



Constraints militating against the use of adaptation strategies to climate change effects by small-scale rice farmers in Northeastern, Nigeria

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ABSTRACT

This study ascertained the constraints militating against the use of adaptation strategies to climate change effects amongst rice farmers in Northeastern Nigeria. Multi-stage sampling technique was used to select 300 rice farmers. The analytical tools used to analyze the data obtained were descriptive and inferential statistics. The result shows the used and unused adaptation strategies for drought resistant rice variety were 33.0% and 67.0%, heat resistant rice variety were 30.7% and 69.3%, short rice cycle seeds were 2.3% and 97.7%, early maturing rice variety were 32.7% and 67.3%, early planting were 32.0% and 68.0%, late planting were 33.0% and 67.0%, early harvesting were 32.7% and 67.3%, late harvesting were 31.7% and 68.3. The result on constraints militating against the use of adaptation strategies shows that the constraints with higher loading factors were low level of income ($\lambda=0.799$), low literacy level ($\lambda=0.727$), inadequate knowledge on how to cope with climate change related issues ($\lambda=0.761$), poor response to climate related issues ($\lambda=0.782$), poor financial support from NGOs (0.648), inadequate agricultural loans (0.655) and high administrative charges on loan ($\lambda=0.555$). Other constraints included inadequate extension workers ($\lambda=0.583$), inadequate extension contacts ($\lambda=0.550$), long bureaucracy in getting formal credit ($\lambda=0.588$), lack of reliable sources of information on climate change ($\lambda=0.708$), loans not readily available during farming season ($\lambda=0.752$), and inadequate financial support from government (0.428). Based on the findings of the study, it is concluded that low users of adaptation strategies were evident in the zone. Therefore, it is recommended that the government should encourage the use of adaptation strategies in the zone.

Keywords: Climate adaptation strategies; rice farmers; extension contacts

INTRODUCTION

According to Pandey (2022) climate change has become a worldwide issue as it is responsible for creating an adverse effect on the environment. 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). Farmers' difficulties and challenges of climate change are crucial to planning relevant policies for adaptation strategies to climate change (Ali *et al.*, 2021). By this means, the anticipated adverse effects of climate change can be reduced through abilities to exchange information, ideas and feedback in both policy and scientific work are important for climate projections that reduces climate change effects (Tajudeen *et al.*, 2022 and Nabara *et al.*, 2023).

Based on the climate change policy and scientific findings, smallholder farmers were supported to adapt to the increasing effects of climate change across the north-eastern zone of Nigeria (Malabe *et al.*, 2019). Unfortunately, they could not usefully respond to climate change based on data available amid 2021 farming season. Therefore, there is a need to investigate rural farmers' challenges concerning adaptation strategies to climate change effects. Therefore, it is against this background that this study provide answers to the following objectives: (i) identify the users and non-users of climate change adaptation strategies among rice farmers in the study area (ii) determine the constraints militating against the use of climate change adaptation strategies among rice farmers in the study area and (iii) ascertain suggestions by rice farmers to constraints militating against the use of climate change adaptation strategies in the study area.

METHODOLOGY

Study Area

This study on the practice of adaptation actions against the adverse effects of climate change by rice farmers was conducted in the north-eastern zone of Nigeria. The zone was the largest geopolitical zone in the country, covering nearly one-third of Nigeria's total area (Ideki and Weli, 2019). In terms of the environment, the zone is primarily divided between the semi desert Sahelian Savannah and the tropical west Savannah eco-regions (Amaza *et al.*, 2016). The zone shares an international boundary with Cameroon Republic to the east, Niger and Chad Republics to the north, and nationally, the zone borders north-central Nigeria to the west and south-eastern Nigeria to the south (Mayomi and Yelwa, 2019). The zone lies within latitudes $9^{\circ}4' 55.1964'$ and longitudes $8^{\circ}40' 30.9972'$ E with a total land mass of 272,395KM². According to the National Population Commission (NPC, 2022), the zone has a projected population of approximately 18,971,965 million people at a growth rate of 2.4%-3.4%.

The north-eastern zone of Nigeria has an annual average temperature of 40°C. The average annual rainfall of the zone varies between 500 mm in the extreme north and 12000 mm in the southern sub region (Mayomi and Yelwa, 2019). The zone has been inhabited for years by various ethnic groups including Hausa, Fulani and Kanuri, Shuwa-Arab, Babur-Bura and Marghi, Jarawa, Gerawa, and Sayawa, Mumuye, Jukun, Chamba, Wurunkum, and

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Bandawa. The major food crops grown are maize, millet, rice, sorghum, cowpea, and cassava, while the cash crops grown in the region included cotton, sesame and groundnut.

Sources of Data

The data for the study were collected from both primary and secondary sources. The primary data were obtained through the use of a structured questionnaire through interview questionnaire administration method, while the secondary information was obtained from published materials such as textbooks, journals, and books of proceedings of conferences, other relevant material and sources.

Sampling Procedure and Size

A multistage sampling procedure was used to arrive at the sample size for this study. In the first stage, Borno, Taraba and Bauchi states were purposively selected based on prominence of rice production. The second stage included a purposive selection of two Local Government Areas (LGAs) from the selected states in the zone. The LGAs selected were Jere and Biu from Borno state, Sardauna and Gassol from Taraba state and Warji and Dass from Bauchi state that were purposively selected based on the high concentration of rice farmers. The third stage involved a random selection of three villages from each of the LGAs selected, which gave rise to a total of 18 villages considered for the study. The sample frame of each village was established based on information obtained from Agricultural Development Programs (ADPs) from each of the selected states. Lastly, a proportionate selection of 29.9% of the rice farmers from each of the villages was made, given rise to a total sample size of three hundred (300) rice farmers.

Data Analysis

Data for the study were analyzed using both descriptive (frequency, percentage and means) and inferential (factor analysis) statistics. Descriptive statistics were used in achieving objectives i and ii while factor analysis was used to determine objective iii of the study.

Model specification

The factor model is expressed in explicit form as:

$$\begin{aligned} X_1 &= \lambda_{11}F_1 + \lambda_{12}F_2 + \dots + \lambda_{13}F_3 + e_1 \\ X_2 &= \lambda_{21}F_1 + \lambda_{22}F_2 + \dots + \lambda_{23}F_3 + e_2 \\ X_{13} &= \lambda_{19}F_1 + \lambda_{19}F_2 + \dots + \lambda_{19}F_3 + e_3 \end{aligned}$$

Where F= observed factor; X= unobserved factor; λ = factor loading and e_n = measurement error terms. The observed factors were categorized as financial constraints, personal constraints, and administrative constraints, while unobserved factors were categorized as 1=not a constraint, 2=minor constraint, and 3=major constraint.

RESULTS AND DISCUSSION

Climate Change Adaptation Strategies

Table 1 shows that in Bauchi state, the users of climate change adaptation strategy for drought resistant rice variety was 33.0%, heat resistant rice variety was 28.9%, short rice cycle seed was 0.0%, early maturing rice variety was 32.0%, early planting was 29.9%, late planting was 34.0%, early harvesting was 30.9%, late harvesting was 29.9%, strengthening early warning system on changes in climate was 34.0%, basin leaching was 23.7%, and building small dams/contour terracing was 25.8% while the non-users of climate change adaptation strategy for drought resistant rice variety was 67.0%, heat resistant rice variety was 71.1%, short rice cycle seed was 100.0%, early maturing rice variety was 68.0%, early planting on changes in climate was 70.1%, late planting was 66.0%, early harvesting was 69.1%, late harvesting was 70.1%, strengthening early warning system on climate change was 66.0%, basin leaching was 76.3%, and building small dams/contour terracing was 74.2% among farmers. This implies that the majority of the rice farmers in the study area didn't used adaptation strategies. This finding agrees with Oluwabunmi *et al.* (2020) who reported poor use of climate change adaptation strategies by farmers in his study area.

Table 1: Distribution of the respondents based on users and non-users of climate change adaptation strategies in Bauchi state (n=97)

Climate Change Adaptation Strategies	Used adaptation strategies		Not used adaptation strategies	
	Frequency	%	Frequency	%
Drought resistant rice variety	32	33.0	65	67.0
Heat resistant rice variety	28	28.9	69	71.1
Short rice cycle seed	0	0.0	97	100.0
Early maturing rice variety	31	32.0	66	68.0
Early planting	29	29.9	68	70.1
Late planting	33	34.0	64	66.0
Early harvesting	30	30.9	67	69.1
Late harvesting	29	29.9	68	70.1
Strengthening early warning system on changes in climate	33	34.0	64	66.0
Basin leaching	23	23.7	74	76.3
Building small dams and contour terracing	25	25.8	72	74.2
	*293		*774	

* - Multiple response

Table 2 reveals that in Borno state, the users of climate change adaptation strategy for drought resistant rice variety was 32.5%, heat resistant rice variety was 30.1%, short rice cycle seed was 2.4%, early maturing rice variety was 33.7%, early planting was 34.9%, late planting was 31.3%, early harvesting was 32.5%, late harvesting was 33.7%, strengthening early warning system on changes in climate was 30.1%, basin leaching was 21.7%, and building small dams/contour terracing was 22.9% while the non-users of climate change adaptation strategy for drought resistant rice variety was 67.5%, heat resistant rice variety

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was 69.9%, short rice cycle seed was 97.6%, early maturing rice variety was 66.3%, early planting was 65.1%, late planting was 68.7%, early harvesting was 67.5%, late harvesting was 66.3%, strengthening early warning system on changes in climate was 69.9%, basin leaching was 78.3%, and building small dams/contour terracing was 77.1% among farmers. This implies the majority of the rice farmers had not used climate change adaptation strategies and this could be due to poor climate change adaptation strategies among farmers in the study area. This finding agrees with Otitoju and Enete (2016) who reported low climate change adaptation strategies among farmers in Nigeria.

Table 2: Distribution of the respondents based on users and non-users of climate change adaptation strategies in Borno state (n=83)

Climate change adaptation strategies	Used adaptation strategies		Not used adaptation strategies	
	Frequency	%	Frequency	%
Drought resistant rice variety	27	32.5	56	67.5
Heat resistant rice variety	25	30.1	58	69.9
Short rice cycle seed	2	2.4	81	97.6
Early maturing rice variety	28	33.7	55	66.3
Early planting	29	34.9	54	65.1
Late planting	26	31.3	57	68.7
Early harvesting	27	32.5	56	67.5
Late harvesting	28	33.7	55	66.3
Strengthening early warning system on changes in climate	25	30.1	58	69.9
Basin leaching	18	21.7	65	78.3
Building small dams and contour terracing	19	22.9	64	77.1
	*254		*659	

* - Multiple response

Results in Table 3 show that in Taraba state, the users of climate change adaptation strategy for drought resistant rice variety was 33.3%, heat resistant rice variety was 32.5%, short rice cycle seed was 4.2%, early maturing rice variety was 32.5%, early planting was 31.7%, late planting was 33.3%, early harvesting was 34.2%, late harvesting was 31.7%, strengthening early warning system on changes in climate was 30.8%, basin leaching was 22.5%, and building small dams/contour terracing was 20.8% while the non-used climate change adaptation strategies for drought resistant rice variety was 66.7%, heat resistant rice variety was 67.5%, short rice cycle seed was 95.8%, early maturing rice variety was 67.5%, early planting was 68.3%, late planting was 66.7%, early harvesting was 65.8%, late harvesting was 68.3%, strengthening early warning system on changes in climate was 69.2%, basin leaching was 77.5%, and building small dams/contour terracing was 79.2% among farmers. This implies that the majority of the rice farmers had not used information on adaptation strategies in the study area and could be the reason behind low adaptation strategies. This finding is in agreement with Nabara *et al.* (2023) who reported low adaptation strategies among rice in Nigeria.

The overall results in Table 4 revealed that the used climate change adaptation strategy for drought resistant rice variety was 33.0%, heat resistant rice variety was 30.7%,

short rice cycle seed was 2.3%, early maturing rice variety was 32.7%, early planting was 32.0%, late planting was 33.0%, early harvesting was 32.7%, late harvesting was 31.7%, strengthening early warning system on changes in climate was 31.7%, basin leaching was 22.7% and building small dams/contour terracing was 23.0% while the non-used climate change adaptation strategies for drought resistant rice variety was 67.0%, heat resistant rice variety was 69.3%, short rice cycle seed was 97.7%, early maturing rice variety was 67.3%, early planting was 68.0%, late planting was 67.0%, early harvesting was 67.3%, late harvesting was 68.3%, strengthening early warning system on changes in climate was 68.3%, basin leaching was 77.3%, and building small dams/contour terracing was 77.0% among farmers. This finding indicated that the majority of the rice farmers had used adaptation strategies information in the zone and could be the reason behind low climate change effects in the zone.

Table 3: Distribution of the respondents based on users and non-users of climate change adaptation strategies in Taraba state (n=120)

Climate Change Adaptation Strategies	Used adaptation strategies		Not used adaptation strategies	
	Frequency	%	Frequency	%
Drought resistant rice variety	40	33.3	80	66.7
Heat resistant rice variety	39	32.5	81	67.5
Short rice cycle seed	5	4.2	115	95.8
Early maturing rice variety	39	32.5	81	67.5
Early planting	38	31.7	82	68.3
Late planting	40	33.3	80	66.7
Early harvesting	41	34.2	79	65.8
Late harvesting	38	31.7	82	68.3
Strengthening early warning system on changes in climate	37	30.8	83	69.2
Basin leaching	27	22.5	93	77.5
Building small dams and contour terracing	25	20.8	95	79.2
	*369		*951	

* - Multiple response

Table 4: Distribution of the respondents based on users and non-users of climate change adaptation strategies (pooled result) (n=300)

Climate Change Adaptation Strategies	Used adaptation strategies		Not used adaptation strategies	
	Frequency	%	Frequency	%
Drought resistant rice variety	99	33.0	201	67.0
Heat resistant rice variety	92	30.7	208	69.3
Short rice cycle seed	7	2.3	293	97.7
Early maturing rice variety	98	32.7	202	67.3
Early planting	96	32.0	204	68.0
Late planting	99	33.0	201	67.0
Early harvesting	98	32.7	202	67.3
Late harvesting	95	31.7	205	68.3
Strengthening early warning system on changes in climate	95	31.7	205	68.3
Basin leaching	68	22.7	232	77.3
Building small dams and contour terracing	69	23.0	231	77.0
	*916		*2,384	

* - Multiple response

Constraints Militating against Climate Change Adaptation Strategies

Table 5 shows the main constraints militating against the use of adaptation strategies to climate change in North-east, Nigeria.

Table 5: Distribution of the respondents based on the constraints militating against climate change adaptation strategies (n=300)

Constraints to Adaptation Strategies	Factor loading (λ)		
	Factor 1	Factor 2	Factor 3
Poor response to climate related issues		0.782	
Lack of bank branches			0.423
Poor financial support from NGOs			0.748
Agricultural loans are not adequate enough			0.655
High cost of farm labor	0.353		
Drought resistant rice varieties are expensive	0.417		
High administrative charges on loan			0.555
Inadequate extension workers			0.583
Inadequate extension contacts			0.550
Long bureaucracy in getting formal credit			0.588
Heat resistant rice varieties are expensive	0.598		
Lack of reliable sources of information on climate change			0.708
High cost of inputs	0.474		
High cost of land	0.579		
Loans are not readily available during farming season			0.752
Low level of income	0.799		
Inadequate financial support from government			0.428
Low literacy level		0.727	
Inadequate knowledge on how to cope with climate change related issues		0.761	
Government inability to respond/come to the aid of climate change affected farmers			0.701
Measure of Sampling Adequacy	0.710		
Approx. Chi-Square	3045.874		
Degree of freedom	190		
Significant level	0.000		

The variables that loaded under factor 1 (financial constraints) were high cost of farm labor ($\lambda=0.353$), drought resistant rice varieties are expensive ($\lambda=0.417$), heat resistant rice varieties are expensive ($\lambda=0.598$), high cost of inputs ($\lambda=0.474$), low level of income ($\lambda=0.799$), and high cost of land ($\lambda=0.579$). In the present contemporary world, financial problems could pose serious challenges to farmers' mitigation strategies as they may not have financial capability to invest in the use of adaptation strategies regarding climate change effects. This finding is in accordance with Malabe *et al.* (2018) who identified financial constraints as a major barrier to climate change adaptation among farmers in Nigeria.

The variables that loaded under factor 2 (personal constraints) were low literacy level ($\lambda=0.727$), inadequate knowledge on how to cope with climate change related issues

($\lambda=0.761$), and poor response to climate related issues ($\lambda=0.782$). Low personal understanding of climate related issues is a serious challenge that may limit the use of adaptation strategies effectively. This finding is in conformity with Akeem (2022) who reported that the use of climate change adaptation strategies is constrained by poor knowledge of climate change and its effects.

The variables that loaded under factor 3 (administrative constraints) were; lack of bank branches ($\lambda=0.423$), poor financial support from NGOs ($\lambda=0.648$), agricultural loans are not adequate enough ($\lambda=0.655$), high administrative charges on loan ($\lambda=0.555$), inadequate extension workers ($\lambda=0.583$), inadequate extension contacts ($\lambda=0.550$), long bureaucracy in getting formal credit ($\lambda=0.588$), Lack of reliable sources of information on climate change ($\lambda=0.708$), Loans are not readily available during farming season ($\lambda=0.752$), inadequate financial support from government ($\lambda=0.428$) and government inability to respond/come to the aid of people affected by climate change related hazards such as floods and droughts ($\lambda=0.701$). This finding agrees with Thakur and Bajagain (2019) who reported that administrative constraints is one of the major constraints militating against the use of adaptation strategies to climate change effects in agricultural.

Suggestions by Farmers to Constraints Militating against Climate Change Adaptation Strategies

Table 6 shows that in Bauchi state the suggested solutions to the constraints militating against the climate change adaptation strategies included the agricultural loan scheme should be channel to real farmers (38.1%), loan should be readily available during farming season (10.3%), government loan scheme for farmers should be increased (11.3%), agencies responsible for providing information on climate change should create more awareness about adaptation strategies (19.6%), government should immediately come to the aid of climate change affected farmers (13.4%), and government should review long bureaucratic processes in getting loan from banks (7.3%). This implies that appreciable numbers of the respondents in Bauchi state suggested that government loan scheme should be provided to real farmers.

In Borno state, 32.5% of the respondents suggested that, Loan should readily be available during farming season, 12.0% of the respondents suggested that government loan scheme for farmers should be increased, 8.4% of the respondents suggested that government loan scheme should be giving to real farmers, 18.1% of the respondents suggested that agencies responsible for providing information on climate change should create more awareness about adaptation strategies, 13.3% of the respondents suggested that, government should immediately come to the aid of farmers whose farm is affected by climate related issues, and 15.7% of the respondents suggested that government should review long bureaucracy in getting loan from banks). This implies that most of the respondents in Borno state suggested that loan should readily available during farming season.

In Taraba state, 32.5% of the respondents suggested that government loan scheme should be giving to real farmers, 9.2% of the respondents suggested that loan should readily available during farming season, 10.8% of the respondents suggested that, government loan scheme for farmers should be increased, 20.8% of the respondents suggested that agencies responsible for providing information on climate change should create more awareness about adaptation strategies, 14.2% of the respondents suggested that government should immediately come to the aid of farmers whose farm is affected by climate related issues, and 12.5% of the respondents suggested that, government should review long bureaucracy in

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getting loan from banks). This implies that appreciable numbers of the respondents suggested that government loan schemes should be giving to real farmers.

Overall result of the study shows that, 27.7% of the respondents suggested that government should devise a means of identifying real farmers to be given the loan. This implies that loan facilities were not channel to most of the real farmers in the study areas and this could be that the farmers were not financially capable enough to carry out the use of adaptation strategies effectively.

Table 6: Distribution of the respondents based on suggestions of farmers to constraints militating against climate change adaptation strategies (n=300)

Variables	Bauchi (n=97)		Borno (n=83)		Taraba (n=120)		Pooled (n=300)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Loan should readily available during farming season	10	10.3	27	32.5	11	9.2	48	16.0
Government loan scheme for farmers should be increased	11	11.3	10	12.0	13	10.8	34	11.3
Government loan scheme should be giving to real farmers	37	38.1	7	8.4	39	32.5	83	27.7
Creating more awareness about adaptation strategies	19	19.6	15	18.1	25	20.8	59	19.7
Immediately aid response to climate change affected farmers	13	13.4	11	13.3	17	14.2	41	13.7
Review long the bureaucracy in getting loan from banks	7	7.3	13	15.7	15	12.5	35	11.6

CONCLUSION

Based on the findings of this study it is concluded that low use of adaptation strategies to climate change effects were evident among rice farmers in the zone. It is also concluded that loan facilities were not properly channelled to real farmers.

It is therefore, recommended that government and non-governmental organizations should encourage adaptation strategies to climate change among rice farmers in the zone. Also, the government should come up with modalities that the loan facilities would be able to reach the real farmers.

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