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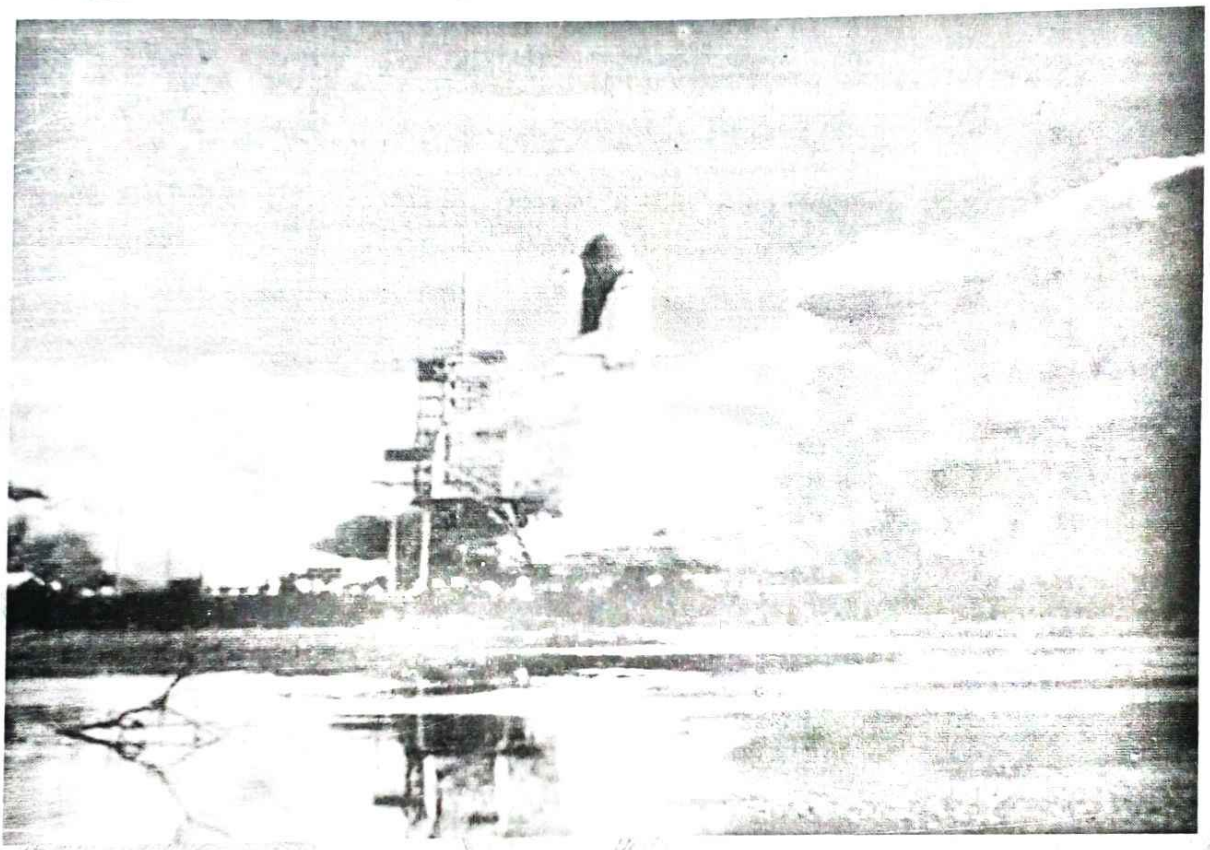

BOOK OF READINGS

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Effects of Rainfall Variariability on Cassava Production in Ilorin –East Area of Kwara State.

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Abstract
The primary focus of this study is to determine the extent to which rainfall has been affecting cassava yield in Ilorin - East Areas of Kwara State. Annual rainfall data for ten years (1991-2001) and cassava data between (11 years record) of the study area obtained were used. In analyzing the data. Attempt was made to determine how rainfall Affect the production of cassava during the period of eleven years. Thus, the mean standard deviation, cumulative index, coefficient of variance, regression analysis, onset, cessation and L R S were discussed. Also discussed were the correlation between rain fall and cassava in other to determine their relationship. The climatic parameters used as independent variable is rainfall, while cassava as the dependent variable (were correlated and analyzed to investigate the extent to which the growth and yield of cassava is being affected over the years). The result shows that rainfall amount is not the determinant factor for good yield, but how well was the distribution pattern of rain during the cropping season. In correlating length of rainy season with cassava yield for the period of the years considered, it was observed that fluctuation in length of rainy season led to fluctuation in cassava yield.

Introduction

Need for enough food in feeding the world ever increasing population has been a major concern in 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).

The pattern of rainfall distribution in any part of the world affects crop production generally. The performance of any crop around the globe depends largely on the availability and distribution of rainfall during the cropping season, particularly, the rainy season. Too much rainfall can result in flooding of cultivated lands on the other hand shortage of rainfall during season can lead to drought, which results to crop wilting and in a more serious situation leads to the death of crop plants.

Therefore, both excess and shortage of rainfall can lead to poor harvest or total loss of crops to farmers (Onwueme and Sinha1990)

Recent studies and research in respect of hydrology and meteorology in Nigeria since the period of the sahelian drought, which began in 1969, concentrated on the socio-economic aspects of environmental degration such as drought, desertification, desert encroachment, and meteorological aspects, their causative mechanisms and factors and possible method of abatement and control (Ojo 1985 and Adefolalu 1986).

However climate variability and subsequent rainfall have negative impacts on crop plants, which in turn affects the economy, the society, and the environment in which man lives.

In Nigeria like in many other parts of Africa due to the low level of Technology, we have not been able to ameliorate the most devasting influence of weather on agriculture. As

a result of this most farmer 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 production 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, 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. Therefore in 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 ©. In Nigeria, the number 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 (Manihot Esculenta Crantz) is a root tuber cassava plant which own its origin from North-East Brazil and Central America and was probably first grown for food by the American Indians in those areas. It has since spread to various parts of the world, so that today it is grown in most parts of the tropical regions.

In Africa, within the tropical belt, the greatest producers of cassava are found in West Africa and the Congo basin. Nigeria, DRC, Tanzania, Mozambique and Ghana are the leading producers.

In Nigeria, it is the staple food for more than half of 150 million estimated populations. cassava tuber like many other root crop consist of almost pure starch but cassava leaves contain about 17 percent protein and are therefore good source of proteins. 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 importance 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 is essentially a tropical crop and does well where mean temperature of 25-29^{0}C occurs. A temperature below 10^{0}C result in the cessation of growth and it is easily killed by frost. Cassava cannot strive well in swampy or water logged areas.

It leads to tuber decay or rot. However, it can survive dry season of 3-4 months through shedding of leaves and reduce growth rate (Sinba and Onwaeme 1990).

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 this paper is to examine the extent to which variation in rainfall has affected crop yield, within this broad aim, the specific objectives are:-

1. To examine rainfall variation between 1991 – 2001

2. To examine the cassava yield between 1991-2001
3. To examine the relationship between cassava yield and rainfall
4. To suggest on improved ways which could lead to high production of cassava.

Statement of Problem.

Cassava is essentially a tropical crop. It does well where mean temperature of 25-29^{0}C occur. An ample supply of manure is essential during the first one or two months after planting. It is one of the main stay of kwarans as it is in the tropical Africa. It is produced under various agro-ecological conditions, some of which are quite unsuitable for many other crops. This makes it a reliable food security crop. It is also a crop that is extensively used in trade and it is gaining more importance as a reliable crop for farming system that have a deteriorating resource base and increasingly unpredictable climate. Over the past years the production of cassava has witness a downward trend in its cultivation. The price of the crop has increased tremendously. It is therefore the purpose of the paper to look into these problems of decline in production from climatic angles holding all other factors constant.

Area of Study

Ilorin Is located on longitude 7^0 and 10^{0}E and latitude 11^{0}s 10^{0}N of the equator and lies West to East of Kwara State.

It is divided into Ilorin West, East and South. It shares common boundaries with Moro, Ifelodun and Asa local government areas. (The study area covers a vast part of Iponrin district and oke –oyi which is the headquarter of Ilorin-East local government)

Climate: - The climate of any region is composed of a great variety of elements and it is very unlikely that two different places can have an identical climate. The climate of the study area is a sub-humid type classified as the tropical wet and dry. Koppen (1971). The rainfall is relatively heavy, with June, July, September and October being the wettest months. Usually rainfall begins in March and ceases in November in the study area. In dry years rainfall begins as late as April or early May and continue until October. The harmattan dominates the months of November and December some times extending to early February in the study area.

Vegetation and soil: - The vegetation of Ilroin is thickly wooded Guinea savanna and the commonest trees include Locust bean trees shear butter bamboo etc. Most parts of the study area have sandy- loam soil but sand is the most dominant

Data Collection.

The data used were obtained from different sources. Rainfall and temperature data were collected from the Kwara State ministry of Agriculture and Rural Development (Kwara A.D.P), Ilorin. Some were obtained from the lower Niger Basin Development Authority, Ilorin. Cassava yield data and cassava rural and urban prices data were obtained from the price monitoring and Evaluation unit/ Department of Kwara A.D.P. Temperature data of the study area was collected from the kwara A.DP., Ilorin. Data on the varieties of cassava was obtained from the Agricultural and Rural Management Training institute (ARMTI) and the college of Agriculture, Ilorin.

The cassava yield data and temperature data collected were mean annual and monthly average records between 1991s and 2001 from the study are. This information is being used to determine the actual effect of rainfall variability on cassava production. Field observation

were made on some selected plots in various parts of the study area. These include Oke-Oyi, Iporin, Agbeyangi Gbadamu etc. This was profitable for first hand information on the sizes of farmlands that experienced significant or low yield as a result of the variation in rainfall in the study area.

Data Ananlysis

Different statistical methods were used in the analysis of the data, which include:- the graphical method for establishing the relationship between rainfall and cassava production (x,y). The annual mean rainfall is computed using the method below:.

Mean $x = x/n$ ---------- (1)

Where x = annual rainfall for a given period or year.

N = number of years.

The mean rainfall used as a measure of central tendency shows what is expected for each period of time

The standard deviation S-D is another statistical method used and is expressed thus:-

$$S\text{-}D = \sqrt{\frac{(X - \bar{X})2}{n}} \text{ ---------- (2)}$$

Where x = annual rainfall for a given period

$\bar{X}$ = the average monthly rainfall

N = number of years

SD = Standard deviation.

The climatic index was also used to analyse the rainfall data in the study area.

The climatic index can be expressed statistically as

$C.I = x1 - x$ ---------- (3)

Where x1 = rainfall of a particular year or period

X = mean of any station

R = standard deviation.

The implication of the index is shown in the table below

Table 1:1 Rainfall Climatic Index.

Climatic index Range	Indication
Oto – 0.5	Mild drought or dryness
Oto + 0.5	Mild wetness
0.6 to 10	Severe wetness
1 and above	Extreme wetness

Another statistical method used in this paper is regression analysis and expressed thus:-

$$\text{Regression (R)} = \frac{n\ xy - \sum x - \sum y}{\sqrt{X^2 - (x)^2 \quad \sum n\ y^2 - (y)^2}} \text{ ---------- (4)}$$

Where x = annual total rainfall of a particular year

Y = cassava yield of a particular year

N =Total number of each cases or year

Summation of figure

Discussion of Result

This section examines the detailed analysis of rainfall for the years under consideration as well as rainfall variation. It also considers both monthly and annual rainfall and departure from the mean, the trend in the climatic indices were also examined. Also discussed is the relationship between cassava and rainfall, the effects of rainfall on cultivation of cassava in the study area.

Patterns of Rain Fall Distribution

The mean annual rainfall differs from year to year for instance the yearly annual rainfall in Ilorin range from 534.8mm – 1853.65mm. In the year 2001, Ilorin recorded rainfall amount of 1853.65mm. This year marks the highest rainfall amount recorded during the study period. The year 1996 recorded the lowest rainfall amount of 534.8mm. The year under review have a rainfall range of 1318.85mm.

Between 1996 and 2001 the response to cassava yield seems not to tally with the rainfall amount (see table 1.3 fig 1.3 and 1.4) Despite the fact that annual rainfall amount in 1996 was the lowest, 301.60 ('000) tone of cassava was produced if compared with the year 1997 which has the second highest rainfall amount of 1740.1m with only107.08 ('000) tons of cassava production. (Table 1.2, Fig 1.2 and 1.5). Therefore it is note worthy that annual amount is not as important as the spread of rainfall for agriculturual productivity.

Rainfall Variation in Ilorin

Rainfall variability is accepted as a major factor which determine or control crop production. The onset and cessation dates of rainy season are very significant in agricultural activities.

The study area naturally experience two seasons, the dry and rainy season. Dry seasons which mostly the harvesting period of many crops including cassava start from November to March. However, in years 1994 and 2001 the study area experienced a steady and well distributed rainfall from March to October.

Area of Cassava Production and Yield

The physical field visitation to the study area did not give the quantity of cassava harvested however the data available shows that the year 1990 recorded the highest cassava yield of 13.40 ('000) tons per hectare. This is followed by the year 1998 and 2000 with 12.94 ('000) and 12.46 ('000) yield tons per hectare respectively.

The year 1997 and 1993 recorded the least cassava yield of 8.78 (000) tons per hectare and 9.43 ('000) tons per hectare respectively. While the year 1997 recorded the lowest crop yield (8.78) per hectare, the year 2000 produced 498.46 tons total amount of cassava and got the highest crop yield of 40.7 tons per hectare (see table 1.3).

Cassava Yield in Relation to Rainfall

Rainfall is the most important climatic Factor influencing cassava production in the tropics and the study area in particular, as it has the biggest effect in determining the potential of any area (see appendix 1). As already mention earlier, it is not the total amount of rainfall per annum only that is sufficient for either high or lower production of cassava, but also its seasonal distribution, its variability, reliability within and between season, its intensity and rate of infiltration into the soil, and the balance between rainfall and

evapotranspiration. The regression analysis of the result shows that the regression is 0.00128 which is as a result of the variation in annual rainfall situation (Appendix 5). From the analysis it is seen that rainfall was not the only factor affecting cassava production, but there are other factors.

Summary.

This paper has tried to Access variation in rainfall with the hope of Knowing its contribution to cassava production in Ilorin Area of Kwara State. The climatic variable measured in this study is rainfall, which has been observed to play a significant role in cassava production. The amount of rainfall seems to fluctuate from year to year in the study area.

The crop used is cassava due to its fluctuating nature in the study area over the years. Both the mean and standard deviation of rainfall were computed. As shown from deviation from the mean, the rainfall figure of Ilorin has a positive correlation coefficient with cassava production.

From the data obtained on cassava yield, it is obvious that the areas of high rainfall amount but not well distributed throughout the cropping season, and with low number of rainfall days annually have low cassava yield. It is also very important to note that low amount of rainfall over the years but covering many days will ensure high yield.

Based on this information, the farmers in the study area and the agricultural planner in the study area can take the advantage of putting the land area into cassava cultivation during the middle of the rainy season which may be of economic benefits to commercial farmers. The government at all level should train and employ agro-meteorologist who will be able to detect and determine phenomena and issue out early warning to farmers.

Finally the Federal Government in her bid to export cassava products should draw and carry out programme that will involve the majority of the farmer in the study area. In this regards, the Federal government should set up machinery that will monitor the production of this crop in virtually all the areas where this crop is cultivated in the country.

Table 1 : 2 Annual Mean Rainfall (MM) and Temperature ^{0}C) 1999-2001

Years	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Rainfall (mm)	869.9	1085.05	1138.12	1085.02	1211.75	534.8	1704.1	1103.7	1292.3	946.7	1833.65
Rainy days (numbers)	N.A	71	74	70	76	N.A	85	72	80	56	57
Maximum Temperature (0C)	31.7	34	33.6	34.05	33.44	32.7	32.86	35.65	34.82	37.93	40.06
Minimum Temperature (0C)	22.7	25	22.4	21.75	24.58	26.2	24.45	21.3	21.89.	22.08	19.79

Source: P.M.E Dept Kwara ADP Weather survey 1991-1992

Table 1.3 Crop Area and Yield Data of Cassava in Ilorin 1991-2001

	Crop (cassava)	Tons ('000)	Hectare
1991	Production	365.2	39.88
	Yield	10.1	
1992	Production	349.09	35.02
	Yield	10.73	
1993	Production	295.6	29.01
	Yield	369.5	
1994	Production	10.27	23.09
	Yield	294.3	
1995	Production	11.17	26.01
	Yield	301.6	
1996	Production	301.6	26.7
	Yield	11.16	
1997	Production	107.8	10.74
	Yield	8.78	
1998	Production	383.46	29.65
	Yield	12.9	
1999	Production	461.96	37.91
	Yield	13.4	
2000	Production	498.46	40.71
	Yield	12.46	
2001	Production	321.82	29.36
	Yield	10.79	

Source: KWADP. P.M.E CAYS 1991-2001

APPENDIX 1
RELATIONSHIP BETWEEN RAINFALL (MM) CASSAVA PRODUCTION (TONS) OF ILORIN BETWEEN 1991 -2001

Year	Annual Rainfall (mm) (x)	Cassava production ('000) (Tons) (y)
1991	869.9	368.62
1992	1085.9	349.09
1993	1135.12	295.6
1994	1085.02	369.5
1995	1211.78	294.3
1996	534.8	301.6
1997	1704.1	107.08
1998	1103.7	383.46
1999	1292.3	461.96
2000	946.7	498.46
2001	1853.65	321.82

Source: KWADP PME Dept, 1991-2001

APPENDIX 2
AVERAGE MONTHLY RAINFALL DISTRIBUTION DATA (MM) IN ILORIN 1991-2001

Year	Jan	Feb	Marh	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual Total (mm)
1991	33.5		N.A	N.A	214.7	176.3	285.7	N.A	N.A	159.7	N.A		869
1992	.		30.1	69.2	160.6	122.1	175.6	115.5	339.6	618	6		1085
1993		3.6	42.2	31.95	141.4	133.6	146.5	205.02	299.6	117.2	17.05		1138.1
1994	12.04	23.1	30.4	78.75	108.1	180.78	158.69	118.14	200.52	173.6	0.9		1085.0
1995			47.47	76.1	150.8	164.1	138.48	200.7	227.78	163.2	29.13	14.02	1211.7
1996	N.A	N.A	NA	68.9	178.6	180.4	106.9	NA	NA	NA	N.A	N.A	534
1997	41.6		96.8	187.8	209.2	382.5	159.9	142.2	309.9	137.2	37		1704
1998		4.5	34.1	74.7	194.3	204.4	106.9	178	178.8	128			1103
1999		52.5	65.6	81.5	132.3	195.8	192.4	181.1	196.4	173.8	20.9		1292
2000			23.4	42.2	125.2	156.1	53.5	203.8	265.4	77.1			946
2001			38.05	70.38	117.7	95.28	121.6	149.46	194.55	65.56	2.4		1853.6

Source: PME Department, Kwara A.D.P Weather survey 1991-2001.

APPENDIX 3

MEAN (X) = 1165.99

Year	Total Rainfall	Mean	Standard Deviation	C.I = X-X	Total from Mean
1991	869.9			-0.8	-296.09
1992	1089.9			-0.2	-76.09
1993	1138.12			-0.1	-27.87
1994	1085.02			-0.2	-80.97
1995	1211.78	1165.99		-0.1	45.75
1996	534.5		363.82	-1.7	-631.19
1997	1704.1			-1.5	538.10
1998	1103.7			-0.1	-62.29
1999	1292.3			-0.3	126.30
2000	946.7			-0.6	-129.29
2001	1853.65			-1.9	687.65
Total	12825.97				

Source: the Researcher

APPENDIX 4

MEAN (X) : 341.04

Year	Total Rainfall	Mean	Standard Deviation	C.I = X-X	Total from Mean
1991	368.62			-0.3	-27.58
1992	349.07			-0.0	8.05
1993	295.6			-0.4	-45.44
1994	369.5			-0.3	-28.46
1995	294.3	341.04		-0.5	-46.74
1996	301.6		100.97	-0.4	-39.44
1997	107.08			2.3	-233.96
1998	383.46			-0.4	-42.42
1999	461.96			1.2	120.92
2000	498.46			-1.5	157.42
2001	321.82			-0.2	-19.22
Total	3751.49				

Source: The Researcher.

APPENDIX 5

ANNUAL RAINFALL AND CASSAVA YIELD

Year	X Annual Rainfall	X^2	Y Cassava Yield ('000)	Y^2	XY
1991	869.9	756726.01	368.62	135880.70	320662.54
1992	1085.9	1179178.81	349.09	121863.82	379076.83
1993	1138.12	1293317.13	295.6	87379.36	336428.27
1994	1085.02	1177268.4	369.5	136530.25	400914.89
1995	1211.78	1468410.71	294.3	86612.49	356626.85
1996	534.8	286011.04	301.6	90962.56	161295.68
1997	1704.1	2903956.81	107.08	114666.13	182475.03
1998	1103.7	1218153.69	383.46	147041.57	423224.80
1999	129.3	1670039.29	461.96	213407.04	596990.91
2000	946.7	896240.89	498.46	248462.37	411892.08
2001	1853.65	3436018.32	321.82	103568.11	596541.64
Total	12825.97	16287321.16	3751.49	1383174.4	48116498.2

$X = 12825.97$

$X^2 = 16287321.16$

$Y = 3751.49$

$Y^2 = 1383174.4$

$XY = 48116498.2$

$$R = \frac{n(x\text{-}y) - (x\text{-}y)}{\left[n x^2 - (x)^2\right]\left[n y - C\text{–}D^2\right]}$$

$$R = \frac{10(48116498.2) - 12825.97 - 3751.49}{\left[10(16287321.14) - 164505506.4\right]\left[10(1383174.4) - 14073677.22\right]}$$

$$= \frac{481164982.0 - 16577.46}{1622295 \times 241933.22}$$

$$R = \frac{481148404.5}{3.949 \times 10^{11}}$$

$$= 1.2184 \times 10^{-3}$$

$$= 0.0012184$$

$$R = 0.001215$$

Fig 1.3

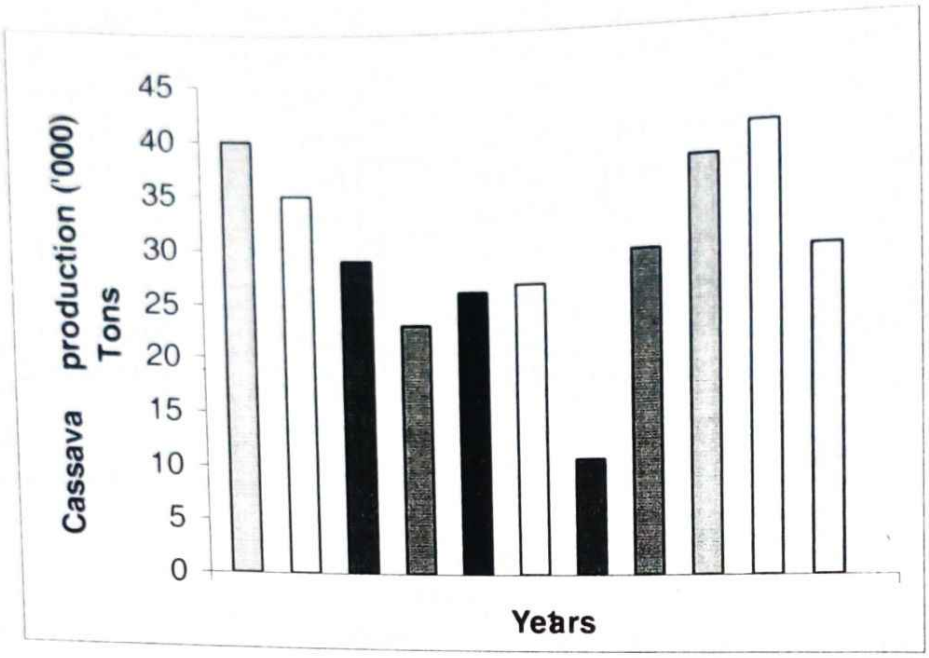
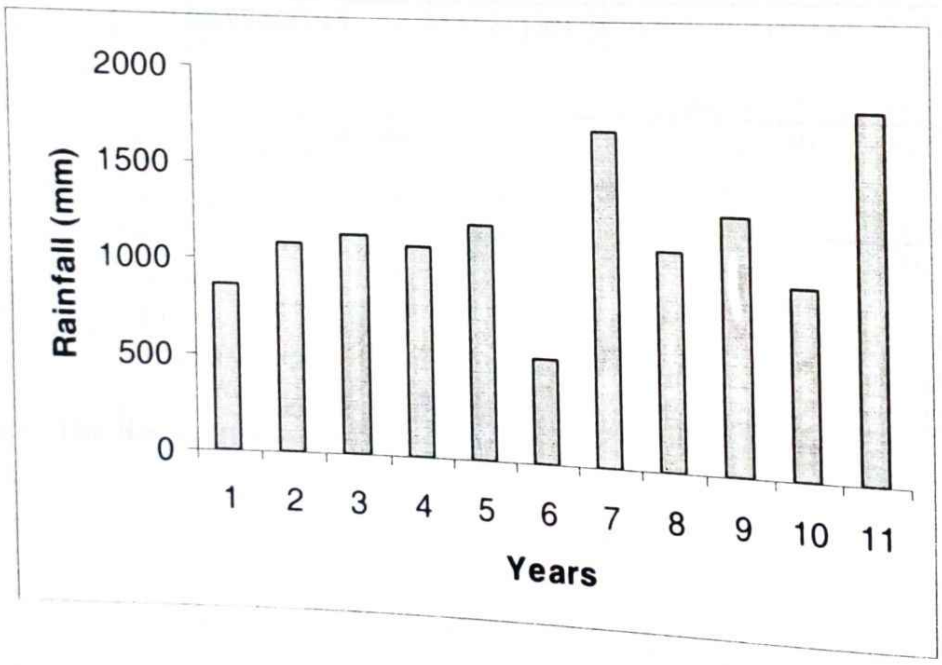

Cassava production ('000) Tons
45
40
35
30
25
20
15
10
5
0
Years

Fig 1.4


Rainfall (mm)
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11
Years

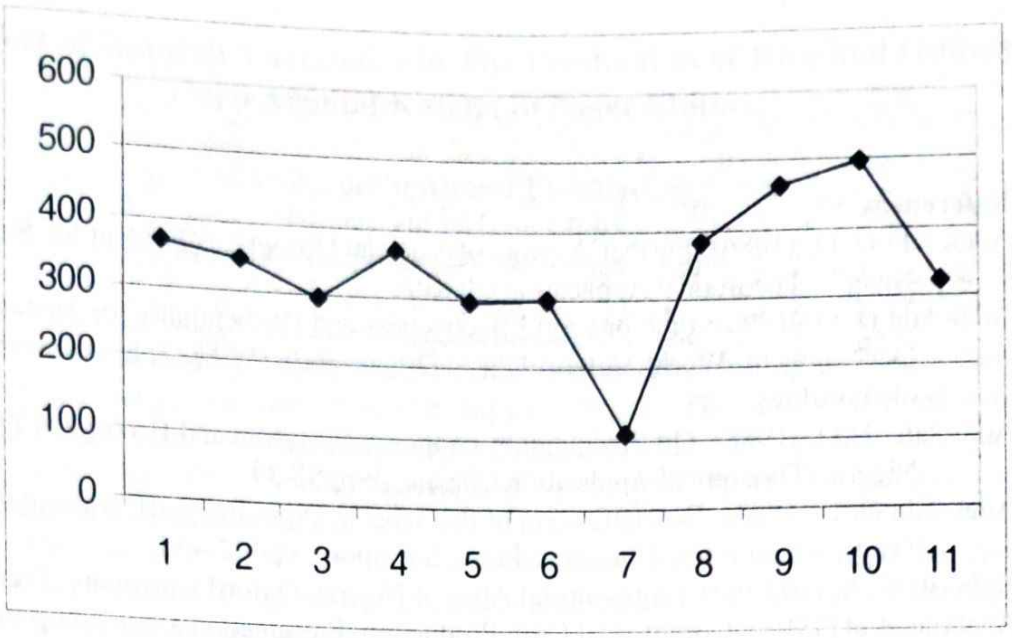
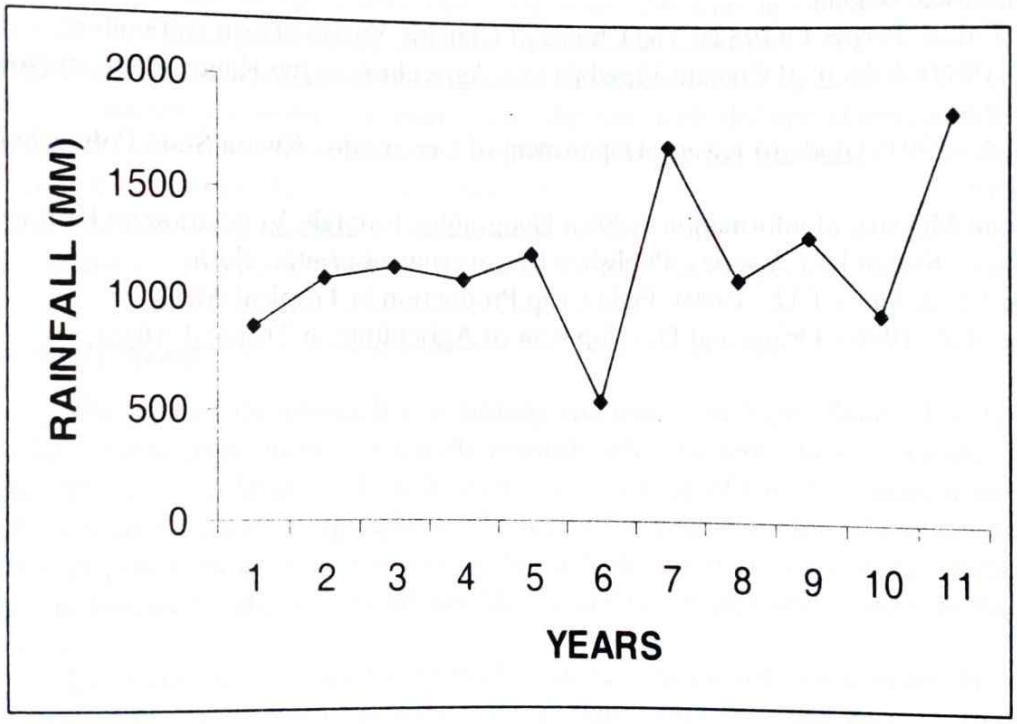


Fig 1.1

YEARS

Fig 1.2



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