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ANALYSIS OF RICE FARMERS' AWARENESS AND ADAPTATION TO CLIMATE VARIABILITY IN KANO STATE, NIGERIA

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ABSTRACT

This study analyzed rice farmers' awareness and adaptation to climate variability in Kano State, Nigeria.
A total of 314 respondents were selected for the study using a multi-stage sampling approach and relevant data were collected from them using structured questionnaire. Descriptive analysis and coping strategy index (CSI) were employed to analyze data. The study revealed that overall; all of the respondents had high awareness of climate variability. Longer dry season (84.4%) and erratic rain pattern (78%) were the top manifestations of climate variability observed by the rice farmers. Rice farmers' CSI of minimum of 165 to a maximum of 1740, an arithmetic mean of M=606.6 were reported and the majority of the rice farmers were between low to moderately resilience to climate variability in the study location. The three top constraints against adaptation to climate variability as perceived by the respondents are high cost of improved seed, inadequate access to funds or credit to acquire technological packages and poverty. The study recommended that because majority of the rice farmers that fell within the group of 'low resilient and moderately resilient' to climate variability; there is an urgent need for government and relevant bodies to bring aids to farmers to further strengthen the resilience to climate variability.

Keywords: Climate variability, Rice Farmers, Climate awareness, Adaptation strategies

INTRODUCTION

Rice is an essential food item in the diet of the majority of Nigerian households. The country is the continent's largest producer of rice and at the same time showed that prior to the government's policy restricting rice importation, Nigeria doubled as Africa's leading consumer of rice and as well one of the major rice importers in the world (Food and Agricultural Organization [FAO], 2018). In 2016, Nigeria's estimated rice demand for instance, was put at approximately 6.3 billion tons, while the country itself supply was approximately 2.3 million tons below what the country need to meet its populace demand for rice (Federal Ministry of Agriculture and Rural Development, 2021). Yet, with the advent of the restriction the importation of rice, it for this reason indicates that the country will continue to strive to meet its rice demand. To achieve this, Nigeria will have to ensure it increases her production capacity in addition to equally deal with the various challenges facing the agricultural sector, in particular those related to climate variability (USAID, 2023).

Climate variability describes "statistically considerable deviations in climate condition that persists for a longer period, commonly for decades or longer. It is any change in climate, rainfall or productivity brought about by natural occurrence and direct or indirect human activities that alter the composition of the atmosphere" (United Nations [UN], 1998; Intergovernmental Panel on Climate Change [IPCC] 2007; Lybbert & Sumner, 2010; Ojuederie & Ogunsola, 2017; Benjamne et al, 2022). The implications of climate variability are severe for the developing world, where poverty, small farm holdings, and shortage of funds to engage in adaptation processes are major challenges (UNOCHA, 2023). Important estimations indicate that in some nations around the world, yields from rain-fed agriculture might be decreased by up to 50% by 2030 (IPCC, 2007). The changes in agricultural production could most likely result in food hardship for 9 billion people by 2050 (Ali, Liu, Ishaq, Shah, Abdullah, Ilyas, & Din, 2017; Ani, et al, 2020).

Then again, Nigeria similar to several other nations around the world is as well caught-up in this web of climate variability issues. Nigeria's susceptibility to the inconsistencies of climate variability issues has been confirmed by the destructive outcomes of flooding among states in southern Nigeria and and diverse lengthy droughts that affected many states some states in the northern region (Audu & Adie 2018). The effects of variability in climate are inescapable across the globe; the weather patterns are shifting, and sea levels are rising, causing increased flash floods and food insecurity. The disappearance of natural habitats, flora, and fauna has been ascribed to the variability of climate and this has been undermining livelihoods in various region of the continent (Dube & Phiri, 2013; International organization for Miration, 2023).

Adaptation is a modification made to a human, ecological or physical system in reaction to an identified susceptibility (US Environmental Protection Agency

[EPA], 2017). Adaptation techniques evolved to be well known in literature from the 1990s and are usually related with variability in climate pattern. Adaptation to climate variability is an change in natural or human systems according to actual or anticipated climatic stimuli and their consequences which moderately harm or exploits helpful possibilities. To achieve a sustainable output level, farmers are required to take adaptation steps to deal with risks posed by climate variability on their farming process (Pandey et al, 2017; Ojo & Baiyegunhi, 2020). For this reason, to guarantee regular production, there is need to continually assess farmers' awareness and adaptation ability, who are stakeholders in the climate variability issues, toward evolving avenues of mitigating unfavorable impacts. This study therefore contributes to that process using rice farmers in Kano state as the area of inquiry.

The objectives of this study are to:

i. describe the level of awareness of climate variability amongst rice farmers in Kano State;
ii. identify and describe the indigenous climate adaptation strategies used by the rice farmers;
iii. determine the coping strategies and resilient level of rice farming household to climate variability;
iv. identify the constraints affecting the use of climate adaptation strategies in the study area.

MATERIALS AND METHODS

The Study Area

Kano including other states of northern Nigeria has insufficient rainfall and often uses irrigation to compensate for this shortfall to meet their water demand for production. The region often experience long dry season and short wet season which is usually characterized by erratic rainfall pattern even as this pattern varies annually (Udeh, 2014). This study was conducted in 3 local government areas of Kano State, namely: Bunkure, Kura and Ajingi. These three local governments are among rice-producing areas in Kano State. The three LGAs are having similar climatic condition as other LGAs in the State. In general, Kano has to mean annual rainfall that ranges from over 1000mm in the extreme South to a little below 800mm in the extreme North. The rain usually lasts for three to five-month with mean temperature range from 26^0C to 33^0C (Olofin, 1980).

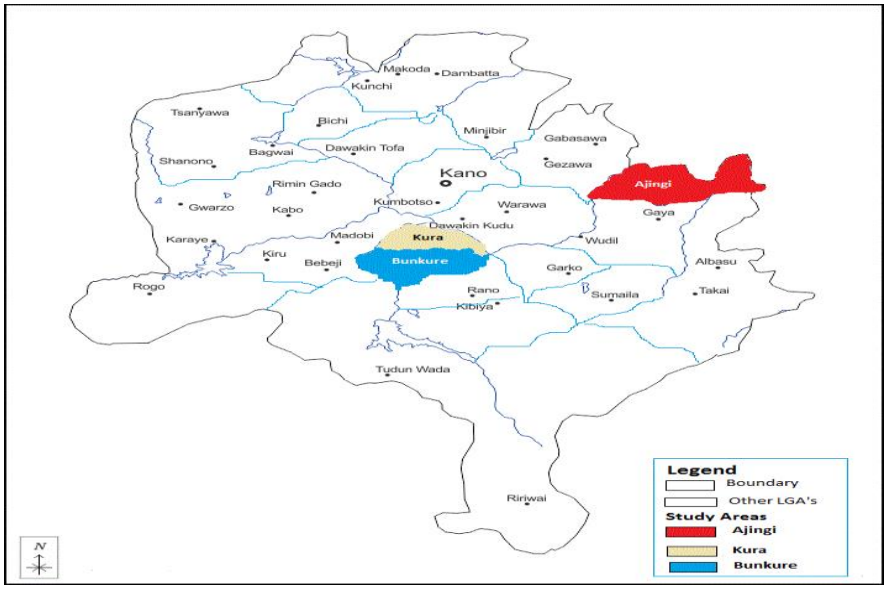

Figure 1: Map of the Study Area

Sampling Techniques and Sample Size

Multi-stage sampling technique was used for this study. First, three local government areas were purposively selected based on volume of rice produced. The second stage involved random selection of two communities each from selected LGA. And from 1765 total population of rice farmers in the six selected communities, a sample of 314 rice farmers were selected using raosoft.com sample size

calculator. In the third stage, the sum of all sampling frames equal to 1765. The percentage of the sampling frame (N) was used to distribute 314 rice farmers across the six communities according to their sampling frame contribution to 1765 total of population of the rice farmers in the entire study communities.

Table 1: Selected Communities for questionnaire administration

No. of LGAs selected	No. of selected communities	Sampling frame (N)	% of N	Sample selected(n)
Bunkure	Lautaye	416	23.57	74
	Tsanbake	192	10.88	34
Kura	Riga	293	16.60	52
	Dan Hassan	326	18.47	58
Ajingi	Unguwar Bai	392	22.21	70
	Gurduba	146	8.27	26
Total		1,765	100	314

Source: Reconnaissance survey, 2019.

Method of Data Analysis

Descriptive statistics such as frequency and percentage distribution were used to describe the level of awareness of climate variability amongst rice farmers in Kano State; identify and describe the indigenous climate adaptation strategies used by the rice farmers; identify the constraints affecting the use of climate adaptation strategies in the study area. Coping strategy index was used to determine the coping strategies and resilient level of rice farming household to climate variability. The Coping Strategies Index (CSI) developed by the East and Central Africa Regional Management Unit of the World Food Programme CARE/WFP (2003) was adopted.

$$CSIi = \Sigma(Dij * Sj)$$

Where;

CSIi = coping strategy index of the i^{th} respondent.

Dij = duration of usage of j^{th} coping strategy by i^{th} respondent (years).

Sj = score of usage of j^{th} coping strategy by the sample

The CSI was used in this study to score the various indigenous coping strategies used by farmers against the vagaries of climate change according to the frequency of usage and severity. The *priori* expectation is that the higher the CSI of a household, the more resilient (and less vulnerable) it is to climate variability.

RESULTS AND DISCUSSIONS

Table 2 shows the rice farmers' level of awareness of climate variability. Remarkably, all the rice farmers indicated that they were aware of climate variability, its effect on agriculture, and the environment. The high level of awareness for climate variability is the first step toward adopting effective strategies towards mitigating it. However, this study finding is corroborated by the result of Farauta et al, (2012), which stated that most farmers in northern Nigeria are aware and well-informed of climate variability. The result in Table 2 also revealed that 96.5% of the rice farmers perceived climate variability through rainfall cessation; 90.4% of the rice farmers perceived climate variability through temperature variation and 85.4% of the rice farmers perceived climate variability through rainfall arrival (early or late). The rice farmers' understanding of climate variability was relatively high because they got information about it from different sources. Thus, the above three top indicators could perhaps characterize the simple idea of 'climate variability to the local farmers. Thus, various findings have shown that different signs of climate variability among farmers include but are not limited to: severe harmattan, higher temperature, drought, erratic rainfall pattern, and increased pest incidence, delay in onset of rain, less rainfall, erratic rainfall pattern and gradual drying of water sources (Hir, 2010; Farauta et al, 2012). Other noticeable signs of climate variability in the study location, as acknowledged by the rice farmers are long dry season (84.4%); rainfall amount (78.8%); erratic rain pattern (78%); through gradual drying of water sources (63.4%). This result can be corroborated by Yekinni & Oladapo (2016) finding, who asserted that rainfall amount, longer dry season, and flooding are among the common indicators of climate variability to local farmers. In general, this result can further be supported by the study of Uzor et al, (2015) who observed that majority of the rural farmers considered for the study in Imo State Nigeria have good knowledge of climate variability through the basic indicators.

Table 2: Level of Awareness of Rice Farmers about Climate Variability

Variable	Frequency (n=314)	Percentage	Rank
Awareness			
Yes	314	100	-
No	0	0	
Climate Variability Indicators			
Rainfall Cessation	303	96.5	1st
Temperature variation	284	90.4	2nd
Rainfall Arrival (Early or Late)	268	85.4	3rd
Longer dry season	265	84.4	4th
Rainfall Amount (High or Low)	247	78.8	5th
Erratic rain pattern	245	78.0	6th
Gradual drying of water sources (rivers, streams, Fadama lands, wells)	199	63.4	7th
Severe harmattan	202	64.3	8th
Drought	194	61.8	9th
Reduction in rice yield	172	54.8	10th
Wind Speed	162	51.6	11th
Increased pest incidence	161	51.2	12th
Warmer temperature	159	50.6	13th
Rate of Evaporation	131	41.7	14th
Increased disease incidence	119	37.9	15th
Flooding	85	27.1	16th

*Multiple Responses
Source: Field Survey, 2021

Table 3: Indigenous Climate Adaptation Strategies used by the Rice Farmers

Coping strategies	Frequency (n=314)	Percentage	Rank
Change in planting date	288	91.7	1st
Mixed cropping	265	84.4	2rd
Use of organic manure	260	82.8	3th
Household fuel conservation	257	81.8	4th
Change in harvesting date	244	77.7	5th
Selective animal husbandry	237	75.5	6th
Seed selection	216	71.3	7th
Minimum Tillage	212	67.5	8th
Conservation tillage	210	67.1	9th
Afforestation	206	65.8	10th
Total	2671		

Source: Field Survey, 2021 *Multiple responses accepted

Table 3 shows that rice farmers in the study location adapt to the effect of climate variability in different ways. For instance, (91.7%) adopted change in planting date, mixed cropping (84.4%), use of organic manure (82.8%), household fuel conservation by increasing wood-fuel efficiency while it is converted to charcoal for reuse. (81.8%), change in harvesting date (77.7%), Selective animal husbandry (75.5%), seed selection (71.3%), minimum tillage (67.5.4%), conservation tillage (67.1%) and afforestation (65.8%). However, change in planting date (91.7%) was identified as the most important strategy employ by the rice farmers in the study location. This is because the onset of the new raining season significantly varies. In response, the farmers constantly change their

planting date to avoid a short dry spell after the onset of the new raining season. The study of Adesina et al, (1999) supports this finding; afforestation, mixed cropping, household fuel conservation, and minimum tillage could help minimize the greenhouse effect by using clean energy sources and enhancing carbon and overall carbon mitigation of climate change (Adesina et al, 1999). This study is also in line with Shemdoe (2011) findings where farmers in Tanzania employ mixed cropping and crop diversification, among other strategies to cope with climate change.

Table 4: Distribution of Farmers' Household Coping Strategy Index

Rice farmers' Houesehold CSI	Locations			Pooled Data
	Kura	Bunkure	Ajingi	
Minimum	234	247	165	646
Maximum	1740	1370	1420	4530
Mean	627.4	624.2	570	1821.6
Standard Deviation	243.5	240.9	229.8	714.2

Source: Field Survey, 2021

Table 4 shows the CSI as the product obtained ranges from a minimum of 646 to a maximum of 4530 with an arithmetic mean of 1821.6 and a standard deviation of 714. However, a high standard deviation obtained shows a wide range of levels of resilience to climate variability among the rice farmers' households in the study locations. In addition, the result obtained from the three locations could further be compared. As shown in Table 4, rice farmers' households in Kura (mean CSI = 627.4) had higher CSI and therefore are expected to have higher resilience and be less vulnerable to the adverse effects of climate variability compared to the rice farmers from Bunkure and Ajingi (mean CSI = 624.2) and (mean CSI = 570), respectively. The study findings can stand as reference data for further studies. However, according to Umar et al, (2014), a study of this nature can serve as baseline data for further references to the level of resilience and/or vulnerability to climate variability in the study area to show subsequent increases or decreases in either way which in turn could help in formulating appropriate policies on climate variability adaptation and mitigation challenges.

Table 5: Rice Farmers level of Resilience to Climate Variability

Resilience Level	Frequency (n=314)	Percentage
Low (165 -525)	126	40.1
Moderate (526 -1050)	173	55.1
High (1051 – 1740)	15	4.8

Source: Field Survey, 2021

Table 5 presents the CSI level categorized into three groups. This was achieved by subtracting the minimum CSI from maximum CSI and divided by three (3) the desired groups. For instance 1740-165/3=525, this value (525) was used as the distance from the first group and the subsequent groups. Therefore this was used for the grouping with "165 - 525 = low resilience", "526 - 1050 as moderate resilience" and "1051 - 1740 as high resilience. It was revealed that 40.1% of the rice farmers fell under low resilience category, 55.1% of the rice farmers fell under moderate resilience category, while only 4.8% of the rice farmers were said to be highly resilience to climate variability. This is similar to the finding from a study by Dawid et al, (2023) which classified household resilience to low, moderate and high resilience with 54.6% of the farmers was moderate-high resilience to climate change. However, according to this study finding the majority of the rice farmers were seen to be moderately resilience to climate variability and this may have connection with the high level of awareness about the effect of climate variability which comes with longer years of experience in rice farming and the adoption of various indigenous climate adaptation strategies. The more experienced the farmer is, the more he/she is better informed about the changes in climate and the more he/she is likely to employ indigenous adaptation measures to help reduce the impact of climate variability on his/her agricultural activities. This corroborates Mengistu et al, (2019) who showed that resilience to climate change increases with an increase in knowledge of climate change indicators. Also, the finding of this study agree with the study of Chaltu (2021) who reported

that the adoption of climate indigenous adaptation strategies play vital role in increasing rice farmers' resilience to climate variability.

Table 6: Constraints to Adaptation Techniques Used by the Rice Farmers

Constraints to Adaptation Techniques	Frequency (n=314)	Percentage	Rank
High cost of improved seed	307	97.8	1st
Inadequate access to funds or credit to acquire technological packages	302	96.2	2nd
Poverty	275	87.6	3rd
Inadequate information on weather incidence	275	86.6	4th
Low priority on adaptation compared to other pressing issues	266	84.7	5th
Inadequate access to improved seed	263	83.8	6th
Poor record-keeping and documentation of Indigenous Knowledge	251	79.9	7th
The inherent uncertainties and ambiguities of climate change	231	73.6	8th
The overreliance on scientific models to identify, understand, and communicate the problem and propose solutions	176	56.1	9th

*Multiple Responses
Source: Field Survey, 2021

Table 6 shows the key challenges to adoption of climate variability adaptation strategies among rice farmers in Kano State. These challenges include; high cost of improved seed (97.8%), inadequate access to funds or credit to acquire technological packages (96.2%), poverty (87.6%), inadequate information on weather incidence (86.6%), low priority on adaptation compared to other pressing issues (84.7%), inadequate access to improved seed (83.8%) are the major hindrance to effective adaptation to climate variability. This finding mirrors the report of Ajayi (2015) which indicate factor such as inadequacy of funds to acquire new techniques as a hindrance to employing adaptation strategies. The results from this study corroborate the findings of Adesiji and Obaniyi (2012), Idrisa et al, (2012), and Kolleh & Jones (2018) who identified similar constraints to adaptation techniques to climate variability in their separate studies.

CONCLUSION

Rice farmers were aware of changes in climate elements due to its effect on their farming activities and the environment. The farmers' long years of experience in rice farming give them added advantage to have good knowledge of basic indicators of the environmental issue. Over time rice farmers have been able to adopt indigenous adaptation strategies in dealing with the effect of climate variability on their farming activities and livelihood. The majority of the rice farmers were seen to be moderately resilience to climate variability. Also, the key hindrances to the use of climate variability adaptation strategies in the study location are; high cost of improved seed, inadequate access to funds or credit to acquire technological packages, and low priority on adaption to climate variability compared to other pressing issues. Based on the study findings, the following recommendations were made: majority of the rice farmers fell within the group of 'low resilient and moderately resilient' to climate variability; therefore, the federal ministry of Agriculture in collaboration with the Federal ministry of Environment should support the rice farmers. These supports can be in the form of policy formulation and the reinvigorating of research bodies to uncover more modern coping actions that will be convenient for the farmers to use. This will help to reduce the practical constraints rice farmers in the study location are adapting to reduce the adverse effect of climate variability and increase their resilient level environmental challenge.

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