Effect of Climate Change on Forest Dependent Livelihoods among Rural Households in Oyo State, Nigeria

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ABSTRACT

Climate change has emerged as one of the most critical environmental challenges of the 21st century, posing significant threats to natural ecosystems and the livelihoods that depend on them. In Nigeria, particularly in Oyo State, rural households rely heavily on forest resources for income generation, food supply, fuelwood, medicinal plants, and other socio-economic needs. However, increasing temperature fluctuations, irregular rainfall patterns, prolonged dry seasons, and extreme weather events have heightened the vulnerability of forest-dependent communities. The study examined the perceived effects of climate change on forest-dependent livelihoods among rural households in Oyo State, Nigeria. A multistage sampling technique was used to select 90 respondents for the study. Data were collected with the aid of a well-structured interview schedule, while the inferential statistical tool employed was ordered probit regression. The study described the socio-economic characteristics of the respondents, identified the perceived effects of climate change on forest-dependent livelihoods, and investigated the constraints hindering adaptation strategies.The study concluded that climate change has contributed to a reduction in the availability of timber. It was recommended that government agencies, extension officers, and non-governmental organizations organize regular training, workshops, and community outreach programmes on climate change adaptation and sustainable resource management.

Keywords: Climate Change, Forest Dependent, Rural Households

INTRODUCTION

Africa is one of the continent's most vulnerable to the effects of climate change and variability, owing to its high exposure and low adaptive capacity. This is aggravated by multiple non-climatic stress factors, such as high poverty levels, population pressure, and overexploitation (Intergovernmental Panel on Climate Change [IPCC], 2014). It has been widely projected that, as global warming persists, climatic conditions will become more unpredictable. In Sub-Saharan Africa (SSA), climate change projections indicate a warming trend accompanied by changes in precipitation patterns (Serdeczny et al., 2015). The low forest cover in the region is largely attributed to deforestation induced by excessive human activities, such as illegal logging, unsustainable charcoal production, and the clearing of forests for farming and settlement (Ongong'a and Sweta, 2014), resulting in forest fragmentation. Unfortunately, most climate change studies have either ignored or downplayed climate variability, probably due to uncertainties regarding expected future changes in rainfall and temperature variability (Ramirez-Villegas et al., 2013; Thornton et al., 2014). Changing climate patterns lead to biodiversity loss, as forest plant species become extinct, resulting in further ecological destabilization and alterations to community livelihoods in affected areas (Dube et al., 2016). Similarly, weather extremes are well known to have severe impacts on agriculture. As rural livelihoods become more precarious, rain-fed agricultural and livestock systems will bear the brunt of climate extremes, increasing the vulnerability of forest-dependent communities,

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who constitute a significant proportion of poor rural farmers (Ofoegbu et al., 2016). Reduced crop yields compromise food security and adversely affect the health of vulnerable groups, including the elderly, women, and children (Altieri and Nicholls, 2017). Grazing animals within forests is a widespread practice among forest-adjacent communities. However, biodiversity loss leads to inadequate pasture, thereby increasing the pressure on livestock farmers, who are forced to seek alternative sources of feed. Consequently, the effects of climate variability on forest-dependent communities remain poorly understood (Turpie and Visser, 2013). Understanding climate variability trends is therefore critical for mitigating adverse effects on the livelihoods of these communities. The importance of forests to human survival cannot be overemphasized, given the environmental, social, and economic benefits they provide. Forests serve as habitats for various species of trees, animals, and fish. More importantly, they play a vital role in the global cycling of water, oxygen, carbon, and nitrogen; stabilize hydrological systems; ensure a regular supply of freshwater; and help prevent flooding, soil erosion, and downstream riverbed degradation (Oregon Forest Resources Institute, 2018). According to Muller-Kuckelberg (2013), one of the most pressing issues of climate change with regard to human development is reduced agricultural productivity. This decline is partly due to increased infestation of pests and diseases. Changes in climate may also introduce new crop pests and diseases, whose incidence, spread, and distribution are strongly influenced by temperature, moisture, and relative humidity. These pests and diseases can damage forests and crops within a short period, necessitating a high level of preparedness.

Because forest-dependent communities largely consist of smallholder farmers, non-governmental organizations and the private sector must collaborate to empower them through climate-smart agriculture initiatives that enhance productivity and household income. Smallholder farmers should be encouraged to adopt conservation agriculture, crop rotation, integrated crop–livestock systems, improved pasture management, energy-efficient cooking stoves, and drought-tolerant crop varieties. Furthermore, local communities must be actively involved in decision-making processes to develop effective adaptation strategies that address their specific concerns. The concerns about climate variability affecting agriculture and food systems globally include the potential for abandoned farmlands, reduced water resources, declining agricultural productivity, increased poverty, and heightened food and nutrition insecurity. These issues are particularly alarming for rural residents and small-scale farmers who depend heavily on agriculture for their livelihoods (Alliance for a Green Revolution in Africa [AGRA], 2014). Such changes also adversely affect ecosystem health, reducing the availability of forest products such as food, fuelwood, medicinal plants, and other non-timber forest products (NTFPs). Over time, this imposes additional stress on the livelihoods of predominantly poor, forest-dependent populations. These communities are frequently confronted with multiple stressors, including population growth, poverty, political instability, overexploitation, development pressures, and poor governance (Onyekuru et al., 2014; Ajiboye et al., 2025). However, climate change is often regarded as the primary stressor on livelihoods, particularly in the 21st century and in developing countries, where it threatens long-established systems (Connolly-Boutin and Smit, 2015). The effects of climate change are evident globally: weather patterns are shifting, and sea levels are rising, leading to increased flooding and food insecurity. Rising temperatures and changing rainfall patterns have also altered ecosystem composition and distribution, thereby reducing the availability of forest goods and ecosystem services (Dube and Phiri, 2013).

METHODOLOGY

This study was conducted in Oyo State, located in the south-western geopolitical zone of Nigeria. Oyo State lies between latitude 7°03′ and 9°12′ North of the Equator and longitude 2°47′ and 4°23′ East of the Greenwich Meridian. The state covers an estimated land area of approximately 28,454 square kilometres, making it one of the largest states in Nigeria in terms of landmass. It shares boundaries with Kwara State to the north, Osun State to the east, Ogun State to the south, and the Republic of Benin to the west. Oyo State is characterized by a tropical climate with distinct wet and dry seasons. The rainy season usually spans from April to October, while the dry season extends from November to March. The average annual rainfall ranges between 1,200 mm and 1,500 mm, while the mean daily temperature varies between 25°C and 35°C. The vegetation of the state is predominantly Guinea savannah in the north and derived savannah/forest mosaic in the southern part, making it suitable for both agricultural production and forestry activities. The state comprises 33 Local Government Areas (LGAs), many of which are predominantly rural and agrarian. Agriculture remains the major occupation of rural households, with farming activities largely rain-fed. In addition to crop production, rural dwellers engage in forest-based livelihood activities such as fuelwood collection, charcoal production, harvesting of non-timber

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forest products (NTFPs), hunting, and the gathering of medicinal plants. For the purpose of this study, rural communities located around Olokemeji Forest Reserve in Oluyole Local Government Area and Onigambari Forest Reserve in Ibarapa East Local Government Area were selected. These areas were purposively chosen due to the high level of dependence of rural households on forest resources for their livelihoods. The proximity of these communities to forest reserves makes them particularly vulnerable to the effects of climate variability and environmental changes. A multistage sampling technique was employed for the selection of respondents. The first stage involved the purposive selection of Oyo State due to its significant forest resources and the high dependence of rural households on forest-based livelihoods. In the second stage, two forest reserves were purposively selected based on their prominence and the level of forest-dependent activities in the surrounding communities. These were Olokemeji Forest Reserve, located in Oluyole Local Government Area, and Onigambari Forest Reserve, located in Ibarapa East Local Government Area. These reserves were selected because rural households in adjoining communities largely depend on forest products and rain-fed agriculture for their livelihoods.

In the third stage, three (3) rural communities were purposively selected from each of the two forest reserve areas based on their proximity to the forest and the intensity of forest-based livelihood activities. This resulted in a total of six (6) communities, with three communities from each forest reserve area. In the final stage, fifteen (15) forest-dependent household heads were randomly selected from each of the six communities using simple random sampling techniques.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the respondents

The results in Table 1 show that 51.1% of the respondents were male, while 48.9% were female. This implies that the multiple uses of forest-dependent resources at the rural household level are dominated by males. This finding corroborates the submission of the Food and Agriculture Organization (FAO, 2011), which reported that men are more involved in commercial and high-value forest exploitation activities, while women tend to participate more in subsistence-oriented forest product collection such as fuelwood, fruits, nuts, and medicinal plants. The results further reveal that 64.5% of the respondents were between 41–50 years of age, 24.4% were between 14–40 years, while 11.1% were above 71 years, with a mean age of 51.89 years. This indicates that most respondents fall within the economically active and productive age bracket. As noted by Ogunfolaju and Olutokunbo (2025), farmers within the middle-aged group are considered the most active and experienced, contributing significantly to agricultural productivity in rural Nigeria. Also, 48.9% of the respondents were Christians, 43.3% were Muslims, while 7.8% were traditional worshippers. This implies that the majority of the respondents were Christians. The majority (53.3%) were married, 15.6% were single, 14.4% were separated, 6.7% were divorced, and 10.0% were widowed, indicating that most rural households in the study area were married. Years spent in school revealed that 60.0% of the respondents had less than 2 years of schooling, while 40.0% had 18 years or more, with a mean of 11.71 years. This suggests that a large proportion of the respondents had low levels of formal education. More than half (52.2%) had a household size of 3–5 persons, while 42.7% had household sizes of 10 and above, and 2.2% had fewer than 2 persons. The mean household size was 5.49, indicating moderate household sizes in the study area. The results also show that 58.9% of respondents earned between ₦5,000 and ₦60,000, while 41.1% earned between ₦61,000 and ₦200,000, with a mean monthly income of ₦63,833.46. The distribution of respondents by primary occupation revealed that 33.3% were traders, 31.1% were farmers, 23.3% were civil servants, 11.1% engaged in other jobs, and 1.1% were artisans. This implies that trading is the dominant primary occupation, and respondents are likely to have a good understanding of the perceived effects of climate change on forest-dependent livelihoods. The distribution of respondents by secondary occupation revealed that 42.2% engaged in farming, 33.3% in trading, 11.1% were civil servants, 8.9% engaged in other jobs, and 4.4% were artisans. This indicates that farming remains a dominant occupation in the study area, likely due to the availability of natural resources.

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Table 1: Distribution of respondents by socio-economic characteristics (n=90)

Socio-economic characteristics	Frequency	Percentage	Mean
Sex			
Male	46	51.1	
Female	44	48.9	
Age			
14-40	22	24.4	
41-70	58	64.5	
Above 71	10	11.1	51.9
Religion			
Christianity	44	48.9	
Islam	39	43.3	
Traditional	7	7.8	
Marital status			
Married	48	53.3	
Single	14	15.6	
Separated	13	14.4	
Divorced	6	6.7	
Widowed	9	10.0	
Years spent in school			
<2	54	60.0	
18>	36	40.0	11.7
Household Size			
< 2	2	2.2	
3-5	47	52.2	
10 >	41	45.6	5.5
Monthly income (#)			
5000-60,000	53	58.1	
61,000-200,000	37	41.1	63833.46
Primary occupation			
Farming	28	31.1	
Trading	30	33.3	
Civil servants	21	23.3	

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Artisans	1	1.1	
Other	10	11.1	
Secondary occupation			
Farming	38	42.2	
Trading	30	33.3	
Civil servants	10	11.1	
Artisans	4	4.4	
Other	8	8.9	

Source: Field Survey, 2025

Perceived effect of climate change on forest dependent livelihoods

The results in Table 2 reveal the distribution of respondents according to their perceived effects of climate change on forest-dependent livelihoods. These perceptions were ranked based on the level of impact using a 3-point Likert scale: high effect, moderate effect, and low effect. Climate change contributing to the reduction in the availability of timber was ranked 1st, with a weighted mean score (WMS) of 4.5. This was followed by a reduction in the availability of fuelwood, ranked 2nd with a WMS of 4.2. Deforestation, increased incidence of pests and plant diseases, and the drying up of rivers and water sources were jointly ranked 3rd, each with a WMS of 4.1. Furthermore, loss of biodiversity, migration and displacement, and changes in soil quality affecting farming were ranked 4th, each with a WMS of 3.9. The results imply that climate change has significantly affected the availability of forest resources upon which rural households depend for their livelihoods. This finding supports Eludoyin et al. (2025), who reported that climate variability—characterized by declining rainfall and increasing temperatures—contributes to forest degradation and reduced forest productivity in Nigeria, thereby limiting the availability of forest resources and livelihood opportunities for rural households.

Table 2: Distribution of respondents according to perceived effect of climate change on forest dependent livelihood

Perceived effects	**WMS**	**Rank**
Climate change has contributed to reduction on availability of timber	4.5	1st
Climate change has contributed to reduction on availability of fuelwood	4.2	2nd
Deforestation	4.1	3rd
Loss of biodiversity	3.9	4th
Increase in pests and plant diseases	4.1	3rd
Drying of river and water	4.1	3rd
Migration and displacement	3.9	4th
Change in soil quality affecting	3.9	4th

Source: Field Survey, 2025

WMS: Weighted Mean Score

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Constraints mitigating against the adaptation strategies

The results in Table 3 reveal the distribution of respondents according to the constraints hindering adaptation strategies. These constraints were ranked based on their severity using a 4-point rating scale: very severe, severe, mildly severe, and not a constraint. Inadequate awareness and education were ranked 1st, with a weighted mean score (WMS) of 2.3. Lack of enforcement of forest conservation and climate adaptation policies, as well as limited access to modern farming techniques, were ranked 2nd, each with a WMS of 2.2. Population pressure was ranked 3rd with a WMS of 2.1, while illegal activities, deforestation, and overexploitation of resources were ranked 4th with a WMS of 2.0. Cultural and social barriers were ranked 5th with a WMS of 1.7. Limited access to markets and lack of incentives for sustainable practices were ranked 6th, each with a WMS of 1.0. These findings indicate that, despite awareness of adaptation strategies, rural households are constrained by socio-economic, institutional, and policy-related factors. This is consistent with studies in Nigeria, which show that limited knowledge and technical skills, coupled with weak institutional support, restrict the adoption of climate adaptation measures among forest-dependent communities (Ogunbameru, 2015).

Constraints mitigating	**WMS**	**Rank**
Inadequate awareness and education	2.3	1st
Lack of enforcement of forest conservation and climate adaptation policies	2.2	2nd
Lack of access to modern farming techniques	2.2	2nd
Deforestation and overexploitation of resources	2.0	4th
Population pressures	2.1	3rd
Lack of incentives for sustainable	1.0	6th
Limited access to market	1.0	6th
Illegal activities	2.0	4th
Cultural and social barriers	1.7	5th

Table 3: Distribution of respondents according to constraints mitigating against the adaptation strategies

Source: Field Survey, 2025

WMS: Weighed mean score

Relationship between selected socio-economic characteristics of the respondents and perceived effect of climate change on forest dependent livelihood

The ordered probit model, along with marginal effects, was used to estimate the perceived effects of climate change on forest-dependent livelihoods among rural households. The dependent variable was the perceived effect of climate change, while the explanatory variables included selected socio-economic characteristics such as age, sex, religion, marital status, years of schooling, household size, monthly income, primary occupation, and secondary occupation. The ordered probit model was appropriate because the dependent variable is ordinal in nature.

The coefficients of the variables are important for interpreting the results, as they indicate the direction and significance of the relationship between the explanatory variables and the perceived effects of climate change. However, unlike linear regression, the coefficients do not represent direct percentage changes but rather the effect on the latent variable underlying the ordered response. The pooled results in Table 4.5 show a likelihood

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ratio chi-square (LR χ^2) of 32.80, a probability value (Prob > χ^2) of 0.0000, and a pseudo R^2 of 0.2212, indicating that the model is statistically significant and has a reasonable explanatory power. The coefficient of age is negative and statistically significant at the 10% level, suggesting that an increase in age reduces the likelihood of perceiving higher effects of climate change on forest-dependent livelihoods. Similarly, marital status has a negative and statistically significant effect at the 10% level, implying that married respondents are less likely to perceive higher climate change effects. In contrast, the coefficient of primary occupation is positive and statistically significant at the 5% level, indicating that respondents engaged in trading are more likely to perceive stronger effects of climate change on forest-dependent livelihoods. The results indicate that age, marital status, and primary occupation significantly influence the perceived effects of climate change. Therefore, the null hypothesis (H_{01}), which states that there is no significant relationship between selected socio-economic characteristics and the perceived effects of climate change on forest-dependent livelihoods, is rejected, while the alternative hypothesis is accepted in rural household of Oyo state

Table 4: Ordered probit regression showing significant relationship between the selected socioeconomic characteristics of the respondents and perceived effect of climate change on forest dependent livelihood

Socio-economic characteristics	**dy/dx**	**Standard error**	**Z- value**
Sex	-.0359655	.08263	-0.44
Age	-.0119052	.00339	-3.51**
Marital Status	-.267256	.06309	-4.24**
Years spent in school	.0061678	.01014	0.61
Household size	.0097087	.02587	0.38
Primary occupation	.5523282	.21387	2.58**

Source: Computed Data, 2025

Significant level * Significant at the 0.05 level

** Significant at 0.1 level

*** Significant at 0.01 level

Pseudo R2 of 0.2212

CONCLUSION AND RECOMMENDATION

The ordered probit model, along with marginal effects, was used to estimate the perceived effects of climate change on forest-dependent livelihoods among rural households. The dependent variable was the perceived effect of climate change, while the explanatory variables included selected socio-economic characteristics such as age, sex, religion, marital status, years of schooling, household size, monthly income, primary occupation, and secondary occupation. The ordered probit model was appropriate because the dependent variable is ordinal in nature. The coefficients of the variables are important for interpreting the results, as they indicate the direction and significance of the relationship between the explanatory variables and the perceived effects of climate change. However, unlike linear regression, the coefficients do not represent direct percentage changes but rather the effect on the latent variable underlying the ordered response.

The pooled results in Table 4.5 show a likelihood ratio chi-square (LR χ^2) of 32.80, a probability value (Prob > χ^2) of 0.0000, and a pseudo R^2 of 0.2212, indicating that the model is statistically significant and has a reasonable explanatory power. The coefficient of age is negative and statistically significant at the 10% level, suggesting

that an increase in age reduces the likelihood of perceiving higher effects of climate change on forest-dependent livelihoods. Similarly, marital status has a negative and statistically significant effect at the 10% level, implying that married respondents are less likely to perceive higher climate change effects. In contrast, the coefficient of primary occupation is positive and statistically significant at the 5% level, indicating that respondents engaged in trading are more likely to perceive stronger effects of climate change on forest-dependent livelihoods. The results concluded that age, marital status, and primary occupation significantly influence the perceived effects of climate change. Therefore, the null hypothesis (H_{01}), which states that there is no significant relationship between selected socio-economic characteristics and the perceived effects of climate change on forest-dependent livelihoods, is rejected, while the alternative hypothesis is accepted.

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