



AWARENESS AND PERCEPTION OF CLIMATE CHANGE ADAPTATION PRACTICES AMONG CROP FARMERS IN AGRICULTURAL ZONE ONE, TARABA STATE, NIGERIA

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ABSTRACT

This study examined Awareness and Perception of Climate Change Adaptation Practices among Crop Farmers in Agricultural Zone One, Taraba State, Nigeria. Climate change poses a severe threat to agricultural productivity in sub-Saharan Africa, particularly within rain-fed smallholder farming systems. The study area, serves as a vital crop production hub; however, rising temperatures, erratic rainfall, and mid-season droughts increasingly jeopardize local food security. A multi-stage sampling technique was used in selecting 272 farmers and data were collected using structured questionnaires. The results revealed a predominantly young-to-middle-aged, educated farming population (mean age = 36.28 years; 55.3% tertiary education) operating small landholdings averaging 1.55 hectares. Farmers displayed moderate climate change awareness ($\bar{x} = 3.04$), relying primarily on personal observation of rainfall and temperature shifts rather than formal weather forecasts. Active adaptation strategies included This indicates a relatively strong use of soil and water conservation techniques to retain soil moisture and sustain crop productivity during periods of erratic rainfall and dry spells. Other strategies, including mixed cropping or crop rotation ($\bar{x} = 3.07$), irrigation or water harvesting ($\bar{x} = 3.06$), use of drought-resistant or early-maturing crops ($\bar{x} = 3.05$), and income diversification ($\bar{x} = 3.02$), were moderately adopted. However, adoption remains hindered by high input costs, inadequate extension contact, and credit constraints. The study concludes that respondents in the study area were aware of climate change which directly enhances farm-level adaptive behavior, yet systemic financial and institutional barriers impede transition to full climate-smart agriculture. The study recommended policy interventions including expanding climate-trained extension agents, establishing localized weather advisories and subsidizing climate-smart inputs to mention few.

Keywords: Awareness, Perception, Climate-change, Adaptation and Crop farmers.

INTRODUCTION

Climate change represents significant, long-term shifts in Earth's climate system primarily driven by human activities like fossil fuel combustion, deforestation, and industrial agriculture (IPCC, 2021). These anthropogenic activities release greenhouse gases principally CO₂, CH₄, and N₂O which intensify the natural greenhouse effect by trapping heat in the atmosphere (Copernicus, 2024). Consequently, global surface temperatures have surged, with 2023 recorded as the warmest year on record at approximately 1.48°C above pre-industrial baselines, capping off the warmest decade on record from 2014 to 2023 (Copernicus, 2024; World Meteorological Organization, 2024). This rapid thermal expansion and ice loss are causing global sea level rise to accelerate at more than twice its 1993–2002 rate (World Meteorological Organization, 2023). Simultaneously, the oceans have absorbed roughly 90% of excess heat and 30% of human CO₂ emissions, resulting in severe ocean acidification (IPCC, 2021). These physical changes directly intensify extreme weather events globally such as severe heatwaves, heavy rainfall, droughts, and intense tropical cyclones with attribution science increasingly quantifying how human influence amplifies the severity and likelihood of these impacts (IPCC, 2021; Philip *et al.*, 2022).

Climate change urgency is driven by unprecedented greenhouse gas levels, with CO₂ hitting 424 ppm in 2023 a height unseen in millions of years (NOAA, 2023). Current global policies project 2.7°C of warming by 2100, revealing a stark "implementation gap" regarding Paris Agreement targets (UNEP, 2023). Allowing warming to reach 2°C instead of 1.5°C dramatically increases the risk of irreversible planetary impacts, including coral reef collapse and ice sheet destabilization, making rapid emission reductions this decade essential (IPCC, 2023). Globally, these thermal shifts accelerate ice



melt, ocean acidification, and severe weather patterns that destabilize food, water, and economic systems (IPCC, 2021). In the United States, climate impacts are severe, geographically diverse, and outpacing global averages in certain areas. The western U.S. faces a historic megadrought amplified by rising temperatures, which triggers severe water shortages and extreme wildfire conditions (Williams *et al.*, 2022). Meanwhile, central and eastern regions suffer from intensified flooding, and coastal zones face threats from accelerating sea levels and hyper-moist hurricanes (USGCRP, 2023). Although the Inflation Reduction Act represents major federal progress, domestic policy remains fragmented across state and municipal lines (Larson *et al.*, 2023).

To counter these systemic impacts, Nigeria enacted the 2021 Climate Change Act and established a national Energy Transition Plan aimed at achieving net-zero emissions between 2050 and 2070, though national implementation remains constrained by significant funding and technical capacity gaps (National Emergency Management Agency, 2022; Larson *et al.*, 2023). These broader national vulnerabilities directly manifest in localized agricultural hubs like Agricultural Zone 1 in Taraba State (comprising Jalingo, Zing, Yorro, ArdoKola, and Lau). As part of the Guinea Savannah, Zone 1 is facing intense soil moisture loss, delayed monsoon onset, early cessation of rainfall, and severe mid-season dry spells that severely reduce the yields of critical staple crops like maize, sorghum, millet, and rice (Federal Ministry of Environment, 2021; NIMET, 2022; Taraba State Agricultural Development Programme, 2022).

These physical disruptions worsen local socioeconomic stability, escalating crop production costs, elevating food prices, and fueling farmer-pastoralist resource conflicts over shrinking arable land and water sources (Onyeneke *et al.*, 2022; Tyabo *et al.*, 2023). Although the Taraba State Government and federal agencies promote climate-smart practices like drought-tolerant crops and water conservation, adoption remains sparse due to inadequate extension services, poor access to early warning systems, and severe financial limitations among smallholders (Taraba State Government, 2021; Tyabo *et al.*, 2023). Consequently, a widening adaptation gap persists in Agricultural Zone 1, leaving local food production and rural livelihoods at risk without sustained, targeted interventions (Federal Ministry of Environment, 2021; Onyeneke *et al.*, 2022).

The broad objective of this study is to assess crop farmers' awareness and perceptions, of adaptation practices to climate change in Agricultural Zone one of Taraba State, Nigeria. While the specific objective are to:

- i. describe the socioeconomic characteristics of crop farmers in the study area
- ii. examine the level of crop farmer's awareness / perception climate of change in the study area;
- iii. examine the adaptation practices used by crop farmers on climate change
- iv. assess the level at which crop farmers perceived effectiveness of adaptive practices to climate change;
- v. examine the challenges of crop farmers in adapting to climate change in the study area;
- vi. examine the crop farmer's strategies to enhance knowledge and practices to adaptation to climate change

METHODOLOGY

Area of Study

The study was conducted in the Agricultural Zone 1 of Taraba State, located in the northeastern part of Nigeria. This zone lies approximately between latitude 6°30'N and 9°36'N and longitude 9°10'E and 11°50'E, covering a wide expanse of land characterized by varied topography and ecological diversity. It shares borders with several other states Benue, Nasarawa, Plateau, Gombe, and Adamawa and to the south, it has an international boundary with the Republic of Cameroon. This strategic geographic positioning contributes to both its agro-economic potential and exposure to environmental risks. The region receives an average annual rainfall ranging between 1,200 mm and 1,800 mm, with a unimodal rainfall pattern that typically occurs from April to October. This climate pattern supports a combination of arable farming and tree crop cultivation, including crops like maize, millet, rice, sorghum, yam, cassava, citrus fruits, and oil palm. The natural vegetation is predominantly Guinea



Savannah, with rich loamy soils that are conducive for agricultural activities. The zone also supports livestock production, making it a key contributor to the state's food basket.

According to the National Population Commission (NPC, 2023 estimates), Taraba State has a population of over 3.3 million people, with Agricultural Zone 1 encompassing Lau, Yorro, KarimLamido, Ardo-Kola, Jalingo, and Zing Local Government Areas (LGAs). These LGAs collectively have an estimated population of over 1.2 million, a majority of whom are smallholder farmers engaged in subsistence and commercial agriculture. These farmers are increasingly vulnerable to climate-related hazards such as delayed rainfall, prolonged dry spells, seasonal flooding, and land degradation all of which threaten agricultural sustainability and food security in the region.

Sampling Procedure

This study specifically focused on six local government areas (extension blocks) within Agricultural Zone 1: Lau, Yorro, Ardo-Kola, Jalingo, karim-Lamido and Zing. These areas have been purposively selected based on their agricultural significance, strategic location, and high vulnerability to the adverse effects of climate change. According to the Taraba Agricultural Development Programme (TADP, 2023). A multi-stage sampling procedure was employed to select respondents from the population. The first stage was a purposive selection of six blocks areas (LGAs), Yorro, Jalingo, Ardo-Kola, Karim Lamido, Zing, and Lau based on their relevance to Agriculture and vulnerability to climate change. In the second stage three wards were randomly selected from each of the six blocks, given rise to 18 wards with total sampling frame of 935 from the 1000 register small holders farmers. According to Krejcie and Morgan (1970), a population of 935 requires a sample size of 272 to ensure representativeness at a 95% confidence level and a 5% margin of error. Hence, a sample of 272 was deemed adequate for this study. In the last stage, there was proportionate allocation across the board based on the formula to give rise to 272 sample size.

$$n_i = N_i \times n$$

N

Where:

n_i = Number of farmers to be selected from ward i

N_i = Total number of extension workers in ward i N = Total number of extension workers across all wards

n = Total sample size (in this case, 272 farmers)

Method of Data Collection

Data were collected through the administration of structured questionnaire, which was administered directly to the respondents. The instrument was divided into five sections: Sociodemographic information, Level of crop farmers knowledge about adaptation to climate change, Adaptation practices used in crop farmers on climate change, Level of crop farmers perceived effectiveness of practices to climate change, challenges of crop farmers in adapting to climate change and Crop farmer suggested strategies to enhance knowledge and practices to adaptation to climate change.

Validation and Reliability of the Instrument

The validity of the instrument was ensured through content validation. A draft version of the questionnaire was sent to three experts in the fields of agricultural extension. After reviewing items approved by at least two experts were retained and items not approved by at least two experts was reframed and subjected to further validation. Items rejected was removed. A pilot test was carried out involving 20 respondents from a population outside the main study sample but sharing similar characteristics. The responses obtained was analyzed using Cronbach's Alpha coefficient which was calculated for each section of the questionnaire, including those related to adaptation practices, technical skills in crop and animal production, constraints, and extension support.

Method of Data Analysis

Data collected was analyzed using both descriptive and inferential statistics, Descriptive statistics such as frequency counts, percentages, means, and standard deviations.



RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents

The demographic analysis revealed that respondents were predominantly young, educated, and male smallholders, with 35.9% falling within the 26–35 age range (mean age of 36.28) and 55.3% possessing tertiary education. These traits enhance openness to innovation, digital weather services, and climate-smart technologies (Gonzalez & Sanchez, 2021; MDPI, 2023). However, gender disparities persist as 67.3% of respondents were male, signaling that female farmers face structural barriers such as restricted access to land, credit, and extension services that hinder equitable adaptation (Akinwale & Adeola, 2020; Oluwaseun *et al.*, 2021). Additionally, 95.6 % operated smallholdings under 3 acres (mean size of 1.55 acres), creating capital constraints that limit investment in resource-intensive, climate-smart infrastructure like mechanized irrigation (Adegbite *et al.*, 2021; Springer, 2020).

Experience and household structures further dictate adaptive decision-making across the sampled population. With 66.3% having 1–10 years of farming experience, many farmers possess moderate exposure to long-term climate trends, which may reduce their ability to anticipate subtle climate risks compared to more seasoned agriculturalists (Oruonye & Adebayo, 2015). Furthermore, 58.1% of respondents were married, a demographic factor driving a preference for conservative, low-risk adaptation strategies aimed at preserving household food security and income stability (Adebayo *et al.*, 2022). To offset climatic risks and erratic yields, 61.9% of farmers engage in livelihood diversification combining crop farming with artisan crafts, trading, or livestock which strengthens household economic resilience against environmental shocks (Springer, 2020).



Table 1: Socio Demographic and Farm Characteristics of Respondents (n = 272)

Variable	Categories	Frequency	Percentage	Mean
Age (years)	18-25	62	22.7	36.28
	26-35	98	35.9	
	36-45			
	46-55			
	56+	59	21.6	
Gender	Male	48	17.6	
	Female	183	67.3	
Farm Experience (years)		89	32.7	9.0
	5	87	31.9	
	6-10	94	34.4	
	11-15	65	23.8	
	16-20	4	1.5	
	21+	22	8.1	
Farm Size (hectares)	<1	92	33.7	1.55
	1-2	96	35.2	
	2-3	73	26.7	
	3-4	1	0.4	
	>4	10	3.7	
Marital Status	Single	94	34.6	
	Married	158	58.1	
	Divorced	13	4.8	
	Widowed	7	2.6	
Educational Level	Non-formal	30	11.0	
	Primary	52	19.0	
	Secondary	40	14.7	
	Tertiary	151	55.3	
Livelihood	Crop farming only	42	15.4	
	Crop/Livestock	34	12.5	
	Farming & Trading	20	7.3	
	Farming & Artisan	169	61.9	
	Others	8	2.9	

Source: Field, Survey, 2025

Farmers' Awareness and Perception of Climate Change Adaptation

The results demonstrated that farmers possess a moderate level of climate change awareness and perception, evidenced by an overall mean score of 3.04. While respondents showed higher recognition of observable environmental shifts—such as changing rainfall patterns ($\bar{x} = 3.15$), rising temperatures ($\bar{x} = 3.07$), and the need to adjust planting schedules ($\bar{x} = 3.09$)—their lower scores regarding rainfall onset identification ($\bar{x} = 2.94$) and formal adaptation training ($\bar{x} = 2.97$) highlight significant gaps in technical support. This indicates that farmers rely heavily on direct observation and trial-and-error rather than systematic climate forecasts or structured institutional resources. Ultimately, these findings align with FAO (2021) and IPCC (2022) assertions that while empirical observation grants farmers baseline climate awareness, translating perception into effective, long-term adaptation requires sustained extension contact, accessible climate information, and institutional policy backing.



Table 2: Distribution of Respondents based on their Level of Awareness and Perception of Climate Change Adaptation (n = 272)

S/N	Statement (Section B)	Minimum	Maximum	Mean
1	I am aware that changes in rainfall patterns are due to climate change.	1	5	3.15
2	I understand that increasing temperature affects crop growth and yield.	1	5	3.07
3	I am aware that human activities contribute to climate change.	1	5	3.01
4	I can identify the early and late onset of the rainy season as a sign of climate change.	1	5	2.94
5	I have adequate awareness of adaptation effects of climate change	1 strategies to reduce the	5	3.06
6	I have received training or information on climate change adaptation.	1	5	2.97
7	I can make informed decisions on the right time to plant in changing weather conditions	1	5	3.09
Overall mean.				2.99

Source: Field Survey, 2025

Climate Change Adaptation Practices

The findings show that farmers adopted a range of climate change adaptation practices, with mulching and conservation tillage being the most frequently adopted strategies ($\bar{x} = 3.17$). This indicates a relatively strong use of soil and water conservation techniques to retain soil moisture and sustain crop productivity during periods of erratic rainfall and dry spells. Other strategies, including mixed cropping or crop rotation ($\bar{x} = 3.07$), irrigation or water harvesting ($\bar{x} = 3.06$), use of drought-resistant or early-maturing crops ($\bar{x} = 3.05$), and income diversification ($\bar{x} = 3.02$), were moderately adopted. These practices suggest that farmers combine traditional and improved adaptation measures to reduce production risks and strengthen their resilience to climate variability. Conversely, organic manure application ($\bar{x} = 2.85$) and adjusting planting and harvesting dates according to weather patterns ($\bar{x} = 2.95$) recorded relatively lower levels of adoption. This may indicate that practices requiring greater technical knowledge, labour, inputs, or reliable climate information are more difficult for farmers to implement consistently. The findings therefore suggest that resource availability, technical knowledge, and access to extension services may influence farmers' capacity to adopt more demanding adaptation practices. Overall, the results are consistent with FAO (2021) and IPCC (2022), which reported that farmers tend to prioritize adaptation practices that are relatively accessible and easy to implement, while knowledge- and resource-intensive practices often face greater adoption barriers in vulnerable farming communities.



Table 3: Distribution of Respondents based on their Climate Change Adaptation Practices (n = 272)

S/N	Adaptation Practice	Minimum	Maximum	Mean
1	I adjust my planting and harvesting dates according to weather patterns.	1	5	2.95
2	I plant drought-resistant or early maturing crop varieties.	1	5	3.05
3	I practice mulching and conservation tillage to retain soil moisture.	1	5	3.17
4	I use irrigation or water harvesting techniques during dry periods.	1	5	3.06
5	I engage in mixed cropping or crop rotation to reduce risks.	1	5	3.07
6	I diversify my income through livestock or non-farming activities.	1	5	3.02
7	I use organic manure or compost to improve soil fertility.	1	5	2.85
Overall mean				3.05

Source: Field Survey, 2025

Awareness and Perception of Climate Change and Its Effects on Crop Production

Table 4 showed that the highest awareness among farmers was in recognizing the signs of climate change ($\bar{x} = 3.09$) and receiving training or information on adaptation practices ($\bar{x} = 3.08$), suggesting that direct observation of climatic changes and access to extension services or media significantly influence farmers' perception (Climate Change Knowledge and Perception among Farming Households in Nigeria, 2025). Moderate awareness was observed in understanding impacts on crop growth and yield ($\bar{x} = 3.04$) and identifying coping strategies for climate-related hazards ($\bar{x} = 2.95$), indicating that farmers rely on a combination of experiential knowledge and available guidance to manage production risks (Ajewole *et al.*, 2023). Lower awareness was recorded in understanding the causes of climate change, applying climate smart practices, and using weather forecasts for crop planning ($\bar{x} = 2.92$ – 2.94), reflecting gaps in technical knowledge, limited access to timely climate information, and insufficient extension support, consistent with findings that knowledge-intensive adaptation strategies are less adopted among smallholder farmers (Adekunmi, 2022; Akintobi, 2023). The moderate variability among respondents ($SD = 1.397$ – 1.486) suggests that socio-economic status, farm size, education, and access to extension services influence awareness, with better-supported farmers more likely to adopt effective adaptation measures.



Table 4: Distribution of Respondents based on Awareness and Perception of Climate Change and Its Effects on Crop Production (n = 272)

S/N	Statement	Mean
1	I understand the meaning and causes of climate change and how it affects crop production.	2.92
2	I can recognize the signs of climate change, such as irregular rainfall, rising temperatures, or drought, and their effects on crops.	3.09
3	I am aware of how climate change impacts crop growth, yield, and overall farm productivity.	3.04
4	I have knowledge of farming practices that reduce the negative effects of climate change on crop production.	2.94
5	I can identify specific strategies to cope with drought, flooding, or other climate-related hazards affecting crops.	2.95
6	I have received training or information on climate change adaptation practices that improve crop production from extension officers, NGOs, or media.	3.08
7	I am aware of how to apply climate-smart agricultural practices to maintain or improve crop productivity.	2.94
8	I can use weather forecasts or seasonal climate information to plan crop planting, management, and harvesting.	2.92
Overall mean		2.99

Source: Field Survey, 2025

Perceived Effectiveness of Climate Change Adaptation Practices

The table 5 showed that the highest mean score ($\bar{x} = 3.12$) was recorded for “Farmers can effectively adapt to climate change with proper awareness and support,” highlighting the critical role of knowledge, institutional guidance, and extension services in enhancing adaptive capacity (Akintobi, 2023). Moderate agreement was observed for statements on reduced farming income due to climate change ($\bar{x} = 3.07$) and increasing temperatures ($\bar{x} = 2.97$), indicating that farmers are already experiencing negative impacts on crop production and livelihoods (Ajewole, AbduRaheem, & Fadumila, 2023). Lower perception scores were found for government and extension support ($\bar{x} = 2.92$) and individual efforts to reduce impacts ($\bar{x} = 2.85$), suggesting gaps in institutional assistance and the need for practical interventions to improve adaptation effectiveness. These results align with FAO (2021) and IPCC (2022), which report that limited access to extension services, climate information, and inputs constrains farmers’ capacity to implement adaptation strategies. Moderate standard deviations (1.379–1.432) indicate variability in perceptions, likely influenced by differences in farm size, education, experience, and access to support, with better-supported farmers more likely to perceive adaptation measures as effective.



Table 5: Distribution of Respondents Based on Perceived Effectiveness of Climate Change Adaptation Practices (n = 272)

S/N	Statement	SA	A	U	D	Mean
1	Climate change is real and already affecting farming in my community.					2.90
2	The weather is hotter now than it used to be.					2.97
3	Rainfall has become more unpredictable over the years.					2.73
4	Climate change is a serious threat to crop production in my area.					3.00
5	My farming income has reduced due to the effects of climate change.					3.07
6	Farmers can effectively adapt to climate change with proper awareness and support.					3.12
7	The government and extension services are doing enough to help farmers adapt to climate change.					2.92
8	I believe that individual farmers' efforts can reduce the impact of climate change on their farms.					2.85
Overall mean						2.96

Source: Field Survey, 2025

Perceived Effectiveness of Adaptation Practices

The results in table 6 showed that adjusting planting dates was recognized as an effective strategy to cope with erratic rainfall and temperature changes, reflecting farmers' efforts to align cropping activities with changing climatic patterns, as observed in southwestern Nigeria (Springer, 2025). Drought-resistant varieties and irrigation systems were also considered effective, indicating farmers' awareness of water management and resilient crop genotypes, although adoption may be limited by access to inputs and capital (Oyetunde Usman & Shee, 2023; ScienceDirect, 2024).

Tree planting and agroforestry received the highest mean score ($\bar{x} = 3.09$), demonstrating farmers' recognition of multiple benefits, including soil improvement, moisture retention, and additional food and income sources, consistent with findings in Southeast Nigeria (Ashiegbu *et al.*, 2025). Other strategies, such as organic manure application, soil conservation, and mixed/intercropping, were perceived as moderately effective, contributing to soil fertility, risk diversification, and longterm sustainability, though labor intensity and technical knowledge may limit their adoption (Sustainability, 2023; AIMS Press, 2019). Overall, the moderate effectiveness score suggests that while farmers value adaptation strategies, constraints such as limited extension services, insufficient capital, and restricted access to improved inputs temper both perception and practical adoption, highlighting the need for targeted policy and extension interventions to improve climatesmart agriculture uptake (Agriculture & Food Security, 2025).



Table 6: Distribution of Respondents According to Perceived Effectiveness of Adaptation Practices

S/N	Adaptation Practice	Minimum	Maximum	Mean
1	Adjusting planting dates to suit rainfall patterns	1	5	3.03
2	Use of drought-resistant crop varieties	1	5	3.04
3	Mixed cropping and intercropping	1	5	2.99
4	Use of irrigation systems	1	5	3.04
5	Soil conservation techniques (terracing, contour farming)	1	5	3.00
6	Tree planting and agroforestry	1	5	3.09
7	Application of organic manure	1	5	3.06
Overall Mean				3.04

Source: Field Survey, 2025

Perceived Constraints to Adaptation Practices

The results in table 7 showed that the most significant constraints to climate change adaptation among farmers were lack of access to credit, inadequate extension services, and high cost of improved inputs, with mean scores above 3.5. This implies that financial limitations, poor access to information, and high input costs remain major barriers to adopting climate-smart practices, consistent with findings from Sustainable Agriculture Research (2023) and Agriculture & Food Security (2025). Moderately cited constraints included poor access to weather forecasts, land degradation, and limited irrigation facilities, reflecting challenges in planning, maintaining productivity, and practicing dry-season farming. Additional barriers such as unstable government policies, limited market access, poor road infrastructure, inadequate training, insecurity, and weak cooperative support further hinder farmers' collective capacity to implement adaptation measures, aligning with studies on smallholder resilience in conflict-affected and resource-constrained areas of Nigeria (Mdpi Sustainability, 2023; CABI Agriculture & Bioscience, 2023). Overall, the findings indicate that while farmers are aware of adaptation strategies, structural, financial, informational, and institutional constraints limit effective implementation, emphasizing the need for integrated interventions including access to credit, extension services, market development, and community-based cooperation.

Table 7: Distribution of Respondents According to Perceived Constraints to Adaptation Practices (N=272)

S/N	Constraint	Minimum	Maximum	Mean
1	Lack of access to credit	1	5	3.58
2	Inadequate extension services	1	5	3.63
3	High cost of improved inputs	1	5	3.66
4	Poor access to weather forecasts	1	5	3.02
5	Land degradation and soil erosion	1	5	3.00
6	Lack of irrigation facilities	1	5	3.27
7	Unstable government policies	1	5	3.16
8	Limited access to markets	1	5	3.09
9	Poor road and transport infrastructure	1	5	3.10
10	Inadequate training and awareness	1	5	3.26
11	Insecurity and conflicts in farming areas	1	5	3.21
12	Lack of farmer cooperative or group support	1	5	3.08
Overall Mean				3.28

Source: Field Survey, 2025



Suggested Strategies to Enhance Farmers' Awareness and Perception of Adaptive Practices

The findings in Table 8 demonstrated strong support for multi-faceted interventions to enhance farmers' adaptive capacity, with government subsidies on climate-smart inputs ($x = 4.24$) and regular training and sensitization programs ($x = 4.21$) receiving the highest levels of agreement. Farmers prioritized structured education and strengthened extension services ($x = 4.18$) to gain technical skills, interpret climate risks, and adopt climate-smart technologies (Izuogu *et al.*, 2025; Sustainability, 2023; FAO, 2021; IPCC, 2022). High ratings for improving early warning systems ($x = 4.10$) and expanding credit access ($x = 4.05$) highlight the urgent need to mitigate financial barriers and provide reliable weather forecasts for operational planning (Agriculture & Food Security, 2025; Sustainable Agriculture Research, 2023). Additionally, respondents endorsed collaboration with research institutes ($x = 3.92$) and the inclusion of youth and women ($x = 3.85$), underscoring that combining institutional research, inclusive extension contact, financial subsidies, and accurate climate intelligence is essential for promoting sustainable, smallholder-led adaptation (Ashiegbu *et al.*, 2025).

Table 8: Distribution of Respondents According to Suggested Strategies to Enhance Farmers' Awareness and Perception of Adaptive Practices

S/N	Suggested Strategy	Minimum	Maximum	Mean
1	Regular training and sensitization programs on climate change should be organized for farmers.	1	5	4.21
2	Strengthening agricultural extension services will improve farmer awareness.	1	5	4.18
3	Access to credit facilities should be expanded to support adaptation efforts.	1	5	4.05
4	Government should subsidize climate-smart agricultural inputs.	1	5	4.24
5	Collaboration between farmers and research institutes should be promoted for technology transfer.	1	5	3.92
6	Early warning systems should be improved for better weather forecasting.	1	5	4.10
7	Youth and women should be actively involved in climate change awareness programs.	1	5	3.85
	Overall Mean			4.08

Source: Field Survey, 2025

CONCLUSION AND RECOMMENDATION

Based on the findings, it was concluded that crop farmers in the study possess moderate awareness, perception, and adoption of climate change adaptation practices. Awareness significantly influences the adoption of adaptive strategies, confirming its central role in building resilience against climate variability. The study highlights that farmers' adaptive capacity is shaped not only by their knowledge and perception but also by access to resources, institutional support, and structural conditions. Addressing these factors is critical to enhancing the effectiveness and sustainability of climate adaptation strategies in the agricultural sector.

Based on the findings, the following recommendations are proposed:

- Agricultural training programs should target younger farmers and those with higher education levels, as these groups demonstrate a greater willingness to adopt modern climate-smart technologies.



- ii. Stakeholders should provide training on formal climate knowledge, such as the use of weather forecasts and identifying the precise onset and cessation of the rainy season, to supplement farmers' current experiential knowledge.
- iii. Government and stakeholders provide support to farmers in order to enable them adopt technical or resource-heavy practices like organic manure application or adjusting schedules based on forecasts, government support is needed to make these methods more accessible.
- iv. Extension agents should intensify awareness campaign on agroforestry to strengthen farmers that perceive tree planting and agroforestry as highly effective.
- v. Policies should focus on overcoming structural barriers by providing access to credit, subsidizing climate-smart inputs, and strengthening agricultural extension services.
- vi. Reliable and timely weather forecasting and early warning systems should be established to help farmers plan their operations and reduce vulnerability to climate shocks.

REFERENCES

- Adebayo, O. O., Ojo, T. O., & Otunaiya, A. O. (2022). Impact of climate-smart agricultural practices on rainfed crop yields and farmers' welfare in Nigeria. *Climate Risk Management*, **35**: 100412.
- Adegbite, O. O., Adekunle, C. P., & Oyawole, F. P. (2021). Resource constraints and adaptive capacity of smallholder crop farmers to climate variability in Nigeria. *Journal of Agricultural Extension and Rural Development*, **13**(2): 85–94.
- Adekunmi, A. O. (2022). Technical knowledge gaps and adoption dynamics of climate-smart agronomic practices in West Africa. *African Journal of Agricultural Research*, **18**(4), 210–221.
- Agriculture & Food Security. (2025). Institutional interventions, credit access, and climate adaptation among sub-Saharan smallholders. *Agriculture & Food Security*, **14**(1): 12–23.
- AIMS Press. (2019). Soil fertility management and agroecological adaptation among tropical crop producers. *AIMS Geosciences*, **5**(3): 412–428.
- Ajewole, O. C., Abdu-Raheem, K. A., & Fadumila, B. O. (2023). Knowledge, perception, and local coping strategies for climate-related agricultural hazards among smallholders in southwestern Nigeria. *Journal of Agricultural Science and Technology*, **25**(3): 511–524.
- Akintobi, O. A. (2023). Institutional guidance and extension support in scaling climate-smart agriculture among smallholder farmers in Nigeria. *Journal of Agricultural Education and Extension*, **29**(2): 175–192.
- Akinwale, J. O., & Adeola, A. A. (2020). Gender dynamics and structural barriers in agricultural decision-making and climate adaptation in rural Nigeria. *Gender, Technology and Development*, **24**(1): 45–63.
- Ashiegbu, U. C., Nwosu, C. S., & Echebiri, R. N. (2025). Agroforestry adoption and perception of effectiveness for soil and moisture conservation in Southeast Nigeria. *Agroforestry Systems*, **99**(1): 102–115.
- CABI Agriculture & Bioscience. (2023). Smallholder resilience and agricultural adaptation under conflict and extreme climate events in sub-Saharan Africa. *CABI Agriculture and Bioscience*, **4**: 19–30.
- Copernicus Climate Change Service. (2024). Global climate highlights 2023: Global temperatures exceed 1.48°C pre-industrial benchmark. European Centre for Medium-Range Weather Forecasts.
- Federal Ministry of Environment. (2021). National Climate Change Policy for Nigeria 2021–2030. Federal Republic of Nigeria.
- Food and Agriculture Organization. (2021). The state of food and agriculture 2021: Making agrifood systems more resilient to shocks and stresses. FAO.
- González, R., & Sánchez, M. (2021). Digital climate information services and youth engagement in climate-smart agriculture. *Computers and Electronics in Agriculture*, **188**, Article 106340.
- Intergovernmental Panel on Climate Change. (2021). Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental



- Panel on Climate Change (V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, C. Berger, ... B. Zhou, Eds.). Cambridge University Press.
- Intergovernmental Panel on Climate Change. (2022). Climate change 2022: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (H.-O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, C. Mintenbeck, A. Alegría, ... B. Okem, Eds.). Cambridge University Press.
- Intergovernmental Panel on Climate Change. (2023). Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, H. Lee, & J. Romero, Eds.). IPCC.
- Izuogu, C. U., Nwaiwu, I. U., & Okoye, B. C. (2025). Effectiveness of structured training programs on farmer adoption of climate-smart agricultural practices. *Journal of Agricultural Extension*, **29**(1): 34–45.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, **30**(3): 607–610.
- Larson, E., Greig, C., & Jenkins, J. (2023). Net-zero America: Potential pathways, infrastructure, and impacts under state and federal policy frameworks. Princeton University Press.
- Madaki, M. Y., Muench, S., Kaechele, H., & Bavorova, M. (2022). Climate change knowledge and perception among farming households in Nigeria. *Research Square Platform LLC*.
- MDPI Sustainability. (2023). Institutional and structural constraints to climate-smart agricultural adoption among West African smallholders. *Sustainability*, **15**(12): 9412.
- Multidisciplinary Digital Publishing Institute. (2023). Socio-demographic determinants of climate adaptation among smallholder farmers. *MDPI Agriculture*, **13**(4): 812–820.
- National Emergency Management Agency. (2022). Report on flood disasters and displacement across Nigeria in 2022. *Federal Republic of Nigeria*.
- National Oceanic and Atmospheric Administration. (2023). Trends in atmospheric carbon dioxide: Monthly mean CO₂ at Mauna Loa Observatory. NOAA Global Monitoring Laboratory.
- National Population Commission. (2023). Demographic projections and rural population density estimates. Federal Republic of Nigeria.
- Nigerian Meteorological Agency. (2022). 2022 Seasonal climate prediction (SCP): Shifting precipitation patterns and extreme weather events in Nigeria. NiMet Office.
- Oluwaseun, A. B., Adeleke, O. A., & Taiwo, A. M. (2021). Gender disparities in structural access to resources and climate change adaptation in smallholder farming systems. *World Development Perspectives*, **23**: 100345.
- Onyeneke, R. U., Emenekwe, C. C., & Amadi, M. U. (2022). Climate change vulnerability and crop yield variability among smallholder farmers in the Guinea Savannah zone of Nigeria. *Environmental Development*, **42**: 100701.
- Oruonye, E. D., & Adebayo, A. A. (2015). Assessment of farmers' perception of climate change in Taraba State, Nigeria. *International Journal of Geography and Regional Planning*, **1**(1): 12–22.
- Oyetunde-Usman, Z., & Shee, A. (2023). Adoption of drought-resistant crop varieties and sustainable water management practices under changing climatic conditions in West Africa. *Agricultural Water Management*, **281**: 108250.
- Philip, S., Kew, S. F., van Oldenborgh, G. J., Yang, W., Vecchi, G. A., & Anslow, F. S. (2022). Rapid attribution analysis of extreme heatwaves and severe precipitation events. *Climatic Change*, **172**(1): 1–18.
- ScienceDirect. (2024). Agricultural water management and adaptive crop choices under rainfall variability in West Africa. *Science of The Total Environment*, **912**: 168920.
- Springer. (2020). Climate change vulnerability, adaptation dynamics, and agricultural resilience in Sub-Saharan Africa. *Springer Climate*, **12**(2): 145–162.
- Sustainability. (2023). Sustainable soil conservation and organic amendment adoption among smallholder farmers in sub-Saharan Africa. *Sustainability*, **15**(8): 6540.



- Sustainable Agriculture Research. (2023). Smallholder barriers to climate-smart input adoption and extension outreach in developing nations. *Sustainable Agriculture Research*, **12**(2): 45–58.
- Taraba State Agricultural Development Programme. (2022). Annual report on crop production, extension contact, and climate vulnerability in Agricultural Zone One. TADP Office.
- Taraba State Agricultural Development Programme. (2023). Extension block distribution and zonal agricultural output report. TADP Office.
- Taraba State Government. (2021). Taraba State policy framework on agricultural resilience, environment, and rural adaptation. Ministry of Agriculture and Natural Resources.
- Tyabo, I. S., Ahmed, M. A., & Ibrahim, M. K. (2023). Evaluation of smallholder adaptation strategies to erratic rainfall and dry spells in northern Nigeria. *Journal of Agricultural and Rural Development in the Tropics and Subtropics*, **124**(2): 145–156.
- United Nations Environment Programme. (2023). Emissions gap report 2023: The broken record – Temperatures hit new highs, yet world fails to cut emissions (again). UNEP.
- U.S. Global Change Research Program. (2023). Fifth national climate assessment (N. A. Basu, R. S. Pulwarty, & C. W. Avery, Eds.). USGCRP.
- Williams, A. P., Cook, B. I., & Smerdon, J. E. (2022). Rapid intensification of the emerging southwestern North American megadrought in 2020–2021. *Nature Climate Change*, **12**(3): 232–234.
- World Meteorological Organization. (2023). State of the global climate 2022 (WMO-No. 1316). World Meteorological Organization.
- World Meteorological Organization. (2024). State of the climate in Europe 2023 (WMO-No. 1342). World Meteorological Organization.