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ANALYSIS OF ADAPTATION OF CLIMATE SMART AGRICULTURAL (CSA) PRACTICES OF YAM FARMERS IN AKWA STATE, NIGERIA

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ABSTRACT
This study investigated the drivers of climate change adaptation of CSA by yam farmers in, AkwaIbom State, Nigeria.. Multi-stage sampling technique was employed for the purpose of this study. Firstly, three (3) Agricultural Zones purposively selected based on a list of yam farmers registered with the AkwaIbom State Agricultural Development Project (AKADP) . Secondly, two Blocks were randomly selected from each of the agricultural zones. In the third stage, three (3) cells were randomly selected and five (5) yam farmers adopting climate smart agricultural practices were randomly selected from each of the (3) cells per block. The total number of respondents were (90) respondents, but only 67 respondents supplied useful information for the research., which constituted the sample size for this study. Descriptive statistics and multinomial logit model were used in presenting and analyzing the data. Majority (61%) of the farmers were involved in average adaptation, 26% in low adaptation and 13% in high adaptation. The result of the multinomial logit showed that the significant factors that encouraged climate change adaptation were level of education ($p<0.01$), age, household size, farm distance from home, land tenure security, access to credit and non-farm income at $p<0.05$, respectively as well as farm size, membership of cooperative societies and farm income at $p<0.10$, respectively. Policies should be enacted that will enhance the accessibility and security of land for farmers as well as increase their access to education and credit facilities.

INTRODUCTION

According to the United Nations Development Program (UNEP), developing countries will require between US$ 140-300 billion per year until 2030 to adapt to climate change. These figures represent a major challenge for the international community, and especially for the countries most vulnerable to the effect of climate change, as most of them also face serious socioeconomic problems. Bearing in mind the importance of such countries as suppliers in the international food system and their economic dependence on agricultural commodities, it is essential to have evidence on the costs and benefits of adopting various measures of climate adaptation. In doing that, decision-makers can better target investments towards the most promising climate adaptation measures, thus achieving the best return for each dollar spent. The combination of projected world population growth and changing human diets will have far-reaching effects on food production systems. The challenge of increasing production by 70% to feed the world's population in 2050 is made all the more difficult by climate change and its negative impacts on agricultural production (Lobell et al. 2008) and food security (Schmidhuber and Tubiello 2007) in hunger prone areas of the global tropics.

The widespread uptake of practices and technologies that are conscious of these impacts is of primary important ceto increase the adaptive capacity of farming systems and mitigate agriculture's considerable contribution to global greenhouse gas emission. Climate smart agriculture (CSA) is a concept intended to address the need for climate consciousness in agriculture while not placing undue burdens on the resource poor small farmers who are often the most vulnerable to climate impacts. As defined by the Food and Agriculture Organization of the United Nations, CSA is agriculture that “sustainably increases productivity and resilience (adaptation), reduces or removes GHGs (mitigation), and enhances achievement of national food security and development goals” (FAO 2010). At the local level, CSA can be conceived as a suite of practices –ideally ones that have been assessed for local suitability–that can improve a farmer’s capacity to adapt to changes in climate and/ or increase the mitigation potential of production through carbon sequestration or reduced emissions, while still meeting or exceeding food security goals. At the national or regional level, CSA is more often considered a conceptual framework that examines the tradeoffs between the three “pillars” of adaptation, mitigation, and food security.

As part of the study “Climate-Smart Agriculture Investment Priorization in the Territories of Incidence of MAP and CCAFS”, the Tropical Agricultural Research and Higher Education Center (CATIE) through its Mesoamerican Agro environmental Program (MAP) and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) conducted a cost-benefit analysis of 15 agricultural practices in the Trifinio region (cross border area between Guatemala, Honduras and El Salvador) and the department of Matagalpa, in Nicaragua. Such practices had been previously prioritized as the result of a qualitative evaluation that used indicators to measure their contribution to the tree pillars of the climate-smart agriculture (CSA). Adopting Climate-Smart Agriculture practices can reduce the risks facing smallholder farmers and mitigate the effects of extreme weather events on farms. Some notable CSAs involved enhancing crop production through minimum tillagesystems/conservation agriculture, evergreen agriculture, shifting of planting dates, agro-forestry systems (to mention but a few) as Climate Smart Agriculture solutions (Landscapes, 2014).

Yam (Dioscoreaspp) are generally classified under the genus Dioscorea, family Dioscoreaceae, and order Dioscoreales. They are the most important food crops in West Africa, except for cereals (Okonkwo, 1985). Yams are the second most important tuber crop in the whole world after cassava, in terms of production (11TA, 2013).They also form an important food source in other tropical countries including East Africa, the Caribbean, South America, India and South East Asia(Okonkwo,1985). Average yam consumption per capita per day is highest in Benin (364 kcal), followed by Cote d’lvoire (342 kcal), Ghana (296 kcal) and Nigeria (258 kcal) (11TA, 2009). Yam may be barbecued, roasted, fried in oil, grilled, boiled, baked, smoke, pounded into paste (fufu) or grated and made into a dessert. It may be cooked or fried with rice, beans, plantain, sweet potato, lamb, chicken and butter nut as squash soup (Umar et al.,2016).

To a large extent, the effect of climate change on yam which is a major crop grown in AkwaIbom State is not known; and at such we do not know if the crop yields or profits from the farms are affected by these climatic variations. Prior to this time, no research, to the best knowledge of the researcher, has been carried out on this subject in this region. It is against this backdrop that this study was designed to assess the climate smart agricultural practices adopted by yam based farmers in Akwa State with respect to income

Thus a study of this nature could give an insight into ways of reducing poverty status of farmers in the face of climate change. Findings could also be discovered on what determine income of yam farming when climate smart agricultural practices are being adopted by crop farmers. Studies focusing on how CSAs adoption could affect farmers' incom are not very common even as the concept of CSA is becoming widely accepted as a measure for mitigating climate change and adapting to climate change while ensuring poverty reduction. Hence the findings of this study will provide a lot of policy impetus with multiple solutions to issues of climate change mitigation, adaptation and farmer's poverty reduction drive.

The broad objective of the study is adoption of climate smart agricultural (CSA) practices of yam farmers in AkwaIbom State, Nigeria. The specific objectives are: identified the socio-economic of respondents adaptation of CSA; examined the major climate smart agricultural (CSA) practices adaptation of yam farmers in the study area; ascertained the determinants of respondents adaptation of CSA farming systems., and identified the constraints of yam farmers adaptation of CSA practices.

Research Methodology

Study Area

AkwaIbom State is situated between latitudes $4^0 32^1$ N and $5^0 3^1$N and longitude $7^0 25^1$ E and $8^0 25^1$ E and situated between Cross River, Rivers and Abia State on the South East. It has a total area of 8412km^2, a shoreline of 129km long and encompasses the Qua Iboe River Basin, the eastern part of the lower Cross River Basin and the eastern half of the Imo River estuary (NES, 2000). The Qua Iboe River, Cross River, Imo River and their tributaries control the drainage, and deposition of sands and clays. Qua Iboe River is the major hydrographic feature, which drains a greater part of the state and enters the sea at Ibeno, which is the major operational base of Mobil in AkwaIbom State.

The state has three distinct vegetation zones which include the saline water swamp forest, the fresh swamp forest and the rain forest.

3.2 Sampling Size and Sampling Technique

Multi-stage sampling technique was employed for the purpose of this study. Firstly, three (3) Agricultural Zones purposively selected based on a list of yam farmers registered with the AkwaIbom State Agricultural Development Project (AKADP) . Secondly, two Blocks were randomly selected from each of the agricultural zones. In the third stage, three (3) cells were randomly selected and five (5) yam farmers adopting climate smart agricultural practices were randomly selected from each of the (3) cells per block. The total number of respondents were (90) respondents, but only 67 respondents supplied useful information for the research., which constituted the sample size for this study.

The primary data was obtained through the use of a structured questionnaire. Also Focused Group Discussion was conducted with selected farmers and leaders of farm associations in addition to personal interviews with the respondents.

Data Analysis

(ii) OLS Multiple Regression Models

The implicit form of the multiple regression model used to analyze the determinants of profit under various CSA regimes in the study is specified as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, \mu)$ ...(2)

Where, Y= amount of revenue realized from climate smart agricultural practices (in Naira

β_0=Intercept of the model;

$\beta_1 - \beta$= slope coefficient of the respective variables;

X_1=age off farmer's (in years);

X_2 = education level of the farmer (0 = noformal education, primary education = 1, secondary education = 2, and tertiary education = 3);

X_3 = Gender (0=male, 1=female);

X_4 =household size (count);

X_5 =farm size (hectares);

X_6 = farming experience (years);

X_7=farmingsystem(mono

cropping = 1, agro-forestry = 2, mixed cropping = 3);

X_8= Farm Gross Margin (naira), and

μ= Stochastic error term (assumed to have zero mean and constant variables).

The differentials in Gross Margin of the CSAs (hypothesis 1) was tested using Friedman test following Conover (1999).

Results and Discussion

1 Climate Change Adaptation Practices by the farmers

The climate change adaptation practices of the rural farmers is shown in Table 4.3. Adaptation practices with similar characteristics were organized into a category, and there were five categories in all: weather management practices, crop management practices, land/soil management practices, water management practices and livelihood diversification. Off farm employment (98%) in livelihood diversification category was the most predominant adaptation measure used by the rural farmers across all the climate change adaptation categories. Agricultural production is seasonal and so, most of the times, rural farmers engage in other economic activities to be active, productive and to earn additional means of living. This could have informed why majority of them where involved in off farm employment activities.

Other predominant adaptation measures practiced by the rural farmers were multiple cropping (96%) and crop diversification (85%) in crop management category; mulching (93%), making of ridges across the farm (85%) and cover cropping (88%) in water management category; as well as organic manure application (84%) and making of mounds in farms (69%) in land/soil management category. Most of these measures are routine traditional agronomic practices and involves no new innovation nor technology, and may therefore have been responsible for their high rate of usage by the rural farmers to adapt to climate change.

All the adaptation practices in the weather management category had a general low usage below 3 percent consisting of: use of weather forecast (4%), change in harvesting dates (24%) and change in planting dates (33%). Weather management practices involves state of the art technology for accurate studying, understanding and prediction of the weather, most of which are lacking in the rural areas. Also, most of the rural farmers have limited formal education to understand and appreciate the importance of weather management in agriculture. These may have accounted for the low frequency of their use of these adaptation practices. In the same vein, the least used climate change adaptation practice was migration (3%) which is in livelihood diversification category. Most of the rural farmers are in their native environment with very low level of education, and in some cases, with no formal education at all. As such, labour mobility is very limited or absence resigning them to faith in their ancestral homes.

2 Levels of Climate Change Adaptation of the Rural Farmers

Figure 1 presents the result of the levels of climate change adaptation of the rural farmers. The result showed that majority (61%) of the farmers were engaged in average adaptation, which involves the use of 7-12 climate change adaptation practices. Often times, the number and frequency of use of adaptation practices affect the effectiveness of climate change adaptation. Rural farmers have poor livelihood which impact their ability to adapt (Enete at al., 2011). Little wonder, most of the farmers were engaged in average adaptation, a large other proportion (31%) in low adaptation (<7 adaptation practices) with only a negligible proportion (8%) in high adaptation (>12 adaptation practices).

3 Factors Affecting Climate Change

Adaptation of the Rural Farmers

The result of the factors affecting climate change adaptation of the rural farmers is presented in Table 4.3. Low adaptation was normalized and used as the base category. The likelihood ratio statistics as indicated by χ^2 statistics were highly significant (P< 0.000), implying strong explanatory power of the model. The result show that age, household size, level of education, farm size, farm distance from home, access to credit, membership of cooperative societies, land tenure security, farm income and non-farm income were the significant factors that drive climate change adaptation of rural farmers.

4 Age of Rural Farmers

The age of rural farmers had a negative relationship with choice of climate change adaptation, even though the relationship was significant for moderate adaptation but insignificant for high adaptation. This shows that an increase in the age of rural farmers by one unit, decreases the likelihood of moderate adaptation by 4.3 percent (p<0.05). It is in line with the findings of Temesgen et al. (2014), although the relationship was not significant. Similar studies of Hassan &Nhemachena (2008) and Otitoju (2013) showed a negative and significant relationship between age and adaptation. However, a positive relationship between age and adaptation has been reported (Deressa, Hassan, Ringler& Yusuf, 2008). These disparities attests to the context specific nature of adaptation (Temesgen et al., 2014).

Table 1 Parameter estimates and marginal effects of explanatory variables from multinomial logit model on choice of climate change adaptation intensity

Explanatory	Moderate Adaptation		High Adaptation	
Variables	**Estimates**	**M. Effects**	**Estimates**	**M. Effects**
Access to credit	-0.7171*	-0.8301*	0.4126**	0.0916**
Access to Extension	-0.2462	-0.79 06	-2.4901	0.32.81
Age	0.2949**	-0.2110**	0.1341	-0.0434
Land Tenure Security	0.2906***	-0.89462***	1.4380	-0.3482
Sex	0.2980	0.6711	0.4312	0.4311
Access to Weather info.	0.7230	0.8341	1.3470**	0.9114**
Household size	0.4370***	-0.9380***	0.4251	0.4613
Membership of Coorp.	0.2857*	0.5263*	0.9560*	0.6345*
Level of Education	-0.6266***	-0.0824***	0.1381***	0.3151***
Information gargets	-0.4130*	-0.8372*	0.4556	0.1345
Marital Status	0.0600**	0.5612**	0.0034	0.0019
Farm Income	1.2501**	-0.9330**	- 0.4560***	0.2886***
Farm Size	3.3819 ***	0.8314***	-1.5780	0.3943
Non Farm Income	0.1234***	-0.4981**	-0.6351**	-0.0341**
Farm Distance	0.1256	-0.9246	-0.4863*	-0.1836*
Access to Farm Tools	-0.5614*	-0.3431*	0.8561	0.0234
Constant	6.3413	-1.9381		
R^2	0.8431	0.8310		
R^2	0.8021	0.8013		

t-statistic computed; *** statistically significant at 1%; **statistically significant at 5%

Source: Field Survey Data, 2018

5 Sex of Rural Farmers

The sex of the farmers although insignificant, had both negative and positive correlation with climate change adaptation. Sex had negative relationship with moderate adaptation, but positive relationship with high adaptation. This means that being a female farmer increased the chances of moderate adaptation, while being a male farmer increased the chances of high adaptation. The first result agrees with that of Hassan & Nhemachena (2008). Moderate adaptation involves fewer climate change adaptation practices compared to high adaptation, and this may have informed the choices of the male and female farmers. However, Deressa et al. (2008), Otitoju (2013) and Temesgen et al. (2014) reported that being a male increased farmers' chance of adoption of climate change adaptation.

6 Household Size of Rural Farmers

The result shows that there are positive relationships between household size and the probability of choosing moderate adaptation ($p<0.05$) and high adaptation ($p>0.10$), respectively. An increase in household size by one unit raises the chances of choosing moderate adaptation over low adaptation by 20.4 percent. This result is supported by the findings of Gbetibouo (2009) and Temesgen et al. (2014), but varies with that of Birungi& Hassan (2010) and Otitoju (2013).

7 Farm Distance of Rural Farmers from the Homes

The farm distance of rural farmers in Akwa Ibom State from their homes had a negative and significant ($p<0.05$) relationship with climate change adaptation. The result showed that a decrease in farm distance by one unit will increase the likelihood of average adaptation by 0.01 percent, and high adaptation by 0.21 percent, respectively. Agriculture in our region is labour intensive, and as such, farmers who travel shorter distances to farm save time and energy, which could be utilize in adaptation.

8 Access to Credit

The results showed that access to credit was significantly and positively related to adaptation. The choice of moderate adaptation increases by 3.26 percent ($p<0.01$) for every one unit increase in access to credit facility. In the same vein, a unit increase in access to credit facility increases the probability of high adaptation by 10.21 percent ($p<0.05$). Lack of finance poses serious constrains to farmers. In this light, any access to credit facility empowers them to undertake adaptation and improved technological practices that will boast their productivity. These are consistent with earlier research results (Deressa et al., 2008; Gbetibouo, 2009; Owombo et al., 2014; Temesgen et al., 2014). In variance however, other studies have reported significant and negative relationship between access to credit and adaptation (ACCCA, 2010; Otitoju, 2013). ACCCA (2010) argued that access to credit could only stimulate adaptation so long as it is profitably. However, the profitability of most agricultural activities remains any issue of concern.

9 Access to Extension Service

The result showed a positive and insignificant ($p>0.10$) relationship between access to extension service and each of moderate and high adaptation. Details of the for this study showed that less than 10 percent of the rural farmers had access to extension service. This implies that the differences in their choice of adaptation was as a result of other factors than extension service. This agrees with the reports of Senait (2002) and Temesgen et al. (2014). However, positive and significant relationships between access to extension service and adaptation have been reported (Gbetibouo, 2009; Otitoju, 2013; Owombo et al., 2014).

10 Access to Weather Information

Similarly, adaptation was positively and insignificantly ($p>0.10$) correlated with access to weather information. As anticipated, farmers who have access to weather information are better equipped to take on adaptation. However, majority (95%) of the rural farmers did not have access to weather information (Table 4.3), probably because, the facilities were not there or they were not educated enough to understand since most of them had low level of education. More so, as data for this study revealed that the farmers had limited access to extension service, which could have properly educated them of weather information. Other studies on access to weather information and climate change adaptation have reported significant positive relationships (ACCCA, 2010; Deressa et al., 2008; Otitoju, 2013).

11 Membership of Cooperative Societies by the Rural Farmers

Farmers generally are poor and hence depend largely on group action for meaningful growth and development. Cooperative society is one of the veritable platforms which farmers utilize to seek for information, assistance, support and solution to challenges facing them. This study showed that a unit increase in the membership of cooperative society increases the likelihood of moderate adaptation by 2.57 percent ($p<0.10$). Also, the probability of choosing high adaptation is increased by 10.24 percent ($p<0.01$) with an increase in membership of cooperative society by one unit. Also, Anyoha et al. (2013) and Owombo et al. (2014) reported positive and significant relationships between social capital and adaptation.

12 Land Tenure Security of Rural Farmers

The results showed that land tenure security had significant and positive effects on choice of climate change adaptation. The probability of choosing moderate adaptation increases by 3.12 percent ($p<0.05$) for every unit increase in land tenure security. In the same vein, a unit increase in land tenure security increases the chances of choice of high adaptation by 4.52 percent ($p<0.01$). Tenure security gives farmers absolute ownership and control over the land. This gives them the impetus to invest in adaptation measures and practices. Otitoju (2013) also reported that tenure security is significantly and positively related with the probability of choosing and using crop diversification in south western Nigeria.

13 Farm Income of Rural Farmers

Farm income of Onna farmers had significant and positive effect on climate change adaptation. Income is central to the livelihood activities of farmers. There are financial implications of every choice of adaptation of the farmer. It therefore follows that when the income prospects from farming is high, farmers would be motivated to invest in adaptation. It agrees with a priori expectations. A unit increase in farm income increases the probability of choosing moderate adaptation by 1.69 percent ($p<0.10$) and high adaptation by 0.21 percent ($p<0.01$). These results are in conformity with those of Temesgen et al. (2014).

14 Non-Farm Income of Rural Farmers

The result showed negative and significant relationships between non-farm income and adaptation. The probability of adopting moderate adaptation decreases by 56.47 percent ($p<0.01$) for every unit increase in non-farm income, while the chances of high adaptation decreases by 4.58 percent ($p<0.05$) for a unit rise in non-farm income. This implies that high income from non-farm activities is an incentive for farmers to disinvest in adaptation. As such, farmers tend to engage and invest more in livelihood activities that yields high returns in revenue. On the other hand, Temesgen et al. (2014) reported positive and insignificant relationships with adaptation. They argued that income from non-farm activities increases farmers' economic base which also impact on climate change adaptation, positively. However, it is only rational for farmers to invest income from non-farm activities in adaptation, to the extent that they can guarantee the profitability of the adaptation. This is highly unpredictable in agriculture.

15 Climate Change Adaptation Practices of the rural farmers

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16 Levels of Climate Change Adaptation of the Rural Farmers

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Conclusion

The study concludes that significant factors that encouraged climate change adaptation were level of education ($p<0.01$), age, household size, farm distance from home, land tenure security, access to credit and non-farm income at $p<0.05$, respectively as well as farm size, membership of cooperative societies and farm income at $p<0.10$, respectively. Policies should be enacted that will enhance the accessibility and security of land for farmers as well as increase their access to education and credit facilities.

Recommendations

The policies that will stimulate farmers' involvement in cooperative societies, attract more people into farming and increase the income level of farmers from agriculture should be formulated. Policies should be enacted that will enhance the accessibility and security of land for farmers as well as increase their access to education and credit facilities.

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