of the energy consumed by more affluent urban dwellers is spent on appliances, space heating, and water heating (Chukwuma et al, 2022). As incomes go up, fuelwood is increasingly being substituted by kerosene, and kerosene by gas or electricity to cook and provide light.

Local evidence of everyday energy practices in relation to ecological outcomes is deficient, which informs the research on the impacts of firewood use in biodiversity in Awka North Local Government Area. Extensive literature demonstrates that the use of wood fuels leads to deforestation and the disappearance of biodiversity. As an illustration, Agboola et al. (2024) established that fuelwood harvesting in Ile-Ife was significantly higher than the regeneration of the forests, showing that it was not sustainable and that it had natural conservation implications of natural resource consumption. Similarly, Asefon and Adepoju (2024) found that in Nigeria, the use of the excess fuelwood leads to a faster pace of deforestation and forest resources make it dangerous to the environment, which highlights the environmental risk of the further use of firewood.

In spite of such insights, there is a critical knowledge gap on the actual effects of species diversity, habitat integrity, and ecosystem services in the Awka North. Extensive ecological research

has attributed the consumption of fuelwood to species loss and ecological imbalance like the loss of valuable tree species and wildlife in the forest of southwestern Nigeria, yet not quantified as in the case of Awka North communities. The local biodiversity of this particular Nigerian setting needs to be informed by understanding how local firewood harvesting and use contributes to biodiversity and how sustainable energy policy, community forest management, and biodiversity conservation strategies can reconcile human energy demands and ecological protection in this particular context.

Objective

Assess the effects of firewood consumption on the biodiversity of the area

Research Question

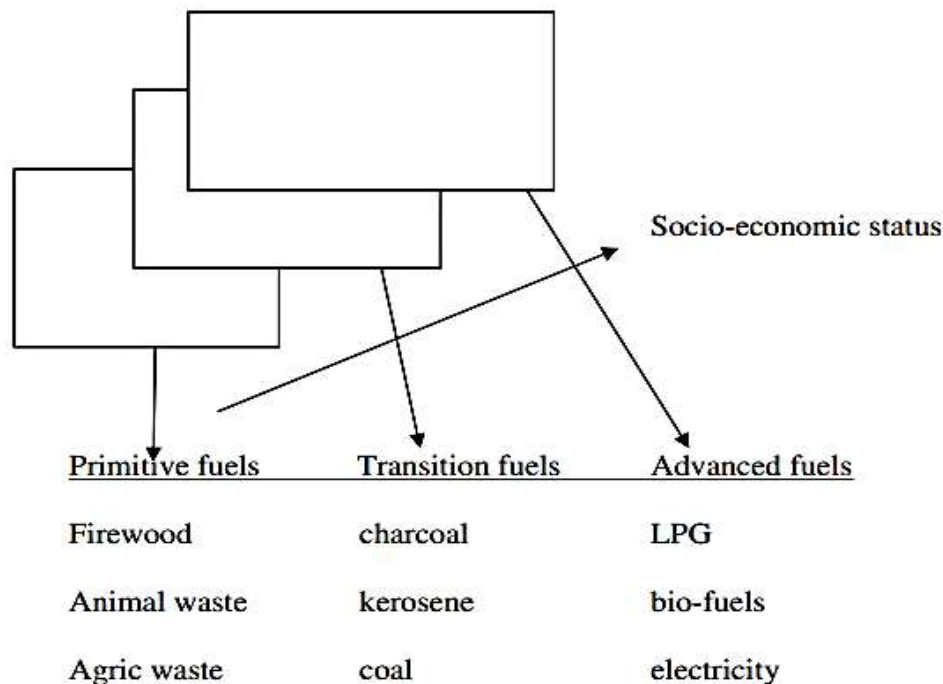
How does firewood consumption effect the biodiversity of the area?

Research hypothesis

There is no significant difference in the effects of firewood consumption across the communities in Awka North Local Government Area.

2. Theoretical framework

The study was anchored on Masera's Stack Model Theory. Masera's Stack Model Theory was proposed by Masera, Saatkamp, and Kammen in 2000.



Source: Masera, Saatkamp and Kammen (2000).

The theory posits that households rarely rely on a single energy source; instead, they adopt a "fuel stacking" approach, combining multiple fuels such as firewood, charcoal, and kerosene based on availability, cost, and convenience. Key tenets include energy diversity, gradual transition to modern fuels, and persistence of traditional fuels despite new options. Moving up the energy ladder is meant to result in higher fuel economy and a reduction in overall emissions, however using several fuels or "fuel stacking" instead may result in the family using more energy overall as they go "up the energy ladder" (Masera et al., 2000). The ability of rural energy development to reduce any environmental impact is thus challenged by a multiple fuel usage pattern. Since the 1980s, this tendency of utilizing several fuels has been recorded (Masera et al., 2000). Furthermore, in many

urban and rural parts of the developing world, it is recognized that it is the rule rather than the exception. Applied to Awka North, the theory explains why communities continue heavy firewood consumption, despite access to alternative energy sources, contributing to deforestation, habitat loss, and biodiversity decline. Understanding fuel stacking informs sustainable energy planning and conservation strategies.

3. Methodology

3.1 Research Design

This study adopted a mixed-method research design, combining qualitative and quantitative approaches to provide a comprehensive understanding of the effects of firewood consumption on biodiversity across communities in Awka North Local Government Area (LGA). The mixed-method design is particularly suitable for exploring complex social-environmental phenomena because it integrates the strengths of both approaches, enhances data validity, and allows for triangulation (Bryman, 2016). Qualitative methods such as focus group discussions (FGDs) and key informant interviews complemented the quantitative household survey, enabling the researcher to examine both subjective perceptions and measurable patterns in firewood use, biodiversity impacts, and associated socio-economic practices.

3.2 Study Area

The study was conducted in Awka North LGA, Anambra State, southeastern Nigeria. The area comprises several towns and villages, including Awba-Ofemili, Ugbene, Ebenebe, Amansea, Ugbenu, Mgbakwu, and Achalla (the administrative headquarters). It is part of the Anambra Basin, characterized by undulating terrain, fertile plains along the Niger River, and a tropical savanna climate with distinct wet and dry seasons. The average annual temperature ranges from 26°C to 30°C, with rainfall averaging 1,500–2,000 mm annually. The dry season extends from November to February, with Harmattan winds affecting temperature and visibility. Topographically, Awka North consists of hills, plateaus, valleys, and plains, while geologically, it is dominated by sedimentary rock formations including coal-bearing strata (Onyenweife, 2023). Hydrological resources include rivers and streams that support agriculture and domestic water use, although the area is prone to seasonal flooding (Obiadi et al, 2022). Vegetation comprises tropical rainforest and savanna woodlands, providing habitats for diverse wildlife, while urban development and economic activities such as farming, trading, and small-scale industries have increasingly modified the landscape (Nse-Nelson et al, 2020). The population of Awka North was projected at 236,060 inhabitants in 2024, primarily of Igbo ethnicity, distributed across the major towns.

3.3 Sample and Sampling Techniques

The study focused on six rural communities in Awka North, selected based on accessibility and population distribution, with a combined population of 126,450. Using Taro Yamane's formula at 5% significance, a sample size of 400 residents was determined. Proportional sampling was applied to allocate respondents to communities, ensuring representativeness. For example, Ebenebe, the largest community, was assigned 120 respondents, while Ugbene, the smallest, had 31 respondents.

3.4 Data Collection Instruments

Data were collected using a structured questionnaire, administered to household respondents by three trained enumerators. The questionnaire was aligned with the study objectives, including sections on firewood use, biodiversity perception, and socio-economic practices. Responses were recorded in hard copy, coded numerically, and entered into SPSS for quantitative analysis. Qualitative data from FGDs and key informant interviews supplemented the survey by providing context on local practices, perceptions, and ecological impacts.

3.5 Validation and Reliability

Face and content validity were established through expert review by three specialists in measurement and evaluation, who assessed item relevance, clarity, and appropriateness. Reliability was tested through a pilot study in Awka South LGA, with data used to calculate Cronbach's Alpha to ensure consistency and dependability of the instrument.

3.6 Data Collection Procedure

Data collection employed a direct delivery and retrieval approach. Ten research assistants were trained on the study purpose, administration procedures, and ethical considerations. The hands-on briefing ensured proper understanding and high return rates for the questionnaire.

3.7 Data Analysis

Data analysis integrated both qualitative and quantitative techniques. Descriptive statistics, including tables and graphs, summarized the data. Quantitative data underwent Principal Component Analysis (PCA) to reduce dimensionality and identify patterns among correlated variables. PCA converts potentially correlated variables into uncorrelated principal components, with the first component capturing the largest variance. This allowed the study to identify key factors influencing firewood use and its ecological impacts across communities. PCA results were interpreted in the context of both environmental and socio-economic variables, providing a holistic understanding of how household energy practices affect biodiversity in Awka North.

4. Results

4.1 Perceived effect of firewood consumption on the biodiversity of the study area

In providing insight into the effects of firewood consumption on biodiversity, the perception of the respondents was sought as they were asked to identify the effects based on the available options in the questionnaire.

Table 1: Responses on the perceived effects of firewood consumption on biodiversity

S/N	ITEMS	Frequency	Percentage
1	Deforestation for firewood reduces habitats for diverse plant and animal species.	311	78%
2	Loss of trees diminishes food and shelter sources for wildlife.	351	88%
3	Reduction in tree cover affects bird populations relying on forests.	193	48%
4	Firewood extraction can lead to the loss of rare plant species.	302	76%
5	Deforestation alters microclimates, impacting local flora and fauna.	293	73%
6	Disturbance of forest ecosystems affects insect and microbial diversity.	241	60%
7	Reduced tree cover affects the balance of predator-prey relationships.	221	55%
8	Biodiversity loss from deforestation impacts ecosystem resilience and stability.	247	62%
9	Disruption of forest ecosystems affects pollination and seed dispersal.	271	68%
10	Deforestation can lead to the local extinction of specialized forest species.	272	68%

The respondents were asked to select all that applied to them. Table 1 shows the perception and response of the respondents on the effects of firewood consumption on biodiversity in Awka North LGA. The total number of responses for each effect of firewood consumption on biodiversity was calculated using the sample size to derive percentages. From Table 1, out of 100% of the questionnaires distributed, 88% of the responses showed that loss of tress arising from firewood consumption causing the reduction in the food and shelter sources from wildlife dominates the effects of firewood consumption in the study, followed by reduction in habitats for diverse species of plant and animals which accounts from 78% of the responses, followed by loss of rare plant species waste which accounts 76%, altering of microclimates and its antecedent effects on local flora and fauna accounts form 73% of the responses and is considered the fourth important effect of firewood consumption on biodiversity based on the responses obtained. Other important effects of firewood consumption on biodiversity are disruption of the forest ecosystem, which affects pollination and seed dispersal, and extinction of specialized forest species, which both garnered 68% of the responses respectively, while the impact on ecosystem resilience and stability garnered 62% of the responses agreeing to this as an effect of firewood consumption on biodiversity. The consideration of firewood consumption having the capacity to disturb the forest ecosystems to such an extent that this affects insect and microbial diversity accounts for 60%, reduction of tree cover disrupting the balance of predator-prey relationship has 55% of the responses, while reduction in tree cover affects bird populations relying on forests is considered the least perceived effects given the 48% of the responses obtained.

Also, the responses were sorted based on the six communities studied in Awka North to portray in clear terms how these effects of firewood consumption on biodiversity are viewed across the study area, and depicted in Table 2 and Figure 1

Table 2: Distribution of responses on the perceived effects of firewood consumption on biodiversity based on communities

S/N	ITEMS	Awba-Ofemili	Ugbene	Ebenebe	Amansea	Ugbenu	Mgbakwu
1	Deforestation for firewood reduces habitats for diverse plant and animal species.	46	52	54	45	58	52
2	Loss of trees diminishes food and shelter sources for wildlife.	57	57	60	63	53	51
3	Reduction in tree cover affects bird populations relying on forests.	37	26	29	38	34	29
4	Firewood extraction can lead to loss of rare plant species.	61	47	53	46	46	49
5	Deforestation alters microclimates, impacting local flora and fauna.	53	48	54	44	56	38
6	Disturbance of forest ecosystems affects insect and microbial diversity.	29	51	47	45	41	28
7	Reduced tree cover affects the balance of predator-prey relationships.	30	36	45	33	41	36

8	Biodiversity loss from deforestation impacts ecosystem resilience and stability.	32	41	53	37	39	45
9	Disruption of forest ecosystems affects pollination and seed dispersal.	42	54	56	48	39	32
10	Deforestation can lead to local extinction of specialized forest species.	39	47	46	42	52	46

. While it is clearly depicted that firewood consumption is leading to diminishing food and shelter sources for wildlife were dominant in Ugbene, Ebenebe, and Amansea, reduction of habitats for diverse plant and animal species due to deforestation for firewood was the dominant effects of firewood consumption in Ugbenu and Mgbakwu and Loss of rare plant species were ranked highest in Awba-Ofemili.

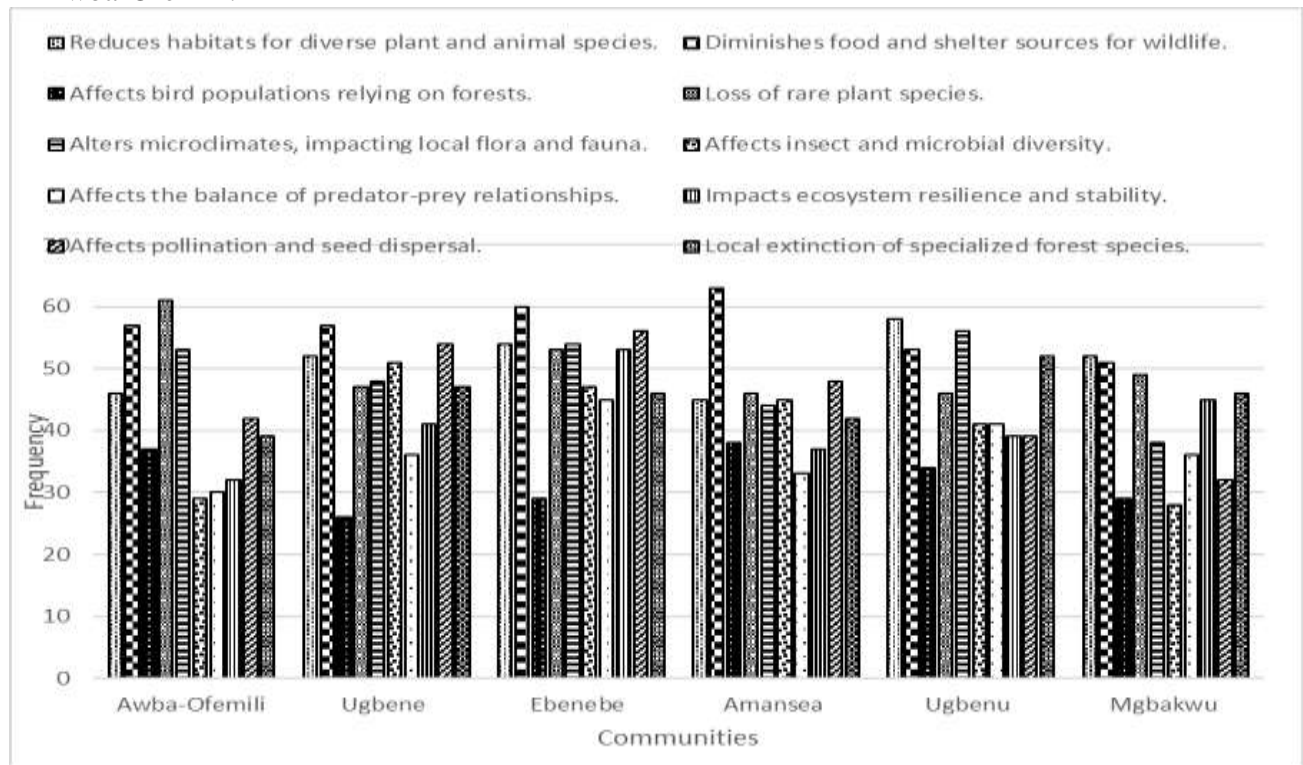


Fig 1: Perceived effects of firewood consumption on biodiversity by community

Further investigation was conducted to isolate the key effect of firewood consumption on biodiversity in Awka North LGA. This was accomplished by examining their responses and subjecting the same to statistical analysis using PCA to isolate dominant biodiversity implications and seeking how the perceived effects differ significantly across the study area. The PCA analysis collapsed the 10 identified effects on biodiversity into four significant and orthogonal components that explained the variation in the observed data from the respondents (Table 3). From Table 3, the four components explained approximately 94.85% of the variance in the data, while each component had eigenvalues greater than 1. The screen plot of these components is shown in Figure 2.

Table 3: Varimax Rotated Component Matrix of the effect of firewood consumption on biodiversity

	Perceived effect of firewood consumption on biodiversity	Component			
		1	2	3	4
Y1	Deforestation for firewood reduces habitats for diverse plant and animal species.	.581	-.312	.502	.559
Y2	Loss of trees diminishes food and shelter sources for wildlife.	-.242	.925	-.175	-.072
Y3	Reduction in tree cover affects bird populations relying on forests.	-.879	.018	-.170	.123
Y4	Firewood extraction can lead to loss of rare plant species.	-.103	-.108	-.959	.227
Y5	Deforestation alters microclimates, impacting local flora and fauna.	-.077	.218	-.119	.961
Y6	Disturbance of forest ecosystems affects insect and microbial diversity.	.229	.813	.479	.173
Y7	Reduced tree cover affects the balance of predator-prey relationships.	.730	.122	.319	.503
Y8	Biodiversity loss from deforestation impacts ecosystem resilience and stability.	.931	.155	.073	.023
Y9	Disruption of forest ecosystems affects pollination and seed dispersal.	.255	.930	-.065	.176
Y10	Deforestation can lead to local extinction of specialized forest species.	.433	-.238	.771	.400
Eigen value		4.254	2.659	1.432	1.140
% of variance explained		42.542	26.594	14.315	11.403
Cumulative % explained		42.542	69.136	83.451	94.854

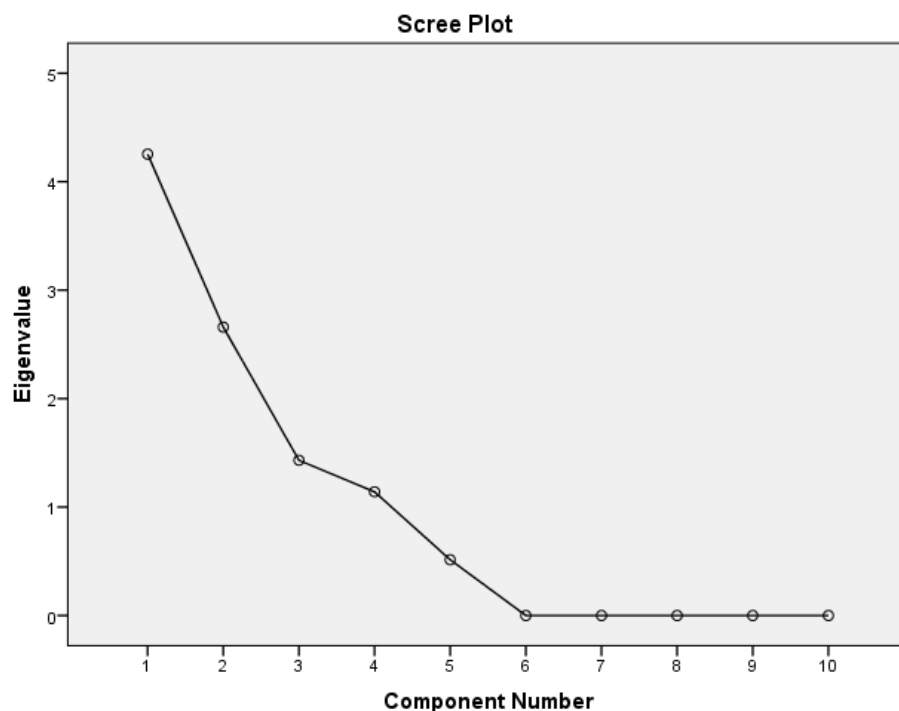


Fig 2: Screen plot for the perceived effects of firewood consumption on biodiversity

Table 4: Variables with high loadings on Component I

Variable code	Variable Name	Loadings	
Y8	Biodiversity loss from deforestation impacts ecosystem resilience and stability.	0.931	Impacts on biodiversity sustainability and resilience
Y3	Reduction in tree cover affects bird populations relying on forests.	-0.879	

Table 5: variables with high loadings on Component II

Variable code	Variable Name	Loadings	
Y9	Disruption of forest ecosystems affects pollination and seed dispersal.	0.930	Reduction in species richness and abundance
Y2	Loss of trees diminishes food and shelter sources for wildlife.	0.925	
Y6	Disturbance of forest ecosystems affects insect and microbial diversity.	0.813	

Table 6: variables with high loadings on Component III

Variable code	Variable Name	Loadings	
Y4	Firewood extraction can lead to loss of rare plant species.	-0.959	Lead to extinction of plant species

Table 7: variables with high loadings on Component IV

Variable code	Variable Name	Loadings	
Y5	Deforestation alters microclimates, impacting local flora and fauna.	0.961	Disruption of ecological balance

Based on the extracted variables and the nature of perceived effects of firewood consumption on biodiversity by the residents in the study area that load high on each of the components, it is shown that the perceived effects of firewood consumption on biodiversity given the responses obtained that loaded highly on component 1 points to *impacts on the biodiversity sustainability and resilience* in the study area. This outcome implies that as communities focus on deforesting forests due to the need for fuel wood, this singular activity decreases the ability of forests to create a sustainable ecosystem for their flora and fauna species and decreases the ability of these ecosystems to be resilient to external stressors like climate change. This further explains why “Reduction in tree cover affects bird populations relying on forests” loads high in this component, and given its negative loading of -0.879 points to the inverse relationship of these particular effects with firewood consumption. Thus, as people continue to exploit the forests for firewood, tree cover reduces and affects the bird populations relying on it, and also affects the sustainability of these forests and their resilience. In component 2, three related effects loaded highly, implying there is a *reduction in species richness and abundance* as residents of these communities continue to exploit the forests for firewood. For components 3 and 4, it is evident that the *extinction of plant species* and *disruption of ecological balance* are dominant effects of continued firewood consumption in these communities of Awka North LGA.

4.2 Hypothesis

An analysis of variance test was employed to determine whether the differences observed in the perceived effect of firewood consumption on biodiversity differ significantly in Awka North LGA. The one-way ANOVA was used to test the differences among the several effects of firewood consumption on biodiversity, given the responses obtained from the respondents (see Table 8). This was conducted using SPSS Statistics (version 20). This was used to test the null hypothesis given thus:

Ho: “There is no significant difference in perceived effects of firewood consumption across the communities in Awka North Local Government Area”.

The outcome of the ANOVA is shown in Table 8.

Table 8: Analysis of Variance

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	494	5	98.8	1.163468	0.339099	2.38607
Within Groups	4585.6	54	84.91852			
Total	5079.6	59				

From the ANOVA table shown above, the significant values or the p-value of 0.34 is shown to be more than the alpha value of 0.05. Thus, since the p-value is greater than 0.05, the null hypothesis is accepted, and this implies that there is no significant difference in perceived effects of firewood consumption across the communities in Awka North Local Government Area. This implies that the observed differences in the responses obtained in the study area are not significant. More so, from the F-statistic, the critical value of F at 0.05 is 2.386. Thus, since the calculated F of 1.163 as shown in Table 8 is less than the critical F value of 2.386, Ho is accepted. Therefore, the difference in the perceived effects of firewood consumption on biodiversity in the study area is not significant. Consequently, the four isolated and dominant effects of firewood consumption on biodiversity are affecting biodiversity across the six communities of Awka North LGA studied in this research, and there is no significant difference in their expected level of impacts.

Discussion

The perceptions of respondents in Awka North LGA indicate that firewood consumption is strongly associated with biodiversity degradation, particularly through the loss of wildlife habitats and food sources. The high percentages for loss of trees diminishing shelter for wildlife (88%) and deforestation reducing habitats for diverse species (78%) reflect deep local awareness of how woodfuel reliance undermines ecosystem integrity. This finding agreed with Asefon and Adepoju (2024), who noted that fuelwood consumption in Nigeria contributes to deforestation and broader environmental degradation, reducing forest cover and associated ecosystem services. Moreover, the respondents' perception that firewood extraction leads to loss of rare plant species (76%) and that deforestation alters microclimates (73%) aligns with regional evidence showing that high extraction pressure significantly alters forest structure and function, thus diminishing species richness. In a related study, Agboola et al, (2024) reported that in Ile-Ife, timber and fuelwood removal greatly exceeded forest replenishment, resulting in measurable biodiversity loss and forest degradation.

The PCA outcomes, revealing components linked to ecosystem resilience/stability and species richness, reinforce that firewood dependence affects multiple dimensions of biodiversity. This multifaceted impact is consistent with broader biodiversity research in Africa. For example, Achieng et al, (2023) emphasized that ongoing environmental change, including resource extraction, drives extensive biodiversity loss across Afrotropical ecosystems, urging integrated monitoring and policy responses. Notably, the perceived lower impact on bird populations (48%) contrasts with some ecological studies showing that bird diversity can be highly sensitive to habitat loss. For example,

research in the Eastern Arc Mountains indicated that forest degradation alters bird movement behaviour and habitat use, revealing that canopy loss directly influences species' foraging and survival. This contrast suggests that local perceptions might under-estimate specific faunal responses, even though larger ecosystem degradation is well acknowledged.

The perception that forest ecosystem disruption affects pollination and seed dispersal (68%) and impacts ecosystem resilience/stability (62%) mirrors findings from West African forest studies, which show that extraction of forest resources often leads to loss of structural complexity and declines in key ecological processes crucial for long-term biodiversity maintenance. In a related study, researchers documented that community perceptions of forest uses and degradation highlighted ongoing loss of large, old trees and associated plant and animal communities, linking human forest use directly to biodiversity decline. This finding agreed with community perception patterns in Awka North.

However, some studies point out that perceived forest degradation does not always align perfectly with measurable biodiversity indicators. For example, surveys in multiple West African forests revealed that communities with the highest pressure on forests were not always the most concerned about degradation, highlighting the complexity of linking perception to actual ecological conditions. This nuance underscores the importance of complementing community perception studies with empirical ecological monitoring. In contrast to the relatively consistent perceptions across communities in Awka North, these findings show that local context and forest governance can influence how people understand biodiversity impacts.

Despite these differences, the consistent pattern of perceived impacts across communities in Awka North and the lack of significant variation shown through ANOVA—points to a broad recognition that firewood consumption is detrimental to biodiversity. This resonates with broader African conservation imperatives, where scholars like Achieng et al. (2023) advocate for enhanced biodiversity monitoring and governance to inform conservation. Such regional frameworks reinforce the local findings that continued reliance on firewood threatens both species diversity and ecosystem sustainability.

Conclusion

The study revealed that firewood consumption in Awka North Local Government Area has significant negative effects on biodiversity across the communities. Residents perceived that the extraction of firewood leads to loss of habitats for diverse plant and animal species, reduction of food and shelter for wildlife, disruption of ecological balance, and local extinction of specialized flora and fauna. Principal Component Analysis highlighted four key dimensions of impact: diminished ecosystem resilience, reduced species richness and abundance, extinction of rare plant species, and microclimatic alterations affecting local flora and fauna. The ANOVA results further confirmed that these effects are consistently perceived across all six communities, with no significant differences in their levels of impact. The findings indicate that continued reliance on firewood as a primary energy source poses a serious threat to the sustainability of local ecosystems, undermining both biodiversity and the ecological services it provides. Urgent implementation of sustainable energy alternatives, reforestation programs, and community awareness initiatives is necessary to mitigate biodiversity loss. Addressing the ecological consequences of firewood consumption will enhance ecosystem resilience, preserve species diversity, and promote long-term environmental sustainability within Awka North LGA.

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