ADOPTION OF CROP MANAGEMENT OPTIONS AS COPING STRATEGIES TO CLIMATE VARIABILITY AMONG ARABLE CROP FARMERS IN EKITI STATE, NIGERIA.

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Abstract

This study examined adaptability of crop management options as climate variability coping strategies among arable crop farmers in Ekiti State, Nigeria. A multistage random sampling procedure was used to select one hundred and fifty respondents from the study area. Data were collected with the aid of a pretested structured questionnaire. Information were collected on socio economic characteristics of the respondents, various options employed as coping strategies to climate variability on their farms and factors influencing their choice of crop management options in coping with climate variability risks. The results of the study established that arable crop farmers in Ekiti State are practicing various crop management options at individual farm level to cope with the perceived negative effect of climate variability on their crop outputs. It was also found out that mixed cropping is the most practiced option (67.83%) while mono cropping is the least practiced (19.67%). Also the result of the multivariate probit regression analysis revealed that farmer's socio economic characteristics do influence the choice of crop management options practiced.

Key words: Crop management, climate variability, arable crop, coping strategies, and Probit model

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Introduction

Climate variability is one of the major challenges facing the world agricultural production systems, and it has become one of the critical determinants of agricultural output especially in developing countries where rain fed agriculture is predominantly practiced with heavy dependence on climatic resources and labour (Ozor, *et al*., 2012). Climate which can be defined as the prevalent pattern of weather observed over a prolonged period of time is expected to influence crop production, hydrologic balances, input supplies and other components of agricultural systems (Smith and Skinner 2002). The term climate change refers to an overall alteration of mean climate conditions, whereas the term climate variability refers to fluctuation about the mean (Baetghen, 1997). According to Risbey *et al.* (1999), climate variability is particularly important for agriculture, which is generally well adapted to mean or average conditions, but is vulnerable to irregular or extreme conditions such as more frequent droughts and deviations from 'normal' growing season conditions. Equally, Watson *et al.,* (1996) stated that variability in climatic variables will interact with other forms of stress associated with agricultural production and affect crop yields and productivity in different ways, depending on the types of agricultural practices and systems in place. The main direct effects will be through changes in temperature, precipitation, length of growing season, and timing of extreme or critical threshold events relative to crop development. In addition, climate variability may also change the types, frequencies and intensities of various crop pests; the availability and timing of plant protection water supplies; and the severity of soil erosion (Ifeanyi-obi *et al.,* 2012).

Examination of the effect of climate variability on crop outputs is very important considering the role of the agricultural sector in economy of Nigeria apart from been the largest single employer of labour for the teeming population, it contributes some 30% of GDP and undisputedly the second largest export earner after petroleum. Therefore any effect of climate variability on agricultural productivity is likely to threaten both the welfare of the population and the economic development of the country (Ozor, 2009). The fourth assessment report of IPCC (FAR) confirms with high confidence that although agriculture in temperate regions of the world (mainly in the industrialized north) is expected to see some benefits from global warming, "agricultural production and food security (including access to food) in many African countries and regions are likely to be severely affected by climate change and climate variability" (IPCC, 2007a). The heavy dependence of sizable percentage of Sub-Saharan African (SSA) economies, vis-à-vis Nigeria on agricultural activities that are practiced mainly in already harsh climatic conditions are cited to be the main reason for this high vulnerability (Claudia, 2010). The observed climate variability affects the region agriculture and the livelihood of its people in many ways, lower crop yields, reduced availability of water, and reductions in area of land available for cultivation, increased risk of plant, animal and human disease among many other predicted risks of climate variability (Aziz Bouzaher *et al.*, 2008).

Like many other parts of the world Nigeria is experiencing the reality of climate variability in terms of abnormal drier and warmer climates and observed changes in timing of rains and frequency of droughts in some parts of the country over the past few decades(Claudia, 2010). Meanwhile, the performance of crops under stress depends both on their inherent genetic capacity and on the whole agro ecosystems in which they are managed. Therefore any effort to increase the resilience of arable crops in the face of climate variability must involve the adoption of climate resilient crop varieties as well as more prudent management of crops, and the natural resources that sustain their production while providing other vital services for people and the environment.

It is therefore necessary to evaluate the management technique adopted at farm level to adapt to the effect of climate variability. Although coping with climate variability may not be new to Nigerian farmers their capacity to adopt long-term measures and strategies to adapt to climate variability risks has been shown to be constrained by many non-climate factors. Reid and Vogel (2006) stated that adaptive capacity and resilience to climate risks in rural Africa have been observed to work well under good governance and effective local community networks and institutions. However, high levels of illiteracy, poor access to credit, technology and markets, weak institutions and infrastructure, severe poverty and poor governance systems and limited sources of employment and income out of agriculture are among the key constraints to adaptation in most cases (Sangotegbe *et al*.,2012). On the other hand, availability of non-farm sources of income and employment (diversified livelihoods) has also been observed to enhance resilience to climate variability. Migration and remittances from family members working in other economic sectors and regions for instance were noted to be a major adaptation mechanism particularly during shocks of draught and flooding (IPCC, 2007; Dinar *et al*., 2008).

Methodology.

The Study Area.

The study was carried out in Ekiti State, Nigeria. The State which lies entirely within the tropics is located between longitudes 4º 45ˈ and 5 º 45ˈ East of Greenwich meridian and latitude 7 º 15ˈ and 8 º 5ˈ North of equator (Carim 2002). The State enjoys a typical tropical climate with two distinct seasons, the raining season which last roughly from April to October and the dry season which prevail for the remaining months. Temperature ranges between 21^{0} and 28^{0}C with high humidity. The southwestern wind and the north East Trade winds blow in the raining and dry seasons respectively. Tropical forest exists in the south while Guinea savannah occupies the northern peripheries. Ekiti State is basically an agrarian state. It lies south of Kwara and Kogi states as well as East of Osun State and it is bounded in the East and South by Ondo State. Majority of the inhabitants are essentially small holder farmers who depend largely on agriculture for their livelihood.

Sampling Technique.

The study population consists of arable crop farmers in Ekiti State. Data were collected with the aid of a pre tested structured questionnaire. A multistage random sampling procedure was used to select one hundred and fifty respondents from the study area. First, five Local Government Areas (LGAs) were selected out of the sixteen LGAs in the state. Second, three villages were selected from each of the selected LGA and lastly, ten farmers were selected from each village. Information were collected on socio economic characteristics of the respondents, their knowledge and perception of climate variability together with various adaptation strategies employed to adapt to the effect of climate variability on their farms. Personal observations and personal interactions on the farmers' field were equally used to augment and confirm some of the farmers claim. The farm level and household information collected were for the 2011/2012 farming season.

Method of Data Analysis

The analytical technique employed in this study was based on standard theory of technology adoption in which a risk-averse farmer is faced with the problem of choosing a mix of crop management climate variability risk coping options that will maximize the expected utility from final wealth at the end of the production cycle given a production function and resource constraints. It was observed that each farmer do take actions to alleviate climate variability risk for every piece of land. Equally, it was also noted that farmers do not choose just one crop management coping option but each farmer usually choose a mix of crop management coping options for his farm plots (Young, *et al.*, 2006). Therefore, the dummy variable which is logically plausible alternative for measuring whether a particular farmer had adopted a coping strategy to alleviate or avert the perceived effects of climate variability was preferred to assigning a specific coping strategy measure to each farmer. However, because of the perceived possibility of correlation between the response variables and the need to account for such correlation structure, a multivariate probit model has been discovered as a good model for this scenario (Gibbons and Wilcox-G¨ok 1998; Balia and Jones 2004, Young, *et al.*, 2006) Therefore multivariate probit model was chosen to estimate the determinants of climate variability risk coping strategy adoption in the study area.

Estimation Technique

The multivariate probit regression model is usually describe in terms of correlated multivariate normal distribution of the latent variables that are manifested as discrete variables through a threshold specification and hence allows the flexible modeling structure and easy interpretation of parameters (Balia and Jones 2004). The Multivariate Probit regression model used in this study is specified as linear combinations of a deterministic and stochastic component as follows;

Given that I_j^0 denotes the underlying latent response associated with ***j*** th coping strategy for j = 1……………..J and I_j denote the binary response outcome associated with the same coping strategy. I_j = 1 if the farmer adopts the coping strategies and 0 otherwise. Therefore the multivariate probit regression model may be specified as linear combinations of deterministic and stochastic components as follows (Young, *et al.*, 2006):

$I_1^0 = x' \beta_i + \varepsilon_1$ for $I_1 = I \quad (I_1^0 > 0)$

$I_2^0 = x' \beta_2 + \varepsilon_2$ for $I_2 = I \quad (I_2^0 > 0)$

$I_j^0 = x' \beta_j + \varepsilon_j$ for $I_j = I \quad (I_j^0 > 0)$

$x = (1, x_1 \ldots\ldots x_n)$ is a vector of 'n' covariates/ independent variables which do not differ for each coping strategy (i.e. the deterministic component) and

$\beta_j = (\beta_{j0}\ \beta_{j1} \ldots\ldots \beta_{jn})$ is a corresponding vector of parameters.

ε_1 is the stochastic component which may be thought of as consisting of unobservable factors which explain the marginal probability of making a type *j* strategy.

Independent Variables

The choice of explanatory variables / covariates for this study is based on comprehensive review of related literatures. The explanatory variables for this study include respondents characteristics such as age, gender, education, household size, farming experience, assess to extension services, membership of farmers group farm income and non farm income. Table 1 shows the measurement and description of the explanatory variables. Table 1 shows that the average age of the respondent is about 53years, showing that the sampled farmers a slightly old although still within the active work range and majority of the respondents are male confirming that the male gender dominance of farming activities in the study area. Also the average schooling years recorded is about 11years showing that majority of farmers are fairly educated while the average farming experience is 22 years and the average family size recorded is about 6 members. The average farm size recorded 0.82ha with average farm income of 23167.50 per season apart from the household consumption and off- farm income of 10237.50 per month. About 60 per cent of the farmers claimed to have received extension services within the past one year on their farm while almost all the respondents belong to one farmer's group or the other.

Table 1. Measurement and Description of the independent variables

Explanatory variable	Mean	Std Dev.	Description
Age	52.95	13.15	Continuous (years)
Gender	0.71	0.46	Dichotomous: Male, 1: Female, 0
Schooling years	10.89	5.08	Continuous (years)
Farming experience	22.23	14.81	Continuous (years)
Household Size	6.14	3.08	Continuous (numbers)
Farm size	0.82	0.55	Continuous (hectares)
Farm income	23167.50	10214.18	Continuous (₦)
Off farm income	10237.50	1186.84	Continuous (₦/month)
Assess to extension services	0.62	0.46	Dichotomous: Yes, 1: No, 0
Membership of farmers group	0.91	0.72	Dichotomous: Yes, 1: No, 0

Source: Field Survey, 2012

Result and Discussion.

The crop management options identified as climate variability risk adaptation strategies in the study area was based on asking the farmer the actions taken to combat the perceived effect of climate variability on their plots. About 19.67% practiced Mono cropping (MCROP), Mixed farming (MFARM) 52.01%, Seed treatment (SDTRT) 42.33 %, mixed cropping (MICROP) 67.83 %, Pesticide application (PESTAP) 37.83 %, and Plant Protection (PLTP) 43.33%,

Figure 1 shows the crop management options adopted by the farmers in the study area to cope with risk associated with climate variability.

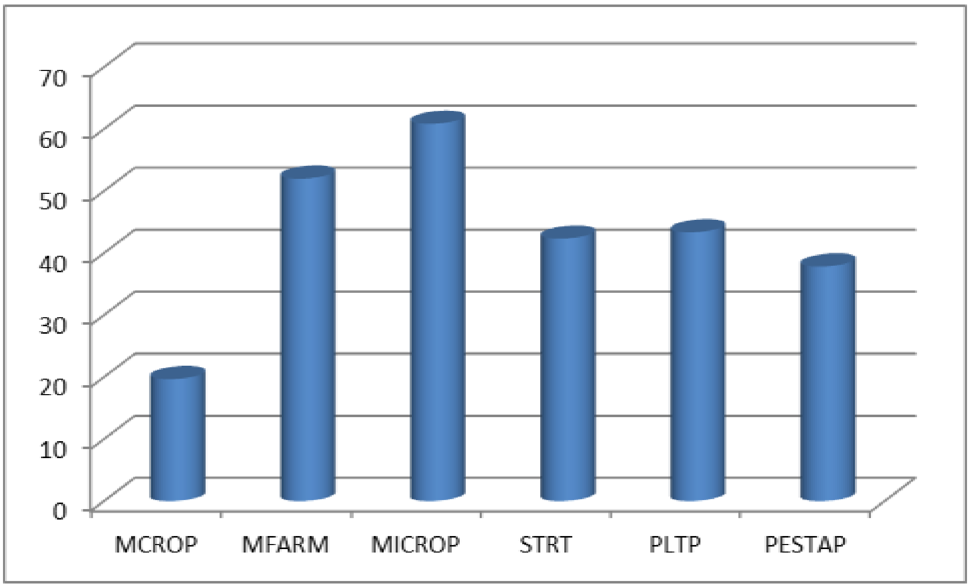

Figure 1: Distribution of Respondents by choice of Climate Variability Coping Strategies

***Total percentage > 100: Multiple answers recorded**

Determinants of Crop Management Adaptation Decisions of Respondents

The result of the multivariate Probit regression analysis used to estimate the determinants of choice of crop management options in climate variability coping strategies among the respondents is presented in Table 2.

The coefficient of age is positive and significant ($p<0.05$) in adopting mixed cropping, mono cropping and application of pesticide while it was negative and significant at the same level for adopting mixed farming option. This shows that a unit increase in the age of the respondents would increase the probability of adopting multiple cropping, mono cropping, and application of pesticides as climate variability coping options among the arable crop farmers while a unit increase in the age of the respondents will reduce the probability of adopting mixed farming option among the farmers.

The coefficient of schooling years is positive and significant ($p<0.05$) for adoption of seed treatment, application of pesticides and plant protection. This is an indication that a unit increase in years of schooling among the respondents would increase the probability of choosing seed treatment, application of pesticides and plant protection as climate variability coping options among the sampled farmers.

This is in line with the findings of Awolala and Ajibefun,(2012) when they concluded that with higher education farmers are more likely to access better information on production technologies and productivity risks such as extreme climate conditions.

Also the coefficient of farming experience is positive and significant for the adoption of seed treatment, mono cropping, pesticide application and plant protection as climate variability coping options. This is an indication that a unit increase in years of farming experience among the respondents would increase the probability of choosing seed treatment, mono cropping, application of pesticides and plant protection as climate variability coping options.

The coefficient of household size is also positive and significant for choosing multiple cropping, mixed farming, mono cropping and plant protection as climate variability coping options. This is an indication that a unit increase in household size among the respondents would increase the probability of choosing multiple cropping, mixed farming, mono cropping and plant protection as climate variability coping options. Equally, the coefficient of farm size shows positive and significant relationship with the probability of choosing mixed farming as a climate variability coping options. This is an indication that a unit increase in farm size among the respondents would increase the probability of choosing mixed farming as climate variability coping options.

The coefficient of farm income is also positive and significant for choosing mixed farming, seed treatment, mono cropping and pesticide application as climate variability coping options. This is an indication that a unit increase in farm income among the respondents would increase the probability of choosing mixed farming, seed treatment, mono cropping and pesticide application as climate variability coping options.

The coefficient of off- farm income is also positive and significant for choosing multiple cropping, seed treatment, mono cropping, pesticide application and plant protection as climate variability coping options. This is an indication that a unit increase in farm income among the respondents would increase the probability of choosing mixed cropping, seed treatment, mono cropping, pesticide application and plant protection as climate variability coping options.

The coefficient of asses to Extension Services is also positive and significant for choosing multiple cropping, seed treatment, mono cropping, pesticide application and plant protection as climate variability coping options. This is an indication that a unit increase in farm income among the respondents would increase the probability of choosing mixed farming, seed treatment, mono cropping and pesticide application as climate variability coping options.

Table 2: Determinants of Choice of Crop Management Options in Climate Variability Coping Strategies

	Multiple cropping		**Mixed Farming**		**Seed treatment**		**Mono cropping**		**Pesticides Application**		**Plant Protection**	
	Coeff.,	P-level	Coeff.,	P-level	Coeff.,	P-level	Coeff.,	P-level	Coeff.,	P-level	Coeff.	P-level
Constant	.301	.156	.196	.018	.176	.039	-.495	.139	.169	.195	.189	.176
Age	.136**	.020	-.327*	.134	-.297	.128	.202**	.014	.259**	.166	.112	.119
Schooling Years	.573	.224	-.341	.165	.130**	.052	.873	.114	.443**	.018	.268 *	.061
Farming Experience	.214	.184	.220	.085	.309*	.018	.336**	.084	.189*	.069	.213**	.073
Household Size	.484**	.014	-.121*	.071	.474	.078	.915*	.043	.390*	.055	.411**	.025
Farm Size	.460	.224	.164*	.074	.249	.118	-.427	.140	.434	.017	.219	.099
Farm Income	.319	.129	-.285**	.024	.058**	.013	.351*	.125	.241**	.037	.317*	.112
Off Farm Income	.162*	.091	.247	.026	.039*	.015	.185*	.084	.177*	.084	.162**	.018
Assess to Extension Services	.128*	.052	.123	.183	.172*	.035	.399 *	.011	.165*	.105	.188 **	.031

Source: Data Analysis, 2013.

Conclusion

This study examined crop management options as adaptive strategy to climate change and also analyzed the factors influencing the choice of such option by arable crop farmers in Ekiti State. The study established that arable crop farmers in Ekiti State are practicing various crop management options at individual farm level to cope with the perceived negative effect of climate variability on their crop output. However, mixed cropping is the most practiced option while mono cropping is the least practiced. This might not be unconnected with the assumption of the farmers that if one crop failed others might compensate for the loss. Also the study revealed that farmers' socio economic characteristics do influence the choice of crop management practiced. It is therefore recommended that more enlightment campaign has to be carried out by relevant government agencies to sensitize the farmers on the need to be more proactive in climate change mitigation strategies.

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