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IMPACT OF CLIMATE VARIABILITY ON FOOD AVAILABILITY IN KWARA STATE, NIGERIA

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Abstract
Food availability is one of the indicators of national development. It is an important component of food security. Many nations, especially developing countries, in the world today find it difficult to provide adequate food for their citizens. Several factors are responsible for the inability of nations to produce enough food for their people. Such factors could be physical, biological or economical. This paper examines the impact of climate variability on food availability in Kwara State. Climatic data on rainfall, temperature, relative humidity, sunshine hour and evaporation were obtained for a period of thirteen years. Similarly, agricultural data on maize, rice, sorghum, millet, yam and cassava were collected for the same period. The data were analyzed using multiple regression, trend analysis and correlation statistics. The result of the study revealed that climate variability has a weak impact on food availability in the State. This implies that variation in food availability in Kwara State could be attributed to other non-climatic factors. The paper, therefore, suggests measures such as application of fertilizer to improve soil fertility and provision of credit facilities to farmers in order to encourage mechanized agriculture.

Keywords: Impact, Climate Variability, Food Availability, Kwara State

Introduction

Food is one of the essentials of life. Availability of food in adequate quality and quantity is significant to the survival of any nation. Food availability is one of the indicators of national development. Any nation that fails to provide enough food will be jeopardizing the life of her citizens. The importance of food availability in sustainable development cannot be overemphasized. The bedrock or foundation of food security in any nation is food availability. However, many nations, especially the developing countries, in the world today find it difficult to provide adequate food for their citizens. Despite considerable increase in technology, many countries are still facing the problems of food shortage. Presently, many people in developing world live their lives in severe hunger.

The problem of providing adequate food has been plagued by many factors. Amongst such factors is climate especially in an environment where food production depends solely on rain-fed agriculture. Climate is one of the fundamental factors that determine the agricultural productivity of an area. It is so fundamental that it affects virtually all aspects of crop production. The type of crop grown, time of planting and harvesting are climate determined (Adeniyi, 2013). Climate affects all aspects of agricultural productivity. According to Ayoade (2005), all stages of agricultural production from land clearing and preparation through crop growth and management to harvesting, storage, transportation and marketing of agricultural products are subject to the influence of climate. Variation in temperature affects plant growth. Every crop has minimum and maximum temperature threshold for effective growth. Low temperature damages crops while high temperature causes increase in transpiration, especially in the tropics. Solar radiation determines the amount of food that can be manufactured by plant through the process of photosynthesis. Rainfall influences the amount of water in the soil especially in rain-fed agriculture.

Rainfall variability influences when and what to plant. Extreme weather events such as flood and drought also affect agricultural productivity. Climate has the potential to transform food production especially the pattern and productivity of crop, livestock and fishery system and to reconfigure food distribution market and access (Nelson, et al. 2009). Yusuf, (2011) reported that despite technological advances such as improved crop varieties and irrigation system, weather and climate are still key factors in determining agricultural productivity. Climatic variability influences crop production and availability through its effects on the agricultural productivity.

Climate has direct and indirect impacts on food availability through its effects on agricultural productivity. The ability of any nation to provide enough food for the people is determined to a large extent by climate. According to FAO (2012), climate affects food availability directly through its effects on agro-ecological conditions and indirectly by affecting growth and distribution of income and thus demand for agricultural produce. Seasonal variations of climatic variables influence growing seasons.

According to Oyiga et al. (2011), food availability in Sub-Saharan Africa is directly affected by several aspects of climate change such as temperature increase, change in rainfall amount and patterns and change in climatic variability. Increase in temperature affects crop yield while variations in rainfall affect the quality and quantity of crop produced. Moderate increase in temperature (1°C-3°C mean temperature) is expected to benefit crop yields in temperate regions but have a negative impact in tropical and seasonally dry regions particularly for cereal crops. However, warming of the climate more than 3°C is expected to have a negative effect in all regions (Badolo, and KindaSomlanare, 2012). According to Liliana, (2005) the impacts of climate change on food production is common in tropical regions between 30° North and 60° South of the equator due to less water availability and increased temperature and in temperate regions between 30^0 North and 60^0 South due to changes in precipitation. Therefore, in order to improve food availability through crop production, the issue of the relationship between climate variability and crop production must be taken into consideration. It is against this background that this paper is being put forward to examine the impact of climate variability on food availability in Kwara State.

Study Area

The study area is Kwara State. It is located on longitude 2^0 6^1E and $5^0 2^1$E and latitude $7^0 30^1$N and $9^0 40^1$N. Kwara State shares boundary with Republic of Benin on the western side. It also shares boundary with five states in Nigeria. In the North it is bounded by Niger State, in the South by Oyo, Osun and Ekiti States, and in the East by Kogi State. It is therefore, referred to as the "gateway" between the Northern and the Southern part of Nigeria. Politically, Kwara State is located in North Central Zone of Nigeria. There are sixteen Local Government Areas in the State. The major ethnic groups in the State are the Yoruba, Fulani, Bariba and Nupe. According to Nigeria Galleria (2015), Kwara State occupies 36,825 square kilometers. According to 2006 population census the population of Kwara State was 2.37 million (NPC, 2006). Figure 1 shows the map of Kwara State.

The climate of Kwara State is characterized by both wet and dry seasons. The rainy season begins towards the end of April and lasts till October while the dry season begins in November and ends in April. The temperature of the state ranges from 33^0C to 35^0C from November to January while from February to April it ranges from 34^0C to 37^0C. The total annual rainfall ranges from 990.3mm to 1318mm. the rainfall exhibits double maximal pattern. Relative humidity ranges from 75% to 88% from May to October and 35% to 80% during the dry season.

The geology of the area consists of pre-Cambrian Basement Complex rock. The soil in the area especially in Ilorin the State headquarters supports the growth of cereal crops (Adeniyi, 2013) and vegetables. Derived savanna dominates the vegetation of the State. Grasses in the State include spear grass, elephant grass and goat weeds while the trees include acacia, shear butter and locust beans trees.

Majority of the people in the State are farmers. The common food crops grown in the State mainly for domestic consumption includes maize, rice, sorghum, millet, beans, yam, cassava, guinea-corn and vegetables.

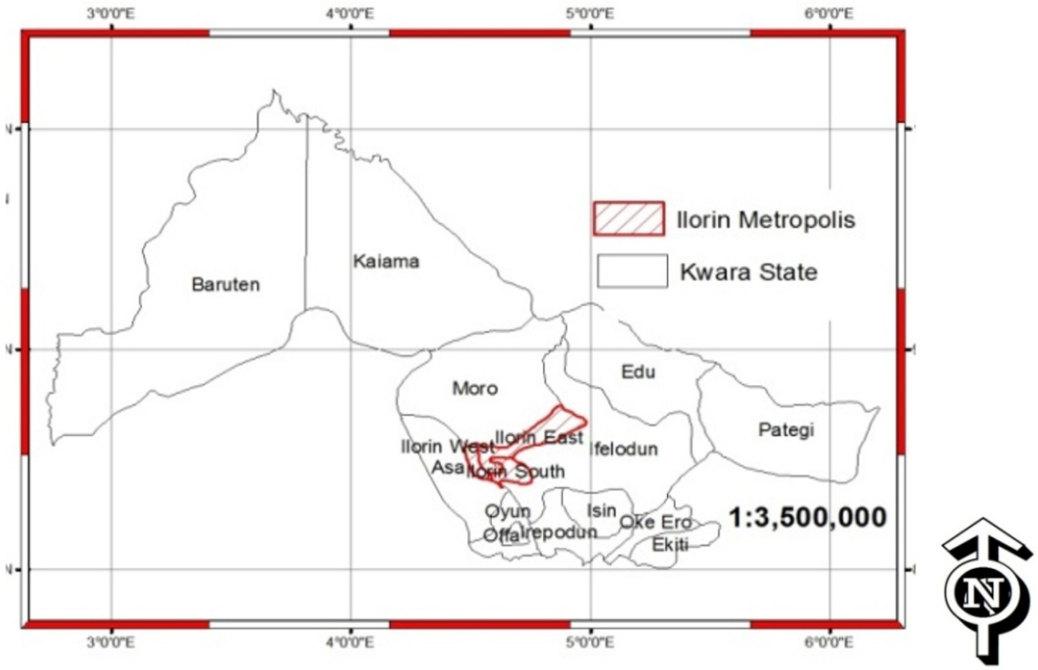

Figure 1: Map of Kwara State showing the LGAs and the State Capital

Material and Methods

Food availability is the physical presence of food through domestic production, commercial importation or food aids. It also includes the production of adequate crops, livestock and fisheries as well as the collection of world food and resources for migratory and indigenous communities (Gina and Bruce, 2011). Therefore, the three main components of food availability are the domestic production, importation and food aids. However, for the purpose of this study, the emphasis is on domestic production of food crops. In other words, the study examines the impact of climate variability on crop productivity as an index of food availability. The choice of domestic production is based on the fact that most of the foods consumed in the State are produced locally.

Two main data were used for the study. Climatic data of rainfall, temperature, relative humidity, evaporation and sunshine hour were collected from Ilorin International Airport, Ilorin. These climatic variables play a vital role in determining crop productivity (Adeniyi, 2013). Agricultural data on maize, cassava, rice, millet and sorghum were collected from Kwara State Agricultural Development Project Office, Ilorin. The choice of these crops is based on the fact that they are the major food crops in the State.

Descriptive and inferential statistics were employed in data analysis. Simple correlation and multiple regression analysis were used in showing the relationship between climatic parameters and crop productivity.

Results and Discussion

Characteristics of Agricultural Productivity in Kwara State (2001-2013)

Table 1 shows the descriptive characteristics of agricultural data in Kwara State (2001-2013). From the table, cassava has the highest mean value, (1011.63) followed by yam (828.41). Millet has the lowest mean value (19.95). This implies that cassava has the highest productivity. Therefore, within the years under review, cassava will be more available in the state than other food crops. In terms of the dispersion characteristic, the highest deviation (436.13) was also obtained in cassava production. This was followed by yam. However, the dispersion characteristics of millet and sorghum were low. In terms of relative deviation, co-efficient of variation, all the crops were heterogeneous with values greater than 33%. This therefore, suggests that crop productivity in Kwara State from 2001-2013 differ significantly. The differences in crop productivity could be as a result of the impact of climate on crop productivity or other non- climatic factors like soil fertility.

Figure 2 shows the temporal pattern of crop productivity. The figure also shows that crop productivity in Kwara State varies from year to year.

From Table 2 temperature and sunshine hour have their highest mean in 2001. Rainfall has its highest mean in 2008. This reveals that 2008 is the wettest year. Evaporation and relative humidity have their highest mean in 2002 and 2009 respectively. Rainfall and temperature have their highest standard deviation in 2008 and 2005. This suggests that the values of rainfall and temperature vary significantly in 2008 and 2005 respectively. The lowest deviation of relative humidity and evaporation was obtained in 2009. The coefficient of variation shows that temperature, relative humidity and sunshine hours were homogeneous with values less than 33% while rainfall and evaporation were heterogeneous with values greater than 33%. In general, the selected climatic variables vary from one year to another. These therefore, suggest that there were variations in crop productivity in Kwara State from 2001 to 2013.

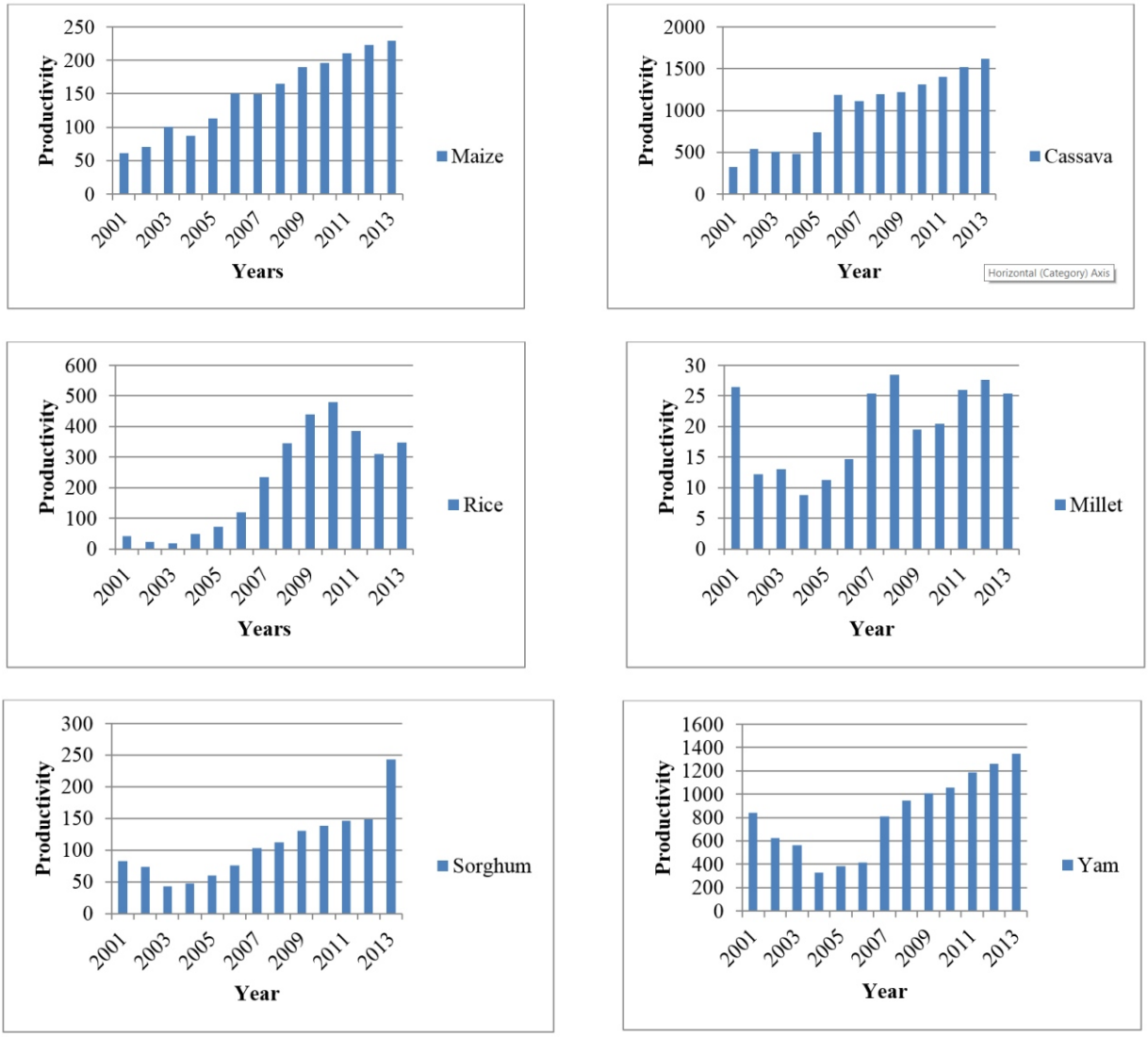

Figure 2: Temporal Pattern of Crops Productivity in Kwara State

Table 1: Descriptive Characteristics of Agricultural Data (2001-2013)

Crop	Mean	Standard Deviation	Co-efficient of Variation
Maize	149.72	58.43	39.03
Rice	220.46	172.56	78.27
Sorghum	108.02	54.72	50.66
Yam	828.41	343.39	41.45
Cassava	1011.63	436.13	43.11
Millet	19.95	7.12	35.69

Source: Author's Computation, 2017

Table 2: Descriptive Characteristics of Climatological Data (2001-2013)

	Rainfall (mm)			Temperature (°C)			Relative Humidity (%)			Evaporation (mm)			Sunshine Hours (hr)		
Year	X	SD	CV	X	SD	CV	X	SD	CV	X	SD	CV	X	SD	CV
2001	58.1	60.6	104.3	33.2	2.9	8.7	73.3	12.5	17.1	5.7	2.7	47.4	7.6	1.3	17.1
2002	79.8	77.6	97.2	32.6	2.6	8.0	71.9	14.8	20.6	7.9	6.8	86.1	6.6	1.4	21.2
2003	107.9	131.1	121.5	32.8	2.8	8.5	74.8	9.9	13.2	5.5	2.6	47.3	7.0	1,7	24.3
2004	129.4	101.9	78.7	32.4	2.5	7.7	79.2	10.8	13.6	5.4	3.0	55.6	6.2	1.7	27.4
2005	129.8	100.8	77.7	32.4	3.0	9.3	79.2	13.2	16.7	5.3	2.9	54.7	6.7	1.2	17.9
2006	132.2	99.1	75.0	32.2	2.7	8.4	76.7	11.1	14.5	4.9	3.1	63.3	6.8	1.9	27.9
2007	130.9	101.8	78.3	32.7	2.5	7.6	77.9	12.6	16.2	5.7	3.4	59.6	6.5	1.2	18.5
2008	146.9	123.7	84.2	32.9	2.5	7.6	79.6	14.8	18.6	6.0	3.5	58.3	6.5	1.2	18.5
2009	133.0	108.3	81.4	32.8	2.8	8.5	80.3	8.3	10.3	4.9	2.4	49.0	6.4	1.4	21.9
2010	95.3	80.0	83.9	33.2	2.9	8.7	78	8.7	11.2	5.6	2.9	51.8	6.2	1.6	25.8
2011	112.6	99.1	88.0	32.6	2.7	8.3	76.1	13.6	17.9	6.1	3.0	49.2	6.4	1.8	28.1
2012	109.5	76.9	70.2	32.2	2.8	8.7	76	11.0	14.5	4.8	2.6	54.2	5.9	1.5	25.4
2013	127.6	109.4	85.7	32.4	2.6	8.0	75.1	10.6	14.1	4.9	2.6	53.1	6.6	1.6	24.2

Source: Author's Computation, 2017

Crop –Climate correlation

The result of the simple correlation coefficient (r) between the climatic variables and the crop productivity in Table 3 shows that the correlation of values of rainfall, temperature, relative humidity and evaporation with all the selected food crops were less than 0.5. Similarly, sunshine hour have a weak correlation with millet, rice and sorghum. However, correlation values of sunshine hour and cassava, maize and yam were greater than 0.5. This implies that sunshine hour has strong correlation with cassava, maize and yam. Evaporation has a negative correlation with all the selected food crops except millet while temperature has negative correlation with all the crops except rice.

The implication is that as evaporation and temperature increases the productivity of the crops reduces except millet and rice respectively.

Relationship between Climate Variability and Crop Productivity (2001-2013)

The result of the regression analysis in Table 4 shows that 41.7%, 30.2%, 31.3%, 41.0, 41.0% and 18.5% of the variance in maize, rice, sorghum, yam, and cassava and millet productivity can be respectively explained by the identified climatic variability. This therefore, implies that the impact of climate variability on the production of food crops in Kwara State is low. This suggests that variation in food availability could be attributed to variation in soil nutrient or varieties of crop. This is because soil fertility affects crop productivity.

Table 3: Crop –Climate Correlation

	Rainfall	Temperature	Sunshine hour	Relative Humidity	Evaporation
Cassava	0.294	-0.160	0.537	0.347	-0.439
Maize	0.272	-0.134	0.525	0.426	-0.407
Millet	-0.151	-0.125	-0.083	-0.243	0.214
Rice	0.146	0.107	0.436	0.396	-0.083
Sorghum	-0.016	-0.068	0.278	0.169	-0.273
Yam	0.294	-0.160	0.537	0.346	-0.439

Source: Author's Computation, 2017

Table 4: Statistical Relationship between climate Variability and crop productivity

Crops	R	R^2	Regression Coefficient	Standard Error	F	Sig.
Maize	0.645	0.417	562.588	58.4325	1.00	0.481
Rice	0.550	0.302	-2241.526	188.73	0.606	0.699
Sorghum	0.559	0.313	1302.074	59.40139	0.636	0.680
Yam	0.640	0.410	4662.639	438.71	0.972	0.494
Cassava	0.640	0.410	4662.639	438.71	0.972	0.494
Millet	0.430	0.185	220.378	8.40992	0.318	0.887

Source: Author's Computation, 2017

Conclusion and Recommendation

The study examines the impact of climate variability on food availability in Kwara State. The result of the temporal pattern of the crop productivity shows that food availability varies within the years under review while the result of regression analysis shows that climate variability has little impact on food availability. In other words, the variation in food availability could be as a result of non-climatic factors like crop management techniques or edaphic factor.

Therefore, the study recommends the following measures towards improving food availability in the State:

i provision of agricultural extension services to educate farmers on new technological innovations.

ii the use of appropriate fertilizer to improve the fertility of the soil.

iii provision of credit facilities to farmers in other to encourage mechanized agriculture.

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