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Climate Change

Assessment of climate change variables affecting cassava production in Nigeria

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ABSTRACT

Climate change is a global challenge affecting agricultural production, Climate change affect cassava production in diverse ways. Total amount and variability of rainfall and the poor deteriorating nature of most Nigerian soil are causing low yields among cassava farmers which consequently result to hunger, poverty, malnutrition and diseases outbreak. The study was conducted in Nigeria to assess the Climate Change variables affecting cassava production among farmers in Nigeria. Both primary and secondary data were used for the study. They were collected from NRCRI umudike and other individual publications. The result shows that climate change had impacted negatively on cassava production. Adaptation of cassava to climate change during production and post harvest activities and the diversification of livelihood sources through the use of different farming methods and improved agricultural practices will help to increase production in the phase of climate change. Examples are establishment of forestry, planting of

improved and disease resistance crop varieties, addition of value into agricultural products and post harvest activities for climate change adaptation and sustainable development.

Keywords: Climate Change, Cassava, Variables, Production

1. INTRODUCTION

Since agriculture holds so many of the answers to challenges posed by changing weather patterns, it makes sense that this sector takes center-stage in climate change negotiation. Cassava is not left out among the crops affected by climate change in Nigeria. Cassava is prone to flood which is one of the impacts of climate change on the resource farmers. Cassava is the third largest source of carbohydrates in the tropics after rice and maize, it is the major staple food grown in the developing world providing a basic diet for millions of people. Nigeria is the largest producer of cassava in the world with the annual cassava output of 45 million metric tonne which is almost 19% of production in the world (Adejuwon 2006). It is a drought tolerant and a food security crop. Cassava plays a very important role in agriculture in developing countries especially in sub-sahara Africa. It can serve as subsistence crop as well as a cash crop. Cassava production in Nigeria is throughout the year and the average yield of cassava per hectare is 10.6 tonnes. Climate variability and change affects growing crops such as cassava, yam cocoyam and others. Natural events – like flooding, desertification, drought and erosion – have contributed to poor conditions for agriculture and food availability through the impacts on crop yields and livestock productivity which results to low access to food due to higher food price. Moreover, higher frequency of extreme weather events under changing climate, such as heat waves, droughts, and floods, can undermine the stability of food systems and also exacerbate the existing problems with food safety and nutritional security.

Figure 1
Cassava farmer and climate change

Cassava Attributes

Cassava has a number of attributes that make it attractive as a crop to promote under any climate change adaptation strategy for small -holder farmers with limited resources; cassava provides an excellent insurance against famine. Once established, the crop is not easily affected by dry spells and drought. Roots can be left in the ground (unharvested) for long periods as a food reserve. The crop is well adapted to multispecies agricultural systems. Because of its extensive root system, cassava can grow in soils too impoverished to support other crops with yields of fresh tuberous roots up to 5 - 6 t/ha. Under good management yields can be as high as 40 - 60 t/ha of tuberous roots. Cassava tubers can be value added to produce a range of products including livestock feed. A plant which is a staple food crop for millions of people across Africa is at risk from disease as regional temperatures rise, scientists said and there is concern that serious food shortages may result and poverty worsen. Climate change will bring about notable shifts in the suitability of agricultural land for a wide variety of crops (Ekanade, 2011). Crop like cassava could emerge as overall winners,

while others will tend to lose ground, literally research on crops has made significant strides in developing new generations of more resilient varieties, such as drought-tolerant, insect and disease-resistant cassava, and superior tropical forages adapted to drought, flooding, and other harsh condition. It's time for the world to recalibrate its scientific priorities. More than any other crop, cassava has the greatest potential to reduce hunger and poverty in Africa, but CBSD and other viruses are crippling yields (Fauquet & Fargette, 1990). Cassava Brown Streak Disease is transmitted by insects whose numbers are surging, with rising temperatures thought to be one of the factors causing the increase (Alex, 2013).

Climate change effect on cassava

Climate variability and change affects growing crops as shown in figure 3 Climate change affects cassava production in diverse ways. Total amount and variability of rainfall and the poor deteriorating nature of most Nigerian soil are causing low yields among cassava farmers which consequently result to hunger and poverty, malnutrition and diseases outbreak. Claude Fauquet says: "It's time for the world to recalibrate its scientific priorities". That may be his motivation for sponsoring many scientists on world cassava conference in China More than any other crop, cassava has the greatest potential to reduce hunger and poverty in Africa, but CBSD and other viruses are crippling yields. We need to treat destructive viruses like the cassava formidable diseases. Nigeria needs Genetic modified crops and conventional breeder cassava to cope with climate change. Cassava thrives in high temperatures, and if drought hits it simply shuts down until the rains come again. There's no other staple out there with this level of toughness."The ideal situation is for farmers to have a diversity of crops, with cassava acting as a failsafe. This would enhance nutrition and reduce climate risk. But on the other hand, it is rising temperatures which now threaten cassava because they appear to be one of several factors which are causing an explosion in whiteflies, the insects which carry the viruses that cause cassava mosaic disease CMD and cassava bacterial blight disease CBBD. This, coupled with what scientists think are genetic changes leading to the emergence of whiteflies, this means that Africa faces the prospect of intensified food insecurity. It is only when the roots are dug up and found to be streaked with brown that farmers know their crop is infected. The severity of root necrosis increases with plant age, but also root necrosis seems to develop most during, or, immediately after, the main period of root-bulking. It is well known in areas where CBSD has long been present that farmers harvest early i.e. before the crop reaches its full yield potential, in order to avoid root necrosis. This decreases the value of cassava as food security crop, because it can no longer be left in the field to provide a reserve of food during periods when there is little other food. CBSD has a limited effect on the growth and appearance of plants, but can be catastrophic for production as the dry rot that it produces in tuberous roots can render entire crops unusable(Hillocks et al. 2001) CBSD is a biological constraints to cassava production in Africa this pandemics is being driven by unusually high populations of the whitefly vector and global warming is likely to exacerbate the situation because higher temperatures will favor the whitefly vector. This potential additional impact from pest and disease is all the more significant as cassava is one of the very few crops that may otherwise be relatively unscathed by future patterns of climate (Jarvis *et al*. 2012).

Figure 2
Cassava Brown Streak Disease (CBSD)

Global warming and intensification of rains in the recent years has made flooding a problem to farmers in some parts of Nigeria. In the past, farmlands being flooded were not much, unlike today that most farmlands are being flooded affecting the yield of cassava and other crops (Ojeh et al. 2014). Rainfall within regions in Nigeria was unreliable, duration of rain has been shortened and it is either too much causing flooding or either too small causing drought, cassava being a drought resistant crop is susceptible to flood. A heavy flood environment is not good for cassava production otherwise the roots will become rotten. Cassava as a root crop does not like much flood which can easily result to root rot diseases caused by fungi (Nwakor et al. 2017) Daily temperature was perceived as hot or high when the sun shines is too much thereby scorching crops like cassava. Excessive temperature causes weathering of cassava leaves due to excessive sunshine poor or degraded soil as a result of poor cultivation practices, erosion and deformation affect cassava production through reducing of yields. Pests and diseases pose problem to farmers and prolonged drought increases the population of variegated grasshoppers which attack cassava plants and destroy them by which results to poor yields of cassava.

Figure 3
Climate change affects cassava farms through Flood as shown in the pictures

Figure 4
Farmer weeding her improved cassava in Nigeria

Adapting cassava to climate change

To adapt to climate change on cassava production there is need to plant improved and different cassava varieties , most improved cassava varieties are early maturity, disease resistance and high yielding , all these good qualities help to reduce the impact of climate change even when the crops are trying to resist drought, floods and other incidence. Also farmers should make use of organic and inorganic manures to improve the fertility of the soil, use irrigation where necessary makes it attractive as a crop to promote under any climate change adaptation strategy. For small holder farmers cassava provides an excellent insurance against famine. Once established the crop is not easily affected by drought. Root tubers can be left in the ground for long period as a food reserve cassava is adapted to wide agricultural systems. Cassava tubers can be value added to produce many products including livestock feed.

Research results showed that variability in the pattern of rain and insufficient rain had negative impact on cassava production. So effort should be made to monitor rainfall patterns. Understanding the biological and economic impact of rainfall on cassava will ultimately improve yield and reduce cost of production in cassava. Research had shown that precipitation imposed a negative effect on cassava production over a long period of time but temperature influenced cassava productivity negatively both in the short and long run. Observation has shown that much of the climate change incidence in Nigeria was triggered more predominantly by manmade causes such as poor drainage system, water disposal habits, poor farming systems, deforestation etc. Flooding is a major climate stressor which leads to secondary impacts of health and destruction of livelihoods.

Adaptation measures that can mediate poverty and impacts of climate change which have been tested include: adopting improved agricultural and environmentally sensitive technologies such as use of improved crops varieties (Adger et al, 2003).

2. METHODOLOGY

The study was conducted in Nigeria. Both primary and secondary data were used to achieve the objectives of the study. The primary data include the result of my previous work on climate change in former southeastern Nigeria. The secondary data were collected from books, journals, internet, proceedings and other publications. In this study three states namely, Abia, Akwaibom and Enugu States were selected because they produce root and tuber crops as their major food crops like cassava in large quantities. In each of these states two LGAs were randomly selected namely Umuahia north and Isiala ngwa north in Abia state, Ikot ekpene and Obot akara in Akwaibom state, Orji river and Ani nri in Enugu state. Two communities and forty eight farmers were randomly selected and interviewed using a well structured questionnaire; about 96 questionnaires were distributed to each of the states. Data collected were analyzed by means of descriptive statistics, such as frequency tables, percentages, means and multiple regression analysis.

The model used for regression analysis was specified in implicit form as follows.

$Y = f(x_1\, x_2\, x_3\, x_4\, x_5\, x_6) + E$ ..... (1)

Where:
Y = cassava output (kg)
X_1 = Temperature
X_2 = change in rainfall pattern
X_3 = poor relative humidity
X_4 = increase sunshine
X_5 = cloud
X_6 = heavy storm| wind
E = Error term.

3. RESULT AND DISCUSSION

Table 1 revealed the effect of climate change on individual farming activities among the farmers. Majority of root and tuber crops were affected mostly during storage (x =2.0) and planting period (x = 1.2) as indicated by the mean scores here. It was observed that yam, cocoyam and sweet potato were highly affected by climate change at storage level, while cassava was affected mainly at the planting stage of operation.

Table 1

Impact of climate change on cassava and other crops production activities

	Crops							
Activity	**Cassava**	**Yam**	**Sweet potato**	**Ginger**	**Cocoyam**	**Cassava itc**	**Yam itc**	**Mean**
Planting	166 (40.3)	16 (5.5)	24(8.3)	12 (4.2)	08(2.8)	96 (33.3)	80(27.8)	1.2
Weeding	36(12.5)	72(25)	- -	- -	20(6.9)	32 (11.1)	48(16.7)	0.7
Fertilizer Application	16(5.5)	16 (5.5)	- -	- -	24(8.3)	24 (8.3)	12(4.2)	0.2
Harvesting	64(22.2)	48 (16.7)	- -	04 (1.4)	40(13.9)	60 (20.8)	48(16.7)	0.9
Processing	24(8.3)	8(2.8)	12 (4.2)	52 (18.0)	72(25.0)	108(37.5)	84(29.5)	1.0
Storage	56(19.4)	140(48.6)	100 (34.7)	60 (20.8)	140(48.6)	48 (16.7)	24 (8.5)	2.0

Source: Nwakor, et.al 2013*Itc= intercrops. Figures in brackets are percentages

Table 2

Result of multiple regression analysis on the effect of climate change on cassava output

Variables	**Linear**	**Cob Douglas**	**Semi log**	**Exponential**
Constant	1387.031	7.703	2218.021	7.033
	(5.419)***	(38.947)***	(7.674)***	(39.576)***
Temperature	515.410	058	450.145	-291
Increase	(3.266)***	(212)	(1.123)***	(2.659)***
Change in	-320.817	-507	-842.108	- 180
Rainfall pattern	(-3.026)***	(- 2.98)***	(-3.391)***	(-2.440)**
Poor relative	-297.631	-598	-941.165	-183
Humidity	(-2.400)***	(-2.674)**	(2.235)***	(-2.124)**
High rate of sunshine	-84.980	0.72	-78.906	- 002
	(-0.813)***	(0.346)	(-0.259)***	(-032)
Cloud/ Harmattan	93.885	419	538.875	063
	(0.941)***	(2.855)***	(2.513)***	(-909)
Heavy storm	159.972	128	249.896	092
(wind)	(3.476)***	(2.146)**	(2.869)***	(2.864)***
R^2	0.930	0.128	0.144	0.067
R adjusted	0.073	0.107	0.123	0.046
F statistics	4.576***	6.193***	7.074***	3.196***

Source; Field survey 2011, Figures in parenthesis are t-value

***=significant at 1%, **=significant at 5%, *=significant at 10%.

The result of the multiple regression analysis of the effect of climate change on crop production shows an R^2 value of 0.93 which indicates that 93% of the variation in the production output of cassava were explained by the independent variables considered in the study. Majority of the climatic variables were highly significant in root and tuber crops production at one percent and five percent (1% and 5%) levels of probability. The coefficients of temperature increase, and storm were significant at 1% level of probability each and were positively signed. This implies that for any 1% increase in the variables above, there would be 515.410 and 159.972% increase in the output of cassava. This is against a priori expectation. But cassava is an economic crop that can survive when there is an increase or decrease in temperature. The result further revealed that change in rainfall and poor humidity were significant at 1% and 5% level of probability respectively and were negatively signed. This indicates that for every 1% change in rainfall there would be a 320.817% decrease in output. Also 5% change in humidity, would lead to a 297.631% decreased output. This is in accordance with a priori expectation. Also the R^2 value at 93% indicates that 7% of the variability in the output was not accounted for in by the explanatory variables. The may be due to exogenous factors e.g: government policies.

4. CONCLUSION

The result of the study revealed that climate change affected agricultural production resulting to low crop yield; delay in planting period due to variability in rainfall pattern, and reduction in farmers' income. Adaptive measures in agriculture ranges from technological solution to adjustment in farm management, structures and adjustment in political changes like adjustment plan. The following levels of adaptation are available for farmers on climate change research

- Adjusting the timing of farm operations, such as planting or sowing dates and treatments.
- Choosing cassava varieties better adapted to the expected length of the growing season and water availability and more resistant to new conditions of temperature and humidity.
- Adapting cassava with the help of existing genetic diversity and new possibilities offered by biotechnology.
- Improving the effectiveness of pest and disease control through better monitoring diversified crop rotations or integrated crop management method.
- Improving water management by increasing water retention to conserve soil moisture and landscape management, such as maintaining landscape feature.
- Using water more efficiently by reducing water losses, improving irrigation practices and recycling or sorting water.
- Identification of vulnerable areas and assessment of the need to change crops and varieties in response to climate trend.
- Give adequate support to agricultural research.
- Building adaptive capacity by awareness creation and provision of information and advice on farm management.

In recommendations farmers are advised to

Plant early
Plant improved cassava varieties
Use organic manure
Observe good agronomic practices
Avoid diseased planting materials
Adhere to the advice of Research and extension experts

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