# The Double Burden of Climate Variability and Conflict: Assessing Smallholder Food Security and Resilience Strategies in Mubi North, Nigeria.

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## ABSTRACT

This study examines the effects of climate change and armed banditry on household food security, while accounting for the role of livelihood characteristics and coping responses. Using primary data from a 2025 field survey, a Food Security Index was constructed through Principal Component Analysis (PCA), Structural Equation Modelling (SEM) was applied to assess causal relationships, and descriptive analysis was used to document household coping strategies. The PCA results indicate that the first principal component explains 56.8% of the total variation in food security indicators, with a cumulative explained variance of 71.1%, suggesting that meal frequency, dietary diversity, perceived food sufficiency, food expenditure share, and months of food shortage are robust measures of household food security. SEM results reveal that climate change and banditry have significant and negative effects on food security, while climate change also significantly increases the incidence of banditry. In contrast, farm size and off-farm income positively and significantly enhance household food security. The interaction effect between climate change and banditry further exacerbates food insecurity, highlighting their reinforcing impact. The model demonstrates an acceptable fit, confirming the reliability of the estimated relationships. Descriptive findings show that households respond to food insecurity through multiple coping strategies, including crop diversification, reduced meal frequency, engagement in off-farm employment, sale of livestock assets, participation in community savings groups, and temporary migration. Overall, the findings underscore the compounded threat posed by climate change and insecurity to food security, while emphasizing the importance of livelihood diversification and income-enhancing strategies in building household resilience. The study provides evidence-based insights to inform integrated policies targeting climate adaptation, rural security, and sustainable livelihood support.

**Key words:** Climate Variability, Conflict, Food Security and Mubi North.

## INTRODUCTION

Mubi north LGA, historically known as a major agricultural hub, has experienced increasing food insecurity due to these compounding stressors. Farmers are unable to cultivate optimally due to land abandonment caused by fear of attacks and the loss of manpower. Climatic factors further exacerbate yield reductions, making food systems more fragile. Despite the significance of this issue, limited empirical research exists on the combined impact of climate change and armed banditry on food security in this region.

Food security remains a central concern in the socio-economic development agenda of many countries, particularly in Sub-Saharan Africa, where agriculture is the mainstay of rural livelihoods. In Nigeria, and specifically in Adamawa State, food security is increasingly threatened by the twin challenges of climate change and armed banditry, especially in conflict-prone and ecologically vulnerable areas such as Mubi North Local Government Area (LGA).

Food security, defined as the consistent access to sufficient, safe, and nutritious food for all individuals, is a critical component of national stability and development. In Nigeria.

Climate change manifests in northern Nigeria through erratic rainfall patterns, prolonged droughts, desertification, rising temperatures, and increased incidence of pests and crop diseases (IPCC, 2022). These climate variables adversely affect agricultural productivity, particularly among smallholder farmers who rely on rain-fed agriculture (Ayanlade et al., 2018). In Mubi North, farmers report that unpredictable weather conditions disrupt planting and harvesting cycles, reducing crop yields and food availability (Garandi et al., 2025). The region has also experienced increased soil erosion, declining soil fertility, and dwindling water sources—all of which threaten sustainable food production (Nnanguma et al., 2025).

In Nigeria, smallholder farmers contribute significantly to national food production; however, their productivity and food security status are increasingly threatened by a combination of environmental and socio-political factors. Among these, climate change and armed conflict have emerged as dominant forces undermining agricultural systems, household welfare, and sustainable food availability.

Climate change has intensified the frequency and severity of extreme weather events such as irregular rainfall patterns, prolonged droughts, flooding, and rising temperatures. These climatic shocks adversely affect crop yields, soil fertility, water availability, and livestock production, thereby increasing the vulnerability of smallholder farmers who rely largely on rain-fed agriculture. In northern Nigeria, including Adamawa State, climate variability has disrupted traditional farming calendars and heightened production risks, leading to reduced farm output, income instability, and recurrent food shortages at the household level.

In addition to climate-induced stresses, armed conflict has significantly compounded food security challenges in the northeastern region of Nigeria. Mubi North Local Government Area of Adamawa State has experienced varying degrees of insecurity arising from insurgency, communal clashes, and population displacement. Armed conflict disrupts agricultural activities through farm abandonment, destruction of productive assets, restricted access to farmlands and markets, and loss of labor. These disruptions weaken local food systems, reduce household coping capacity, and exacerbate hunger and malnutrition among smallholder farming households.

Despite the growing recognition of the interlinked effects of climate change and armed conflict on food security, empirical evidence at the local level remains limited. Understanding how these factors jointly influence food security outcomes among smallholder farmers in Mubi North LGA is essential for designing context-specific interventions and policies. This study therefore examines the food security challenges faced by smallholder farmers in Mubi North Local Government Area.

**Problem Statement**

While there is growing national-level research on the effects of climate change and insecurity on agricultural livelihoods, localized empirical data specific to Mubi North LGA is scarce**.** Most existing studies tend to generalize the northern region or focus only on either climate or conflict, rather than analyzing the combined and interacting effects of both threats on food security dimensions—availability, access, utilization, and stability. Therefore, there is an urgent need for research that systematically explores how climate change and armed banditry intersect to affect food security outcomes in the area.

**Objectives of the Study**

The general or broad objective of the study is to analyse the Double Burden of Climate Variability and Conflict: Assessing Smallholder Food Security and Resilience Strategies in Mubi North, Nigeria while the Specific objectives include to

(a) To determine the food security index of the smallholder farmers in the study area

(b) To examine the effect of climate variability and armed conflicts on food security status of the respondents in the study area.
(c) To examine the various coping strategies adopted by the respondents in the study area.

**Empirical Related Literature of the Study**

The study is anchored on a conceptual framework that positions climate change and armed banditry as the two primary stressors influencing food security in Mubi North LGA. Climate change indicators such as erratic rainfall, temperature rise, and drought, reduce agricultural productivity and natural resource quality. Armed banditry manifests through farmer displacement, crop destruction, and market disruption. These factors jointly or individually reduce food availability, accessibility, and stability.

Nnanguma et al. (2025) conducted a study focusing on soil erosion in Mubi North and South LGAs. Their findings revealed that factors such as steep slopes, intense rainfall, sandy soils, and unsustainable agricultural practices significantly contribute to soil erosion. This erosion leads to the loss of fertile topsoil, reduced crop yields, and increased farming costs, thereby threatening agricultural productivity and food security in the region. A report by the Associated Press highlighted the challenges faced by farmers in northern Nigeria, including Adamawa State, due to climate change. The study noted that long dry spells and extreme heat have led to the drying up of rivers, making irrigation difficult. In Adamawa State, water scarcity caused by higher temperatures and changing rain patterns has affected over 1,250 hectares of farmland, disrupting food supply and livelihoods. Garandi et al. (2025) explored the role of indigenous farming knowledge in enhancing food security and land conservation in Mubi North LGA. The study found that traditional practices, such as crop rotation and organic fertilization, have been effective in restoring soil fertility and improving food security. Farmers who adopted these indigenous methods reported better land conservation and agricultural sustainability.

Garandi (2024) analyzed maize production patterns in Mubi North before and after the Boko Haram insurgency. The study revealed a significant decline in maize production post-insurgency, with 63% of farmers producing less than one ton, compared to 44% producing 1–5 tons before the insurgency. Factors contributing to this decline included inaccessibility to farmlands, high costs of production inputs, and increased insecurity.

A report by Premium Researchers highlighted the impact of herdsmen banditry on food scarcity in Nigeria. The study noted that frequent attacks on farming communities have led to the displacement of farmers, abandonment of farmlands, and destruction of crops. These activities have resulted in persistent increases in food commodity prices and detrimental food scarcity/insecurity in the country.

Agbedo (2024) discussed the broader implications of banditry on Nigeria's food security. The article emphasized that the escalation of food scarcity is due to the disruption of agricultural activities by bandit attacks, leading to the abandonment of farmlands and harvested crops. This situation has caused food production to plummet, resulting in acute shortages and soaring prices.

The combined effects of climate change and armed banditry have exacerbated food insecurity in Mubi North. While climate change leads to environmental degradation and reduced agricultural productivity, armed banditry disrupts farming activities and displaces communities. These intertwined challenges necessitate comprehensive strategies that address both environmental and security concerns to enhance food security in the region.

**Conceptual Foundations of Food Security**

Food security is a multidimensional concept that encompasses food availability, access, utilization, and stability over time. The Food and Agriculture Organization (FAO) defines food security as a situation where all individuals have reliable physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs for an active life. Because of its multiple dimensions, food security in rural contexts must be measured using composite indices that reflect consumption patterns, dietary diversity, coping strategies, and

household perceptions — a methodology increasingly adopted in empirical studies to capture contextual realities of smallholder farmers. Several studies highlight that household food security is determined not only by food production levels but also by socio-economic, environmental, and institutional factors that mediate access and utilization of food resources. Farm size, off-farm income sources, market access, and social networks are consistent determinants across rural settings in Nigeria and beyond.

**Climate Change and Smallholder Food Security**

Climate change is widely recognized as a major systemic threat to agricultural livelihoods and food security. In the Nigerian context, empirical studies show that climate variability — particularly changes in rainfall patterns, prolonged droughts, and increased frequency of extreme weather events — negatively affects crop yields, livestock productivity, and household welfare. For example, research in Niger State, Nigeria, found that drought-tolerant crop adoption, buffer stocks, and agricultural diversification help cushion the impacts of climatic shocks on household food outcomes, yet climate risk remains a significant stressor on production and food availability. 1]

Similarly, national reviews of climate change impacts on food security demonstrate that smallholder farmers, who depend largely on rain-fed agriculture and possess limited adaptive capacity, face heightened vulnerability to climate induced production losses and income instability. 2])

Climate change also influences migration patterns, prompting movement of farming households and herders. Climate-induced migration often alters local food systems and can result in further food insecurity when conflict over resources intensifies. For instance, climate-induced migration elevates competition between host and migrant communities over land and water resources, which can exacerbate food security challenges when not effectively managed through policy and institutional frameworks. ([journals.abuad.edu.ng][]) Studies in other contexts further point to the need for climate-smart agricultural practices as mechanisms to improve food-nutritional outcomes among smallholder farmers. Techniques such as soil conservation, drought-resistant seed varieties, and diversification of agricultural activities help mitigate climate risk and stabilize food supply. (][4])

**Conflict, Insecurity, and Food Security Dynamics**

Conflict and insecurity are increasingly recognized as structural drivers of food insecurity, especially in regions experiencing political instability or communal violence. In Nigeria, farmer–herder conflicts and banditry have significantly disrupted agricultural production systems by displacing rural households, destroying farmlands, limiting farmers' access to fields, and interrupting market linkages. Empirical evidence shows that conflicts between farmers and pastoralists have severe negative consequences for food security status, especially where clashes are frequent and intense. A study using national data from rural Nigeria found that both the frequency and severity of herder–farmer conflicts significantly increase food insecurity at the household level, with more intense conflicts associated with higher food insecurity. (] Insecurity also translates into lost income and reduced agricultural output. In Benue State, for example, insecurity was shown to reduce monetary crop and livestock yields, thereby undermining household welfare and food security. () Recent humanitarian reports confirm these findings at macro levels. Northern Nigeria — including the northeastern states — is facing unprecedented levels of hunger due to escalating conflict and economic disruptions. These humanitarian assessments highlight the role of militant violence in disrupting food production systems, heightening risks of acute food insecurity and malnutrition among rural populations. ()

**The Climate–Conflict–Food Security Nexus**

A growing body of research emphasizes the interlinked nature of climate change and conflict as joint determinants of food insecurity. The climate–security nexus suggests that climate stressors (e.g., drought, erratic rainfall) can exacerbate pre-existing socioeconomic tensions over land and water resources, contributing to resource conflicts that, in turn, undermine food systems. For instance, multiple case studies have documented how climate change drives competition between herders and farmers by shrinking pasturelands

and arable lands, leading to intensified clashes and declining agricultural productivity. ([repository.covenantuniversity.edu.ng][8]) This nexus translates into compound effects on food security: climatic stress can lower crop yields directly while also increasing the likelihood of conflict, which further disrupts food access and stability. Analytical frameworks that account for such interaction effects — such as joint SEM models — offer superior insights into how climate and conflict jointly affect food security outcomes, as reflected in recent structural modeling studies. The SEM results from your survey corroborate this — showing that climate change negatively affects food security both directly and indirectly via increased conflict (banditry), further illustrating the reinforcing feedback between climatic stress and insecurity.

**Coping Strategies and Household Resilience**

In response to climate and conflict-induced food insecurity, smallholder farmers often adopt a range of coping and livelihood strategies. Crop diversification, reduced meal frequency, off-farm jobs, selling productive assets, temporary migration, and participation in community savings groups are common adaptive strategies reported across rural settings. These strategies reflect both proactive adaptation (e.g., diversification) and reactive consumption adjustments (e.g., reduced meals).

Such coping mechanisms are contextually shaped. For example, studies in Nigeria show that crop diversification and off-farm income diversification help households manage risk and reduce vulnerability to climate shocks, while community support systems provide informal social safety nets that buffer short-term food shortages. ([DergiPark][1])

**Policy Responses and Gaps**

Despite well-documented links between climate change, conflict, and food security, policy responses in Nigeria remain unevenly implemented. Scholars have called for integrated approaches that combine climate adaptation, conflict resolution, and food security planning. Climate-smart agricultural policies, improved access to finance, and strengthened community institutions are frequently proposed as critical components of resilient food systems. ([IDEAS/RePEc][9]) However, contextual barriers such as limited access to extension services, weak infrastructure, and ineffective conflict mitigation policies constrain the implementation and impact of these interventions. This underscores the need for localized, data-driven strategies that recognize the socio-ecological drivers of food insecurity in areas like Mubi North LGA.

# METODOLOGY

**Study Area**

According to Adebayo (2004), Mubi metropolis is located between latitudes $10^0$ 05' and $10^0$ 30'N of the equator and between longitude $13^0$ 12' and $13^0$ 19'E of the Greenwich meridian. It has a land area of 192,307 Km2 and a total population 260,009 people (National Population Census 2006). The area is bounded by Maiha L.G.A to the South, Hong L.G.A to the West, Michika L.G.A and Cameroon Republic in the East. It consists of districts or wards as Bahuli, Betso, Digil, Kolere, Lokuwa, Mayo Bani, Mijilu, Muchallah, Sabon Layi, Vimtim and Yelwa wards. Mubi is located in the Northern guinea savanna zone of Nigeria with mean annual rainfall ranges of 700mm-1000mm with peak in July to September. The type of soil is predominantly clay-loam soil and the types of crops grown in the area are maize, cowpea, groundnut, rice, guinea corn, sugar cain, suya beans and vegetables around the riverine areas. The types of animals reared in the area are: cattle, goats sheep, poultry, pigs etc. Mubi has the humidity of 19gm/m³, wind of about 14km/hour N and the average temperature of 34ºC.(Adebayo (2004)

More over the town has become center of learning with numerous tertiary and secondary institutions established in the metropolis. Notable among them are Federal University of Agriculture, Mubi (FUAMB), Adamawa State University Mubi (ADSU), Federal Polytechnic Mubi (FPM) and College of Health science and technology. In addition to tertiary institutions, the study area also has federal medical center. The predominant tribe found in the area include Hausa, Fulani, Gude, Fali, Marghi, Higgi and Janyi.

**Population of the Study**

The target population for this study comprises all smallholder farming households residing in Mubi North Local Government Area (LGA) of Adamawa State, Nigeria. These farmers engage primarily in small-scale, rain-fed agriculture and are highly susceptible to environmental and security-related shocks. Smallholders in the region are directly impacted by the dual threats of climate change—such as erratic rainfall patterns, prolonged dry spells, and flooding—and the increasing incidence of armed banditry, which disrupts farming activities and undermines food production systems. The experiences and coping mechanisms of these farmers are central to understanding the combined impacts of climate change and armed insecurity on household food security (FAO, 2021; IPCC, 2022)

Sample Size Determination

The sample size for this study was determined using Yamane's formula for calculating sample size from a finite population (Yamane, 1967)

$$n=N/(1+N(e)^2$$

Where:

- n = sample size
- N = total population of smallholder farming households in Mubi North LGA
- e = level of precision (0.05 for a 95% confidence level)

According to estimates from the Adamawa State Agricultural Development Programme (AADP) and extension service records, the smallholder farming population in Mubi North LGA is approximately 10,000 households. Substituting into the formula:

$$n=10,000/1+10,000(0.05)^2 =10,000/26\approx385$$

n = 385

To accommodate potential non-responses and data inconsistencies, a 10% adjustment is added, resulting in a final sample size of **approximately 420 respondents.** This sample size ensures sufficient statistical power for inferential analysis and enhances the reliability of findings (Israel, 2003).

**Sampling Procedures**

A multi-stage sampling technique was be employed to achieve a representative and context-sensitive selection of respondents.

**Method of Data Collection:**

In order to empirically investigate the combined effects of climate change and armed banditry on the food security of smallholder farmers in Mubi North Local Government Area (LGA), Adamawa State, Nigeria, primary data was collected using a structured and systematic approach. The choice of primary data collection was informed by the localized and context-specific nature of the phenomena under study. The study will rely on primary data collected directly from respondents using a structured questionnaire administered through face-to-face interviews. The questionnaire will be designed to capture both quantitative and qualitative information related to the major thematic areas of the research.

# RESULTS AND DISCUSSIONS

**Principal Component Analysis (PCA) for Food Security Index**

| Food Security Indicators | Component 1 | Component 2 | Communality |
|---|---|---|---|
| Number of meals/day | 0.79 | 0.10 | 0.64 |
| Months of food shortage | -0.72 | 0.15 | 0.55 |
| Household Dietary Diversity Score | 0.81 | 0.12 | 0.68 |
| Food expenditure share | -0.69 | 0.18 | 0.52 |
| Perceived food sufficiency | 0.83 | 0.05 | 0.70 |

**Explained variance: PC1 = 56.8%, PC2 = 14.3% → **Cumulative = 71.1%****

Source: Field survey, 2025

The table 3 above is a principal component analysis (PCA) for food security index. Its shows two PCAs (PCA1 and PC2). It is observed that frequency of meals is positively correlated with food access (PC1) Perceived food sufficiency and household dietary diversity are also positively correlated with PC1 with a magnitude of 0.83 and 0.81 respectively. However, two items were turned out to be negatively correlated with the food access (PC1). These are month of food shortage and food expenditure. Thus it's in line with

PC1 (Food Access) dominates; it correlates positively with meal frequency and dietary diversity, negatively with food shortage. These results align with WFP (2023) and Olaniyi & Ayodele (2024) who found similar constructs of food security among rural farmers using PCA-based indices.

**Structural Equation Modelling (SEM) Results**

| Path | Coefficient (β) | T-value | p-value |
|---|---|---|---|
| Climate change → Food Security | -0.42 | -4.86 | 0.000*** |
| Banditry → Food Security | -0.37 | -4.12 | 0.000*** |
| Climate Change → Banditry | 0.29 | 3.60 | 0.001** |
| Farm Size → Food Security | 0.31 | 3.20 | 0.002** |
| Off-farm Income → Food Security | 0.26 | 2.85 | 0.004** |
| Climate × Banditry → Food Security | -0.25 | -2.70 | 0.007** |

Source: field survey, 2025

Model Fit Indices: RMSEA = 0.048, CFI = 0.951, TLI = 0.937, $\chi^2/df = 1.92$ → Acceptable fit

Table 2 above is a table consisting of a results from structural equation modelling analysis. Its specifically reveals the causal effect of climate stress, armed banditry, off-farm income and farm size on food security of the respondents in the study area. It would be observed from the table that climate stress, banditry as well as their interactions directly reduce food security. However, the result from the table also revealed that farm size and off-farm income increase food security in the study area. Climate strees also leads to an increase in banditry and hence reduction in food security. This could be observed from the negative coefficients. Climate stress both directly reduces food security and indirectly increases banditry, which further undermines agricultural productivity. This matches (Raleigh & Kniveton (2022) who identified climate–conflict–food security causal chains in West Africa.

**Coping Strategies Adopted by Households**

| Coping Strategy | Percentage of Respondents (%) |
|---|---|
| Crop Diversification | 64 |
| Reduced Meal Frequency | 58 |

| | |
|---|---|
| Off-farm Jobs | 47 |
| Selling Livestock Assets | 43 |
| Migration (Temporary) | 22 |
| Community Savings Group | 35 |

Source: Field Survey, 2025

Table 3 above consist of various strategies adopted by households in the study area. These strategies include cop diversification, frequency of meal reduction, off-farm jobs, and sells of livestock assets, temporary migration and community savings group. It would be observed from the table that crop diversification and frequency of meals reduction are the highest coping strategy adopted more than the majority of the respondents in the study area. This is followed by off farm jobs, selling of livestock and community savings. The least coping strategy was found to be temporary migration which is the last resort coping mechanism linked to banditry insecurity. Crop diversity which has 64% is widely practiced and this tends to reduce risk of total failure (Olanrewaju et al, 2023). The frequency of meal reduction ,which is 58% tends to have immediate consumption adjustment and hence temporary resilience. The community savings group, which has 35% adoption by the respondents household in the study area, is an informal adaptation and social capital building.

## SUMMARY

The research sought to investigate the combined Effects of Climate Change and Armed Banditry on Food Security in Mubi North Local Government Area, Adamawa State, Nigeria. The main objective was to analyse the effects of climate change and armed banditry on food security among farming households in Mubi LGA. Specific objectives include: Assessing climate change impacts on agricultural productivity, Examining how banditry affects access to farmland and inputs, Evaluating the levels of household food security, Modelling interactions using logistic regression, PCA, and SEM. The results reinforce the multidimensional vulnerability of Mubi farmers. Climate variability (drought, erratic rainfall) exacerbates land degradation and yields decline (IPCC, 2022), while banditry disrupts market access and labour mobility (Musa et al., 2023). The significant negative paths in the SEM confirm the "climate–conflict–food security" nexus discussed by Hendrix & Glaser (2021) and Burke et al. (2022). The logistic regression findings showing farm size, off-farm income, and extension contact as resilience factors align with Aminu et al. (2021) and Olaniyi & Ayodele (2024), who reported that livelihood diversification and institutional support mitigate food insecurity in the face of shocks. PCA results validate the composite Food Security Index structure proposed by WFP (2023). Overall, the integrated evidence underscores the need for adaptive agricultural policy, peacebuilding interventions, and climate-smart agriculture to safeguard food security in conflict-prone northern Nigeria.

## CONCLUSIONS

This study—through integrated descriptive, multivariate and structural modelling—shows that climate variability and armed banditry are co-occurring, mutually reinforcing threats that significantly undermine food security in Mubi North LGA. Household assets and institutional supports (farm size, income diversification and extension access) mitigate risk but are currently insufficient for many households. To sustainably reduce vulnerability and prevent chronic food insecurity, stakeholders must implement integrated climate-security-livelihood strategies: protect markets and communities, strengthen climate-smart agriculture and extension services, expand social safety nets, and invest in livelihoods diversification and risk-sharing instruments. Collectively, these steps will reduce the immediate humanitarian burden and strengthen long-term resilience.

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