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Climate Change Adaptation Decisions among Farming Households in Otukpo Local Government Area of Benue State

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Abstract
The study accessed climate change adaptation decisions among farming households. Data for the study were collected by administration of structured questionnaires to the respondents at Otukpo local government area of Benue State. Multi statge sampling technigues was used to select120respondents for the study. Data analysis was done using both descriptive and inferential statistical tools such as frequency, percentage, mean and standard deviation, and binary Probit regression mode.Resultsshowed that 50% of the respondents were within the age of 41-60 with the mean distribution of 43.73yrswhich showed farmers in the study area are within their active age. It was found that 75.0% of the respondents were males, while 25.0% were females, also 82.5% of them were married, while 15 .0% were single. Results also showed that 58.3% of the respondents had tertiary education, while 24.2% had secondary education,12.5% had primary education and 5.0% had no formal education. Their major source of information on climate change was from radio. The major constraints militating against farmers' decision making in climate change adaptation includes inadequate government policies to power climate change adaptation programmes, far distance of households' farms to their homesteads, lack of awareness about NGOs programmes on climate change, lack of access to weather and climate change information and inadequate extension programmes directed to meet climate change adaptation strategies. It was recommended that farmers should be educated on the proper decisions and adaptation strategies against the major constraints to climate change adaptation.
Key Words: *Climate Change, Adaptation Decisions, Farming Households, Otukpo.*

INTRODUCTION

Agriculture in Nigeria as a nation is a principal source of food, fibre, livelihood and foreign exchange earnings, (Badiare and Delgado, 1995). It contributes about 52 % of the GDP, generates more than 85% of the foreign exchange and employs about 80% of the population. Despite its high contribution to the overall economy, agriculture is characterized by its environmental, behavioural and multitude of factors, of which climate change related problems like drought and flood, which often lead to food insecurity amongst others(Fischer *et al*., 2002; Wolfe *et al*., 2005;Lobell*et al*., 2008).

Climate change can be defined as the change in the state of the climate that can be identified using statistical data by changes in the mean and variability of climate properties that has persisted for an extended period, typically decades or longer (IPCC, 2001). As posited by the United Nations framework convention on climate change (UNFCC), that climate change refers to a change of climate that is attributed directly or indirectly to human activities that alters the composition of global atmosphere and that is; in addition to natural climate variability observed over comparable time period. (Currents, 2008). However, the nature of these biophysical effects and the responses to them are complex and uncertain. Farmers are experiencing climate change even though they have not considered its deeper implications. This is shown in the late arrival of rain, the drying-up of streams and small rivers that usually flows year round are among the effect of climate disturbances in some communities in Nigeria (BNRCC, 2008). Climate change will have adverse effects on household farming in the country because these people depend more directly on natural resources and are less able to adapt to climate variations and extreme

weather. Household farming is affected by environmental change because they are much more exposed to existential risks such as disease, hunger, low income and most importantly poor adaptive decisions. In line with climate change impacts on food production, the adaptive decisions of farming household has to be taken into considerations, unfortunately the study area is one with the least adaptive capacity.

Adaptation decisions to climate change refers to adjustment in natural or human system in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001). It is important to know whether farmers make decisions for adaptation due to climate change and its effect. If they do and recognize that climate change is occurring, the government needs to help them overcome constraints they face in taking up appropriate adaptation decisions to climate change. On the other hand, it they do respond by making adaptation decisions about events but do not recognize that climate change is occurring then the state would need to ensure that they have awareness about the occurrence of climate change. Although, if farmers do not respond to making adaptation decisions about events then the state would need to be actively involved in ensuring that farmers under-take appropriate adaptation decision at household level to climate change if the impending welfare losses to this vulnerable group in society are to be abated.

Household level analysis of adaptation focuses on tactical decisions farmers make in response to seasonal variations in climatic, economic and other factors. These tactical decisions are influenced by a number of socio-economic factors that include household characteristics, household resource endowments, access to information (seasonal and long- term climate changes and agricultural production) and availability of formal institutions (input and output markets) for smoothening consumption (Kandlinkar and Risbey 2000;Braashaw*et al*., 2004;). Household adaptation decision making occurs over a very short time period usually influenced by seasonal climatic variations, local agricultural cycle, and other socio-economic factors. The goal of an adaptation decision should be to increase the capacity of the household to survive external shocks or change. The assessment of farming adaptation decision among household is important to provide information that can be used to formulate policies that enhance adaptation decision as a tool for managing a variety of risks associated with climate change in agriculture (IPCC 2001). To approach the issue appropriately, one must take into account household's understanding of adaptation decisions of climate change, since they believe that climate as having a strong spiritual, emotional and physical dimension. It is assumed that these communities have an inborn adaptive knowledge from which to draw and survive in high stress ecological and socio-economic conditions. This, the farmers response is critical to understanding and estimating the effects of climate change on production and food supply for ease of adaptation decision, accounting for these adaptation decisions is necessary in order to estimate climate change (BNRCC, 2008).

This study investigated the effect of adaptation decision at the household level andassessed the major constraints militating against farming household adaptation decisions to climate change.

METHODOLOGY

The study was carried out in Otukpo Local Government Area of Benue state. Located in the middle Belt Region of Nigeria. It also the Eponymous name of a subgroup of the Idoma, Otukpo is located between latitude 6^0 25'and 8^0 8' north and longitude 7^0 47' and 10^E 0' East. The local government area is bordered to the north by Apa LGA; to the south by Obi, Ado and Okpokwu LGA; to the east by Gwer west and Gwer east LGA and to the west by Ohimini LGA and Ankpa LGA of Kogistate.Otukpo local government area has a land mass of 390 square kilometers and a population of 190,457 (National population census, 2006).

The population of this study consists of all agricultural farming households in Otukpo local government area. A double stage sampling techniques was used in the selection of farmers. Firstly, a simple random sampling was used to select five (5) villages from the study area and secondly, twenty five (25) farming households were randomly selected given a total number of sample sizes one hundred and twenty (120) respondents used for the study.

Data was collected from primary source. The primary data for the study was generated through the use of structured questionnaires that were administered to 120 household heads of the farming household in the study area.
The data for this study was analyzed using both descriptive and inferential statisticssuch as frequency, percentage, mean and the ordered Probit model:

Probit Model
Since adaptation to climate change will be obtained from a dichotomous (discrete) choice question with yes = (1), if adapted to climate change or No = (0) if not adapted; binary probit model was employed to realized determinants of farmers adaptation to climate change in the study area.
X_1 = Gender of household head (Dummy, 1 if male, 0 if female)
X_2 = Household size continuous (number)
X_3 = years of formal education continuous (number)
X_4 = years of farming experience continuous (years)
X_5 = farm size continuous (hectare)
X_6 = farming income continuous (number)
X_7 = Extension visits per cropping system continuous (number)
X_8 = Member of Cooperative
X_9 = Access toradio
X_{10} = Access to televisionX_{11} = Newspaper
X_{12} = Constraints
The explicit form of the binary Probit model was specified as follows:
$Pr(Y = 1/x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + ... + e$
Where
Y = Dichotomous probability estimated 1, if farmers adapted to climate change and 0 if otherwise.
β_0 = Intercept
$\beta_1 ... \beta_{11}$ = Coefficients of independent variables
$x_1 ... x_{11}$ = Determinants of farmers adaptation to climate change
e = the stochastic error term.

RESULTS AND DISCUSSION
Socio- Economic Characteristics of Respondents
The socio-economic characteristics of the respondents are presented in table 1. The result of age reveals that 50.0% of the respondents were between 41-60 years while 45.0% were within the ages of 21-40 and the remaining 5.0% falls within the age of 60 and above, with a mean distribution of 43.73 which means that farmers in the study area are still in their active or productive age. This result agrees with the findings of Yusuf *et al.,* (2007) and that of Okoruwa and Ogundele (2003) who observed that, "farmers in their active and productive age can bring in positive contribution to agricultural production".
The result also shows that 75.0% of the respondents were males while the remaining 25.0% were females. This implies that more men were involved in farming activities than women in the study area, as it assumes that men can easily get information about new technologies to adapt to climate change. Thus, the study also agrees with Asfaw and Adamssie (2004) in their findings that male-headed households are likely to get information about new technologies and undertake risky business than female-headed households.
The result revealed that 82.5% of the respondents were married while 15.0% were single and 2.5% of the respondents were divorced. This means that most of the respondents in the study area were married people with responsibilities of wives, children and other dependants or relatives and this implies higher family labour in the study area. This result agrees with that of Oyekale (2007)
The result obtained also shows that 49.2% of the respondents had a household size of less than or equals to 10, 24.2% are between the ages of 21 and above while 18.3% falls between 11-15 and 8.3% were between 16-20 in their house size. This indicates a high percentage household size in the study area and

thus, implies that large family is normally associated with a higher labour endowment, which enables a household to accomplish various agricultural tasks. This study therefore agrees with the findings of Croppenstedt, Demeke, and Meschi (2003) "that households with a larger pool of labour are more likely to adopt agricultural technologies and use it more intensively because they have fewer labour shortages at peak times". It is therefore expected that households with large families are more likely to adapt climate change.

The study also shows that 58.3% of the respondents had tertiary education while 24.2% had secondary education, 12.5% had primary education while the remaining 5.0% had no formal education. This implies that majority of the respondents in the study area are literate having different forms of education, which enable them to adopt new innovation easily. Education as one of the factors influencing adoption of innovation; the farmers with higher level of education can adopt new technologies better than those who are illiterate. This study also agree with that of Norris and Batie (1987) that higher level of education is believed to be associated with access to information on improved technologies and higher productivity. Evidences from various sources indicate that there are positive relationships between educational levels of household head and the adoption of improved technologies and adaptation to climate change (Igodon*et al.,*1990; Lin 1991). Other studies by Gould *et al.* (1989) and Okeye (1998) also suggest an agreement with this study that educated and experienced farmers are expected to have more knowledge and information about climate change and agronomic practices that they can use. Maddison (2006) also suggest that due to these reasons improved knowledge and farming experience will positively influence farmers' decision to take up adaptation measures. Therefore farmers with higher levels of education are more likely to adapt to climate change.

The result of farming experience reveals that 40.0% of the respondents have less than or equals to 10 years of farming experience, while 24.2% were in the group of 21 years and above of farming experience, also 19.2% have about 16-20 years of farming experience and 16.7% have 11-15 years of farming experience. This shows that most respondents in the study area have been farming for a long time and are more experienced in agricultural production thereby increasing productivity, which also increases their adoption of improved technology. This study agrees with the study by Kebede*et al.,*Kunjal and Coffin (1990) which shows that there is a positive relationship between years of experience in agriculture and the adaptation of improved agricultural technologies. Also, Maddison (2006),Nhemachen and Hassan (2007) in their findings indicated that experience in farming increases the probability of uptake of adaptation measures to climate change.

The result of farm size also revealed that 32.5% of the respondents have less than or equal to 1.0 hectare of farm while 29.3% have 3.1 above hectares also, 20.0% have between 1.1-2.0 hectares while the remaining 18.3% have between 2.1-3.0 hectares of farm and mean distribution of 3.318 hectares. This implies that most of the respondents in the study area have a small farm holding thus reduces production capacity. This study agrees with the findings of Nyangena (2006) that farmers with small areas of lands are likely to invest in soil conservation than those with larger area of farm. Also farmers with small farms do not adopt measures that require large area of land. Also, farm size has both negative and positive effects on the adoption, which shows that the effect of farm size on technology adoption is inclusive. Bradshaw, Dolan and Smit (2004).

Result from the analysis shows that 39.2% of the respondents have ₦50,000-150000 annual farm income, 25.0% have less than or equal to N50,000 while 18.3% have ₦15,000-₦250,000 and 17.5% have ₦250,001 and above as annual farm income and mean distribution of ₦160651.67.This implies that the farmers in the study area get low income in their output thereby reducing their productivity and capacity to take up new adaptation strategy such as improved seeds varieties in order to improve their farm productivity. Farm income represents wealth, it is required that the adaptation measures in climate change requires sufficient finance. This study agrees with Frenzel (1999),Knowler and Bradshaw (2007) and in their investigation on the impact of income on adaptation which found a positive correlation. Higher–income farmers may be less risk averse and have more access to information, a lower discount rate, and a longer-term planning horizon (CIMMYT, 1993). This study shows that farm income responds to climate

change. When farmers are financially buoyant they can easily buy improved seed varieties, fertilizer and modern farm tools to improve their production.

The result shows that 86.7% of the respondents in the study area had less than or equal to 2 times of extension visits, 9.2% had 3-4 times of extension visits while 3.3% had 5-6 times of extension visits and 0.8% had extension visits 7 and above number of times per one cropping season. This shows that most of the respondents had extension visits. This could improve their level of awareness to certain information on techniques that relates to their production and improve their knowledge on adaptation to climate change. This study agrees with the fining of (Maddison, 2006; Nhemachen and Hassan, 2007), which observed that access to information increases probability of adapting climate change.

TABLE 1 Socio-Economic Characteristics Of Respondents.

Variable	Frequency	Percentage (%)
Age		
21-40	54	45.0
41-60	60	50.0
≥61	6	5.0
Mean	**43.73**	
Sex		
Male	90	75.0
Female	30	25.0
Marital Status		
Single	18	15.0
Married	99	82.5
Divorced	3	2.5
Household Size		
≤10	59	49.2
11-15	22	18.3
16-20	10	8.3
≥21	29	24.2
Mean	**13.97**	
Educational Qualification		
No formal Education	6	5.0
Primary	15	12.5
Secondary	29	24.2

Tertiary	70	58.3
Mean	**12.40**	
Farming Experience		
≤10	48	40.0
11-15	20	16.7
16-20	23	19.2
≥21	29	24.2
Mean	**15.61**	
Farm size		
≤1.0	39	32.5
1.1-2.0	24	20.0
2.1-3.0	22	18.3
≥3.1	35	29.3
Mean	3.318	
Annual Farm Income		
≤50000	30	25.0
50001-150000	47	39.2
150001-250000	22	18.3
≥250001	21	17.5
Mean	160651.67	
Number of Extension visit		
≤2	104	86.7
3-4	11	9.2
5-6	4	3.3
≥7	1	8.0
Mean	**88**	
Total	120	100

Source: Field survey, 2015.

Level of Experience in Climate Change.

The result in table 2 shows that about 55.0% of the respondents have moderate experience of the issues of climate change, 34.2% have high level of experience while 10.8% have low level of experience of the issues of climate change. This shows that many of the farmers in the study area had various level of experience of climate change. This study agrees with Ekong (2003) who stated that local people take cognizant of changes and have experienced changes in their immediate environment.

Table 2. Level of Experience in Climate Change

Source: Field survey, 2014.

Level of Experience	Frequency	Percentage
High	41	34.2
Moderate	66	55.0
Low	13	10.8
Total	120	100

Sources of information on Adaptation to Climate Change among Farmers.

The result in table 3 reveals that about 44.2% of the respondents were aware of climate change adaptation through friends, 32.5% of the farmers indicated agricultural seminar as their source information on climate change adaptation, 28.3% of them got their information from extension agents, 27.5% got their information from newspapers, while 20.0% got their information through other means and 13.3% got their information from journals. This shows that the most widely used source of information on adaptation to climate change by the respondents in the study area is through friends. The source of information on awareness of climate change and the source of information on adaptation to climate change have a positive relationship. This implies that the source through which farmers have access to information on the awareness of climate change, is the same source used in accessing the information on adaptation to climate change. Also, access to about climate change positively and significantly affects adaptation. This study is in line with Deressa*et al*. (2009) who stated that information on awareness to climate change increase the level adaption to climate change.

Table 3. Sources of Farmers Adaptation to Climate Change.

Source of Adaptation	Frequency*	Percentage
Extension agents	34	28.3
Journals	16	13.3
Agricultural Seminar	39	32.5
Friends	53	44.2
Newspaper	33	27.5
Others	24	20.0

Source: Field Survey, 2015.

Determinants of Farmers Adaptation to Climate Change.

The probit model was used for estimating the decision of farmers' whether or not to adapt to climate change. Perceive change in climate variables is an important pre-condition to take up adaptation measures (Maddison, 2006). Table 4 presents the results from the regression analysis which showed that three of the explanatory variables affected the probability of adaptation decision. Variables that were negative and significantly affected the decision of adaptation include household size, farming experience and access to radio and they are significant at 1%, 10%, 5% respectively. The result shows that household size has a significant but negative relationship with the probability of adapting to climate change. The possible reason is due to the fact that increase household size reduces the probability of the adapting to climate change. This implies that the respondents in the study area that have a larger family might be forced to divert part of its labour force into non- farm activities to generate income and reduce consumption demands, it also increases the likelihood of using other adaptation (crop farming to non-farming, crop to livestock, use of chemical and so on) as an adaptation measure. This also means that a unit increase in family size would result in a decrease in the probability of using improved crop variety about 5 percent. This could be due to the fact that household with larger families may be forced to divert part of their labour force to off- farm activities in attempt to earn income in order to ease the consumption pressure imposed by large family rather than adopting improved varieties. This result agrees with Croppenstedt*et al*.(2003) and Deressa*et al*. (2011) who also noticed that the possible reason for this relationship is due to the large family size which is normally associated with a higher labour endowment and this would enable a household accomplish various agricultural tasks.

Years of farming experience was found to be positively significant but negatively related to the decision of adapting to climate change. This means that the significant relationship of farming experience of the respondents with the level of adapting to climate change is attributed to the fact that experienced farmers have the knowledge on the various farm management practices and techniques that can be used as measures to combat the effects of climate change which can help them adapt to climate change, while the negative relationship of farming experience with the level of adapting to climate change is attributed to the fact that inexperienced farmers who have no knowledge of the various management practices and techniques that can be used as measures of adaptation to climate change, therefore they cannot adapt to climate change.

Access to radio was found to be significant but negatively related to the probability of adapting to climate change. The significant relationship of access to radio of the respondents with probability of adapting to climate change is attributed to the fact that majority of the respondents had access to radio and rely on it as one of the major source of information on climate change and having the knowledge of the effect of climate can help them to adapt to climate change, while the negative relationship of access to radio of the respondents with the level of adapting to climate change is attributed to its affordability and ease of operation, also lack of electricity in the study area. This implies that some of the farmers who lack financial resources cannot afford radio and when there is no source of electricity in the area where the major source of information is through radio, farmers will find it difficult to adapt to climate change because information will less accessed.

Table 4. Determinants of Farmers Adaptation To Climate Change.

Variable	Coefficient	Robust Standard Erro	Z- test	P>/Z/
Age	.0087038	.0172767	0.50	0.614
Household size	-.0278487	.0111689	-2.49***	0.013
Education	-.0044279	.0366331	-.12	0.904
Farming Experience	-.0304386	.0186946	-1.63*	0.103

Farm size	.0229197	.0232237	0.99	0.324
Annual income	1.10e-06	1.08e-06	1.01	0.311
Number of extension visits	-.1441537	.0978499	-1.47	0.141
Member of cooperative	.0535767	.1347284	0.40	0.691
Access to Radio	-1.143162	.3857651	-2.96**	0.003
Access to Television	.3430683	.3564219	0.96	0.336
Newspaper	.2952133	.4117105	0.72	0.473

Log pseudo Likelihood = -44.808403
Wald chi^2 11= 17.12
Prob> chi^2 =0.1045
Pseudo R^2
Number of Observation =120
Source: Field Survey, 2015.
Note:***,**,* = Z negative and statistically significant at 1%, 5% and 10% respectively.

Constraints Militating Against Farmers Decision Making in Climate Change Adaptation.

The results in table 5 shows that about 56.7% of the respondents identified inadequate government policies to power climate change adaptation programmes as their major constraints militating against their decision making in climate change adaptation in the study area. About 50.0% of the respondents indicates that far distance of households farms to their homesteads affects their adaptation to climate change, about 42.5% were affected by lack of access to weather and climate change information, 35.8% were attributed to lack of awareness about NGOS programmes on climate change, 31.8% were attributed to inadequate extension programmes directed to meet climate change adaptation strategies, 27.5% of the respondents were affected by high cost of irrigation facilities as well as poor access to climate change adaptation information, 20.8% of the respondents were attributed to illiteracy of farmers, 10.0% were attributed to high of cost farm land, 7.5% of them were attributed to traditional beliefs, while 4.2% were attributed to beliefs against adaptation and the remaining few 2.5% were attributed to religious beliefs. The study found out that the major constraints militating against the respondents' decision making in climate change adaptation in the study area is inadequate government policies to power climate change adaptation programmes. This implies that government institutions responsible for climate change issues in Nigeria, like other government institutions in most developing countries are still weak and irresponsive to the yearnings of the people. Mostly, like some of the small-scale farmers, having low resources base are vulnerable and less able to cope with the consequences of climate change. Such farmers also have less likelihood of accessing weather information or capacity to develop technologies on their own. For example, high cost of irrigation facilities as one among the several constraints facing the farmers in the study area could be due to the fact that the farmers have inability of using the already existing water due to technological incapability or lack of resource fund to invest on irrigation technology for climate change adaptation. The study agrees with Deressa (2008) who stated that poor irrigation potentials can most probably be associated with the inability of farmers to use the already existing water due to technological incapability. Most African farmers are resource poor and cannot afford to invest on irrigation technology for climate change adaptation so as to sustain their livelihood during harsh climate extremes such as flooding and drought. Lack adaptive capacity due to constraints on resources such as lack of access to weather and climate change information creates gaps between the farmers and useful information that should help them in their farm work. Weather forecasts are supposed to guide farmers on climate change variability so that they can make informed decisions and useful farm plans. However, absence of this undoubtedly makes farmers become ignorant of the weather situations and hence become vulnerable to

the impact of climate changes in the climate and weather conditions. Also lack of capacity of extension personnel on programmes directed to meet climate change adaptation strategies or to build resilience capacity of farmers on climate change will in the present information age pose serious challenges to farmers' coping strategies as they may not be aware of recent developments regarding climate change adaptations and the necessary readjustments needed.

Table 5Constraints Militating Against Famers Decision Making In Climate Change Adaptation.

Variable	Frequency*	Percentage (%)	Ranking
High cost farm land	12	10.0	9th
High cost of irrigation facilities	33	27.5	6th
Lack of awareness about NGOS programmes on climate change	43	35.8	4th
Lack of access to weather and climate change information	51	42.5	3rd
Illiteracy of farmers	25	20.8	7th
Poor access to climate change adaptation information	33	27.5	6th
Land fragmentation	17	14.2	8th
Lack of collateral	12	10.0	9th
Inadequate extension programmes directed to meet climate change adaptation strategies	38	31.7	5th
Far distance of households farms to their homesteads	60	50.0	2nd
Belief against adaptation	5	4.2	11th
Religious beliefs	3	2.5	12th
Traditional Beliefs	9	7.5	10th
Inadequate government policies to power climate change adaptation programmes	68	56.7	1st

Source: Field Survey, 2015.
*Multiple Responses

CONCLUSION AND RECOMMENDATIONS

Based on the finding of the study, the following conclusions were made, Farmers took decisions on the appropriate adaptation measures or strategies employed to combat the adverse and negative influence of climate change on their livelihood, which also implies high level of adaptation. Access to higher education and farming experience were found to promote adaptation, which implies that higher education improves awareness and enhances the potential benefits of adaptation as an important policy measure.
Based on the finding of this research work, the following recommendations were made.
Government should support climate change adaptation programmes to enhance the proper adaptation strategies of farmers in the rural areas and also improved technologies for seed germination and improved seed varieties should be provided in order to improve agricultural productivity.

Support should be given to fund extension workers who will educate the farmers practically on issues of climate change adaption strategies and how to make proper decisions regarding these issues.There is need for farmers' education on the right decisions and adaptation strategies to be employed against constraints of climate change in their immediate environment.

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