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Farmers' Perception and Adaptative Initiative to the Effect of Climate Change on Food Production in Abakaliki Local Government Area of Ebonyi State, Nigeria

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Abstract: ***Farmers' perception and adaptive initiative to the effects of climate change on food production in Abakaliki L.G.A of Ebonyi State was studied. Multi-stage random sampling technique was used to select a total of 120 respondents. Primary data were collected with the use of structured questionnaire and interview schedule and analyzed by descriptive and inferential statistical tools. The result of the study shows that the farmers practised different agricultural activities which include crop productions, livestock production and agro- processing as well as marketing of agricultural produce. Climate change manifestations perceived by the farmers were unusual heavy rainfall, increase in temperature and soil erosion problem, among others. Some adaptive strategies such as mixed farming, mixed cropping and planting of tree crops, as well as use of organic and inorganic manure were adopted by the respondents. The result of factor analysis identified socio-economic, institutional and infrastructural problems as factors militating against the farmers' adaptation to climate change. The study revealed that the farmers have accurate perception of climate change and its impact on agricultural production and environment. It was recommended that government should articulate and integrate climate change awareness and adaptation measures into the mainstream policy frameworks among others.***

Keywords: Farmers, Perception, Adaptation, Climate Change, Food Production, Abakaliki L.G.A, Ebonyi State.

1. Introduction

Agriculture places heavy burden on the environment in the process of providing humanity with food and fibre, while climate is the primary determinant of agricultural productivity (Apata and Adeola, 2009).The fundamental role of agriculture in human welfare concern has been expressed by federal agencies and others regarding the potential effects of climate change on agricultural productivity. The effectiveness of rainfall for crop and fish production is a function of the temperature values which affect evaporation and transpiration (Rudolf and Harmann, 2009). Smith and Skinner (2002) asserted that climate plays a dominant role in agriculture having a direct impact on the productivity of physical production factors, for example the soil's moisture and fertility adversely if rains fail to arrive during the crucial growing stage of the crops (Rudolf and Hermann, 2009). Interest in this issue has motivated a substantial body of research on climate change and is expected to influence crop and livestock production, hydrologic balance inputs supplies and other component of agricultural systems. However, the nature of these biophysical effects and the human responses to them are complex and uncertain. It is evidence that climate change will have a strong impact on Nigeria particularly in the areas of agriculture, land use, energy consumption, biodiversity, health and water resources (Apata, Samuel and Adeola, 2009).

Climate change refers to any change in climate overtime, either due to natural variability or as a result of human activity (IPCC, 2007; Fusel, 2007). The changes occur due to variation in different climatic parameters such as cloud cover, precipitation, temperature and increase in Green House Gases (GHG's) emission through human activities. Adverse impacts of climate change in Nigeria and other developing nations include frequent drought, increased rural-urban migration, increased biodiversity loss, depletion of wild and other natural resource base, changes in vegetation types, increased health risk and the spread of infectious diseases and changing livelihood systems (Abaje and Giwa, 2007; Hassan and Nhemachena, 2008).

Climate change could have adverse effect on various biophysical and economic activities like agriculture, water resources, forestry, human health, biodiversity and wildlife. The consequences of climate change are severe in third world smallholding peasant agriculture because it is rain fed and relies on the mercy of nature, but the magnitude of impact varies greatly by region (World Bank, 2007).

Nigeria like all the countries of sub-Saharan Africa is highly vulnerable to the impact of climate change (NEST, 2004; IPCC, 2007 and Apata *et al.,* 2009). Though climate change is a threat to agriculture and non-agriculture socio-economic development, agricultural production activities are generally more vulnerable to climate change than other sectors. (Kurukulasuriya *et al*., 2006). Ole *et al*. (2009) asserted that analysis of 9000 farmers in 11 African countries predicted falling in the farm revenues with current climate scenarios. Also, Butt *et al* (2005) predicted future economic losses and increased risk of hunger due to climate change. Food crop farmers in Nigeria provide the bulk of arable crops that are consumed locally.

The local farmers are experiencing climate change even though they have not considered its deeper implications

(Apata *et al*., 2009). This is evidenced in the late arrival of rain, the drying-up of stream and small rivers that usually flows year round (Apata *et al*, 2009).There is a general consensus among scientists, economists and policy makers that the entire globe is facing a real and serious long-term threat from climate (Kinuthia, 1997; Ghazi, 2000; Hansen *et al*., 2007; Okolo, 2010; Speranza, 2010). Projections suggest that by the end of the 21st century, climate change will have substantial impact on agricultural production and hence, on the scope for reducing poverty (Slater *et al*., 2007).

There seem to exist death of knowledge about how farmers perceive climate change and its effects on their agricultural productivity in the study area. Hence, this study sought to explore farmers' perception and adaptation initiatives to climate change and investigate the factors affecting their perception in the study area. Answers on the following questions were sought. What are the agricultural practices of the respondents? How do the respondents perceive climate change? What are the adaptation strategies adopted by farmers to mitigate the effects of climate change on their activities? What are constraints to farmers' adaptative measures against climate change in the study area?

1.1 Objectives of the Study

The general Objective of the study was to investigate farmers' perception and adaptative initiative to the effect of climate change on food production in Abakaliki L.G.A. The specific objectives were to;

1) ascertain the agricultural production activities of farmers in the study area.
2) assess the perception of climate change among the farmers in Abakaliki L.G.A;
3) determine the adaptation strategies that the farmers have adopted in response to climate change,
4) analyze the relationship between the socioeconomic characteristics of the farmers and their level of adaptation to climate change in the study area;
5) identify the constraints to adaptation to climate change by the respondents in the study area.

1.2 Hypothesis

A null hypothesis was tested.

Ho_1: There is no significant relationship between the socioeconomic characteristic of the farmers and their level of adaptation to climate change.

2. Methodology

The study was carried out in Abakaliki L. G. A of Ebonyi State. It has a land mass of 240 square kilometers with a population of about one hundred and forty nine thousand, six hundred and eighty three (149,683) (NPC, 2006). Multi-stage random sampling technique was used in selecting the respondents used for the study.

Stage 1: This involved random selection of four (4) communities out of seven (7) autonomous communities in the study area;

Stage 2: three (3) villages were randomly selected, making a total of 12 villages;

Stage 3: This involved random selection of ten (10) respondents from each of the villages making a total of 120 respondents who were used for the study. Primary data were collected with a well-structured questionnaire and oral interview schedule administered to the respondents. Both descriptive and inferential statistics were used in analyzing the data. Descriptive statistics such as frequency counts, mean and percentage were used to analyze objective (i) (ii) and (iii); while multiple regression was used to analyze objective (iv) and factor analysis was used to analyze objective (v).

2.1 Model Specification

Model for multiple regression analysis is stated as:

$Y = F(X_1\ X_2\ X_3\ X_4\ X_5\ X_6\ X_7\ X_8)$

- - - - - Implicit form

$Y = a_0 + a_1 + X_1 + a_3 + X_2 + a_3 + X_3 + a_4 + X_4 + X_5 + X_5 + a_6 + X_6 + a_7 + X_7 + et)$ - - - explicit form.

Where;

Y = Adaptation strategies to climate change (No. of strategies adopted)
X_1 = Age (years)
X_2 = Household size (Number)
X_3 = Gender (Dummy) (Male = 1, Female = 0)
X_4 = Marital status (Dummy) (Married = 1, Single 2)
X_5 = Educational level (years)
X_6 = Annual Income (₦)
X_7 = Farm size (ha)
X_8 = Occupation (Dummy)
X_9 = Farming experience (years)
a_o = Constant
$a_1 - a_9$ = Coefficients of regression

2.2 Test of Hypothesis

F-test was used to test the hypothesis at 5% level of significance. This is expressed thus:

$$F - cal = \frac{R^2 (N - K)}{1 - R^2 (K - I)}$$

Where:

R^2 = Coefficient of multiple determination
N = Sample size
K = Number of variables

Decision rule: If F-cal > F-tab, reject the null hypothesis otherwise accept its alternative.

3. Results and Discussion

The results and discussion were done according to the specific objectives of the study

3.1 Agricultural Production Activities of Farmers in the Study Area

Analysis of agricultural production activities of the farmers was carried with frequency counts and percentages and result got was presented in Table 1.

Table 1: Frequency distributions of the respondents based on agricultural production activities of farmers in the area.

Variables	*Frequency (120)*	*Percentages (%)*
Crop production	75	62.50
Livestock production	70	58.33
Apiculture	13	10.83
Snailery	24	20.00
Agro-processing	72	60.00
Marketing/distribution	84	70.00
Farm input procurement	12	10
Crop rotation	80	66.67
Mixed farming	64	53.33
Afro-forest	16	13.33
Shifting cultivation	90	75.00
Mixed cropping	58	48.33
Source: Field Survey, 2015.		

The result in Table 1 shows that the respondents were involved in many agricultural production activities such as crop production (62.5 percent) livestock production (58.33 percent) and agro-processing (60 percent) as well as marketing of agricultural produce (70 percent). Notable farming system practised in the study area include crop rotation (66.67 percent) mixed farming (53.33 percent) and shifting cultivation (74 percent) and mixed cropping (48.33 percent). However, few farmers practised apiculture (10.83 percent), snailery (20.0 percent) and agro forestry (13.3%) respectively. This finding implies that the respondents have the potentials to cope with climate change as according to Kandlinkar and Risbey (2000) households which practice multiple agricultural production activities have high chances and better able to take decisions on various adaptation management practices in response to changes in climatic conditions.

3.2 Perception of climate change among the Respondents

Perception of climate change among the farmers was analyzed using frequency counts and percentages and result obtained was presented in Table 2.

Table 2: Frequency distribution of the respondents according to their perception of climate change.

Factors	*Frequency (120)*	*Percentages (%)*
Increase in temperature	60	50.00
Delayed rainfall	56	46.67
Unusual heavy rainfall	74	61.67
Quality of cultivated land depreciation	70	58.33
Soil erosion problem	80	66.67
Deterioration of Soil texture and structure	65	54.17
Soil fertility status depreciation	54	45.00
Increase in precipitation	64	53.33

Source: Field Survey, 2015.

The result in Table 2 indicates soil erosion problem (66.67 percent), unusual heavy rainfall (61.67 percent) and depreciation in quality of cultivated land (58.33 percent) as the major indicators of climate change in the area. Other manifestations of climate change as perceived by the respondents include: deterioration of soil texture and structure (54.17 percent), increase in precipitation (53.33 percent) and increase in temperature (50 percent). Moreover, delayed rainfall (46.67 percent) and depreciation of soil fertility status (45 percent) were climate change variability perceived by the respondents. This result conforms to the report of IFPRI (2007), which states that most farmers perceive that long-term temperatures are increasing and the over-all perception on long term changes in precipitation is that region of the world are getting drier and there are pronounced changes in the timing of rains and frequency of droughts.

3.3 Adaptation strategies adopted in response to climate change by the farmers in the area

Adaptation strategies adopted in response to climate change by the farmers in the area was analyzed using frequency count and percentages as presented in Table 3.

Table 3: Frequency Distribution of Respondents according to adaptation strategies adopted in Response to climate change

Strategies	*Frequency (120)*	*Percentages*
- Change land under cultivation	36	30.00
- Use of mulching materials	60	50.00
- Minimum tillage	24	20.00
- Planting of trees	84	70.00
- Crop diversification	62	51.67
- Change in planting date	54	45.00
- Irrigation	48	40.00
- Change in harvesting dates	40	33.33
- Increased weeding	68	56.67
- Agro-forestry practices	72	60.00
- Mixed cropping	80	66.67
- Mixed farming	88	73.33
- Use of organic and inorganic Manure	90	75.00

Source: Field Survey, 2015.

The result of data analysis in Table 3 indicates that the farmers adopted multiple adaptive strategies in response to climate change. The prominent measures include use of organic and inorganic manure (75 percent), mixed farming (73.33 percent), planting of trees (70 percent), mixed cropping (66.67 percent) as well as increase in weeding (56.67 percent). Other major strategies adopted in the area were agro forestry (60 percent) and use of mulching materials (50 percent). The implication of this result is that, the adaptive measures were used complementarily and therefore justifies the review of Kurukulasuriya and Mendelsolhn (2006a) which states that adequate adaptation strategies significantly reduce the effects of climate change on crop production.

3.4 Relationship Between the socio-economic characteristics of the farmers and their level of adaptation to climate change

Ordinary least square method of multiple regression analysis was used to analyze relationship that exist between the socio-economic characteristics of the farmers and their level of adaptation to climate change. The result is presented in Table 4.

Table 4: Multiple Regression Result

Variables	*Variable Names*	*Regression coefficients*	*Standard errors*	*t-values*
Bo	Constant	1.428	.592	2.412*
X_1	Sex	.051	.090	.565*
X_2	Age	.098	.100	.983*
X_3	Educational qualification	.008	.097	.084*
X_4	Marital status	.043	.105	.414*
X_5	Household size	.098	.107	.912*
X_6	Major occupation	.176	.109	.611*
X_7	Farm size	.213	.096	.229*
X_8	Farming experience	.014	103	.137*
X_9	Annual farm income	.130	.113	.148*

* = Statistically significant at 1% level of probability
** = Statistically significant at 5% level probability
*** = Statistically significant at 10 level of probability
R^2 = 0.861 (86.1%)
Adjusted R^2 = 0.782 (78.2%)
F-ratio = (0.158)
Durbin Watson Constant = (1.471)
standard error of estimates (SEE) = (0.08055)
Source: Data Analysis, 2015.

The result of multiple regression analysis presented in table 5 indicates that the coefficient of multiple determination (R^2) was 86.1% and adjusted R_2 was 78.2%. This means that about 86.1% variation in level of adaptation to climate change in the area was caused by combined relationship of socio-economic characteristics of the sampled respondents. The high value of R^2 (86.1%) signify that the socioeconomic characteristics of the farmers had significant relations to their level of adaptation to climate change in the study area and this was confirmed by the positive coefficients of the independent variables adopted in the regression model, and the closeness of adjusted R^2 (78.2%) to R^2 (86.1) in numerical value indicates that the explanatory power of the regression model employed was not exaggerated. Also, the over all significant relationship of socioeconomic characteristics of the farmers on level of adaptation was shown by the low value of f-ratio (0.158), which was statistically significant at 1% level of probability and this was statistically reliable because the value of the standard error of estimates (0.08055) was low, more so, the normal Durbin- Watson value (1.47) shows there was absence of autocorrelation among the independent variables used. The coefficient of sex (X_1) bores positive sign and statistically significant at 1 % level of probability, this implies that the sex of the respondents had positive relationship to their level of adaptation to climate change and so the a priori expectation was met.

Age (X_2) had positive coefficient indicating direct relationship with the level of adaptation to climate change in the area, and this was statistically significant at 1% level, hence, the a priori expectation was met. Educational status (X_3) bore positive sign and statistically significant at 1% level, meaning that there was positive relationship between the educational status of the respondents and their level of adaptation to climate change, hence the a priori expectation was met.

Marital Status (X_4) bore positive sign and statistically significant a t 1% level, this means that marital status of the sampled respondents was positively related to their level of adaptation to climate change, thus, the a priori expectation was met.

Moreover, the coefficients of household size (X_5), major occupation (X_6), farm size (X_7) farming experience (X_8) and farm annual income (X_9) bore positive signs and statistically significant at 1% level, respectively, indicating that there was positive relationship existing between those independent variables and the level of adaptation to climate change and so the a priori expectation was met.

3.5 Constraints of Adaptation to Climate Change by the Respondents

Factor analysis on constraints to adaptation to climate change in the area was carried out and presented in Table 5.

Table 5: Varimax rotated factor analysis on constraints to Adaptation to climate change by the respondents.

Variables	Variable Names	Factor 1 (socio-economic problems)	Factor2 (institutional problems)	Factors (infrastructure problem)
V_1	High cost of improved varieties of crop	0.128	0.786	-0.182
V_2	High cost of farm labour	.0.594	.226	0.040
V_3	Lack of financial resources	0.744	1.156	-0.143
$V_{4.}$	Poor access to information source relevant to adaptation	0.949	- 0.007	-0.047
V_5	Lack of relevant information on adaptation measures	0.002	0.030	0.825
V_6	Lack of access to weather forecasts	0.052	0.006	0.505
V_7	Lack of irrigation facilities	-0261	-0.503	0.763
V_8	Absence of government policies on adaptation strategies	0.020	0.765	-0.307
V_9	Lack of improve breed of farm animals	-0.091	0.895	0.225
V_{10}	Non availability of farm inputs	-0.018	.0.571	-0.429
Source; Data analysis, 2015.				

The result of factor analysis presented in Table 5 indicates the various factors that constrained the respondents from adopting all available adaptation measures to climate change. After a careful examination of the factors, factor 1 was named socio-economic problems, this is because those factors that are highly loaded under factor 1 were mainly

soicio-economic problems, they were poor access to information source relevant to adaptation, lack of financial resources, and high cost of farm labour with coefficients .949, .744 and .594 respectively.
Factor 2 was named institutional problems due to the fact that those factors that a loaded high under factor 2 were problems related to agricultural research institutions and government negligence. Factors that were highly loaded under factor 2 were lack of improved breed of farm animals, high cost of improved varieties of crops, absence of government policies on adaptation strategies and non-availability of farm inputs with coefficients .895, .786, .765 and .571.

Similarly, factor 3 was named infrastructural problems after a careful examination of factors that are highly loaded, which were lack of relevant information on adaptation measures, lack of irrigation facilities and lack of access to weather forecasts with coefficients .825, .763, and .505 respectively. The result therefore, conforms to the findings of Brett, (2009) which states that factors such as poor access to information source relevant to adaptation, poor/low extension services, inadequate knowledge on how to cope, absence or poor policies related to climate change by the government and interest groups constrain farmers from coping with adaptive measures to climate change.

3.6 Test of Hypothesis

Ho_1: The null hypothesis which states that the socio economic characteristics of the respondents have no significant relationship with their level of adaptation to climate change in the area was tested using f-test statistics under 0.5 level of significance as shown below.

Decision rule: If F-cal is greater than F-tab reject the null hypothesis otherwise accept the alternative. Since F-cal (75.707) is greater than F-tab (2.17) the null hypothesis was rejected; while it's alternative was accepted. This implies that the socio-economic characteristics of the respondents had significant relationship with their level of adaptation to climate change in the study area.

4. Conclusion and Recommendations

The study has revealed that the farmers have accurate perception of climate change and its impact on their agricultural production and environment. In response to the adverse effect of this phenomenon, they have adopted a number of on-farm adaptation strategies to sustain their livelihood, and preserve their natural resources and environment. Based on the findings of this study, it was recommended that Government should articulate and integrate climate change awareness and adaptation measures into the mainstream of policy frameworks. Moreover, adequate functional rural infrastructures such as irrigation facilities, meteorological stations, storage and processing facilities should be integral components of rural development programme of the new Nigerian administration.

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