FUDMA Journal of Earth and Environmental Sciences (FUDJEES), Vol. 1, No. 1, 2024

RELATIONSHIP BETWEEN DERIVED PRECIPITATION INDICES AND MILLET YIELD IN KANO STATE, NIGERIA

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https://doi.org/10.33003/jees.2024.0101/8

ABSTRACT

This study examined the relationship between derived precipitation indices and millet in Kano State, Nigeria. Data on monthly rainfall (mm) and millet yield (kg/ha) from 1992-2022 were used for the study. The rainfall data was sourced from NiMet and IITA while the crop yield data was sourced from KNARDA. The data obtained were subjected to correlation analysis in SPSS environment version 20. The result obtained revealed that a relationship exists between precipitation indices and millet at the onset of rainfall (r=0.421, p=0.018) at the significant level of 1% and negative (r=0.059, p=0.753) at the Cessation period. Also, the study revealed that there were low and negative relations between the rainfall data and millet production in May (r= -0.057, p= 0.760) and June (r=0.193) at a 0.05 significant level. In July (r=0.233), and August a very low and positive relationship was observed between rainfall and millet yield (r=0.156, p=0.401). The result of the study further revealed that a very low and positive relationship was observed between A.G.S.R and Millet yield (r=0.298) and between Millet production with LRS (r=0.194, p=0.296). A markedly and negligible negative relationship was observed between SI and millet yield (r=0.010) at a 0.05 significant level. The study concluded that variation occurred in millet production in Kano state between the onset and cessation period of rainfall received. Based on the findings, the study recommends that medium-maturing varieties of millet should be introduced to minimize the effect of precipitation indices.

Keywords: Cessation, Millet, Onset, Precipitation Indices, Rainy Season.

INTRODUCTION

Rainfall in Northern Nigeria has become more unpredictable in the last few decades displaying both inter-annual and intra-annual variability some periods of dry spells are often experienced destroying plants of economic importance. Since agricultural activities in Northern Nigeria are mostly rain-fed, for successful crop production Millet are special crop for precipitation. According to the Food and Agricultural Organization (FAO 2012), by the year 2020 cereal production including access to food in many African countries will be compromised by, climate variability. These changes will affect the length of the growing season and yield of the Milled of different countries and because of this variation, there is a need to have a reliable rainy season, for successful crop production (Bello, 2012). In some countries of Africa, the yield of the millet of different cultures from rain-fed agriculture could be reduced by up to 50% (FAO, 2012). This would further adversely affect cereal production in the continent.

Precipitation effectiveness is the quantity of water that is useful in raising crops planted on the soil. Precipitation effectiveness is that portion of total precipitation used to satisfy vegetation needs that is the actual available precipitation used in plant development (American Meteorological Society, 2009). Forbes and Watson (1992) consider precipitation effectiveness as that portion of the total rainfall that directly satisfies crop water needs. Precipitation

effectiveness is an important factor in determining the ultimate yield of any crop under rain-fed agriculture. The limit to the production capacity of land resources is set by climate, as climatic variability constitutes a major problem to agricultural productivity, especially in developing countries of the world. However, enough knowledge of agro-climatic parameters reduces climatic problems in food production (Adebayo and Onu, 2012).

Precipitation parameters have an influence on all stages of the agricultural production chain including land preparation, sowing, crop growth and management, harvesting, storage, transport, and marketing (Ayoade, 2004). Hence, a detailed knowledge of the rainfall of a place is an important prerequisite for agricultural planning and management. More so, for rain-fed agriculture, rainfall is the single most important agro-meteorological variable influencing crop production in the tropics (Emeghara, 2015).

The most important characteristics of rainfall for crop growth are onset date (OD), Cessation Date (CD), Length of the Rainy Season (LRS), Mean Annual Precipitation (MAP), Hydrological Ratio (HR), Number of Rainy Days (RD), Rainfall Intensity (RI), Specific Water Consumption (SWC), Rainfall amount in the growing month of May, June, July, August and September, Seasonality Index (SI), Index of Reliability, and Pentad Dry Spells. Consequent to this, a declining amount of rainfall portends an adverse effect on crop production.

Millet (Pennisetum Americanum L) ranks third after wheat and rice among the world's most important food grains. Wheat, rice, and Maize are grain commodities in International Commerce. These crops are also extensively researched for the purpose of increasing yield. However, Millet has received much less attention, except in the USA and West African countries where it is primarily produced for livestock and direct consumption by the poor people who grow it. More information is needed about the requirements for growing Millet (Denddy, 1995).

Hence, an in-depth knowledge and understanding of the pattern of precipitation effectiveness indices about millet production is pertinent as it governs and determines its yield. On this premise, a detailed knowledge of precipitation effectiveness indices is an important prerequisite to combating food shortage and rising food prices which have precipitated hunger and starvation in our nation despite the abundance of vast areas of land (Emeghara, 2015).

To this effect, many studies in Nigeria have been carried out in the past on the relationship between climate and Millet. For instance, Similarly, Abdullahi (2018) carried out research on the effect of precipitation effectiveness indices on the yield of millet (Pennisetum Typhoideum) in the Jigawa central senatorial zone of Jigawa state, Nigeria. In addition, Mbaya (2017) investigated spatiotemporal assessment of rainfall variation on pearl millet (Penesetum Glaueum) yield in the three local government areas of Yobe State, Nigeria. Saleh (2014), observed a relationship between rainfall variability on millet (Penisetum Americanum) yields in the Sudan Savanna ecological zone of Nigeria. Ahmed (2012) conducted a study on the analysis of rainfall variability and its implication for some crops in Gombe State. Muhammad (2014) examined the relationship between climate variability and crop production in Bauchi and its environs.

However, an attempt has been made in the study area (Kano) to look at crop climate relationships (Bello, 2012 and Saleh, 2014), but their study was based on Sorghum and Millet crops in a few local government areas. In addition, the relationship between precipitation effectiveness indices and millet in the Kano State is lacking in their studies. On the basis of this background, this study aimed to assess the relationship between the derived precipitation

effectiveness indices with millet production in the Kano state for sustainable millet production in the state.

STUDY AREA

Kano state is located between latitude 12° 3'N and longitude 8° 32'E. has a landmass that approximately covers an area of 21000 square kilometers. The state shares a boundary with Jigawa state from the North and East. From the west and southwest, it borders Katsina and Kaduna States respectively as well as Bauchi State from the extreme southeast (Olofin, 2014).

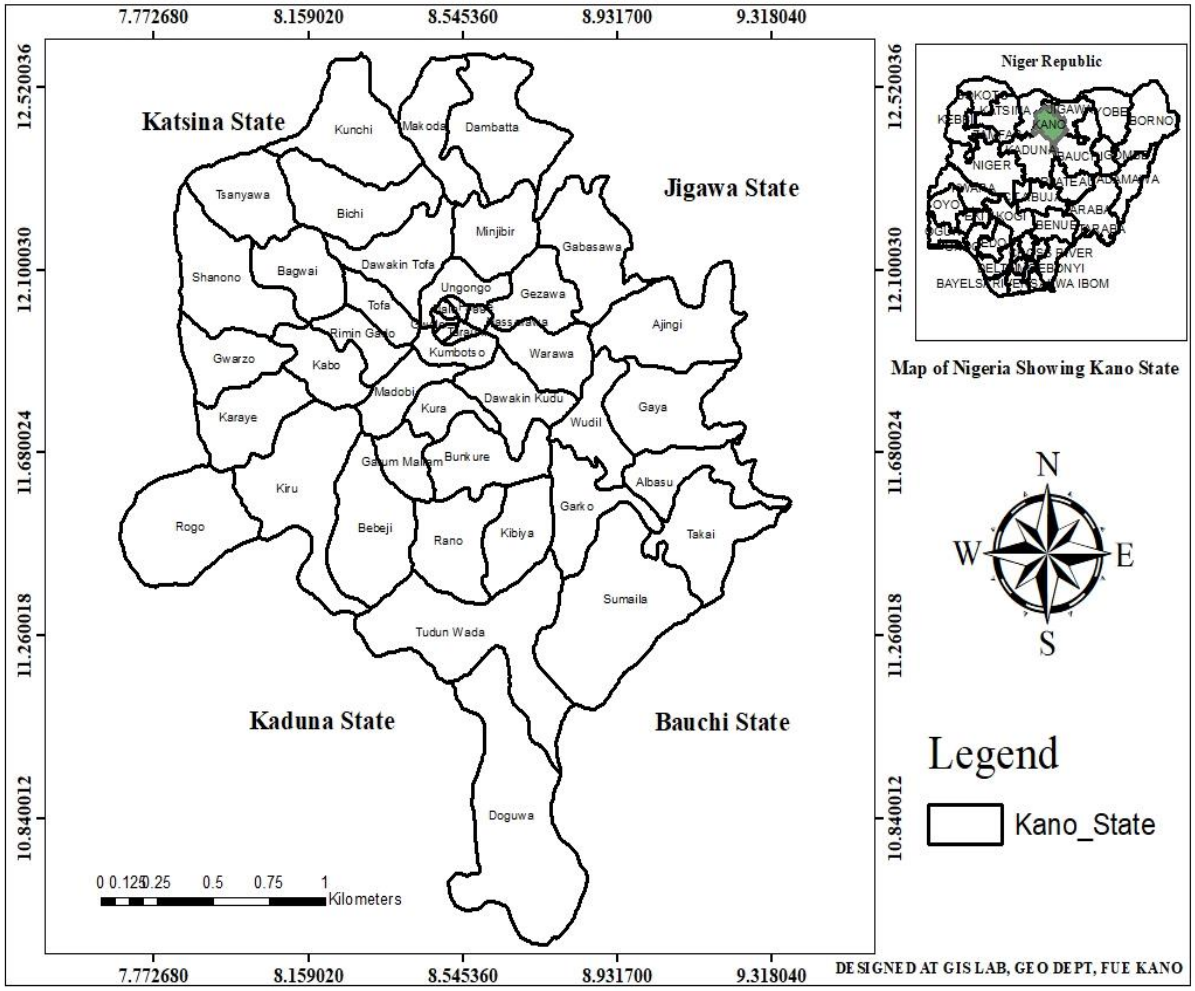

Figure 1: Map of the Study Area

Kano has three marked temperature regimes; warm, hot, and cool. The mean annual temperature is about 26°C, mean monthly ranges of maximum temperatures range between 21°C in December/January and over 35°C in the hottest months (April/May). The wet season starts properly in May and ends in October. November to February is the dry-cool season with harmattan haze. Between October to February sunrise is a few minutes after six in the morning and sunset is a few minutes after six in the evening. From March to September the sunrise is before in the morning and the sunset is at a minute to seven in the evening. Visibility is excellent in the mid-to-fully rainy season (July/August/September); good in March to June and fair to poor during the harmattan days i.e. November to February when visibility is a few meters (Buba, 2014).

MATERIALS AND METHODS

The study employed a quantitative research method to understand the relationship between rainfall effectiveness indices and millet yield production. The data used for the study was mean monthly rainfall (mm) for Kano station which was collected from Nigerian Meteorological Agency (Nimet), headquarters in Abuja and the International Institute for Tropical Agriculture (IITA), Kano for 31 years (1992-2022).

The data obtained were subjected to correlation analysis in the Statistical Package for Social Science (SPSS) version 20 to find out the nature of the relationship between the precipitation effectiveness indices and millet.

RESULTS AND DISCUSSIONS

Relationship between Derived Precipitation Indices and Millet Yield

The results of the relationship between millet yield and derived precipitation indices are presented in Table 1. The relationship that exists between May rainfall and millet yield was a markedly low and negative relationship which was not significant at 0.05 confidence level. The correlation coefficient was (r = -0.057, p = 0.760). This result implied that May rainfall did not influence the yield of millet in the area during the study period. This agrees with the result of Olaniran and Babatolu (1987) that rainfall in May shows a negative correlation with maize yield during the vegetative period, in Kabba, Nigeria.

Table 1. Relationship between Millet Yield and Derived Precipitation Indices in Kano State

Derived Precipitation Indices	Correlation Coefficient	Millet Yield
May Rainfall	Pearson Correlation	-0.057
	Sig. (2-tailed)	0.760
June Rainfall	Pearson Correlation	0.193
	Sig. (2-tailed)	0.298
July Rainfall	Pearson Correlation	0.233
	Sig. (2-tailed)	0.206
August Rainfall	Pearson Correlation	0.156
	Sig. (2-tailed)	0.401
September	Pearson Correlation	0.366*
	Sig. (2-tailed)	0.043
AGSR	Pearson Correlation	0.298
	Sig. (2-tailed)	0.104
Rainfall Total	Pearson Correlation	0.279
	Sig. (2-tailed)	0.129
Onset	Pearson Correlation	0.421*
	Sig. (2-tailed)	0.018
Cessation	Pearson Correlation	-0.059
	Sig. (2-tailed)	0.753
LRS	Pearson Correlation	0.194
	Sig. (2-tailed)	0.296
SI	Pearson Correlation	-0.010
	Sig. (2-tailed)	0.957
	N	**31**

Source: Fieldwork, 2023

A very low and positive relationship was observed between June rainfall and millet yield in Kano state (r = 0.193). The relationship was not significant at a 0.05 confidence level (p =

0.298). This means that June rainfall made little contribution to millet production for the period under investigation. A very low and positive relationship was observed between July rainfall and millet yield in Kano State (r = 0.233). The relationship was not significant at a 0.05 confidence level (p = 0.206). This indicates that July rainfall made little contribution to millet production for the period under review. This result was in line with Haruna and Tasi'u (2017) who indicated that a positive relationship exists between July rainfalls with millet yield. This result corresponds with the work of Saleh (2014) that rainfall amount had positive relationship with millet yield in the Savanna ecological zones of Nigeria.

The correlation that occurred between millet production with August rainfall was very low and positive but, not significant at a 5% confidence level (r = 0.156, p = 0.401). This implies that August rainfall had little influence on millet production during the studied period. Equally, it is the same thing with the finding of Saleh (2014) that August rainfall is correlated at 0.05 levels of significance and few at 0.01 with the yield of Millet in the Sudan Savannah ecological zone of Nigeria.

The relationship between September rainfall and millet yield was low and positive and was significant at a 0.05% confidence level (r = 0.366, p = 0.043). This indicates that September rainfall significantly influences millet production during the study period. This contradicts the finding of Abdullahi (2018) that rainfall in May, June, July, and September also had an insignificant negative relationship with millet yield in Jigawa State. This signifies that without much rainfall during the pre-sowing period which is a major and to some extent a measure of the soil moisture available at germination. A very low and positive relationship was observed between AGSR and millet yield in the Kano state (r = 0.298), the relationship was not significant at a 0.05 confidence level (p = 0.104). This means that AGSR made little contribution to millet production for the period under investigation. The relationship that exists between rainfall total and millet yield was very low positive which was not significant at a 0.05 confidence level. The correlation coefficient was (r = 0.279, p = 0.129). The implication of this result was that rainfall total contributed very little to the yield of millet in the area during the study period. This result disagrees with Haruna and Tasi'u (2017) that millet yield significantly correlated with annual rainfall at 0.05 significance levels in Katsina State and Potiskum, at 0.05 significance levels. Millet yield significantly and negatively correlated with annual rainfall and the length of the growing season. A negative relationship has been found between millet yield and rainfall as was observed in Nepal (Gyawali, 2021). Adam (2021) observed a weak correlation between factors with the production of millet yield in Sudan. In another view, this also provides additional proof of the Kowal and Kassum (1973) at Samaru and Adebayo 1994 at Ngurore. Total rainfall was insignificant with the final grain yield in Wailo Ganjuwa Local Government Area of Bauchi State and inadequate and anticipated moisture status of the soil at planting may lead to crop failure. The onset date of rainfall relates positively with millet production in the study area, (r = 0.421, p = 0.018). The relationship was significant at a 5% confidence level. The implication of this finding was that the onset date of rainfall significantly influences millet production for the period under review in the study area. The cessation date of rainfall relates negatively with millet production in the study area, (r = -0.059, p = 0.753). The relationship was not significant at a 5% confidence level. The implication of this finding was that the cessation date of rainfall does not influence the millet production for the period under review in the study area. The correlation that occurred between millet production with LRS was very low and positive but not significant at a 5% confidence level (r = 0.194, p = 0.296). This implies that LRS made little contribution to millet production during the study period in the study area. Haruna and Tasi'u (2017) observed that positive relations occurred between the lengths of the growing

season with millet yield. A markedly and negligible negative relationship was observed between SI and millet yield in Kano State (r = -0.010). The relationship was not significant at a 0.05 confidence level (p = 0.957). This means that SI does not contribute to millet production for the period under investigation.

CONCLUSION AND RECOMMENDATIONS

The relationship between derived precipitation indices and millet was analyzed for Kano. All those indices for (June, July, August, Sept, Rainfall total, and AGSR,) show statistically positive correlation with millet. This implies that the longer the rainy season persists the higher the yield of the millet. However, May, Onset, Cessation, and length of the rainy season and seasonality index showed statistically that there is a negative relationship with millet yield. Only September rainfall and onset date of rainfall were statistically significant with millet productions.

The study recommends that medium-maturing varieties of millet should be introduced to minimize the challenges faced by precipitation indices and also weather should be made available in all states to provide adequate information on the climate of the area for future studies.

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