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Effect of climate shocks on food security among farming households in northeast Nigeria: A binary logistic regression approach

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Abstract - Food security in Nigeria is threatened by multiple factors including rising energy/fuel costs, food prices inflation, persistent terrorism and impacts of climate shocks. This study examined the effects of climate shocks on foods security among farming households in Northeast Nigeria. Data on socioeconomic characteristics, food security indicators and climatic shocks including flood, drought, irregular rain and extreme heat (above 40^0c) were sourced from the General Household Survey (GHS) Wave 5 conducted by the National Bureau of Statistics. Descriptive statistics and binary logistic regression were employed to analyze the data. Results of analysis revealed that majority of the respondents were responsible, adult male household heads, with an average family size of 7.15. Only 18.43% of the households were classified as food secure while a significant 81.43% were food insecure. Furthermore, one unit increase in exposure to irregular rain, drought and extreme heat greater than 40^0C was found to reduce the probability of food security among respondents in the study area by 13.78%, 15.56% and 18.08% respectively. The study concluded that exposure to irregular rain, extreme heat and drought had significant negative effects on food security in the study area. The study recommends the training and retraining of respondents in climate-smart agricultural practices as a strategic approach to mitigating the impact of climate shocks on food security.
Keywords: Climate shocks, Food security, Farming households, Logistic regression

INTRODUCTION

The world faces increasing threats from climatic shocks driven by global warming. These impacts are particularly severe in agriculture that largely depends on rainfed systems; any changes in rainfall pattern or intensity can significantly disrupt crop and livestock production, thereby affecting human well-being, especially in terms of food security. The giant strive of every country is to attain food security which exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and preferences for an active and healthy life (FAO et al., 2024). However, food security remains a pressing challenge in Sub-Sahara Africa where agriculture is predominantly rainfed and highly sensitive to climatic variability. Nigeria is among the countries whose agricultural systems largely depend on rainfall to sustain food production for its growing population (Adamagashi *et al.*, 2023). Within Nigeria, Northeast region stands out to be vulnerable to climate-related shock such as irregular rainfall, extreme heat, floods and drought due to its semi-arid climate, fragile farming systems and persistent insecurity (FAO, 2021).

Climatic shocks refer to sudden, extreme or unanticipated (short to medium term) climatic-related events that have significant adverse impacts on human systems, agricultural productivity, livelihood and natural ecosystems. World Bank (2020) gave effects of climatic shocks as persistent drought, severe storms, massive flooding and punishing heat waves that limit people to work, attend school, access healthcare and otherwise live productive lives. Effect of climatic shocks remain a global threat with Africa including Nigeria bearing the major burden due to heavy reliance on rainfed agriculture, limited adaptive capacity, high poverty and socioeconomic vulnerability, environmental degradation, rapid population growth, conflict and insecurity. FEWS NET, 2022 emphasized that climatic change reduces food supply which in turn drives up food prices and weakens households' purchasing power. This aligns with Omokaro *et al.* (2025) who reported that climate-induced shocks are intensifying the food security crisis. It is worthy to note that Nigerian Government has launched several valuable programs such as irrigation schemes, watershed restoration, and the development of climate-smart seed varieties alongside policy frameworks aimed at addressing climate-related shocks. However, their effectiveness has been limited by persistent implementation challenges including underfunding, insecurity and low adoption at the grassroots level.

Although numerous scholars have explored the broad impacts of climatic change, only a limited number have specifically analyzed the effects of climatic shocks on food security in Nigeria (Emagha, 2025; Sambo and Sule, 2023; Gittard, 2023; Ogar *et al.*, 2025; Akinkuolie *et al.*, 2025). Moreover, there remain a significant gap in literature regarding the magnitude and directional effect of these climatic shocks on food security, particularly in the semi-arid Sahelian savanna of the Northeast region. Hence the specific objectives of this study were designed to address this gap and contribute meaningfully to the existing body of knowledge.

The specific objectives of the study are to:

- describe socio economic characteristic of respondents in the study area'
- analyze food security status of respondents in the study area
- examine the effect of climatic shocks on food security in the study area

METHODOLOGY

This study was conducted in Northeast Nigeria. It is one of the six regions of the country and comprises six states: Borno, Yobe, Bauchi, Gombe, Adamawa and Taraba. Geographically, it is the largest region covering nearly one third of Nigeria's total land area. The region spans two major ecological zones: the semi-arid sahelian savanna in the northern part and the tropic west sudanian savanna in the south. Climatically, Northeast Nigeria experiences high temperature throughout the year with a short rainy season typically occurring between June and September, characterized by brief but intense rainfall. The population is predominantly Fulani, except in Borno State where Kanuri people constitute the majority. The economy of the region is primarily agrarian with most inhabitants engaged in farming and livestock rearing. Key crops cultivated include millet, wheat, sorghum, beans, groundnut and maize. Despite its agricultural potential, the region faces multiple challenges that hinder productivity. These include climatic shocks, land degradation, persistent insecurity due to insurgency and communal conflicts all of which have significantly worsened food security in the area.

This study utilised pooled secondary data drawn from the six states that make up Northeast Nigeria: Adamawa, Bauchi, Gombe, Taraba, Yobe, and Borno. A total of 814 respondents were included in the analysis. However, the distribution of the sample across states was not uniform based on the severity of security challenges being experienced in some parts of the region. The sampling percentages for each state were as follows: Adamawa (28.75%), Bauchi (27.64%), Gombe (16.34%), Taraba (13.14%), Yobe (8.48%), and Borno (5.65%**)**.

The higher representation of Adamawa and Bauchi states in the sample may be attributed to their relatively stable security conditions and better accessibility compared to other states in the region. These two states have experienced fewer disruptions from insurgency and are generally more accessible to field researchers and survey teams, enabling more robust data collection.

In contrast, the lower representation from Borno and Yobe states is likely due to ongoing security challenges such as armed conflict, insurgency, and displacement, which have made many areas within these states unsafe and inaccessible for fieldwork. As reported by various humanitarian and security agencies, large portions of Borno and parts of Yobe remain under severe threat from Boko Haram insurgency and related insecurity (UNOCHA, 2023). These limitations have inevitably constrained field activities and reduced the effective sampling coverage in these locations.

However, the unequal sampling size across states, while not ideal, reflects the real-world operational difficulties in conflict-affected zones and does not necessarily indicate sampling bias. Instead, it underscores the challenges of conducting empirical research in volatile regions.

This study utilised secondary data from General Household Survey (GHS) wave 5, obtained from National Bureau of Statistics (NBS). Relevant variables extracted for analysis include climatic shock indicators such as erratic rainfall, flooding, drought and extreme temperature exceeding 40^0C as well as responses to food-insecurity related questions

This study employed Binary logistic regression to analyze the influence of climatic shocks on food security in study area. The food security (dependent variable) was captured using Household Food Insecurity Experience Scale (HFIES) methodology developed by the food and Agriculture Organization (FAO). The HFIES composed eight standardized questions that captured self-reported food related behavours and experience associated with increasing level of food insecurity over a recall period (12 months). Each question is binary coded, where Yes=1 and No=0. The total HFIES score ranges from 0 to 8 and higher scores indicate more severe food insecurity. Following the classification guideline provided by FAO (2021), households were grouped into four major categories: Food Secure(Score=0), Mildly food insecure(Score=1-3), Moderately food insecure(Score=4-6), Severely food insecure(score=7-8).Moreover, for the purpose of binary analysis, a dummy variable was created thus as: household with an HFIES score of Zero were regarded as being food secure(food secure=1) while households with a score of one or more were categorized as being food insecure(food insecure=0). However, the independent variables (climatic shocks: irregular rain, drought, high temperature (>40^0C) and flood) were also captured as dummy. Therefore, the binary logistic model is explicitly specified as:

$$\text{Logit}(P_i) = In\left(\frac{P_i}{1-P_i}\right) = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where:

P_i = probability that household i is food secure
X_1 = irregular rainfall
X_2 = flood
X_3 = drought
X_4 = very high temperature (>40^0C)

β_o = intercept
β_1 to β_4 = coefficients of independent variables
ε_i = error term

RESULTS AND DISCUSSION

Socioeconomic and climatic shocks demography

The socio economic and climatic Shock variables in Table 1 showed that most of the respondents were male household head (86.86%), married (83.23%) and lived in rural area (84.89%). The mean household size and household head age were estimated at 7.15 and 50.42 years, respectively. This household size is notably higher than the national average of 4.7 to 5.0 persons per household (World Bank, 2021), indicating that families in the study area tend to be larger. The average age of household heads suggests that many are middle-aged to older adults, which may reflect a pattern of youth migration to urban areas, leaving older individuals to manage rural households. This demographic structure places a significant burden of food provision on aging household heads and may heighten their vulnerability to food insecurity, particularly under conditions of economic hardship, rising food prices, and increasing exposure to climate shocks. Furthermore, the key climatic shocks reported by respondents in the study area include flooding (13.39%), irregular rainfall (14.00%), extreme heat above 40°C (12.65%), and drought (35.63%). Among these, drought emerged as the most prevalent, affecting more than one-third of the surveyed population. This high incidence highlights the region's growing susceptibility to extended periods of dry weather. According to Gbefo and Attigah (2022), average rainfall across Northern Nigeria has declined significantly, especially in the core Sahelian zone. Similarly, UNDP Nigeria (2022) highlighted that the Northeast region is experiencing more frequent and intense drought episodes, driven by global warming and deforestation. Collectively, these climatic shocks have led to a decline in agricultural productivity, increased food insecurity, and greater vulnerability for both human populations and livestock in the region

Table 1: Socioeconomic and climatic shocks demography

Variable		Frequency	Percentage	Mean
Household head sex	Male	707	86.86	
	Female	107	13.14	
Sector	Rural	691	84.89	
	Urban	123	15.11	
Marital status	Single	24	2.29	
	Married	675	83.23	
	Widow/widower	94	11.59	
	Divorced	18	2.22	
Household size	<=4	197	24.20	7.15
	5-8	375	46.07	
	>8	242	29.73	
Household head age	<=40	212	26.04	50.42
	41-50	216	26.54	
	50-60	216	26.54	
	>60	170	20.88	
Flood shocks	Yes	109	13.39	
	No	705	86.61	
Irregular rains	Yes	114	14.00	
	No	700	86.00	
Very high temperature ($>40^0$C)	Yes	103	12.65	
	No	711	87.35	
Drought	Yes	290	35.63	
	No	527	64.37	

Source: Data Analysis 2025

Figure 1 revealed that most of the respondents (81.57%) in the Northeast Nigeria were food insecure while only 18.43% were food secure. In order words, less than one fifth of the population sampled were food secure. This suggests that most respondents in that region did not have consistent access to adequate, safe and nutritious food required for maintaining a healthy and active life. Several interconnected factors such as notably prolonged insurgency, recurrent climatic shocks and widespread poverty contributed to the high rate of food insecurity observed in the region. Apart from these aforementioned factors, another one of the most immediate and impactful is national food inflation**,** which has drastically eroded household purchasing power. The period during which the

survey data was collected (2023/2024) coincided with a nationwide spike in food prices, a crisis that reached critical levels in 2024**,** triggering widespread "hunger protests" across several Nigerian states (Abati, 2024). As food prices soared, especially for staples like rice, maize, and beans, low-income households in Northeast Nigeria were disproportionately affected, pushing many below the threshold of food security.

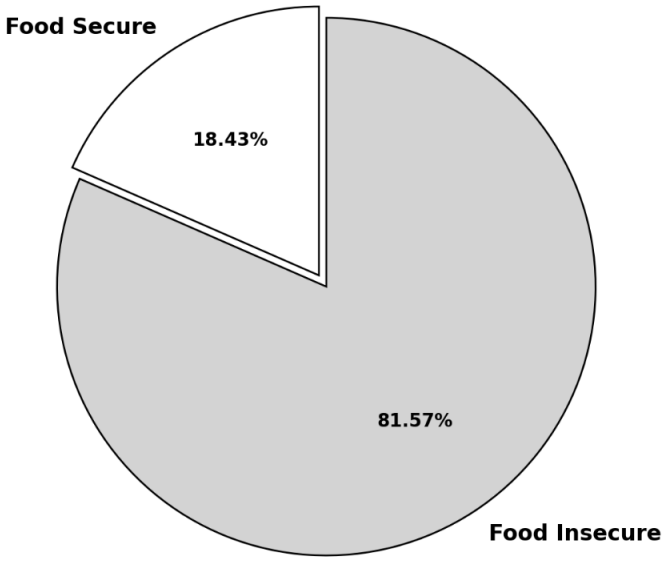

Figure 1: Food security status among Northeast households
Source: Data Analysis 2025

Effects of climatic shocks on food security in Northeast Nigeria

Table 2 showed how climatic shocks (Irregular rainfall, floods, droughts and very high temperature) among respondents in the study area influenced food security in the study area. It is obvious from Table 2 that irregular rainfall, droughts and very high temperatures above 40^0C negatively impacted food security. This suggests that as the frequencies of aforementioned climatic shocks increase in the study area, there will be probability or likelihood that food security will reduce. In order words, climatic shocks experienced by respondents in Northeast Nigeria significantly posed a serious threat on food security. Results from Table 2 showed that a one-unit increase in exposure to irregular rainfall is associated with a 13.78% average decrease in the probability of a household being food secure, holding other variables constant. This relationship is statistically significant at the 5% level, suggesting that erratic rainfall is a critical determinant of food security in Northeast Nigeria. This finding aligns with expectations, as irregular rainfall often disrupts planting and harvesting schedules, reduces access to pasture for livestock, and contributes to increased food prices and reduced access to food (FEWS NET, 2022). In support of this, Gbefo and Attigah (2022) reported that rainfall in Northern Nigeria has declined by roughly 20% during key growing seasons over the past two decades, posing significant threats to agricultural output and the sustainability of rural livelihoods. In addition, a 2025 regional study revealed that agricultural productivity decreases by 12–18% in response to rainfall variability, thereby exacerbating food insecurity. It is important to note that rainfall variability directly affects soil moisture availability, which is essential for crop germination, growth, and yield. As highlighted by Gbefo and Attigah (2022), the consequence of such climatic disturbances is often complete crop failure or severely reduced yields.

Drought shocks were found to have a significant negative impact on food security in the study area. As presented in Table 2, a one-unit increase in drought exposure reduces the probability of being food secure by an average of 15.55%, holding other variables constant. This relationship is highly statistically significant at the 1% level. These findings align with Gittard (2023), who observed that experiencing a drought reduces agricultural yields by approximately 14% and lowers dietary diversity by 1%. Similarly, Akinkuolie *et al.* (2025) reported that droughts significantly diminish crop productivity and exacerbate food insecurity, especially in Nigeria's semi-arid northern zones where rain-fed agriculture predominates. Notably, a 15.55 percent reduction in the likelihood of being

food secure suggests that approximately one in every six households could fall into food insecurity as a result of drought, which represents a serious and alarming outcome. This has cascading effects on household nutrition, livelihoods, and adaptive resilience, particularly in conflict-affected regions of Northeast Nigeria. Therefore, it is crucial to prioritize climate adaptation strategies that specifically address food insecurity caused by drought in the region, as this remains an urgent policy concern.

Furthermore, result revealed that very high temperature (>40^{0}C) negatively impacted food security among respondents in the study area. Result from Table 2 showed that a unit increase in exposure to extreme heat (>40 °C) reduces the chance of being food secure by 18.08% on average. This is consistent with Akinkuolie *et al.* (2025) findings that a 1 °C increase in temperature can reduce cereal crop yields by 10–15%, intensifying food insecurity especially in arid and semi-arid zones like Northeast Nigeria. Similarly, assessment by Oderinde *et al.* (2022) confirmed that rising temperatures are among the most influential factors destabilizing food availability and affordability in Nigeria. It is important to note that the effects of rising temperatures are not limited to agriculture; they also extend to livestock rearing, another critical livelihood activity in Northern Nigeria. Heat stress reduces livestock productivity, affecting weight gain, reproduction rates, and milk production, thereby reducing food diversity access and food security among respondents in the study area.

Table 2: Effects of climatic shocks on food security in Northeast Nigeria

Climatic Shocks	Dy/dx of Food Security Coefficient	P>|z|
Irregular rain	-0.1278**	0.015
Floods	0.2418	0.639
Droughts	-0.1551***	0.000
Very high temperature (>40^{0}C)	-0.1808**	0.021
Number of observations = 814		
LR chi2(4) = 53.32		
Prob > chi2 = 0.0000		
Log likelihood = -362.28327		
Pseudo R2 = 0.0685		

Note: The number of observations is 814 with **, *** statistically significant at 5% and 1% level, respectively.
Source: Data Analysis 2025

CONCLUSION AND RECOMMENDATIONS

The study concluded that the majority of respondents were middle-aged to older male household heads, predominantly married and residing in rural areas, with an average household size larger than the national norm. Among the climatic shocks reported, drought emerged as the most prevalent, highlighting its significance in the region. Furthermore, less than one-fifth of the respondents were food secure, with climatic factors such as irregular rainfall, extreme heat, and drought found to have significant and negative effect on food security in the study area.

Based on the findings of this study, it is therefore recommended that:

- Respondents should be trained and retrained in climate smart agricultural practices that include cultivation of climate-resilient crop varieties, soil and water conservation, improved agronomic practices, agroforestry, afforestation and use of technology and information like mobile weather alerts and climate forecasts.
- Government and stakeholders should strengthen early warning and response systems by expanding Nigerian Meteorological Agency (NIMET's) localized weather forecasting services and integrating them with farmers' cooperatives
- Governments and relevant stakeholders should target social safety nets to climate-vulnerable zones by prioritizing food and cash aid to areas with high drought and temperature stress.

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