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Climate Change

Adoption of climate change adaptation strategies among maize farmers in Ogbomosho agricultural zone of Oyo state, Nigeria

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Despite the efforts of both government and non – governmental organizations on recommendation of climate change adaptation strategies to crop farmers, which were aimed at reducing its adverse effects on crop yields, the demand for food is still at an alarming rate, because of the ever increasing population in Nigeria. It is therefore imperative to determine the adoption of climate change adaptation strategies amongst maize farmers in Ogbomosho Agricultural Zone of Oyo State, Nigeria. Multistage Sampling Procedure was adopted in the selection of 111 maize farmers in the zone; data were obtained through structured interview schedule. The data collected were analyzed with frequency distribution, percentage, mean and ranking as descriptive statistical tools, while Tobit regression was used as inferential tool to make inference about variables used in the study. Both male (80.2%) and female (19.8%) have different educational backgrounds, while 34.2% do not have formal education. The mean age and year of farming experience are 47 and 23 years respectively. Most of the respondents (88.3%) have contact with extension agents. Maize farmers adopted different adaptation strategies against the effects of climate change and have different perceptions about the effects of climate change on maize production. Tobit regression analysis revealed that years of farming experience (-1.87*) and extension contact (2.53*) have significant relationships with adoption of climate change adaptation strategies adopted amongst maize farmers, in the study area. Therefore, the needs to improve on extension contact (which is the major source of information available to maize farmers on climate change) and intensification of efforts on extension services, as a whole (which will encourage adoption and application of different climate change adaptation strategies available to maize farmers) were recommended, in order to increase general food production (particularly maize), in the study area, and the State at large.**

INTRODUCTION

Maize (Zea mays L.) is the most important cereal crop in sub-Saharan Africa (SSA). Along with rice and wheat, maize is one of the three most important cereal crops in the world. According to FAO data, the land areas planted to maize in West and Central Africa alone increased from 3.2 million in 1961 to 8.9 million in 2005.This phenomenal expansion of the land area devoted to maize cultivation resulted in increased production from 2.4 million metric tonnes in 1961 to 10.6 million metric tonnes in 2005. While the average yield of maize in developed countries can reach up to 8.6 tonnes per hectare, production per hectare in many SSA countries is still very low (1.3 tonnes per hectare), (IITA, 2007). In Nigeria, maize is a staple food of great socio-economic importance. Ironically, the demand for maize as a result of the various domestic uses sometimes outstrips supply (Akande, 1994). Studies in maize production in different parts of the country (Nigeria) have shown an increasing importance of the crop amidst growing utilization by food processing industries and livestock feed mills. The crop has thus grown to be a local "cash crop" most especially in the Southwest part of Nigeria where at least 30 percent of the cropland has been put to maize production under various cropping system (Degrande, 2000). Maize has been in the diet of Nigerian's for centuries. It started as a subsistence crop and has gradually become more important crop.

Maize has now risen to a commercial crop on which many agro-based industries depend on as raw materials (Iken and Amusa, 2004). The concern in this study is about climate change and maize production and the strategies employed by the maize farmers to mitigate its effects in order to maintained maximum production. Countries in Sub-Saharan Africa (including Nigeria) are particularly vulnerable to impact of climate change, given dependence on agriculture production and limited adaptive capacity (Bryan et al., 2013). A number of countries in Africa already face semi-arid conditions that make agriculture challenging (Boko et al., 2007). Climate change adversely affects agricultural production in Africa through reduction in the length of growing season and force large regions of marginal agriculture out of production (Boko et al., 2007). Even in the moist tropics, increased heat is expected to reduce crop yields (Dinar et al., 2008).

As a consequence, staple crops such as maize, sorghum, millet and cassava, are likely to result in significant yield losses of between 8 and 22 percent by 2050 (Schlenker and Lobell, 2010). Projected reductions

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in crop yield in some countries could fall by as much as 50 percent by 2020, and crop net revenues could fall as much as 90 percent by 2100, with smallholder farmers being the most affected (Boko et al., 2007). Climate may change more rapidly than expected and is projected to have complex, long term effects for the environment, and for Tanzanian production system (URT, 2012). It is clear that climate change will bring about substantial losses especially to smallholder farmers whose main source of livelihood is derived from agriculture (Komba and Muchapondwa, 2012).

This study therefore focused on adoption of climate change adaptation strategies among maize farmers in Ogbomosho Agricultural zone of Oyo State, Nigeria. Specifically, the study described the personal characteristics of the maize farmers in the area; identified enterprise characteristics of the respondents; investigated the adaptation strategies employed against the effects of climate change; and perceived effects of climate change on maize production.

METHODOLOGY

The study was carried out in Ogbomosho Agricultural zone of Oyo State, Nigeria. The zone is one of four Agricultural zones in Oyo State. Multistage sampling procedure was adopted in this study. During the first stage, three Local Government Areas (LGAs) were purposively selected from the five LGAs that constitute the zone, because of their rurality in nature.

In the second stage 15 percent maize farmers were randomly sampled from the registered maize farmers list in each LGA, which sum up to a total of one hundred and eleven (111) maize farmers that constituted the sample size of the study. The descriptive statistical tools used in the study include frequency distribution, percentage, mean and ranking; while Tobit regression was used as inferential tool to test the relationship that exists between variables. Tobit model specification $Y= b0 + b_1X_1+b_2X_2+...bnXn$ Where: Y= Adoption (adoption index); b0= Constant; b= coefficient of parameters estimated; X_1= Age (actual years); X_2= Sex (male=1; female=0); X_3= Educational level (actual years spent in school); X_4= Marital status (married=1; unmarried=0); X_5= Years of farming experience (actual years); X_6= Extension contact (yes=1; no=0).

RESULTS AND DISCUSSION

Personal characteristics of respondents

Table 1 showed that 43.2% of the respondents sampled were between the age range of 31-40 years, 26.1% and 24.3% were within the age range of 41-50 years and less and equal to 30 years respectively. The mean age is 47 years. This implies that most of the maize farmers are in their productive age, and they are expected to be efficient in maize production and versatile of climatic variability in the area and tendency to adopt appropriate strategies in mitigating against the effects of climate change. Again, majority (80.2%) were male, while only 19.8% were female. This implies that most maize farmers in the area are male, and it also indicate women involvement in maize production; 34.1% of the farmers sampled do not have formal education, while 27.0% (primary); 36.9% (secondary) and (1.8%) tertiary respectively are literate, though with different educational background. The innovations on climate change are expected to be shared by the elites within the farmers' population in the area.

Majority (88.3%) were married; while only 11.7% were single. This implies that most farmers sampled are married, an indication that they should exhibit certain level of responsibility and ability to take rightful decision with respect to adoption of appropriate climate change adaptation strategies on maize production. This assertion is in line with Akintonde in Ayanwuyi *et al.*(2012), who reported that been married as a status may suggests a high degree level of responsibility and great capability for sound rational decision making among farmers. Some (47.7%) of the respondents indicated less and equal to 30 years of farming experience; 39.6%,8.1% and 4.5% indicated 11-20 years; 21-30 years and more than 30 years of farming experience; with the mean of 23 years. This implies that all the sampled respondents are not novice in maize production. Their years of experience in maize production are expected to guide them on the mitigation measures to be adopted against the effects of climate change. Majority (98.3%) of respondents have contact with extension agents and this is expected to have positive effect on maize production because of the advisory role that extension agents offered as their major responsibility in the extension service.

Enterprise characteristics of respondents

Table 2 revealed the multiple responses with respect to types of maize cultivated among the sampled farmers and it shown that all the respondents indicated improved maize variety; 86.5% indicate local maize variety and 63.1% indicated both (improved and local) maize varieties being cultivated in the area; most (55.9%) respondents cultivates more than 4ha of maize farmland; 21.6%; 15.3% and 7.2% indicated 2.1-4.0ha; 1.0-2.0ha and less than and equal to 0.99ha of maize farmland. This implies that maize farmers operate on medium scale maize production in the area. The variation in the size of maize farmland cultivated may be due to differences in their access to various production inputs required for maize production such as capital, improved maize seed, fertilizer, land and so on. All (100.0%) indicated co-farmers; 91.9% indicated extension agents as sources of information on climate change; 93.7% and 15.3% indicated radio and television; while 95.5% indicated others such as farmers' association; newspapers; National Programme on Food Security (NPFS); extension bulletins. This suggests that maize farmers in the area obtained information from different sources on climate change which is expected to assist them in making rightful/alternative decision on the appropriate strategies to be adopted and use for maize production. This funding is in line with Nhemachena and Hassan (2007), who reported that availability of better climate and agricultural information helps farmers to make informed and comparative decisions among alternative crop management practices and this allows them to better choose strategies that make them cope well with changes in climatic conditions.

Climate change adaptation strategies adopted

Table 3 revealed different adaptation strategies adopted by the maize farmers against the effects of climate change. Majority (86.5% each; and 80.2%) cultivation of improved varieties; intercropping; and zero tillage respectively, while 74.8%; 73.9%; and 70.3% indicated mulching; fertilizer/green/organic manure application and altering of planting date as part of climate change adaptation strategies adopted. Again, 64.9%; and 60.4% indicated crop rotation and use of irrigation, while 45.9% and 37.8% indicated making of ridges across the slope and shifting cultivation. This implies that all the sampled maize farmers adopted different climate change adaptation strategies against its effects on maize production; which is expected to reduce the various effects on maize production. This corroborate the assertion of Balew*et al.* (2014), who stated that adoption of climate change adaptation strategies is believed to minimize the negative impacts of climate change on crop yields. The variation in the adaptation strategies adopted may be due to differences in the capability of individual maize farmers sampled for the

Table 1 Distribution of respondents by personal characteristics

Personal characteristics	Frequency	Percentage
Age (years)		
≤ 30	27	24.3
31-40	28	43.2
41-50	29	26.1
>50	7	6.3
Mean:	47	
Sex		
Male	89	80.2
Female	22	19.8
Educational level		
No formal	59	53.2
Primary	20	18.0
Secondary	30	8.1
Tertiary	2	20.7
Marital status		
Married	98	88.3
Single	13	11.7
Years of farming experience (years)		
≤ 10	5	4.5
11-20	9	8.1
21-30	44	39.6
>30	53 4.5	
Mean:	23	
Extension contact		
Yes	98	88.3
No	13	11.7
Total	**111**	**100.0**

Source: Field survey, 2015

Table 2 Distribution of respondents by enterprise characteristics; N=111

Enterprise characteristics	*Frequency	Percentage
Type of maize variety cultivated		
Improved	111	100.0
Local	96	86.5
Both	70	63.1
Size of farmland under maize cultivation (ha)		
≤ 0.99	8	7.2
1.0-2.0	17	15.3
2.1-4.0	24	21.6
> 4.0	62	55.9
Mean:	2.7	
Source of information on climate change		
Extension service	98	88.3
Radio	104	93.7
Television	17	15.3
Co-farmers	111	100.0
Others	106	95.5

Source: Field survey, 2015

Table 3: Distribution of respondents by climate change adaptation strategies adopted on maize production

Adaptation strategies adopted	*Frequency	Percentage
Cultivation of improved varieties (drought resistant)	96	86.5
Altering of planting date/time	78	70.3
Use of irrigation	67	60.4
Crop rotation	72	64.9
Mulching	83	74.8
Application of fertilizer/green /organic manure	82	73.9
Zero tillage	89	80.2
Intercropping	96	86.5
Ridges across the slope	51	45.9
Shifting cultivation	42	37.8

Source: Field Survey, 2015
*: Multiple responses

Table 4 Distribution of respondents by perceived effects of climate change on maize production

Perceptional statement	Frequency (Percentage)						
	Level of agreement						
	SA	A	U	D	SD		Rank
Effect of climate change is enormous on maize production	55 (49.5)	43 (38.7)	13 (11.7)	-	-	4.38	4th
Climate change affect both quality and quantity, thereby reducing farm revenue from maize production to farmers	72 (64.9)	39 (35.1)	-	-	-	4.65	2nd
Effect of climate change on crop especially maize is more or less that of HIV in human	61 (55.0)	34 (30.6)	-	-	-	3.97	6th
With different adaptation strategies on climate change, its effect on maize is still obvious	52 (46.8)	48 (43.2)	11 (9.9)	-	-	4.37	5th
Information on climate change is still low, especially on possible solution to its effects on maize production especially	9 (8.1)	6 (5.4)	23 (20.7)	31 (27.9)	42 (37.8)	2.18	8th
Effect of climate change on maize production drastically reduced the food security status of most farmers, because maize is one of the most staple food for Nigerian population including livestock	56 (50.5)	49 (44.1)	6 (5.4)	-	-	4.43	3rd
Most of the climate change adaptation strategies employed for maize production are less effective	16 (14.4)	22 (19.8)	17 (15.3)	36 (32.4)	20 (18.0)	2.80	7th
Use of irrigation is the best approach (strategy) to curb the effect of climate change on maize production but it's expensive	89 (80.2)	22 (19.8)	-	-	-	4.80	1st

Source: Field Survey, 2015
SA: Strongly Agree
A: Agree
U: Undecided
D: Disagree
SD: Strongly Disagree
WMS: Weighted Mean Score

Table 5 Test of significant relationship between selected personal characteristics and adoption of climate change adaptation strategies- using Tobit regression (Marginal effects after Tobit analysis)

Personal characteristics	dy/dx	Std. Error	z-value
Age	-0.0004	0.0015	-0.24
Sex	-0.0030	0.0355	-0.09
Marital status	0.0033	0.0044	0.77
Educational level	0.0184	0.0315	0.59
Years of farming experience	-0.1022	0.0544	1.87*
Extension contact	0.1113	0.0440	2.53***

Source: Data analysis, 2015
dy/dx: Coefficient explanatory variables
***: Significant at 1%
*: Significant at 10%

study in terms of capital (e.g. irrigation); scale of maize production and land ownership status.

Perceived effects of climate change on maize production

Table 4 revealed that use of irrigation is the best approach (strategy) to curb the effect of climate change on maize production because it had the highest Weighted Mean Score (wms) of 4.80; followed by climate change affect both quality and quantity, thereby reducing farm revenue from maize production to farmers (2nd) (wms=4.65); while most of the climate change adaptation strategies employed for maize production are less effective were ranked least (7th) (wms=2.80) and Information on climate change is still low, especially on possible solution to its effects on maize production especially (8th) (wms=2.18) respectively. This ranking order may be true, but they were actually determined on individual maize farmer's perception of effects of climate change on maize production in the area.

Test of significant relationship between variables

Tobit regression was used to established relationship that exists among variables. Result analysis it in Table 5 revealed that there is significant relationship between some of the selected personal characteristics of the maize farmers and adoption of climate change adaptation strategies. The significant variables are years of farming experience (t=-1.87*) and extension contact (t=2.53***). The coefficient of extension contact is positive which suggests a probability that the higher the frequency of extension contact with maize farmers on the adoption of climate change adaptation strategies, may lead to increase in the level of adoption of climate change adaptation strategies. Years of farming experience exhibited an inverse significant relationship with adoption of climate change adaptation strategies, which may be true because of the fact that as farmer's years of farming experience increases there is likelihood reduction in the application of various adaptation strategies that may be employed against the effects of climate change on maize production, that is the possibility of contending with some of the climate change

adaptation strategies recommended that may lead to increase in the maize yield.

This implies that these afore-mentioned personal characteristics (years of farming experience and extension contact) have decisive influence on the adoption of various climate change adaptation strategies among the maize farmers in the area.

CONCLUSION AND RECOMMENDATIONS

The study therefore concluded that both male and female of different age groups engages in maize production in the study area; majority sampled have different educational background and years of farming experience. The farmers cultivate both local and improved maize varieties on different hectares of farmland and received information mainly through different sources. The respondents adopted different climate change adaptation strategies against its effects on maize production and have different perception towards these effects. Providing farmers with adequate information in order to increase and resensitize the farmers' knowledge on appropriate climate change adaptation strategies should be considered necessary so as to reduce the incidence of food insecurity across the study area, State and Nigeria at large.

There is need to improve on extension contact as major information source available to maize farmers on climate change and need to intensify effort on extension services as a whole in order to encourage application of different climate change adaptation strategies available to maize farmers as this would lead to increase in maize production and food production at large in the area and State at large.

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