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Adoption of Climate Smart Agricultural Practices by Rice Farmers in Akwa Ibom State, Nigeria

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Abstract

The rise in population amidst climate change has exerted undue pressure on food production and security. Rice production has also been adversely affected by rising temperature and varying rainfall resulting in reduced productivity. In order to cope with the negative impact of climate change events on rice production, farmers need strengthen and improve their adaptive capacity. Therefore, a study was conducted to empirically estimate the factors affecting the adoption of Climate Smart Agricultural (CSA) practices in rice production. Multistage sampling procedure was employed to select the representative rice farmers for the study. With the aid of oral interview and questionnaires, information were elicited from 90 farmers. Data were analyzed using descriptive statistical tools and univariate probit model. Results revealed that majority (62.5 percent) of rice farmers were women, 75 percent were married, 67.5 percent were within economically active age and 85 percent had post primary education. Findings further showed that education level of farmers, family size, farm income and access to information on climate change were positively and directly related to rice farmers willingness to adopt climate smart agricultural practices at 1 percent and 5 percent levels of significance respectively. Result also showed that about 55.85 percent of rice farmers in the study location received information on climate change from village meetings, friends, relatives and other farmers. Agricultural policies that aimed at increasing incomes of rice farmers and creating awareness on climate change will be rational decision.

Introduction

Climate change has been an issue of global concern among researchers, development practitioner sand policy makers. It is no longer news that changes in rainfall patterns and increasing temperatures have negatively impacted agricultural production and food systems (Etim *et al.*,2019). Despite this, the agricultural sector still remains the main stay of rural livelihood in Nigeria (Etim *et al.*,2019; Etim and Etim, 2020).

A number of substitute technologies to tackle this challenge have been proposed by (Teklewold *et al.*,2017; Tran *et al.*,2019). Earlier empirical studies by Etim *et al.*,(2019) also suggested the development of sustainable farming systems that are resilient to effects of climate change through the adoption of climate smart agricultural CSA) practices. However, several factors including farmers knowledge and educational level, cultural differences, resource availability, social and economic status have influenced the willingness of farmers to adopt new agricultural technologies.

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To guide policy makers informulating policies and programs on appropriate climate smart agricultural (CSA) practices that will mitigate the adverse impact of climate change on rice production, an understanding of factors affecting the adoption of CSA practices is required. Etim *et al.,* (2019) and Etim and Etim (2020) agreed that knowledge of CSA practices would strengthen and improve the adaptive capacity of farmers to cope with climate change events. Also, United Nations Development Program (2016) posited that mitigating climate change is the focal point of Sustainable Development Goals. Regrettably, there is paucity of information regarding the determinants of adoption of climate smart agricultural practices by rice farmers in Akwa Ibom State.

This study was therefore conducted to fill this lacuna by empirically estimating factors affecting the willingness of to adopt climate smart agricultural practices in Akwa Ibom State, Nigeria. The underlying economic theory on factors that affect the decision to adopt climate smart agricultural (CSA) practices is hinged on the assumption that rice farmers are motivated by utility maximization (Adesina & Zinnah, 1993). Although not directly observed, the utility (uij) for a given farmer (i) to use a particular practice (j) can be defined as a farm-specific function of a vector of explanatory variables. (x), and an error term with zero mean (eij). This function can be represented as

$$Ui_j = \beta j\, X_i + ei_j \qquad j=1,0;\ i= 1 \text{ --------- } n$$

Where j = 1 represents technology adoption and j=o represents non-adoption. Thus, the ith farmer adopts (j=1) if Ui1>Uio.

The Probit model is suitable for analyzing adoption decisions that have dichotomous values, but if the adoption choice has a continuous value range censored from below (and/or above) then the Tobit model is more appropriate.In this paper, focus is in analyzing only the binary adoption choice. Probit model is therefore operationalised.

Methods

Study Area

The study was carried out in Ini Local Government Area of Akwa Ibom State. Ini is circumscribed to the North, East and West by Abia State and to the South by Obot Akara, Ikono and Ibiono Ibom Local Government Areas of Akwa Ibom State. The it comprises 5 clans viz: Ikpe, Ikono, Iwerre, Itu Mbon Uso and Nkari. The people of Ini are of the Ibibio ethnicity. Ini is regarded as the food basket of the state with most inhabitants predominantly farmers. According to National Population Commission 2006, it has an estimated population of 99,196 with 52,644 males and 46,552 females. There are 2 distinct seasons namely: the short dry season and rainy season. Ini is situated in the tropical rainforest belt. The area is also characterized by heavy rains with annual precipitation ranging between 2000-3000 mm.

Sampling and Data Collection Procedure

The study utilized multistage sampling procedure in selecting the representative rice farmers. The first stage involved the purposive selection of 2 out of 5 clans in Ini. The second stage sampling was the selection of 5 villages per clan to make up 10. Lastly, 8 rice farmers were selected randomly per village to make a total of 80 farmers.

Theoretical Model

The univariate Probit regression model was employed to empirically establish vital factors most likely to affect the decision of farmers to adopt CSA practices. Studies by Rahm and

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Huffman, (1984); Hailu (1990); Etim and Benson (2016); Etim and Udoh (2018) have previously employed this model. The model is express ed mathematically as

$$\phi(\beta xi) - \int_{-}^{\beta xi} \frac{1}{\sqrt{2\pi}} \exp\left(\frac{-t^2}{2}\right) dt$$

Where - ∞ (βxi) is normally distributed and represents the probability that the ith farmer will adopt in a given activity, β is a vector of unknown coefficients; Xi is a vector of characteristics of the ith farmer; t is a random variable distributed as a standard normal deviate, exp. is the exponential function. The probability of adopting CSA practices is the area under the standard normal distribution curve lying between – ∞ and βxi. The larger the value of βxi, the more likely a farmer is willing to adopt CSA practices.

Empirical Model Specification

The study employed the univariate PROBIT model to describe crucial factors likely to affect farmers' willingness to adopt CSA practices in rice production. Identifyingthese factors as reported by farmers to affect their decision to adopt CSA practices would be a useful guide for the formulation of programs by policy makers.

The empirical model for willingness to adopt CSA practice in rice production is specified as

$$Yi^* = P\ (Y_i = 1) = \beta xi + \varepsilon i$$

Where Y_i is the "Willingness to Adopt" (WTA) in rice production; Y_i^* is the estimated value of Y_i ($Y_i^* = 1$) if $Y_i > 0$, and εi is the error term which follows a normal distribution (mean $\mu = 0$, variance $\sigma = 1$). P is the probability function, β is the vector of parameters to be estimated. X_i is the matrix of explanatory variables that affects the it farmer's willingness to adopt CSA practice in rice production.

The dependent variable Y_i or WTA takes a value of 1 for farmers who are willing to adopt CSA practice in rice farming and 0 otherwise.

Table 1. Summary Statistics of Some Explanatory Variables

Dependent WTA	**Willingness to Adopt CSA practice in Rice Production (1=Yes, 0 = No)**
Sex	Sex of the farmer (Dummy = 1male, 0 if female)
Farming Experience Age	Experience of farmer in rice production (years) Age of the farmer in years
Marital Status	Marital status of the farmer (1 = married, 0 if otherwise)
Education	Number of years of formal education
Family Size	Number of family members
Extension contact CSA information	Access of extension contact (Dummy = 1 if yes, 0 if otherwise) Access to CSA information (Dummy = 1 if yes, 0 = otherwise)
Farm Income	Amount of Income to household in naira
Social Organization	Membership of social organization (Dummy = 1 if yes, 0 if otherwise)

Results and Discussion

Socio-economic Characteristics of Farmers

Figure 1 shows the sex of the farmers. Majority (62.5percent) of the farmers were female whereas only 37.5 percent were male.

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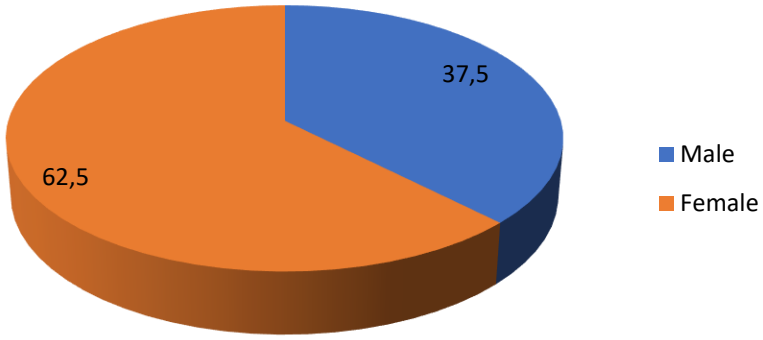

Figure. 1. Sex of Rice Farmers

The age distribution of rice farmers shows a varied picture. Figure 2 revealed that majority (37.5 percent) of rice farmers were within the age range of 41-60 years whereas 30 percent were within the age range of 21-40 years. Only 10 percent were above 60 years. Result suggest that most of the women were within economically active age.

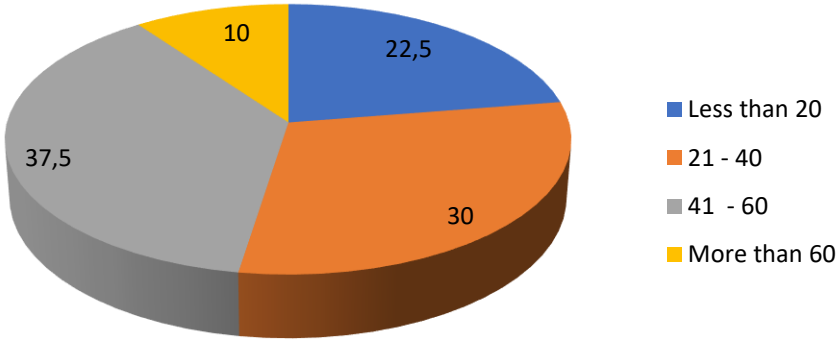

Figure 2. Age of Farmers

The marital status of farmers is shown in figure 3. Most (75 percent) of the farmers were married whereas 25percent were single.

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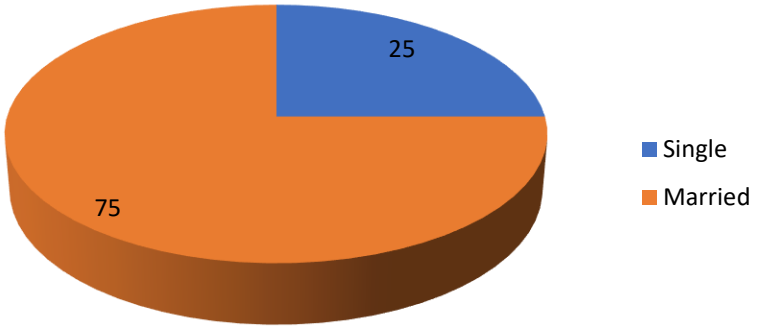

Figure 3. Marital Status of Rice Farmers

The highest educational level of farmers is revealed in figure 4.Result reveals that 52 percent of farmers had senior education,32.5 percent had tertiary education whereas 15 percent had primary education. Results suggests that most of the farmers were literate.

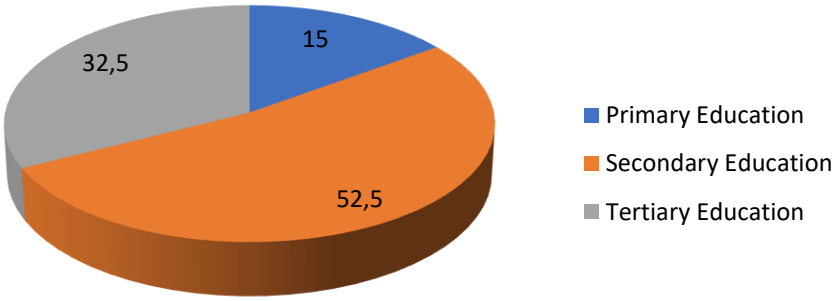

Figure 4. Educational level of Farmers

Figure 5 shows the years of rice farming experience. About 27.5 percent, 35 percent and 37.5 percent had less than 10 years, 11-20 years and 21-30 years of experience respectively.

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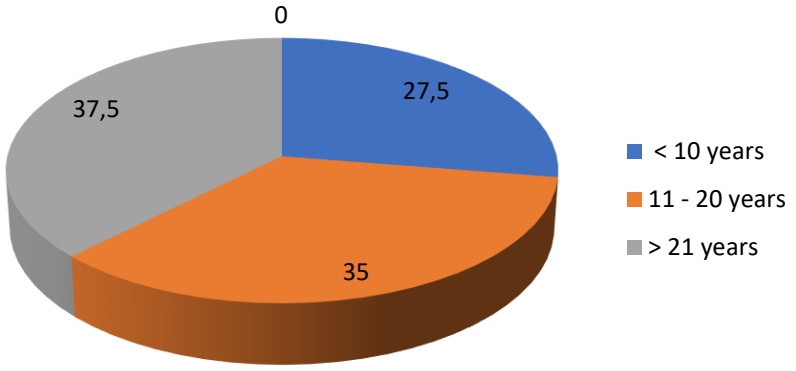

Figure 5. Years of Farming Experience

The farm size is shown in figure 6. About50 percent cropped farmlands less than 1 hectare, whereas 40 percent cropped farms between 1 to 2 hectares. Only 10 percent of the farmers cultivated more 2 hectare of land. This result is in conformity with earlier empirical findings by Etim*et al.* (2017) (2019)

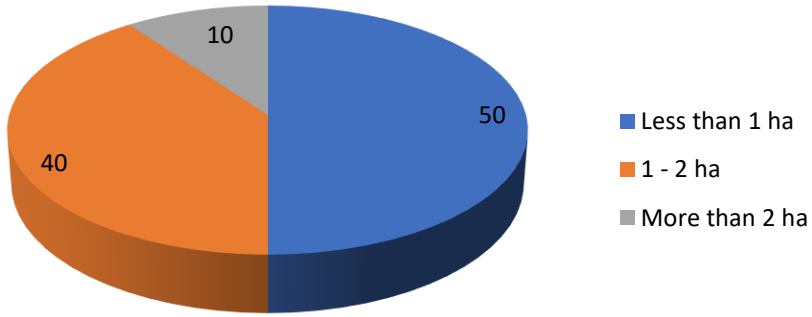

Figure 6. Size of Farmland

Figure 8 showed the different sources of information on climate change. Results show that 43.75percent of the rice farmers received information on climate change from friends, relatives and other farmers,25 percent obtained information via radio, 18.75 percent received information in village meetingswhile12.50 percent of the rice farmers received information on climate change from extension personnel.

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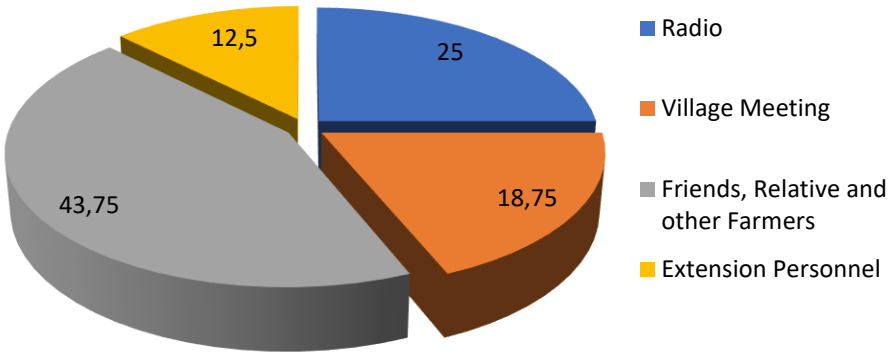

Figure 7. Sources of Information on Climate Change

Determinants of the Willingness of Adopt CSA Practices in Rice Production

The result of the Probit estimates of the factors affecting rice farmers' willingness to adopt CSA practices is presented in table 2.Results revealed from the Akaike information criterion (AIC) indicate that the model has a good fit. Studies by Etim and Udoh, 2018; Etim*et al.*, 2019; Etim and Etim have documented that age could either have a positive or negative effect on the decision of farmers to adopt agricultural innovation.

The result in this study however, revealed that age with a coefficient of0.3180and is positively significantly positive effect($p<0.10$) on farmers willingness to adopt CSA practices. This may not be unconnected to the fact that as the farmers grow older, there is more consciousness of the relevance of agricultural production with age based on experience. With a marginal effect of 0.0812, a unit increase in age of the farmer, will result in 8.12 percent rise in the probability of adopting CSA practices in rice production. The result of this study is synonymous with earlier empirical finding of Nnadi and Akwiwu (2005) (2008).

The variable education with a coefficient of 0.0772 is positive and significant ($p<0.01$). This is an indication that farmers who have reached some level of education are more likely to adopt CSA practices in rice production faster than the ones who are less educated. (Madukwe, 1995; Ayannale and Bamire, 1996; Lapar and Pandey (1999) in Philippines; Nkamleu and Adesina (2000) in Cameroon; Chianu and Tsujii (2004) in Nigeria; Chirwa (2005) in Malawi; Abdulai and Huffman (2005) in Tanzania; Etim *et al*., 2013; Etim and Benson, 2016; Etim and Udoh, 2018) obtained similar empirical results from their respective studies. Finding of this study is an indication that education is a valuable asset for technology adoption decisions. Studies by Weir and Knight, 2006; Martins *et al.*,2010, Etim and Udoh,2018; Matthews-Njoku, 2005support the fact that education stimulates the timeliness and willingness to adopt agricultural innovations.

The coefficient of family size is positive and significant ($p<0.01$) suggesting that farmers with larger family members are more likely to adopt innovations in rice production and vice versa. The marginal effect of 0.0281imply that a unit increase in family members will cause a rise in the probability to adopt CSA practices in rice production by 2.81 percent. Larger family members indicates the availability of labour for participation in rice production. Finding is however, contrary to recent empirical result of Etim and Udoh (2018).

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Farm income has a coefficient of 0.3191 and is positively significant (p<0.01). This means that farmers with higher income from farming were more likely to adopt CSA techniques in rice production. The marginal effect of farm income of 0.0116 indicates that a naira rise in farm income of will result in1.16 percent increase in the probability to adopt CSA practice in rice production. Finding conform with earlier empirical results of Etim and Benson (2016); Etim and Udoh (2018).

Access to information on climate change has a coefficient of 0.4203 and is positively significant (p<0.05). implying that farmers with access to information about climate change were more likely to adopt CSA practices earlier and faster than farmers with less access to climate change information. Result support fact that farmers with access to environmental information have a higher probability to adopt knowledge, skills and processes that would lead to transformed behaviour in support of an ecologically sustainable environment. Earlier empirical studies by Haklay, (1999); Schwarte *et al.*, (2008) and Thompson *et al.*, (2020) confirmed that environmental decision making and technology adoption could be enhanced if the communities are given information on environmental management and climate change.

Table 2: Probit Model Estimates of the determinants of willingness to adopt to climate smart agricultural practices in rice production

Variable	**Coefficient**	**Standard Error**	**z-test**	**P-value**
Constant	0.0381	0.0326	1.1687	0.0807
Sex	0.0996	0.0625	1.5936	0.0021
Age	0.3180	0.1218	2.6108	0.0812**
Education	0.0772	0.0158	4.8861	0.0663***
Family size	0.1366	0.0343	3.9825	0.0281***
Marital status	0.6210	0.4002	1.5517	0.1400
Access to Information	0.4203	0.2107	1.9948	0.0922**
Farm Income	0.3191	0.0820	3.8915	0.0116***
Membership of Social Organization	0.0087	0.0233	0.3734	0.0022
Diagnostic Analysis				
Log-likelihood	-5.1630	Akaike	criterion	18.8143
Schwarz criterion	26.6050	Hannan-	Quinn	22.5172

Note, *, **, *** represent significance at 10%, 5% and 1%.

Conclusion

The results, the majority of rice farmers (62.5%) are women and 75% are married. 67.5% have a business age and 85% have a primary education. The results show that farmers' climate-dependent farmland was reduced by 1% and 5%, respectively. Family size It is also a good result for farmers' income and the desire of rice farmers to access climate change. Show that it is a good relationship. As a result, an estimated 55.85% of the paddy farmers in the study area attended village meetings; Friends No one can comment on climate change from relatives, and agricultural policies increase rice farmers' incomes and respond to climate change. Awareness-raising decisions were made.

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