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Original Article

Yam (*Dioscorea* spp.) Farmers' Adaptation to Climate Change in Some Selected Local Government Areas in Niger State, Nigeria

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ABSTRACT

This investigation examined the socio-economic factors affecting yam farmers' adaptation to climate change in Niger State of Nigeria. A total of hundred and twenty yam farmers who responded to questionnaire were selected randomly from six local government areas namely: Bosso, Chanchaga, Paikoro, Lapai, Bida and Mokwa in Niger State. Data collected were analyzed using descriptive statistics and multinomial logit regression analysis. Results obtained indicated that the average farm size was 1.5ha, an indication that the study covered small scale family managed farm units. The average years of schooling, age of the farmers and years of experience were 7.1, 42 and 17 respectively, suggesting that the farmers have some basic literacy, were relatively youthful and energetic and have some experience in yam production. Over 90% of the respondents perceived long term change in temperature and rainfall pattern in the study area. The common adaptation options for climate change used by farmers were: crop diversification (33.30%) while 20.83% of the farmers did not use any adaptation measure to mitigate climate change. The study recommends increased formal and informal institutional support such as farm advisory services and education in promoting the use of adaptation options to reduce the negative effects of climate change.

Keywords: Adaptation, risk reduction, climate change.

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INTRODUCTION

Climate change has been defined as a long-term change in the statistical distribution of weather patterns over a period of time that range from decades to millions of years. It may be a change in the average weather conditions or a change in the distribution of weather events with respect to an average such as greater or fewer extreme weather events (Adejuwon, 2004). Climate change may be limited to a specific region, or may occur across the whole earth (Wikipedia, 2011). The goal of adaptation measures should be to increase the capacity of a system to survive external shocks or change. It has been ascertained that adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climate and socio-economic conditions, including climate variability, extreme weather conditions such as drought and floods and volatile short-term changes in local and large-scale markets (Klanlinkar and Riskey, 2000).
An understanding of farmers' perceptions regarding long-term climatic changes, and current adaptation measures will be important to guide policy makers for future successful adaptation of the agricultural sector (Baethgen *et al*., 2003). This is important to provide information that can be used to formulate policies that enhance adaptation as a tool for managing a variety of risks associated with climate change in agriculture. Africa is generally acknowledged to be the continent most vulnerable to climate change. West Africa is one of the most vulnerable to the vagaries of the climate, as the scope of the impacts of climate variability over the last three or four decades has presented (IPCC, 2013). This is in large measure due to weak institutional capacity, limited engagement in environmental and adaptation issues, and a lack of validation of local knowledge (Spore, 2008; Royal Society 2005 and Adams *et al*., 1998). Accordingly, there is the need to gain as much information as possible, and learn the positions of rural farmers and their needs, their knowledge and perception of climate change, in order to offer adaptation practices that meet these needs.

Climate change has negative impacts on agricultural productivity through increase in temperature, low precipitation and other weather vagaries which restrict farmers to production of certain crops and animals that can thrive well in such conditions (Adger *et al*., 2003). Although a number of researchers have analysed the effect of climate change on agriculture especially in Asian countries, there is a dearth of studies related to Nigerian farmers especially yam farmers and the socio-economic factors which influences their choice adaptation measures. This study aims at filling this information gap by providing policy makers with basis for informal agriculture-friendly climate change intervention schemes and policies. Farmers' production has been dwindling due to the effect of climate change and for farmers to cope with these effects, they must put some measures in place in order to tackle the problem posed by climate change. Empirical studies measuring the economic impacts of climate change on agriculture in Africa (Kurukulasuriya and Mendelsohn, 2006; Benhin, 2006) show that such negative impacts can be significantly reduced through adaptation.

The study will lead to an increased understanding of environmental, social and economic implications of climate induced risks. The investigation will identify which adaptation measures practiced by the yam farmers are effective for the purpose of standardization and dissemination through extension mechanisms to enhance adaptive capacity of other vulnerable communities to reduce their risks to climate change. Practicing and prospective farmers will also be guided by the findings in their investment decisions. Also, the lessons learnt on indigenous adaptive experience and coping mechanisms will be published to promote replication and policy influence. The output of the study can also be used as baseline study for the future research in similar areas.

MATERIALS AND METHODS

Study Area

The study area is Niger State which is located in the Southern Guinea Savanna zone of Nigeria on latitude 9^0 37^1North and longitude 6^0 33^1 East. It has a mean annual precipitation of 1,300mm taken from a long record of 50 years. The highest mean monthly rainfall is September with almost 3000mm. The rainy season starts on average in April and lasts between 190-200 days. Temperature rarely falls below 22^0C, the peaks are 40^0C (February-March) and 35^0C (November-December). Niger State is bordered by the states of Kwara to the West, Kaduna to the North, Kogi to the South and Federal Capital Territory (FCT) to the East. The selected Local Government Areas (LGA) covered in this study were: Bosso, Chanchaga, Paikoro, Lapai, Bida and Munya. These LGAs had a total population of 2,245,000 in 2010 (Wikipedia, 2011).

The vegetation in the study area is dominated by herbaceous plants which are occasionally interspersed with shrubs. The soil characteristics in the study area is determined by the basement complex as well as sedimentary rocks which have a strong influence on morphological characteristics of the local soils. Yam (*Dioscorea spp*) is the major crop cultivated in the study area but other crops grown by the people include maize (*Zea mays*), sorghum (*Sorghum vulgare*), groundnuts (*Arachis hypogaea*), cassava (*Manihot esculentus*) and miscellaneous crops such as okra, pepper (*capsicus spp*) garden egg(*solanum raddi)*and tomatoes (*lycopersicon esculents)* (Adejuwon, 2004).

Sampling Technique and Sample Size

The study was carried out in six Local Government Areas of Niger State. The locations were chosen randomly whereby, from each of the Local Government Area, two farming communities were selected. The heads of households were chosen proportionately to the population of the yam farmers in each community. Proportionate selection was done to ensure representativeness and to reduce bias. Sampling framers for yam farmers for each of the communities were obtained by the researcher from the village heads through a reconnaissance survey. A total of one hundred and twenty respondents were sampled from the frames from which information were elicited.

Data Collection

Data for the study were obtained with the questionnaire complemented with oral interviews. Personal visits to farms were made to interact with the farmers and in rare cases in their farmstead settlements. Data collection for this study commenced in March 2011 and ended in May, 2011. Data were collected on the following: socio-economic characteristics of farmers such as household size, gender of household head, age, level of education, access to credit, extension services, personal income and farm size in hectares. Others were perception of farmers on some climatic factors such as temperature and precipitation; adaptation measures adopted by farmers in the study area such as change in planting dates, crop diversification, soil conservation and changing tillage operations.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The socio-economic characteristics of the respondents are summarized in Table1. Results indicated that the average farm size was 1.5 ha, an indication that the study covered small scale family managed farm units. The average years of schooling, age of the farmers and years of experience were 7.1, 42 and 17 respectively, suggesting that the farmers have some basic literacy, were relatively youthful and energetic and have some experience in yam production. Education increases one's ability to receive, decode, and understand information relevant to making innovative decisions (Wozniak, 1984). Maddison (2006) and Nhemachena and Hassan (2007) also indicated that experience in farming increases the probability of uptake of adaptation measures to climate change. Results also indicated that majority of the households (83.33%) were male-headed suggesting that farming is considered as a male occupation in the study area. Tenge *et al.* (2004) affirmed that female-headed households may have negative effects on the adoption of soil and water conservation measures because, they have limited access to information, land and other resources due to traditional social barriers. Educated and experienced farmers are expected to be more informed about climate change and respond positively based on their knowledge. This corroborates the work of Maddison (2006) who found that educated and experienced farmers are expected to have increased knowledge and information about climate change and agronomic practices that they can use in response to climate change phenomenon. Due to lack of education, a lot of traditional farming practices detrimental to the environment still persist and farmers find it difficult to modify. The study also indicated that majority of the respondents (80.83%) have no access to extension services, this may serve as a barrier in adopting new farming practices which could help the farmers in adjusting to adverse effect of climate change. This corroborates the work of Yirga *et al.* (2007), who found that extension education on crop and livestock production and information on climate change enabled farmers to take decision. Various studies in developing countries including Ethiopia reported a strong positive relationship between access to information and adoption behaviours of farmers. Moreover, Maddison (2006) and Nhemachena and Hassan (2007) showed that access to information through extension, increase the chance of adapting to climate change.

Perception of Respondents on Climatic Change

Farmers in the study area perceived changes in some climatic factors of their environment and this had led to the action of majority adopting one adaptation measure or the other. The parametized factors were rainfall and temperature. Perceptions of farmers are presented in Table 2. Changes in temperature globally have been attributed to climatic change phenomenon. Depending on the agro – ecology, the change could be in the trend of increasing, decreasing or unchanged respectively. Results in figure 1 showed that 93 of the respondents perceived that the change in temperature are long term with only 7 claiming to have noticed no change in temperature. Only about 20 respondents believed there was really a decreasing temperature trend. This corroborates the work by CEEPA (2006) who reported that many African studies indicate a large number of agriculturists already perceiving that climate has become hotter and the rains less predictable and shorter in duration. Result of the survey also showed that 117 of the respondents across the study area perceived that there was long term change in the quantity of rainfall while only three did not notice any change in the rainfall pattern. However, while 30 noticed increase in rainfall, 87 believed there was really a decreasing rainfall trend. This is also in consonance with CEEPA (2006) Findings.

Climate Change Adaptation Measures Adapted by the Farmers

There were six categorical dependent groups known as adaptation categories in this study. Results in Table 3 indicate the measures adopted by farmers to mitigate climate change. They showed that crop diversification is the most commonly used method as 33.3% of the farmers confirmed it, 14.2% practiced changing tillage option, 15% practical changing planting dates and 12.5% undertook soil and water conservation. Planting of trees was the least practiced among the adaptation methods identified in the study area as reported by 4.2% of the farmers. The adoption ofcrop diversification as an adaptation method by many could be associated with the lower experience and the ease of access by the farmers. Moreover, 20.80% of the surveyed farmers reported not to have taken any adaptation method. This could be due to lack of information and poverty among respondents.

Factors influencing the choice of adaptation measures among respondents in the study area

The factors influencing the choice of adaptation measures were examined using the multinomial logic model. The results are presented in Table 4.

The results showed that the likelihood ratio (X^2) value was 86.97 and this was significant at 0.01 probability level. This test confirms that all slope coefficients are significantly different from zero. The pseudo R^2 value of 0.2245 also confirmed that all the slope coefficients are not equal to zero. In other words, the explanatory variables are collectively significant in explaining the choice of climate change adaptation measure by crop farmers in the study area. Previous studies by Hill (1983) obtained pseudo – R^2 values of between 0.3226 and 0.3484 while Zepeda (1990) and Rahji and Fakayode (2009) reported pseudo R^2 values of 0.25 and 0.3145 respectively as representing a relatively good – fit for a multinomial logit regression model. Hence, the pseudo R^2 value of 0.2245 in this study is indicative of good fit and the correctiveness of the estimated model and therefore economically validated. Level of education, age and extension education were found to be significant at explaining the choice of adaptation measures by the respondents.

CONCLUSION AND RECCOMENDATIONS

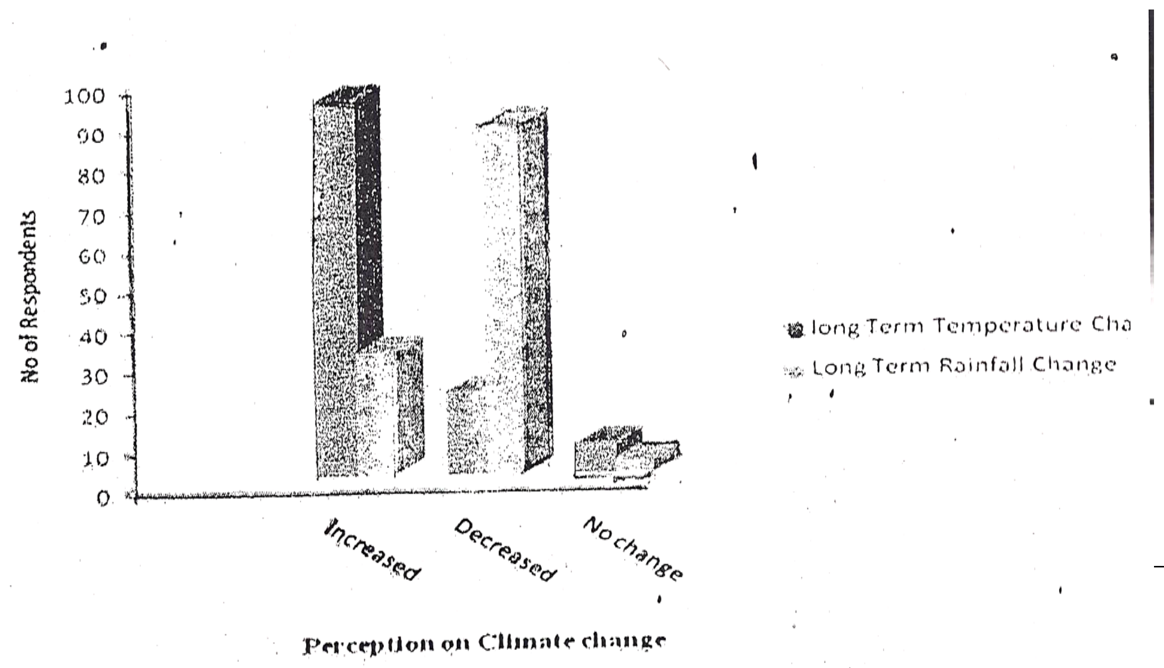
The three variables significantly affecting the farmer's choice of adaptation measures to climate change were extension education, years of formal education and age of farmers. Farmers adapted to climate change phenomenon by using different methods to mitigate the adverse consequences. The adaptation stemmed from their awareness of these techniques. It was established from this study that some socio-economic characteristics of farmers significantly influenced their adaptation decisions which underscores the need for appropriate policy attention to enhance their productivity and livelihoods

The following policy recommendations are made. There is need for formal and informal institutional support such as farm advisory services and extension education to promote the use of adaptation options and indigenous knowledge systems to reduce the negative effects of climate change. This is with a view to increasing farmers ability to cope and the evolution of appropriate risk reduction production strategies in response to perceive climate change to improve their well – being. The current stance of the Nigerian Emergency Management Agency (NEMA) in sensitizing farmers by giving early warning signs based on scientific data should be further encouraged. There is also the need for the evolution of emerging technologies and land management practices by the government that could greatly reduce agriculture's negative impacts on the environment and enhance its positive impacts. The importance of education in empowering the farmers and enhancing their capacity to choose appropriate climate change adaptation measures cannot be over emphasized. Increased literacy campaign among farmers will enhance the farmers capacity to cope with climate change.

Table 1: Summary of the Descriptive Statistics of the Variables in the Model

Variables	Mean	Standard Deviation	Minimum	Maximum
Education (years)	7.10	5.80	0.00	18.00
Age (years)	42.00	10.80	25.00	67.00
Household size (No)	7.20	3.80	1.00	15.00
Farm size (ha)	1.50	0.66	0.10	2.50
Experience (years)	17.00	9.10	7.00	35.00

Source: Field Survey, 2011



Variable	Increase	Decrease	No change
Long time temperature	93	20	7
Long time Rainfall	30	87	3

Table 3: Adaptation measures adopted by farmers

Adaptation Measure	Frequency	Percentage
Crop Diversification	40	33.00
Changing Planting Date	18	15.00
Changing tillage Operation	17	14.20
Tree – Planting	5	4.20
Soil and Water Conservation	15	12.50
No Adaptation	25	20.80
Total	120	100.00

Source: Field Survey, 2011

Table 4: Multinomial Logit Estimation Results.

Variables	Crop Diversification	Changing Planting Dates	Changing Tillage Operation	Tree Planting	Soil and Water conservation
Education	0.294	0.194	0.004	0.076	0.114
	(3.09)***	(- 1.3)	(- 0.03)	(- 0.72)	(-1.16)
Gender	0.759	0.713	0.436	1.001	0.534
	(0.53)	(-0.42)	(-0.26)	(-0.62)	(-0.39)
Age	0.092	0.089	0.076	0.053	0.114
	(1.89)	(-1.13)	(-1.45)	(-1.02)	(2.35)**
House-hold size	0.106	-0.112	0.017	0.059	0.056
	(-0.86)	(-0.54)	(-0.13)	(-0.46)	(-0.47)
Income	0.008	0.006	0.01	0.006	0.007
	(1.24)	(-0.89)	(-1.6)	(-0.89)	(-1.12)
Extension	1,892	0.001	0.897	1.956	2.616
	(-1.52)	(6.74)***	(-0.63)	(-1.55)	(2.15)**
Credit	0.2	-0.669	0.018	0.019	0.015
	(-1.57)	(0.00)	(-1.26)	(-1.5)	(-1.14)
Form size	-0.664	0.375	-0.197	-0.111	-0.422
	(-1.57)	(-0.39)	(-0.28)	(-0.17)	(-0.70)
Experience	-0.064	-0.063	-0.052	-0.019	-0.012
	(-1.37)	(-0.67)	(-0.92)	(-0.38)	(-0.26)
Constant	-5.68	6.964	-4.379	-4.369	-6.133
	(-2.00)**	(2.82)***	(-1.36)	(-1.43)	(-2.17)**

,** and * = Significant at the 0.01,0.05 and 0.10 levels of probability respectively. Figures in parenthesis are calculated Z – values. Numbers of observations=119, Log likelihood=-150.21616, LR Chi square = 86.97***, Pro>Chi square = 0.0002, Pseudo R^2 = 0.2245.

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