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Research Article

RAINFALL VARIABILITY AND CROP YIELD IN GUINEA SAVANNA NIGERIA: AN EMPIRICAL ANALYSIS OF THE IMPACT ON FOOD SECURITY IN ANYIGBA KOGI STATE

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ABSTRACT

This paper examines the effect of rainfall variability and crop yield in Guinea Savanna Nigeria: An empirical analysis of the impact on food security in Anyigba Kogi State. The main Objective of the study is look at the impact of rainfall variability and crop yield in guinea savannah Nigeria. Secondary sources of data collection were employed in the study. Twelve years of data were obtained from the annual collation of database on the Geography and Planning Department at Prince Abubakar Audu University. There were significant differences with the computed years for the experiment. Year 2007 produced the lowest rainfall with 1.36 mm while the highest rainfall for the period of the sampling is year 2019 with average rainfall of 4.9 mm. The variability of the maximum temperature changes accordingly given 31.60°C. The maximum temperature. It was observed that 2007–2019 decade was associated with less minimum temperature of 0.5°C (2.7%) with year 2019 showing the lowest minimum temperature with 12.12°C while the highest minimum temperature 2017 at 24.19°C, respectively. It was observed that 2007–2019 had a high relative humidity (%), year 2007 and 2012 showed the lowest relative humidity (%) with 12% while the highest was computed from year 2018 with 84.35 (%), respectively. It was observed that 2007–2019 had a very low Pinch Evaporation, year 2008 showed the lowest Pinch Evaporation with 3, while the highest was computed from year 2013 with 41.9, respectively. It can be concluded that variation in these climatic variables have significant implications on plants, animals, humans and the environment economically and otherwise.

Keywords: Rainfall, Climate, Variability, Temperature and Yield.

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INTRODUCTION

Precipitation variability has come to be a contemporary issue commonly because of its impacts on herbal and human systems. Labiru (2016) cited that agriculture, fisheries, hydrology, and forestry are among the maximum cited regions that are affected by rainfall variability. Precipitation variability is described because the diploma to which rainfall varies inside a place or over the years. Agriculture, which is one of the important socio-economic and country-wide gross home product sectors in maximum African countries, is extra at risk of rainfall variability. Despite the current technological advances, weather and climate are decisive elements in agricultural manufacturing. The lengthy-term disaster between farmers and pastoralists, particularly in the north-important part of the country, is especially attributed to climate trade and rainfall variability. Rainfall viability is becoming a growing concern, particularly in rain-fed agricultural regions of the sector; given its distribution, sample and seasonality. In areas wherein rainfed agriculture is practiced, the erratic nature of water and its irregularity in each the quantity received and its distribution stays a first-rate hazard to agricultural production, as yields are an increasing number of low and there is amazing variability in annual yields manufacturing (Agidi, 2014) Therefore, the unpredictable pattern of onset, cessation, and period of the developing season on the site can negatively have an effect on farmers in the place who rely on rainfall for their agricultural sports Agidi (2017).

In Nigeria, rainfall variability affects rain-fed agriculture on which many human beings depend. In this vicinity, the crop loses its viability and farmers have lost a source of earnings. The reason for the lower in crop yields may be 12 month-to-year fluctuations. The annual variability of rainfall, mainly in northern Nigeria, is high, which frequently leads to climatic dangers, specifically floods and droughts with devastating outcomes on meal production and related calamities and suffering (Osman, 2015). Despite Nigeria's remarkable potential in crop production, the frequent incidence of drought caused by the irregular distribution of rainfall and/or cessation of rains during the developing season is the largest obstacle to increasing production, and that is extra severe in the northern part of the United States of America wherein maximum of the tubers are produced. However, version simulations are not sufficient to compare rainfall variability with actual crop yield. Modeling gives a mechanism for integrating the many scales of records evolved in/for agricultural studies. Surprisingly, little systematic research has focused on revealing the impact patterns of precipitation variability in spatiotemporal impact mapping the usage of modern system. There is not any doubt that farmers and agricultural agencies increasingly more need particular spatial decision support device maps to plot cropping schemes and monitor yields (Labiru, 2016). Studying the effect of annual variability in precipitation starts off evolved through mapping the direct bodily results of variable precipitation on crop yields. In standard, the clinical proof for rainfall variability and its sizeable influences on crop yield is more potent than ever (Hare, 2010)

Over the years, notwithstanding technological advances in crop production in Kogi State such as advent of high-yielding vegetation, software of fertilizers, and provision of extension offerings, crop yield nonetheless varies in one-of-a-kind elements of Kogi State. This ends in starvation and hunger of those who rely best on this vegetation for his or her socio-financial activities. Igwebuike *et al*. (2014) cited that climate projections and analysis of past and present developments suggest that smallholder families in tropical and subtropical areas are uncovered to extended climate danger and are more and more susceptible to these dangers, leading to crop decline. Agidi (2017) referred to that inter-annual variability in rainfall and crop yields has caused a decline in crop yields because of variability in rainfall styles. It is toward this historical past that these studies seek to have a look at the impact of rainfall variability and crop yield in guinea savanna

Nigeria: An empirical analysis of the impact on meals safety in Anyigba Kogi State.

METHODS

Study area

A quantitative assessment of rainfall variability was carried out in Anyigba, Kogi State, Nigeria, which lies between 7°12[1] East of the Greenwich Meridian and 7°36[1] North of the Equator. It is located in the southern Guinea Savannah zone with an altitude of 420 m above sea level. The general climate is humid, with distinct rainy and dry periods.

Methodology

This research work was solemnly based on secondary data which was obtained from the Department of Geography and Planning, Prince Abubakar Audu Anyigba University Kogi State. The study used rainfall data from 2007 to 2019 from Anyigba. The 12 years of data was obtained from the annual database collection of the Department of Geography and Planning, Prince Abubakar Audu University. The data consisted of an overall assessment of rainfall variability.

Examination of rainfall variability

To examine rainfall variability in Anyigba, Kogi State, the following indices were used.

i. Coefficient of variation (CV): Measure of relative variability that comprises mean and standard deviation was used to determine the rainfall variability. The rainfall variability was examined using the CV which is given as.

$$CV = \left[\frac{SD}{\overline{RF}}\right] \times 100\%$$

Standard deviation (sd) is defined by

$$SD = \frac{(RF - \overline{RF})}{N}$$

Where RF = The annual rainfall for a given period
$\overline{RF}$ = The average annual
N= Number of variable II. Precipitation variability index (PVI)

This model (PVI) is a modification of the precipitation periodicity index (PPI) developed by Hassan (2013). It can be expressed as:

$$PVI = \left(\frac{A}{Y} - \frac{B}{Y}\right)100\% = \frac{Hd}{M} - \frac{Ld}{My}$$

Where PVI is precipitation variation index
Hd= Highest daily rainfall in a given month
Ld= Lowest daily rainfall in a given month
M= Total monthly rainfall
My= Total monthly rainfall* Total annual rainfall

PVI is an improved version of the PPI developed by Hassan (2013). This model can explain the tendency of drought in a given rainy season. It has three threshold levels that explain the region's variability in dryness and vulnerability to drought.

1. Is a normal distribution rainfall with adequate moisture for the cropping period
2. Is a moderate rainfall distribution with enough moisture but may require some measure of moisture supplement during the cropping season
3. It is prone to dry spells during the cropping season, requiring some forms of irrigation to complement the rain waters.

RESULT AND DISCUSSION

Rainfall (mm)

To determine the deviation of each climate variable from the established normal climate for the study period (2007–2019), climate variable anomalies are calculated and are shown in Fig. 2 for precipitation. There were significant differences with the calculated years for the experiment. The year 2007 brought the lowest rainfall of 1.36 mm, while the highest rainfall for the sampling period was in 2019 with an

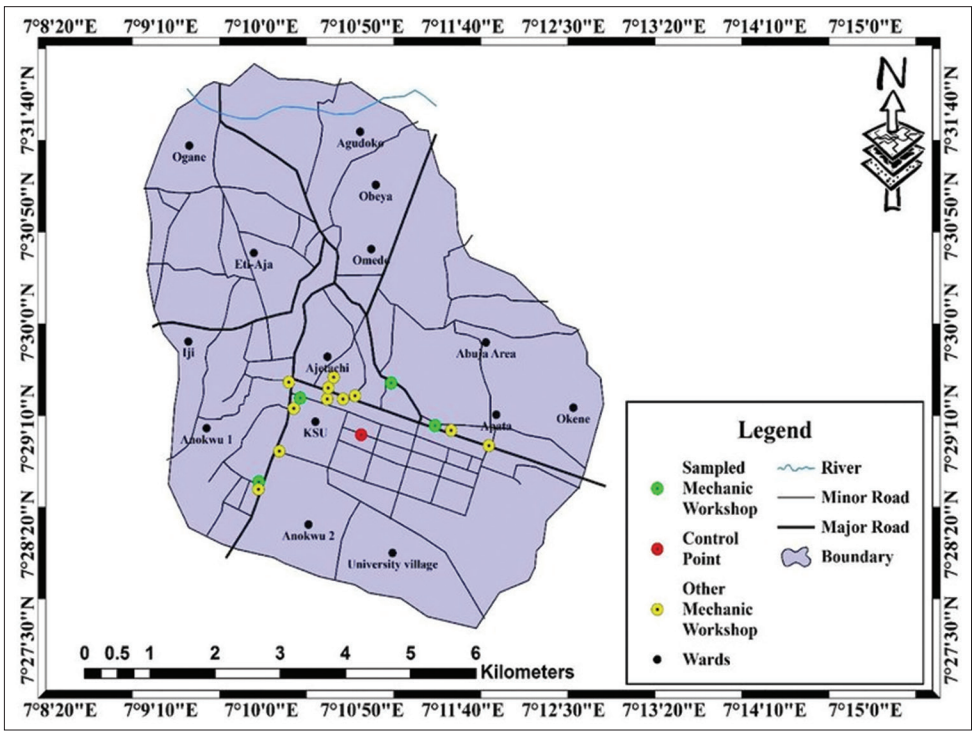

Fig. 1: Study area

average rainfall of 4.9 mm. It shows that the onset of rains in this area is prevalent in April or May, which means that agricultural activities were carried out in mid-April; so the soil had to have enough water. Termination, on the other hand, shows that November is the most common termination date in Anyigba. This means that the rains have stopped in Anyigba, which has decreased since November, which means that the rains will stop soon. These anomalies revealed that the climate change signal is getting stronger and growing year by year. This again confirms the fact that Nigeria like most of the world is experiencing the basic features of climate variability (Odjugo, 2013). Climate variability poses a major challenge not only to agriculture but also to all human endeavors. It is a limiting factor, especially in agriculture (Ukhurebor *et al*., 2019)

Maxi temperature (°C) and mini temperature (°C)

Variability for maximum and minimum temperatures (°C) for the period considered (2007–2019) is shown in Fig. 3. Variability of maximum temperature changes in maximum temperature correspondingly using the established normal maximum temperature of 31.60°C. A positive sign means a lower maximum temperature than normal. It was observed that the years 2007–2019 had lower maximum temperatures, the year 2015 showed the lowest maximum temperature at 23.99°C and the highest was calculated from 2009 at 30.29°C, respectively.

Minimum temperature and maximum temperature will change accordingly using the set normal maximum temperature. The decade 2007–2019 was observed to be associated with a lower minimum temperature of 0.5°C (2.7%), with 2019 showing the lowest minimum temperature of 12.12°C and 2017 the highest minimum temperature of 24.19°C. The temperature has gradually decreased in recent decades, with each decade having a lower maximum and minimum temperature. These results confirm IPCC (2014) and WMO (2012) reports that global trends of most countries are now experiencing their 2005 abnormal national temperatures above and this may affect plant growth and development (Bhandari, 2013). It follows that all other areas of human endeavor can be affected by this trend.

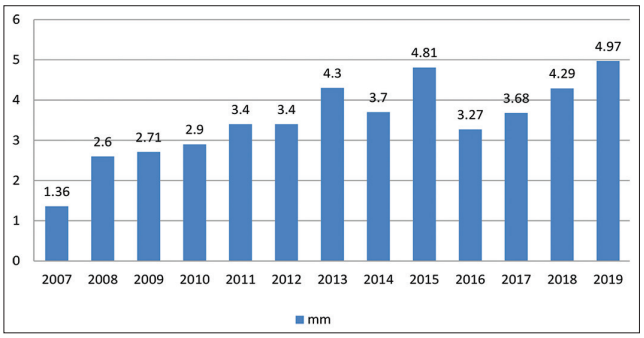

Fig. 2: Graphical illustration showing the average mean of rainfall (mm) from 2007 to 2019 in Anyigba

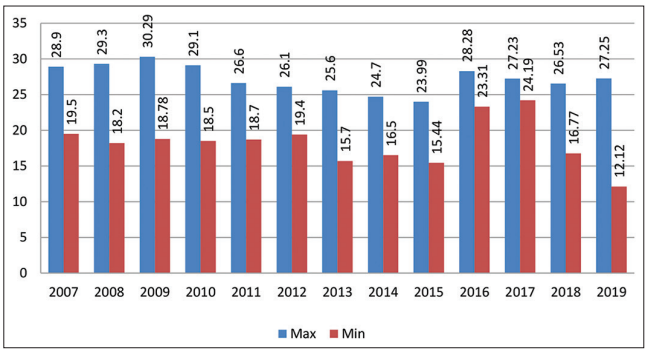

Fig. 3: Graphical illustration showing the average mean of maximum and minimum temperature (oC) from 2007 to 2019 in Anyigba

Relative humidity (%)

Anomalies of climate variables are calculated and are shown in Fig. 4 for relative humidity (%). Deviation from normal climate means climate variability. High relative humidity (%) was observed in 2007–2019, 2007 and 2012 showed the lowest relative humidity (%) with 12%, while the highest was calculated from 2018 with 84.35 (%). Relative humidity, i.e., the actual vapor content of the atmosphere, is the original source of precipitation that forms in the troposphere and radiates from the troposphere above the Earth's underlying surface. This concept scientifically refers to the actual moisture content of an air sample expressed as the percentage of moisture contained in the same volume of saturated air at the same temperature (Okhakhu, 2016). It follows that relative humidity is a positive result of the combined processes of surface evaporation and plant transpiration that occur in the environment and produce abundant clouds of rising moisture. Solar radiation, pressure gradient force, evaporating surfaces, and warm convective currents must all interact for adequate moisture to rise into the Earth's troposphere from bare ground, plants, and water bodies. The rising moisture vapor is trapped by circulating warm air in various types of clouds before it condenses through saturation to form ice, hail, dew, drizzle, or rain that eventually reaches the Earth's surface (Oyediran, 2014).

Pinch evaporation

Anomalies of climate variables are calculated and are shown in Fig. 5 for pinch evaporation. The years 2007–2019 saw very low Pinch Evaporation, the year 2008 showed the lowest Pinch Evaporation with 3. While the highest was calculated from 2013 with 41.9 and transpiration is the loss of water in the form of vapor by plants, mainly through leaves, although in woody plants, small losses can also occur through the lenticels of the bark of the branches. On the leaves, evaporation occurs from the cell walls toward the airy intercellular spaces and the process of stomatal diffusion into the atmosphere occurs. Crop

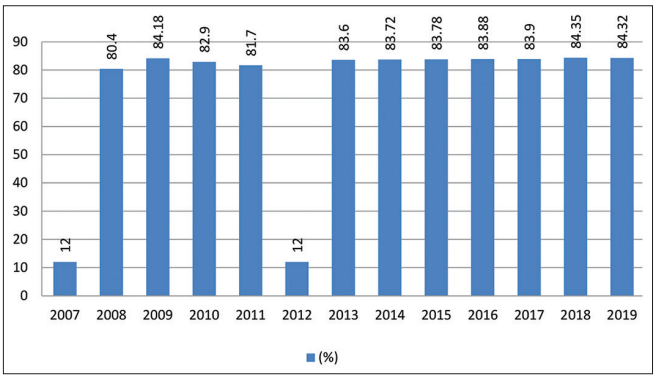

Fig. 4: Graphical illustration showing the average mean of relative humidity (%) from 2007 to 2019 in Anyigba

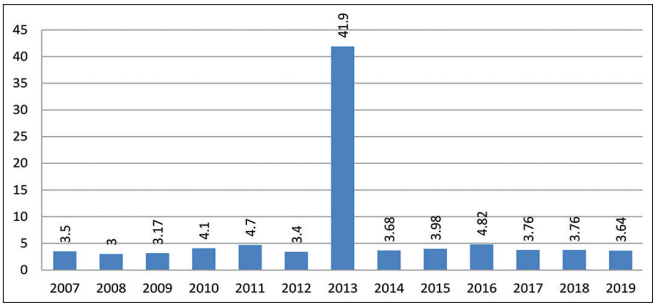

Fig. 5: Graphical illustration showing the average mean of pinch evaporation from 2007 to 2019 in Anyigba

Table 1: Precipitation periodicity index (PPI)

S. No.	Precipitation periodicity index implication	
1	<20%	Least variability
2	≥20% but ≤30%	Moderate variability
3	≥30%	High variability

Adapted from Hassan (2013)

evapotranspiration is the amount of water used by a crop at any stage of growth from seeding/planting to harvest, whenever soil water is not limited (Mishra, 2013). Determining the evapotranspiration or water requirement of a given crop is very important for water management planning, not only from a physical and biological point of view, but also from an application point of view (Farahani *et al*., 2009).

CONCLUSION AND RECOMMENDATION

Conclusion

Variations in rainfall have a significant impact on agricultural activities, as most local (subsistence) farmers depend on favorable weather conditions during agricultural activities from sowing to harvest. It also plays a key role in determining agricultural yields. It also affects other human activities. The consequences are evident in the destruction of some plants, soil erosion, and the difficulty of tillage due to waterlogging and have significant economic consequences and could also lead to environmental threats. The temperature can cause deterioration of water availability in the soil and can also lead to respiration to prevent the processes of photosynthesis, which would have a negative effect on agricultural yields and this could also lead to a threat to the environment. It can be stated that changes in these climate variables have significant impacts on plants, animals, people, and the environment economically and otherwise. The consequences received from this take a look at have further discovered that there may be climate variability. It is consequently paramount to urgently preserve the general public on alert because of its vicious effects on agriculture and different factors of human lives to take the proper measures and version possibilities in mitigating and controlling its influences.

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