VOL. 08 NO. 1,
MAY, 2025
E-ISSN 3027-0995
P-ISSN 3026-8265

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Biotechnology and Agricultural Research (JBAR)

Analysis of Factors Influencing Rice Farmers' Adaptation Strategies to Climate Change in Bauchi and Jigawa States, Nigeria

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DOI: https://doi.org/10.70382/ajbar.v8i1.002

Abstract

The study analyzed rice farmers' perception and adaptation strategies to climate change in Bauchi and Jigawa States, Nigeria. A multi-stage sampling procedure was used to select 400 rice farmers comprising 200 respondents from each State. Data were collected using structured questionnaires and analyzed using descriptive and inferential statistics. The results of tobit regression revealed that, age, marital status, educational level and farming experience were positive and significant (P<0.01), while access to credit was positive and significant (P<0.05) in influencing the adaptation strategies to climate change. The results of multiple regression further revealed that, climate index, age, farming experience, farm size and household size were positive and significant (P<0.01), while land tenure was also positive and significant (P<0.05) and membership of cooperative was negative and significant (P<0.05). The result also revealed that, high cost of improved varieties ($\overline{x}$=2.9) and ($\overline{x}$=2.7), poor extension service delivery ($\overline{x}$=2.5)

and ($\overline{x}$=2.3) and lack of credit facilities and incentive ($\overline{x}$=2.1) and ($\overline{x}$=2.3) were the major constraints faced in the adoption of climate change adaptation strategies. It was concluded that socio-economic and institutional factors influenced climate change adaptation strategies in the study area were age, marital status, educational level, farming experience and access to credit. The study can also be concluded that climate change adaptation strategies practiced by rice farmers in the study area had a significant effect on the yield. The study therefore recommends that, farmers should be sensitized to pool their resources together so as to enjoy the economics of scale in purchasing farm inputs, most of these agro-allied companies sell in large quantities to agro-dealers as a result of purchase the companies reduce the price.

Keywords: Analysis; Factors; Influencing; Adaptation; Strategies; Climate change.

Introduction

Climate refers to the long-term pattern and averages of temperature, precipitation, humidity, wind and other atmospheric conditions in a particular region over a decades or centuries. It is distinct from weather, which describes short-term variations in atmospheric conditions. Climate is influenced by factors such as the earth's tilt, solar radiation, atmospheric composition (green-house gases), ocean currents and land surface features. Human activities, particularly the burning of fossil fuels and deforestation have significantly altered the earth's climate system, leading to global warming and climate change.

Climate change refers to long-term shifts in temperature, precipitation patterns, wind patterns, and other aspects of the Earth's climate system. These changes can occur naturally, but are predominantly caused by human activities such as burning fossil fuels, deforestation, and industrial processes (Adekunmi, 2022). Climate change is the observed and projected changes in the Earth's climate system over a long period of time, typically spanning decades or longer. It includes changes in temperature, precipitation, atmospheric composition, and other factors that can have significant environmental, economic, and social impacts (Yeleliere *et al*., 2023). Climate change refers to the alteration of global or regional climate patterns, including temperature, precipitation, and wind patterns, as well as other climatic variables. These changes are primarily attributed to the increased greenhouse gas emissions caused by human activities, leading to global warming and related impacts on ecosystems, communities, and the overall planet (Ismail, 2023). Climate change entails the variations in statistical distribution of weather patterns over a prolonged period, typically spanning decades or more. It is driven by natural processes as well as human activities, which result in alterations to the Earth's

atmospheric and oceanic conditions, leading to shifts in weather patterns, sea level rise, and other environmental consequences. Climate change refers to the alteration in the Earth's climate system, caused by both natural factors and human activities. It encompasses changes in temperature, precipitation, extreme weather events, and other climatic variables that can occur on global, regional, or local scales, and is recognized as a significant global challenge due to its potential to affect ecosystems, economies, and human well-being (Igberi *et al*, 2022).

Rice production in African nations, especially Nigeria, relies largely on the natural weather conditions of the locality. Unexpected changes in the climatic condition of Nigeria are evident in increased desert encroachment and extreme droughts in the Northern region (Akomolafe, *et al*., 2023). Nigeria rice farming is one of the most profitable types of agribusiness, staple food for the larger population and as such is that it is evaluated that almost 7 million tons of rice are consumed per year (Malabe and Ango 2023). From 1980 to date, Nigeria has become the highest producer of rice in West Africa and third in Africa, after Egypt and Madagascar. The trend has made Nigeria to attain 2.103 and 3.46 million metric tons (MMT) of milled rice production in 2005 and 2008 respectively (NRDS, 2022).

Bauchi and Jigawa States are among the major agricultural states located in the northern part of Nigeria. Rice production plays a significant role in the agricultural sector of both states. Bauchi State has favorable agro-ecological conditions for rice cultivation. It is known for its high potential for irrigated agriculture due to its flat or gently sloping land that can be easily flooded for irrigation which also constitute loamy or clay soils with good water retention to help in maintaining the flooded conditions needed for rice growth and development. The state government has been actively involved in promoting rice production through various agricultural programs and initiatives. The majority of rice cultivation in Bauchi State is carried out by small-scale farmers, who rely on rain-fed and irrigation farming methods. The major rice varieties cultivated in State include NERICA–L-42, NERICA–L-41 and Faro 44 (Bose *et al*, 2022).

Jigawa State, on the other hand, is also known for its vast agricultural land and favorable climatic conditions for rice cultivation. It is one of the leading rice-producing states in Nigeria after kebbi. Jigawa State has a large number of irrigation schemes, such as the Auyo, Hadejia, and Kafin-Hausa irrigation schemes, which contribute to its high rice production. The state government has implemented various policies and initiatives to support rice farmers, including the provision of improved rice seedlings, fertilizers, and training programs. The major rice varieties cultivated in Jigawa State include FARO 44, 52, and 15, as well as new high-yielding varieties like NERICA (Orifah *et al*., 2021).

Despite numerous studies on analysis of rice farmers' perception and adaptation strategies to climate change in Bauchi and Jigawa States, past studies have shown none or little empirical studies that simultaneously analyzed rice farmers' perception and adaptation

strategies to climate change in both States. Thus, the need for this study to analyzed rice farmer' perception and adaptation strategies to climate change in Bauchi and Jigawa States, Nigeria. This study was aimed at: (i) determine the factors influencing climate change adaptation strategies by rice farmers (ii) examine the effect of climate change adaptation strategies practiced by rice farmers on yield and (iii) describe respondents' constraints to the adaptation strategies to climate change in the study area.

METHODOLOGY

The Study Area

The study was carried out in two States namely; Bauchi and Jigawa States, Nigeria. Bauchi state Comprises of three Agricultural Zones such as Northern Zone (9 LGAs) Central Zone (4 LGAs) and Western Zone (7 LGAs). The study Areas has a population of 4,653,066 million people (NPC 2006). The population growth of the State stand at 3.7% with a projection of 8,308,800 million people. It lies approximately between 9°3 and 12°3 North and longitude 8°50–11°50 East. The area has a total land mass of 49,259 sq kilometres. Bauchi State is bordered in a clockwise direction by Yobe, Gombe, Taraba, Plateau, Kano and Jigawa states., The major occupations of the people include farming, livestock rearing and trading. The major tribes of the area are Hausa, Fulani, Jarawa, Sayawa and minor tribes such as Yoruba and Igbo other Nigeria tribes are found. Agricultural production accounts for a greater percentage of the total employment in the study area and as result, over eighty percent (80%) of the inhabitants of the State practiced one form of agriculture or the other in which different crops and livestock are produced. The climate of the study area is characterized by long dry season (October-May) with a short rainy season (May-October), National Bureau of Statistics (2016).

The study was conducted in Jigawa State, Nigeria. The State is situated in the north-western part of the country which lies between latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E. The state has a total land area of approximately 23,154 square kilometers with twenty-seven (27) Local Government Areas (LGAs) (National Population Commission, NPC, 2006). The state had a population of 4,348,649 persons (NPC, 2006), with a projected population of 7,599,100 in 2024 using 3.5% annual growth rate with about 48 % of the population falling under the age of fifteen. Rainfall variability is pronounced in this area and rainfall distribution skewed, with its annual average ranging from 635mm to 899mm, or less than 1000 mm (NIMET, 2016). The State experiences a mean annual temperature of about 30^{oC}. The topography is characterized by high land areas which is almost 750 meters. Soil is fertile ranging from sandy-loamy with many compartments of fadama and alluvial plains suitable for the cultivation of rice, sugar-cane, millet, vegetables and sorghum (Ahmed, 2010). Jigawa state is predominantly an agrarian state with over 80% of the population involved in Agriculture. The major rain fed crops grown in the state includes rice, millet, sorghum, cowpea, groundnut, cocoyam, soya

beans. Dry crops include sugarcane, Hot pepper, okra, tomatoes, onions and spinach. The major livestock kept in the state includes, sheep and goat, poultry, cattle. The major rivers in the state that provide water for irrigation activities are the Hadejia and Katagum rivers. The Hadejia-Nguru River has the largest fadama area in Nigeria. Jigawa state is divided into four ADP Zones namely Gumel zone, Birnin-Kudu zone, Hadejia zone and Kazaure zone.

Sampling Procedure and Sample Size

A random sampling procedure was used for selecting respondents. The first stage was selection of three Local Government Areas from each State. In this regard, Jamaáre, Dass and Ningi in Bauchi State was selected while in Jigawa State, Kazaure, Hadejia and Birnin-Kudu was chosen. The sample frame for Rice farmers associations is constituted by two thousand and seven (2,007) registered members based on figures for the selected LGAs provided by Bauchi State Agricultural Development Programme and Jigawa Agricultural and Rural Development Authority. In the second stage of sampling, three villages noted for rice cultivation was selected from each of the 6 LGAs.

In Jama'are LGA in Bauchi State, Dako-Dako, Bodinga and Yola was selected while in Dass LGA had Bagel, Dass Kantaga and Lushi was selected and Ningi LGA, Kujera, Kafin Zaki and Gadan maiwa was selected, similarly, the locations was selected for Kazaure LGA in Jigawa State were Furji, Gada and Dambo dam. In Hadejia LGA, Yamidi, Ganuwa Kuka and Shawara. In Birnin-Kudu LGA, Kafin gana, Zuma and Kantoga was selected for the study because of widespread rice cultivation in the areas. The total number of registered farm families in the eighteen (18) selected villages was 2,007. This figure therefore represents the sample frame. The sample size for each village was determined by a mathematical formula given by Miller and Brewer (2003) as;

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

where:

N is the sample frame for the eighteen villages

n is the sample size and

α is the margin of error (fixed at 5%)

$\frac{2,007}{1+2,007(0.05)^2}$ = 400 farm families

Table 1: Sampling Procedure and Sample Size

States	Zones	L.G.A	Village	Sampling Frame	SampleSize20%
Bauchi	North	Jama'are	Dako-Dako	200	40
			Bodinga	85	17
			Yola	72	14
	South	Dass	Bagel	80	16
			Dass Katanga	106	21
			Lushi	94	19
	Central	Ningi	Kujera	54	11
			Kafin Zaki	102	20
			Gadan Maiwa	212	42
Sub-total	**3**	**3**	**9**	**1,005**	**200**
Jigawa	Zone 1	Kazaure	Furji	75	15
			Gada	68	14
			Dambo dam	142	28
	Zone 2	Hadejia	Yamidi	85	17
			Ganuwar Kuka	90	18
			Shawara	107	21
	Zone 3	B/Kudu	Kafin Gana	97	19
			Zuma	188	38
			Kantoga	150	30
Sub-total	**3**	**3**	**9**	**1,002**	**200**
Total		**6**	**18**	**2,007**	**400**

Source: BSADP (2020) and JARDA (2021)

Method of Data Collection

This study utilized primary data, primary data were collected through the use of structured questionnaire and administered with the help of trained enumerators.

Method of Data Analysis

The data collected were analyzed using descriptive and inferential statistics, the inferential statistics were tobit and multiple regression

Descriptive statistics

Frequency, percentage was used in achieving objective iii of the study.

Inferential statistics

Tobit regression model

Tobit model for a continuous dependent variable is thus:

$Y_i^* = \beta_0 + \beta_i X_i + \mu_i$

$Y_i = Y_i^*$ if $\beta_o + \beta_i X_i + \mu_i > 0$ … (1)
$Y_i = 0$ if $\beta_0 + \beta_i X_i + \mu_i \leq 0$

Where:
Y_i = Numbers of adaptation strategies adopted by farming household (adoption index)
Y_i^* = latent variable and the solution to utility maximization problem of intensity of the dependent variable was subjected to a set of explanatory variables and conditional on being above or below a certain limit,
β_i = vector of unknown parameters, and
μ_i = error term which is normally distributed with mean 0 and variance σ^2
Xi = vector of the explanatory variables (i = 1, 2, 3, ...11) such as:
X_1 = Age (years)
X_2 = Sex (male = 1, female = 0)
X_3 = Marital status (married = 1, otherwise = 0)
X_4 = Educational level (number of years spent on formal education)
X_5 = Farming experience (Number of years in rice farming)
X_6 = Farm size (hectare)
X^7 = Household size (number of persons)
X_8 = Farmers contact with extension agents (number of visit/month)
X_9 = Membership of cooperative
X_{10} = Access to credit
X_{11} = Land tenure

Multiple regression model
Multiple regression model determine the relationship between rice farmers' adoption index, socio-economic characteristics and their rice yield.
The multiple regression model was explicitly stated as:
$Y = F (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 \text{----------} X_{11}$
The functional form is expressed in the explicit form as:
$Y = b_0 + b_1x_1 + b_2x_2 + b_3 + x_3 + b_4 + x_4 + b_5 + x_5 + b_6x_6 + b_7x_7 + b_8x_8 + e$ ----------2
Where:
Y= Numbers of paddy rice harvested 100kg/hectare (Yield)
X_1= adoption index
X_2=Age (in years)
X_3=Sex (Male =1 Female =0)
X_4= Marital status (Married=1 otherwise=0)
X_5= Education level (No of years spent in school)
X_6= Farming experience (No of years spent in farming activities)
X_7= Farm size (In hectare)

X_8=Household size (No of people in the household)
X_9=Extension contact (Number of visit)
X_{10}= Membership of co-operatives
X_{10}= Access to credit (Amount in ₦)
X_{11}= Land tenure (Land owner=1, otherwise= 0)
In= logarithm.
bo= Constant.
b_1- b_{11}= Regression coefficient.
X_1-X_{11}= Independent variables.
e= error term.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

Factors Influencing Adaptation Strategies to Climate Change in Bauchi and Jigawa States

The results of Tobit regression revealed that LR chi^2 (10) = 30.86. this statistic tests the overall significance of the model. A significant chi-square indicates that at least one of the predictors is significantly related to the outcome. Probability >Chi^2 = 0.0006 indicates rejection of null hypothesis, suggesting that the model has significant predictors, which shows that the model is statistically significant and suggesting that the included factors collectively influence adaptation strategies. On the other hand, the Log likelihood = 227.90684 indicate a high-fitting model, meaning parameters explained the censored and uncensored observations well. Five (5) variables were significant factors that influence the adaptation strategies to climate change in the study area. These include age, marital status, educational level, farming experience and access to credit. The results shows that age of rice farmers had a positive coefficient and significant (P< 0.01), implies that a unit increase in the age of rice farmers increase the climate change adaptation strategies, it also indicate that older farmers are more likely to adopt strategies, likely due to accumulated experience and knowledge of climate variability. This agreed with findings of Bello *et al* (2023) who said age was positively significant (P<0.01) implying that older farmers had higher adaptive capacity than the younger once, the findings disagreed with Goni *et al* (2024) who said age had a negative coefficient and significant (-0.0388001, P<0.05) which implies older farmers are not likely to adopt Climate Smart Agricultural practices compared to young and agile farmers. It Marital status had a positive coefficient and significant (P<0.01), this implies that married individuals may have better access to labour, resources, or social networks, facilitating adaptation. Educational level had a positive coefficient and significant (P<0.01), indicating that education enhances awareness of climate risks and technical knowledge of adaptation practices. This is in line with findings of Adisa *et al* (2024) who said level of education (t = 1.729, p < 0.05) had

positive significant relationship with the climate adaptation strategies used by the rice farmers. Farming experience had a positive coefficient and significant (P< 0.01), implies that experienced farmers are more adept at implementing adaptive techniques (e.g., crop rotation, water management). Access to credit had a positive coefficient and significant (P<0.05), implies that access to credit and Financial resources enable investments in adaptive technologies (e.g., irrigation systems, improved seeds). This agrees with the findings of Ullah *et al.* (2021) who established that, the estimated coefficient of the investigated variable (access to credit) confirms to a priori expectation about its influence on the adoption of technology.

Based on the above findings therefore the null hypothesis (H_O) was rejected and the alternative hypothesis (Ha) was accepted, that there is a significant relationship between the socio-economic characteristics of rice farmers and adaptation strategies to climate change adopted in the study area

Table 2: Factors Influencing Adaptation Strategies to Climate Change in Bauchi and Jigawa States (Pooled)

climate_index	Coef.	Std. Err.	t.	P>t
Cons.	.0.632078	.0550933	11.47	0.000***
Age	.0798756	.0273437	2.92	0.004 ***
Sex	.00126	.0008146	1.55	0.123^{NS}
Marital status	.0452951	.016141	2.81	0.005***
Educational level	.0154793	.0056452	2.74	0.006***
Farming experience	.0152402	.0056127	2.72	0.007***
Farm size	.0005422	.005474	-0.10	0.921^{NS}
Household size	.003605	.0025909	1.39	0.165^{NS}
Extension agent	.0184638	.0138251	-1.34	0.182^{NS}
Membership of Co-operative	.0054298	.0139359	-0.39	0.697^{NS}
Access to credit	.0654174	.0270805	2.42	0.016**
Land tenure	-.0011318	.0010624	-1.07	0.287^{NS}
LR $chi^2(10) = 30.86$				
Prob > chi^2 = 0.0006				
Log likelihood = 227.90684				

Source: Field Survey (2024)

Note: ***= P<0.001, **= P<0.05

Effect of Climate Change Adaptation Strategies Practiced by Rice Farmers on Rice Yield in Bauchi and Jigawa States

The results of regression revealed that the model explains 52.37% of variance in rice yield (R-squared = 0.5237), indicating a moderately strong fit. The model is statistically valid

prob>= 0.0000 confirming that predictors collectively influence rice yield. Seven (7) variables that show significant effects on the yield of rice in the study area, these include climate index, age, farming experience, farm size, farming experience, household size, membership of co-operative and land tenure. The results show that climate index had a positive coefficient and significant (P<0.01), the massive coefficient (2193.08) implies that adopting climate change strategies could double the yield of the rice farmers in the study area thereby rejecting null hypothesis. Age of rice farmers had a positive coefficient and significant (P<0.01), this implies that older farmers may leverage accumulated knowledge to optimize yields. This finding agreed with Garba *et al*, (2021) who said that age is an important factor that influence farmer's decision to take up an innovation on a research conducted under shelterbelt projects in the frontline states of north western Nigeria.

Farming experience had a positive coefficient and significant (P<0.01), implies that experienced farmers may likely employ more efficient techniques, leading to better yields, This is similar to the findings of Abubakar *et al.* (2022) who reported the coefficient of farming experience was found to be positive and significant (P<0.05) in influencing the decision to adopt improved rice production management practices, which predicts positive relationship and influence on farmers' adoption of the improved management practices in the study area. This also agreed with the findings of Chukwu *et al.* (2021), the farming experience was positively signed and statistically significant at 1% level of significance. This means that the higher the farming experience of the respondents, the higher their level of adoption of innovations on improved rice production technologies. farm size had a positive coefficient and significant (P<0.01), implies that Larger farm sizes correlate with higher yields, likely due to economies of scale, better resource allocation, or access to technology. This agreed with findings of Goni *et al* (2024) who said farm size had a positive coefficient and significant at (P≤ 0.01) influencing the adoption of climate smart agricultural practices. This finding corroborates with Kassa and Abdi (2022) who stated that that farmers with larger farmlands adopted more climate smart agricultural techniques, indicating encouragement to them. Household size had a positive coefficient and significant (P<0.01), this implies that larger households may provide more labor for farming activities, thereby enhancing productivity. This finding is consistent with results by Verkaart *et al.* (2020); Paltasingh *et al.* (2018) and Ayinde *et al.* (2019) who reported in their finding, household size was found to be positively and statistically significant to the intensity of adoption at 10% level of significance. The positive significance of household size implies that farmers with larger households tend to be more willing to adopt and continue to use the climate change adaptation strategies than those with small household size. Membership of co-operative society had a negative coefficient and significant (P<0.05), this could reflect inefficiencies in cooperative support, conflicting priorities, Members may have less access to resources or support that could enhance their

production, the cooperative's management practices may not align with maximizing individual production or Membership might lead to a focus on collective goals that do not prioritize individual output and source of land variable has a positive coefficient and significant (P<0.05), indicating that it is associated with an increase in rice production.
Based on the above findings therefore the null hypothesis (H_O) was rejected and the alternative hypothesis (Ha) was accepted, that there is a significant relationship between the climate change adaptation strategies practiced and their yield

Table 3: Determinant of effect of climate change adaptation strategies practiced by rice farmers on yield in Bauchi and Jigawa States (Pooled)

qty_rice	Coef.	Std. Err.	t.	P>t
Cons	1779.609	1287.726	1.38	0.168
Climate_index	2193.08	537.1735	4.08	0.000***
Age	43.23005	15.87923	2.72	0.007***
Sex	54.87945	976.4115	0.06	0.955
Marital status	-156.1554	317.2512	-0.49	0.623
Educational level	106.4912	110.8385	0.96	0.337
Farming experience	434.7969	123.5608	3.52	0.001***
Farm size	641.7338	106.3979	6.03	0.000***
Household size	230.0587	50.57372	4.55	0.000***
Extension agent	110.3481	269.9244	0.41	0.683
Membership of co-operative	-640.2583	273.1068	-2.34	0.020**
Access to credit	444.1859	302.2484	1.47	0.142
Land tenure	138.6632	77.44987	1.79	0.074**
Prob > F = 0.0000				
Adj R-squared = 0.4996				
R-squared= 0.5237				

Source: Field Survey (2024)
Note: ***= P<0.001, **= P<0.05

Constraints Faced in practicing Mitigation Strategies to Climate Change
In this section the respondents were asked to indicate their perception on constraints faced in practicing mitigation strategies to climate change on their farming activities. The constraints faced on practicing mitigation strategies to climate change on rice farms in Bauchi and Jigawa State is presented in Table 4 below. The perception of the respondents was measured on 3 point likert scale; any mean score of perception equals/above 2.0 was considered as “severed” and below 2.0 was “Not severed

The result in Table 4 revealed that the mean score ($\overline{x}$=2.9) of rice farmers in Bauchi State perceive the high cost of improved crop varieties as a severe constraint, the same trend was observed in Jigawa State ($\overline{x}$=2.7) of rice farmers acknowledged high cost of improved crop varieties as a severe constraint to adaptation to climate change. This agreed with findings of Goni *et al* (2024) who said high cost of inputs (71.2%) impede adoption of climate smart agricultural practices in the study area. This also agrees with findings of Abubakar *et al.* (2020) who found out that 31.3% of the adopters were constrained by the high cost of inputs (chemical fertilizers, agro-chemicals and tractor hiring to carry out tillage operations) Poor extension services delivery ($\overline{x}$=2.5) and ($\overline{x}$=2.3) was perceived as a constraint to adaptation strategies in both State, with Bauchi rated slightly higher. Lack of credit facilities and incentives ($\overline{x}$=2.1) was perceived as constraint to climate change adaptation strategies in Bauchi State, the same trend was observed in Jigawa State ($\overline{x}$=2.1) of rice farmers acknowledge lack of credit facilities and incentives as a severed constraint against climate change adaptation strategies. Inadequate information about climate Change ($\overline{x}$=2.0) was perceived as constraints against climate change adaptation strategies in Jigawa State, while Bauchi State rice farmers does not. Insect pest and disease ($\overline{x}$=2.0) was considered a severed constraints by rice farmer in Jigawa State, while Bauchi State farmers does not.

Table 4: Distribution of respondents based on constraints faced in effort to practice climate change adaptation strategies

	Bauchi State		**Jigawa State**	
Constraints of practicing adaptation Strategies	**Mean**	**Remark**	**Mean**	**Remark**
high cost of improved crop varieties	2.9	Severed	2.7	Severed
Poor extension services delivery	2.5	Severed	2.3	Severed
Lack of credit facilities and incentives	2.1	Severed	2.3	Severed
Inadequate information about climate Change	1.9	N-severed	2.0	Severed
Low access to high yielding and early maturing seed	1.8	N-severed	1.4	N-severed
Inadequacy of improved Seeds	1.7	N-severed	1.9	N-severed
Insect pest and disease	1.9	N-severed	2.0	Severed
limited technology on climate change	1.7	N-severed	1.8	N-severed
Inadequate access to good agro-chemicals	1.8	N-severed	1.5	N-severed

Source: Field Survey (2024)

CONCLUSION AND RECOMMENDATIONS

The study concluded that, the socio-economic and institutional factors influenced climate change adaptation strategies in the study area were age, marital status, educational level, farming experience and access to credit. it also concluded that climate change adaptation

strategies practiced by rice farmers in the study area had a significant effect on the yield. The study therefore, recommended:

i. Farmers should be sensitized and encouraged to pool their resources so as to enjoy economies of scale in purchasing farm inputs. Most of these agro-allied companies they sell in large quantities to agro-dealers as a result of that bulk purchase the companies reduce the price.
ii. Government and relevant stakeholders should make sure extension agents work regularly with farmers. Use phones and social media to share important farming information quickly
iii. Co-operative societies in collaboration with government and non-governmental organizations should create small loan programs specifically for farmers to help them access credit easily. These loans should have low interest rates and flexible repayment terms, Promote the formation of farmer cooperatives that can pool resources and access credit together. This can improve their bargaining power and reduce risks for lenders

References

Abubakar, H. N., Garba, Y., Gana, A. K. and Jocob, I. A. (2022). Factors influencing adoption of rice improved production practices by farmers in adopted villages, Niger state, Nigeria. *Advances in Plants & Agriculture Research,* **9**(1):183-189. Retrieved March 11, 2023. from: http://dx dOI:

Adekunmi, A. O. (2022). Rice Farmers' Awareness and Perception of Climate Change in Ondo State, Nigeria European Journal of Agriculture and Food Sciences, ***4****(1)215:221* DOI: 10.24018/ejfood.2022.4.1.355

Ahmed, K., (2010). The Kano physical environment. In: Adamu, A.U., Ado-Kurawa, I. (Eds.), Perspectives on Kano, vol. 1. Inuwar Jama'ar Kano (Kano Forum) Telletes Press, Lagos, pp. 7–46.

Akomolafe J.K, Sennuga S.O, Bamidele J, Osho-Lagunju B, Alabuja F.O. (2023). Assessment of Cassava Production towards Household Food Security in Bwari Area Council, Abuja, Nigeria, Indiana Journal of Agriculture and Life Sciences. 2023;3(2):1-7.

Bauchi State Agriculture Development Programme:(BSADP). Annual Report for Zonal and Development Area Statistics Bauchi, Nigeria. Nigeria: BSADP; 2020

Bello, A.S.,Ibrahim, A. A.and Yakubu, S.(2023). Analysis of Adaptation to Climate Change among Rice Farmers in Western zone of Bauchi State, Nigeria, Journal of Agripreneurship and Sustainable Development (JASD) 6(1):265-6365

Bose, A. A., Danwanka, H. A and Asani, B. C. (2020) Assessment of Contribution of Bauchi State Agricultural Development Programme on Rice Production in Dass Local Government Area, Bauchi State, Nigeria, Agricultural Extension Journal **4**(4):159-165

Chukwu, Y. A., Eze, A.Y. and Osuafor, O. O. (2021). Socio-economic Determinants of Adoption of improved Rice Production Technologies Among Rice Farmers in Ebonyi, State, Nigeria: A Logit Regression Model Approach. *Elixir International Journal,***94**(6): 39900-39908. Retrieved February 25, 2022 from: https://www.researchgate.net/publication/318216607\

Garba, A., Muhammad, M. B., Usman, I. and Aliyu, A. (2021). Assessment of Farmers' Information Sources Under Shelterbelt Projects in the Frontline States of North Western Nigeria, *Journal of Agripreneurship and Sustainable Development (JASD)* **4**(4):2651-6144

Goni, I. C., Garba, M., Bose A. A. and Abdullahi, S. (2024).Factors Influencing the Adoption of Climate Smart Agricultural Practices among Irish Potato Farmers in Plateau State, Nigeria, *Nigerian Journal of Agriculture and Agricultural Technology* (NJAAT), **4**(4):2811-1893

Igberi C. O., Osuji E. E., Odo N. E., Ibekwe C. C., Onyemauwa C. S., Obi H. O., Obike K. C., Obasi I. O., Ifejimalu A. C., Ebe F. E., Ibeagwa O. B., Chinaka I. C., Emeka C. P. O., Orji J. E., Ibrahim-Olesin S. (2022). Assessment of Prioritized Climate Smart Agricultural Practices and Technologies of Household Farmers in Southeast, Nigeria. *Universal Journal of Agricultural Research,* **10**(1), 53 - 63. DOI: 10.13189/ujar.2022.100105.

Ismail, U.I. (2023). Effects and Knowledge of Climate Change among Farmers in Southern Taraba, Nigeria, *Fane-Fane Int'l Multidisciplinary Journal,* 7(1):112-12

Jigawa State Agricultural and Rural Development Authority (JARDA) (2021): Internal Implementation report: prepared by planning and evaluation department, Jigawa State Pp10

Kassa, B. A. and Abdi, A. T. (2022). Factors Influencing the Adoption of Climate-Smart Agricultural Practice by Small-Scale Farming Households in Wondo Genet, Southern Ethiopia. *Journal of Scientific Advisory Group for Emergencies.* **2**(1):1–13

Malabe, K. M and Ango, A. K (2023). Rice Farmers' Levels of Information Source on Mitigation Actions Against Climate Change Effects in North-East Zone, Nigeria DOI: https://doi.org/10.21203/rs.3.rs-3452005/v1

National Bureau of Statistics Report-NBS (2016). National Bureau of Statistics/Federal Ministry of Agriculture and Rural Development (2010/2011). Collaborative Survey on National Agriculture Sample Survey (NASS)

National Population Commission (2006). Population figure of the Federal Republic of Nigeria, Abuja. Retrieved from http://www.npc.gov.ng/

National Rice Development Strategy (NRDS) (2022). Federal Republic of Nigeria: Prepared for the Coalition for African Rice Development. pp1-64

Nigerian Meteorological Agency – NIMET, (2016). Nigeria Climate Review Bulletin 2007, Nimet-No. 001, February 2008, Abuja.

Orifah, M. O., Sani M. H., Murtala N. and Ibrahim A. A. (2021): Perceived Effectiveness of Adaptation Strategies to Climate Change among Rice Farmers in Jigawa State, Nigeria: Implication for rice production. DOI: 10.2478/ats-2021-0013

Ullah, A., Dilawar, K., Zheng, S. and Ali, U. **(**2021). Factors influencing the adoption of improved cultivars: a case of peach farmers in Pakistan. *Ciência Rural, Santa Maria,* **48**(11):1–11. Retrieved April 28, 2022 from: http://dx.doi.org

Yeleliere, E., Antwi-Agyei, P., Nyamekye, A.B., (2023). Impacts of climate change on the yields of leguminous crops in the Guinea Savanna agroecological zone of Ghana, Regional Sustainability 4(2):139–149