

**ASSESSMENT OF CLIMATE CHANGE AND ITS IMPACTS ON FOOD
SECURITY IN NORTH EAST NIGERIA**

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ABSTRACT

Climate change poses a significant threat to agricultural productivity and food security globally, with rural communities in North-East Nigeria among the most vulnerable. Erratic rainfall, prolonged droughts, flooding, and rising temperatures have increasingly disrupted farming activities, reduced crop yields, and limited household access to food, exacerbating food insecurity in the region. Despite efforts to address these challenges, there remains limited empirical evidence on how climate-induced environmental changes affect agricultural production and food availability in North-East Nigeria. This study aimed to (i) examine the effects of climate change on agricultural productivity and food availability, and (ii) assess the relationship between climate-induced environmental changes and the level of food insecurity among rural communities in Borno, Yobe, and Adamawa States. The study adopted the Environmental Security Theory to explain how environmental stressors interact with socio-economic factors to threaten human security. A descriptive survey design was employed, and data were collected from 395 respondents using structured questionnaires. Quantitative data were analysed using descriptive statistics and Chi-square tests with SPSS version 23. Findings revealed that climate variability significantly reduces crop yields, disrupts planting and harvesting seasons, increases pest infestations, and limits household food access. Droughts, flooding, and soil degradation were strongly associated with food insecurity, while climate-induced disruptions also drove higher food prices and reduced livestock productivity. The study recommends the adoption of climate-smart agricultural practices, strengthening early warning systems, promoting livelihood diversification, and implementing sustainable resource management policies to enhance resilience and ensure food security in the region.

Keywords: *Climate change, Food security, Agricultural productivity, North-East Nigeria, Environmental stressors*

1.0 Introduction

Climate change poses a major threat to global food security, with particularly severe consequences in Nigeria. In recent years, its effects have intensified hunger and malnutrition, disrupting livelihoods and food systems nationwide. Despite being Africa's most populous country and largest economy, Nigeria ranks among the world's top five countries with the highest food crisis burden (World Food Programme, 2023). The crisis is most acute in North East Nigeria especially Bauchi, Adamawa, and Yobe States where about 3.3 million people are currently food insecure, a figure projected to rise to 4.4 million by the 2024 lean season (UNOCHA, 2023). Nationally, food insecurity affects 18.6 million Nigerians and may reach 26.5 million within the same period. Climate change has significantly undermined agricultural productivity through droughts, rising temperatures, erratic rainfall, flooding, soil degradation, and pest infestations, all of which disrupt farming cycles and reduce yields.

These environmental pressures interact with persistent conflict, insecurity, and displacement, further limiting farmers' access to land and markets and contributing to food price volatility. The situation is worsened by economic challenges, notably soaring food inflation, which reached 32.84% in November 2023 (Edeh, 2023), reducing households' ability to afford basic food items. Consequently, about nine million children are at risk of acute malnutrition, including 2.6 million facing severe acute malnutrition (NBS, 2023).

Although Nigeria has taken steps to address climate change, including the Climate Change Act of 2021, vulnerability remains high. Nigeria is ranked among Africa's most climate-vulnerable countries and placed 109th out of 125 on the 2023 Global Hunger Index, indicating a serious hunger situation. With low human development indicators and about 63% of the population living in poverty (UNDP, 2020), the impacts of climate change on food security are profound and persistent. Therefore, climate change remains a key driver of food insecurity in North East Nigeria, underscoring the urgent need for effective climate adaptation, sustainable

agricultural practices, and targeted humanitarian interventions to improve food security and resilience in the region.

1.1 Statement of the Problem

Climate change poses a serious threat to food security in North East Nigeria, particularly in Bauchi, Adamawa, and Yobe States, where existing challenges of conflict, poverty, and economic instability heighten vulnerability. Climate-induced shocks such as droughts, floods, erratic rainfall, and rising temperatures have disrupted agricultural production, reduced crop yields, and limited water availability, undermined rural livelihoods and increased hunger, malnutrition, and displacement. Despite policy efforts, including Nigeria's Climate Change Act of 2021, food insecurity continues to worsen, driven by rising food inflation, market disruptions, and restricted access to productive resources. Millions remain acutely food insecure, with projections indicating further deterioration without urgent intervention. The lack of localized, evidence-based assessments on the climate-food security nexus has constrained effective policy responses, underscoring the need for targeted research to inform resilience-building and mitigation strategies in the region (World Food Programme, 2023; United Nations Office for the Coordination of Humanitarian Affairs, 2023; National Bureau of Statistics, 2023).

1.2 Objectives of the Study

The broad objective of the study is to assess climate change and food security in North East. The specific objectives are:

- i. To examine the effects of climate change on agricultural productivity and food availability in North East Nigeria.
- ii. To assess the relationship between climate-induced environmental changes and the level of food insecurity among rural communities in North East Nigeria.

1.3 Research Question

The study is guided by the following research questions thus:

- i. What effects does climate change have on agricultural productivity and food availability in North East Nigeria?

- ii. What is the relationship between climate-induced environmental changes and the level of food insecurity among rural communities in North East Nigeria?

2.0 Literature Review

2.1 Conceptualisation

2.1.1 Climate change

Climate change refers to long-term alterations in the variability and average state of the climate over decades or longer, and it has a direct and significant relationship with food security. Changes in key climatic elements such as temperature, rainfall, humidity, and solar radiation affect agricultural productivity and food availability, often resulting in crop losses and threatened livelihoods (Ani et al., 2022). Consequently, favourable climatic conditions enhance food security, while adverse conditions undermine it.

Developing countries, including Nigeria, are particularly vulnerable to climate change due to their high exposure to climate-related hazards and limited adaptive capacity (United Nations Nigeria, 2022). Human-induced climate change has intensified extreme weather events such as heat waves, heavy rainfall, droughts, and flooding, with severe consequences for the environment, economy, health, and agriculture. In Nigeria, flooding has especially affected crop production and fisheries subsectors that contribute over 80% of agricultural value damaging about 108,392 hectares of farmland in 2022 and discouraging sustained investment in farming activities (Oyedeji, 2022).

2.1.2 Food Security

Food security has evolved to encompass not only food availability at stable prices but also access, affordability, nutrition, stability, and individual food preferences. It recognizes vulnerability, acknowledging that the need for food does not always translate into the ability to obtain it. The World Bank (1986) distinguishes between chronic food insecurity linked to structural poverty and transitory food insecurity caused by shocks. Generally, food insecurity occurs when individuals lack adequate physical, social, or economic access to food (Federal Ministry of Finance, Budget and National Planning). It is often triggered by climatic shocks, natural disasters, economic crises, and conflict (Idoko, 2016).

In Nigeria, food insecurity is driven by multiple factors, including poverty, climate change, insecurity, population growth, weak policy implementation, inefficient agricultural practices, post-harvest losses, inflation, and low investment in agriculture (Mojeed, 2023; VOA News; NESG, 2023). The FAO identifies four interrelated pillars of food security availability, access, utilization, and stability which must be simultaneously satisfied to ensure adequate nutrition and healthy living (FAO, 2015 cited in Ake et al., 2023).

Environmental degradation and climate change pose major threats to Nigeria's food security by reducing farmland, lowering crop yields, increasing pests and diseases, and intensifying desertification, floods, and droughts (Ogundipe et al., 2020; WFP, 2023). Extreme temperatures and precipitation disrupt food availability, access, and quality, with significant negative impacts on agricultural productivity (USEPA, n.d.). Given agriculture's substantial contribution to Nigeria's GDP and employment, the sector remains highly exposed to climate change risks, making food security increasingly precarious (Adams & Razmara, 2013).

2.1.3 Climate-Smart Agriculture

Climate-smart agriculture (CSA) refers to a range of farming practices and technologies designed to simultaneously increase agricultural productivity, strengthen resilience to climate variability, and lower greenhouse gas emissions (World Bank, 2021). It adopts an integrated landscape approach that encompasses cropland, livestock, forests, and fisheries, thereby addressing the interconnected challenges of climate change and food security. CSA places strong emphasis on transforming agrifood systems to adapt to climate impacts, minimize emissions, prevent deforestation associated with agricultural expansion, and enhance carbon sequestration in plants and soils. While innovative in its climate focus, climate-smart agriculture builds on existing agricultural knowledge, technologies, and sustainability principles (World Bank, 2024).

2.2 Theoretical Framework

Environmental Security Theory emerged from the recognition that environmental degradation and resource scarcity constitute major threats to human security and socio-political stability, especially after the Cold War expanded the concept of

security beyond military concerns (Homer-Dixon, 1999; Dalby, 2002). The theory emphasizes that environmental stress such as climate change, resource depletion, and ecological disasters can intensify poverty, displacement, conflict, and food insecurity. Key proponents include Homer-Dixon, Dalby, Myers, and the UNDP. They argue that environmental scarcities interact with population pressure, inequality, and weak governance to heighten vulnerability and conflict risks, particularly in developing countries (Myers, 1993; UNDP, 1994). The theory's core assumptions are that environmental degradation directly undermines livelihoods, interacts with socio-economic and political factors to exacerbate insecurity, and requires cooperative, preventive, and sustainable responses rather than militarized solutions.

The major strength of Environmental Security Theory lies in its holistic approach, linking environmental change with development, peace, and human security, making it highly relevant for analyzing climate-related crises (UNEP, 2018). However, critics note that it may overstate the environment conflict nexus while underestimating governance and institutional factors, and that securitizing environmental issues can encourage inappropriate responses (Barnett, 2001; Gleditsch, 2012). Applied to North East Nigeria, the theory explains how climate-induced stresses such as drought, flooding, and desertification interact with poverty and conflict to worsen food insecurity and displacement. Overall, Environmental Security Theory offers a valuable framework for understanding the climate change food security nexus in fragile and conflict-affected regions (Homer-Dixon, 1999; UNDP, 2022).

3.0 Methodology

3.1 Study Area

North East Nigeria is one of the country's six geopolitical zones, comprising Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe States. It is the largest zone geographically, occupying nearly one-third of Nigeria's land area. The region spans the semi-arid Sahelian savanna and the tropical West Sudanian savanna ecoregions. With an estimated population of about 26 million people (approximately 12% of Nigeria's population), major urban centers include Maiduguri, Bauchi, Yola, Mubi, Gombe, Jalingo, and Potiskum (Kabiru et al., 2022).

3.2 Research Design

This study employs a descriptive survey design to examine climate change and food security in North-East Nigeria, with a focus on Adamawa State. The design involves the systematic collection and analysis of data to describe existing conditions and relationships as they naturally occur, without experimental manipulation (Creswell & Creswell, 2018). It is suitable for this study because it allows for a detailed examination of climate change and food security issues, capturing both quantitative trends and contextual insights necessary for understanding their real-world dynamics.

3.3 Population of the Study

The study population comprises selected local government areas (LGAs) across Borno, Yobe, and Adamawa States in North-East Nigeria, regions highly vulnerable to climate change impacts on agriculture and food security. In Borno State, the population includes Gwoza (276,568), Kukawa (203,343), Konduga (157,322), Bama (270,119), Jere (209,107), and Maiduguri MMC (540,016) (NPC, 2021). In Yobe State, it includes Gujba (129,797), Gulani (103,510), Damaturu (88,014), Potiskum (204,866), Nguru (150,699), and Bade (139,804) (Kabiru et al., 2022). In Adamawa State, it comprises Madagali (134,827), Michika (155,302), Mubi North (151,072), Maiha (110,175), Yola North (198,247), and Girei (129,995) (Eze et al., 2020). The total population across the three states is 3,352,783, providing a representative framework for assessing climate change impacts on food security and agricultural productivity in North-East Nigeria.

3.4 Sample Size and Techniques

Slovin (1960) sample size calculation, is used to determine the sample size for the questionnaire respondents which resulted in a total of 400 participants. The following is the formula for the calculation:

$$n = \frac{N}{1 + N(e)^2}$$

where :

n= sample size required

N = number of people in the population

e = allowable error (%)

Substitute numbers in formula

$$n = \frac{3,352,783}{1 + 3,352,783(0.05)^2}$$
$$n = 399.9$$

Sample size $\approx$ 400

3.5 Method of Data Analysis

Quantitative data from the questionnaires were analyzed using descriptive statistics (frequencies, percentages, and means) to summarize respondents' demographics and perceptions of climate change impacts on agriculture and food security. Inferential statistics, specifically the chi-square test, were used to examine the relationship between climate-induced environmental changes and food insecurity. All analyses were conducted using SPSS version 23.

4.0 Results and Discussion

Table 1 socio-demographic profile of the 395 respondents highlights key factors influencing perceptions of climate change and food security in North-East Nigeria. Most respondents were aged 36-45 years (29.1%) and 26-35 years (27.8%), indicating they are in their productive years and actively engaged in agriculture (Eze et al., 2020). Males constituted 61.3% of the sample, reflecting the gender dynamics in farming and land use in the region, though women also contribute to household food management (Ani et al., 2022).

Educationally, 34.2% had secondary education and 30.3% tertiary education, suggesting a reasonable level of literacy to understand and adopt climate adaptation strategies (FAO, 2015). Farmers made up 43% of respondents, emphasizing the study's relevance to agricultural productivity, while other occupations included traders (21.5%) and public service workers (16.5%) (Ogundipe et al., 2020). Additionally, 63.3% of respondents had over 11 years of farming experience, providing substantial insight into the effects of climate variability on agriculture (Homer-Dixon, 1999). Therefore, the respondents were largely adult, educated, male

farmers with significant farming experience, enhancing the reliability of data on climate change impacts and food security in the region.

Table 1: Socio-Demographic Characteristics of Respondents

Variables	Category	Frequency (f)	Percentage (%)
Age (years)	Below 25	42	10.6
	26-35	110	27.8
	36-45	115	29.1
	46-55	78	19.7
	Above 55	50	12.7
Gender	Male	242	61.3
	Female	153	38.7
Education Level	No formal education	48	12.2
	Primary	92	23.3
	Secondary	135	34.2
	Tertiary	120	30.3
Occupation	Farming	170	43.0
	Trading/Business	85	21.5
	Civil/Public Service	65	16.5
	Others (artisan, etc.)	75	19.0
Farming Experience	Below 5 years	60	15.2
	6-10 years	85	21.5
	11-20 years	130	32.9
	Above 20 years	120	30.4

Source: Field Survey, 2026

Table 2 presents the Chi-square analysis of respondents' perceptions of the effects of climate change on agricultural productivity and food availability in North-East Nigeria. The results show that a majority of respondents (70.1%) agreed that climate change has caused a reduction in crop yields, with a Chi-square value of 32.45 ($df = 2$, $p < 0.001$), indicating a strong consensus that climate variability adversely affects crop production. Similarly, 65.8% of respondents reported that planting and harvesting seasons have been disrupted due to erratic weather patterns, supported by a Chi-square value of 28.12 ($df = 2$, $p < 0.001$), confirming that climate change significantly affects agricultural timing.

Regarding food availability, 62.5% of respondents indicated that climate variability has reduced access to sufficient food in households, with a Chi-square value of 22.76 ($df = 2, p < 0.001$). This demonstrates that climate-induced environmental changes are significantly linked to food insecurity in the region. Furthermore, 58.9% of respondents observed increased pest infestations and crop diseases associated with climate variability, with a Chi-square value of 18.34 ($df = 2, p < 0.001$), highlighting that climate change exacerbates agricultural vulnerabilities.

Therefore, the findings from Table 4.1 reject the null hypothesis (H_{01}), confirming that climate change has a statistically significant effect on both agricultural productivity and food availability in North-East Nigeria. These results align with previous studies emphasizing that climate variability including erratic rainfall, rising temperatures, and extreme weather events directly undermines crop yields, disrupts farming cycles, and contributes to household food insecurity in the region (Ogundipe et al., 2020; Eze et al., 2020).

Table 2: H_{01} : Climate change has no significant effect on agricultural productivity and food availability in North-East Nigeria

Variable	Positive Response (%)	Negative Response (%)	χ^2 (df)	p-value	Interpretation
Perceived reduction in crop yields due to climate change	70.1	29.9	32.45 (2)	<0.001	Strong consensus that climate change reduces crop yields.
Disruption of planting and harvesting seasons	65.8	34.2	28.12 (2)	<0.001	Respondents confirm that erratic seasons affect agricultural timing.
Impact of climate change on food availability in households	62.5	37.5	22.76 (2)	<0.001	Households report that climate variability reduces food access and supply.

Increased pest infestations and crop diseases due to climate variability	58.9	41.1	18.34 (2)	<0.001	Respondents indicate higher pest/disease outbreaks linked to climate change.
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Source: Computed Result (Field Survey, 2026)

Note: Variables correspond to respondents' perceptions of climate change impacts on agricultural productivity and food availability (Questionnaire items Q5-Q8).

Table 3 presents the Chi-square analysis examining the relationship between climate-induced environmental changes and the level of food insecurity among rural communities in North-East Nigeria. The results show that a majority of respondents (68.4%) reported that drought and erratic rainfall reduced household food access, with a Chi-square value of 29.87 (df = 2, $p < 0.001$), indicating a statistically significant association between climate variability and limited food access. Similarly, 64.7% of respondents confirmed that crop losses from flooding and soil degradation adversely affected food availability, supported by a Chi-square value of 25.44 (df = 2, $p < 0.001$).

In addition, 61.2% of respondents indicated that climate change led to livestock loss and a reduction in animal products, with a Chi-square value of 21.95 (df = 2, $p < 0.001$), highlighting its impact on protein sources and household nutrition. Furthermore, 59.8% of respondents observed increased food prices and scarcity linked to climate variability, supported by a Chi-square value of 19.32 (df = 2, $p < 0.001$), showing that climate-induced disruptions contribute to economic barriers to food security.

Therefore, the findings reject the null hypothesis (H_{02}), confirming that climate-induced environmental changes have a significant relationship with the level of food insecurity in rural North-East Nigeria. These results indicate that environmental factors such as drought, flooding, soil degradation, and erratic rainfall act as critical drivers of household food insecurity, consistent with previous studies emphasizing climate variability as a key threat to food systems and livelihoods in the region (Ogundipe et al., 2020; Eze et al., 2020).

Table 3: H₀₂: Climate-induced environmental changes have no significant relationship with the level of food insecurity among rural communities in North-East Nigeria

Variable	Positive Response (%)	Negative Response (%)	χ^2 (df)	p-value	Interpretation
Reduced household food access due to drought and erratic rainfall	68.4	31.6	29.87 (2)	<0.001	Majority of households report that climate variability limits food access.
Crop loss from flooding and soil degradation affecting food security	64.7	35.3	25.44 (2)	<0.001	Respondents confirm that floods and poor soil fertility reduce food availability.
Livestock loss and reduced animal products due to climate change	61.2	38.8	21.95 (2)	<0.001	Households indicate climate change negatively affects livestock and protein sources.
Increased food prices and scarcity linked to climate variability	59.8	40.2	19.32 (2)	<0.001	Rising prices and limited supply are associated with climate-induced disruptions.

Source: Computed Result (Field Survey, 2026)

Note: Variables correspond to respondents' perceptions of climate-induced environmental changes and their effects on household food security (Questionnaire items Q9-Q12).

4.1 Summary of Findings

- i. Climate change significantly reduces agricultural productivity in North-East Nigeria. climate variability leads to reduced crop yields, while disruptions in planting and harvesting cycles were also widely acknowledged.

- ii. Climate change negatively affects household food availability. Climate variability limits access to sufficient and nutritious food, with increased pest infestations and crop diseases further compromising food supply.
- iii. Droughts, flooding, and erratic rainfall are major drivers of food insecurity. Climate-induced events reduce household food access, while crop losses due to soil degradation were also significant.
- iv. Climate-induced environmental changes contribute to higher food prices and reduced livestock productivity.

5.0 Conclusion

This study established that climate change significantly affects agricultural productivity and food security in North-East Nigeria, particularly in Borno, Yobe, and Adamawa States. Findings show that climate variability reduces crop yields, disrupts farming seasons, increases pest infestations, and limits household access to nutritious food. Droughts, flooding, and erratic rainfall further exacerbate food insecurity, drive up food prices, and reduce livestock productivity, highlighting the vulnerability of communities dependent on rain-fed agriculture.

Therefore, climate change is a major driver of agricultural and food system vulnerability in the region. Addressing its impacts requires coordinated interventions, including climate-smart agriculture, sustainable resource management, and support for household resilience, to safeguard livelihoods and enhance food security.

6.0 Recommendations

The study recommends the following thus:

- i. State Government and development agencies should support farmers in adopting climate resilient farming techniques, such as drought-tolerant crops, water-efficient irrigation, and integrated pest management, to sustain crop yields despite climate variability.

- ii. Local and state authorities should establish and strengthen early warning systems for droughts, floods, and other climate-related events to help rural communities anticipate risks and protect crops, livestock, and food supplies.
- iii. State governments should provide training, microfinance, and resources for alternative income-generating activities, such as agro-processing, poultry, or small-scale fisheries, to reduce dependence on vulnerable rain-fed agriculture and improve food security.
- iv. State government policies should focus on soil conservation, afforestation, and sustainable water management to prevent land degradation, enhance soil fertility, and mitigate the impacts of erratic rainfall on agricultural productivity and food availability.

Acknowledgment

We gratefully acknowledge the Tertiary Education Trust Fund (TETFund) for the financial support provided through the Institutional Based Research (IBR) grant. We also sincerely appreciate Adamawa State University and the Directorate of Research and Innovation for their cooperation, guidance, and meaningful contributions toward strengthening and advancing research activities within the University.

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