



## RAINFALL VARIABILITY AND CASSAVA PRODUCTION OUTPUT IN KAURA LOCAL GOVERNMENT AREA OF KADUNA STATE

**Fada Mallam**

Department of General Studies, Nuhu Bamalli Polytechnic, Zaria.

**Birat Sylvester Garba**

Department of General Studies, Nuhu Bamalli Polytechnic, Zaria.

**Sheyin Emmanuel Ali**

Department of Agricultural Extension and Management, Nuhu Bamalli Polytechnic, Zaria

### Abstract

*Climate change has brought about irregularity in Patten and intensity of climatic variables such as rainfall that is important in crop production, making planning in agriculture difficult. The importance of cassava in the diet of Nigeria and it industrial use necessitates it need to examine the relationship between rainfall variability and cassava production output in the study area. The cassava yield of the study area is influence by the extent of rainfall variation and cassava production output line graphs are tending toward the same direction. This research was carried in Kaura Local Government of Kaduna State and the primary objective was to assess the effect of rainfall variability and cassava production in the area. Fourteen years daily and monthly rainfall data with annual cassava production output data of Kaura Local Government were collection for the study. The analysis was carried out using E-view statistical software and a mathematical approach to determine the extent of variability. The result shows that rainfall variability is significantly affecting the cassava output. A single shift in the rainfall totals and rain days total affects cassava output toward the same direction. Rainfall total variability extent is 98.4% with 94.4% of rain days totals all explained the high variation between rainfall variability and the cassava output for the period under study. It is therefore recommend that an educating and sensitization team should be re- enforce to help educate farmers on the impact of rainfall variability and how they can subscribe to better crop variety that has resistance to the variability in the weather element named; rainfall.*

**Key Words:** Cassava Production Output, Climate, Rainfall, Variability,

### Introduction

Climate change has brought about irregularity in pattern and intensity of climatic variable such as rainfall that is important in crop production; making planning in agriculture difficult (Sowvnm, 2020). Impacts are significantly negative on rain fed agriculture (Travis & Daniel, 2010) on which the economies of most developing countries depends (Lamboll, 2011) with less adaptive capacity (Michael, 2006; Un-OHRLLS, 2009). Particularly, many low income countries, located in the tropical and sub Saharan Africa (SSA) in particular is the most vulnerable region in the world to climate variability and climate change (Michael, 2006). In sub Saharan Africa (SSA), temperature has increased by 0.7 °c over the last century and projected to increase by 3.2-3.4 °c by 2050-2090 (Attri & Rathore, 2003; bedding ton, 2012) in recent decades, the raising temperature is associate with increased spatial and temporal

variability in amount and distribution of rainfall that exceeded the long term spatial and seasonal variability (Ayalew, 2012; Tayeet 2013). This can also be seen posing some threat to crop production and food security on a general note.

The issue for food security in Nigeria and globally is topical. Rainfall variability is playing a vital role in determination of crop production in the tropics, for instance, in the last decade, the tropical Africa has been experiencing longer period of dryness along the northern coast of the west African region (also Known as the Sahelian part of west Africa which covers the northern fringes of Burkina Faso and Nigeria where Kaura Kaduna state in Nigeria is partly located); this seems leading to severe fall in crop and stock production in many parts of the west Africa region. It's true that climate has a strong influence on agriculture because rainfall variability is strictly

connected to significant shift in climate change which in turns affects crop production. Rainfall is considered as the most weather-dependent of all human activities (Hansen, 2002), with impacts on food security (Schmidhuber & Tubiello, 2007).

One of the main features responsible for conditions over west Africa is west Africa monsoon system (WAM), which also influences the region climatic variability, (Lafore, 2010; Plocher, 2010) both variability and change in climate may affect food production, availability of food supplies, food utilization, access to food and food prices everywhere in the world (Schmidhuber & Tubiello, 2007). It is especially true in sub-Saharan Africa which is known to be particularly vulnerable to climate change due to a combination of naturally high levels climate variability, high reliance on rain-fed agriculture and limited economic and institutional capacity to cope with and adapt to climate variability and change (Challinor, 2011). The impact 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 vulnerability in the output of crops. The sub-Saharan Africa is already facing recurrent food crises and water scarcity triggered or exacerbated by climate variability and extreme events such as droughts, excessive rains and floods which affect agricultural productivity and hence rural household food security (Hailer, 2005; Dilley 2005). 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 (Coulomb, 1999), due to the increasing population rate.

The central Nigeria which consists of high temperature and single rainfall maxima with dry spells occurrences amidst growing seasons is probably most experience rainfall variability region in the history of Nigeria. The rainfall variability of west Africa and Nigeria is specific is high responsible of some of the weather hazards like dry spell, drought and flooding which in turns affect crop production.

However, since cassava has now become a crop that the federal government of Nigeria want to start exporting, even though the cassava consignment was

faced with rejection by united state and the international market due to claims that Nigeria cassava are of low quality (Audu, 2017), not much has been done about cassava production in Nigeria to rescue the country from such allegations, as such, the quantity and quality needed in the international market and for local consumption seems not been met for the end users. If solutions are to be proffered, then an empirical study on how cassava production in Nigeria must be conducted.

Finally, most farmers may be aware that factors like the soil degradation, crops seedlings constraint, government policies not favoring farmers, etc., have influence (s) in cassava production but the knowledge of rainfall variability to farmer activities which is more empirical in nature and approach; a good number of the farmers are not aware of it.

### **The Study Problem**

Many researchers conducted their study on crop production and rainfall variability in different locations locally and globally but from all literatures reviewed, there has not been any reported research work on cassava yield in relation to any of the climatic elements in the study area. For instance, Alexander, (2015) 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 and a decrease in amount of rainfall in the Niger delta region will leads to an increase in tuber temperature and a decrease in amount of rainfall in the Niger Delta region leads to an increase in tuber production because the rate of leaching reduces whenever there is decrease in rainfall amount, but in the case of Kaura Local Government of Kaduna state in central Nigeria, there has not been any reported work on cassava production and rainfall variability, probably after this research, a different result is lie to be gotten since the study area is experiencing single rainfall maxima as compare to the Niger Delta region that has double rainfall maximum.

Another research work on cassava production was done by Samuel (2019), their study was to investigated the effects of climate variability on cassava production among small scale farmers in Anambra state, but the issue of rainfall variability and

crop production is far beyond small scale regions, because the variability that exist in central Nigeria.

Sun (2006) states that 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' (Reddy 2008; 2013).

This informs the study in establishing the relationships and also examined the extent of rainfall variability and its effects on cassava production output in Kaura Local Government of Kaduna State.



Figure; 1

Source; Kaduna State Urban Planning and Development Authority

## Materials and Methods

Data for this research work was sourced from Nigeria meteorological Agency (NiMet) Abuja. The long-term observed daily rainfall data from the achieves of meteorological station located in Samaru, School Agricultural Technology, Nuhu Bamalli Polytechnic Zaria covering 14 years from 2007-2021.

The second data required for this study is annual cassava data which was drawn from Kaduna State Agriculture Development Project (KSDP), Agricultural Department Kaura local Government. The data covers the fourteen (14) years for the study.

The methods/techniques used in this research work were; descriptive statistical technique of summation, mean and graphs, with standard deviation, coefficient of variance, and correlation analysis. To ascertain the extent of rainfall variability in the study area, and discuss the impact to cassava production output, coefficient of variance was determined as

$CV = \frac{\sigma}{\pi} \times 100$ , where  $\pi$  and  $\sigma$  or (SD) are the mean and standard deviation of rainfall which were draw from the table above respectively. A mathematical approach and statistical software known as E - view 9 were also used in carrying out the analysis where applicable.

## The Study Area

This section looks at the Kaura Local Government of Kaduna State, the study area. It is centred basically on the geographical location and description of the study area.

Kaura Local Government area is situated in Kaduna between longitudes 8°23'E of the equator and between latitude 9°35'N to 9°42'N of the equator. The total population of Kaura Local Government is about 216,540 thousand people based on the 2006 National Population census.

The climate of the area is completely "tropical" that is open savanna. The area experience high

temperature throughout the year. Rainfall is about 800-1500mm during the wet season which begins from the month of April 22 – 27 and October 15, 16 or 22. In most instances, the areas usually experience its first rainfall in either March or April (SMI, NiMet, 2020).

## Result and Discussion

Fig. 1a, b, & c

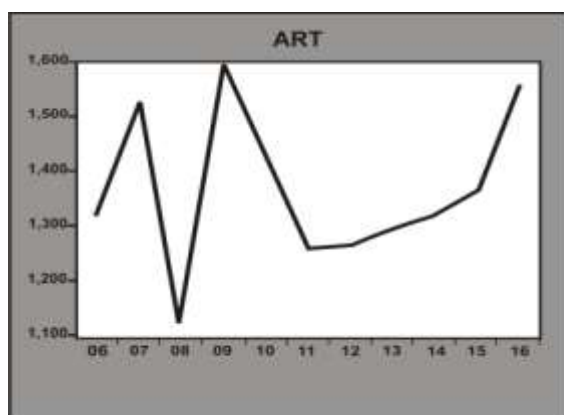


Fig. 1a: Annual Rainfall Total

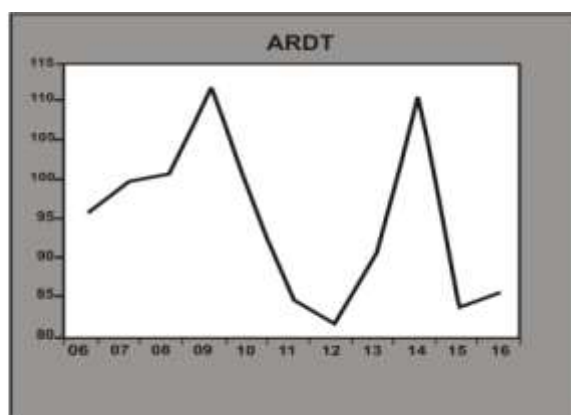


Fig. 1b: Annual Rain Days Total

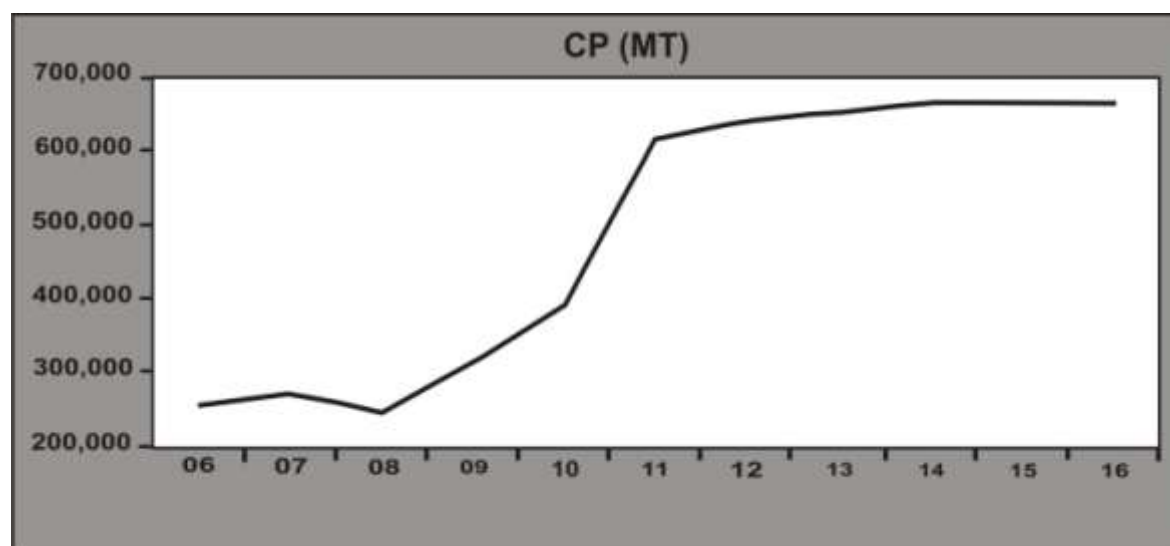


Fig. 1c: Cassava Production output

The above trends revealed that there are annual variations in rainfall total, rain days total and the Annual cassava output produced. This means that, there is variability in each of the variable used in this study.

### The Extent of Rainfall Variability in Kaura Local Government

### Variability Test in the Output of Cassava Kaura Local Government

Trends; Annual Rainfall Total, Rainy Days Total, Area Cultivated, and Cassava Output In Kaura Local Government of Kaduna State

The results were presented graphically in linear forms so that the variations in annual rainfall total, annual rain days total, cassava production output and area for cultivation of cassava clearly are seen.

The extent of variation in cassava output, rainfall variability are examined using the annual cassava production output data, the monthly rainfall and the rainy days per month for the period of fourteen years as presented below:

**Table 1: Descriptive statistic for Coefficient of variance computation of cassava production.**

| Statistical types | Cassava Production (MT) |
|-------------------|-------------------------|
| Mean              | 491381.8                |
| Median            | 618440.8                |
| Maximum           | 669204.6                |
| Minimum           | 246844.4                |
| Std. Dev          | 191386.2                |
| Skewness          | -0.273459               |
| Kurtosis          | 1.203000                |
| Jarque-Bera       | 1.617150                |
| Probability       | 0.445493                |
| Sum               | 5405200                 |
| Sum Sq.Dev        | 3.66E+11                |
| Observations      | 11                      |

**Coefficient of variance CV=38% File work (2021)**

The above descriptive statistic shows that there is high level of variation in the annual output of cassava in the study area since the coefficient of variance is greater than 30%.

**Table 2 Descriptive Statistics of Monthly Rainfall for Computation of Coefficient of Variance**

| Statistical types | Cassava Production (MT) |
|-------------------|-------------------------|
| Mean              | 117.8445                |
| Median            | 92.65000                |
| Maximum           | 391.2000                |
| Minimum           | 0.000000                |
| Std.Dev           | 115.9206                |
| Skewness          | 0.563242                |
| Kurtosis          | 2.153419                |
| Jarque-Bera       | 10.59021                |
| Probability       | 0.005016                |
| Sum               | 15084.10                |
| Sum Sq.Dev        | 1706573.                |
| Observations      | 128                     |

**Coefficient of variance CV=98.3%**

The result show that 98.4% is the extent of Kaura Local Government rainfall variability and since the coefficient of variance computed is greater than 30%, it explains that the study area rainfall is highly variable and this variability is responsible for annual variation of cassava output in the study area.

#### **Rainfall Variability Extent Using Number of Rainy Days in Kaura Local Government**

**Table 3: Descriptive Statistic of Monthly Number of Rainy Days; Coefficient of variance CV=38.95%**

| Statistical types | Number of Rainy Days Per Month (NOROM) |
|-------------------|----------------------------------------|
| Mean              | 7.924242                               |
| Median            | 8.000000                               |
| Maximum           | 24.00000                               |
| Minimum           | 0.000000                               |
| Std.Dev           | 7.478847                               |
| Skewness          | 0.413790                               |
| Kurtosis          | 1.789657                               |

|              |          |
|--------------|----------|
| Jarque-Bera  | 11.82399 |
| Probability  | 0.002707 |
| Sum          | 1046.000 |
| Sum Sq.Dev   | 7327.242 |
| Observations | 132      |

**Coefficient of variance CV=94.4%**

The result shows that the rainfall variability of Kaura Local Government Area is 94.4%. This explained that there is very high level of variability of monthly of rain days per annum.

The result on extent of cassava output variation, with that of rainfall variability extent both explained a high level of variability in the study area. The implication is that, the variability in rainfall totals and numbers of rainy days per month per annum are responsible for the cassava annual yield variation in space and time in the study. That is, whenever a

negative shift occurred in the rainfall totals or number of rain days per annum, then the annual cassava yield (output) of the year will decline too.

#### **Rainfall Variability and Cassava Production in Kaura Local Government of Kaduna State**

In this section, the relationship between rainfall variability and output of cassava Kaura Local Government of Kaduna State is examined using monthly & annual rainfall and rainy days in relation to annual cassava output for the period of fourteen years.

**Table 4: The Inferential Statistics for Monthly Rainfall and Cassava Output per Annum**

|                                | C_P_MT_  | MR       |
|--------------------------------|----------|----------|
| Cassava Production output (MT) | 1.000000 | 0.791465 |
| Monthly Rainfall (ML)          | 0.791465 | 1.000000 |

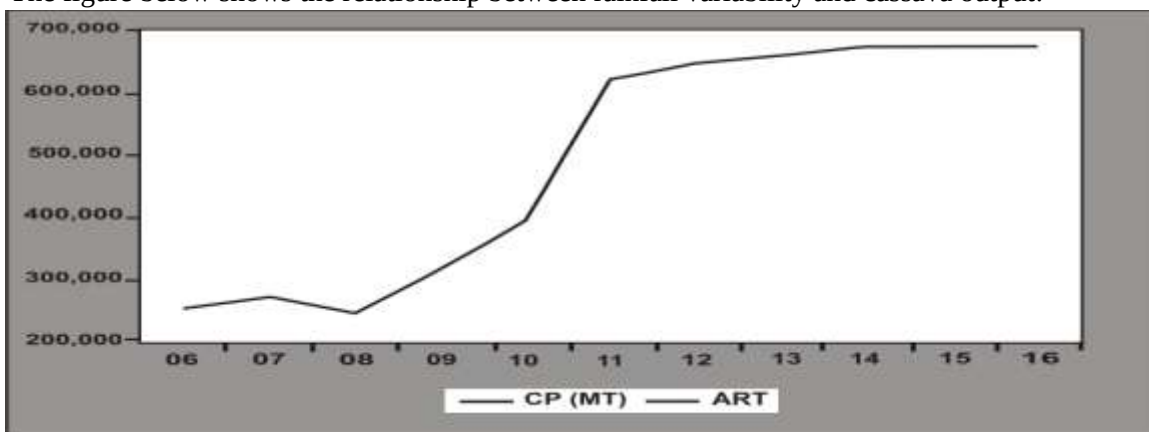
**Source: Author's computation using E-view 9 statistical tool**

The result above shows that 79% of the variability in the output of cassava in Kaura Local Government Area of Kaduna state is explained by rainfall

variability in the study area. The remaining 21% is explain by others factors other than rainfall.

#### **Graphical Representation of the Relationship between Annual Rainfall Variability and Annual Cassava Production Output in Kaura Local Government**

The figure below shows the relationship between rainfall variability and cassava output.



**CP (MT) = Cassava Production Output, ART = Annual Rainfall Total. Figure 5.2: Annual Rain Total and Annual Cassava Produce in Kaura Local Government**

The multiple linear graphs above shows that both annual rainfall totals and the quantity of cassava

produce annually in the study area work hand in hand. The implication of it is that, the variation in



the output of cassava Kaura Local Government Area Kaduna State is caused by the rainfall variability in the study area.

### Summary

The following under listed issues came out as the major findings of this study

1. Monthly and annual rainfall total, with annual number of rainy days in Kaura Local Government reveals considerable fluctuation of varying extent over time and space.
2. Rainfall variability in Kaura Local Government accounts for the variation in the output of cassava in period and place under study.

The trends analysis in this study reveals that there is a high extent of variability both in rainfall totals with number of rainy days, and annual cassava output in the study area between 2007 – 2021

The study reveals also that there exists a positive relationship between rainfall variability and the cassava output for the period under study.

For the purpose of this study meeting up to her objectives through policy formulation and proper implementation:

### References

- Amikuzone, J. Donkoh, S.A. (2012). Climate variability and yields of major staple food crops in Natteren Ghona. *AM.Cbpsci. j.* 20(2), 349-360.
- Amos T.T. Thompson, O.A. (2015). Climate change and cocoa production in the Typical Rain forest Ecological Zone on Ondo state, Nigeria. *J. Env. Earth Sci*, 5 (1), 36-41.
- Bewket, W. (2009). Rainfall variability and crop production in Ethiopia; case study in the amhara region. *Proceeding of the 116<sup>th</sup> international conference of Ethiopian studies, Addis Ababa, Ethiopian.*
- Binbol, N. & Marcus, N. (2005). Geography of Nasarawa state: A study of flora and fauna.
- Coulomb, P. (1999). Une voix straitens pour la security aliment ire dice a 2050. Paris: economical.

### Recommendations

1. An educating and sensitization team should be re-enforced to help educate farmers on the impact of rainfall variability and how they can subscribe to better crop variety that has resistance to the variability in the weather element rainfall
2. Government, community base organization and all stake holders in the agricultural sector should give priority to improving output per unit area through the provision of high yielding crop variety, inputs and incentives to farmers to curtail the variability effect of rainfall to the crop production.
3. Farmers are also advised to subscribe to high cassava crop yielding variety to boost the quantity produce in the study area.
4. Government policies on researches and data collection of crop production and related subject should be revisited and strengthened, regulatory agencies such as Kaduna state agriculture development project (KSDP) be empowered through increase budgetary allocations and given free hand to operate in the state. This will help reposition Kaduna state to becoming one of the major food producers in Nigeria.

- Hansen, J. W. (2002). Realizing the potential benefits of climate prediction to agriculture: issue, approaches, and challenges. (74), 2309-330.
- IPCC, R. F. (2007). What is on the 5<sup>th</sup> IPCC Report for West Africa? Jens O. Raeder, Rafael posada, Andrea's H. Fink and Frank Casper.
- Joachim, G. (2008). Rural 21 volume 43 the ultra-poor neglected resource, future *potential. International journal for rural development* (5), 1866-8011, D20506F.
- Samuel, E; Caleb I; & Ogonna, O. (2019). Perceived Effects of Climate Variability on Cassava Production Among small scale farmers in *Anambra State, Nigeria. Journal of Agricultural Studies* 7 (2), 27-43.
- Schmidhuber, J., & Tubiello, f. (2007). Global food security under climate change. *Proc. Nat'l acad. Sci. U. S. A.* (104), 19703-19708.
- SMI, Nimet. (2016). Annual farmers report on agricultural activities. Nigeria meteorological

agency, lafiia synoptic weather station. Lafia: NIMET Agro-met report on climate and agriculture.

Sowunmi, F. (2020). Effect of Climatic variability on Cassava Production in Nigeria. *Journal of Agric Business and Rural Development*. Vol. 57 No. 3.

Travis, L., & Daniel, S. (2010). Agriculture technologies for climate change mitigation and adaptation in developing countries: policy options for innovation and technology Diffusion. *International centre for trade and sustainable development – IPC Platform in on climate change, agriculture and trade* (6), 33.