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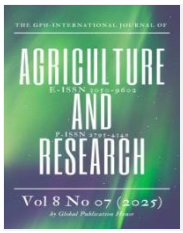

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ANALYSIS OF FACTORS INFLUENCING THE ADAPTATION PRACTICES TO CLIMATE CHANGE AMONG RICE (*Oryza sativa*) FARMERS IN WUKARI LOCAL GOVERNMENT AREA, TARABA STATE, NIGERIA

By:

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Abstract:

This study assessed the factors influencing the adaptation practices to climate change among rice farmers in Wukari Local Government Area of Taraba State, Nigeria. The specific objectives were to: describe the socioeconomic characteristics of rice farmers, determine the factors influencing the adaptation practices to climate change by rice farmers and to identify the constraints of the adoption of adaptation practices towards climate change. A multistage sampling technique was used to select 245 rice farmers across five wards. Data were collected using structured questionnaire and analyzed through descriptive statistics, multiple regression analysis and Likert scale rating. Results showed that the farmers are middle-aged (mean of 41.6 years), married (77.1%), and male (81.2%), with moderate household sizes (mean of 6 members). Many had no formal education (46.9%). Multiple regression analysis identified age($\beta = 0.032467$), education level($\beta = 0.035128$), household size($\beta = 0.237546$), and cooperative membership ($\beta = 0.054872$) all significant at $p < 0.001$as positive determinants of adaptation practice adoption, while farm size ($\beta = -0.022156, p < 0.001$) showed a negative relationship. Financial constraints ($\bar{x}=4.560$),inadequate irrigation infrastructure($\bar{x}=4.408$), and change from traditional methods($\bar{x}=4.326$) emerged as the most significant constraints to adaptation. The study recommends enhanced access to financial services, improved infrastructure development, targeted climate education programs, and farmers should be encouraged to join cooperative groups.

Keywords:

Climate change, Adaptation practices, Rice farmers, Constraints to adaptation practices.

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INTRODUCTION

Agriculture has been considered one of the most susceptible sectors to the adverse influence of climate change (Masud et al.,2017). The agricultural sector is positioned to continuously experience the impact of climate change manifesting directly from changes in land and water regimes. Some causes for food insecurity and poverty can be traced to the vulnerability of agriculture to production hazards, which ultimately affect the income of farmers (Ojo & Baiyegunhi, 2019). The potentially negative impacts of climate change on crop yield and farmers' livelihood are predicted to increase the number of hungry people globally by 20% by 2050 (Ojo & Baiyegunhi, 2021).The consequence of climate change on food security and poverty relies on several interacting factors such as the timing of extreme events which are predicted to become more recurring in the future (Kusangaya, et al., 2014).

Feeding the world's growing population under climate uncertainties is a major challenge facing farmers in both developed and developing nations (Zama, et al., 2021). The evidence of climate change is real, and its consequences are being felt globally, with poor rural households in developing countries bearing the brunt of the burden (Danso-Abbeam, et al., 2021), due to warm climate and level of poverty that impede their capacity to mitigate the effect of climate change through the use of adaptation strategies (Ojo & Baiyegunhi, 2021). Kaur (2017) stated that globally climate change has been considered to have catastrophic effects on the planet earth especially developing countries including Nigeria. Nasiru (2018) reported that farmers in Nigeria are vulnerable to the effects of changing climate and in 2022 alone, flooding destroyed significant metric tons of rice in the country. Based on Ajah et al. (2017) future changes in climate are expected to have devastating consequences on agricultural production and wreak havoc on farmers' livelihoods. Small-scale rice farmers who are already poor might become poorer, except challenges confronting them as regard to adaptation strategies climate change are well taken note of (Akeem, 2022).

Climate change is the variation in the statistical distribution of average weather conditions over a prolonged period of time from 30-35 years and above in any region of the world (Ikeh, et al., 2014). The Inter-governmental Panel on Climate Change (IPCC, 2007) also defined climate change as a change in the state of the climate that can be identified by changes in themean and/or the variability of its properties and persists for an extended period typically decades or longer, whether due to natural variability or as a result of human activity. It reflects abnormal variations to the expected climate within the earth's atmosphere and subsequent effects on other parts of the earth which has extensive impacts on the already daunting challenges facing sustainable development, especially in Sub-Saharan Africa (Agyo & Ornan, 2021).Indicators of climate change include irregular rainfall, mostly with continuous salt stress, prolonged drought, incidence of flood, and temperature changes impact agricultural productivity, with the impacts of each varying in different regions of the world (Ojo & Baiyegunhi, 2019). In Nigeria, the impact of this change in climate are becoming more intense, this is occasioned by the increase in flooding, drought and general rainfall fluctuation experienced in the country in the past few years (Ifeanyi-Obi, et al., 2017). To attain a sustainable level of output, farmers are expected to take adaptation measures to cope with risks posed by climate change on their productive activities (Ojo & Baiyegunhi, 2020).

Nigeria is one of the countries in the world that has the potentials to produce rice (Oryza sativa) in larger quantity (Idoma, et al., 2017). This is a fact because Nigeria has an estimated 4.6 million hectares of land that is suitable for rice production (Danbaba, et al., 2013). Rice is one of the major crops cultivated in Nigeria, and it plays a very significant role in food security and provision of employment (Umar, et al., 2020). It is also a major food crop in sub-Saharan because it has become a substantial source of calories to the diets of the inhabitants of the region (Macauley & Ramadjita, 2015). However, in Nigeria, rice production is already under pressure on the demand side due to population growth, whereas the supply side is further exposed to natural pressures through climate change (Idoma, et al., 2017). Rice output in Nigeria, in general, will need to expand in order to meet future population growth. Any decrease in rice yield as a result of climate change would jeopardize the food security efforts of Africa's most populous country (Onyeneke, et al., 2021).

Climate change poses a significant threat to agricultural productivity and food security in Nigeria, particularly in Wukari Local Government Area (LGA) of Taraba State, where rice farming is a primary livelihood for smallholder farmers. They experience climate change effects such as delayed onset date of rains, increase in number of dry days during the raining season and increase in maximum temperature (Angye et al., 2024). While farmers in Wukari LGA have begun adopting adaptation strategies, such as changing cropping pattern, irrigations, crop diversification, mixed cropping and livestock farming systems, using different crop varieties, changing planting and harvesting dates, increasing use of water and soil conservation techniques and diversifying from farm to non-farm activities to cope up with climate change (Egunsola et al.,2022), they are still constrained by inadequate capital and lack of credit facilities, inadequate extension services, low level of farmers' education, low level of climate change awareness,land tenure system, and poor infrastructural facilities such as irrigation facility and dams (Agyo & Ornan, 2018).

A growing body of research highlights the role of socioeconomic factors in shaping farmers' adaptive capacity, including access to credit, education, land tenure systems, and gender dynamics (Ajayi et al., 2022). For instance, studies in Taraba State reveal that inadequate capital, limited access to extension services, and low education levels constrain farmers' ability to adopt advanced practices like Alternate Wetting and Drying (AWD) or climate-resilient rice varieties (Oluwatusin et al., 2023). Similarly, gender disparities exacerbate vulnerabilities, as women, who constitute a significant portion of the agricultural workforce often face restricted access to land, credit, and decision-making power, further limiting their adaptive responses (Adepoju & Adekola, 2023).

The lack of targeted analysis in Wukari LGA undermines the design of effective policies to enhance resilience. For instance, while interventions such as the Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) aim to alleviate credit constraints nationally, their impact on Wukari's smallholders, who often lack collateral or financial literacy, remains unclear (Federal Ministry of Environment, 2022). Similarly, the efficacy of digital media in disseminating climate information or training programs tailored to local agroecological conditions has not been systematically evaluated (Eze et al., 2023). Without

addressing these gaps, climate-induced yield losses could deepen poverty cycles, threaten food security, and exacerbate rural-urban migration in Taraba State (FAO, 2022).

Specifically, the study seeks to:

Describe the socioeconomic characteristics of the rice farmers in the study area

2. Determine the factors influencing the adaptation practices to climate change
3. Identify the constraints to adoption of adaptation practices towards climate change.

This study addresses a critical gap in the literature by focusing on the factors influencing the adaption practices to climate change among rice farmers in Wukari Local Government Area. By producing empirical evidence, it informs policies that bridge resource gaps, empower marginalized groups, and promote sustainable agricultural livelihoods in the face of escalating climate risks.

Materials and Methods

The study was conducted in Wukari Local Government Area of Taraba State. It is located between latitude 7˚51'N to 7˚85'N and longitude 9˚46'E to 9˚78'E of the Greenwich meridian. Wukari Local Government Area is situated in the Southern part of Taraba State. It is bounded in the North by Gassol LGA, in the East by Donga LGA, in the South by Benue State, and in the West by Nasarawa State and Ibi LGA of Taraba State (Tikon *et al.*,2021). Wukari covers an area of approximately 4,308 square kilometers and has a population of 318,400 (NPC, 2016).There are ten wards in Wukari LGA namely, Awkana, Avyi, Bantaje, Chonku, Hospital, Jibu, Kente, Puje, Rafin Kada and Tsokundi (Tikon *et al.*,2021). Wukari Local Government Area is dominated by Jukuns ethnic group with Hausa, Igbo, Yoruba, Tiv, Idoma among other ethnic groups as minorities, whose main occupations are farming, livestock rearing and trading. The major crops grown in the area are yam, cassava, groundnut, maize, sorghum, millet, rice and tree crops (Kehinde, *et al.*, 2015). A multistage sampling technique was used to select the respondents for the study.

In the first stage, five wards (Banteje, Jibu, Puje, Tsokundi and Rafin Kada) were randomly selected from the ten wards in the local government area. In the second stage, two villages were randomly selected, totaling ten villages. The last stage involved the application ofproportional factor to determine the number of the respondents. The Cochran's method for sample size determination was used to determine the sample size for this study at 94% confidence level and 6% margin of error.
It is expressed mathematically as;

$$n_0 = \frac{z^2 pq}{e^2} \quad \text{..... (1)}$$

n_0= Sample size,
z = is the selected critical value of desired confidence level,

p = is the estimated proportion of an attribute that is present in the population,

q = 1 - p and

e = desired level of precision.
p = q = 0.5
e = 0.06
z = 1.88

$$n_0 = \frac{1.88^2 \times 0.5 \times 0.5}{0.06^2} = 245.4444 \approx 245$$

The sample frame which is the list of rice farmers in the selected communities were compiled with the assistance of staff of Agricultural Development Programme (ADP), resident extension agents, officials offarmers association and community leaders. Primary data, collected with the aid of a well-structured questionnaire was used in the study.

The multiple regression model was used to determine the factors contributing to the adaptation practices towards climate change adopted by rice farmers. However, this study applied the four functional such as linear, semi-log, double log and exponential functions to determine the relationship between the dependent and independent variables.

Model specifications.

i. **Linear function**

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon \ldots\ldots\ldots\ldots\ldots (2)$$

ii. **Exponential function**

$$log\ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon \ldots\ldots\ldots (3)$$

iii. **Double -log function**

$$logY = log\beta_0 + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 + \beta_4 logX_4 + \beta_5\ logX_5 + \beta_6\ logX_6 + \beta_7 logX_7 + \beta_8 logX_8 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

iv. **Semi-logfunction**

$$Y = log\beta_0 + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 + \beta_4 logX_4 + \beta_5\ logX_5 + \beta_6\ logX_6 + \beta_7 logX_7 + \beta_8 logX_8 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where:

Y= Number of adaptation practices adopted (dependent variable)

β_0= Intercept or constant term

β1-β8 = Parameters to be estimated

X_1 = Age (Years)

X_2 = Education level (Years spent in school)

X_3= Household size(Numbers)

X_4 = Farming experience (Years)

X_5 = Farm size (hectares)

X_6 = Cooperative membership (years of membership)

X_7 = Land ownership (lease = 1,family land =2, inherited = 3,own land = 4)

X_8=Extension contacts (number of contacts)

ε=error term

A Likert scale is a commonly used tool in research surveys to measure respondents' attitudes, opinions and perceptions. It provides a range of response options, typically from "strongly disagree" to "strongly agree", that allows respondents to indicate their level of agreement or disagreement with a statement.The likert scale rating was used identify the constraints to adoption of adaption practices towards climate change. It was categorized as:

Very High Extent (VHE) = 5 points

High Extent (HE) = 4 points

Medium Extent (ME) = 3 points

Low Extent (LE) = 2 points

Very Low Extent (VLE) = 1 points

RESULTS AND DISCUSSION

Socioeconomic characteristics of rice farmers in the study area

Descriptive statistics such as mean, percentage, and frequency distribution was employed to describe the socioeconomic characteristics of the respondents. Table 1 shows the result of the socioeconomic characteristics of the rice farmers in the study area. Rice farmers in Wukari LGA are predominantly middle-aged, with (48.20%) aged 38-57 years and (40.40%) aged 18-37 years. Only (11.40%) are old farmers (58-68 years) with a mean age of 41.6 years. This means that the respondents are in their active years and therefore, they are strongenough to engage in agricultural practices more than the older farmers. The result aligns with recent findings by Adebayo and Olanrewaju (2022), who reported an average age of 44.3 years among rice farmers in Taraba State. This age structure suggests accumulated farming experience but raises concerns about youth engagement in agriculture, which Nwachukwu et al. (2024) identified as crucial for long-term agricultural sustainability.

The gender distribution of respondents, reveals a significant disparity among rice farmers in Wukari LGA, with males constituting an overwhelming majority (81.2%) compared to females (18.8%). This implies that there are male farmers than female in the study area. This substantial gender imbalance reflects persistent trends documented by Yusuf and Abdullahi (2023), who reported that women's participation in commercial rice farming across Northern Nigeria remained below (22%) despite increasing involvement in agricultural activities.

Abubakar et al. (2022) attributed this gender gap to socio-cultural factors, land tenure systems, and unequal access to production resources.

The marital status distribution of respondents reveals that vast majority of rice farmers in Wukari LGA (77.6%) are married, while (18.4%) are single, (2.9%) are widowed, and only (1.2%) are divorced. It indicates that majority of the respondentswere saddled with the responsibility of cateringfor their families. This can create the need for portfolio diversification as a climate change adaptation strategy, in order to meet the various needs of the family members. This predominance of married farmers aligns with findings by Abubakar et al. (2023), who reported that (74.8%) of agricultural households in Northern Nigeria were headed by married individuals.

The distribution of respondents' household sizes, with the majority (53.9%) of rice farmers in Wukari LGA have relatively small households of 1-5 members, followed by (24.9%) with 6-10 members, (20.8%) with 11-15 members, and only (0.4%) with 16-20 members. The mean household size is 6 members with a standard deviation of 4.3, indicating moderate variability in household composition. The findings suggest availability of labour force for farming in the study area. This may imply thathouseholds have labour source which is needed in farming activity. This finding is consistent with Yusuf et al. (2022), who reported an average household size of 6.8 among smallholder farmers in North-Eastern Nigeria. According to Musa and Ibrahim (2021), household size significantly influences climate adaptation decisions, as larger households typically have more labor available for implementing adaptation practices but face greater resource constraints.

The educational background of respondents also shows that nearly half (46.9%) of rice farmers in Wukari LGA have no formal education, followed by those with primary education (20.8%), secondary education (18.8%), and tertiary education (13.5%). This indicate that a good number of the respondents have relatively low access to formal education. This educational profile aligns with findings by Ibrahim et al. (2022), who reported that approximately (43%) of smallholder farmers in North-Eastern Nigeria lacked formal education. According to Adamu and Musa (2023), the high prevalence of limited educational attainment among farmers significantly impacts their climate adaptation capacity, as education influences information access and technological adoption.

The table also presents the distribution of respondents' farming experience reveals that the majority (56.7%) of rice farmers in Wukari LGA have relatively limited experience (1-15 years), followed by those with moderate experience of 15-30 years (24.9%), and those with extensive experience of 31-45 years (19.2%). The mean farming experience is 17.0 years with a standard deviation of 12.4, indicating long term knowledge in rice production and will help them in making decisions regarding adopting climate change adaptation practices. This finding aligns with Adamu et al. (2023), who reported an average farming experience of 18.5 years among rice farmers in Northern Nigeria. According to Ibrahim and Musa (2022), farming experience significantly influences climate adaptation decisions, as more experienced farmers often demonstrate better understanding of local climate patterns and appropriate response strategies.

The distribution of the respondents' membership in cooperative societies showing that a significant majority (80.0%) of rice farmers in Wukari LGA are members of cooperative societies, while only (20.0%) are non-members. This high cooperative membership rate exceeds findings by Mohammed *et al.* (2022), who reported (65%) cooperative participation among smallholder farmers in North-Central Nigeria. The strong cooperative engagement aligns with Adebayo and Idris (2023), who found increasing cooperative membership among Nigerian farmers as a climate adaptation strategy. According to Ibrahim and Yusuf (2021), cooperative membership significantly enhances farmers' access to climate information, agricultural inputs, and adaptation technologies through collective bargaining and resource pooling. Aliyu *et al.* (2024) established that cooperative member were 1.7 times more likely to adopt improved climate-resilient rice varieties compared to non-members due to better access to extension services and credit facilities.

Table 1: Socioeconomic characteristics of rice farmers in Wukari Local Government Area

Variable	Frequency	Percentage	Mean	Standard deviation
Age				
18–28	44	18.00		
29–37	55	22.40	41.6	12.4
38–47	58	23.70		
48–57	60	24.50		
58–68	28	11.40		
Gender				
Male	199	81.22		
Female	46	18.77		
Marital status				
Single	46	18.80		
Married	189	77.10		
Divorced	3	1.20		
Widowed	7	2.90		
Household Size				
1–5	132	53.90		
6–10	61	24.90	6	4.3
11–15	51	20.80		
16-20	1	0.40		
Educational level				
Non formal education	115	46.90		
Primary	51	20.80		
Secondary	46	18.80		
Tertiary	33	13.50		
Farming Experience				
1–15	139	56.70	17	12.4
16–30	61	24.90		
31–45	45	19.20		
Cooperative membership				
Yes	196	80		
No	49	20		
Total	245	100		

Source: Field Survey, 2025

Factors influencing adaptation practices to climate change among rice farmers

As revealed in Table 2, The log-linear (Semi Log) model specification of the multiple regression yields an excellent fit with an adjusted R-squared value of 0.8613, indicating that approximately (86.13%) of the variation in the logarithm of adaptation practices adopted by rice farmers is explained by the independent variables included in the model.

This high explanatory power suggests that the model captures most of the key factors influencing farmers' adaptation decisions, revealing a complex interplay of demographic, socioeconomic, and institutional factors that collectively shape rice farmers' adaptation behavior.

The analysis demonstrates that age plays a crucial role in adaptation decisions, with the coefficient (0.032467) being positive and highly significant ($p < 0.001$), suggesting that older farmers are more likely to adopt adaptation practices. For each additional year of age, the adaptation practices adoption increases by approximately 3.25%, holding other factors constant. This aligns with findings by Abdulai *et al*. (2023), who found that older farmers tend to have accumulated more knowledge and experience regarding climate variability, making them more likely to implement adaptation strategies.

Education emerges as another critical determinant, showing a strong positive relationship (0.035128, $p < 0.001$) with adoption of adaptation practices, where each additional year of formal education is associated with approximately 3.51% increase in adaptation practices. According to Nguyen *et al.* (2021), education enhances farmers' capacity to process information and understand the benefits of climate-smart agricultural practices.

Household size demonstrates a substantial positive effect (0.237546, $p < 0.001$) on adaptation practices, suggesting that larger households are better positioned to adopt more adaptation practices, likely due to greater labor availability. Rahman and Alam (2022) noted that adaptation measures often require additional labor inputs, making households with more members better equipped to implement diverse practices.

Interestingly, farm size shows a significant negative relationship (-0.022156, $p < 0.001$) with adaptation practices, suggesting that smaller farms adopt more adaptation practices per unit area. This finding indicates that resource constraints on smaller farms may drive farmers to implement more intensive and diversified adaptation strategies to maximize productivity on limited land, which is consistent with research by Kumar *et al*. (2021), who found that smaller landholders often implement more intensive adaptation strategies.

The institutional dimension is captured through cooperative membership, which shows a positive influence (0.054872, $p < 0.001$) on the adoption of adaptation practices, with farmers who belong to cooperatives showing approximately (5.49%) higher adoption rates compared to non-members. This effect works synergistically with other factors, as cooperatives provide platforms for knowledge sharing that can enhance the benefits of education, facilitate resource pooling that can support larger households in implementing labor-intensive practices, and offer technical support that can be particularly valuable for older, more experienced farmers seeking to adopt new technologies. Danso-Abbeam *et al.* (2022) emphasized that cooperatives provide platforms for knowledge sharing,

pooled resources, and enhanced access to inputs necessary for implementing adaptation measures.

The model reveals that these factors do not operate in isolation but interact in complex ways to influence adaptation decisions.The accelerating returns to education suggest that farmers with higher levels of formal education can leverage their knowledge more effectively, while cooperative membership provides the institutional support that can amplify the benefits of individual characteristics. The negative relationship with farm size suggests that adaptation intensity may be driven more by necessity and resource optimization on smaller farms rather than simply by resource availability, indicating that adaptation strategies are context-specific and influenced by the interplay of multiple constraining and enabling factors.

Table 2: Factors influencing the adaptation practices to climate change among rice farmers.

Variable	**Coefficient (B)**	**Std. Error**	**t-value**	**p-value**
(Constant)	0.872634***	0.028033	31.13	0.000
Age (X_1)	0.032467***	0.002128	15.26	0.000
Education Level (X_2)	0.035128***	0.035128	17.13	0.000
Household Size (X_3)	0.237546***	0.019184	12.38	0.000
Farming Experience(X_4)	-0.019843***	0.005217	-3.80	0.000
Farm Size (X_5)	-0.022156***	0.001929	-11.49	0.000
Cooperative Membership (X_6)	0.054872***	0.012755	4.30	0.000
Land Ownership (X_7)	0.023784**	0.007682	3.10	0.002
Extension Contacts (X_8)	-0.025947*	0.012445	-2.09	0.038

Source: Field Survey,2025

Note: *** p<0.001, ** p<0.05, * p<0.01

Constraints to Climate Change Adaptation Among Rice Farmers

The data on Table 3 reveals a hierarchical pattern of constraints to climate change adaptation practices among rice farmers in Wukari LGA, with financial constraints being the most significant impediment: Lack of access to financial resources ($\bar{x}$= 4.560): Ranked as the primary barrier, with 167 respondents strongly agreeing, Inadequate irrigation ($\bar{x}$= 4.408): Second most significant constraint, Change from traditional methods($\bar{x}$=4.326): Third-ranked barrier, Challenge from new technologies ($\bar{x}$= 4.228): Fourth most important constraint, Lack of training ($\bar{x}$ = 4.065): Fifth-ranked barrier, Lack of trust in government ($\bar{x}$ = 3.897): Sixth most significant impediment, Lack of improved seed ($\bar{x}$ = 3.861): Seventh-ranked constraint, Lack of access to information ($\bar{x}$= 3.310): Ranked lowest among barriers.

Table 3: Constraints to adoption of adaptation practices towards climate change

Constraints to adaptation climate change	**Likert scale responses**					**Weighted score**	**Mean score**	**Decision Rule**
	1	**2**	**3**	**4**	**5**			**Rank**
Lack of access to information	29	56	52	26	82	811	3.310	8th
Lack of improved seed	3	24	64	67	87	946	3.861	7th
Lack of trust in government	20	35	25	35	103	955	3.897	6th
Lack of training	9	23	37	50	126	996	4.065	5th
Challenge from new technologies	20	14	7	53	151	1036	4.228	4th
Change from traditional methods	6	22	31	13	173	1060	4.326	3rd
Inadequate irrigation	7	15	21	30	172	1080	4.408	2nd
Lack of access to financial resources	0	3	23	52	167	1118	4.560	1st

Source: Field Survey, 2025

Financial access emerges as the dominant barrier to adaptation, aligning with Olagunju et al. (2021) who found that limited financial resources constrained (78%) of smallholder farmers from implementing climate-smart agricultural practices in Nigeria. This primacy of financial constraints explains the earlier findings showing farmers' preference for low-cost adaptation strategies. The second-ranked barrier, inadequate irrigation ($\bar{x}$ = 4.408), reflects infrastructural deficiencies that limit farmers' ability to manage rainfall variability. This corresponds with Adebayo and Oladele's (2023) finding that only (12%) of rice farmers in Nigeria's Middle Belt region have reliable access to irrigation infrastructure despite its critical importance for climate adaptation. The high ranking of barriers related to traditional methods

($\bar{x}$ = 4.326) and new technologies ($\bar{x}$ = 4.228) indicates significant socio-cultural and technical adoption challenges. Amadi and Udo (2022) identified similar barriers, noting that farmers' reluctance to abandon traditional practices often stems from risk aversion rather than ignorance, while technical complexity frequently hinders adoption of novel approaches. Lack of training ($\bar{x}$ = 4.065) as the fifth-ranked barrier supports Ibrahim et al. (2024) who demonstrated that capacity building interventions increased adaptation practice adoption by (37%) among farmers in northern Nigeria. The moderate concern about government trust ($\bar{x}$ = 3.897) aligns with Nzeadibe and Egbule's (2023) observation that institutional credibility significantly influences farmers' willingness to participate in government-led adaptation initiatives.

Interestingly, lack of access to information ($\bar{x}$ = 3.310) ranks lowest, suggesting that basic climate change awareness has improved, as noted by Eweoya et al. (2022) who documented increasing climate information penetration in rural Nigeria. However, Gwanya et al. (2021) emphasized that information access alone is insufficient without complementary resources to act on that information. These findings support Mohammed and Abdulkadir's (2021) integrated barrier framework, which posits that constraints to climate adaptation exist in interconnected layers, with financial limitations serving as the foundation upon which other barriers accumulate. The results suggest that adaptation policies should prioritize financial inclusion mechanisms and context-specific technology transfer approaches, as recommended by Adah and Chikezie (2023) in their study of climate resilience building among Nigerian smallholder farmers.

4. Conclusion and Recommendations

This study provides comprehensive insights into the climate change adaptation landscape among rice farmers in Wukari LGA. The study revealed that rice farmers in Wukari LGA are predominantly middle-aged, most farmers are married, suggesting potential advantages in household labor availability. Household sizes were predominantly small to moderate,a significant gender disparity was observed, with males constituting more of rice farmers compared to females. Educational attainment was relatively low, cooperative membership was high indicating strong social organization and most farmershad moderate farming experience.The findings also identified factors influencing adaptation practices highlighting the crucial roles of human capital (age, education), social capital (cooperative membership), and resource endowment in determining farmers' adaptive capacity. The significant constraints, particularly financial limitations and inadequate infrastructure, underscore the need for targeted interventions to enhance climate resilience among rice farmers in the region. The study recommends the need for specialized agricultural credit schemes with favorable terms for climate adaptation investments, including flexible repayment schedules aligned with harvest cycles and risk-sharing mechanisms to encourage adoption of capital-intensive adaptation practices, stakeholders should prioritize investments in small-scale irrigation systems water harvesting structures, and improved storage facilities to enhance farmers' capacity to manage climate variability and reduce post-harvest losses, and the government should make education accessible to farmers especially climate change education.

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