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DETERMINANTS OF CLIMATE CHANGE ADAPTIVE STRATEGIES AMONG SMALL-SCALE YAM FARMERS IN FEDERAL CAPITAL TERRITORY, NIGERIA

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ABSTRACT
The study examined the determinants of adaptation to climate change among small-scale yam farmers in the federal capital territory Abuja, Nigeria. Multistage sampling technique was used to select 100 yam farmers for the study. Focus Group Discussion and structured Questionnaire was used to elicit information on determinants of adaptation to climate change from the respondents. Data obtained were analyzed using descriptive and inferential statistics. The respondents were within the mean age of 45 years and majority (86%) of the farmers were male. Farmers major sources of information on climate change were radio and television with means of (2.6) and (2.6) respectively. Identified adaptation strategies used by farmers to mitigate the effect of climate change included planting beside the river(86%), planting disease and pest resistant crop (73%) and changes on planting and harvesting dates(63%). Results of Tobit regression analysis showed that level of education, farm size and access to credit were positive and significantly influenced adaptation to climate change at 5%, 5% and 1% level of significance respectively, while age was negative and significantly influenced adaptation to climate change at 10% level of significance. The study recommended increasing 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.

Keywords: Climate change, Adaptation, Yam farmers.

INTRODUCTION
Climate change has become a new reality bringing in its wake changes in weather patterns, upsetting seasonal cycles and impacting negatively on ecosystems, farming systems and other livelihood processes. Farmers therefore need adequate knowledge on the nature and causes of climate change and the various mitigation and adaptation strategies to use. This of course, depends on their access to credible information sources and their capacity to apply the information Bello *et al*. (2013).

Climate change has been identified as one of the most crucial factors that negatively affect Sustainable agricultural production and the scope for reducing poverty in Nigeria. Therefore, any change in climate is bound to impact on the agricultural sector in particular and other socio-economic activities in general. The impacts could be measured in terms of effects on crop growth, availability of soil water, health and availability of farm labour, soil fertility, soil erosion, incidents of pests and diseases, and sea level rise Nwajiuba *et al.* (2008). The Intergovernmental Panel on Climate Change (IPCC), refers to climate change as any change in climate over time, whether due to natural variability or as a result of human activity

(IPCC,2007). It may also be referred to as any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer).

NEST (2004) stated that mitigation and adaptation are the two principle elements of climate change response. Mitigation refers to measures that may either reduce the increase in greenhouse emissions (abatement) or increase terrestrial storage of carbon (sequestration) while adaptation refers to all the responses to climate change that may be used to reduce vulnerability. Oladipo (2010) stated that although Nigeria, like other developing countries, is not required under the current global climate change negotiations to take on emission reduction commitments, it nevertheless has to adapt to the expected impacts of anticipated climate change. This makes adaptation the major response option to climate change in the nation. Small scale farmers who constitute the bulk of the poor in Africa and Nigeria, face prospects of tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases (Zoellick, 2009). It is projected that crop yield in Africa and in Nigeria may fall by 10-20% by the year 2050 or even up to 50% due to climate change. Most farmers in Nigeria and particularly the study area, depend on rain fed agriculture and hence fundamentally are dependent on the vagaries of weather. This phenomenon threatens to deepen vulnerabilities, erode hard-won gains and seriously undermines prospects for development.

It is also observed that much of climate change that agricultural research has tended to concentrate on, assessing the adaptation strategies of the farmers depend to a very large extent on their perception knowledge level and sources of information about climate change available to them. Given the high level of illiteracy among rural farmers in the study area coupled with the poor nature of the public extension service, access to adequate information on climate change by these farmers is very poor. To better address the food security concerns that are central to national development, it is imperative to investigate the determinant, knowledge level and adaptation strategies to climate change by rural yam farmers in the study area.

The general objective of the study is to determine climate change adaptive strategies on small-scale yam farmers in Federal capital Territory, Abuja Nigeria.

The specific objectives were to:

i. describe the socio-economic characteristics of the respondents in the study area;
ii. identify the farmers' sources of information/awareness on climate change;
iii. ascertain the determinants of adaptation to climate change by small-scale yam farmers;.
iv. determine the adaptive strategies used by small-scale yam farmers in mitigating the effects of climate change.

METHODOLOGY

Study area

The Federal Capital Territory (FCT) is located in the epicenter of Nigeria. Specifically, the territory is located north of the confluence of the River Niger and Benue River. It is bordered by the states of Niger to the West and North, Kaduna to the northeast, Nasarawa to the east and south, and Kogi to the Southwest. It lies between latitudes 8°25′ and 9°20′ North of the equator and longitudes 6°45′ and 7°39′ East of Greenwich Meridian. The Federal Capital Territory has a landmass of approximately 7,315 km2, of which the actual city occupies 275.3 sq km. It is situated within the Savannah region with moderate climatic conditions. The territory is currently made up of six Area Councils, namely: Gwagwalada, Abuja Municipal, Abaji, Kuje, Bwari and Kwali. It had a population of 1,408,239 persons according to 2006 population census but has grown to 2,245,000 in 2010 (Wikipedia, 2011). A typical year consists of wet (March to

October), and dry (November to February) seasons. Maximum monthly rainfall averages about 342 mm which usually occur in August. Monthly maximum and minimum temperatures are around 44 and 16°C, respectively. The average humidity ranges from 30 to 85% and is highest in the rainy months and lowest in the dry season.

The vegetation in the study area including most parts of the FCT 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 the morphological characteristics of the local soils. The major crops grown in the area include maize (*Zea mays*) and sorghum (*Sorghum vulgare*), groundnuts (*Arachis hypogaea*), yam (*Discorea rotundata*), and miscellaneous crops such as okra, sweetpotato and garden egg. The study was conducted in Abuja Municipal Area Council of Federal Capital Territory (FCT) Abuja to ascertain the determinants to of climate change adaptation among small-scale yam farmers in Federal Capital territory. Using multistage sampling technique, Abuja Municipal area council was selected for the study because of its proximity to the researcher and also is one of the major yam growing areas in Federal capital territory in the first stage, in the second stage, five communities namely orozo, karshi, Gugugu, kwoi and Tunga were selected also from the selected area council. The third stage involves the random selection of twenty yam farmers each from the selected communities, giving a total of one hundred yam farmers for the study. Focus group discussion and structured questionnaire were used to obtain primary data from the farmers with the help of trained enumerators who understands the local languages. Data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequency counts, percentages and means were used to analyse objective 1 and 4, a 3 point likert scale rating was used to satisfy objective 2 while objective 3 was achieved by the use of tobit regression model analysis.

The model is expressed implicitly as

$Y= f (X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8,X_9,X_{10}) + e$

Where,

Y = level of Adaptation strategies

X_1 = Age of the farmer (years)

X_2-= Sex (male=1, female=0)

X_3= Marital status

X_4= Household size (Number of people feeding from the same pot}

X_5= Level of Education (years of formal schooling)

X_6= Farming Experience (in years)

X_7= Farm size (hectares)

X_8= Membership of Cooperative (membership=1, 0= otherwise)

X_9= Access to Credit (Naira)

X_{10}= Ownership of radio (1=yes, 0= otherwise)

E = Error term.

The 3-point Likert rating was used to elicit information from the respondents on farmers' sources of information/awareness on climate change: most preferred = 3; Preferred = 2; Not preferred = 1 Mean = 3+2+1/3 = 6/3 = 2. Decision rule: Any mean score > 2 implies preferred information source. Any means core <2 implies not preferred information source.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Yam Farmers

The findings in table 1 shows that majority (46%) of the farmers are still at their productive age between the ages of 31-50 years with mean age of 45years. This indicate that the majority of the respondents were within active age for agricultural production. The result is in agreement with the report of Ekwe *et al.* (2006) that most farmers are within the middle-age and vibrant in agricultural production. The results of the study also revealed that most (86%) of the farmers were males and (16%) were female. This result is in agreement with the findings of Bello *et al*.(2013) that implied male domination of farming activities in the study area. It also shows that yam is male crop. From the result, the yam farmers had average household size of 10 persons. This indicates that respondents have large household size which will provide adequate labour for farming activities. Household with large size tended to attach greater importance to food security than those with small size. This finding had implication for adoption level of technologies in the study area. It however signified that the farmers had a fairly large household, which could probably supply farm labour.

About 61% of the farmers had 1 to 15 years of farming experience, while 38% of them had farming experience of between 16 and 30 years , The mean years of farming experience was 14 years This implied that most of the respondents had been in the farming business for a long time. Years of farming experience were important because management skills improved with experience. Hassan (2008) also indicated that experience in farming increases the probability of uptake of adaptation measures to climate change.

Result also indicated that the average farm size was 2.9 ha, an indication that the study covered small-scale family managed farm units. The farmers have different forms or levels of education suggesting that the farmers have some basic literacy, were relatively informed 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).

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 more 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.

Sources of Information on Climate Change

The result in table 2 shows that the farmers most preferred source of information on climate change were radio and television with average of (2.6) and (2.6) respectively while Newspaper extension contact and mobile phones with average of (1.4), (1.6) and (1.3) respectively are not preferred. Radio and televisions were the major avenues through which the respondents sourced information on climate change from. These findings concur with Isife and Ofuoku (2008), who documented that radio, has the highest audience and has the strength of reaching a large population of farmers and other rural dwellers faster than other means of communication. They also noted that television provides farmers with the opportunity of seeing and hearing in the process of learning new ideas. The implication of this finding is that there is need for extension services to rise up to the challenge of information dissemination, (especially as regards the issues of climate change), as this is the central focus of its services. The result from focus group

discussion indicated that farmers prefer radio because it was cheaper to use even without electricity.

Determinants of Yam Farmers' Adaptation to Climate Change

The data in table 3 shows the Tobit estimates of determinants of small-scale yam farmer's adaptation to climate change in the study area. The result shows that coefficients of level of education, farm size and access to credit were positive and significantly influenced the level of adaptation to climate change at 5%, 5%, and 1% levels respectively. This implies that increase in level of education, farm size and access to credit increases the probability of adaptation to climate change. These results are in agreement with the findings of Gutu *et al.* (2012) who reported that households with relatively big farm sizes were more likely to take up more adaptation strategies when compared with farmers with small farm sizes.

The results further imply that an increase in the level of education of a farmer brings about an increase in the knowledge on the adaptation strategies of climate change because it is expected that an educated farmer have greater access to climate change information, improved technologies and higher productivity and strategies to enable them mitigate the effect of climate change. This result is contrary to the findings of Deressa *et al*. (2008) who found out that as house head years of education increase, the chance of crop and income diversification and weather monitoring decreases. This was because most of the educated farmers took farming as secondary occupation. Therefore, their livelihoods do not mainly depend on their farms.

Coefficient of age was negative and significantly influenced the level of adaptation to climate change at 10% which implies that an increase in farmers age, decreases the level of climate change adaptation, this is because the aged farmers are weak and fragile and unable to explore many coping or adaptive strategies associated with yam production. This result is in agreement with Oyekale (2012) in similar studies that as the age of household head increases, the chance of diversifying crop and income significantly reduces ($p<0.01$) but contradicts Deressa *et al* (2008) who explained that age increases adaptation to climate change.

Strategies Used by Small-scale Yam Farmers to Adapt to the effect of Climate Change

Table 4 shows the indigenous adaptive measures being used by farmers to cushion the harmful effects of climate change. The measures being used includes: planting of draught tolerant crop (29%),planting of disease and pest resistant crops (73%), planting by the river side (86%), increase in the use of organic manure (61%), changes in planting and harvesting date (63%), contour cropping across the hill slope (55%), water harvesting and storage (31%) increase irrigation (76%) and early harvesting (81%).These findings are in support of strategies put forward by First National Communication (2003) and Canada-Nigeria Climate Change Capacity Development Project reports (2004). These reports emphasized the need for diversification to new plant species and varieties that would have higher resistance to anticipated temperature increase and reduced rainfall, adopting zero/minimum tillage and other appropriate technologies to reduce soil erosion and loss of organic nutrients, but increase soil moisture availability and reduce weed and pest infestation.

Table 1: Distribution of Respondents on Socio-economic Characteristics of Small-scale Yam Farmers

Variables	Frequency	Percentage	Mean
Age			
>30	5	5	45
31-40	22	22	
41-50	46	46	
51-60	27	27	
Total	100	100	
Sex			
Female	14	16	
Male	86	86	
Total	100	100	
Marital status			
Single	7	7	
Married	93	93	
Total	100	100	
Level of Education			
Adult education	6	6	
Primary Education	32	32	
Quaranic Education	10	10	
Secondary education	38	30	
Tetiary Education	13	13	
Total	100	100	
Household size			
1-5	19	19	10.5
6 -10	33	33	
11-15	27	27	
16-20	21	21	
Total	100	100	
Farm Size (hectares)			
1 -2	33	33	2.9
3-4	58	58	
>5	9	9	
Total	100	100	
Farming Experience (years)			
1-15	61	61	14
16-30	38	38	
31-45	1	1	
Total	100	100	

Source: Field survey, 2015

Table 2: Farmers Preference of source of information on climate change

Sources of Information	Mean	Overall preference
Radio (n=100)	2.6	Preferred
Television (n=100)	2.6	Preferred
Newspaper (n=100)	1.4	Not preferred
Extension Agent	1.6	Not Preferred
Mobile Phone	1.3	Not Preferred

Based on a 3 point scale of most preferred, Preferred and Not Preferred

Table 3: Adaptation Strategies Used to Mitigate the effect of Climate Change

Adaptation strategy used	Percentage (n=100)
Planting of draught tolerant crop	29
Planting of pest and disease resistance crop	73
Planting beside the riverside	86
Increase in the used of organic manure	61
Changes in planting time	63
Contour cropping across hill slope	55
Water harvesting and storage	31
Increase irrigation	76
Early Harvesting	81
No Adaptation	-

*Multiple responses
Source: Field survey, 2015

Table4: Tobit estimates of determinant of small-scale yam farmers adaptation to climate change in Federal capital Territory.

Variables	Coefficient	Std. Error	T –ratio
Age (years)	-.00502	.00224	-2.23*
Sex	-.02867	-03567	-0.80
Marital status	-.01606	.05519	-0.29
Household size	.00207	.00290	0.71
Level of Education	.06283	.01785	3.52**
Farming Experience	.00416	.00276	1.50
Farm size	.00416	.01212	3.39**
Cooperative	.01714	.03224	0.53
Assess to credit	.19138	.04734	4.04***

Constant	.60145	.09528	5.31
X^2	48.88***		
Log likelihood	69.501612		
Pseudo R^2	0.5423		
Total Sample	100		

Source: Computed from STATA800 Tobit result/Field Survey, 2016.
***, **, * are 1%, 5%, and 10% significant level respectively.

CONCLUSION AND RECOMMENDATIONS

The study revealed the state of climate change and adaptation measures by yam farmers in Abuja municipal area council of Federal capital Territory Nigeria. From the findings of the study, most farmers were aware of the concept of climate change. Radio and television were their major sources of information on climate change. Strategies used in adapting to the effect of climate change include: planting of disease and pest resistant crop, planting beside the river, changes in planting and harvesting dates and increase in the use of organic manure. Determinants of yam farmers adaptation to climate change are age, level of education, farm size and access to credit. It is therefore recommended that policy issues on climate change should be implemented with great concern. There is also the need for increased 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.

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