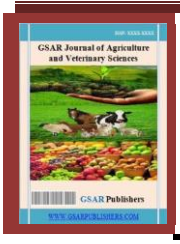

GSAR Journal of Agriculture and Veterinary Sciences
ISSN: 3048-9075 (Online)
Abbreviated key title: Glob.J. Agri.Vet.Sci.
Frequency: Monthly
Published By GSAR Publishers
Journal Homepage Link- https://gsarpublishers.com/journal-gjavs-home/

IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN AGATU LOCAL GOVERNMENT AREA, BENUE STATE, NIGERIA

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Article History

Received: 15/05/2026
Accepted: 23/05/2026
Published: 26/05/2026

Vol – 3 Issue –5

PP: -88-94

Abstract

Climate change poses a serious threat to agricultural productivity and food security in Nigeria, particularly in rural communities that depend heavily on rain-fed farming systems. This study examines the impact of climate change on agriculture and food security in Agatu Local Government Area of Benue State, Nigeria. Agatu is predominantly agrarian, with smallholder farmers relying on crops such as yam, cassava, maize, rice, and millet for subsistence and income. Using a mixed-methods research design, the study combined household surveys, key informant interviews, and focus group discussions to assess farmers' experiences, adaptation strategies, and food security status. Quantitative data were analyzed using descriptive statistics, while qualitative data were examined through thematic analysis. The findings reveal that erratic rainfall, flooding, agricultural drought, and increased pest infestations are the most significant climate-related challenges affecting agricultural productivity in the area. The results further indicate widespread food insecurity, with the majority of households experiencing inadequate food availability, limited access, poor utilization, and unstable food supplies throughout the year. Although farmers have adopted coping strategies such as crop diversification, the use of early-maturing crop varieties, agroforestry, and cooperative farming, the adoption of improved irrigation systems remains limited due to high costs and inadequate technical support. The study concludes that climate change has significantly undermined agricultural sustainability and food security in Agatu. It recommends the promotion of climate-smart agricultural practices, the expansion of irrigation infrastructure, improved access to extension services, and supportive policies aimed at strengthening farmers' adaptive capacity and resilience to climate change.

Keywords: *Adaptation strategies; Agriculture; Climate change and Food security.*

INTRODUCTION

Climate change has become a global phenomenon with significant implications for various aspects of human and environmental systems. The agricultural sector, a vital component of human survival, is particularly vulnerable to the impacts of climate change due to its dependence on climatic factors such as rainfall, temperature, and humidity. According to the Intergovernmental Panel on Climate Change (IPCC, 2022), climate change poses serious risks to agricultural productivity, especially in developing countries where technological advancements and adaptive capacities are limited. In many developing countries, including Nigeria, agriculture forms the backbone of the economy, providing food, employment, and raw materials for industries (Food and Agriculture Organization of the United Nations [FAO], 2021).

Climate change refers to long-term alterations in temperature, precipitation, wind patterns, and other elements of the Earth's climate system. According to the Intergovernmental Panel on Climate Change (IPCC, 2021), these changes are primarily driven by increased greenhouse gas emissions from anthropogenic activities, such as fossil fuel combustion, deforestation, and industrial processes. Food security 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 food preferences for an active and healthy life (FAO, 2020). It is a critical component of global development and human well-being, and it is commonly assessed through four interconnected dimensions

The impacts of climate change on agriculture include changes in the timing and intensity of rainfall, increased frequency of

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extreme weather events such as droughts and floods, and a rise in average global temperatures (World Bank, 2021). These changes disrupt planting and harvesting cycles, reduce crop yields, and exacerbate food insecurity (United Nation Environmental Programme [UNEP], 2019). Nigeria, as one of the most populous nations in Africa, is particularly at risk due to its reliance on rain-fed agriculture and the limited availability of irrigation systems (International Food Policy Research Institute [IFPRI], 2017).

Climate change also impacts public health, as heatwaves and changing disease vectors contribute to the spread of illnesses such as malaria and cholera (World Health Organization, 2020). The compounding effects of these challenges underscore the need for robust mitigation and adaptation strategies, including investments in renewable energy, climate-resilient infrastructure, and community-based initiatives to build resilience against climate-related risks (IPCC, 2022).

Agatu Local Government Area (LGA) in Benue State, Nigeria, is largely agrarian, with most of its population engaged in subsistence farming. The area is well known for the production of staple crops such as yam, cassava, maize, rice, beans, soybeans, sorghum, millet, beniseed, and melon, which support both local consumption and wider distribution across the country. It also contributes significantly to fish production in Benue State's Zone C, accounting for over 80% of output (Kim et al. 2015). Similarly, it has been identified as an important agricultural hub in the state.

Despite this agricultural potential, the region is increasingly affected by climate change. Farmers report erratic rainfall patterns, prolonged droughts, flooding, high temperatures, and shifting seasonal cycles, all of which have negatively impacted agricultural productivity (Kim et al. 2015). These changes have led to flooded farmlands, crop failures, reduced yields, livestock losses, and increased pest and disease outbreaks contributing to food insecurity and economic instability (Ikpe and Omede, 2025[1]).

In response, adaptation measures such as irrigation development have been suggested to support year-round farming and improve productivity. The area's floodplain, estimated at about 25,000 hectares of alluvial deposits, presents significant potential for irrigation expansion (Ogwumike & Obadeyi, 2018). However, resource-based conflicts, particularly between farmers and herders, further intensify the challenges. Competition over land and water has escalated tensions, often worsened by climate-induced scarcity, while activities such as tree cutting for fish-smoking ovens also contribute to environmental degradation and reduced resource availability (Ikpe & Omede, 2025[2]).

Overall, while Agatu LGA holds strong agricultural potential, the combined effects of climate change and resource conflicts pose serious threats to food security and livelihoods. Addressing these challenges requires integrated strategies such as irrigation development, sustainable land management, and effective conflict resolution mechanisms (Kim et al., 2015).

Statement of the Problem

The agricultural sector in Agatu LGA faces mounting challenges due to climate variability and change. Farmers are grappling with declining crop yields, erratic growing seasons, and a surge in pests and diseases, which collectively undermine food production. These issues are further exacerbated by limited access to modern farming technologies, insufficient extension services, and a lack of adoption of climate-smart agricultural practices (Kim et al., 2015).

The reduced productivity of staple crops has led to widespread food shortages, increased dependence on imported food, and escalating food prices. These developments are straining the local economy and contributing to broader challenges in maintaining the nation's food supply.

Although the impact of climate change on agriculture is widely acknowledged, there is limited empirical research specifically addressing its effects on crop yields and food security in Agatu LGA. This study seeks to address this gap by conducting an in-depth analysis and providing actionable recommendations to mitigate the challenges faced by the region.

Aim and Objectives of the Study

This study aims to examine the effects of climate change on agriculture and food security in Agatu LGA, identify the challenges faced by farmers, and propose strategies to enhance agricultural resilience and ensure sustainable food security. The aim of the study was achieved through the following set objectives: to,

i. Assess the effects of climate change on crop production and food security in the area.
ii. Analyze the relationship between key climate variables (e.g., rainfall and temperature) and agricultural productivity.
iii. Identify the major challenges faced by farmers as a result of climate change.
iv. Propose strategies for mitigating the impacts of climate change and improving agricultural resilience and food security.

Research Questions

i. What are the major climatic factors influencing crop production in Agatu LGA?
ii. How have climate change and climate variability impacted crop yields and food security in the area?
iii. What challenges do farmers face as a result of climate change in Agatu?
iv. What strategies can be implemented to mitigate the effects of climate change and improve agricultural resilience?

The Study Area

Agatu Local Government Area (LGA) lies within the Guinea Savanna ecological zone, characterized by a tropical climate with distinct wet and dry seasons. The area is primarily

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agrarian, with most of its population engaged in subsistence farming. Major crops cultivated include maize, rice, yam, cassava, and millet. Agatu's vulnerability to climate change is heightened by its low-lying terrain, which makes it prone to flooding, and its reliance on rain-fed agriculture. The region is highly vulnerable to climate-related shocks, particularly flooding, which affects farmlands on an annual basis. In addition, unpredictable rainfall patterns disrupt planting and harvesting schedules, thereby threatening both subsistence and commercial agriculture (Kim et al., 2015).

Research Methodology

This study adopts a mixed-methods research design, combining quantitative and qualitative approaches to obtain comprehensive data. The quantitative component involves the use of surveys to collect numerical data, while the qualitative component includes interviews and focus group discussions to gain an in-depth understanding of local perceptions and practices. This approach enhances data triangulation, thereby improving the validity and reliability of the findings.

The study targets smallholder farmers in Agatu LGA, who constitute the majority of the population and are key stakeholders, as they directly experience the impacts of climate change on agriculture. In addition, local leaders, agricultural extension officers, and representatives from relevant governmental and non-governmental organizations involved in climate change and food security initiatives were included in the study population.

A multistage sampling technique was employed to select respondents. In the first stage, Agatu was stratified into five major zones based on geographical location and farming practices. In the second stage, three communities were randomly selected from each zone to ensure adequate representation. In the third stage, systematic sampling was used to select households within the chosen communities, targeting at least 30 households per community. In the final stage, purposive sampling was used to select key informants such as community leaders and extension officers for qualitative interviews. A total sample size of 300 households was determined using Cochran's formula for sample size determination, adjusted for the finite population of the study area.

Quantitative data were collected using structured questionnaires administered to household heads. The questionnaire covered areas such as farming practices, climate change impacts, adaptation strategies, and food security indicators. The instrument was pre-tested in a neighboring Apa LGA to ensure clarity and reliability.

Qualitative data were collected through key informant interviews and focus group discussions (FGDs). Semi-structured interviews were conducted with local leaders, extension officers, and NGO representatives to obtain insights into climate adaptation policies and practices. FGDs were conducted with farmers to explore community-level perceptions and coping strategies. Each discussion group comprised 8–10 participants, ensuring variation in gender, age, and farming experience.

Quantitative data were analyzed using descriptive statistics. Descriptive statistics such as frequencies and percentages were used to summarize demographic and farming characteristics. Qualitative data were analyzed using thematic analysis. Recorded interviews and FGDs were transcribed verbatim, coded, and organized into themes. This process facilitated the identification of recurring patterns and insights into local adaptation strategies.

Results and Discussion

Demographic Characteristics of Respondents

The demographic characteristics of the respondents are presented in Table 1. The results show that the majority of the respondents were smallholder farmers, reflecting the agricultural dependency of the Agatu population.

Table 1: Demographic Characteristics of the Respondents

S/N	Demographic Variable	Frequency (N=300)	Percentage
Gender			
A	Male	180	60
B	Female	120	40
	Age Group (Years)		
A	18-30	50	16.7
B	31-50	170	56.7
C	Above 50	80	26.6
	Educational Level		
A	No Formal Education	70	23.3
B	Primary Education	110	36.7
C	Secondary Education	90	30.0
D	Tertiary Education	30	10.0

Source: Fieldwork, 2025

The demographic characteristics of respondents in Agatu reveal that 60% are male and 40% are female. This reflects a

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common gender gap in agricultural communities, where men often dominate labour and decision-making processes (FAO, 2019). Nevertheless, women play a vital role in food production, household farming activities, and family nutrition (Ikpe, 2021). These gender dynamics highlight the importance of incorporating both men and women in agricultural policy formulation to ensure equitable access to resources, services, and opportunities.

Regarding age distribution, the majority of respondents (56.7%) fall within the 31–50 years category, indicating a relatively experienced and economically active farming population. However, 26.6% are above 50 years of age, suggesting an ageing farming population that may face difficulties in adopting new agricultural technologies. In contrast, only 16.7% of respondents are within the 18–30 years age group, pointing to low youth participation in agriculture. This may be attributed to rural-urban migration, limited access to land and credit, or reduced interest in farming (FAO, 2014). Strengthening youth engagement through training, access to resources, and agricultural incentives is therefore essential for ensuring the sustainability of the sector.

In terms of educational attainment, 36.7% of respondents have primary education, 30% have secondary education, 23.3% have no formal education, and only 10% have tertiary education. This suggests that while a considerable proportion of farmers possess basic literacy skills that can support the adoption of improved agricultural practices and climate adaptation strategies, a significant number still lack formal education. The relatively low level of tertiary education further limits the adoption of modern farming technologies and innovative practices. This underscores the need for continuous adult education, extension services, and capacity-building programmes to enhance agricultural resilience and productivity (Ikpe, 2021).

Table 2: Respondents' Perception of Impacts of Climate Change on Agriculture

S/N	Climate Change Impact	Frequency	Percentage
A	Erratic Rainfall	94	31.3
B	Flooding	79	26.3
C	Drought	71	23.7
D	Increased Pest Infestation	56	18.7
	TOTAL	**300**	**100**

Source: Fieldwork, 2025

Erratic rainfall is the most commonly reported impact of climate change, with 31.3% of respondents identifying it as a major concern (Table 2). The unpredictable distribution of rainfall can severely affect agricultural productivity by disrupting planting and harvesting schedules, leading to reduced yields and, in some cases, crop failure (IPCC, 2021). Erratic rainfall also exacerbates water scarcity, particularly in areas with limited irrigation infrastructure (Lobell et al., 2014), thereby posing a significant threat to food security and agricultural resilience.

Flooding, reported by 26.3% of respondents (Table 2), is another major impact of climate change. Excessive rainfall and rising water levels often result in crop submergence, destruction of infrastructure, and contamination of water sources. Flooding also contributes to long-term soil degradation and declining agricultural land fertility (United Nations Convention to Combat Desertification [UNCCD] 2020). Furthermore, the financial burden associated with recovery and reconstruction places additional pressure on smallholder farmers. The increasing frequency and intensity of flooding correspond with global climate change trends (Behnassi et al. 2016).

Drought is also a significant concern, as reported by 23.7% of respondents (Table 2). Characterized by prolonged periods of low rainfall, drought leads to severe water shortages that negatively affect crop production, livestock, and overall food security (Ikpe, 2021). With climate change increasing the frequency and severity of drought events, agricultural systems are becoming more vulnerable, thereby intensifying the challenges faced by farmers.

Increased pest infestation, reported by 18.7% of respondents, represents another major climate-related challenge (Table 2). Rising temperatures and changing rainfall patterns create favourable conditions for the spread of pests and crop diseases, resulting in significant crop damage and reduced agricultural productivity (Ikpe et al. 2024). The growing prevalence of pest infestations in the region reflects global trends, where climate change is contributing to the expansion and severity of agricultural pests and diseases.

Table 3: summary of Food Security Status: Availability, Access, Utilization, and Stability.

S/N	Food Security Dimension	Status	Frequency (N=300)	Percentage
A	**Availability**	Adequate	80	26.7
		Inadequate	220	73.3
B	**Access**	Sufficient	100	33.3
		Insufficient	200	66.7
C	**Utilization**	Optimal	70	23.3
		Suboptimal	230	76.7

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D	**Stability**	Stable	60	20.0
		Unstable	240	80.0

Source: Fieldwork, 2025

The dimension of food availability (Table 3) reveals that 73.3% of respondents experience inadequate food availability, while only 26.7% report adequate availability. Inadequate food availability may result from low agricultural productivity, poor infrastructure, limited access to markets, and environmental challenges (FAO, 2011). Climate change, economic instability, and poor agricultural practices further aggravate this situation, making a consistent food supply a major concern. Consequently, households experiencing inadequate food availability are often forced to depend on insufficient or less nutritious food sources, thereby increasing the risk of food insecurity (Ikpe & Omede[2]).

Regarding food access, 66.7% of households report insufficient access to food, whereas only 33.3% indicate sufficient access (Table 3). Food access is largely influenced by economic factors such as household income, food prices, purchasing power, and the availability of social safety nets (Kim et al., 2015). In many rural and low-income communities, food may be physically available but remain inaccessible due to poverty, poor transportation systems, and weak market infrastructure. The high proportion of households with insufficient access suggests that economic and market-related barriers are significant contributors to food insecurity in the study area.

In terms of food utilization, 76.7% of households report suboptimal utilization of food resources. Proper food utilization involves appropriate food preparation, storage, processing, and consumption practices that ensure adequate nutritional intake (Ikpe, 2021). Suboptimal utilization may arise from poor dietary diversity, inadequate nutritional knowledge, unsafe water, poor sanitation, and unhealthy feeding practices. This finding highlights the need for improved nutrition education, better dietary practices, and interventions aimed at reducing malnutrition and undernutrition among households.

Food stability is reported as unstable by 80.0% of respondents, indicating inconsistency in food availability, access, and utilization over time. Food security is considered stable when households consistently have access to sufficient, safe, and nutritious food despite fluctuations in production, income, or market conditions (Kim et al. 2015). Food instability may result from seasonal variations, climate change, economic shocks, conflicts, and political instability, often leading to alternating periods of food surplus and scarcity (Ikpe, 2021). Such instability negatively affects long-term nutrition, health, and household well-being, making it difficult for individuals to consistently meet their dietary requirements.

Table 4: **Adaptation Strategies used by Farmers in Agatu**

S/N	Adaptation Strategy	Frequency (N=300)	Percentage
A	Crop Diversification	80	26.7
B	Improved Irrigation	42	14.0
C	Early Maturing Varieties	68	22.7
D	Agroforestry	51	17.0
E	Cooperative Farming	59	19.6
	TOTAL =	**300**	**100**

Source: Fieldwork, 2025

Crop diversification is the most widely adopted adaptation strategy in Agatu, with 26.7% of farmers practicing it. This strategy reduces the risk of crop failure caused by pests, diseases, or adverse weather conditions and helps stabilize farmers' income, particularly in regions with unpredictable environmental conditions (Altieri, 2002). It also enhances resilience to climate variability and improves food security (Lobell et al., 2014).

Improved irrigation systems were adopted by 14.0% of farmers. Efficient irrigation methods, such as drip and sprinkler systems, can significantly increase crop yields, especially in areas experiencing irregular rainfall or water scarcity (Rodriguez et al., 2015). Despite these benefits, the adoption rate remains relatively low due to high initial costs and limited access to resources and technical knowledge.

Early maturing crop varieties were adopted by 22.7% of farmers. These varieties are particularly useful in regions with shortened growing seasons or unpredictable weather patterns, as they enable crops to mature before adverse climatic conditions occur (Behnassi et al., 2016). This strategy contributes to yield stability and improved food security in the face of climate change.

Agroforestry, adopted by 17.0% of farmers, involves the integration of agriculture with tree planting. This practice improves soil fertility, reduces erosion, and provides additional income through tree products (Nair, 1993). Agroforestry is especially valuable in areas with degraded soils, as it offers ecological benefits while enhancing resilience to climate change.

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Cooperative farming was adopted by 19.6% of farmers. This strategy enables farmers to pool resources, labour, and equipment, thereby increasing productivity and reducing individual costs (Moyo, 2010). It also improves access to markets, technical knowledge, and bulk purchasing opportunities, while fostering social cohesion and enhancing profitability. The responses from the focus group discussion and interviews were consistent with farmers' perceptions of climate change and its effects in the study area. The findings indicate a clear convergence of views, as participants similarly identified key climate-related challenges affecting agricultural productivity and livelihoods.

Conclusion

The study highlights the vulnerability of smallholder farmers in Agatu to the impacts of climate change, including irregular rainfall, flooding, drought, and pest infestations. These challenges pose serious threats to food security and agricultural sustainability. Adaptation strategies such as crop diversification, the use of early maturing crop varieties, cooperative farming, and agroforestry demonstrate the resilience of farmers in coping with these challenges. However, the adoption of improved irrigation systems remains limited due to high installation costs and inadequate technical expertise. The demographic data further reveal that the farming population is predominantly composed of middle-aged males with low levels of formal education, a factor that may hinder the adoption of modern and advanced agricultural practices. Understanding these socio-economic and environmental conditions is essential for designing targeted interventions aimed at improving climate change adaptation and enhancing agricultural productivity in the study area.

Recommendations

i. Climate-smart agricultural practices, such as improved irrigation systems and drought-resistant crop varieties, should be promoted through farmer training and technical support to enhance productivity and resilience to climate change.

ii. Government and relevant stakeholders should encourage the adoption of irrigation systems by providing subsidies, micro-financing opportunities, and technical guidance on sustainable water management practices.

iii. Policies should ensure equal access to agricultural resources, credit facilities, land, and training opportunities for both male and female farmers in order to improve agricultural productivity and strengthen resilience to climate change.

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