EFFECTS OF RAINFALL VARIABILITY ON CASSAVA PRODUCTION IN IFELODUN AREA OF KWARA STATE

By

Akinyeye, P.S. and *Yahaya, T. I

Department of Geography Federal University of Technology, Minna

And

***Police Secondary School Minna**

Abstract

The primary focus of this study work has been on the relationship between rainfall variability and cassava production in Ifelodun Area of Kwara State.

Six stations were chosen to cover the whole state rainfall data for each station for the period of ten years (1986-1996) were used in the analysis. An attempt was made to determine how rainfall variations affect the production of cassava during the period of ten years. Thus, amount of rainfall, deviation from the mean, climatic index, onset, cessation and length of rainfall (LRS) were discussed. Also discussed were the relationship between each of the above climatic parameters and cassava through the use of existing statistical techniques such as climatic index, regression analysis etc. the result reveals that most of these parameters have close relationship with cassava production. The Annual trend in cassava yield indicate that the periods characterized with high rainfall amount had high yield of cassava. However, there are periods with high rainfall but low yield which show that high amount of rainfall alone does not account for high yield but with other climatic factor combined.

In correlating length of rainy season with cassava yield for the period of the year considered, it was observed that fluctuation in length of rainy season led to fluctuation in cassava yield.

Introduction

Need for enough food for feeding the word's ever increasing population has been a major concern in the developing as well as in the developed parts of the world. The problem is likely to be man's number one challenge in the remaining decades of last century (YAO, 1973)

Several factors tend to affect agricultural production in an area. Such factors include the influence of topography, soil fertility, management practices and weather among others. The must crucial meteorological variables, which have significance on agricultural production, are the moisture content of the soil, solar radiation, rainfall and temperature of the environment. The influence of these weather elements have direct and indirect effect on crop development and yield.

In Nigeria like in many other parts of Africa, due to the low level of technology and capital, we have not been able to ameliorate the most devastating influence of weather on agriculture. As a result of this, most farmers still live at the mercy of weather. This is the reason why agricultural products have been erratic and unpredictable.

Consequently, it has constituted one of the major causes of low agricultural productions and the threatening famine and food shortage as well as the escalating food prices.

The differences in the variations of rainfall vary between the south, the West, East and the North. These differences in rainfall variation could be as a result of difference in location pattern, the distributions and amount of annual rainfall. For instance, the planning for agriculture most especially crop production, the amount of rainfall, the

intensity and frequencies must be considered. Also to be considered are the length of rainy season (LRS), onset (O) and cessation. (C)

In Nigeria, the numbers of the growth season in the North is different from those of the East and West. Thus in analyzing for agricultural purposes especially for crop production rainfall value in all its ramifications must be considered.

Preview of Cassava.

Cassava is a staple food crop in many areas of the tropic and it is capable of producing high yield under condition of poor fertility and low rainfall.

In Nigeria it is the staple food for more than half of 130Million-estimated population. Cassava tubers like many others root crop consist of almost pure starch, but cassava leaves contain about 17% protein and are therefore a good source of protein. The cassava crop has very wide adaptability to environmental and soil condition and drought resistant. The bulk of the country's output comes from the southern part of the country, which has higher rainfall spread of over 7-9 months of the year. Apart from its consumption locally, it also has an industrial use and assumes world importances in international trade as a source of starch and as constituent of animal feeds, particularly in European Economic Community and the Far East trade where the market is presently expanding.

Cassava does well in warm areas, with an average daily temperature of 25-290, and it is therefore suited to areas below 1,500 meters. It grow well when there is well-distributed rainfall of about 1,100-1,5000mm per year, but it can also grow in very dry areas.

Cassava prefers light, sandy soil and will grow on soil of low fertility. Heavy soil are suitable, as they do not allow the tubers to expand. There are many different local varieties of cassava, improved varieties obtained by breeding programme, are also available, but the local varieties are probably as high yielding as the improved varieties,, if they are free from cassava mosaic virus.

Aim and Objectives

The aim of the study is to examine the variation in rainfall in kwara state over a period of years using monthly rainfall for six stations. Within this broad aim, the specific objectives are:-

1. To examine the degree of wetness and dryness of the study area
2. To examine the relationship between cassava and rainfall
3. To suggest on improved planning strategies which could lead to judicious land use and at the some time enhance cassava production

Statement of Problem

Cassava is an important carbohydrate staple food in the tropic and is widely found in many tropical and sub-tropical countries, including Nigeria and most especially in Kwara State.

It is one of the highest yielding plants. In Kwara state, the yearly production of fresh cassava is estimated at 10-12 thousand tones on a land area of 1.2 to 1.4 thousand hectares. Cassava roots supply nearly 50 percent of the daily calorie intake to the populace. It also plays a vital role in alleviating famine condition by providing a sustained food supply when others crops failed.

Area of Study

Location:- Kwara state is located on latitude 9^0N and longitude 5^0E. Kwara State was created on 27th may, 1967 along with eleven others state in the federation. At its creation in 1967, the state was made of the formal Ilorin and Kabba provinces of the Northern region of Nigeria. The state was then called central West state but later changed to "Kwara" the local name for the river Niger. On February, 13, 1976 part of the state to form Benue state.

On August 27, 1991, five local government area, namely Oyi, Yagba, Okene, Okehi and Kogi were also existed to form part of Kogi while the sixth, Borgu Local government area was merged with Niger state. The state shares boundaries with Ondo, Oyo, Osun, Niger and Kogi States

Climate: - There are two main climatic season, the dry and wet seasons with an intervening cold and dry harmattan period usually experienced from December to January.

The annual rainfall range from 1,000 –1,500mm while the maximum average temperature ranges between 30^0C and 35^0c. in areas where the dry season last longer, large numbers of people search of water and pasture.

The variation in the amount of rainfall provide an explanation of the difference in agricultural activities and crops production throughout the world.

Vegetation and Soil: - The climatic pattern and sizeable expanse of arable and rich fertile soil of the state provide good vegetation for the state.

The vegetation is mainly the wooded savannah with the presence of tall grasses, tall trees with broad leaves, scattered tress and deciduous which well sited for the cultivation of a wide variety of food crops like yam, cassava, Maiza, Boans, Rice, Sugar-cane, Fruits, Vegetables etc. the state is also good for rearing of livestock like cattle, sheep, goats and poultry.

Rainfall and Crop Production.

Several articles have been in the past written on rainfall variability of different areas. Rainfall is undoubtedly the most important climatic variable, and it has far-reaching influence on agriculture production. The pattern of rainfall vary not only from place to place but with time at a particular place as noted by lamb 1968,1972, Olaniran 1972, Salter et al 1967, Kramer 1983, Adefolalu, 1991 etc.

The nature of the rainfall can vary during the growing season and this has major implication on crop production, the effect of rainfall condition are not constant, varying not only with other physical conditions such as soil type and relief but also with economic, technological, social and political condition. Moreover, the human factor vary with time and it is easy to mistaken their influence for a change in rainfall characteristics.

Data Collection.

Rainfall data were obtained from various sources. The rainfall data were obtained from Geography Department University of Ilorin, Ilorin international Airport and from the Ministry of water Resource and Rural development.

Six stations were selected within Kwara State for the study. These station are chosen from Ifelodun L.G.A of Kwara State, the station are share, Oke-ode, Omupo, Idofian, Igbaya and oro-Ago. Rainfall data for at least Ten years at each station were collected.

A lot of materials were extracted from sources such as the work of Kowal and Kassam (1972), Adefolalu (1987) and Kwara State atlas. Material were also obtained from papers presented at the Nigeria Geographical Association 26th annual conference.

Minna by Adeyemi (1993). The various parameter studied in the write up were complied from various sources or computed from the various data mentioned above. The data were made up of monthly and annual rainfall data.

Data Analysis

Statistically derived indices such as mean, variability, standard deviation, climatic index, wet and dry period, length of rainy period etc were used for the study. This is so because statistical analysis is growing in importance as part of geographical methods. This enables facts to be easily summarized and arrive at conclusion objectively.

The mean assumes a central tendency for each period and rainfall hourly, daily, monthly ad annual were computed. Climatic index were also used to analyze the rainfall data in the study area.

The climatic index can be expressed statistically as

$$C.I = \frac{\chi 1 - \overline{\chi}}{r}$$

Where

$\chi 1$ = rainfall of a particular year or period

χ = mean of any station

r = standard deviation.

The implication of the index is shown in the table below

Climate Index	Degree of drought
0 to – 0.5	Mild drought
0.6 to 1. 0	Severe drought
1.0	Extreme drought

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1.0 above	Extreme drought

Table1

Another method used in the research work is the use of ogive to determine onset, cessation dates length of rainy season for the period of Ten years

The ogive Method can be expressed as: -

January $1^{st} - 10^{th}$ $(r_1r_2r_3 + \text{-------- } r_{10}) = DN_1 = R1$

$11^{th} - 20^{th}$ $(r_1r_2r_3 + \text{-------- } r_{10}) = DN_2 = R_2 + R1$

$21^{st} - 31^{st}$ $(r_1r_2r_3 + \text{-------- } r_{11}) = DN_3 = R_3 + R1$

Another method used is the regression analysis. It can be expressed as:-

$$b = r = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\sum xy - \left(\sum y^2\right) - \left(\sum y\right)^2}}$$

Where n = number of cases or year

x = annual rainfall total of a particular year

u = crop yield of a particular year

for prediction to be made, the study made use of correlation co- efficient:- expressed as

$Y = a + b\chi$

Where Y = the dependent variable e.g crop yield
X = the independent variable e.g crop rainfall
A = regression coefficient (constant)

Discussion of Result.

This section examines variations in rainfall in the study area. It also examines the relationship between cassava and rainfall. The analysis of rainfall data the period of ten years (1986 –95) indicate that mean rainfall in the study areas varies from one station to the others as can be seen in table 2 below

Table 2:
Mean annual rainfall of each station

STATION	MEAN ANNUAL RAINFALL (MM)	YEARS
Share	968.4	1986 – 95
Oke-ode	820.8	1986- 95
Omupo	793.6	1986 – 95
Idofian	762.1	1986 – 95
Igbaja	695.0	1986 – 95
Oro-Ago	619.2	1986 – 95

Table 2 above indicates that the pattern of mean annual rainfall within ifelodun changes from place to place. For instance, share has the highest rainfall mean of 968.4mm, Oro – Ago which is in north – Eastern part of the state recorded 619.2mm rainfall. Both the north –eastern and north Western part of the study area drastically recorded decreases in rainfall (fig 2)Table 2).

In terms of inter annual variability of rainfall, there were marked deviation during the study period for each station of the study area, for instance, share recorded the highest deviation of about 362mm of rainfall from the mean in 1986. share also recorded the highest negative deviation in 1994 of 384.6mm of rainfall from the mean. Also there were highest recorded negative deviation from the mean in Oke-Ode, Omupo, Idofian, Igbaja and Oro –Ago were – 268.6 (1994) –284.5 (1994), -271.4 (1994), -245.3 (1994), -201.5 (1994) respectively (fig3-8).

Again, for the highest recorded positive deviation from the mean it was 362.3 (186), 231.3 (1993). 265.8(1986), 230.3 (1993), 178 (1956) and 225.5 (1986) from the stations under study (fig3-8)

Onset, Cessation and Length of Raining Season (LRS)

In crop production two of the most important indices of raifall, which are very useful in making decision, are the onset (O) and cessation (C) of the rains. When combined together, onset and cessation determines the length of raining season (LRS).

For this study, the onset, cessation and length of raining season were estimated from graphs of decade values obtained from rainfall data of the study area for the period under study.

The length of rainy season pattern shows that 1986 had the highest days of rainfall with a value of 88 days, this was followed by 1992 (80), 1993 (76).

The pattern generally shows decrease and fluctuations in trend 1987 (38), 1988 (31), 1989 (41) and 1995 (33) in 1994 recorded the lowest value in rainy days. This could be due to an abnormally in the atmosphere as a result of various human activities on the

earth surface that result to deplection of the ozone layer or as a result of faulty recording system of data.

The beginning of the rainy season is shown in figure 9 this is when the value fall between decade 7 and 12 for the period under study. This tally to the 21st of March and 20th of May. This shows that rain commences as early as March 21st and as late as 20th May at Ifelodun and it's environ during the period under study. This period marks the onset of the rainy season. The cessation (C) refers to the end of rainy season. This is when the value falls between decade 22 and 25 which corresponds to 23rd August and 14th October. This means the rains and as early as August 23rd and as late as October14th. The implication of this to crop cultivation is that various crops such as cassava can be cultivated and harvested between 21st March and 14th of October.

Annual Trend in Cassava Yield

Different factors could influence yield in cassava, which may in turn affect the total yield at any given year. Some of these factors include rainfall, temperature and length of the rainy season. Late harvesting makes cassava rotten and may cause poor quality of the crop.

Appendix 1 and Figure 10 shows the yearly variation in cassava yield in Ifelodun from 1986-1995. Figure 10 shows fluctuation in the trend of cassava yield from year to year 1994 had the lowest yield of 27, 300 tons while the highest was recorded in 1986 (64, 2,000 tons). As can be seen in Appendix 2 (Fig 10).

It could be observed from Appendix 72and fig 8 that the periods that are characterized with high rainfall amount also had high yield of cassava. However, there are periods with high rainfall but low yield, which shows that rainfall amount, only does not account for high yield, there are other factors.

Cassava Yield in Relation to Rainfall

Comparing the year-to-year yield of cassava to rainfall value in the study area for the period under study as shown in Appendix 3. It could be observed that 1986 and 1993 recorded highest yield of 64, 2000 and 534, 000 tons of cassava with highest value of 1019.2mm and 967.1mm, although the mean annual rainfall for 1987 was a little high but with low yield which mean that high rainfall does not necessarily mean high yield.

1989 and 1995 has low mean rainfall of 681.7mm and 695.3mm during the period under study but the yield for the periods are very encouraging as indicated in appendix 3 which means that rainfall could be low but with other climatic factors combined there could be a better yield.

During the period under study the computation correlation co-efficient between rainfall value and cassava yield gave a correlation of co-efficient of determination of dxy 0.39. This showed that about 39% of the changes in cassava yield have been due to differences in the annual rainfall quantity. Other factors accounted for the remaining 61%.

Cassava Yield in Relation to Length of Rainy Season (LRS)

In correlating length of rainy season with cassava yield for the period for the years (1986-1995), It was observed that fluctuation in length of rainy season led to fluctuation in cassava yield.

A correlation co-efficient of r χ y 0= 68 and determinant co-efficient d χ y =0.46 was obtained. This shows that 46% of changes in cassava yield could have been due to changes in length of rainy season. The remaining percentage were accounted for by all other factors.

Summary

The work has tried to Asses variation in rainfall with the hope of knowing its contribution to cassava production in Kwara state. The rainfall amount, onset cessation date and length of rainy season have been analyzed. The relationship between rainfall parameters and cassava were analyzed. The result shows that rainfall has positive relationship with cassava in the study area. The computed 6 χ y value was 0.65 which indicated that rainfall has effect on production of cassava.

A positive relationship also exist between length of rainy season with cassava yield. A correlation coefficient rxy of 0.68 was obtained. The general finding showed that rainfall had a little bit of influence on cassava production as erroneously believe that cassava is a drought resistant crop. However, for high production of cassava other climatic factors also very important.

Also for better cassava production and greater agricultural production, it is necessary from the above findings to introduce the use for proper planning in agriculture in the face of climate events. Again premium importance in term of research finding should be given to other as this holds a high percentage of influence on agriculture and cassava in particular.

Finally, for effective and improved planning strategies in judicious land use the government must have regular seminar for the farmers both at local and state level for proper awareness and techniques on this, and officers incharge of keeping data records in both yield and other weather parameters should also be educated on the importance of keeping correct and up date records in other to enhance cassava production.

Regression of Rainfall and Cassava Yield.

$$b = r = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\sum xy - \left(\sum y^2\right) - \left(\sum y\right)^2}}$$

$$= \frac{10(337170.8) - (7793.9)(418.8)}{\sqrt{10\left((6295641.6) - (7793.9)^2\right)10(18838.8)^2}}$$

$$= \frac{3371708 - 326498}{\sqrt{(42956416 - 60744877.21)(188388 - 175393.44)}}$$

$$= \frac{107622.68}{\sqrt{2211538.97 \times 12994.56}}$$

$$= \frac{107622.68}{169622.78}$$

$$= \quad 0.63$$

$$\text{dx} \qquad = 0.632 = 039$$

$$b = \frac{n\sum xy - \sum x \sum y}{n\left(\sum x^2\right) - \left(\sum x\right)^2}$$

$$\frac{10(337170.8) - (7793.9)(418.8)}{10(6295641.6) - (7793.9)^2}$$

Regression Analysis of Cassava and Length of Rainy Season

$$= \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\left(\sum xy - \left(\sum y^2\right)\right)n\left(\sum y^2\right) - \left(\sum y\right)^2}}$$

$$= \frac{10(24548.7) - (553.2)(418.8)}{\sqrt{10\left((35452.89) - (558.2)^2\right)10(19938.8) - (418.8)^2}}$$

$$= \frac{24548.7 - 231680.2}{\sqrt{(354528.9 - 306030.24)(183888 - 175393.44)}}$$

$$= \frac{13806.8}{\sqrt{48498.66 \times 18494.56}}$$

$$= \frac{13806.8}{120297.2}$$

$$= 0.63$$

dx = 0.682 = 0.46

$$b = \frac{n\sum xy - \sum x \sum y}{n\left(\sum x^2\right) - \left(\sum x\right)^2}$$

$$\frac{10(24548.7) - (553.2)(418.8)}{10(35452.89) - (553.2)^2}$$

$$\frac{245487 - 231680.16}{354528.9 - 306030.24}$$

$$\frac{13806.84}{48498.66}$$

$$= 0.28$$

$$a = \bar{y} - b\bar{x}$$

$$= 41.9 + 028\ (779\ .4)$$

$$= 41.9 + 218.23$$

$$= 260.13$$

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APPENDIX 9

Regession Analysis Between Cassava Yield And Length Of Rainy Season

YEAR	CASSAVA YIELD '000 TONS	LRS X	X^2	Y^2	XY
1986	64.2	88.3	7796.9	4121.6	5668.9
1987	34.6	38.2	1459.2	1197.2	1321.7
1988	45.4	30.9	954.8	2061.2	1402.9
1989	47.3	41.2	1697.4	2237.3	1948.8
1990	30.4	72.4	5241.8	924.2	2200.96
1991	49.2	64.3	4134.49	2420.6	3163.6
1992	37.7	80.4	6464.2	1421.3	3031.1
1993	53.4	76.3	5821.7	2851.6	4074.4
1994	27.3	28.4	806.6	745.3	775.3
1995	29.3	32.8	1075.8	858.5	961.04
	$\Sigma y = 418.8$ y = 41.9	$\Sigma x = 553.2$ x =55.3	Σx^2 = 35452.89	Σy^2 = 18838.8	Σxy = 24548.7

APPENDIX 8

Regression Of Rainfall And Cassava Yield

YEAR	RAINFALL X	CASSAVA YIELD 'Y'	X2	Y2	XY
1986	1019.2	64.2	1038768.6	4121.6	65432.6
1987	927.6	34.6	860441.8	1197.2	32094.9
1988	711.9	45.4	506801.6	2061.2	32320.3
1989	681.7	47.3	464714.9	464714.9	2237.3
1999	754.1	30.4	56866.8	924.2	36240.7
1991	736.6	49.2	541579.6	1412.3	30438.98
1992	807.4	37.7	651894.8	2851.6	51643.14
1993	967.1	53.4	935282.4	745.3	13458.9
1994	493.0	27.3	243049	745.3	13458.9
1995	695.3	29.3	483442.1	858.5	20372.3
	$\Sigma x = 7793.9$ X= 779.4	$\Sigma Y = 418.8$ Y = 41.9	Σx^2 = 6295641.6	Σy^2 = 18838.8	Σxy = 337170.74