



## **ANALYSIS OF ADAPTATION TO CLIMATE CHANGE AMONG RICE FARMERS IN WESTERN ZONE OF BAUCHI STATE, NIGERIA**

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### **ABSTRACT**

The study analyzed the adaptations to climate change among rice farmers in the Western Zone of Bauchi State. Multi-stage sampling technique was used in selecting 140 respondents, data were collected using structured questionnaire and analyzed using both descriptive and inferential statistics. Result reveals that 41.4% of the respondents were within the age of 36-45 with a mean of 28 years. About (33.6%) of the respondents has the household size of 8-10 with a mean of 8 persons per household, and about (42.9%) of them had primary education. The result further reveals that most (82.9%) of the respondents were married and about (41.4 %) had a farming experience of 16-21 with a mean of 13 years. It also shows that about (47%) of rice farmers had quarterly extension visit. The result revealed that (67%) of rice farmers perceived increased in temperature as the effect of climate change in the study area, about (18.1%) of the respondents perceived high cost of inputs as the major constraints to adaptation strategies by the rice farmers. The regression result reveal that marital status, age of the farmers, educational level, farming experience, farm size, access to extension and extension visit had a positive coefficient and significant ( $P < 0.01$ ). The major constraints to the adoption of existing climate change adaptation strategies by rice farmer are high cost of inputs, insufficiency of financial resource, high cost of labour and inadequacy of climate information, The study concluded that socio-economic characteristic of farmers play a significant role in perceptions and adaptations to climate change among rice farmers in the study area. Marital status, age of the farmers, educational level, farming experience, farm size, access to extension and extension visit were the significant factors influencing perception and adaptations to climate change by rice farmers in the study area. Based on the finding, it is recommended that, Extension agents should sensitize and raise awareness to climate change, adequate media information should be provided by the various agricultural programmes (ADPs) so as to create conducive policy that will enhance adaptive capacity of the farmers to mention few.

**Keywords:** Climate, Adaptation, Rice, Awareness, Constraints.

### **INTRODUCTION**

Climate change is occurring in every part of the planet earth. Natural processes can lead to climate change; however, anthropological activities such as coal mining, bush burning, fumes from cars and industries as well as emission of greenhouse gasses (IPCC, 2007). The change and variability in climate are becoming a serious global problem that affects many sectors of economic growth in the world. Those sectors that are widely affected by the impacts of climate-related hazards and calamities include; agriculture, water, fisheries, forestry, wild life, energy, industrial processes and product use, waste management, human health, and the



sustainable livelihood of both rural and urban communities (Lema and Majule, 2009; Bie *et al.*, 2008).

Nigeria is currently reaching a lower middle-income status but is vulnerable to climate change since Nigeria's agriculture is still dependent on climate and it has been detected that the temperature conditions in all the ecological zones in Nigeria are rising, as well as less predictable rainfall patterns (MEST, 2010). Such changes may manifest in the reduction in land quality and low agricultural yields (Idrisa *et al.*, 2012). Rice is a staple food which constitutes a major part of the diet of many countries in the world (Oteng and Anna, 1999). It is widely cultivated with high production in South-East Asia, and largely exported by the United States of America in the world and Southern Europe regions (Longtau, 2000). In Sub-Saharan Africa, West Africa is the leading producer and consumer of rice. The crop is widely produced in Cote d'Ivoire, the Gambia, Guinea, Guinea Bissau, Liberia, Burkina Faso, Senegal and Sierra Leone (NISER, 2002). The sub region produces 42% of all the rice produced in Africa while the other four regions North Africa, East Africa, Central Africa and Southern Africa produce 32%, 23.8%, 1.2% and 1% respectively showing insignificant levels of production (Oteng and Anna, 1999). Africa has great potential for expanding its agricultural production in general and rice in particular (Oteng and Anna, 1999) as the potential arable land in Africa is 637 million ha and about 68 percent of the total area is in reserves (Okigbo, 1982).

In Nigeria, the cultivation of rice has been in existence for a very long time. It was one of the major commercial food crops in the 17th and 18th centuries (Mobil and Okran, 1985). The crop is very important with regards to the diets of Nigerians, as well as its availability throughout the year is of great concern as the crop, maize, millet and sorghum and other cereals are grown for food and income for both the rural and urban households in Nigeria (Mabe *et al.*, 2012). Presently, rice is one of the major cereals produced in Nigeria, but its production as for other crops, is affected by extremities in weather and climate such as floods, salt stress and extreme temperatures. Kranjac-Berisavljevic *et al.* (2003). The major climate change impacts will be on rainfall, which will be changing and less reliable. This is expected to affect the onset and length of growing seasons of the crop, particularly in semiarid areas where yields from agricultural farmlands that are mostly rain-fed could be reduced by up to 20 to 50% by 2050 Sarr *et al.* (2007). The increase in temperatures is also likely to reduce the duration of the hot off-season period for irrigated rice farming, owing to increased risk of sterility due to high temperatures at flowering stage of the crop (Darko *et al.*, 2013).

The production of rice in Nigeria is therefore expected to reduce by 36 per cent as many rice farmers have abandoned their rice fields as a result of the effects of climatic pressures in the country (Oppong-Ansah, 2011). Despite the damaging effects of climate change to Nigeria's agriculture, options aimed at responding (adapting) to climate change are few and therefore makes the poor who depend on farming, fishing and/or forestry as their main livelihood become more vulnerable to the changes in climatic condition (Sagoe, 2006). Therefore, the need to encourage rural farmers' adaptation to the changing climatic conditions cannot be over emphasized. Adaptation is generally seen as the most basic way by which one can respond to the adverse impact of climate change. It is how individuals, groups and natural systems make preparation for and react to the changes in climate (Mitchell and Tanner, 2006). Successful adaptation can reduce humans' exposure to external shocks (such as flood) and stresses (such as gradual temperature increase) by building on and strengthening existing coping mechanisms and assets (Mitchell and Tanner, 2006). According to (IPCC, 2001), the level of damage caused to any agricultural system by climate change will depend on its ability to adapt. This adaptive capacity of the agricultural system is the ability of the system to adjust to climate change to avert any estimated damage and take advantage of opportunities so as to



be able to cope with the consequences. Therefore, the adaptive capacity of any agricultural system is its ability to make changes in its behavior to enable it withstands the changes in external conditions. Nonetheless, for a farmer to adapt to climate change, he must first detect that change followed by the identification and implementation of a better adaptation (Maddison, 2006). Many adaptations to climate change some of which include crop diversification, changing the timing of operations, diversification of sources of income, development and promotion of new crop varieties, and improvement of water management techniques (Smith and Lenhart, 1996). Some of these adaptations are only potential adaptation measures instead of the ones actually used by the farmers. In fact, it has not been proven that these adaptation options are feasible, realistic, or even likely to occur. Additionally, they would only be possible if and only if farmers have full information of climatic conditions. This implies that studies on the impact of climate change often take on certain adaptations with very little information on how, when, why, and under what conditions these adaptations occur.

Nigeria has a great potential in producing rice in Sub Saharan Africa, but lack of adequate supply of water together with undesirable climate change indicators such as temperature, precipitation, relative humidity and bright sunshine duration have the tendency of negatively affecting rice yields in the districts of study and in Nigeria as a whole (Mabe *et al.*, 2012). To be able to continue high rice production in the country and in the districts of study, it is very important for rice farmers to adapt to climate change (Mabe *et al.*, 2012). There exists very little knowledge on whether farmers perceive climate change and have adopted any adaptation to climate change. This study therefore intends to capture the extent of farmers' awareness and perceptions of climate change and variability and the types of adaptation strategies they have put in place in response to these changes.

The study was aimed to examine the socio-economic characteristics of farmers in the study area; investigate farmers' awareness of changes in the climatic condition, identify the various adaptation strategies to climate change, determine the factors that affect the adoption of the various adaptation strategies, and to find out the constraints to the implementation of existing climate change adaptation strategies used by rice farmers.

## **MATERIALS AND METHODS**

### **The study Area**

The study areas are Dass and Tafawa Balewa Local Government Areas both located in the western Agricultural Zone of Bauchi State. It is located in the Northern Guinea Savannah of Bauchi State at an altitude of 600m above sea level with latitude  $9^{\circ}03'$  and  $10^{\circ}30'N$  and longitude  $8^{\circ}50'$  and  $11^{\circ}3E$  of Greenwich meridian. It has a land mass of 24270.701km and estimated population of 1977379 (BSADP, 2018). It has a rainfall range of 600- 1200mm and temperature of  $9.11^{\circ}C$  to  $40.55^{\circ}C$ . The economics activities include rearing of small and large ruminant, crop production, and marketing of agricultural products. Dass town is characterized by two distinct climatic seasons, dry and wet seasons. It is located within the Guinea savannah type of climate with 6-7 month of rainfall, usually starting from April and 5–6 months dry season from November to March every year respectively. The town records more than 1000mm annually. The rainfall in the area originates from the Atlantic maritime air masses, occurring on the leeward side of North Central Highland of Jos plateau. There are different type of soil and soil profile in Dass because of the fact that the area is occupied by ridges and hills. Therefore, soils around and on the hills are azonal soils, that are immature having several layers with different structures that are said to have result from recent deposition of sediments



examples are alluvial soil and peat. Although soils like laterites are typical example of Zonal soil found in the area.

The vegetation of the area of the study area is the Guinea Savannah type, receiving rainfall for over six month the vegetation is mostly green for the larger part of the year showing fresh leaves and tall grasses. During the dry season the area looks patchy and dry with tree shedding their leaves to conserve water. This region has abundant grasses with average height of 1.5m; trees have umbrella shape because they lack competition for sunlight. They (trees) developed resistant to dry season and bush burning during dry season with their thick bark. Most prominent trees in the area are locust-bean ashiwali, tamarind, acacia, baobab and economic trees (e.g., mango) and host of shrubs and herbs.

Furthermore, the survey also covered Tafawa Balewa Local Government Area of Bauchi State about 80km from the state capital (Bauchi). Tafawa Balewa is located between latitude 10 and 15° N and longitude 90° and 30° E. The local government area shares boundary with Toro Local Government Area from the North West, South West with Bogoro Local Government Area, West with Plateau state and south with Dass Local Government Area and at Eastern side with Bauchi Local Government Area. The area has a mean annual rainfall of 900-1150mm which falls between April/May and October. It experiences a dry season from November to April with temperature rising up to 40°C and falling into as low as 11°C during harmattan season in November/ January (BSADP, 2006). The Local Government has an estimated population of 124,742 people (NPC, 2006).

### **Method of Data Collection**

This is the process of obtaining information when carrying out a given research. Data collection is divided into two, namely primary and secondary data. Primary data are those data collected afresh, for the first time by the research process, through face -to- face interview, questionnaire administration, direct measurement, observation or observational technique. Secondary data on the other hand refers to those data which has already been collected by someone else (or in some previous research). These data are obtained from already existing literature (paper and electronic research reporters, government documents, institutions publication and statistical reports (Eboh, 2009). Questionnaire was used in collecting data for the project work. A total number of 120 respondents were selected at random in the study area. However verbal interview was employed as a supplementary method.

A Multinomial Logit model was used to estimate the maximum likelihood to achieved objective The linear function assumes a linear relationship between the dependent and the independent variables. It takes the form:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + \dots + b_n x_n + E_i$$

where;

Y = Rice farmers decision to adopt (dependent variable)

$Y_1$  = Rainfall,  $Y_2$  = Temperature

$b_0$  = constant;

$b_1 - b_6$  = Coefficient

$X_1$  = Age (years)

$X_2$  = household (number of individual)

$X_3$  = farm size hectare)





$X_4$  = farming experience years)

$X_5$  = rice output

$X_6$  = income

$X_7$  = climate change noticed

$X_8$  = information on climate

$E_i$  = error terms

The estimated functions were evaluated in terms of the significance of  $R^2$  as indicated by F-statistics, the significance of the coefficients as given by the t statistic, the signs of coefficients and magnitude of the standard error, which also formed the assumed a priori assumptions of the study.

## RESULTS AND DISCUSSION

Table 1 shows that 41.4% of the respondents fell within 36-45 years of age with average of 28. Idrisa *et al.* (2012), reported that younger farmers are more receptive to new ideas than older ones. They may have much wider contacts with outside farming and alternative employment opportunities. They are therefore much more willing to take risk in adopting new practices than older farmers, this finding disagreed with Adebayo *et al.* (2011), who testified that, the active productive age of farmers is between 41 - 50 years and as such, farmers in this age range can withstand stress which may have an implication on farmers productivity as well as the spread of innovation.

Majority (76.4%) of the farmers were male while the females constituted about 23.6%. This indicates that most of the rice cultivation were done by male farmers in the study area. It also indicates that there were more male-headed households engaged in farming than female-headed households in the study area. This is in agreement with Idrisa *et al.* (2010), which states that more males were found to be engaged in farming activities than their female counterpart because of its labour-intensive nature. It also showed that men are easily contacted by disseminators because their movements are not restricted thereby having the chance of being aware of improved technologies faster than the women. This finding agreed with Adesina (2000), who found out that 84% of the farmers who adopted improved rice variety were male and only 16% were female. Jan *et al.* (2007) found that gender is one of the factors significantly influencing adoption of irrigated rice production, the proportion of males among the farming indicates that there is large gender disparity in rice farming in the study area. Kiker *et al.* (2002) reported that female headed households may respond less favorably to adoption of new technology than male headed households due to wealth differences as well as cultural factors. Males are usually in a better position to attend extension meetings in traditional set-ups and thus have more access to information on new agricultural. Majority (82.9%) of the respondents were married, about 12.1% were single while about 2.9% were widows and 2.1% were divorced. The high number of married respondents could increase the release of family labour, thus making more hands available for productive activities on respondents' rice farms. This agreed with Ayoade (2003), who indicated that married people account for majority of rice farmers' population. The results indicate that most of the farmers in the area were married and it is assumed that marriage creates some stability and also improves access to more family labour for agricultural activities as it is necessary to feed their family (Obioha, 2009).

The result reveals that 33.6% of the farmers had 8 -10 members in their respective households, while 28.6% had a family size between 5-7 members with average of 8 persons.



Household size also in many village settings is believed to be one of the sources of labour. The findings suggest availability of labour force for farming in the study area. This may imply that households have labour source which is needed in farming activity. Household size is an important source of labour especially during the peak of farming, for example, during weeding and harvesting where an evenly available farming labour is required (Njuguna *et al.*, 2015). This goes with the findings of Okoye *et al.* (2004) that farmers with a fairly large household size may employ family labour to reduce cost of production. Large household size might imply more cash constrain as the need to meet the family daily requirements increase with large family size, thus leaving the household with little cash to purchase production inputs and new technologies (Audu and Aye, 2014).

The result revealed that 42.9% of the respondents had primary education, about 32.1% had secondary education, about 19.3% had tertiary education, and about 2.1% had Qur'anic education. The finding implies that a good number of farmers have formal education which can help them in their agricultural activity. Education has an important role in farming especially when farmers are trained on a particular aspect and put it into practice. Educated farmers can easily seek information and disseminate it to other farmers who are not knowledgeable enough. The high level of literacy among the respondents may facilitate better adoption of improved rice seeds and better ability of impacting knowledge and skills for adoption of an innovation. Adewumi *et al.* (2007) have similarly posited that extent of literacy helps to eradicate ignorance and promote adoption of new technology. It helps farmers to interpret the technology packages transferred to them by development agencies. Education is also seen as human capital stock which is believed to increase farmers' self-awareness and managerial skill at farm level. Thus, household head with higher education levels are expected to have the ability to accept new ideas and innovation, hence would be more willing to adopt new improved rice varieties.

The results further revealed that those with farm sizes less than 1 hectare of land were 50.7%, those with farm sizes of 1-2 and 2.1-3.1 hectares accounted for about 37% while 9.3%. This shows that majority of the farmers (50.7%) are subsistence farmers with average of 1.5 hectares. Majority of the respondents had farm size of less than hectare, meaning that most of the farmers operated on small scale basis. This implies that the majority of the respondents were small scale farmers. Small scale farmers lack the capital to invest in large scale agricultural production, they make use of mainly family labour; most of them depend on other farmers for agricultural information. Fragmentation of land among family members is a common feature among the farmers and it is done to ensure that every member of the family owns a piece of land. Fragmentation of farmland among family members also discourages commercial agriculture. This sometimes result to arguments and quarrels within members of the same family. However, if family land is not shared among members, some members of the family may not be able to acquire a piece of land if they do not have money to buy any. The finding confirms Ati (2009), who reported that majority of farmers in Nigeria operate on small scale basis which is a limiting factor to agricultural production.



**Table 1:** Distribution of farmers based on their Socio-economic Characteristics

Variable	Frequency	Percentage	Mean
<b>Age of Farmers (Years)</b>			
15-25	5	3.6	28
26-35	43	30.7	
36-45	58	41.4	
46-55	14	10.0	
56-65	14	10.0	
<b>Gender</b>			
Male	107	46.4	
Female	33	23.6	
<b>Marital status</b>			
Single	17	12.1	
Married	116	82.9	
Divorced	3	2.1	
Widow	4	2.9	
<b>Household size</b>			
2-4	19	13.6	8
5-7	40	28.6	
8-10	47	33.6	
11-13	7	5.0	
14-16	15	10.7	
17-19	12	8.6	
<b>Educational Level</b>			
None	5	3.6	
Primary	60	42.9	
Secondary	45	32.1	
Tertiary	27	19.3	
Qur,an	3	2.1	
<b>Farm Size</b>			
< 1	71	50.7	1.5ha
1-2	53	37.9	
2.1-3.1	13	9.3	
< 4	3	2.1	
<b>Farming experience</b>			
1-5	3	2.1	13yrs
6-10	42	30.0	
11-15	22	15.7	
16-21	58	41.1	
<b>Total</b>	<b>120</b>	<b>100</b>	

Source: Field survey, 2021

Table 1 result furthered revealed that a good number of 41.4% of rice farmers were found to have between 16 - 21 years of farming experience, while 30% had between 6 - 10 years of experience and 15.7% were found to be between 11– 15 years of farming experience. This means that the rice farmers had experience in their production with a mean of 13 years. The long farming experience shows that the farmers will be able to make sound



decisions as regards resource allocation and general management of their farms. This is in line with Johannes *et al.* (2010) and Kudi *et al.* (2011) who argued that as farmers gain more experience, they are able to evaluate the benefits of new technologies and therefore, increase the rate of adoption. With respect to the use of improved rice seed; farmers may use this experience in making decision on their utilization, this is supported by the finding of Eboh (2009), which indicated that farmers usually are more involved in practices that they are more familiar with than other practices.

Table 2 shows that the major indicators of climate change as perceived by the farmers who had a primary qualification include changes in rainfall pattern (43.57%), Humidity general dryness (19.29%), Increase in temperature (26.43%) and Storming windy rains (40.00%), while farmers that had secondary qualification perceived increase in flood (23.57%) as most severed climate change in the study area. This implies that the respondents were aware of climate change events in the area. Some of the climate change indicators identified by the farmers such as Changes in Rainfall Pattern and Humidity General Dryness are capable of reducing farm yields and adding to the production cost. Increase Flood and Storming Windy Rains could be as a result of increased rainfall intensity, high humidity and warmer environment. Farmers' knowledge of climate change indicators will help them adopt some adaptation measures.

**Table 2:** Distribution of respondent based on the climate change indicators on level of education of rice farmers

Variables	Primary	Qur,anic	Secondary
<b>Tertiary</b>			
Changes in rainfall pattern	61(43.57%)	32(23.14%)	44(31.43%)
32(23.57%)			
Humidity general dryness	27(19.29%)	35(25.32%)	15(10.71%)
27(19.29%)			
Increase flood	19(13.57%)	29(21.32%)	33(23.57%)
15(10.71%)			
Increase in temperature	37(26.43%)	24(17.45%)	14(10.00%)
24(17.14%)			
Storming windy rains	56(40.00%)	28(19.55%)	22(15.71%)
26(18.57%)			

Source: Field survey, 2021

### **Distribution of Farmers Based on their Adaption Strategies**

Table 3 shows various adaptation measures practiced by the respondents. These include the practice of migration (45%), off-farm jobs (9.3%), irrigation practices (22%), crop diversification (54%) and no adaptation (5.4%), among others. These measures are aimed at maximizing yields and ensure food security. Crop diversification which implies growing a number of different crops in the same plot or in different plots reduces the risk of complete crop failure as different crops are affected differently by climate events. Nhemachena and Hassan (2007), reported that farmers are using crop management practices that include use of irrigation, water and soil conservation techniques and varying planting and harvesting dates to ensure that critical, sensitive growth stages that do not coincide with very harsh climatic conditions in the season.





**Table 3:** Distribution of farmers based on their adaption strategies

Variable	Yes = 129	No = 11
Migration	11(8.5%)	5(45%)
Off-farm jobs	12(9.3%)	0(0%)
Irrigation	29(11%)	0(0%)
Crop diversification	70(54%)	0(0%)
No adoption	7(5.4%)	6(55%)

Source: Field Survey, 2021

### Factors Influencing the Adoption of Strategies that Rice Farmers Adopt

Effects of farmer's socioeconomic and institutional characteristics on their adaption strategies (no of adaptation measures used). Dependent Variable: using a Multinomial Logit model to estimate the maximum likelihood of adoption of the various adaptation strategies by rice farmers. Independent Variables: these are variables which are thought to have influence on level of adoption of improved rice seed. These explanatory variables are: age( $X_1$ ), sex ( $X_2$ ), level of education ( $X_3$ ), household size ( $X_4$ ), farm size ( $X_5$ ), extension contact ( $X_6$ ), and farming experience ( $X_7$ ). The independent variables for the study were:

Age of the Farmers: this refers to chronological age or how old is the farmer, that is, number of years lived by the farmer. Farmer's age and adoption of technology are associated. As a farmer's age increases, it is expected that the farmer becomes conservative. Therefore, it is priori expected that farmer's age and level of adoption relate negatively. Thus, as a farmer's age increases the level of technology adoption is expected to decrease (Dereje, 2006).

Sex: refers to the biological form of human being a male or female, it is prior expected that farmers who are male engaged in farming activities than their female counterpart because of its labor-intensive nature. It also expected that men are easily contacted by disseminators because their movements are not restricted thereby having the chance of being aware of improved technologies faster than the women.

Level of Education was measured by number of formal school years completed by the farmer. Education (formal) is assumed to increase farmers' ability to obtain, process, and use information relevant to the adoption of improved rice seed. It is expected that educated individuals can make better decision to adopt components of the improved rice seed than non-educated ones. In this study, education was treated as a continuous variable that was measured in number of years spent in formal school system.

Household Size: This was measured in term of number of wives, children and dependents living in a household. It often determines how much family labour was put into the farm activities (Adeniji *et al.*, 2007).

Farm Size: The variable was measured in number of hectares of land devoted to rice production Farm size was expected to positively influence the adoption of improved rice seed; the probable reason could be that large land size provides a household with an opportunity to adopt the improved rice seed and their production. The regression result shows that several characteristics of the farmers influence either positively their adaptive capacity to climate change. Factors that were highly significant at 1% level include marital status, age, educational level, farming experiences, farm size, access to extension and extension visits number of extension contacts per year, amount of savings and farm association were not significant. The R square value of 0.594 implies that about 59.4% of the adaptive capacity of the respondents was determined by their socio-economic and institutional characteristics.



The study revealed that age was positively significant implying that older farmers had higher adaptive capacity than the younger once. Farming experience had positive significant implying that higher experience increases the probability of uptake of many adaptation measures. This implies that highly experienced farmers are likely to have more information and knowledge on changes in climatic conditions and crop and livestock management practices. Frequent contact with extension agents also increases the probability of taking up adaptation measures. This is because farmers who have significant extension contacts have better chances of to be aware of changing climatic conditions and management practices, they can use to adapt to climate change. Similarly, educational level showed significant effect implying that farmers with higher educational levels were most likely to adopt adaptation measures than those with lower educational level. The R square value of 0.594 implies that about 59.4% of the adaptive capacity of the farmers was determined by their socio-economic and institutional characteristics.

This finding agreed with that of Idrisa *et al.* (2012) that literacy level positively influenced the intensity of adoption of improved soya-bean seed by farmers in Borno state. The results further reveal that farm size had positive and significant relationship with adoption of improved varieties rice at 10% level of significance. This signifies a positively influence of the farm size on the adoption of improved rice. That is, a unit increase in farm size could result to a significant influence on the adoption of the improved rice varieties by .494 in the study area. Farm size was identified as an important socio-economic factor by (Jackline, 2002) in an adoption study of agricultural technologies.

**Table 4:** Factors influencing the adoption of the various adaptation strategies by rice farmers

Variable	B	S.E	Z-Value	P-Value	Exp.(β)
Marital Status	2.850	0.8143	3.5000	0.000***	17.2878
Age	3.150	0.3706	8.5000	0.000***	23.3361
Educational level	1.380	0.4059	3.4000	0.000***	3.9749
Farming Experience	2.100	0.6176	3.4000	0.000***	8.1662
Farm Size per Hectare	2.250	0.7759	2.9000	0.002***	9.4877
Amount of Savings	1.360	0.9067	1.5000	0.068	3.8962
Farm Association	1.560	1.9500	0.8000	0.212	4.7588
Access to Extension Services	1.890	0.6750	2.8000	0.003***	6.6194
Extension Visits	1.650	0.3235	5.1000	0.000***	5.2070
R <sup>2</sup> =59.4%					
F=46.32					

Note: \*= $p < 0.05$ , \*\*= $p < 0.01$ , \*\*\*= $p < 0.001$ .

Source: Field Survey, 2021

### Constraints to the Adoption of Climate Change Adaption Strategies by Rice Farmers

Adaptation to climate change in the State is constrained by factors. The distribution of the respondents on these factors is presented in Table 5. The table shows that about 18.2% of the farmers claimed that high cost of input was the main factor hindering adaptation to climate change, while about 16.1% complained of insufficiency of financial resources. Also, about



15.2% of the respondents claimed the high cost of labour as the factor hindering adaptation to climate change, while only about 10.4% complained of inadequate knowledge on strategies. This study reveals that high cost of inputs is the main factor hindering adaptation to climate change.

**Table 5:** Constraints to the adoption of climate change adaptation strategies by rice farmers

Constraints	Frequency	Percentage
Insufficiency of Financial Resources	101	16.1
Off-Farm Employment	13	2.1
Shortage of Land	43	6.9
High Cost of Labour	95	15.2
Transportation Problems	48	7.7
Insecure Property Rights	42	6.7
Inadequate Knowledge on Strategies	65	10.4
High Cost of Inputs	114	18.2
No Access to Water	17	2.7
Inadequacy of Climate Information	89	14.0
<b>Total</b>	<b>627</b>	<b>100</b>

\*Multiple responses

Source: Field Survey, 2021

## CONCLUSION AND RECOMMENDATIONS

Emanating from the study findings it can be concluded that socio-economic and institutional characteristic of farmers play a significant role in perceptions and adaptations to climate change among rice farmers in the study area. Marital status, age of the farmers, educational level, farming experience, farm size, access to extension and extension visit were the significant factors influencing perception and adaptations to climate change by rice farmers in the study area.

Based on the finding of the study, the following recommendations were made:

1. Extension agents should sensitize and raise awareness to climate change.
2. Adequate media information should be provided by the various agricultural Programme (ADPs) so as to create conducive policy that will enhance adaptive capacity of the farmers.
3. Government and policy makers need to increase coverage and improve quality of and access to those services that are responsive to climate change related risk. A special focus is also needed on disadvantage groups –poor farmers of very remote areas, aged men and women, children.
4. Government should create conducive policy that will enhance adaptive capacity of the farmers: given the high degree of uncertainty about how climate change may affect farmers, and rural people in dry land area, government policy intervention in the state should focus primarily on addressing the underlying causes of vulnerability of the peoples and the limited adaptive capacity of the farmer.

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