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RESEARCH PAPER

Assessment of Strength of Association Between Climatic Parameters and Some Selected Crops in Funtua, Katsina State, Nigeria

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ABSTRACT

Agricultural production in Nigeria and particularly Funtua Local Government Area of Katsina State is rain-fed hence it is dependent on weather. This situation threatens food security and leads to poverty, among the farmers in the study area. This eventually leads to shortage of food, increasing importation of "common" foodstuffs especially sorghum, millet and maize, hike in the prices of foodstuffs and mal nutrition in the study area. The aim of this paper is to assess the strength of association between climatic parameters and some selected food crops in Funtua, Katsina State, Nigeria. The methods adopted in this study were descriptive statistics and Spearman's rank correlation. The study revealed that there is correlation coefficient of 1.00 which indicates a sharp increase in the degree of association between sorghum yield, maize yield and annual rainfall and this shows that, the higher the annual rainfall, the higher the crop yields. Correlation coefficient of 0.65 for sorghum and 0.97 for maize indicates an increase in the degree of association between maximum temperature and annual food crop precisely maize and sorghum. The study also revealed that the ratio between the variance estimates (F) was 1.75 and since the calculated F of 1.75 was lower than 3.24, so the predictors (relative humidity, maximum temperature and annual rainfall) does not significantly differ as an independent variables, and any of them can be chosen as the independent variable for the crop yields in the study area. Its therefore recommended that with the increasing rate of erratic rainfall patterns, drought and desertification, drought resistant and short duration high yielding crops should be developed through research efforts and made available to farmers in the study area and the State in general.

Keywords: Climatic Parameters, Food Security, Food crops, Climatic variability,

INTRODUCTION

Climate variability is the biggest environmental problem of our time that is threatening the existence of man and the environment. It is a major threat to agricultural system and food security in many countries in sub-Saharan Africa (Nigeria inclusive). Climate variability refers to all variability in climate as a result of natural variations and human activities. Natural variation is due to increase in the concentration of carbon dioxide and other heat trapping gases (such as methane, ozone, nitrous oxide, carbon monoxide and water vapour) in the atmosphere (Eboh, 2009).

Jones and Thornton (2003) estimate that, due to increased temperatures and erratic rainfall, crop yields in Africa may fall by 10 to 20% by 2050. However, this figure masks variation. In some areas crop reductions will be greater (northern Uganda, southern Sudan, and the semi-arid areas of Kenya and Tanzania) while in other areas crops yields may increase (southern Ethiopia highlands, central and western highlands of Kenya and the Great Lakes Region) Thornton and Smith, (2009). Analysis of climate risk identified maize in southern Africa as one of the most important crops in need of adaptation investments (Lobell *et al.,* 2008). Climate change projections suggest that by 2030 maize yields in southern Africa will be 50% of the average yields achieved at the beginning of this century.

Agricultural production in Nigeria and particularly Funtua Local Government Area of Katsina State is rain-fed hence it is dependent on weather. Climate variation refers to a change in climatic conditions that is attributable directly or

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indirectly to natural or human causes. IPCC (2007) assessment reports predicted increased evapotranspiration and lower soil moisture levels in drier areas as a result, some cultivated areas may become increasingly arid. Several factors that directly connect climate variability and agricultural productivity include; average temperature increase, change in rainfall amount and patterns, rising atmospheric concentrations of CO_2 pollution levels and climatic variability with associated extreme events such as drought, flood and storms. All these impact negatively on crop production in the study area.

The location of the study area, in the arid zone makes it vulnerable to the gradual deforestation of the environment due to the persistent deforestation, overgrazing, desertification and over irrigation practices. this have greatly affected the socio-economic life of the inhabitants, population pressure and human activities which coupled with non-adherence to existing legislation against land degradation problem posing serious threat to human and livestock in the entire Local Government. Every year, farmers in Funtua Area are usually in high spirit to plant their crops in anticipation that yields would be favourable. Though as it may, this is not usually the case as crop failure is witnessed annually. The situation threatens food security and leads to not only poverty, but hunger among some farmers of Northern Nigeria eventually leads to shortage of food, increasing importation of "common" foodstuffs especially rice, millet and maize, hike in the prices of foodstuffs, mal nutrition and so on in the study area. Against this background, the present study is designed to assess the strength of association between climatic parameters and some selected crops in funtua.

METHODOLOGY

Study Area

Funtua is a Local Government Area in Katsina State of Nigeria and its located within latitude $11^0$32'N and $11^0$53N of the equator and longitude 7°19′E and 7°31E and it has an area of 448 km² and a population of 225,571 at the 2006 Census (National Population Census, 2006) 420,110 in 2012 estimate. Funtua became a Local Government in 1967 and the inhabitants of the Local Government are predominantly Hausa and Fulani by tribe. Their main occupations are Trading, farming and animal rearing. The geological formation of the area is of the basement complex origin in the south and sedimentary formation in the north giving rise to the clay, loamy and sandy soil in the south and north respectively. Weather varies according to the season of the year. Maximum temperature ranges from 29^0 – 38^0C. Harmattan season (November – February). Lower temperature from 18^0 - 27^0C. The wind is dry from January to April, signaling the arrival of the rainy season, which last from April to September. The mean average rainfall ranges from 400-1300mm. Funtua consists largely of shrubs vegetation with some wooded savanna in the south. Due to the vast arable land which nature has bestowed on the state, it is currently playing a leading role in commodity/food production namely: cotton, groundnut, millet, guinea corn, maize, wheat and vegetables.

Source of Data

Data used in this research work were generated from both primary and secondary sources. The primary data are those that were collected directly from the field survey. Secondary data are those data that were obtained from Katsina State Agricultural and Rural Development Authority (KTARDA) for a period of twenty years (1993 to 2013), Nigerian Meteorological Agency (NIMET), previous researches, journals, textbooks, newspapers, magazines and encyclopedia. The data collected from KTARDA and NIMET includes crop yield data and climatic parameters data respectively. The crop yields include (maize and sorghum) and climatic parameters include (rainfall, relative humidity and temperature). The data on crop yields were obtained from the official records of the Katsina State Agricultural and Rural Development Authority (KTARDA) for a period of twenty years (1993 to 2013). The crops selected for the study were mainly food crops whose yields were documented by KTARDA. Rainfall, Temperature and relative humidity data were obtained from the Nigerian Meteorological Agency (NIMET) of Katsina State, the choice of the climatic parameters were based on their importance in determining the time of farm preparations and planting, growth, development and yield of crops in the study area.

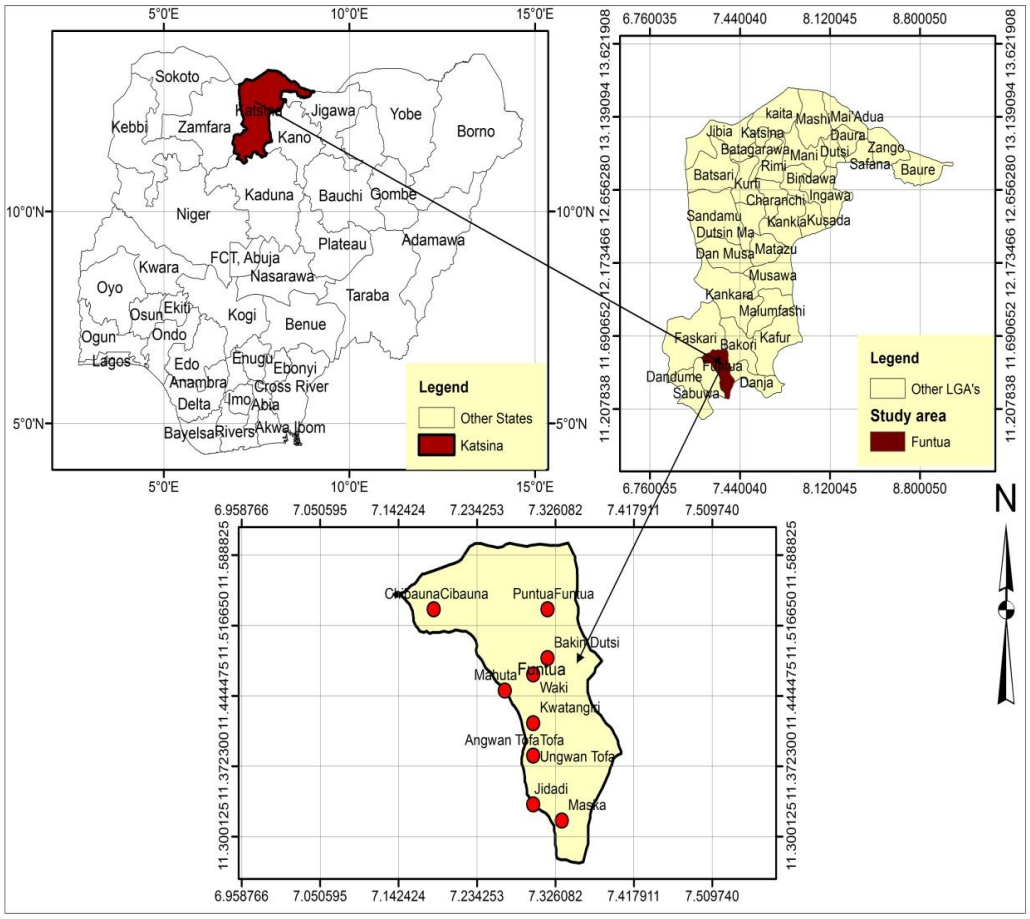

Figure 1: Location of the Study Area
Source: Katsina State Ministry of Work (2015)

Method of Data Analysis

The methods of data analysis were descriptive statistics and Spearman's rank Correlation. used to test the strength of associations between climatic variables and crop yields. This analysis was performed using Statistical Package for Social Science version 20.0. Climatic variables (independent variable y) and crop yields (dependent variable x).

$$r = \frac{\sum d_x d_y}{\sqrt{\left(\sum d_x^2 \sum d_y^2\right)}}$$

Where, $\sum d_x^2 = \sum x^2 - \frac{(\sum x)^2}{n}$

$$\sum d_y^2 = \sum y^2 - \frac{(\sum y)^2}{n}$$

and $$\sum d_x d_y = \sum xy - \frac{\sum x \sum y}{n}$$

RESULT AND DISCUSSIONS

Figure 2 shows the strength of association between food crop precisely maize and sorghum in the study area and climatic parameters such as annual rainfall, maximum temperature and relative humidity. It shows that, the years 1994 to 1999 have the highest yields of maize and sorghum with a corresponding high annual rainfall of more than 900mm, annual maximum temperature of more than 20^0C and annual relative humidity of 40%. This implies that, the higher the annual rainfall, the higher the crops yield in the study area.

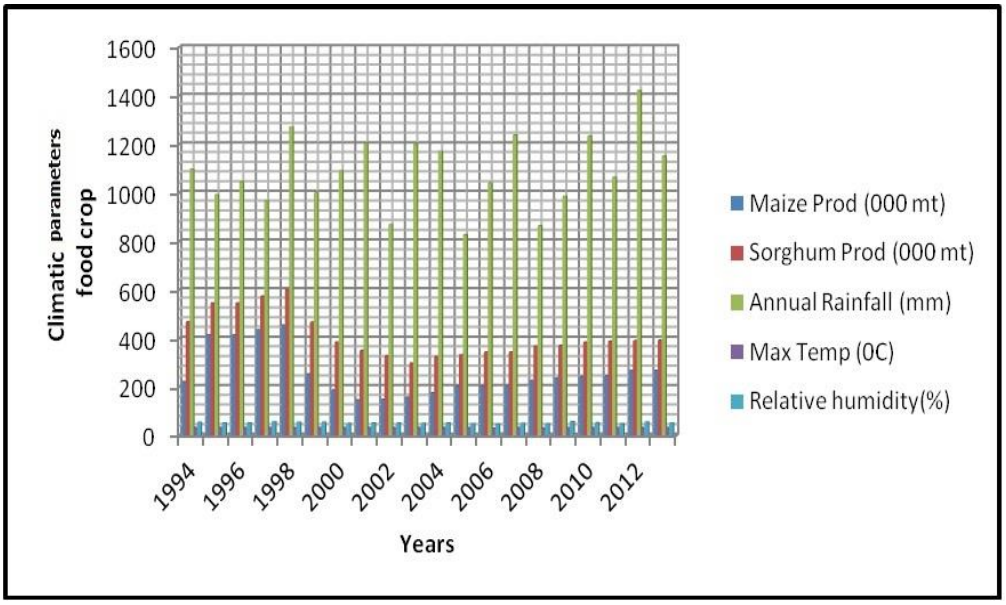

Figure 2: Strength of association between climatic parameters and food crops

Table 1: Descriptive Statistics of variables under study

	Mean	Std. Dev	N
Sorghum Prod (000 mt)	409.80	91.004	20
Maize Pro (000 mt)	255.20	96.591	20
Annual Rainfall (mm)	1085.35	151.646	20
Max Temp (0C)	31.85	.745	20
Relative humidity (%)	51.50	2.646	20

Source: Author's Data Analysis, 2015

As in Table 1, mean annual rainfall was 1085.35mm and the standard deviation was 151.646mm; mean of annual maximum temperature was 31.8^0C and the standard deviation was 0.7^0C and mean of annual relative humidity was 51.50% and the standard deviation was 2.6%. Mean of maize yield was 255.20 metric tons and standard deviation was 96.591metric tonnes and means of sorghum yield 409.80 metric tons and standard deviation was 91.004 metric tonnes. Inspection of the dependent (maize and sorghum productions) and independent variables (annual rainfall, maximum temperature and relative humidity) reveals that all the variables fall within the range of 100%.

Table 2: Correlation between maximum temperature, annual rainfall, relative humidity, maize yield and sorghum yield

		Sorghum Prod (000 mt)	Annual Rainfall (mm)	Max Temp (^{0}C)	Relative humidity (%)	Maize Prod (000 mt)
Spearman's Correlation	Sorghum Prod (000 mt)	1.000	.095	.065	.476	1.000
	Annual Rainfall (mm)	.095	1.000	.047	.247	.020
	Max Temp (^{0}C)	.065	.047	1.000	.387	.097
	Relative humidity (%)	.476	.247	.387	1.000	.405
Sig. (1-tailed)	Sorghum Prod (000 mt)	.	.491	.299	.017	.
	Annual Rainfall (mm)	.491	.	.423	.147	.466
	Max Temp (^{0}C)	.299	.423	.	.046	.342
	Relative humidity (%)	.017	.147	.046	.	.038
N	Sorghum Prod (000 mt)	20	20	20	20	20
	Annual Rainfall (mm)	20	20	20	20	20
	Max Temp (^{0}C)	20	20	20	20	20
	Relative humidity (%)	20	20	20	20	20

This correlation analysis was done based on climatic parameters such as annual rainfall, maximum temperature and relative humidity and these were the independent variables, while crop yields such as sorghum and maize are the dependent variables.

As in Table 2, Correlation coefficient of 1.00 indicates a high degree of association between sorghum yield, maize yield and annual rainfall and this shows that, the higher the annual rainfall, the higher the crop yields. Correlation coefficient of 0.65 for sorghum and 0.97 for maize indicates moderate degree of association between maximum temperature and annual food crop precisely maize and sorghum. This shows that, the higher maximum temperature, the higher the crop yields. The study revealed that there is high strength of association between crops examined as indicators for food security with climatic parameters.

Table 3: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	39028.248	3	13009.416	1.759	.195[b]
1	Residual	118322.952	16	7395.184		
	Total	157351.200	19			

a. Dependent Variable: Sorghum yield (000 mt) and Maize yield
b. Predictors: (Constant), Relative humidity (%), Annual Rainfall (mm), Max Temp (^{0}C)

As indicated in Table 3, the ratio between the variance estimates (F) was 1.75. Since the calculated F of 1.75 was lower than 3.24, so the predictors (relative humidity, maximum temperature and annual rainfall) do not significantly differ as independent variables, and any of them can be chosen as the independent variable for the crop yields in the study area.

Conclusion

The study revealed the major climatic problems encountered by the farmers in Funtua Local Government Area which are water related-drought of farmlands, inadequate adaptation strategies, and socio-economic challenges. Also a reasonable relationship between crop yields and climatic variability, particularly the temporal change in annual rainfall, maximum temperature and relative humidity has been established. The year preceded by a very wet season, high relative humidity had very high yield for maize and sorghum under this study. Food crops such as maize and sorghum are highly sensitive to climate variability such as drought.

Therefore, it can be concluded that impact of climate variability on food crops is real and its manifestations are felt across the study area. The negative consequences of the impact of climate variability on food crops are severe among poor and vulnerable communities in Katsina State, especially Funtua Local Government which is the study area.

Recommendations

Based on the findings and conclusion of this study, the following are recommended: -

1) There is a need to radically depart from reliance on rain-fed food production through heavy utilization of irrigation. There is therefore the need for adequate provision of irrigation and drainage infrastructure which could be regarded as crucial for food security adaptation.

2) The Katsina State Government should take a bold step to establish better-equipped weather stations as against the scanty and ill-equipped ones. This will assist in accurate and proper availability of these data (climatic and crop yield) for use.

3) With the increasing rate of erratic rainfall patterns, drought and desertification, drought resistant and short duration high yielding crops should be developed through research efforts and made available to farmers in the study area and the State in general.

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