Climate Change Adaptation Strategies for Rural Household's Food Security and Sustainability in South West Nigeria

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ABSTRACT

The issue of climate change and its influence on farm activities has been a serious concern to food policy makers in recent times. Change in rainfall, water level, ponds, lakes, rivers, springs, streams, frequent storms and drought all have effects on food production, quality, availability, nutrition and security, as a result of this different countries especially the developing countries stimulate different adaptation techniques to manage this challenge. Therefore, this study examine rural household's climate change adaptation and mitigation strategies for food security and sustainability in south west Nigeria. Multi-stage sampling technique was used and a total of 381 respondents were randomly selected from 45 communities in the selected States. Descriptive statistics and probit regression model were utilized to analyze the collected data. Result shows that all the respondents were adversely affected by climate change. 64.83% of respondents were vulnerable to climate change because of peasant nature of farming in the area. In order to manage this, more than half of the respondents have resulted into monitoring of weather, crop rotation and mixed farming. This study also revealed that climate change has resulted into decrease farmland cultivation and also changed farmer's future productive plan, hence 9.18% of the farmers are not willing to grow their productivity in subsequent season. This concur that climate change has negative influence on food security status of most of the farmers. 55.12% of the respondents applied adaptation technique for coping with climate change such as weather monitoring, crop rotation and mixed farming. Result of probit model reveals the significant relationship between the determinants vulnerability of climate change and livestock land, land problem ($p<0.01$), fallowing land, land conflict, crop rotation, mixed farming and cover crops meaning that, they are the main determinant vulnerability of climate change whereas it has a negative relationship with bush burning indicating that bush burning is not a vulnerability determinant to Climate Change. This study also revealed that attainment of sustainable and secured food production depends on development of circumspect and tractable adaptation policy

that focused on sensitizing farmers on modern farming practices and appropriate training on weather monitoring to reduce the negative influence of climate change.

Keywords: Adaptation, Climate change, Food Security, Rural households, Sustainability.

1. INTRODUCTION

Emerging challenges of climate variability, with its associated influence on farming activities constitute serious concerns to food policy makers. In the South west Nigeria, activities of oil industries as well as low and inter-seasonal rainfall have subjected the region to high vulnerability to climate change (Dabi et al, 2007). The linkage between climatic factors and household well-being can best be understood by noting that such fluctuations ultimately translate into some form of income shocks. These risks and uncertainties cannot be slightly handled due to its influence on consumption pattern (Dercon, 1996). This is the situation in rural communities, where there is little or no active credit and insurance institutions to safeguard and/or protect vulnerable households. Moreover, rainfall variability is not the only exogenous factor affecting farm productivity as well as income level. It is the factor that contributes to income variability that is most likely to influence household well-being, especially in a predominantly agrarian setting. Changes in climate correlate with other forms of stress associated with agricultural production and crop yields and productivity in diverse ways, depending on types of agricultural activities and approach used (Watson *et al.,* 1997). According to Blaikie (1994) vulnerability is the characteristics of a person or group of individual who anticipate, manage, gain-stay and recover from the effect of natural hazard. Vulnerability represents the ability to revamp the effect of disaster and the means to mitigate risks (Chambers, 1989). Vulnerability is common in under develop countries due to inadequate resources and capacity to mitigate this challenge. At the community level, caste, gender, ethnicity, age, educational level and proximity to necessary resources all determine vulnerability influence (Blaikie, 1994, Warrick and Rahman, 1992, Adger and Kelly, 2001).

In some circumstances, risk, uncertainty and vulnerability to climate change are seen as object of analysis, while few climatic factors serve as subject of risk (Downing and Patwadhan, 2000). Scholars have evaluates the diverse aspects of social vulnerability, mostly in the settings of vulnerability to food insecurity (Chambers, 1989; Swift, 1989). In the neo-classical economics, risk aversion changed completely the behaviour of the economist off profit maximization. Therefore, the threats of excessive climate change and managing techniques have been assumed to result in risk minimization, which have adverse as well as significant influence on household well-being. Scholars also emphasized on some social factors that are involved in collective vulnerability as gender and ethnicity (Blaikie, 1994) also role of credit in repossession from defaults and disorderliness of livelihoods (Adger and Kelly, 2001). The focus is on absolute poverty as variable

for climate change vulnerability because it aggravate vulnerability through the mechanisms of inadequate resources for handling external shocks, relation of poverty to disempowerment, inadequate access to resources when shocks occur, and reliance of the poor on communal and other resources which may be more physically vulnerable to external shocks.

The objective of this study assess perception level of farmers about climatic change, factors influencing households to adverse effects and the significant correlation of the form of climate change and socio economic characteristic of the farmer. The study is justified by Wisner (1978), who stated the systematic evaluation of individuals and societal behaviour to disaster in social system controlled by diverse means of production that are potentially rich, which has been largely neglected. Within the framework of social vulnerability analysis, policy makers will be able to recognize group of people that are mostly affected by adverse climatic factors, and devise ways to assist them. Also, a better knowledge of farmer's perceptions of long-term climatic changes, recent adaptation measures and their determinants will be important to inform policy maker for future success of adaptation in agricultural sector (Nhemachena, 2007).

2. MATERIALS AND METHODS

2.1 Sampling Technique

Multi-stage sampling technique was used for this study where 3 States (Ekiti State, Ondo State and Oyo State) were randomly selected as well as 3 Local Government Areas (LGAs) from each of the selected States, 50 respondents were randomly selected from each LGA and structured questionnaire were administered to them, to make a total of 150 from each State and 450 from all the States. Due to insufficient information and non-return, 381 respondents (100 from Ekiti State, 146 from Ondo State and 135 from Oyo State) were used.

2.2 Methods of data analysis

Data were analyze with the use of descriptive statistics such as frequencies distribution, percentage, mean, standard deviation and coefficient of variation to find out the socio economic characteristics and also probit regression model to analyze the determinants of vulnerability of climate change on rural household.

$$Pij = \text{Prob}\,(yij=1) = \Phi(-\alpha Z) = \int \frac{1}{(2\Pi)^{1/2}}$$

Where: yij = binary dependent variables with values 1 if affected by climate change and 0 if otherwise.

Collinear variables were discarded by careful observation of variance inflating factors using Ordinary Least Square method. The independent variables used are marital status, household size, fallowing land (ha), fishing, livestock land (ha), problem getting land, land conflict, bush burning, crop rotation, mixed farming, fertilizer application, cover cropping, market distance (Km), amount of loan obtained (₦). Marginal contributions of independent variables were estimated using Limdep 7.0 statistical package.

3. RESULTS AND DISCUSSION

3.1 Socio-economic profile of the farmers

Table 1 show that 61% of household heads proportion were male, 89% were married, 9% were single and 2% were divorcee. The mean age was approximately 50 years, with standard deviation of 5.03 years, which gives variability index of 30.11 % compared to 48 years computed for the nation in 2004. Average farming experience was approximately 19 years. Average household size was 6 members while only an average of 1.48% were contributing financially to rural households. This also revealed the reflection of rural setting where incomes are mainly deduced from farming activities of husbands and wives. 77% of the household heads were literate. Also, 22% of the household heads were involved in cooperative societies. The average amount of loans obtained from different sources is about ₦15, 000 with high variability index of 792.57%.

Table 1: Socio-Economic Characteristics of the Respondents

Socio-economic characteristics	Mean	Standard Deviation	Coefficient of variation
House head age (years)	49.92	15.03	30.11
Sex (male=1, Female=0)	0.61	—	—
Farming experience (years)	19.02	13.85	72.81
Married marital status (yes=1, No= 0)	0.89	—	—
Household size	6.07	2.77	45.56
Number financing home	1.48	1.35	91.29
Head can read or write (yes=1, No=0)	0.77	—	—
Nearest market distance (km)	6.69	11.33	169.41
Daily market operation (yes=1, No=0)	0.77	—	—
Membership of cooperative (yes=1, No=0)	0.22	—	—
Amount of loan obtained (₦)	15001.31	118895.21	792.57

3.2 Climate change and adaptation strategies

Table 2 shows the form of climate change as indicated by respondents, 31.76% noticed hot weather, 22.31% indicated increased rain that often results into flooding and erosion, 27.56% indicated delay in rainfall while 18.37% indicated deforestation. Also the perceived causes of climate change are: prolonged dry season (30.45%), depletion of ozone layer (23.62%), increased temperature (19.16%), fall in temperature (10.76%) and deforestation (16.01%). This study shows the main factors that make farm households vulnerable to climate change are: peasant nature of farming (64.83%), farming as a major occupation (13.39%), inadequate financial power for income diversification (8.14%), lack of skill in other ventures (8.92%) and other reasons (inability to clearly forecast climate change and lack of institutional supports) (4.72%). Part of the technique to manage this challenges include: planting of cover crops (24.93%), adoption of mixed cropping (18.37%), monitoring of changes in weather variables (17.06%), irrigation (9.46%), crop rotation (16.01%) and mono-cropping (14.17%).

Table 2. Perceived Forms of Climate Change, Causes, Vulnerability and Coping Strategies

Description of variables	Frequency	Percentage
Form of climate change		%
Hot weather	121	31.76
Increased rain	85	22.31
Delayed rain	105	27.56
Deforestation	70	18.37
Total	381	100
Perceived causes		
Prolonged dry season	116	30.45
Ozone depletion	90	23.62
Increased temperature	73	19.16
Fall in temperature	41	10.76
Deforestation	61	16.01
Total	381	100
Vulnerability factors		
Peasant nature of farming	247	64.83
Farming as major occupation	51	13.39
No money for diversification	31	8.14
Lack of skill for other enterprises	34	8.92
Other reasons	18	4.72

Total	381	100
Coping strategies	Frequency	Percentage
Cover crop	95	24.93
Mixed cropping	70	18.37
weather monitoring	65	17.06
Crop rotation	61	16.01
mono-cropping	54	14.17
Irrigation	36	9.46
Total	381	100

3.3 Determinants of Vulnerability to Climate Change

Table 3 shows dependent variable which is a self reported binary variable indicating whether a household is affected by the form of climate change or not viz a viz Chi Square value of the estimated equation which is statistically significant ($p<0.01$), which implies that the model is a good fit for the data. Results shows that variables such as number of hectares of fallowing land, livestock land, problem with getting fertile land, mixed farming, crop rotation, bush burning, use of organic manure and planting of cover crops are statistically significant ($p<0.10$). Climate change have a significant relationship with number of land being kept under fallowing ($p<0.01$). Increase in the number of degraded plots of land owns by farmer significantly increase climate change, which corresponds with the report of Leary and Kulkarni (2007), that scarce and degraded natural resources contribute to vulnerability and distracts farmers from capacity to adapt to climate change. Also, marginal coefficient of 0.3025 implies that increase in fallow land by 10% that is increase in the probability of the effect of climate change by 3.025%. Livestock land area is statistically significant ($p<0.01$) having positive relationship, which implies that increase in land devoted to livestock farming increases the probability of the effect of climate change. Dabi *et al* (2007) reported that the event of climate change, lands which is the source of livelihood to farmers may be highly erodible and degraded. Also, forms of climate change can have negative influence on livestock production due to increase incidence of pests and diseases. The marginal coefficient shows the increase in livestock land areas by 10% and increase in the probability of the effect of climate change by 0.443%. Farmers that have challenges with obtaining fertile land from their immediate communities have high significant probability ($p<0.01$) of effect of climate change, due to inability to get enough land for farming and diversify production activities in line with the report of Leary and Kulkarni (2007). The marginal coefficient shows that if the number of people without access to fertile land increases by 10%, the probability of being affected by climate change increases by 1.497%. Also, farmers using bush burning techniques for preparation of land have low

significant probability ($p<0.05$) of being affected by climate change. The form of climate change that has to do with cultural practice is instability of rainfall.

However, bush burning reduces the intensity of weed growth as well as cost of labour in case of irregular rainfall. This study stresses on the techniques of how farmers can manage climate change against further peril to environmental safety. According to Watson *et al* (1997), human activities increases atmospheric concentrations of greenhouse gases, which influence radioactive balances and tend to warm the atmosphere. The marginal coefficient reveals the increasing proportion of farmers using bush burning by 10% which reduces the probability of being affected by climate change by 1.282%. The marginal coefficient shows that if the proportion of farmers using cover crops increases by 10%, probability of being affected by climate change increases by 1.136%. Also, farmers that were planting cover crops have higher significant probability of being affected by climate change ($p<0.01$), which was because of the possession of less resistance to environmental stress. The most popular cover crops in the South west Nigeria are melon, pumpkin, cowpea etc. The marginal coefficients for this variable shows increase in proportion of farmers that engage in mixed farming by 10% and increase in probability of being affected by climate change by 1.8%.

Table 3: Probit Regression Results of the Determinants of Vulnerability to Climate Change

Variables	**Estimated coefficient**	**t-statistics**	**Marginal coefficient**	**t-statistics**
Constant	-1.8237***	-4.6240	-0.4187***	-4.8490
Marital status	0.2657	0.8470	0.0610	0.8450
Household size	0.0298	0.9170	0.0068	0.9230
Fallowing land	0.1417***	2.5950	0.3025***	2.5790
Fishing	-0.0429	-0.4170	-0.0099	-0.4170
Livestock land	0.1928**	2.2190	0.0443**	2.1650
Land problem	0.6518***	3.3120	0.1497***	3.3050
Land conflict	0.4171**	1.9950	0.0958**	2.0020
Crop rotation	0.4985*	1.8610	0.1144*	1.8410
Bush burning	-0.5585**	-2.2930	-0.1282**	-2.2870

Cover Crops	0.4948***	2.6230	0.1136***	2.6680
Mulching	-0.0825	-0.3320	-0.0189	-0.3310
Fertilizer use	-0.1564	-0.7920	-0.0359	-0.7930
Mixed Farming	0.7841***	3.5200	0.1800***	3.4830
Loan	0.325105	1.5060	0.756206	1.4480
Log likelihood	-133.4379			
Function restricted log likelihood Chi-square	-191.7571 116.6384**			

Fig 1. that 9.18% of the farmers are unwilling to grow their productivity in subsequent season. Hence resulting to change in farmers' future production plan and consequently reduce food production and threatens food security status of the rural households.

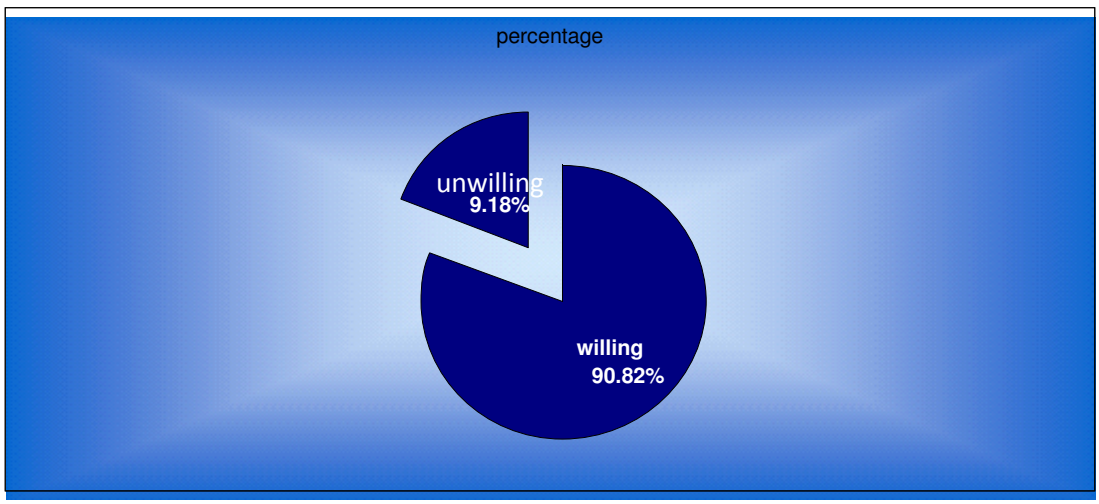

Figure 1. Climate Change and Households' Food Security Status

4. CONCLUSIONS

This study examines rural household's climate change adaptation and mitigation strategies for food security and sustainability in south west Nigeria. It equally assess level of perception of rural households on climatic change and determine factors influencing households to vulnerability of climate change and most appropriate adaptation techniques to mitigate this. Study revealed that farmers were adversely affected by climate change due to peasant nature of farming, nature of their

primary occupation, inadequate skill and income diversification. In order to mitigate this, majority of the farmers have resorted into weather monitoring, crop rotation and mixed cropping. The attainment of sustainable and secured food production hinges on development of circumspect and tractable adaptation policy that focused on sensitizing farmers on modern farming practices and training on appropriate means of weather monitoring to reduce the negative influence of climate change.

Based on the findings, the following recommendation will be useful for policy interventions:

(i) Improved and modern techniques should be encouraged and farmers should be appropriately protected by some insurance institutions.

(ii) Poverty alleviation and rural development agencies should target skill development for involvement in secondary occupations by farmers.

(iii) Awareness and sensitization of rural dwellers on technicalities required for adequately monitoring of climatic change

(iv) Farmers should be trained and empowered in order to effectively monitor the weather and report noticeable changes to appropriate institutions.

(v) Skill development to ensure less dependent on degraded land and development of appropriate soil management practices

(vi) Government should promote and facilitate irrigation practices with appropriate coping strategy.

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