EFFECT OF RAINFALL VARIABILITY ON CROPS PRODUCTION IN OYO STATE, NIGERIA (1990-2009)

Akinniran, T. N[1]. Ezekiel A.A[2], Ganiyu, M.O[3], Adeyemo. S.A.[4]

[1,2&3]Department of Agricultural Economics, LAUTECH, Ogbomoso, Oyo State

[4]Department of Agricultural Technology, Oyo State College of Agriculture Igboora, Oyo State

tnakinniran@lautech.edu.ng

Abstract: This study examines effect of rainfall variability on crops production for the periods of 1990 and 2009 in Oyo State, Nigeria. Secondary data was used for this study, the data on seasonal output of maize, yam, cassava and cowpea and also total annual rainfall for the periods under consideration were collected. These data were analyzed with graphs and mean. The mean values for five years interval (1990-1995, 1996-2000, 2001-2005 and 2006-2010) were 1228.040, 1307.080, 1308.420 and 1258.124(mm) respectively. It indicates that for the past twenty years the effect of climatic variability on the annual rainfall distribution is not obvious because of little gap in the mean values within the interval of five years. Graphical representations of annual output of crops versus annual amount of rainfall distribution show that the output of maize varies significantly with the annual rainfall distribution while the output of yam between1992 and1996 followed the pattern of rainfall distribution but from 1997 to 2009, the outputs of yam do not follow the trend again. Furthermore, there is no observed nexus between the cassava output and the annual rainfall distribution that is, rainfall variability has no effect on the cassava productivity. Finding also reveals that cowpea outputs and annual rainfall are initially commoved along the same trend but later the pattern is no longer moving towards the same direction. Base on this finding, it was found that the low crop yield witnessed from the output of farms produce should not be attributed to rainfall variability alone other factors such as land degradation, low soil fertility, untimely planting, improper selection of cropping system, diseases and pest infestation could also cause damage and low yield of crops on the farm.

Key words: rainfall pattern, climatic variability and crops production.

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1. Introduction

Agriculture, particularly the crop sub-sector has ever since the beginning of life served as man's supplier of foods. Agricultural practices exist in the rural economy which is characterized by low income, poor infrastructural facilities, and low level of education in terms of adequate record keeping and measurement of the farm produce. Agriculture remains the mainstay of Nigerians' economy despite its decline during the oil boom of the 1970s that heralded the petrol dollar era, it provides about 42 percent of Nigeria's gross domestic product (GDP) of which crop sub-sector takes larger percentages, main source of food for most of the population, 50 percent of total employment and the bulk of raw materials used by the mainly agricultural-based industrial sector (Zenith Bank, 2009).

The effect of climate change on agricultural system can be seen in the interaction between changes in climate variables and the stresses that result from actions taken to increase agricultural production. Impacts on crops yield, agricultural productivity and food security vary depending on the types of agricultural practices (Watson *et al.*, 1997). There is a growing evidence that further increases in global warming would lead to changes in main climate variables – temperature, precipitation, sea level rise, and atmospheric carbon dioxide content may significantly affect African agricultural production (Watson *et al*, 1997). Thus, the importance of focusing on the impact of weather-related shocks on food crop production context cannot be overemphasized. The local farmers are experiencing climate change even though they have not considered its deeper implications. This is evidenced in the late arrival of rain, the drying-up of stream and small rivers that usually flows year-round, the seasonal shifting of the "Mango rains" and of the fruiting period in the Southern part of Oyo State (Ogbomoso), and the gradual disappearance of flood-recession cropping in riverine areas of Ondo State are among the effects of climate disturbances in some communities of South-Western Nigeria (BNRCC, 2008).

Crop production is an integral part of agriculture dealing with the cultivation, protection, harvesting and storage of cultivated plants for man's use. It is the sum total of all activities involved in producing, preparing and processing of agricultural crops (Akanbi et al, 2004) Arable crops are staple agricultural food crops which provide the required nutrients for man and livestock. Within the agricultural sector itself, the crops (arable and tree) production sub-sector is the largest, with arable crop production dominating about 30 percent of overall GDP. The arable crop sub-sector is particularly important not only because of the size and employment generation potentials, but also because it supplies food and therefore has the potential for dampening the rate of inflation since the price of food accounts for about 60 percent of the overall rate of inflation (Central Bank, 2000). Arable crops are important food items to the livelihood of millions of people providing nourishment and generating income. However, Nigeria produces a wide variety of arable crops most of which are consumed as food, the major food crops include rice, maize, cassava, yam, sorghum, millet and cowpea and the minor ones are cocoyam, melon, sweet potato and plantain. Other arable crops which double as industrial and food crops to some extent also include groundnut, cotton and beni-seed (Akinyosoye, 2005). With climate change, food and water supplies will become unreliable and insecure and the available arable land reduced causing population movements by making certain parts of the world much less viable place to live (Brown, 2008). Agriculture is by far the most significant user of water resource (UN Research, 2009). Agriculture has faced obvious challenges and the foremost problem of the sector in Nigeria is that it is still largely informal, subsistent, rain-fed and lacking mechanization. Also, the natural resource base on which agriculture depends is poor and

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deteriorating and consequently experienced stunted growth, between 1970 and 2008 the sector grew at about 1.7 percent per annum on the average, a growth rate that is not commensurate with a population growth rate of 2.7 percent. Of course, the degree of reliance on rainfall by Nigerian farmers is absolute and it is posting more problems in area of food production, food security and sustainable agriculture. The agricultural practices depend on natural weather patterns, so also variations in rainfall levels result in large variations in total output and farm incomes and again changes in rainfall will also increase variability in groundwater recharge and river flow, hence affecting all water sources. However, the rainfall characteristics in Nigeria have been examined for secular change that is, dominant trend notably by (Olaniran *et al*, 2001) and by (Olaniran, 2000) and the results show that there has been a progressive early retreat of rainfall over the whole country spanning up to a half a century now and consistent with this pattern there has also been a significant decline of rainfall frequency that is, the number of rain days in September and October which respectively coincide with the end of the rainy season in the northern and southern parts of the country. Furthermore, the combined effect of these declines was found to lead to a significant decrease in annual rain days over the whole country. In effect, except farmers change to early maturing crop varieties, streamline their farming calendars with the changing rainfall regime or have access to irrigation water, the secular changes in rainfall frequency for the country pose serious threat to the maturity of annual crops and consequently to food security for the nation.

1.1 Objectives of the Study

The general objective of this study is to determine the effects of rainfall distribution and variability on the arable crops production over years in Oyo State with a view to pointing out policy recommendations based on the findings of this study. And the specific objectives are to: (i) identify the pattern, trend and characteristics of rainfall over years , (ii) determine the effect of climatic variability on rainfall distribution pattern and (iii) analyze the relationship between the arable crops output and the annual rainfall distribution in the study area.

1.2 Hypothesis of the Study

Ho: There is no significant relationship between the annual output of arable crops production and the annual rainfall distribution pattern.

2. Methodology

This research was conducted in Oyo state, Nigeria. The state is located in the Southwestern part of the country, it consist of thirty three (33) Local Government Areas grouped under four (4) Agricultural Zones of Oyo State Agricultural Development Programme (OYSADEP), these are; Ibadan-Ibarapa, Oyo, Saki and Ogbomoso Zones. Oyo state covers a total land area of about 27,249,000 square kilometers with a total population of about 5.6 million (National Population Commission, 2006). It is situated between Latitude 7^{o} N and 19^{o}N and Longitude 2.5^{o}E and 5^{o}E of the meridian. The state is predominantly agrarian, annual mean rainfall is above 1000mm and the rainy season in the state average eight months in a year. Rain starts in Oyo state during the first week of March with storms. Mean temperature varies from daily minimum of 18.9^{0}C to a daily maximum of 35^{0}C. Humidity is quite high, about 70 percent with a maximum of about 60 percent in the evening and a maximum of around 80 percent in the morning. The settlement pattern indicates that so many people of various Nigerian ethnic backgrounds reside in Oyo state. However, Nigerians with Yoruba ethnic background

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constitute the majority of the population of the state. The primary occupation of the people is farming at subsistence and semi-commercial units which depend mostly on rainfall as the chief source of water supply; that is the farmers in Oyo state cultivate land at the expense of rain. The prevailing vegetation type in Oyo state is that of Guinea Savanna woodland which is characterized by species of *Derived Savanna* especially the Oyo and Saki zones while Ibadan – Ibarapa zone is a Tropical rain forest. Secondary data were obtained from Oyo State Agricultural Development Programme (OYSADEP) Office and Meteorological stations located at International Institute of Tropical Agriculture (IITA) Ibadan. The data on annual rainfall distribution in Oyo State for the periods of 1990 and 2009 were collected from the meteorological office at IITA while the seasonal total production (outputs of four major arable crops namely: maize, yam, cassava and cowpea) growing within the state were obtained from OYSADEP for the periods of 1990 and 2009. These data was used to assess the effect of rainfall fluctuation as a result of current climatic variations on the arable crops production during the last decade in Oyo state. The data were analyzed using descriptive statistics graphs and five yearly averages to know the trend of effect of rainfall distribution on the output of selected crops.

3. Results and Discussions

3.1 Annual Rainfall Distribution for Oyo State between the years 1990 and 2009

The result of the graphical method (figure 1) shows that annual rainfall for the periods of 1990 and 2009 vary minimally, there is no obvious pattern in the distribution as shown in the figure. This implies that there is little disparity in the amount of rainfall in the past twenty years within the state. For example, in 1990 the amount of rainfall was 1150mm and it increased in 1991 to 1400mm and dropped again in 1992 to 1180mm, the distribution of rainfall varied in this pattern until 1995 when the amount was further raised to 1450mm, but between 1996 and1997 there was a steady decline in the amount. However, there was a drastic reduction (760mm) in the amount of rainfall in the year 1998. It continues fluctuating in this way till 2009, that is, it m a definite pattern meanwhile the state received the maximum rainfall in year 2000. Generally, it implies that the annual amount of rainfall in Oyo state is not stable and this reflects on the yield of arable crops produced yearly in the state.

3.2 The Result of Yearly Average of Rainfall Distribution

In order to examine the effects of climate change on rainfall distribution in Oyo state, five yearly averages used and the result shows that for the five years difference there is a little variation in the trend of rainfall distribution, that is, for the years 1990 - 1995, 1996 - 2000, 2001 -2005 and 2006 -2010, the mean values were 1228.040, 1307.080, 1308.420 and 1258.1249(mm) respectively as shown in the table 1 below. The result also indicated that for the last twenty years the effects of climatic variability on the annual rainfall distribution is not obvious because there is small difference in the mean values and the total amount of rainfall within the five years interval. The implication of this result on the arable crops production is that the yields will be redundant.

3.3 Relationship between the Annual Output of Crop and Rainfall Distribution

The third objective is to determine the relationship between the arable crops production and the rainfall distribution for the periods of 1990 and 2009 in Oyo state. For this, graphs of annual rainfall versus total seasonal crops output for each year were plotted to show the pattern and trend, with the mind that rainfall variability due to current climatic changes will impact the crop production and to actually infer the impacts of precipitation on the annual output of some arable crops grown in Oyo state. Figure 2

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shows the relationship between the annual rainfall (mm) and maize output (metric tons) for the years between 1990 and 2009. It can be observed that the annual output of maize varies significantly with the annual rainfall distribution, while figure 3 shows that for few years (1992 to1996) yam outputs followed the pattern of rainfall distribution and starting from 1997 to 2009 the outputs of yam fell out of the trend. For cassava, as shown in the figure 4 there is no observed nexus between the cassava outputs and the annual rainfall distribution that is rainfall variability has no effects on the cassava productivity and it agrees with a research carried out in Ilesa, Osun state by Ezekiel *et al* (2012). The study revealed that the quantity of cassava harvested was disputed with the current effects of climate change. And lastly, figure 5 shows the relationship between the cowpea outputs and annual rainfall and initially they commoved but later move separately in the different direction. Similar study on cowpea carried out in Nigeria by Ajetomobi *et al* (2010) revealed that there is a positive relationship between cowpea output and precipitation in all Southern states in Nigeria except Kwara, this implies that increase in precipitation will lead to increase in yield in the Southern part except Kwara State.

4.1 Summary and Conclusion

This study was conducted in Oyo state to investigate the effects of seasonal rainfall distribution on arable crops production. The findings show that the annual rainfall distribution has no obvious pattern and trend, the state witnessed a minimum (760mm) amount of rainfall in 1998 and the maximum (1500mm) in the year 2000. Also, the result revealed that there is little variation in the mean values of annual amount of rainfall. For periods between 1990 and 1995, 1996 - 2000, 2001 -2005 and 2006 -2010, the mean values were 1228.040, 1307.080, 1308.420 and 1258.1249 (mm) respectively. Also, annual output of maize varies significantly with the annual rainfall distribution, though from 1997 to 2009 the outputs of yam fell out of the trend. For cassava, as shown in the figure 4 there is no observed nexus between the cassava outputs and the annual rainfall distribution that is rainfall variability has no effect on the cassava productivity. Those crop whose yield was most sensitive to rainfall variability was yam while maize, cassava and cowpea were least sensitive to rainfall variability, and this may be due to the facts that maize as a crop can be irrigated on a well leveled soil and in the case of cassava and cowpea, these crops are more tolerant to weather changes and they are grown in the area where yam and maize cannot be cultivated. Also, a substantial proportion crops produced at fadama sites that is, poorly drained or swampy valley bottom locations, where soil water is available for plant growth for a period much longer than the rainy season. These practices are probably responsible for the lower sensitivity of maize, cassava and cowpea outputs to rainfall variability. In conclusion, the observation that crops yield were in general not strongly affected by seasonal rainfall variation in Oyo state is confirmed by the mean annual rainfall and the result of exponential functional analysis, both of which revealed that there is little variation in total seasonal rainfall distribution and consequently indicates little effect on crop productivity in the state.

4.2 Policy Recommendations

Based on the findings of this study, the following recommendations were made;

(i) The farmers should continuously adopt the various mitigating factors and adaptations in order to ensure optimum crops yield and to reduce the households' vulnerability to adverse effect of climate change particularly in Oyo state.

(ii) Farmers should not attribute the low yield they witnessed from the output of their farms produce only to rainfall variability instead they must be encouraged to look into

other factors such as low soil fertility, untimely planting, improper selection of cropping systems, diseases and pest infestation among others.

(iii) Farmers should be guided on the time to cultivate their farms at the expense of downpour each year since most farmers do not have access to irrigation, they propagate rain-fed agriculture.

(iv) Since rainfall distributions in the state have no definite pattern and trend, it therefore becomes imperative that water resource development should be focused on efficient utilization of agricultural land this calls for stern government policy on harnessing and controlling of the water resource

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Table 1: The Result of Yearly Average Rainfall Distribution

Annual rainfall (mm)	Minimum(mm)	Maximum (mm)	Total (mm)	Mean values (mm)
1990-1995	1078.4	1413.4	6140.2	1228.040
1996-2000	794.3	1653.0	6535.4	1307.080
2001-2005	1119.6	1495.5	6542.1	1308.420
2006-2010	1039.0	1400.8	6290.6	1258.124

Source: Field Survey, 2011

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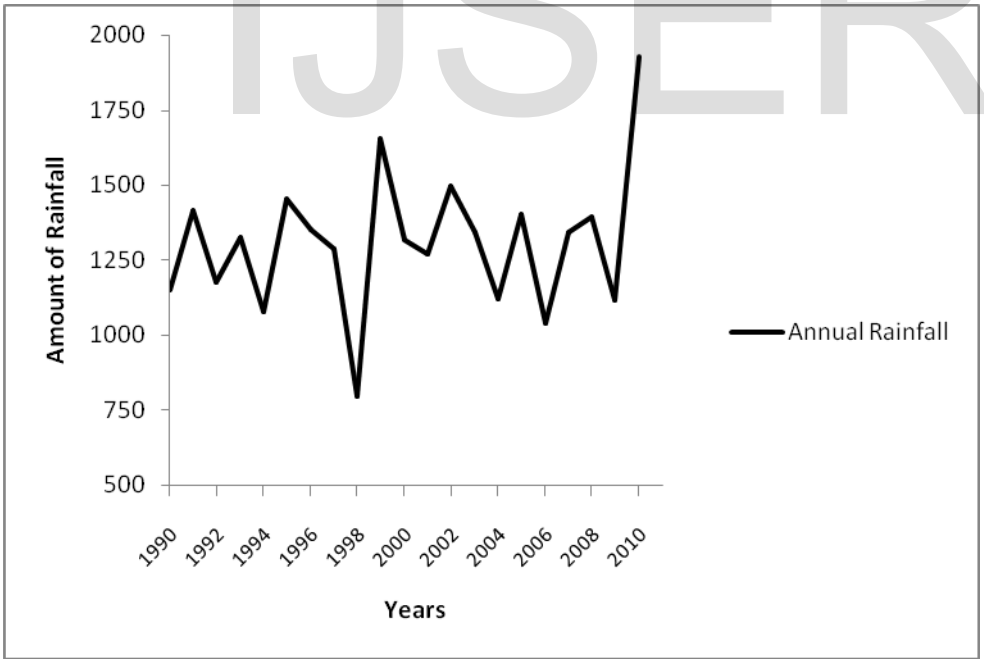

Figure 1: Annual Rainfall Distribution for Oyo state between the years 1990 and 2009

Source: Field Survey, 2011

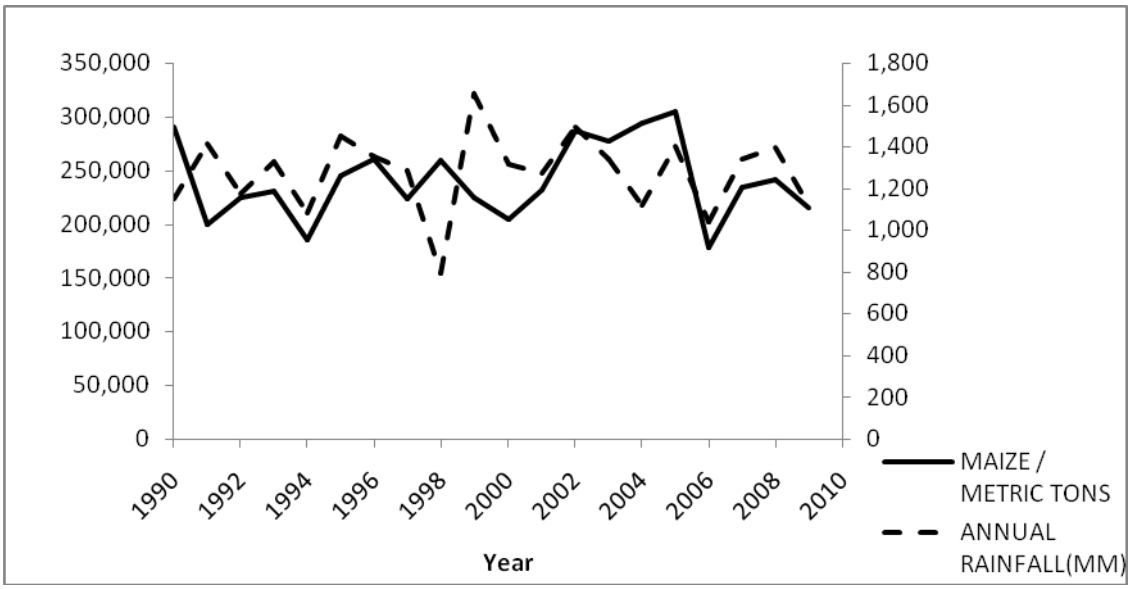

Figure 2: Annual Rainfalls and Annual Maize Output

Source: Field Survey, 2011

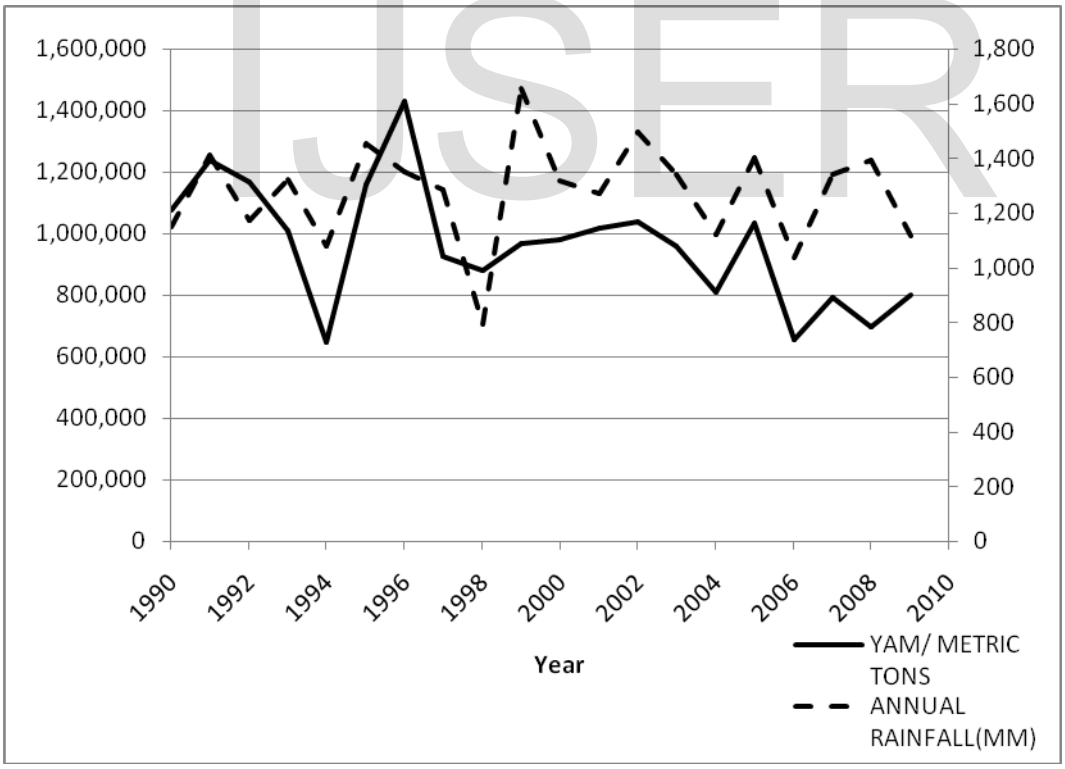

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Figure 3: Annual Rainfall and Annual yam Output

Source: Field Survey, 2011

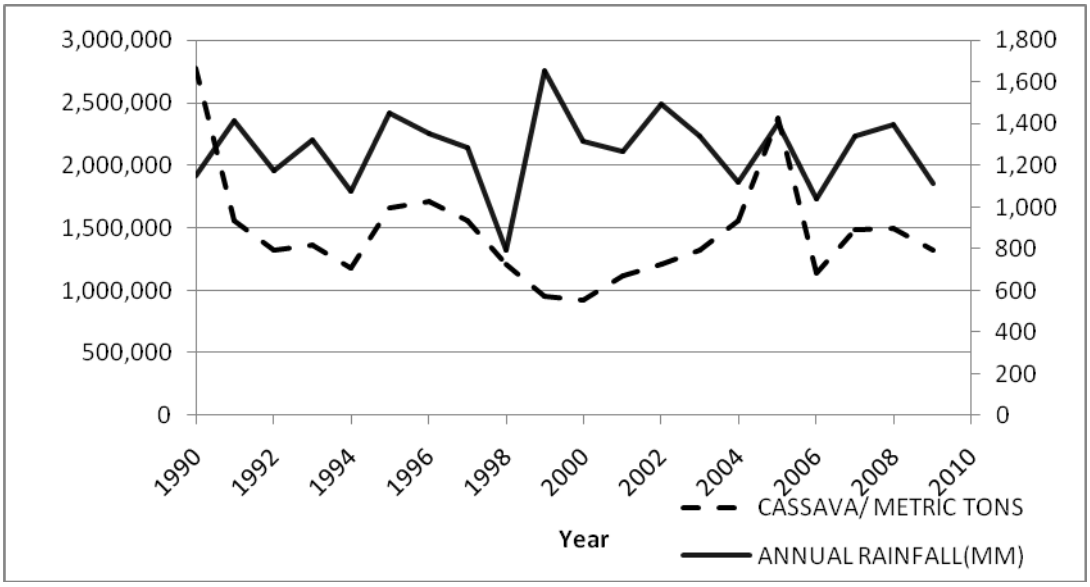

Figure 4: Annual Rainfall and Annual cassava Output

Source: Field Survey, 2011

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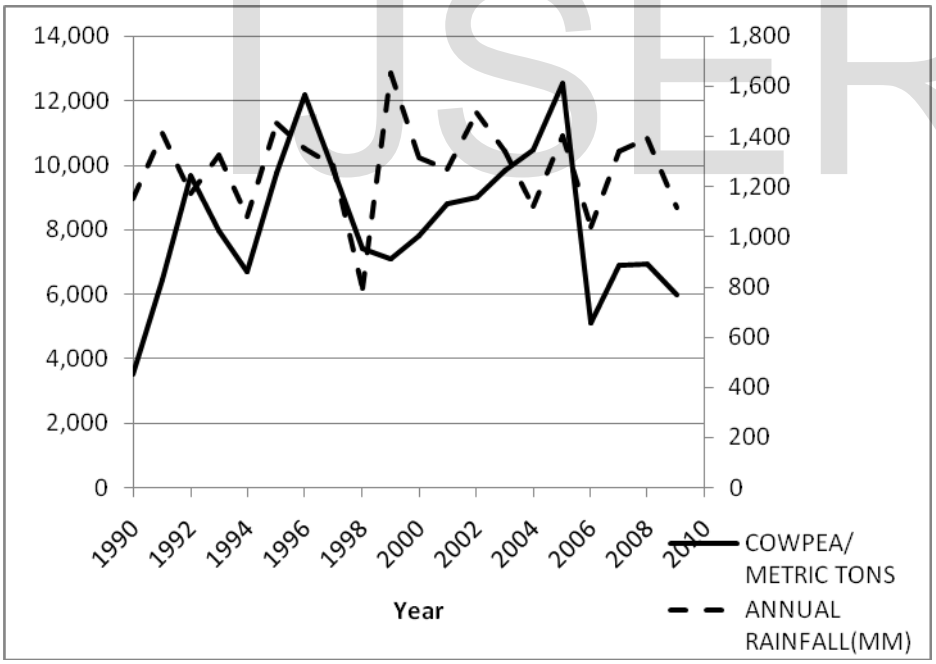

Figure 5: Annual Rainfall and Annual cowpea Output

Source: Field Survey, 2011

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