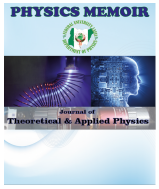

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Original Research

Impact of Rainfall Variability on Yam (Dioscorea Spp) Yield in Lafia Local Government Area of Nasarawa State, Nigeria

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Abstract

Rainfall variability influences almost all human endeavours, most especially in the field of business, health, transportation and tourism, and most importantly in the aspect of agriculture. Agriculture is the main activity engage by most developing countries even with the general threat to food security globally. This study centered on examining the impacts between rainfall variability and yam yield for the period of eleven years covering from 2006- 2016 in Lafia Local Government area. Eleven years (monthly/annual) rainfall data with annual yam yield data of Lafia Local Government were collected for the study. The analysis was carried out using EViews 9 statistic for the trends and impacts analysis while Mann Kendall analytical approach was also used with the aid of Xl statistical software/tool for an in-depth regressing/coefficient of determinants analysis and variance of regression models analysis in the study. The result shows that rainfall variability has a significant impact of about 79% over yam production output (yield) and the remaining 21% is contributed by other factors than rainfall. The study also reveals a variability level of rainfall and yam output of Lafia at 10% and 37% coefficient of variance for a low and moderate extent of variability respectively. It was also concluded that there exists a strong positive impactof rainfall variability over yam-tuber output for the period under study. It is therefore recommended that other researchers and relevant bodies should carry an empirical study on the impacts of total land area for yam cultivation, soil fertility and socio-political factors to yam tuber production output (yield) in the study area.

Keywords: Rainfall variability, Yam production output, EViews Statistical Analysis

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1. Introduction

Climate and weather have influence on almost all human endeavors [1-14]. Since the beginning of time, climate dictates mans activities like in the aspect of businesses [10], health [13], transportation and tourism [4], and most importantly, agriculture [14]. That is why any shift, variability or change in climates affects man.

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The most noticeable weather element that has much impact on man's activity in the tropical region, is rainfall. Rainfall is considered as the most weather-dependent of all human activities [8], with impacts on food security [15]. Their impacts are significant on rain fed agriculture [16] on which the economies of most developing countries depend [12] with less adaptive capacity [17]. Particularly, many low income countries, located in the tropical and sub-tropical region of Africa are susceptible to shifting and variable climate [11] and this can also be seen posing some threat to crop production and food security on a general note.

Agriculture on the other hand is basically depending on rainfall for food production in most parts of the globe; the main socio-economic activity engaged by larger percentage of the population in West Africa is agriculture, in spite of how variability in rainfall affects the whole world [9]. The issue of food security globally and in Nigeria particularly is newsworthy. Rainfall variability is playing a vital role in determining crop production in the tropical region, for instance, in the last decade, the tropical Africa has been experiencing longer periods of dryness along the Northern coast of the West African region which seems leading to severe fall in crop and stock production in many parts of the West African region [8].

The impacts of climate variability to many sectors like agriculture, water availability and health, is depending on the adaptive capacity of the flora and fauna in the community, and the impacts might result in strong inclination to the output of crops. The Sub-Saharan Africa is already facing recurrent food crises and water scarcity triggered by climate variability and extreme events such as droughts, excessive rains and floods which affects agricultural productivity and hence rural household food security [7]. This chronic food insecurity may even increase in the future since the food demand is expected to be multiplied by more than five in Africa by 2050, due to the increasing population rate [18].

More so, since yam has now become a crop that the Federal Government of Nigeria wants to start exporting [3], even though the yam consignment was faced with rejection by United State and the international market due to claims that Nigerian yams are of low quality [3]. The quantity and quality of yam yield needed in the international market and for local consumption seems not been met to the end users. The national assembly have called on the executive arm of government to design a better policy that will boost yam (yield) production output and also stop exportation of Nigerian yam till when the yam produced in the country is sufficient for local consumption before the country can start exportation; this simply means that there is the need for yam production in Nigeria to be boosted through a forensic assessment of the impacts of rainfall variability to yam yield in Nigeria.

Furthermore, [18] have worked on the relationship between rainfall variability and yam tuber production output in Lafia Local Government. In their work, they were able to establish the association that exist between rainfall and yam production output but they were unable to assess or examine the impacts of the independent variable (Rainfall variability) over the dependent variable (Yam production output "yield"), and this bring up to date my study.

More so, similar study was conducted but in a different location with different approach, like in the works of [2] where they worked on "temporal variation of rainfall occurrence: the effect on tuber crop production in Niger Delta, South-South, Nigeria". They had their findings and assert that any increase in temperature and a decrease in amount of rainfall in the Niger Delta region will lead to an increase in tuber production because the rate of leaching reduces whenever there is decrease in rainfall amount, but in the case of Lafia Local Government of Nasarawa state, central Nigeria, there has not been any reported work on the impact of rainfall to yam yield. Probably after this research, a different result from that of [2], is likely to be gotten since the study area is experiencing single rainy season per year compared to the Niger Delta region that is experiencing rainfall all through the year.

However, understanding how climate variability influences crop production and yield can be helpful in designing policies that aim at reducing climate vulnerability and improving food security; this means that having knowledge on sequences of rainfall variability and events can assist acquiring specific information for agricultural planning, which this work set out to provide. The study aimed at examining the impacts of rainfall variability over yam production output (yield) in Lafia Local Government area of Nasarawa State, Nigeria.

The aim was achieved through the following specific objectives;

- assessment of trends of annual rainfall total and yam production output (yield) of Lafia Local Government area between 2006-2016.
- assessment of the extent of annual rainfall variability and yam output variability in the study area between 2006-2016.

- examination of the impacts of rainfall variability on yam output in Lafia Local Government area of Nasarawa state between 2006-2016.

2. Study Area and Research Methodology

2.1. The Study Area

The geography of the study area (Lafia Local Government) deals with physical setting and the socio economic activities involve in the area. Lafia Local Government area is situated in Nasarawa State and it is the headquarters of the state. Nasarawa State lies between latitude 7°45' & 9°25' N of the Equator and between longitude 7° & 9°37' E of the Greenwich Meridian [5]. Lafia is one of the largest towns in Nasarawa state with an area coverage of about 2,756 km^2 and has a population of about 330, 712. Lafia is bounded to the North by Nasarawa Eggon and Wamba Local Government Areas and to the East, are Plateau State and Awe Local Government Area. Lafia is bounded to the South by Obi and Doma Local Government Areas, and Kokona Local Government Area lies to the West.

The temperature of Lafia is generally high during the day; particularly between the months of March and April and begins to decrease in the month of May and all through to the months of December, January and February when the temperature is relatively cold due to the harmattan wind blowing across the State from North-East. The mean monthly temperatures in the area range between 20°C and 36°C, with the hottest months being March/April and the coldest months being December/January.

The rainfall period of Lafia in Nasarawa State lasts for 5-6 months with an annual rainfall figures ranging from 1100mm to about 2000mm and it has a varied diurnal rainfall from 131.7 millimetres in some places to 145 millimetres or more in others [20].

Furthermore, about ninety per cent of the rainfall is between May and September, the wettest months being July and August. Lafia Local Government rainfall comes in thunder storms of high intensity, particularly at the beginning and towards the end of the rainy season with high variability in its characteristics [20]. The foremost socio-economic activity of the people of Lafia Local Government area is agriculture.

2.2. Research Methodology

Data for this research work was a long-term observed daily rainfall data sourced from Nigerian Meteorological Agency (NiMet) Abuja, covering 11 years (2006-2016). The second data used in this study was the annual yam data which was drawn from Nasarawa Agriculture Development Programme (NADP), State Ministry of Agriculture, Lafia, Nasarawa state. The data covers a period of eleven years.

The methods used in this research work were non-parametric statistical approaches with the aid of some softwares like E-views 9 for trends, linear graphs and impact analysis while Mann Kendall analytical approach with the aid of Xl-Stat tool was also used in assessing trends and variability extent of the two variables under study with an in-depth analysis of regression for coefficient of determinant and variance of regression models.

3. Results and Discussion

3.1. Trends; Annual Rainfall Total and Yam Output in Lafia Local Government Area

The results were presented graphically in linear forms so that the trends in annual rainfall total and yam production output are clearly seen. This is to enable objective one of the study to be achieved. The trends in Figure 2 revealed that there are annual variations in rainfall total and the annual yam output produced. This means that, there is variability in each of the variable used in this study.

3.2. Examining the Extent of Rainfall and Yam output Variability in the Study Area

To determine the extent of variability of rainfall and that of yam output in the study area as in object two of the study, [6] model was used. [6] states that when (Coefficient of Variance CV <=0.1 or 10%) it indicates low variability, and for (CV <=0.4 or 40% and >10%) it is indicating moderate variability while when (CV >0.4 or 40%) it shows a high variability extent.

Table 1. Non-parametric Trend and Variability Analysis of Rainfall in Lafia LGA

Statistic	**Annual Rainfall Total**
Minimum	1123.8
Maximum	1595.7
Mean	1371.2
Standard deviation	138.3
Coefficient Variation	**0.10**
Z	0.16
S	9.0
p-value	0.542
Alpha	0.05

Table 2. Non-parametric Trend and Variability Analysis of Yam output in Lafia LGA

Statistic	**Yam Production (MT)**
Z	0.86
S	47
Coefficient Variation	**0.37 (37%)**
p-value	< 0.0001
Alpha	0.05

Table 3. The Inferential Statistics for Annual Rainfall and Annual Yam Output (Yield)

	$Y_P(MT)$	MR
Yam Production Output (MT)	1.000000	0.791465
Monthly Rainfall (ML)	0.791465	1.000000

Y_P = Yam production output in Metric Tonnes; while MR = Monthly Rainfall

3.3. The Extent of Rainfall Variability of Lafia

The extent of rainfall variability is examined using the monthly/annual rainfall data for the period of eleven years. Table 1 explains the mean, standard deviation with minimum annual rainfall and maximum annual rainfall of the study area during the period of the study. The coefficient of variations which measure the variability of the climatic elements under study, shows that Lafia had about 0.10 (10%) coefficient of variance (CV). Therefore, in considering the level of defining the Coefficient of Variance (CV) by [6] in table 1, it indicates that the annual rainfall had a low variability extent in the study area. This explains objective two of the study.

Table 4. Regression Analysis of Rainfall Coefficient of Determinant for Yam output Predictions in the Study Area

Statistic	**Value**
DF	8.000
R^2	0.992
Adjusted R^2	**0.990**
MSE	350798176.804
DW	1.676

Table 5. Analysis of Variance of Regression Model

Source	**DF**	**Sum of Squares**	**Mean Squares**	**F**	**Pr>F**
Model	2	363480509861.877	181740254930.939	518.076	<0.0001
Error	8	2806385414.432	350798176.804		
Corrected Total	10	366286895276.309			

Table 2 helps in answering the second objective of the study. The extent of variability in yam yield is moderate at 37% coefficient of variance according to the definition of [6] on variability extent determination. More so, table 2 shows that yam output in Lafia had a positive trend since the Z value is 0.86 with slope of 47. This indicates that Yam output had increased over the study period with the tendency of increasing in the near future. Although, yam output trend is significant at 0.05. Table 4 shows that coefficient of determinant was 0.99 with the mean standard error estimate of about 350798176.804. This implies that the annual rainfall contributes in predicting yam output by 99%. This means that in an assessment of factors for predicting yam output in the study area, only rainfall has 99% and other factors has the remaining 1%. Table 5 shows that the impact is significant since the p value is less than alpha value. This implies that the independent variable (annual rainfall) can be used in predicting the yam output in the study area with a mean square error of 350798176.804.

3.4. Impacts of Rainfall Variability over Yam Production output in Lafia Local Government

The impacts of rainfall variability to yam output of Lafia Local Government area of Nasarawa State, Nigeria is examined using annual rainfall and annual yam output for the period of eleven years under study. This was to enable the researcher achieve the third objective of the study.

3.5. Regression Analysis for Determination of Rainfall Impacts over Yam Output

The result in table 3 shows that 79% of the variability in the output of yam in Lafia Local Government Area of Nasarawa State is explained by rainfall variability in the study area. The remaining 21% is explained by other factors than rainfall.

4. Conclusion

The aim of this research was to assess the trends and impacts of rainfall variability on yam production output (yield) in Lafia Local Government of Nasarawa State over a period of 11 years between 2006 to 2016. In an attempt to achieve the aim, the following objectives were used in carrying out the research, thus:-

- an assessment of trends in Annual Rainfall totals and Yam Yield of Lafia Local Government area between 2006-2016.
- an assessment of Rainfall variability extent of Yam output (yield) variability extent in the study area between 2006-2016.

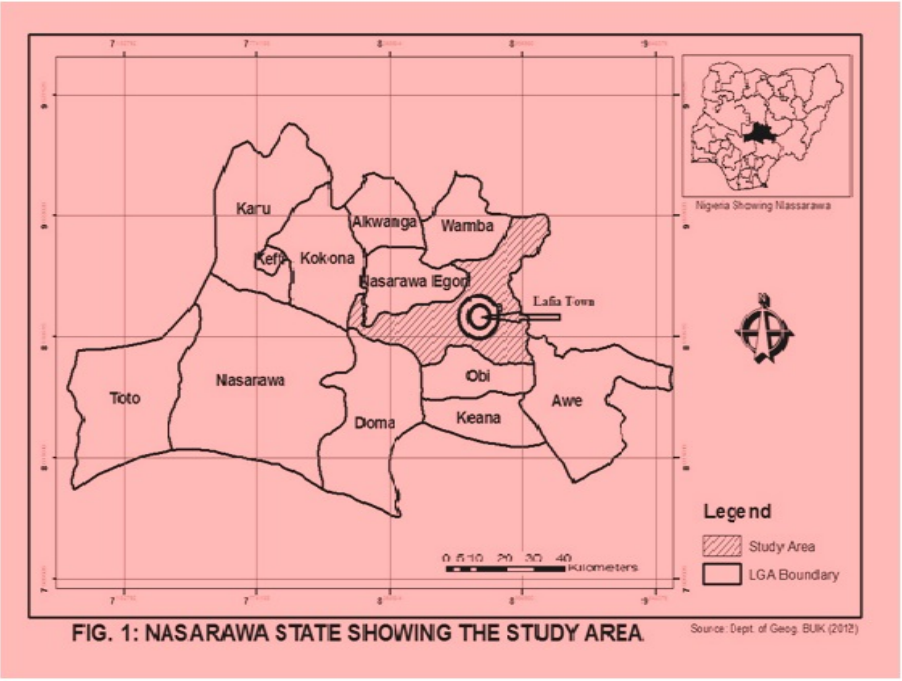

Figure 1. Nasarawa State Showing the Study Area

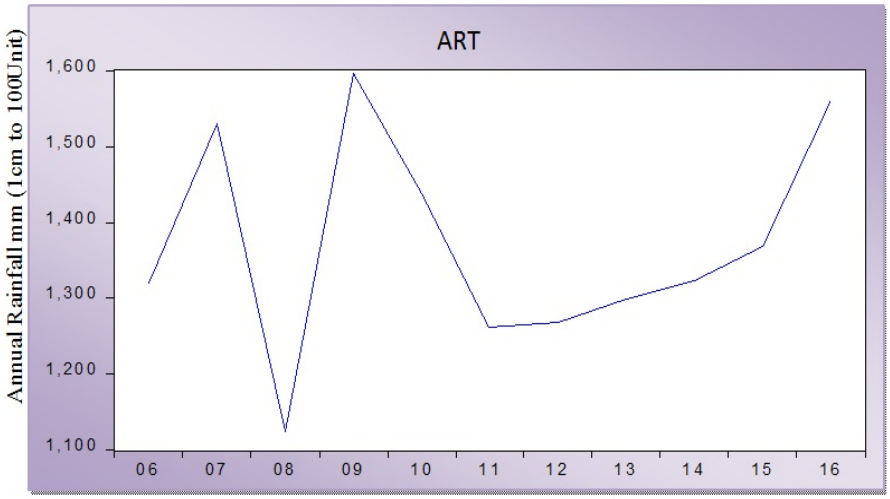

Figure 2. Annual Rainfall Totals (ART) trend

- examining the impacts of rainfall variability on yam production output (yield) in Lafia Local Government area of Nasarawa state between 2006-2016.

In an attempt to achieve the above objectives, the following under listed issues came out as the major findings of this study:

1. There is an increase-decrease trend of Annual Rainfall totals and Yam output in the study area between 2006-2016.

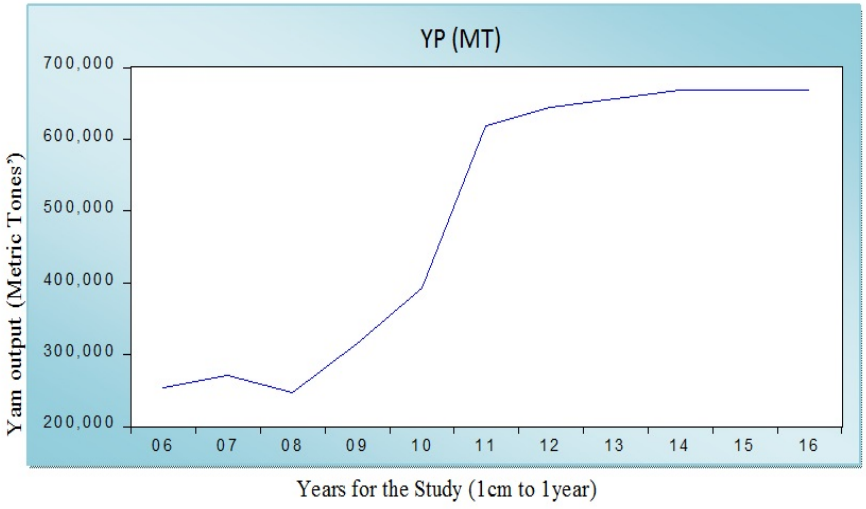

Figure 3. Yam Production output (YP) output trend

2. There is a low extent of variability of rainfall in Lafia but with a positive increasing trend over the period of the study. On the other hand, there is a moderate extent of variability of yam output with a positive trend movement over the years within the period of the study.
3. An in-depth study was conducted on the impact of rainfall variability to yam yield and the finding reveals that rainfall variability in Lafia Local Government area has significant impact of 79% to yam output in the period under the study with a coefficient determinant of 0.99 and the mean standard error estimate of about 350798176.804. This implies that the annual rainfall contributes in predicting yam output by 99% while the other factors in predicting yam output accounts for the 1% left.

Finally, the increase-decrease movement trends analysis in this study reveals that there is a varying fluctuation in the trends of rainfall and yam yield between 2006-2016 in the study area. For instance, the monthly and annual rainfall total with annual yam production output results in Lafia Local Government reveals considerable fluctuations of varying extent over time and space. The study also reveals that rainfall variability has significant impact of 79% with a predicting contributory capacity of about 99% to yam output of the study area. This means that rainfall variability in Lafia Local Government accounts for the variation in the output of yam in the period and place under study. To this end, the researcher therefore recommends that for the purpose of this study meeting up to her objectives through policy formulation and proper implementation:

1. Government policies on researches and data collection of crop production and related subjects should be revisited and strengthened. Regulatory agencies such as Nasarawa Agriculture Development Programme (NADP) should be empowered through increase budgetary allocations and being given free hand to operate in the state. This will help reposition Nasarawa state to becoming one of the major food producers in Nigeria.
2. Finally, other researchers should as a matter of urgency carried out an empirical investigation on the assessment of the impacts of land area for yam cultivation with rainfall variability over yam yield in the study area.

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