ANALYSIS OF PRECIPITATION EFFECTIVENESS INDICES FOR CROP PRODUCTION IN KATCHA LOCAL GOVERNMENT AREA OF NIGER STATE NIGERIA

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ABSTRACT

Precipitation effectiveness of onset (o) and cessation © date of rains length of the rainy season LRS, seasonal and intra-seasonal distribution of rainfall for katcha L.G.A of Niger state of Nigeria are analyzed for improved crop production. Result revealed that the onset of rain is between March 25th and may 15th whereas cessation date range from October 13th to November 12th. Length of rainfall shows that rainy season ranges from 180-200days. Seasonal and intra-seasonal distribution of rainfall shows that in the dry season (November to March) the area receives between 60to 200mm of rainfall. December to March has rainfall of less than 40mm while July, August and September rainfall amount is excess of 200mm for optimal yield, crops should not be planted before April 11th for fed agriculture.

Keywords: *Analysis, Effectiveness, Crop, Produciton.*

INTRODUCTION

Of all climatic elements, rainfall is probably the most important as far as crop production is concerned and indeed the availability of water is one of the major climatic factors that affect crop yield (Akinyeye, 1987). Of more immediate concern to agriculture is the ability to determine the characteristics of rainfall for an area where the crop(s) is/are grown. When in what amount and for how long shall the rain last? Answers to these question help decision to be made on and how planting is to be made achieve optimum yield.

In Nigeria because of the copious amount of rainfall received annually, planners play little or no attention to rainfall characteristics. From the work of Adefolalu (1991), it become glaring that rainfall

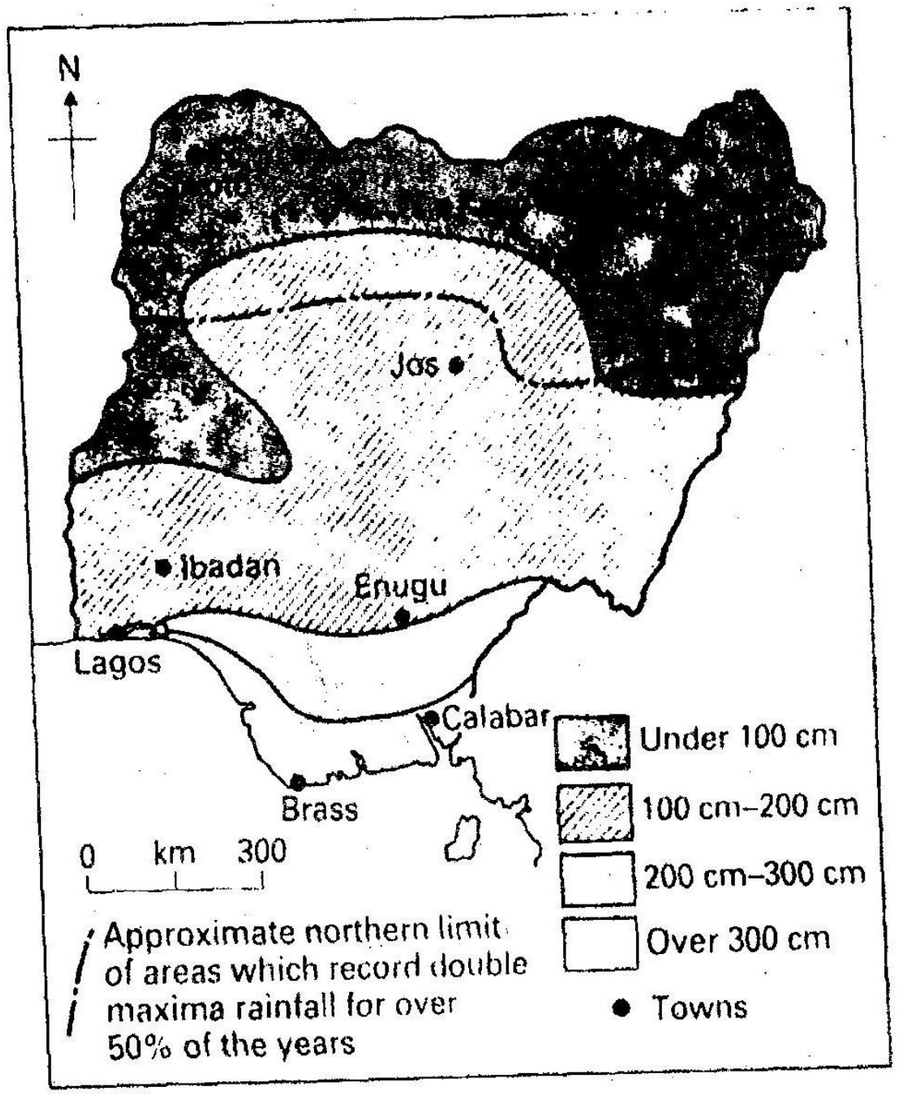
amount upon which planners is only a measure of precipitation characteristics but not its effectiveness.

Precipitation at global and regional scale may appear smooth with zonal symmetry but the picture at state or local government levels requires a more thorough understanding if the features exhibited are to be useful for fiscal planning. Precipitation characteristics which are better measure of it effectiveness include date of onset, cessation and length of the rainy season (LRS). Break (dry spell) during the course of a particular rainy season and false start of rains are equally important as prolong dry spell are hostile to plant life, while late rains may cause potential losses. The realization of these factors therefore calls for a micro-study of precipitation effectiveness indices of onset and cessation dates of rains, length of the season, and intra-seasonal features of rainfall in katcha Local Government Area of Niger State for improved crop production.

AIM OF THE STUDY

The aim of this study is to analyze and discuss rainfall characteristics and their derived parameters for application in crop production and planning in the study area. These include

i. Onset date of rains (Ø)
ii. Cessation date of the rains
iii. Length of the rainy season (LRS)
iv. Seasonal and intra-seasonal distribution features of rainfall.



STUDY AREA: Fig. 1

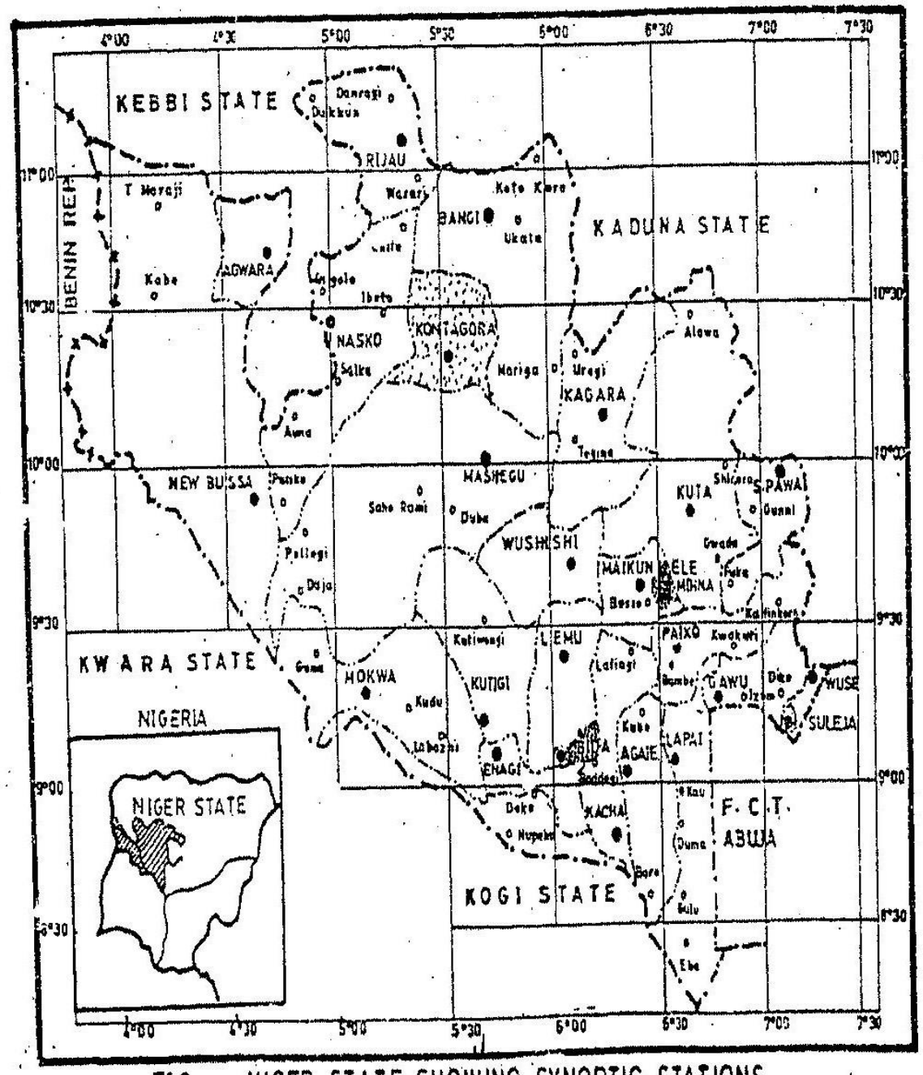


FIG NIGER STATE SHOWING SYNOPTIC STATIONS

Fig. 2
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The study area is katcha Local Government Area of Niger state. It lies between latitude 8 40N, and longitude 5 38E. The area lies between the Guinea Savanna belt underlain by the basement complex rocks namely magmites, gneisses. These rocks crop out in some places as isolated hills. The major aquifer types are saprolite and fractured basement aquifer developed from basement complex of granite and gneiss and as a surface texture of loamy sand to sandy loam.

The study area experiences two distinct seasons namely the dry and rainy seasons. The dry season covers five months (November to March), while the remaining seven month of the (April to October) constitute the rainy season. The distribution patterns and amount of rainfall remain fairly normal. The major food crops grown in the study area are maize, guinea-corn, sugar-cane, millet, melon and rice.

MATERIALS AND METHOD

Data

Daily rainfall data for forty five years (1960-2004) from five stations obtained from the national cereal research institute (NCRI), badeggi and Niger state agricultural development project (NADP) were used for analysis.

Estimation of onset and cessation Date

The onset () and cessation date of the rains are estimated from the graphs of pentad rainfall values. These graphs are called frequency cumulative curves or ogives. These orgive are plotted from 5-days pentad rainfall values as indicated below let daily rainfall for the year to be represented by (I, t)

Where i=1, 2, 3 ….nth day of the year. If each pentad (p) is 5 days in duration, then there are 365/5 or 73 pentads in normal year.

The pentad rainfall values are given by the expression:

$$R(P=1) = I=5 \quad \sum r(i, t) \quad I=I \quad I=II$$

$$R(P=2) = R(P-1) + \sum r(i, t) \quad i=6 \quad i=N$$

$$R(p=75) = R(p=n-1) + \sum r(i, t) \quad i=N-5$$

To obtain the ogive, rainfall values are plotted against the pentad numbers. From the rainfall ogive, two characteristics point are used to identify the start (onset) and end of the rains (cessation).

Onset (Ø)

Before the rains start, the five days pentad rainfall value has zero value. Thus the plot will be along the abscission and remain zero until the first recorded amount is computed for the appropriate pentad number. After these initial positive values, the succeeding pentad rainfall values will increase monotonically in response to additional rainfall values. Thus the ogive will show these increase rainfall values for each pentad and the curve rises with positive gradient. The onset (Ø) is at first point of inflection

Cessation (¢)

As the name implies, cessation (¢) refers to the end of the effective rainy season and not the last day rain fell. It is marked by the last inflexion point on the ogive before it becomes parallel for the second (and last) time to the abscissa. Thus, it usually lies somewhere before the last day rain is receive.

Haven determined the onset (Ø) and the cessation (¢) dates, the pentad number to one decimal place, length of the rainy season (LRS) is given by:

LRS=¢ - Ø

Monthly Rainfall

Monthly rainfall is useful in discussions of seasonal and intra-seasonal features of rainfall. It is also used in the estimation of a crude length of the rainy season.

To determine monthly rainfall from the tabulated pentad rainfall values, the following criteria shall be used (see table 1).

Table 1: Monthly tabulated pentad rainfall values

Month	R (Pentad No.)
January	R (Pentad No.6)
February	R (P12) - R (P6)
March	R (P18) - R (P12)
April	R (P24) - R (P1 8)
May	R (P=3O) - R (P=24)
June	R (P36) - R (P=3O)
July	R (P43) - RP36)
August	R (P 49) - R (P 43)
September	R (P 55) - R (P = 49)

October	R (P=61) - R (P=55)
November	R (p 67) - R (P 61)
December	R (p 73) - R (p=67)

RESULTS:

Onset (ȼ) and Cessation Dates of Rains

An onset date of rains is categorized into Early, Normal and Delayed. Results revealed that rains will start between March 25(earliest) and May 15(latest) in any onset dates of rains.

Earliest onset is between March 25 and April 11. Normal onset is between April 11 to May 1. There are variations within the area under study. In the southern sector the onset is between April 11 and April 21. In. the north rains are expected between April 21 and May 1. In the north-east the onset date is between May 1 to May 11 Delayed onset is between April 21 and May11.

The patterns of cessation dates of rains appear to follow the same pattern with the onset dates. Cessation dates are divided into three categories, namely: prematured, Normal and Early. Generally rains will stop between October 13 (earliest) and November 12 (latest) in any cessation date of rains. In the study area premature cessation date is between October 13 and October 23. It is observed that the premature cessation date in the western sector is between October 13 and October 18. However in the eastern portion, rains will stop between October 23 and November 2. Delayed cessation date is between November 2 and November 12.

Length of the Rainy Season

Length of the rainy season (LRS) is synonymous with the Hydrologic Growing Season (HGS) in the Sahel. Analyses reveal that the length of the rainy season in the study area ranges from 180 to 200 days.

Table 2: Rainfall statistics for Katcha LGA (1960-2004).

Month	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ai
Rainfall (mm)	1.5	3.2	22.3	65.2	132.5	178.3	215.0	233.5	205.0	83.5	3.7	0.4	11
Standard Deviation (mm)	5.4	8.8	56.0	84.4	57.6	66.5	62.4	96.2	62.2	44.1	9.6	2.2	16
Coefficient of Variation (%)	352.3	273.1	250.8	129.4	43.4	33.9	29.0	41.2	29.9	52.8	260.3	600.5	14

Source: Computed by the authors (2007)

Seasonal and Intra -seasonal Features of Rainfall

Table 2 shows the characteristics features, seasonal and intra-seasonal distribution of rainfall in Katcha LGA.

Two main seasons (dry and rainy) are experienced in the study area. The dry season starts from November and end in March, whereas the rainy season occurs between April and October. Seasonality of rainfall is outstanding as regards the dry and rainy season distribution of rainfall. In the dry season (November to March) the area receive between 2-20mm of rainfall per month while in the rainy season (April - October) rainfall amount is between 60-200mm. December to March has rainfall of less than 30mm while July, August and September rainfall amount is. In excess of 700mm with relatively lower values of coefficient of variations of 29.0, 41.2 and 29.9 percents respectively.

Intra -seasonal features of rainfall distribution show that during the month of December, January, February and March, rainfall value is less than 40mm. As the rains increase in amount in the month of April, the spatial distribution shows that maximum amount is received in the Southern portion. August is the month of highest monthly rainfall with value of 233.5mm with relatively higher value of coefficient of variation as compared to the months of July and September. This implies that rainfall distribution in August is more variable than of July and September even though it received the highest rainfall amount.

On the whole, for the study period the mean annual rainfall is 1148.5 with standard deviation of 167.3mm and coefficient of varia 14.6%. this corroborates earlier studies of Ogunwole et. al (1997) in the same Guinea- Savanna environment.

DISCUSSION

Works by Adefolalu and Oguntoyinbo (1985) have indicated that it is not the total annual rainfall that is important but its seasonal variability as a function of its characteristics: onset, peak, cessation, length of the rainy season and the precipitation intensity during onset and cessation phases. For maximum crop production, the effectiveness of precipitation is to be related to the time of sowing, growth and development, maturity of plants and the harvest periods. A study conducted by Olaniran (1991) listed at the back has revealed that planting simultaneously with the defined onset date is positively correlated to crop yield even in the transition zone from the Guinea-Sudan(to the south) to the Sudan- Sahel(to the north).

The agricultural implication of the Onset date is that crops planted within the normal onset period are likely to perform well on rain-fed agriculture. It is therefore advisable that for growth, maturity and optimum yield, planting of seasonal crops, particularly grains should not be started before April 11 for rain-fed agriculture. Knowledge of cessation dates of rains is very useful in agricultural planning. A crop that cannot reach maturity before the cessation date will result in lower yield except with supplemental irrigation. Characteristic features of the seasonal and 1ntra-seasonal distribution of rainfall confirm that rain-fed agriculture is possible in the study area during the months of April to October and breaks (day spells) are to be expected in the m August.

CONCLUSIONS

This paper has demonstrated the application of agro-climatology to agricultural planning and production. The study provided detailed information on precipitation effectiveness indices of onset, cessation, and length of the rainy season and seasonal and intra-seasonal features of rainfall in Katcha Local Government Area of Niger state. Thus it provides a baseline data for grass root agricultural planning in the area. It is therefore expected that farmers, agricultural companies and government agricultural agencies will utilize this Information along with advances in agricultural technology to produce higher crop yields for stainable development.

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