

Climate Change and Livelihood Diversification in Nasarawa State, Nigeria

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Abstract

Climate change poses increasing challenges to livelihood security by affecting natural resources, income-generating activities and household welfare in Nasarawa State, Nigeria. This study examined the effects of climate change on livelihoods and assessed livelihood diversification strategies adopted by respondents in Nasarawa State. A descriptive survey design was adopted. The target population comprised adult residents engaged in livelihood activities, and a sample size of 400 respondents was determined using Yamane's formula. A multistage sampling technique was used to select respondents, while primary data were collected through structured questionnaires and Key Informant Interviews. Of the 400 questionnaires administered, 388 were retrieved and found valid for analysis. Data were analyzed using frequencies and percentages, while interview responses were interpreted to complement the quantitative findings. The study finds out that reduced availability of natural resources was the most reported effect of climate change, identified by 59 respondents (15%), indicating increasing pressure on livelihood resources in the study area. The study also established that respondents adopted different livelihood diversification strategies, particularly additional wage employment and small-scale enterprises. The study recommends that government and relevant agencies strengthen support for livelihood diversification through accessible credit, entrepreneurship training, vocational skills and market opportunities to enable residents to develop alternative sources of income and reduce vulnerability to climate-related livelihood shocks.

Keywords:

Climate Change, Livelihood Diversification, Livelihood Strategies, Livelihood Vulnerability, and Nasarawa State.

Introduction

Climate change has emerged as one of the most significant environmental and socioeconomic challenges affecting rural livelihoods globally. Rising temperatures, changing rainfall patterns, prolonged dry spells, floods, droughts and other climate-related extremes are increasingly disrupting agricultural production and the natural-resource systems on which rural households depend. Because many rural households rely heavily on climate-sensitive activities such as crop production, livestock rearing, fishing and natural-resource extraction, changes in climatic conditions can reduce agricultural productivity, income and food security. Consequently, livelihood diversification has become an important strategy through which households spread risk and respond to environmental and economic uncertainties. Evidence from cross-country studies shows that climate-related shocks can encourage households to diversify their income sources, although the outcomes vary according to household resources, local economic opportunities and the type of diversification pursued (Asfaw et al., 2019). Similarly, Musumba et al. (2022) demonstrated that rural households in Africa dynamically adjust their livelihood activities in response to shocks such as drought, with non-farm activities constituting

an important component of livelihood diversification. These findings suggest that diversification can serve not only as an economic strategy but also as an important mechanism for strengthening household resilience to climate-related stresses.

In Africa, the relationship between climate change and rural livelihoods is particularly important because of the continent's strong dependence on rain-fed agriculture and natural resources. Smallholder farmers constitute a substantial proportion of the rural population, while limited access to irrigation, credit, agricultural inputs, markets, extension services and social protection increases their exposure to climate risks. Climate variability can therefore translate directly into fluctuations in agricultural production and household income. Waha et al. (2018), using evidence from 18 African countries, established that agricultural diversification is an important strategy for managing climatic risks and improving food security, although the opportunities for diversification differ considerably across locations. The importance of livelihood diversification in the African context is further demonstrated by evidence that climate shocks can influence households to move beyond conventional agricultural activities. Climate-related losses in farm productivity may encourage households to engage in livestock production, petty trading, wage employment, seasonal migration, artisanal activities and other non-farm enterprises. However, diversification does not necessarily produce uniform outcomes because households differ in their access to land, labour, finance, education, markets and social networks. Musumba et al. (2022) found that access to non-agricultural credit was positively associated with livelihood diversity, while drought and land resources also influenced the number and combination of livelihood activities pursued by rural households. More recent evidence from Ghana similarly indicates that climate stress can become a push factor for livelihood diversification, including movement of agricultural labour into artisanal and small-scale mining activities, demonstrating that climate-induced diversification may generate both livelihood opportunities and environmental consequences (Siaw et al., 2026).

In Nigeria, climate change poses a substantial threat to rural livelihoods because agriculture remains an important source of employment, income and food for a large proportion of households. Increasing temperatures, irregular rainfall, droughts, floods and other climatic disturbances can affect crop yields, livestock production, water availability and the stability of rural income. Empirical evidence from Nigeria indicates that changes in temperature and precipitation have affected agricultural productivity and household income sources, with farmers responding by modifying crop choices, input use and the composition of their livelihood activities. In particular, climate-induced changes in agricultural conditions have been associated with reduced income shares from crop production and increased reliance on livestock and wage employment, suggesting that households use diversification as part of their response to climatic pressures (Amare & Balana, 2023). Nigerian studies also demonstrate that livelihood diversification can contribute to household resilience under changing climatic conditions. Kehinde et al. (2020), for example, found that climate change encouraged arable crop farmers to move into other livelihood activities, including trading, artisanal employment and the production of alternative crops. More recent research in Nigeria has similarly shown that livelihood diversification can improve household resilience to climate-related shocks, while crop diversification may strengthen food security under conditions of extreme temperature exposure (Alhassan et al., 2025; Amolegbe et al., 2026).

The problem is particularly relevant in Nasarawa State, where rural livelihoods are strongly connected to agriculture and natural resources. Smallholder farmers in the state are increasingly exposed to changes in rainfall and temperature conditions, with implications for crop production and household welfare. Research among smallholder farmers in Nasarawa State has documented changing climatic conditions and differences in how men and women respond to rapid climate warming, indicating that climate change is already influencing agricultural livelihood decisions in the state (Adebayo et al., 2023). Earlier evidence from Nasarawa also reported increasing temperature trends and declining rainfall, while farmers identified climate variability as a significant constraint to sustainable agricultural production and livelihood activities. Recent studies provide further evidence of the livelihood implications of climate change in Nasarawa State. Research conducted in Awe Local Government Area reported that climate change has important implications for rural livelihoods in an agrarian community where households depend heavily on agriculture and natural resources (Elegu et al., 2025). These findings indicate that diversification is already an important component of rural livelihood systems in the state. However, there remains a need to examine more explicitly how

climate change influences households' decisions to diversify and the forms of livelihood activities adopted in response to climatic pressures. Despite the growing body of research on climate change adaptation and livelihood diversification, much of the existing literature in Nigeria has focused either on agricultural adaptation strategies or on the economic effects of livelihood diversification, with comparatively limited attention to the direct relationship between climate change and livelihood diversification at the sub-state level. In Nasarawa State, where farming communities face changing climatic conditions alongside increasing economic pressures, understanding how households diversify their livelihoods is essential for designing appropriate adaptation and rural development interventions. This study therefore examines climate change and livelihood diversification in Nasarawa State, Nigeria, with particular attention to the ways in which climatic changes influence household livelihood choices and the strategies adopted by rural households to sustain income, food security and resilience.

Objectives of the study

- i. To examine the effects of climate change on the livelihoods of rural households in Nasarawa State, Nigeria.
- ii. To assess the livelihood diversification strategies adopted by rural households in response to climate change in Nasarawa State, Nigeria.

Empirical Literature Review

Climate Change and Rural Household Livelihoods

Ojo, Ayanwale, Adelegan, Ojogho, Awoyelu, & Famodimu, (2024) examined climate-change vulnerability and adaptive capacity among 300 smallholder farmers in three plantain-producing states in southwestern Nigeria. The study found that financial constraints substantially affected farmers' ability to adopt climate adaptation strategies, with 80% of the farmers classified as financially vulnerable to climate risks. The study demonstrated that improved financial capacity could enhance farmers' ability to adopt adaptation measures and strengthen resilience. The study was restricted to plantain farmers in southwestern Nigeria and focused primarily on financial vulnerability and adaptive capacity rather than the broader effects of climate change on rural household livelihoods. The present study addresses this gap by examining the effects of climate change on the livelihood systems of rural households in Nasarawa State.

Odozi (2026) examined the adaptive capacity of smallholder farmers in rural Nigeria using the Sustainable Livelihood Framework. The study found that livelihood assets, community infrastructure, social capital and family support were important determinants of farmers' capacity to cope with climate change. The study emphasized that households with stronger livelihood assets were better positioned to respond to climatic stresses. The study focused on adaptive capacity rather than directly examining the effects of climate change on household livelihoods and livelihood changes arising from climate pressures. Furthermore, it did not specifically examine Nasarawa State. The present study extends this line of research by examining how climate change affects the livelihood systems of rural households in Nasarawa State.

Jimin, Okechukwu, Anzenge, & Ancha, (2026) investigated socioeconomic conditions, climate-change vulnerabilities and agricultural challenges among rice farmers in Benue and Nasarawa States. The study found that high temperatures, flooding, erosion, erratic rainfall and land degradation were major challenges confronting farmers. Respondents adopted improved crop varieties, agroforestry, rainwater harvesting, irrigation, crop diversification and cooperative membership as responses. The study was restricted to rice farmers and therefore does not represent the wider population of rural households whose livelihoods may include farming, livestock production, petty trading, wage employment and other activities. The present study addresses this gap by examining climate-change effects across the broader livelihood systems of rural households in Nasarawa State.

Livelihood Diversification Strategies Adopted by Rural Households in Response to Climate Change

Bindoumou, Djeukem, & Nguena, (2026) examined farm household livelihood diversification under climate risk in the Central Region of Cameroon. The study found that households could reduce their

vulnerability to climate-related risks by diversifying their income portfolios across different agricultural and natural-resource-based activities, including wild mango kernels, *Gnetum africanum*, cassava sticks and maize. However, the study was conducted in Cameroon and therefore does not reflect the socioeconomic, climatic and institutional conditions of rural households in Nigeria. In addition, the study focused on identifying an optimal livelihood portfolio under climate risk rather than examining the range of livelihood diversification strategies adopted by rural households in Nasarawa State. The present study addresses this geographical and contextual gap by examining livelihood diversification strategies adopted by rural households in response to climate change in Nasarawa State, Nigeria.

Anyachukwudinarum, Ashagidigbi, Afolabi, & Akinrinola, (2024) investigated the impact of livelihood diversification on the economic performance of rural households in Nasarawa State using 390 respondents. The study employed an endogenous switching regression model and found that education, market access, cooperative membership, access to public transportation and seasonal migration significantly influenced household income, while education, household size, farmland access, market access, cooperative membership and entrepreneurial skills influenced poverty outcomes. The study concluded that livelihood diversification improved living standards and reduced poverty among rural households. However, the study focused on the economic effects and determinants of livelihood diversification rather than examining climate change as a factor influencing households' diversification decisions. Consequently, it did not establish whether rural households diversify their livelihoods specifically as a response to climatic pressures. The present study fills this gap by directly examining the relationship between climate change and livelihood diversification among rural households in Nasarawa State.

Sylvester, Umar, & Galadima, (2024) examined climate-smart agricultural practices and food security among farmers in Nasarawa State. The study found that participation in non-agricultural activities was associated with household food-security outcomes, while inadequate capital and information constrained the adoption of improved agricultural practices. The study recognized the importance of non-agricultural activities but did not systematically examine the range of livelihood diversification strategies adopted by rural households in response to climate change. Its primary focus was climate-smart agriculture and food security rather than livelihood diversification. The present study extends the analysis by identifying and examining the specific diversification strategies adopted by households under climate-related pressures.

Theoretical Framework

This study is anchored on the Sustainable Livelihoods Framework (SLF) developed by the Department for International Development (DFID, 1999). The framework provides a comprehensive approach for understanding how households utilize different livelihood assets and strategies to cope with shocks, stresses and changing environmental and socioeconomic conditions. It identifies five major livelihood assets, namely human, natural, financial, physical and social capital, which influence the capacity of households to pursue different livelihood strategies and achieve sustainable livelihood outcomes (DFID, 1999). The framework is particularly relevant to this study because climate change constitutes an important component of the vulnerability context that can affect rural livelihoods. Changes in rainfall patterns, increasing temperatures, droughts, floods and other climate-related stresses can reduce agricultural productivity, household income, food availability and access to natural resources. In response, households may modify their existing livelihood activities or engage in alternative activities to reduce their vulnerability. Such strategies may include crop diversification, livestock production, petty trading, wage employment, seasonal migration, agroforestry and other non-farm activities. The SLF further explains that households' capacity to diversify their livelihoods depends on the livelihood assets available to them. Households with greater access to land, labour, education, credit, infrastructure, social networks and other resources are likely to have more opportunities to adopt alternative livelihood strategies. Similarly, institutional factors such as government policies, extension services, markets, financial institutions and access to climate information can either facilitate or constrain households' ability to respond to climate-related stresses. In relation to this study, climate change represents the vulnerability context, livelihood assets represent the resources available to rural households, livelihood diversification represents the livelihood strategies, while improved income, food security, employment and resilience constitute

possible livelihood outcomes. The framework therefore provides a basis for examining how climate change affects rural household livelihoods and how households in Nasarawa State respond through diversification of their farm and non-farm livelihood activities.

The framework is considered appropriate because it recognizes that rural households do not depend exclusively on a single livelihood source and that their ability to cope with environmental shocks is influenced by the resources and opportunities available to them. Thus, the Sustainable Livelihoods Framework provides the theoretical basis for examining both the effects of climate change on rural livelihoods and the livelihood diversification strategies adopted by rural households in Nasarawa State, Nigeria.

Methodology

The study was conducted in Nasarawa State, Nigeria, located in the North-Central geopolitical zone of the country. The state comprises 13 Local Government Areas and has an agrarian economy in which agriculture, livestock production, trading, wage employment and other economic activities constitute important sources of livelihood. According to the National Population Commission (NPC) and National Bureau of Statistics (NBS) population projections, Nasarawa State had a projected population of 2,712,349 people in 2020. The study adopted a descriptive survey research design to examine the relationship between climate change and livelihood diversification in Nasarawa State. The target population comprised adult residents of Nasarawa State who were engaged in livelihood activities. The sample size was determined using Yamane's (1967) formula, $(n=N/[1+N(e)^2])$, where n represents the sample size, N represents the population size and e represents the level of precision. Using a population of 2,712,349 and a 5% level of precision, the calculation yielded approximately 400 respondents. A multistage sampling technique was adopted for the selection of respondents. First, the state was stratified into the three senatorial zones, namely Nasarawa North, Nasarawa South and Nasarawa West. Local Government Areas were subsequently selected from the three zones, followed by the selection of communities and respondents. Proportionate allocation was used to distribute the 400 questionnaires among the selected areas based on their population sizes. Primary data were collected using a structured questionnaire administered to selected respondents. The questionnaire covered respondents' perceived changes in climatic conditions, effects of climate change on livelihood activities, sources of livelihood and livelihood diversification strategies adopted by respondents. Key Informant Interviews (KIIs) were also conducted with selected community leaders and other relevant stakeholders to obtain supplementary information on climate-related livelihood changes and diversification. Quantitative data obtained from the questionnaires were coded and analyzed using frequencies and percentages, while information obtained from the interviews was analyzed through interpretation of the responses. The results were presented in tables and discussed in relation to the study objectives.

Data Presentation and Analyses

A total of 400 questionnaires were administered to respondents across the selected areas of Nasarawa State, out of which 388 questionnaires were retrieved and found valid for analysis, representing a 97% response rate. The analysis is therefore based on the 388 valid responses. Data were analyzed using frequencies and percentages and presented according to the objectives of the study.

Table 1: Major Livelihood Activities of Respondents in Nasarawa State (N = 388)

S/N	Major Livelihood Activity	Frequency	Percentage (%)
1.	Crop farming	52	13 (%)
2.	Livestock rearing	38	10 (%)
3.	Petty trading/business	46	12 (%)
4.	Salaried employment	43	11 (%)
5.	Transportation services	30	8 (%)
6.	Food processing	49	12 (%)
7.	Artisanal work	39	10 (%)
8.	Construction/workmanship	39	10 (%)

9.	Fishing	30	8 (%)
10.	Other services	22	6 (%)
	Total	388	100 (%)

Table 1 presents the major livelihood activities of respondents in Nasarawa State. The results show that crop farming constituted the largest single livelihood activity, accounting for 52 respondents (13%). This was followed by food processing with 49 respondents (12%) and petty trading/business with 46 respondents (12%). Salaried employment accounted for 43 respondents (11%), while artisanal work and construction/workmanship each accounted for 39 respondents (10%). Livestock rearing accounted for 38 respondents (10%), while transportation services and fishing each represented 30 respondents (8%). The least reported livelihood activity was other services, with 22 respondents (6%). The findings indicate that livelihoods in Nasarawa State are not exclusively dependent on agriculture. Although crop farming and livestock rearing remain important, a substantial proportion of respondents are engaged in non-agricultural activities such as food processing, petty trading, salaried employment, artisanal work, construction and transportation. This livelihood diversity suggests that respondents have already adopted multiple economic activities, which provides an important basis for examining how climate change influences livelihood diversification in the state.

Climate Change and Rural Household Livelihoods

Table 2: Effects of Climate Change on Livelihoods of Respondents in Nasarawa State (N = 388)

S/N	Effects of Climate Change on Livelihoods	Frequency	Percentage (%)
1	Reduced income from major livelihood activity	48	12 (%)
2	Increased cost of livelihood activities	44	11 (%)
3	Reduced agricultural productivity	50	13 (%)
4	Damage to business/property	44	11 (%)
5	Reduced availability of water	34	9 (%)
6	Increased food and household expenses	55	14 (%)
7	Loss of employment/business opportunities	18	5 (%)
8	Reduced availability of natural resources	59	15 (%)
9	Temporary relocation/migration	36	10 (%)
	Total	388	100 (%)

Table 2 presents the effects of climate change on the livelihoods of respondents in Nasarawa State. The findings show that reduced availability of natural resources was the most frequently reported effect, with 59 respondents (15%). This was followed by increased food and household expenses, reported by 55 respondents (14%), and reduced agricultural productivity, reported by 50 respondents (13%). Reduced income from major livelihood activities was reported by 48 respondents (12%), while increased cost of livelihood activities and damage to business/property were each reported by 44 respondents (11%). Furthermore, temporary relocation/migration was reported by 36 respondents (10%), while 34 respondents (9%) identified reduced availability of water as an effect of climate change. The least reported effect was loss of employment/business opportunities, with 18 respondents (5%). The findings indicate that climate change has multidimensional effects on livelihoods in Nasarawa State, extending beyond agriculture to income, household expenditure, businesses, natural resources, water availability and human mobility. The high proportion of respondents reporting reduced availability of natural resources suggests that increasing climatic pressures may be affecting the resources upon which several livelihood activities depend. Similarly, increased household expenses and reduced income may place additional financial pressure on respondents and their families. The reported reduction in agricultural productivity is also significant given that crop farming and livestock production remain important livelihood activities in the study area.

Overall, the findings suggest that climate change is placing considerable pressure on existing livelihood sources and may encourage individuals to seek alternative or additional livelihood activities to maintain income and household welfare. This provides a basis for examining the livelihood diversification strategies adopted by respondents in response to climate-related challenges.

KII Responses

Question: How has climate change affected the livelihoods of people in your community?

Agricultural Extension Agent in Wamba Local Government Area:

Climate change has affected farming through irregular rainfall, prolonged dry periods and increased temperatures. Farmers no longer depend entirely on the traditional planting calendar because rainfall is becoming less predictable. These changes reduce crop yields and income. Livestock farmers are also affected because water and pasture become scarce during prolonged dry periods. As a result, many farmers are looking for other sources of income to support their households.”

Civil Servant in Lafia Local Government Area:

Climate change has affected people's income and cost of living. When agricultural production declines, the prices of food and other commodities increase, which affects both producers and consumers. Some people who depend on agriculture have started engaging in trading, transportation and other activities because their traditional sources of income are no longer as reliable as before. Climate-related events such as flooding can also damage property and business premises.

Farmer in Toto Local Government Area:

The weather is no longer the way it used to be. Sometimes the rain starts late, and at other times there is too much rain within a short period. This affects what I produce and the income I get from farming. The cost of inputs and transportation has also increased. Because farming alone is becoming difficult, I have to look for other activities to support my family.

Community Leader in Kokona Local Government area:

Our people are experiencing changes in rainfall and temperature, and these changes are affecting their means of livelihood. Farmers complain about poor harvests, while traders and other business people are affected when agricultural production falls because purchasing power in the community also declines. During periods of water scarcity, households spend more time and money obtaining water. Some families have also moved temporarily to other places in search of work.”

The interview responses generally corroborate the questionnaire findings presented in Table 2. The Agricultural Extension Agent and Farmer emphasized irregular rainfall, increased temperature, reduced agricultural productivity and declining income, while the Civil Servant highlighted increased costs, reduced income and damage to businesses and property. The Community Leader further identified water scarcity and temporary movement in search of livelihood opportunities. These responses demonstrate that climate change affects livelihoods through multiple pathways, including agricultural production, household income, business activities, water availability and mobility. The interview evidence therefore supports the quantitative finding that climate change has multidimensional effects on livelihoods in Nasarawa State.

Livelihood Diversification Strategies Adopted in Response to Climate Change

Table 3: Livelihood Diversification Strategies Adopted by Respondents in Response to Climate Change (N = 388)

S/N	Livelihood Diversification Strategy	Frequency	Percentage (%)
1	Engaging in petty trading/business	33	9 (%)
2	Taking up additional wage employment	42	11 (%)
3	Combining farming with livestock rearing	33	9 (%)
4	Food processing/value addition	39	10 (%)
5	Transportation services	29	7 (%)
6	Seasonal migration	22	6 (%)
7	Artisanal activities	29	7 (%)
8	Construction/workmanship	22	6 (%)
9	Starting small-scale enterprises	42	11 (%)

10	Crop diversification	39	10 (%)
11	Agroforestry	39	10 (%)
12	Other income-generating activities	19	4 (%)
	Total	388	100 (%)

Table 3 presents the livelihood diversification strategies adopted by respondents in response to climate change in Nasarawa State. The findings indicate that taking up additional wage employment and starting small-scale enterprises were the most commonly reported diversification strategies, each accounting for 42 respondents (11%). This was followed by food processing/value addition, crop diversification, and agroforestry, each reported by 39 respondents (10%). Furthermore, engaging in petty trading/business and combining farming with livestock rearing were each reported by 33 respondents (9%). Transportation services and artisanal activities each accounted for 29 respondents (7%), while seasonal migration and construction/workmanship were each reported by 22 respondents (6%). The least reported strategy was other income-generating activities, with 19 respondents (4%). The findings demonstrate that respondents employ a wide range of both farm and non-farm livelihood strategies to cope with climate-related pressures. The prominence of additional wage employment and small-scale enterprises suggests that respondents increasingly seek alternative sources of income beyond their primary livelihood activities. Similarly, food processing and value addition provide opportunities to generate additional income from existing agricultural products, while crop diversification and agroforestry represent strategies for reducing dependence on climate-sensitive agricultural activities. The adoption of petty trading, livestock rearing, transportation and artisanal activities further indicates that livelihood diversification in Nasarawa State extends beyond agriculture. These activities provide alternative or supplementary income sources that can help households manage declining income, increased livelihood costs and other effects of climate change identified under Objective One. Overall, the findings indicate that livelihood diversification is an important response to climate-related livelihood pressures in Nasarawa State. Respondents combine agricultural and non-agricultural activities to spread livelihood risks, maintain income and improve their capacity to cope with changing climatic conditions. The results therefore support the Sustainable Livelihoods Framework, which emphasizes that households draw on different livelihood assets and activities to respond to shocks and vulnerability.

KII Responses

Question: What livelihood diversification strategies are people adopting in response to climate change?

Agricultural Extension Agent in Obi Local Government Area:

Many farmers are no longer depending only on crop production. Some combine farming with livestock rearing, while others engage in food processing and petty trading. Some farmers also diversify their crops and plant trees to reduce the risks associated with changing weather conditions. Those who have the opportunity are taking up additional wage employment or small businesses.

Civil Servant in Karu Local Government Area:

People are increasingly combining different sources of income. Apart from their regular employment or farming, some engage in small-scale businesses, transportation, food processing and trading. The reason is that relying on one source of income has become risky. When one activity is affected by climate or economic conditions, another activity can provide income for the household."

Farmer in Akwanga Local Government Area:

I cannot depend on farming alone anymore. Apart from farming, I engage in livestock rearing and sometimes petty trading. During periods when farming does not provide enough income, the other activities help me meet household needs. Some farmers in this community also process agricultural products for sale rather than selling everything as raw produce.

Community Leader in Doma Local Government Area:

People in the community are becoming more involved in different activities. Some have started small businesses, others engage in transportation, food processing, livestock rearing and artisan work. Young people sometimes travel to other places temporarily to look for work. These activities help families earn income when farming or other traditional livelihoods are affected by climate conditions. The interview responses indicate that respondents have adopted both agricultural and non-agricultural livelihood diversification strategies in response to climate-related pressures. The Agricultural Extension Agent identified livestock rearing, food processing, petty trading, crop diversification, agroforestry and wage employment, while the Civil Servant emphasized small businesses, transportation and trading. The Farmer confirmed the practical use of livestock rearing, petty trading and food processing as supplementary livelihood sources, while the Community Leader identified small-scale businesses, transportation, artisanal activities and temporary migration. These qualitative findings are consistent with Table 3, where additional wage employment and small-scale enterprises were the most frequently reported strategies. The interview evidence further demonstrates that livelihood diversification is not limited to agricultural activities but includes a broad range of farm and non-farm activities. This suggests that respondents use diversification to spread livelihood risks, maintain household income and cope with the effects of climate change.

Discussion

i. The findings in Table 2 show that climate change has affected livelihoods in several ways. Reduced availability of natural resources was the most reported effect, with 59 respondents (15%), followed by increased food and household expenses with 55 respondents (14%) and reduced agricultural productivity with 50 respondents (13%). Other reported effects included reduced income from major livelihood activities (12%), increased costs of livelihood activities (11%), damage to business/property (11%), temporary relocation/migration (10%), reduced water availability (9%) and loss of employment/business opportunities (5%). These findings are strongly supported by the interview responses. The Agricultural Extension Agent explained that irregular rainfall, prolonged dry periods and increasing temperatures have affected crop yields and household income, while the farmer reported that unpredictable rainfall and increasing production costs have made farming less reliable. The Civil Servant similarly observed that climate-related changes have increased the cost of living and affected business activities, while the Community Leader identified water scarcity, poor harvests and temporary movement in search of employment as important livelihood consequences. The findings can be explained through the Sustainable Livelihoods Framework, particularly the concept of the vulnerability context. The framework recognizes shocks, trends and seasonality as external factors that can affect people's livelihood assets and the choices available to them. Climate variability and environmental changes therefore constitute vulnerability factors capable of weakening livelihood systems. In this study, the reported reduction in natural resources and water availability reflects pressure on natural capital, while reduced income and increased household expenses indicate pressure on financial capital. Damage to businesses and property represents pressure on physical capital. The findings further show that climate change does not affect only one livelihood group. The study established that respondents were engaged in crop farming, livestock rearing, petty trading, salaried employment, transportation, food processing, artisanal work, construction, fishing and other services. Therefore, the effects reported in study demonstrate that climate-related vulnerability cuts across the different livelihood activities in the study area. This is consistent with the Sustainable Livelihoods Framework's people-centred perspective, which considers livelihoods as combinations of assets and activities rather than dependence on a single occupation. The qualitative responses also reveal an important connection between livelihood vulnerability and livelihood outcomes. The farmer's report of declining reliability of farming and the community leader's observation of temporary movement for employment suggest that climate-related pressures are influencing the ability of respondents to maintain existing livelihood outcomes. Thus, the findings indicate that climate change is not merely changing environmental conditions; it is also influencing how people organize their economic activities and secure household welfare.

ii. The findings also shows that respondents adopted a range of livelihood diversification strategies in response to climate change. Additional wage employment and starting small-scale enterprises were the most reported strategies, each accounting for 42 respondents (11%). This was followed by food processing/value addition, crop diversification and agroforestry, each with 39 respondents (10%).

Petty trading/business and combining farming with livestock rearing each accounted for 33 respondents (9%), while transportation and artisanal activities each accounted for 29 respondents (7%). Seasonal migration and construction/workmanship each accounted for 22 respondents (6%), while other income-generating activities accounted for 19 respondents (4%). The interview responses closely correspond with these findings. The Agricultural Extension Agent reported that people combine farming with livestock rearing, food processing, petty trading, crop diversification and agroforestry. The Civil Servant identified additional participation in small businesses, transportation, trading and other income-generating activities. The farmer explained that livestock rearing and petty trading provide supplementary income when farming does not generate sufficient returns. The Community Leader similarly identified small businesses, transportation, food processing, artisanal work and temporary migration as livelihood responses within the community. These findings fit directly into the livelihood strategies component of the Sustainable Livelihoods Framework. The framework views livelihood strategies as the combination of activities through which people use their available assets to pursue desired livelihood outcomes. Thus, the diversification strategies reported by respondents can be understood as practical ways of reorganizing available human, natural, financial, physical and social resources in response to climate-related vulnerability. For example, additional wage employment and small-scale enterprises require human and financial capabilities, while food processing involves the use of skills, physical resources and existing agricultural products. Combining farming with livestock rearing represents the use of different productive resources to spread livelihood risk. Similarly, crop diversification and agroforestry represent attempts to manage dependence on particular agricultural activities and natural-resource conditions. The SLF recognizes that access to different livelihood assets influences the range of strategies available to people. The result therefore suggest that respondents are not simply abandoning their existing livelihoods because of climate change. Rather, they are combining existing activities with additional sources of income. This is particularly evident from the prominence of wage employment, small-scale enterprises, food processing, petty trading and livestock rearing. Such diversification enables respondents to spread risk across different activities when one livelihood source becomes vulnerable.

The relationship between the Effects of Climate Change on Livelihoods and Livelihood Diversification Strategies Adopted in Response to Climate Change in Nasarawa State is therefore clear. Effects of climate change on livelihoods demonstrates the vulnerability created by climate change, while livelihood diversification strategies adopted in response to climate change demonstrates the livelihood strategies developed in response to that vulnerability. The Sustainable Livelihoods Framework provides the link between the two: climate-related shocks and stresses affect livelihood assets and existing activities, while people draw upon their available assets to develop alternative or complementary livelihood strategies in pursuit of improved income, well-being and reduced vulnerability. Overall, the quantitative and interview findings complement each other. The questionnaire results establish the extent and distribution of livelihood effects and diversification strategies among the 388 respondents, while the interviews explain how and why people are experiencing these changes. Together, the findings demonstrate that climate change is increasing livelihood vulnerability in Nasarawa State and encouraging the people of Nasarawa State to diversify into both agricultural and non-agricultural activities as a means of maintaining their livelihoods.

Conclusion

The study concludes that climate change is increasingly affecting livelihoods in Nasarawa State, Nigeria, by placing pressure on the natural resources and economic activities on which people depend. The results revealed that reduced availability of natural resources, increased food and household expenses, reduced agricultural productivity, declining income and increased costs of livelihood activities were among the major effects experienced by respondents. The effects were not restricted to farming but extended to trading, businesses, employment, transportation, food processing, artisanal activities and other livelihood activities. The study also concludes that livelihood diversification has become an important response to climate-related livelihood pressures. Respondents adopted both agricultural and non-agricultural strategies, particularly additional wage employment, small-scale enterprises, food processing, crop diversification, agroforestry, petty trading and livestock rearing. The interview responses further confirmed that people increasingly combine different livelihood activities when their major sources of income become unreliable. In line with the Sustainable

Livelihoods Framework, the findings demonstrate that climate-related stresses can weaken livelihood assets and existing livelihood activities, thereby encouraging people to mobilize available human, financial, natural and physical resources into alternative or complementary livelihood strategies. Livelihood diversification therefore represents an important mechanism through which people in Nasarawa State seek to reduce vulnerability, maintain income and sustain household welfare under changing climatic conditions.

Recommendations

Based specifically on the two major findings of the study, the following recommendations are made:

- i. Government and relevant environmental agencies should strengthen measures to reduce the livelihood effects of climate change in Nasarawa State. The study found that reduced availability of natural resources, increased household expenses, reduced agricultural productivity and declining income were major effects of climate change. Therefore, government should improve access to climate information, water resources, climate-resilient agricultural support and natural-resource conservation programs to reduce the vulnerability of livelihoods to climate-related stresses.
- ii. Government and development agencies should support livelihood diversification among residents of Nasarawa State. Since the study found that respondents adopted additional wage employment, small-scale enterprises, food processing, crop diversification, agroforestry, petty trading and livestock rearing as responses to climate change, accessible credit, entrepreneurship training, vocational skills, market facilities and technical support should be provided to enable people to establish and sustain multiple sources of livelihood. This will reduce dependence on a single livelihood activity and strengthen their capacity to cope with future climate-related shocks.

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