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Climate Change Mitigation Activities and Determinants in the Rural Guinea Savannah of Nigeria

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Abstract

Nigeria loses about $750 million annually to the depletion of its 350 000 hectares of land by direct human activities and climate change. Consequently, the Sahara Desert has been moving southwards by 600 metres annually. 10 000 farming families have already been forced to move off the degraded land that has become barren. In the light of this, this study examined climate mitigation activities and determinants in Nigeria. Specifically, the study examined climate change knowledge/perception, cost implications and mitigation practices of rural households as well as factors responsible for the level of mitigation activities. 120 household respondents were selected across 8 communities in the Guinea Savannah of Kwara State, Nigeria. Study analytical tools used were descriptive statistics, principal component and Tobit analysis. Results showed that households perceived the effects of increased temperatures, reduced rainfall, desertification, flooding and increased crop pest and disease infestations. Crop harvest losses due to changing climate were large and worrisome. Principal component analysis PCA results implied that prevalent practices undertaken to combat climate change were crude and non-radical. These activities were inorganic and organic fertilizers use, mulching, bush fallow and crude agro-forestry practices. Factors determining the extent of mitigation activities were found to include educational status, type of farming activities and farm size. The study therefore calls for radical efforts at educating the rural masses on climate change devastations and the need for mitigating climate change, use of early maturing crop varieties. Green zone/forest should be developed while tree planting and afforestation should be encouraged and possibly enforced.

Keywords: Sahara Desert, afforestation, tobit, principal component analysis, Green Zones

1. Introduction

Climate change has taken a centre point in the midst of diverse threatening environmental challenges facing the planet earth now. It is arguably the most threatening environmental problem of our time, stimulating discourses vis-a-vis the causes, long term effects, as well as how to forestall the lingering and frustrating impacts. The effects of climate change is more pronounced in African societies because of its geography, its sole dependence on agriculture and its generalized incapacity to cope and adapt to climate extreme (FAO, 2003; Bolaji-Olatunji et al., 2010).

Climate Risk Management and Adaptation (CRMA, 2008) define climate change as any significant change in climate over time whether due to natural variability or because of human activity. Climate change is a change in global weather patterns. Climate change has cumulative effect on natural resources and the balance of nature (NEST, 2004). This in turn affects agriculture. The total average impact of climate change may be positive or negative depending on the climate scenario (Apata et al., 2009). Even with this situation, indigenous peoples have very weak approach towards tackling climate change effect. Hence mitigating climate change is therefore crucial for developing countries. The study therefore sought to provide answer to the following questions:

i. Are farmers aware of climate change?

ii. Do climate change impacts imply cost to farmers?

iii. What are the climate change mitigation practices of rural households?

iv. Are there factors affecting climate change mitigation practices?

1.1 Objectives of the Study

The general objective of this study was to examine climate change mitigation activities and determinants in the rural guinea savannah of Kwara State, Nigeria.

The specific objectives were to:

i. Determine farmers' knowledge on climate change;

ii. Identify cost implications of climate change effect;

iii. Examine climate change mitigation practices of farmers; and

iv. Determine the factors affecting mitigation practices.

2. Data and Sample Characteristics

2.1 Study Area

This study was carried out in Kwara State, Nigeria. The state is located in the agro-ecological zone of the country. With a population of about 2.37 million (Census, 2006), the state is made up of four zones based on agronomic and cultural charateristics. It has about 260 528 farm families (KWADP, 2006) and about 36,820 hectares of farmland (FOS, 1995). The state lies between latitude 7015'N and longitude 6018'E and covers a land area of about 32,500 km^2 (Kwara State Ministry of Information, 2002). The state has two main climate seasons: the dry and wet season. The natural vegetation comprises wooded and rainforest savanna, with annual rainfall ranging between 1000 to 1500 mm. The annual rainfall pattern across the state extends between the months of April and October with minimum temperature ranging from 21.1℃ to 25℃ while maximum average temperature ranges from 30℃ to 35℃. Agriculture is the mainstay of the economy of the state. Crops produced in the state include varieties of cash and food crops which include cereals, tubers, cocoa and kola-nut (KWADP, 2006).

The data for this study were obtained from primary sources with the use of well-structured questionnaires augmented with personal oral interview. A random sampling procedure was used to select 15 households, each, from eight communities in the Guinea Savannah of the state giving a total of 120 respondents.

3. Analytical Techniques

The main analytical tools used for this study are descriptive statistics, likert scale, principal component analysis and the tobit model. Simple descriptive statistics such as mean, mode and frequency distribution were used to describe the socio-economic characteristics of respondents, describe variations in farmers'revenue between years 2008-2010 and climate mitigation practices adopted by the farmers.

Perception of the respondents on the effects of climate change was placed on a 5 point likert scale, where 1 was strongly disagree, 2 was disagree, 3 was neutral, 4 was agree and 5 strongly agree. Each respondent had a minimum score of 20 points and maximum score of 100 points. The respondents'perception was therefore judged by the mean scores.

3.1 Principal Component Analysis

The principal component analysis was used to isolate the main climate change mitigation practices undertaken by respondents in the study area.

The main applications of factor analytic techniques are: (1) to reduce the number of variables and (2) to detect *structure* in the relationships between variables, that is to classify variables. Therefore, factor analysis is applied as a data reduction or structure detection method (the term factor analysis was first introduced by Thurstone, 1931).

Combining Two Variables into a Single Factor: The correlation between two variables can be summarized with a scatterplot. A regression line can then be fitted that represents the "best" summary of the linear relationship between the variables. If we could define a variable that would approximate the regression line in such a plot, then that variable would capture most of the "essence" of the two items. Subjects' single scores on that new factor, represented by the regression line, could then be used in future data analyses to represent that essence of the two items. In a sense we have reduced the two variables to one factor. Note that the new factor is actually a linear combination of the two variables.

Principal Components Analysis: The example described above, combining two correlated variables into one factor, illustrates the basic idea of factor analysis, or of principal components analysis to be precise. If we extend the two-variable example to multiple variables, then the computations become more involved, but the basic principle of expressing two or more variables by a single factor remains the same.

3.2 Tobit Model

The Tobit model, developed by Tobit 1957, was used to determine factors explaining the extent of climate change mitigation practices of the respondent farm households. It is expressed as follows:

$$Y_i = ß_o + ß_i X_i + u_i$$

Where Y is the extent of mitigation practices adopted by the households.

X_i are set of independent variables such as gender, farmer's educational status, farming experience, etc.

$ß_i$ = vector of unknown coefficients.

4. Results and Discussion

4.1 Socio-economic Profile of Respondents

Table 1 presents the socio-economic characteristics of respondents. The results of the findings show that both male and female gender, young and old, engage in climate change mitigation activities. However, the number of males is more than that of females (Table 1). Most of the respondents are male. This could result from the fact the male are more capable of carrying out the tedious activities associated with climate change mitigation than the female. Majority of the respondents are married. The average household size of the respondents is 6. This likely implies that the repondents have family labour to assist in climate change mitigation practices as this would save the cost. The modal age group of the respondents is 31- 40 while the average is 42 years. These imply that the respondents are still agile and capable of engaging in climate change mitigation practices.

Table 1. Socioeconomics Characteristics of Respondents (n = 120)

Characteristics	Frequency	Percentage
Gender		
Male	98	817.
Female	22	18.3
Marital Status		
Married	84	70.0
Single	16	13.3
Divorced	2	1.7
Widow	17	14.2
Household Size		
1 – 4	33	27.5
5 – 8	65	54.2
9 – 12	19	15.8
> 12	3	2.5
Education status		
No formal education	31	25.8
Primary education	46	38.3
Quranic education	12	10.0
Secondary education	18	15.3
Primary Occupation		
Formal	35	29.2
Farming	85	70.8
Farming experience (years)		
<10	26	21.7
10 – 20	63	52.5
21 – 30	27	22.5
>30	4	3.3
Farm size(ha)		
< 1	52	43.3
1	36	30.0
2	20	16.7
> 2	12	10.0

About 85% of the respondents have less than secondary education. Majority of the respondents have farming as their primary occupation. The modal farming experience of the respondents is 10-20 years while the mean is 15 years. This likely suggests that the respondents could have knowledge about climate change and its effects.

4.2 Variation in Respondents'Revenue Resulting from Climate Change

Figure 1 presents the household farm revenue over a three years period:2008, 2009 and 2010. The output of any particular years determines the amount of income/revenue that is generated. In 2008 according to the graph the highest output gained by household 51 is higher that is why it generate the highest income of 2250000 naira. At the end of 2009 the output fell drastically implying a low income compared to the highest income gained in 2008. By the end of 2010, the highest income of 2,350,000 was gained by household due to the higher output return, which arises naturally from the temperature and rain fall variations due to climate change effects.

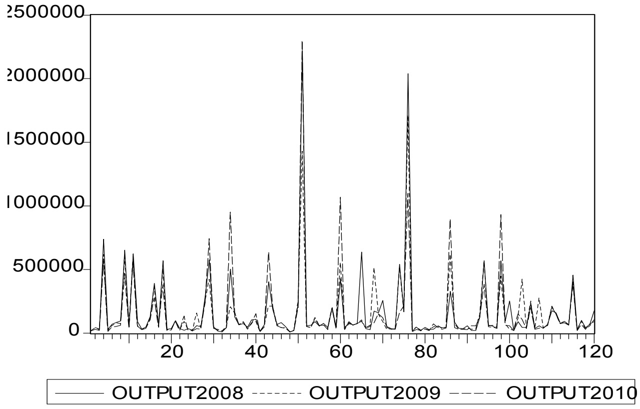

Figure 1. Graph of household farm revenue 2008-2010 in Naira

4.3 Farmers' Perception on Climate Change Effects

Farmers' knowledge about climate change is very important and to a large extent determines what actions they adopt in trying to reduce it effects. The result on farmer perception is presented in Table 2.

Table 2 shows that the respondents of different opinion on the effects of climate change. The mean scores for desertification, increased temperature, reduced rainfall, flooding as well as crop pest infestation and diseases suggest that the respondents strongly agree that climate change bring about these effects in the study area. Also, while most of the respondents believe that rise in temperature is the most reknown effect of climate change, rural-urban migration was seen as the least.

Table 2. Likert scale of farmers' perception on climate change effects

Perception	Mean Score on Likert Scale	Majority of Respondent	Rank
Desertification	4.53	SA	5
Rise in temperature	4.92	SA	1
Delayed rainfall	3.61	A	13
Reduced rainfall	4.75	SA	4
Dry weather	3.85	A	9
Excessive devegetation	3.67	A	10
Fuel wood scarcity	3.59	A	14
Change in livestock system	2.70	N	17
Decline in forest resources	3.53	A	15
Incidence of drought increase	3.52	A	16
Decline in crop productivity	3.66	A	11
Reduction in crop production	2.54	N	19
Increase in cost of food	2.70	N	17
Incidence of flooding	4.78	SA	3
Farmer seriously affected	4.06	A	7
Decline in livestock productivity	4.09	A	6
Crop pest infestation & diseases	4.83	SA	2
Rural urban mitigation	0.96	SD	20
Frequent death of livestock	3.89	A	8
Food shortage/insecurity	3.65	A	12

SA = Strongly agree; A = Agree; D = Disagree, N = Neutral

Source: Field survey, 2011.

4.4 Principal Component Analysis results for Respondents Climate Change Mitigation Practices

At this point, it is important to stress that factor or component are the terminologies which derived from variance and correlation of variables of respondents' climate change mitigation Practices**.** This was used to explain the variability that exist between the variables.

KMO of Sampling Adequacy and Bartlett's Test

Before conducting a principal component analysis PCA, it is essential to check for sampling adequacy to correlate and test of relationship existence between variable as this will help to detect whether the PCA is suitable for our respondents' climate change mitigation Practices variables data. To test for sampling adequacy and the presence of relationship, Kaiser meyer olkin test and Bartlett's test is required respectively. The result of the test is as presented in Table 3.

From the Table KMO is 0.602, implying that the PCA is suitable for the analysis of the respondents' climate mitigation practices. Also, the p-value of 0.000 (i.e $p > 0.05$) suggests that there is relationship between the variables, hence the PCA is satisfactory.

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.602
Bartlett's Test of Sphericity	Approx. Chi-Square	1870.324
	Df	210
	Sig.	0.000

Additionally, based on the PCA criteria for the scree plot Figure 3 and Rotated component scores in Table 6, it is shown that respondents' prevalent climate change mitigation Practices including were inorganic and organic fertilizers use, mulching, bush fallow and crude agro-forestry practices.

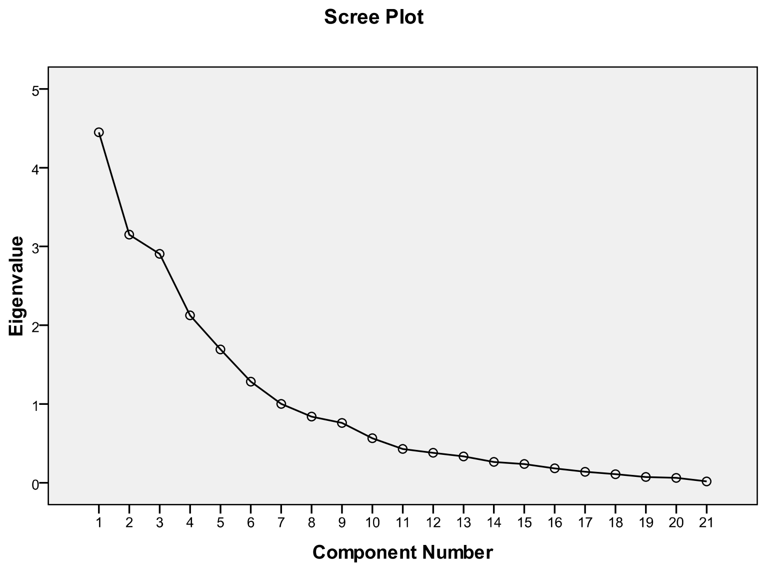

Figure 2. Scree plot derived from pca of respondent climate change mitigation practices component plots

Total Variance Explained by Components Eigen values

The results showed that out of 21 climate mitigation practices/components, only 7 components were extracted because only these component explained a high enough variability that is extracts at least as much as the equivalent of one original variable (eigen value>/1**)** (eigen is a measure of explained variance), which is a common criterion for a component to be useful. When the eigen value is less than 1.0, this means that the components explains less information than a single variable would have explained. Additionally based on the PCA criteria for the scree plot Figure 1, the place where the smooth decrease of eigenvalues appears to level off to the right of the plot is just after component 7 (According to this Cattell criterion,).

Furthermore the principal component analysis PCA captured out the important variables of climate change mitigation practice after rotation of component matrix (Figure 2) which loaded through the cummunalities percentage of explained variable. For soil nutrient management index, application of organic fertilizer had regarded to be important for climate change mitigation since it had 90% explained variable .for soil management index, water storage for irrigation, had rated highest for mitigation of climate change effect as it had 86% explained variable. For cultivation system index, zero tillage had recognized to be important explanatory variable that can mitigate climate change effect. As it had 83% explained variable. For planting operation index, specialize crop under irrigation had estimated through PCA to be important variable climate change mitigation since it had 93% explained variable. For cropping system index, specialize crop under irrigation had regarded important climate change mitigation since it had 93% explained variable. For crop variety index, early mature variety had been estimated to be important variables for mitigation since it had 67% explained variable. For farming method, changing to irrigation/fadama had regarded to be important for climate change mitigation as it had 89% explained variable (Table 4).

Table 4. Rotated component matrix, communalities extraction percentages for respondent climate change mitigation practices

Variable	1	2	3	4	5	6	7	Communalities Percentage
1. Organic fertilizer	0.910							90
2.Inorganic fertilizer	-0.886							88
3.livestock storage		-0.334				-0.702	-0.702	67
4. water storage		0.836						86
5. crop storage		-0.356	0.740					76
6. mulching		0.708					0.350	83
7.Bush fallowing			-0.784					67
8. Zero tillage			0.495	-0.733		0.336		83
9. Ridges across the land			0.642	-0.389				75
10. Specialize crop under dry land				0.812	0.308			90
11. Specialize crop under irrigation		0.330		0.834	0.301			93
12. Multiple crop under irrigation					0.859			81
13. Mixed multiple					0.913			84
14.Cereal/legume intercropping		-0.642				0.352		62
15. Planting different varieties of crop						0.773		66
16. early mature varieties.						0.729		67
17.agro forestry farming							0.894	85
18. changing to irrigation or fadama farming					0.585		0.546	89
19. hardy and drought tolerant crop	0.695		0.375					75
20. hardy and drought tolerant breed		0.862						68
21.pastoralist farming	0.892							91
Eigenvalues	4.449	3.150	2.906	2.125	1.693	1.284	1.001	
% of variance	21.188	15.000	13.838	10.120	8.061	6.115	4.768	

Extraction: Principal component analysis; *Note.* Loadings < .30 are omitted; Source: Computer Print-out (2011)

4.5 Determinants of Climate Change Mitigation Practices

Table 5 presents the factors that determine the extent of mitigation activities by the respondents. The results show that household size, educational status, and farming experience are the significant determinants of climate change mitigation practices by the households.

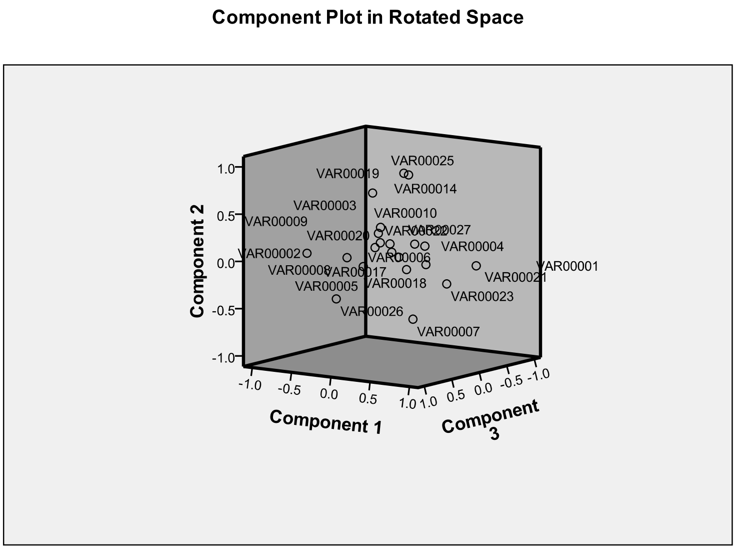

Figure 3. Component plots for respondent climate change mitigation practices

Table 5. Tobit estimation result to determine factors affecting the climate change

Explanatory variable	Coefficient	Std error	t-value	p> |t|
Gender	0.0367294	0.0398188	0.92	0.358
marital status	0.0176222	0.0155381	1.13	0.259
farm size	-0.0030651	0.0170211	-0.18	0.857
Household size**	0.0088156	0.0045845	1.92	0.057
Education status*	0.212418	0.0058478	3.63	0.000
Farming experience*	0.457631	0.0096849	4.73	0.000
Farming type	-0.0025515	0.0081241	-0.31	0.754

The household size is positively correlated with climate change mitigation practices. This could result from the use of family labour to carry out mitigation activities in order to save cost.

Education has a positive effect on mitigation practices, probably because more educated people are more aware of climate change, its causes, its effects, and the measures required to reduce exposure to it. Farming experience is also positively related to climate change mitigation practices, as farmers acquire and develop more skills with time in taking measures against the impact of climate change.

5. Conclusion and Recommendations

The results of the study reveal that the respondents embark on various climate change mitigation practices. However, the measures are crude. Based on the findings, the following recommendations are suggested: Efforts should be made by relevant stakeholders to educate farmers on climate change, its causes, effects, as well as the appropriate mitigation measures against it. Besides, farmers should be provided with early-maturing varieties. This would help guide against adverse effects of drought on crops. Green zone/forest should be developed while tree planting and afforestation should be encouraged and possibly enforced.

References

Apata, T. G., Samuel, K. D., & Adeola, A. O. (2009). *Analysis of Climate Change Perception and Adaptation among Arable Food Crop, Farmer in South Western Nigeria.* Contributed Paper at the International Association of Agricultural Economists 2009 Conference, Beijing China.

Bolaji-Olatunji, K. A., Olufolaju, A. D., & Awe, F. (2010). Climate Change, Adoption and Sustainable Natural Resources Management in Nigeria. *Proceedings of the 44th Annual Conference of Agricultural Society of Nigeria (ASN)* . pp. 1449-1451.

Climate Risk Management and Adaptation Strategies Group (CRMA). (2005). The climate risk management and adaptation strategy results framework. Retrieved May 20, 2011 from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy

F. O. S. (1995). Federal Office of Statistics, Abuja, Nigeria. *Annual Reports.*

Food and Agricultural Organization (2003). State of the World's Forests. Retrieved May 20, 2011 from http://www.fao.org/DOCREP/003/X6953E/X6953E02.htm.

KWADP. (1996). Kwara State Agricultural Development Projects. *Annual Reports.*

Nigeria Environmental Study/Action Team (NEST). (2004). Executive summary of five multi-sector surveys on Nigeria's Vulnerability and adaptation to climate change. Retrieved May 25, 2011 from http:// *www.nestinteractive.org/projectview.php*

Tobin, J. (1958). Estimation of Relationship for Limited Independent Variables. *Econometrica, 26,* 26-36. http://dx.doi.org/10.2307/1907382