EFFECT OF CLIMATE VARIABILITY ON OUTPUT OF CASSAVA IN ABIA STATE, NIGERIA

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ABSTRACT

The effect of climate variability and change on cassava farmers' output in Abia State, Nigeria from 1980 - 2011 was analyzed and studied in 2012. A multistage random sampling technique was used in the selection of agricultural blocks, circles and cassava farmers. A structured questionnaire was administered to 120 randomly selected cassava farmers. Data was analyzed with multiple regression analysis and descriptive statistics. Data for annual yield of cassava for all the time period were obtained from National Agricultural Extension Research and Liaison Services Ahmadu Bello University Zaria. Data on the three important climate variables required for cassava growth- temperature, rainfall and relative humidity were obtained from National Root Crops Research Institute Umudike meteorological station. A Cobb-Douglas regression analysis result showed that the coefficients for farm size, quantity of fertilizer, labour cost and rain were determinants of cassava production in the study area. The study identified Problems of non access of farmers to meteorological data, irregular training of farmers on climate change pestilence and inefficient extension system as major problems affecting farmers to coping with climate change effects. Policies aimed at organizing regular trainings on climate change variability, accessibility of farmers to meteorological data and provision of rural infrastructure to curb rural-urban migration by the youths will help provide cheap labour were advocated for increased cassava production.

Keywords: Effect, Climate Change, Variability, Cassava Farmers, Output

INTRODUCTION

Nigeria's diverse ecological and socioeconomic conditions make the country a classic case in the challenges of climate variability and change confronting humanity. These ecosystems are home to equally diverse cultural and socioeconomic systems, with a high proportion of farming communities depending on rain fed agriculture for livelihood and survival. The impacts of climate change is affecting many sectors, including agriculture and food security, health, energy and infrastructure, biodiversity forestry resources and settlement patterns among others (BNRCC, 2012). Climate change refers to a change in weather pattern that is attributable directly or indirectly to human activities that affect the atmospheric conditions of the earth leading to global warming. Climate change has the potentials to affect all natural systems thereby becoming a threat to human development and survival socially, politically and economically (Pidwirny and Sidney, 2007). Global warming on the other hand is the increase in the surface temperature of the earth due to climate change (ECA, 2006). Global warming can lead to rise in the sea levels, oceans warm and glaciers melt, thereby threatening agricultural productivity and human settlements. Other impact may include, change in rainfall patterns and increase in soil erosion, storms, floods and drought. The ultimate result at the end would be a deepening food crisis, as well as worsening weather, energy decrease and general environmental breakdown throughout the world (Julius *et al*., 2009). According to BNRCC (2012) data on trends from

30 years and above is a good time span to understand long term climate change patterns. However, the risk associated with increasing climate variability pose technological and economic challenges to societies like Abia State which depend on agriculture for survival. Although climate change will have global impact on agriculture, countries on tropical and subtropical regions are likely to suffer more agricultural losses as a result to climate change. This is because of their dependence on agriculture and generalized incapacity to cope and adapt to climate extremes (Rarieya, 2007). The yield of agricultural crops such as cassava are seen to be subjected to daily, monthly and yearly variations, so the production as well as supply of the agricultural product is sometimes inconsistent and does not satisfy demands due to rapid population growth (IPCC, 2007). Comparing the output of various crops in Nigeria, cassava production ranks first with 34 million metric tons followed by yam production at 27 million tons in 2002, sorghum at 7 million tons, millet at 6 million tons and rice at 5 million tons. Nigeria's cassava production is by far, the largest in the world, a third more than population on Brazil and almost double the production of Indonesia and Thailand. Cassava production in other African countries, Madagascar, Mozambique, Tanzania, and Uganda appears small compared to Nigeria substantial output of 34 million metric tons (FAO, 2010). Cassava is also tolerant to soil infertility and drought stress. It is highly productive and also available throughout the year, besides it is being processed into many foods, depending on local customs and preferences (Nwaobiala, *et al*., 2009). Despite the fact that cassava (*Manihot esculanta crantz)* plant grows and produces well in the Nigerian environment, it has shown different growth behaviour and yield in different years as a result of difference in the annual weather condition, this is because climate variability has the possibility of degrading soil and water resources subsequently (Pidwirng and Sidney, 2007). The study tends to analyze effects of climate variability and change on the output of cassava famers in Abia state, Nigeria from 1980-2011.

METHODOLOGY
Study Area
This study was conducted in Abia State, Nigeria. Abia State lies between longitudes 7° 23^1 and 8° 2^1 East of the equator and latitudes 4° 47^1 and 6° 12^1 North of the Greenwich Meridian. The State is located East of Imo State and shares common boundaries with Anambra, Enugu and Ebonyi States in the North West and North East respectively. On the East and South East, it is bounded by Cross River and Akwa Ibom States and by Rivers State on the South. Abia State is made up of 17 local government areas and most of the people especially, the rural dwellers are engaged mainly in subsistence farming. They engage in arable crop production such as cassava, yam, rice, maize and sweet potatoes.

Sample Size and Data Analysis
The research was conducted in the three agricultural zones of Abia State namely Umuahia, Ohafia and Aba. A list of cassava farmers were collected from Agricultural Development Project (ADP) which formed the sampling frame. A multistage random sampling technique was used in the selection of agricultural blocks, circles and cassava farmers. First two (2) blocks each were randomly selected from the three agricultural zones (Umuahia zone – Ikwuano block, Isiala Ngwa North, Ohafia zone – Uzuakoli block, Isuikwuato block, Aba zone – Obingwa block and Ukwa West) to give a total of 6 blocks. From the selected blocks two circles were randomly selected to give a total of 12 circles. Finally, ten cassava farmers each were randomly selected from the selected circles and this gave a sample size of 120 cassava farmers. A structured questionnaire was used in soliciting information from the farmers. Data on annual yield of cassava were obtained from National Agricultural Extension Research Liaison Services (NAERLS) Ahmadu Bello University Umudike, Abia State, while National Root Crops Research Institute meteorological station Umudike, Abia State provided climatic data on temperature, rain and relative humidity from 1980-2011. Objectives i and iii were achieved with

descriptive statistics such as frequency counts, percentages and mean scores, while objective ii was realised with multiple regression analysis. Problems associated with coping the resultant effects of climate change among farmers was measured using a 6 – item statement rated on a 3-point likert type scale of very serious 3, moderately serious 2 and less serious.. A midpoint was obtained thus; 3+2+1 =6/3 =2.00. Based on the mid score decision rule, any mean score greater than or equal to 2.00 implied a serious problem and mean score less than 3.00 denotes no serious problem.

Model Specification
The Multiple Regression Analysis is explicitly specified as;

i. Linear Function
$$Y = b_0+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6+ei$$

ii. Semi – log function
$$Y = L_nb_0+b_1L_nX_1+b_2L_nX_2+b_3L_nX_3+b_4L_nX_4+b_5L_nX_5+b_6+ei$$

iii. Exponential function
$$LnY = b_0+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6+ei$$

iv. Cobb-Douglas Function
$$LnY = L_nb_0+b_1L_nX_1+b_2L_nX_2+b_3L_nX_3+b_4L_nX_4+b_5L_nX_5+b_6+ei$$

Y = Output of cassava (tones)
X_1 = farm size (hectares)
X_2 = quantity of fertilizer (kg)
X_3 = Labour (man days)
X_4 = depreciation of capital inputs NGN (Nigeria Naira)
X_5 = Perception of temperature (^0C)
X_6 = Perception of rain (mm)
ei = error term
b_0 = intercept
b_1-b_6 = estimated coefficients

RESULTS AND DISCUSSION
Socio economic Characteristics of Farmers in Abia State, Nigeria
Results in Table 01 reveal that 55 percent and 45 percent of the respondents were males and females respectively. This result indicates that cassava farming is dominated by men. The mean age of the farmers were 50.80 years while a fairly good proportion (38.75%) acquired secondary education. Educated farmers are expected to be more receptive to adaptation methods of climate change variability while farmers with low level of education or without formal education would be less receptive. Furthermore, the farmers had a mean farming experience of 29.80 years and farm sizes of 1.77 hectares. The farmers also had a mean annual farm income of N144, 321.00.

Table 1: Average Statistics of Selected Socio-Economic Characteristics of Cassava Farmers in Abia State, Nigeria

Variables	Mean
Male(%)	55.00
Age (years)	50.80
Secondary Education (%)	38.75
Farming Experience (years)	29,80
Farm Size (hectares)	1.77
Annual Farm Income (₦)	144,321.00

 Source: *Field Survey Data, 2012*

Effect of Climate Variability on Cassava Production in Abia State, Nigeria

In determining the effect of climate change variability on cassava production, the Cobb-Douglas functional form was chosen as the lead equation because of a high R^2 value, number of significant variables and agreement with *a prior expectation.*

Table 2: Regression Estimates of the Effect of Climate Variability on Cassava Production in Abia State Nigeria.

Variables	Linear	Exponential	Cobb-Douglas +	Semi – Log
Constant	-1983.979	7.791833	3.826923	-33144
	(-1.12*)	(29.59***)	(31.36***)	(-1.54*)
Farm size (X_1)	5228.92	0.3943419	0.2549954	3316.652
	(28.70***)	(14.55***)	(3.59***)	(3.54***)
Quantity of fertilizer (X_2)	0.0921475	0.0000277	0.223346	2047.741
	(0.93)	(0.19)	(3.40***)	(2.36**)
Labour (X_3)	0.187274	0.0000324	0.3083888	3255.156
	(1.37*)	(1.59*)	(1.91**)	(1.53*)
Depreciation of capital inputs (X_4)	0.060416	0.000312	0.0849324	-492.2139
	(0.40)	(1.40*)	(0.76)	(-0.33)
Perceived Rain (X_5)	343.8494	0.0997097	0.2236876	103.1013
	(1.36*)	(2.66**)	(1.67*)	(0.06)
Perceived Temperature (X_6)	270.0218	-0.0490962	0.884724	4031.845
	(0.95)	(-1.16*)	(0.76)	(2.13**)
R^2	0.4219	0.5546	0.6505	0.5694
R – Adjusted	0.3174	0.4406	0.6305	0.5448
F – ratio	0.0000***	0.0000***	0.0000***	0.0000***

Source: Field Survey, 2012
*   Significant at 10.00% level of probability
**   Significant at 5.00% level of probability
***   Significant at 1.00% level of probability
Figures in parentheses are t – values
 + Lead equation

The R^2 value of 0.6505 indicates 65.05% variability in cassava output explained by the independent variables. The F–value was highly significant at 1.00% level of probability indicating a regression of best fit. The result of Cobb-Douglas regression analysis showed that the coefficient for farm size (0.2549954) was positively signed and highly significant at 1.00% level of probability. This implies that a 1.00% increase in farm size will lead to 0.25% increase in cassava output. This is in agreement with *a priori expectation*. Since increase in farm size will result in a corresponding increase in output. Nwachukwu *et al.*, 2009, asserted that the larger the farm size, the more output a farmer realizes from his farm. The coefficient of quantity of fertilizer (0.223346) was positively signed and highly significant at 1.00% level of probability. This implies that a 1.00% increase in fertilizer applied will lead to a 0.22% increase in cassava output. This is in agreement with *a priori expectation* and conforms to the findings of Nwaru (2004).

The coefficient for labour (0.3083888) was positively signed and significant at 10.00% level of probability. This implies that a 1.00% increase in labour will bring about a 0.308% increase in cassava output. This is in disagreement with *a priori expectation*, probably because labour may work in shifts, thus resulting in high output. This result is in agreement with the findings of Nwaobiala, (2013) found a

positive relationship between labour and output. The coefficient for rain (0.2236876) was positively signed and significant at 5.00% level of probability. This is in agreement with *a priori expectation*, since farmers perception about crop production especially cassava is influenced by availability of rainfall during the production process. This result is not surprising because cassava has a special attribute which is thriving well even in extreme conditions of drought and such has been called the famine security crop (Awa and Tumanteh, 2001).

Identification of Farmers' Problems in Coping with Climate Change Effects in Abia State, Nigeria
The result in Table 3 showed that 65 percent and 57.20 percent of the farmers with mean of 2.83 and 2.44 indicated that non access to meteorological data and irregular training on climate change pestilence was major problems they face in coping with the resultant effects of climate change in the study area. Data on annual climate variation have shown to guide farmers on timing, type of crop variety to plant and adaptation measures to adapt in coping with climate change effects. Farmers complained of inefficiency in extension delivery in the state (43.33%) with a mean of 2.27 as another problem. This is not surprising because Agricultural Development Programmes (ADP's) being the sole agency responsible for extension service in the country is faced with myriads of problems ranging from poor funding and extension agent- farmer ratio (Naswem, 2007). This has drastically affected technology dissemination and awareness on climate change effects and variability. The farmers also identified shortage of labour (35.8%) and traditional land tenure system (35%) with mean ratings of 2.04 and 2.02 respectively as problems. Rural urban migration among the rural youths has caused farm labour shortage resulting to high wage rate used in ameliorating climate change effects. Since most farmers do not have access to land because of land tenure, farmers find it difficult shifting to another farm during emergencies.

Table 3: Problems Associated with Farmers Coping with Climate Change in Abia State, Nigeria

Problems	Very Serious	Moderately Serious	Less Serious	Total	Mean
Scarcity of Improved Cassava Varieties	96(26.67)	64(26.67)	56(46.66)	216	1.8
Non Access to Meteorological Forecast/Data	234(65)	96(26.67)	10(8.33)	340	2.83*
Irregular Training on Climate Change	207(57.50)	70(29.17)	16(13.33)	253	2.44*
Pestilence	99(27.50)	94(39.17)	40(33.33)	233	1.94
Scarcity of Fertilizers	126(35)	78(32.50)	39(32.50)	243	2.02*
Traditional Land Tenure Systems	156(43.33)	96(40)	20(16.67)	272	2.27*
Inefficient Extension System Shortage of Labour	129(35.8)	76(31.67)	40(33.33)	245	2.04*

Source: Field Survey Data, 2012
Decision Rule 2.0 and above is Serious
Less than 2.0 is Less Serious
Very Serious 3, Moderately Serious 2, Less Serious 1
Values in parentheses are percentages.

CONCLUSION
The main objective of the study is to analyze the effects of climate variability and change on cassava farmers' output in Abia State, Nigeria from 1980-2011. According to the results obtained from the

study, a Cobb-Douglas production function result showed that farm size, quantity of fertilizer, labour and rain had significant effect on the output of cassava in the study area. The combined effects of all the explanatory socio-economic variables explained 65.05% in the total variability of cassava output which was statistically significant at 1.00% level of probability. Though rain had negative effects on cassava output, the attribute of drought tolerance which the crop has, had proved that it is a famine crop. Problems of non access of farmers to meteorological data, irregular training of farmers on climate change pestilence and inefficient extension system as major problems affecting farmers to coping with climate change effects. The study therefore recommends that deliberate policy aimed at organizing training for farmers on early warnings in coping with climate variability and change, access to meteorological data and subsidy on farm inputs such as fertilizers, seeds and agrochemicals and reduction of labour costs should be advocated for increased cassava production.

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