Climate Variability: Relative Effect on Nigeria's Cassava Productive Capacity

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ABSTRACT: The study analyzed the relative effect of climate variability on cassava production in Nigeria. It elicited secondary data from reputable sources such as Food and Agriculture Organization statistical data base (FAOSTAT); World Bank database; Central Bank of Nigeria Statistical Bulletin and the International Institute of Tropical Agriculture (IITA) for the 1960 – 2008. Multiple regression model was employed in the course of data analysis and the results showed that the climate variables had no significant effect on the output of cassava within the period under study. On the basis of the outcome, the study suggested mounting of intensive expansion programs to boost cassava production since the crop is not influenced by climate variability as part of efforts to revitalize Nigeria's export subsector and national income generation drive.

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INTRODUCTION

Issues bordering on climate change and variability have become topical and occupy the center of many scientific studies. Some of these studies have shown significant impacts of climatic variability on agricultural activities; especially during the last 40 years (Ayanlade *et al*., 2010). It has been observed with dependable empirical evidence that the earth's climate has exhibited marked "natural" variations and changes, with time scales varying from many millions of years down to a few years. This results in changes in soil moisture, increase in mean sea level, and prospects for more severe extreme high temperature events, floods and droughts in many locations (IPCC, 2001). Climate change has been known as one among the range of risks affecting the food security of poor people and in developing countries (Parry *et al.*, 2009).

As the largest sector in Nigerian economy, agriculture is important because it contributes 42 percent to the country's Gross Domestic Product; employs about 80 percent of the country's poor who live in the rural areas and work predominantly in agriculture (NBS, 2006). Nigeria's agriculture also depends highly on climate because temperature, sunlight, water, relative humidity are the main drivers of crop growth and yield. Given the rain-fed nature of agriculture in Nigeria, the sector has been adjudged to be vulnerable to climate change and variability.

Interest in cassava production, arises from its dominance in terms of production over other crops in Nigeria. Comparing its output with various crops in Nigeria, cassava production ranks first with 34 million metric tonnes, followed by yam production at 27 million tonnes in 2002, sorghum at 7 million tonnes, millet at 6 million tonnes, and rice at 5 million tonnes. Nigeria's cassava production is by far, the largest in the world; a third more than the production in Brazil and almost double the production of Indonesia and Thailand. Cassava production in other African countries such as the Democratic Republic of Congo, Ghana, Madagascar, Mozambique, Tanzania and Uganda appears small compared to Nigeria's substantial output of 34 million metric tonnes (FAO, 2007).

The major advantage cassava has over other carbohydrate/starch crops is the variety of uses to which it can be put to. Each component of the crop is valuable. The leaves may be consumed as a vegetable, or cooked as a soup ingredient or dried and fed to livestock as a protein feed supplement. The stem is used for plant propagation and grafting, while the roots are typically processed for human and industrial consumption (IITA, 2005). In addition to being a feed source, cassava is also being used in the production of yeast and alcohol. It is demanded as a starch for various industrial purposes in the textile, plywood, paper and pharmaceutical industries. It could also serve as a source of ethanol for fuel. Cassava is also tolerant to soil infertility and drought stress. It is highly productive, it is available throughout the year, and can be processed into many foods, depending on local customs and preferences (IITA, 2005).

However, crop yield and production is extremely susceptible to climate change and climate variability. It has been estimated that climate changes are likely to reduce yields and/or damage crops in the

21st century (IPCC, 2001).The effect of climate variability and climate change on crop yield has been a subject of longstanding interest as climate is a primary determinant of agricultural productivity. Climate affects the various aspects of plant growth and yield. The effect of climatic elements and their extremes include the significant alteration of crop production. This is because crop yield is the product of both growth and development. Temperature and rainfall pattern provide major constraint on primary productivity, which in turn determines secondary productivity. For instance, cassava growth failure can result if rain does not fall at all under rain-fed agriculture, or if it does not fall at the right time. There may, on the other hand, be excessive rainfall like in the Eastern States of the country, which can cause erosion and leaching of the soil nutrient leading to low output (Raheem and Chukwuma, 2001).

METHODOLOGY

The study area is the Federal Republic of Nigeria. Geographically, Nigeria occupies a landmass of 923,768sq km in the West Coast of Africa between the latitudes of 4^0 and 14'N and longitudes of 2^0 45' and 14^0 30'E. Nigeria shares her borders with Niger Republic to the North, Chad and Cameroun to the East, Benin Republic to the West and Guinea to the South. Administratively, the country is divided into 36 States with Abuja as the Federal Capital territory, and a population of 140,003,542 persons (NPC, 2007).

The country's strength includes abundant land, labour, and natural resources. It has an area covering 92.4 million hectares, consisting of 91.1 million hectares of land. 1.3 million hectares of water bodies. The agricultural area is 83.6 million hectares, which comprises arable land (33.8 percent), land permanently in crop (47.9 percent) forest or woods (13.0 percent), pasture (47.9 percent) and irrigable land (2.4 percent) (Adetunji, 2006). Climate in Nigeria varies from humid tropical in the South to sub-humid tropical in the north, having wet and dry seasons. Nigeria's atmospheric temperatures are continually high throughout the year with mean temperature ranging between 25^0C in the South and 20^0C in the North.

The diverse nature of the country's climate consequently gives rise to a high degree of biological diversity resulting mainly in six vegetation zones: the mangrove swamps, the saltwater and fresh water swamps, tropical lowland rainforests, Guinea, Sudan and Sahel Savannas. Nigeria is agrarian, and agriculture remains the hub of the economy, providing employment for over 70 percent of the population. Data for this study were gathered from various secondary sources comprising Food and Agriculture Organization statistical data base (FAOSTAT); World Bank database; Central Bank of Nigeria Statistical Bulletin and the International Institute of Tropical Agriculture (IITA) and they covered 1960 - 2009 periods.

Data were analyzed using Cobb – Douglas Production function and the model is specified thus:
The Cobb-Douglas production function is specified thus:

$$\text{Log Yit} = \beta_0+\beta_1\text{Log}(L_{it})+\beta_2\text{Log}(A_{it})+\beta_3\text{Log}(F_{it})+\beta_4\text{Log}(K_{it})+\beta_5\text{Log}(R_{it})+\beta_6\text{Log}(T_{it})+e$$

Where: Y = Output of cassava (tonnes)
L = Labour (Agricultural labour force)
A = Area planted (hectares)
F = Fertilizer (tonnes)
K = Capital (proxied by tractors)
R = Rainfall (mm)
T = Temperature (^{0}C)
βs = coefficients to be estimated
e = Stochastic variable

In the course of estimation, Durbin Watson statistic was employed to detect the presence of autocorrelation in the model. Any DW test outside the range of 1.5 – 2.5 shows the presence of autocorrelation.

RESULTS AND DISCUSSION

The result of the Cobb - Douglas Production model used for estimating the effect of climate variability on cassava production is presented in Table 1. As expected, the coefficient of area harvested was positive and significant at 1% level of probability. This implies that increase in the land area cultivated will result to an increase in the output of cassava. Over the years, the demand – supply gap for food, especially those of major staples has led to campaign on expansion of land area, particularly crops like cassava that do well even in poor soils. This probably, may have resulted in sustained production. This result is in line with Arbar *et al.,* (2002); Hallam (2004) and Rahji and Adewumi (2008). Capital which has been proxied by farm machineries and tractors had a positive coefficient and also significant at one percent probability. This means that as the use of machinery increases, there is the probability of increased output. The coefficient for agricultural labour involved in cassava production was significant at 5 % but was negative, implying that there is a negative relationship between labour and output of cassava within the study period. This is in contrast with some previous studies such as Nwachukwu (2010). However, the negative relationship could mean that efficiency in labour use is increasing in the production given the observed scarcity of agricultural labour in the sector.

Temperature and rainfall were not significant indicating that these two variables had no significant effect on production of cassava over these years. Given the fact that cassava grows well even in marginal soils, the result never came as a surprise. According to Phillips (2005), cassava grows very well even in extreme conditions of drought and as such has been called the famine security crop.

Table 1: Estimates of the effects of Climate Variability on Cassava Production

Variables	Coefficient	t-values
Constant	14.007	2.291**
Area harvested (X_1)	0.936	25.916***
Capital proxied by machinery (tractors) (X_2)	0.102	2.723***
Fertilizer (X_3)	-0.025	-1.283
Labour (X_4)	-3.379	-2.389**
Rainfall (X_5)	0.013	0.165
Temperature (X_6)	0.647	1.165

$R^2 = 0.920$
F-ratio = 683.152
DW = 1.541
Figures in parenthesis are t-values
Note: ** - denotes 5% level of significance
*** - denotes 1% level of significance

Source: Computations from Data, 2010.

The F-ratio of 683.152 confirms the overall significance of the model while the goodness- of- fit measure ($R^2 = 0.920$) indicates how well the data fit into the regression line. Fitness accuracy was 92%. There was no presence of autocorrelation as confirmed by the Durbin – Watson estimate of 1.541.

CONCLUSION

Climate change and variability research has been receiving substantial attention of scientists and researchers across the globe in recent times. This stems from the bizarre menace that marks such changes as has been proved by empirical evidence. Having assessed the relative effect of climate variability on cassava production, the result showed that the climate variables had no significant effect on cassava production which has been attributed to the nature of the crop especially in the area of withstanding extreme weather conditions. On the basis of the outcome, the study suggests mounting of intensive expansion programs to boost cassava production since the crop is not influenced by climate variability as part of efforts to revitalize Nigeria's export subsector and national income generation drive.

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