

Assessment Of Climate Change–Induced Challenges Among Smallholder Farmers In Yobe State, Nigeria

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Abstract: This study assessed climate change–induced challenges among groundnut smallholder farmers in Yusufari Local Government Area (LGA), Yobe state, Nigeria, with adaptation strategies examined as supportive responses. The study examined farmers’ awareness and perceptions of climate change, identified key climate-related challenges affecting groundnut production, and assessed the adaptation strategies employed to cope with these challenges. A descriptive survey research design was adopted, involving 150 male and female groundnut farmers selected through multistage sampling techniques. Data were collected using structured questionnaires and analyzed using descriptive statistics; including frequencies, percentages, and the relative importance index (RII). Findings revealed that 80% of respondents were aware of climate change, indicating widespread recognition of climatic variability. The most significant climate-induced challenges were low yield (RII = 0.63), pest and disease infestation (RII = 0.53), drought (RII = 0.47), delayed planting (RII = 0.43), and soil erosion (RII = 0.30). Adaptation strategies adopted by farmers were mainly low-cost and knowledge-based, with early maturing seed varieties (RII = 0.74), changes in planting dates (RII = 0.72), and improved seed varieties (RII = 0.71) being the most prominent. The study concludes that climate change poses serious threats to groundnut productivity and smallholder livelihoods in Yusufari LGA, while adaptive responses remain constrained by limited access to resources, extension services, and infrastructure. The study recommends strengthening access to improved seed varieties, expanding climate-smart extension services, promoting soil and water conservation practices, and implementing gender-sensitive and youth-inclusive interventions to enhance resilience, food security, and sustainable agricultural development in semi-arid regions of Nigeria.

Keywords— climate change; groundnut farmers; climate-induced challenges; adaptation strategies; semi-arid agriculture; Yusufari LGA

INTRODUCTION

Climate change is an unavoidable reality that is increasingly shaping agricultural systems worldwide, with particularly severe implications for arid and semi-arid regions such as the Sahelian zone of Africa. Global temperatures have risen steadily over the past century, and projections indicate that the impacts of climate change will be more pronounced near the equator, including Sub-Saharan Africa (Climate Ark, 2007). Climate change refers to observable and long-term alterations in the climate system, primarily driven by human activities that modify atmospheric composition and contribute to global warming (Ozor, 2009; IPCC, 2007). These changes result in shifts in mean climatic conditions, increased variability, and prolonged effects that significantly impact both ecosystems and human livelihoods (Udeh & Ikpe, 2022). In northeastern Nigeria, particularly Yobe State, climate change is manifesting as rising temperatures, unpredictable rainfall patterns, delayed onset and early cessation of rains, prolonged dry spells, and increasing desertification (Nigerian Meteorological Agency [NiMet], 2023; Oloruntade et al., 2021). These climatic stresses adversely affect agricultural productivity and threaten

food security among smallholder farmers. Groundnut (*Arachis hypogaea*), a key cash and food crop in Yobe State, contributes substantially to household income, nutrition, livestock feed, and soil fertility through nitrogen fixation (FAO, 2021). In Yusufari Local Government Area, groundnut production is predominantly rain-fed and largely managed by smallholder farmers with limited access to irrigation, improved seeds, and modern inputs. This reliance on rainfall makes groundnut yields highly sensitive to climate variability, including erratic precipitation, heat stress, and soil moisture deficits (Ahmed et al., 2020; Ajetomobi & Abiodun, 2019). Adaptation to climate change is essential to mitigate these negative impacts. Adaptation involves implementing strategies and measures that reduce vulnerability, manage risks, and improve resilience to climate variability (IPCC, 2000; Oladipo, 2010). In agriculture, adaptation strategies include adjustments in crop management, such as altering planting dates, using drought-tolerant or early-maturing varieties, diversifying income sources, applying soil and water conservation practices, and enhancing access to extension services (IPCC, 2001; Akinagbe & Irohibe, 2014; Ikpe, 2014). Effectively implemented adaptation measures can reduce the severity of

crop losses, enhance productivity, and provide opportunities for sustainable agricultural development. Farmers' perceptions of climate change are critical for shaping adaptation responses. Perception refers to farmers' understanding and interpretation of long-term climatic changes based on lived experience and socio-economic context (Maddison, 2007; Deressa et al., 2009). Studies in the Sahel and northern Nigeria report that farmers perceive rising temperatures, irregular rainfall, delayed onset of rains, and frequent droughts, which directly influence decisions regarding crop selection, planting schedules, and input use (Abid et al., 2019; Ayanlade et al., 2022). When farmers correctly perceive these climatic changes, they are more likely to adopt effective adaptation strategies, such as using improved or drought-tolerant groundnut varieties, practicing soil and water conservation, and diversifying cropping and income activities (Below et al., 2012; Bryan et al., 2013). Conversely, limited awareness or misperception of climate signals increases vulnerability to crop failures and income losses.

In Yusufari LGA, groundnut farming is primarily subsistence-oriented, and declining yields due to climate stressors have direct implications for household welfare and food security. Farmers' adaptive capacity is constrained by limited financial resources, poor access to credit, inadequate extension services, weak institutional support, and infrastructural deficits (IPCC, 2022; Ogunniyi et al., 2021; World Bank, 2023). Despite the importance of groundnut in the region, few studies have specifically examined climate change-induced challenges and adaptation strategies among groundnut farmers at the local government level. Existing research often focuses on cereal crops or regional-scale analyses, limiting the development of targeted adaptation interventions (Sultan et al., 2020; Traore et al., 2021). Given these gaps, this study investigates the climate change-induced challenges faced by groundnut farmers and the adaptation strategies they employ in Yusufari LGA, Yobe State, Nigeria. By analyzing farmers' experiences and adaptive responses, the study provides location-specific insights to inform policy, enhance extension services, and improve the resilience and productivity of groundnut-based farming systems in the semi-arid Sahelian zone of Nigeria.

STATEMENT OF THE RESEARCH PROBLEM

Climate change is increasingly threatening agricultural productivity in the Sahel, with particularly severe implications for climate-sensitive crops such as groundnut, which are predominantly cultivated under rain-fed conditions. In Yusufari Local Government Area (LGA) of Yobe State, farmers have reported rising temperatures, erratic rainfall patterns, delayed onset of rains, and frequent dry spells. Despite these observations, the specific impacts of climate change on groundnut yield remain insufficiently documented. Groundnut serves as a major source of household income, food security, and soil fertility enhancement for smallholder farmers in the area. However, empirical evidence linking farmers' perceptions of climate change to actual yield

outcomes is limited. This lack of crop-specific information constrains the development of effective, location-specific adaptation strategies and climate-responsive agricultural policies. Several studies provide relevant background on climate change and agricultural production in Yobe State, but they exhibit notable limitations. For instance, Abdullahi et al. (2023) surveyed sesame farmers in Machina LGA using structured questionnaires and descriptive statistics, reporting that rising temperatures, delayed rainfall onset, and recurrent droughts were major constraints to productivity. While the study recommended improved extension services and access to climate-resilient inputs, it did not examine groundnut production or assess yield impacts. Similarly, Yusuf and Mustapha (2024) investigated smallholder crop farmers' perceptions and adaptation strategies in Bade LGA, revealing widespread awareness of irregular rainfall and heat stress. They concluded that adaptive capacity was low due to poverty and limited institutional support, yet the study focused on mixed cropping systems without analyzing crop-specific yield outcomes.

Remote sensing and GIS analyses by Mohammed et al. (2022) identified significant vegetation loss and desertification in northern Yobe State, including the Yusufari axis, linked to prolonged dry spells and rising temperatures. While this research highlighted threats to agricultural productivity, it did not consider farmers' perceptions or examine effects on groundnut yield. Likewise, Adamu et al. (2023) assessed climate change perception and livelihood impacts along the Komadugu-Yobe Basin, showing that drought frequency and reduced agricultural output were negatively affecting rural livelihoods. However, the study was primarily livelihood-oriented and did not focus on crop-specific productivity. More closely related, Garba et al. (2024) evaluated climate variability and crop production challenges among rain-fed farmers in northern Yobe State. The study identified erratic rainfall and high temperatures as major causes of low crop yields, recommending drought-tolerant varieties, but it aggregated data across multiple crops and did not isolate groundnut production or target Yusufari LGA specifically. Although these studies demonstrate farmers' awareness of climate change, environmental degradation, and general impacts on agriculture in Yobe State, there remains a clear gap in empirical research linking farmers' perceptions to observed challenges and adaptation in Yusufari LGA. Most prior studies are either non-crop-specific, focus on other crops such as sesame, or examine broader regional patterns, thereby limiting the development of crop- and location-specific adaptation strategies. This knowledge gap underscores the need for the present study, which explicitly investigates climate change-induced challenges faced by groundnut farmers and the adaptation strategies they employ in Yusufari LGA, Yobe State, Nigeria, to inform targeted adaptation interventions and evidence-based agricultural policy formulation. This study is significant as it provides empirical evidence on climate change-induced challenges and adaptation strategies among groundnut farmers in Yusufari Local Government Area, Yobe

State, Nigeria. By linking farmers' perceptions of climate variability to observed effects on groundnut yield, the research generates location- and crop-specific insights that are essential for designing targeted adaptation interventions.

Understanding the primary challenges faced by groundnut farmers such as low yield, drought, pests, and delayed planting and the strategies they adopt to cope with these stressors can help policymakers, extension agents, and development agencies to prioritize resources, provide relevant technical support, and promote climate-resilient agricultural practices. The findings can also inform the development of improved seed programs, irrigation schemes, pest and disease management approaches, and training programs that align with farmers' real-world needs and constraints. At the household and community level, the study contributes to enhancing food security, income stability, and livelihood resilience among smallholder groundnut farmers, who rely heavily on rain-fed agriculture. From a broader perspective, the research supports the achievement of national and international development goals, including Sustainable Development Goal 2 (Zero Hunger), SDG 5 (Gender Equality), and SDG 13 (Climate Action), by providing evidence-based recommendations for reducing vulnerability to climate change and strengthening adaptive capacity in semi-arid farming systems. Furthermore, the study addresses a critical gap in existing literature by focusing specifically on groundnut a crop of high economic and nutritional importance in Yobe State thus providing a foundation for future research and policy formulation in the region.

OBJECTIVES OF THE STUDY

The primary aim of this study is to assess the challenges posed by climate change and the adaptation strategies adopted by groundnut farmers in Yusufari Local Government Area, Yobe State, Nigeria. Specifically, the study seeks to:

1. Examine farmers' perceptions and awareness of climate change in Yusufari LGA.
2. Identify and analyze the specific climate change-related challenges affecting groundnut production and yield.
3. Evaluate the adaptation strategies employed by groundnut farmers to mitigate the impacts of climate variability. This study focuses on assessing climate change-induced challenges and adaptation strategies among groundnut farmers in Yusufari Local Government Area (LGA) of Yobe State, Nigeria. The spatial scope is limited to Yusufari LGA, a semi-arid region in northeastern Nigeria characterized by low rainfall, high temperatures, and frequent droughts, which make it highly vulnerable to climate variability.

The area is a major groundnut-producing zone, and agriculture forms the primary livelihood for most households. By concentrating on this LGA, the study provides a detailed understanding of local farmers' perceptions, experiences, and adaptive responses to climate change, though the findings may not be directly applicable to other LGAs or states with different environmental and socio-economic contexts. Temporally, the study covers a five-year period from 2020 to 2025, capturing

recent climatic patterns, rainfall anomalies, temperature fluctuations, and drought events that are still recent in farmers' memory. The content scope is centered on farmers' perceptions of climate change, sources of climate information, perceived impacts on groundnut production, and the strategies they employ to adapt, such as altered planting dates, adoption of drought-tolerant varieties, and livelihood diversification. The research is limited to groundnut farming and does not consider other crops or livestock systems. Additionally, while it provides insights into local adaptation practices, the study does not evaluate broader national or international climate policies or institutional frameworks affecting agricultural adaptation.

MATERIALS AND METHODS

The study area

Yusufari Local Government Area (LGA) is geographically situated between latitude 12°55'03"N and 13°28'03"N of the equator, and longitude 10°15'0"E to 11°23'0"E of the Greenwich meridian.

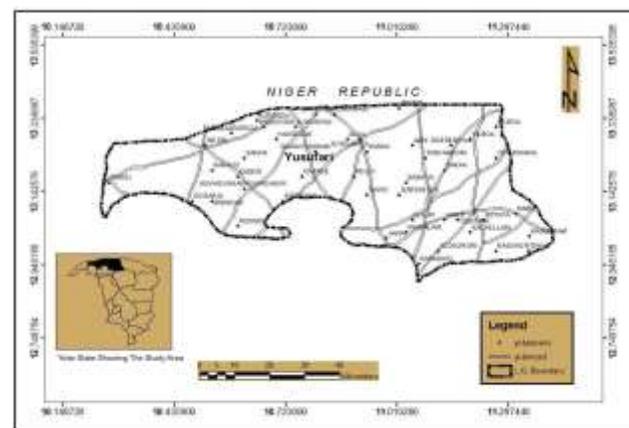


Figure 1: The Study Area

Source: modified and Adopted from the Administrative map of Nigeria

It shares boundaries with Yunusari LGA to the east, Karasuwa and Bursari LGAs to the south, Nguru LGA to the west, and the international border with the Republic of Niger to the north. The LGA covers an area of approximately 3,928 km² (1,517 sq. mi) (Figure 1). The climate is predominantly semi-arid, with low and erratic annual rainfall averaging about 444 mm and a short growing season of approximately 60 days between July and August (Maigari, 2000). The region is highly vulnerable to climatic extremes, having been severely affected by the droughts of the 1970s and 1980s. The dry season extends for more than eight months, from October to June, leaving only a brief wet period in which the air is moderately humid (Maigari, 1996; 2000). Potential evapotranspiration ranges from 6.9 mm to 8.5 mm per day, reflecting the high water stress typical of the area (Maigari, 2000). Average daily temperatures hover around 25°C, with monthly means of approximately 27°C, while peak temperatures during the

hottest months of April, May, and June can reach 40°C (Jajere & Baka, 2010 in Jajere, 2014). These climatic conditions, particularly prolonged drought, high temperatures, and low rainfall, have direct implications for groundnut cultivation, making farmers in Yusufari LGA especially susceptible to climate-induced challenges and highlighting the importance of effective adaptation strategies.

Methodology

This study employed a descriptive survey research design to assess climate change-induced challenges and adaptation strategies among groundnut farmers in Yusufari Local Government Area (LGA) of Yobe State, Nigeria. The survey design was deemed appropriate because it enables the systematic collection of quantitative and qualitative data on farmers' socio-economic characteristics, climate change perceptions, agricultural challenges, and adaptive practices, while allowing generalization of findings to the broader groundnut-farming population (Creswell & Creswell, 2018). The target population consisted of all male and female groundnut farmers in Yusufari LGA who had actively engaged in farming for at least five consecutive years, ensuring respondents had sufficient experience to provide informed perspectives on climate impacts and adaptation strategies. Using multistage sampling, major groundnut-producing wards were first purposively selected. Within these wards, stratified sampling ensured proportional representation of farmers, followed by simple random sampling to select 150 respondents, guaranteeing each eligible farmer an equal chance of inclusion. Data collection involved structured questionnaires administered through face-to-face interviews. Key variables included socio-demographic characteristics (age, gender, marital status, education, farming experience), awareness and challenges and adaptation strategies. Data analysis employed descriptive statistics such as frequencies, percentages, and the Relative Importance Index (RII) to determine the prevalence and perceived importance of climate challenges and adaptation measures. Findings were interpreted in narrative form, supplemented with relevant literature to contextualize results within regional and national agricultural and climatic realities. This methodology provides a robust framework for understanding both farmers' experiential knowledge and the practical adaptation strategies employed under semi-arid conditions, offering evidence to inform policy, extension services, and sustainable agricultural interventions in Yusufari LGA.

RESULTS AND DISCUSSION

SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

Figure 2 shows that male respondents constituted 80% of the sample, while females accounted for only 20%, reflecting a pronounced gender disparity in agricultural participation in Yusufari LGA.

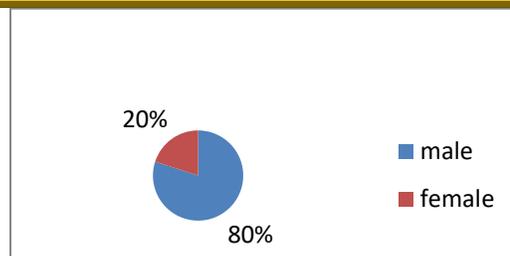


Figure 2. Sex of the Respondents

Source: Field Survey, 2025

This pattern aligns with the male-dominated household structures common in rural northern Nigeria, where men typically make key decisions in farming and community affairs, and women mainly support production, processing, and household management (Ekeleme & Olatundun, 2022; FAO, 2011, 2025). Although women contribute significantly to agricultural labor globally and across sub-Saharan Africa often between 60% and 80% of total labor they face systemic barriers such as limited access to land, credit, agricultural inputs, and extension services (FAO, 2011; FAO, 2025). In Nigeria, these constraints result in lower yields per hectare for women compared to men (World Bank & ONE Campaign, 2014; Uwadie et al., 2019). Evidence from Yobe State highlights similar trends, with women restricted in land ownership, decision-making, and access to inputs like seeds and fertilizers (Tijani & Tijjani, 2019; SWOFON, 2021). Studies on climate change adaptation further show that socio-cultural norms, low literacy, and economic inequalities limit women's engagement in innovative farming practices (Madaki et al., 2024; Umar et al., 2023). These findings underscore the importance of gender-sensitive policies that empower women, enhance access to resources and training, and promote equitable participation in agricultural decision-making. Addressing the gender gap can improve productivity, strengthen food security, and enhance resilience to climate change among smallholder farmers in Yusufari and northern Nigeria (FAO, 2025; World Bank, 2014).

The socio-demographic characteristics of respondents in Yusufari LGA indicate a predominantly middle-aged farming population. Table 1 shows that 36.7% of respondents fall within the 36–45 years age group, followed by 26–35 years and 46–55 years, each representing 23.3%. Only 6.7% are below 25 years, while 10% are over 55 years. This distribution suggests that the majority of farmers are in their prime working age, capable of performing labour-intensive activities such as groundnut cultivation and implementing climate adaptation strategies. The small proportion of younger farmers reflects limited engagement of youth in agriculture, consistent with broader trends in northern Nigeria, where migration, urban employment, and declining attractiveness of farming reduce youth participation (Omoju et al., 2023).

Table 1: Age, marital status, education, occupation and farming experience of Respondents

Age	Freq.	%
Below 25	10	6.7
26-35	35	23.3
36-45	55	36.7
46-55	35	23.3
Above 55	15	10.0
Marital status		
Single	15	10.0
Married	115	76.7
Widowed	10	6.7
Divorced	10	6.7
Education		
No formal Edu.	35	23.3
Primary	45	30.0
Secondary	50	33.3
Tertiary	20	13.3
Occupation		
Full-time farmer	105	70.0
Part-time farmer	30	20.0
Others	15	10.0
Years of farming		
Less than 5 years	15	10.0
5-10 Years	40	26.7
11-20 years	60	40.0
Over 20 years	35	23.3

Source: Field Survey, 2025

The presence of older farmers indicates a wealth of experience and indigenous knowledge but also highlights potential challenges regarding succession planning and the physical demands of farming. Consequently, interventions promoting youth involvement through mentorship, access to land, and training in climate-smart agriculture are essential for ensuring long-term sustainability. Marital status data further reveal that 76.7% of respondents are married, while 10% are single, and 6.7% each are widowed or divorced. This pattern reflects family-oriented social structures, where households can pool labour for farming, manage risk collectively, and make joint decisions on resource allocation and adaptation practices. Married households are better positioned to cope with climate-induced challenges, including irregular rainfall and pest infestations, while non-married or vulnerable households may face constraints in accessing labour, credit, and inputs (Galadima, 2014; IFAD, 2017). Educational attainment shows that 33.3% of respondents reached secondary school, 30% primary, 23.3% had no formal education, and 13.3% attained tertiary education. While basic literacy enables farmers to interact with extension services, radio programmes, and simple adaptation practices, limited higher education may hinder adoption of modern technologies and scientific farming innovations, affecting the effective implementation of climate adaptation strategies (FAO, 2022; Ajao et al., 2020).

Occupation and farming experience indicate that 70% of respondents are full-time farmers, 20% part-time, and 10% engage in other livelihoods, highlighting the heavy reliance of households on agriculture for income and food security. The

majority (66.7%) have more than ten years of farming experience, with 23.3% exceeding 20 years, reflecting substantial indigenous knowledge of local agro-ecological conditions, seasonal rainfall patterns, and coping strategies. Such experience is critical for climate adaptation, as long-term farmers employ traditional forecasting, soil fertility management, and drought-coping mechanisms (Audu & Barde, 2018; Yusuf & Ibrahim, 2021). However, low youth participation and reliance on aging farmers pose risks to the sustainability of agriculture, emphasizing the need for policies that promote youth involvement, provide access to land, credit, and climate-smart training, and strengthen adaptive capacity to climate change in Yusufari LGA and similar semi-arid communities.

Knowledge of climate change

Figure 3 indicates that 80% of respondents in Yusufari LGA are aware of climate change, while 20% reported no knowledge of it.

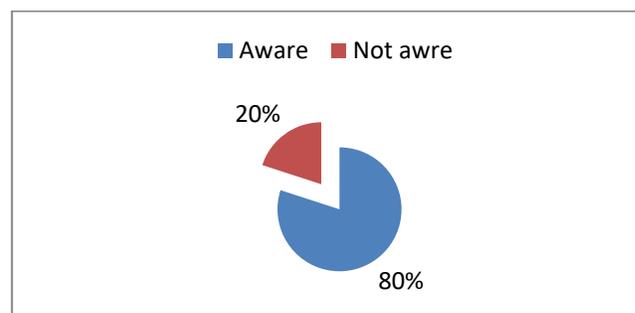


Figure 3: Knowledge of climate change by Respondents
Source: Field survey, 2025

This high level of awareness demonstrates that most farmers recognize ongoing environmental and climatic shifts affecting their livelihoods and agricultural productivity. Awareness is a key factor in shaping attitudes toward adaptation, influencing the adoption of coping strategies, improved technologies, and modern farming practices (Ajao et al., 2020; Apata et al., 2009). The finding reflects growing acknowledgement of climate variability as a critical challenge in semi-arid areas like Yusufari, where declining rainfall, frequent droughts, and desertification increasingly threaten agriculture (Aliyu & Saidu, 2020; Yobe State Government, 2022).

The 20% of respondents lacking awareness point to persistent gaps in information dissemination, which may hinder effective local adaptation. Limited extension services, low literacy, and poor access to rural media contribute to uneven climate knowledge among farmers (Audu & Barde, 2018; Yusuf & Ibrahim, 2021). In such contexts, farmers often rely on indigenous knowledge to interpret climatic changes. Therefore, enhancing awareness through targeted climate education, participatory training, community meetings, and radio programmes is essential. Integrating local knowledge with scientific climate information can strengthen adaptive decision-making, improve resilience, and facilitate more effective planning among groundnut farmers in Yusufari and

other semi-arid regions of northeastern Nigeria (FAO, 2022; Nwajiuba et al., 2019).

Climate-Induced Challenges

The analysis of the challenges faced by groundnut farmers in Yusufari LGA in Table 2 reveals that low yield (RII = 0.63) is the most critical constraint, reported by 63.3% of respondents. This challenge reflects the cumulative effects of climate variability, declining soil fertility, and other agronomic limitations, which together reduce crop output. Irregular rainfall patterns, shortened growing seasons, and increased temperatures can directly reduce pod formation and overall yield, making low production a persistent concern (FAO, 2022; Audu & Barde, 2018). The predominance of low yield underscores the vulnerability of smallholder farmers in semi-arid regions to both biophysical and socio-economic stressors, which hinder consistent and sustainable groundnut production.

Table 2. Challenges of climate change by Respondents

S/N	Challenge	Freq.	%	RII	Rank
1	Low yield	95	63.3	0.63	1 st
2	Pest and disease	80	53.3	0.53	2 nd
3	Drought	70	46.7	0.47	3 rd
4	Delayed planting	65	43.3	0.43	4 th
5	Soil erosion	45	30.0	0.30	5 th
6	Flood	20	13.3	0.13	6 th

Source: Field Survey, 2025

The second most reported challenge is pest and disease infestation (RII = 0.53), affecting 53.3% of farmers. Climatic changes, particularly warmer temperatures and unpredictable rainfall, create conducive conditions for pests and pathogens to thrive, leading to increased crop losses (Yusuf & Ibrahim, 2021; Aliyu & Saidu, 2020). These biotic stressors compound yield reductions and highlight the urgent need for integrated pest and disease management practices, such as timely pesticide application, resistant varieties, and crop rotation, as strategies for maintaining productivity under variable climatic conditions. Drought (RII = 0.47) and delayed planting (RII = 0.43) were also significant challenges, reflecting the impact of erratic rainfall and shortened rainy seasons on crop schedules.

Prolonged dry spells limit soil moisture availability, which negatively affects seed germination, early growth, and tuber development in groundnut, while delayed planting often disrupts optimal crop calendars and reduces final yield (Ajao et al., 2020; Galadima, 2014). These findings are consistent with studies in northern Nigeria, which indicate that drought and altered rainfall patterns are major determinants of crop performance in semi-arid agro-ecological zones (FAO, 2022; Yusuf & Ibrahim, 2021). Soil erosion (RII = 0.30) was reported by 30% of respondents, indicating a moderate constraint to production. Wind and water erosion in semi-arid northern Nigeria result in the loss of nutrient-rich topsoil, thereby degrading land fertility and reducing the capacity of soils to support groundnut growth (Aliyu & Saidu, 2020).

Although its prevalence is lower than that of drought and pests, soil erosion remains an important long-term threat to sustainable crop production, necessitating soil conservation measures such as mulching, ridging, and contour farming. Finally, flooding (RII = 0.13) was the least reported challenge, suggesting that excessive rainfall and waterlogging are not major threats in Yusufari LGA compared to prolonged dry spells. This finding reflects the semi-arid nature of the region, where inadequate rainfall rather than excessive rainfall predominantly shapes the agricultural landscape (Audu & Barde, 2018). Overall, the ranking of challenges confirms that climate-induced constraints, particularly low yield, pests, and drought, are the primary barriers to groundnut production in Yusufari LGA. These findings emphasize the importance of adaptive farming practices, including the adoption of improved and drought-tolerant seed varieties, timely planting, integrated pest and disease management, and soil conservation strategies, to enhance resilience to climate variability. These results are in agreement with previous studies in northern Nigeria, which report that smallholder farmers’ productivity and livelihoods are significantly affected by climate variability and resource limitations in semi-arid agro-ecological zones (Audu & Barde, 2018; FAO, 2022; Yusuf & Ibrahim, 2021).. In light of these findings, policymakers, extension agents, and development partners should prioritize interventions that target high-impact constraints, especially those related to yield losses and drought management, while promoting capacity-building programs to strengthen farmers’ adaptive responses and ensure sustainable groundnut production.

Adaptation Strategies

The findings reveal that groundnut farmers in Yusufari LGA adopt a range of adaptation strategies to cope with the adverse impacts of climate change, although the level of adoption varies considerably across strategies. The use of the Relative Importance Index (RII) provides a clearer understanding of the relative significance of each strategy beyond simple frequency counts. The most important and widely adopted adaptation strategy is the use of early maturing seeds (EMS), which ranked first with an RII value of 0.74. This high ranking indicates that early maturing varieties are perceived by farmers as the most effective means of reducing climate-related risks. Early maturing seeds allow crops to complete their growth cycle within shorter and increasingly unpredictable rainy seasons, thereby minimizing exposure to drought and moisture stress during critical growth stages. This finding reflects farmers’ adaptive awareness and aligns with studies that identify early maturing and drought-tolerant varieties as key climate-smart innovations in semi-arid environments (Ajao et al., 2020; FAO, 2022).

Table 3 Adaptation Strategies by Respondents

Strategies	Always used	Rarely Used	Never used	RII	R
ISV	80(53.3)	34(10.7)	36(19.3)	0.71	3 rd

CPD	75(50.0)		0.72	2nd
	25(10.0)	50(26.7)		
EMS	90(60.0)		0.74	1st
	27(40.0)	33(10.0)		
CR	65(56.7)		0.69	4th
	45(28.7)	40(14.6)		
I	45(30.0)		0.61	5th
	93(62.0)			

Source: Field Survey, 2025

The second-ranked strategy is changing planting dates (**CPD**), with an RII of 0.72. This strategy enables farmers to adjust sowing periods in response to delayed rainfall onset and shortened growing seasons, which are common climatic challenges in Yusufari LGA. The relatively high RII suggests that farmers actively monitor rainfall patterns and modify traditional planting calendars to reduce the risk of crop failure. Similar observations have been reported in northern Nigeria, where flexible planting dates are widely used as a low-cost and knowledge-based adaptation measure (Audu & Barde, 2018). Improved seed varieties (**ISV**) ranked third with an RII of 0.71, indicating high but slightly lower importance compared to the top two strategies. Improved varieties are typically bred for higher yield potential, drought tolerance, and resistance to pests and diseases, making them valuable under changing climatic conditions. However, their lower rank relative to early maturing seeds may be attributed to constraints such as limited access, high cost, and inadequate extension support, which restrict widespread adoption among smallholder farmers (Aliyu & Saidu, 2020; Yusuf & Ibrahim, 2021). Crop rotation ranked (**CR**) fourth with an RII of 0.69, reflecting moderate adoption among respondents. Crop rotation is a traditional agronomic practice that enhances soil fertility, reduces pest and disease pressure, and improves overall system resilience. Although beneficial, its lower ranking suggests that farmers may prioritize immediate yield-stabilizing strategies over longer-term soil management practices, particularly under conditions of climatic uncertainty and resource constraints (FAO, 2022). The least adopted strategy is irrigation (**I**), which ranked fifth with an RII of 0.61. Despite its potential to buffer crops against rainfall variability, irrigation remains limited in Yusufari LGA due to inadequate water resources, high installation costs, and lack of technical capacity. This finding is consistent with previous studies in semi-arid northern Nigeria, which report that irrigation adoption among smallholder farmers is constrained by financial and infrastructural limitations (Aliyu & Saidu, 2020). Overall, the RII-based analysis indicates that farmers rely more on low-cost, knowledge-based, and seed-related adaptation strategies than on capital-intensive measures such as irrigation. The uneven adoption pattern underscores the combined influence of climatic conditions, economic capacity, access to inputs, and institutional support on farmers' adaptive behavior. From a policy and sustainable development perspective, enhancing farmers' adaptive capacity requires targeted interventions, including improved access to early maturing and improved seed varieties, expanded extension services, climate-smart

training programs, and financial support mechanisms. Addressing these constraints will not only strengthen resilience to climate change but also contribute to improved productivity, food security, and sustainable livelihoods in line with SDG 2 (Zero Hunger) and SDG 13 (Climate Action).

CONCLUSION

The study on climate change-induced challenges and adaptation strategies among groundnut farmers in Yusufari LGA, Yobe State, Nigeria, reveals that climate variability poses significant threats to agricultural productivity, particularly for rain-fed groundnut cultivation. Farmers in the study area are generally aware of climate change, with 80% recognizing shifts in rainfall patterns, rising temperatures, drought, and delayed planting as major challenges. Low yield emerged as the most critical constraint, followed by pest and disease infestation, drought, and delayed planting, highlighting the vulnerability of groundnut farmers to both biophysical and socio-economic stressors. In response, farmers have adopted a range of adaptation strategies, with early maturing seeds, adjustment of planting dates, and improved seed varieties being the most frequently employed. These strategies are predominantly low-cost, knowledge-based, and rely on indigenous and experiential understanding of local agro-climatic conditions. However, capital-intensive measures such as irrigation are less adopted due to financial, technical, and infrastructural constraints. Socio-economic characteristics, including gender disparity, limited youth involvement, low literacy levels, and reliance on aging farmers, further influence the capacity to adapt. Overall, the findings indicate that while farmers demonstrate adaptive awareness, the effectiveness of strategies is constrained by limited access to improved inputs, extension services, and institutional support. The study confirms that enhancing the resilience of groundnut farming in semi-arid regions requires an integrated approach that combines farmers' local knowledge with scientific innovations, targeted policy interventions, and improved access to resources. Addressing these challenges is crucial not only for sustaining groundnut production and household food security but also for achieving broader development goals, including SDG 2 (Zero Hunger) and SDG 13 (Climate Action).

RECOMMENDATIONS

Based on the study findings, the following recommendations are proposed:

1. Promotion of Early Maturing and Improved Seed Varieties: Agricultural agencies and seed companies should increase the availability and affordability of early maturing and drought-tolerant groundnut varieties to enhance farmers' resilience to shorten and unpredictable growing seasons.
2. Extension Services and Climate-Smart Training: Government and non-governmental organizations should expand extension services to provide practical guidance on adaptive strategies such as adjusting planting dates, crop

rotation, pest management, and soil conservation. Training programs should integrate indigenous knowledge with scientific techniques to improve adoption of climate-smart practices.

3. Enhanced Access to Credit and Inputs: Financial institutions and development partners should design accessible credit schemes to enable farmers to invest in improved seeds, fertilizers, and low-cost irrigation technologies.

4. Soil and Water Conservation Measures: Farmers should be encouraged to adopt soil conservation techniques such as ridging, mulching, and contour farming to mitigate erosion and maintain soil fertility, ensuring sustainable groundnut yields.

5. Support for Irrigation and Water Management: Investment in small-scale irrigation infrastructure and water harvesting systems can reduce dependence on erratic rainfall, allowing farmers to cope with droughts and dry spells more effectively.

6. Gender-Sensitive Interventions: Programs should target women farmers by improving access to land, inputs, training, and decision-making platforms, addressing the pronounced gender disparities observed in the study.

7. Youth Engagement in Agriculture: Initiatives to attract youth into groundnut farming, such as mentorship programs, access to land, and training in climate-smart techniques, are essential for sustaining agricultural productivity and intergenerational knowledge transfer.

8. Research and Policy Support: Continuous research is needed to develop context-specific, crop-focused adaptation strategies for semi-arid regions. Policymakers should integrate these findings into regional agricultural and climate adaptation policies to strengthen smallholder farmers' resilience.

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