Rainfall Pattern And Trend On Arable Crops Production In Oyo State, Nigeria (1990-2009)

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

[1]Department of Agricultural Economics, LAUTECH, Ogbomoso, Oyo State
[2]Department of Agricultural Technology, Oyo State College of Agriculture Igboora, Oyo State
muibatdeen@yahoo.co.uk

Abstract: This paper examines the implication of rainfall pattern and trend on arable crops production for the periods of 1990 and 2009 in Oyo State, Nigeria. Secondary data was used for this study, the data on annual 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, analysis of variance, time trend and simple regression model. ANOVA result shows that there is no obvious nexus in the amount of annual rainfall within five years interval. The results also show that the annual output of maize varies significantly with the annual rainfall distribution and the output of yam between1992 and1996 followed the pattern of rainfall distribution but from 1997 to 2009, the outputs of yam did not follow the same trend with the rainfall distribution. 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. Time trend analysis showed that time as a variable factor has a positive relationship with the amount of rainfall and its coefficient of 0.013 indicates that a unit increase in time variable would lead to 1.3% increases in rainfall amount. The outputs of crop each and annual rainfall was regressed and show positive coefficients for the four crops, therefore, it implies that for each crop, 1% increase in annual rainfall would lead to 12.1%, 52.6%, 7.2% and 56.2% increase in seasonal output of maize, yam, cassava and cowpea respectively. Base on this finding, it is concluded that the low crop yield witnessed from the output of farms produce should not be attributed to rainfall variability alone other factors such as 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.

Ganiyu, MO, Akinniran, TN, Adeyemo. S.A. **Rainfall Pattern And Trend On Arable Crops Production In Oyo State, Nigeria (1990-2009).** *World Rural Observ* 2013;5(2):7-11]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online). http://www.sciencepub.net/rural. 2

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

1. Introduction

In many countries, and virtually every less developed country, agriculture is the biggest single industry. Agriculture plays significant role in every country as it contributes to three fundamental aspects of development: national food security, national social and economic stability and environmental protection. It provides not only food but also raw materials for manufacturing industries like textiles, sugar, vegetable oil, jute and tobacco among others. In addition all the countries of the world import and export large number of agricultural products which brings about economic development of the world, (Alabi and Alabi, 2009). 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 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 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. Hence, the volatility of agricultural output due to rainfall fluctuation can mean a large burden for the low-income farming households (John *et al.*, 2007).

1.1 Objectives of the Study

The broad objective of this study is to determine the effect of rainfall distribution pattern on the output of 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 study was carried out 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 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 graphs, analysis of variance, time trend and simple regression model in order to capture the objectives of this work. ANOVA was used to know if

there is a significant difference in the amount of rainfall within the interval of five years within the study periods. The time-trend analysis was used to show trends in rainfall distribution between the periods of 1990 and 2009 while simple regression model was used to determine the relationship between the annual rainfall distribution and the total annual output of each of the four selected arable crops (viz: maize, yam, cassava and cowpea). The annual output of each crop represents the dependent variable while the annual amount of rainfall is the independent variable. The regression model was fitted in exponential function as below:

$Q_t = e^{bx}$ ---------- (1)

This has been used by Onyenweaku, (2004); and Okoye *et al.*, (2006) and it is linearized as;

$LnQ_t = b_o + b_1X_t + \mu$---------- (2)

Where Q= annual crops output (maize, yam, cassava and cowpea as the arable crops which are measured in metrictons).

LnQ_t = natural logarithm to base 10 of annual crops output in time t

b_o = constant term

b_1 = coefficient estimate and

X_t = annual rainfall (mm) in time t

μ= error term.

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.

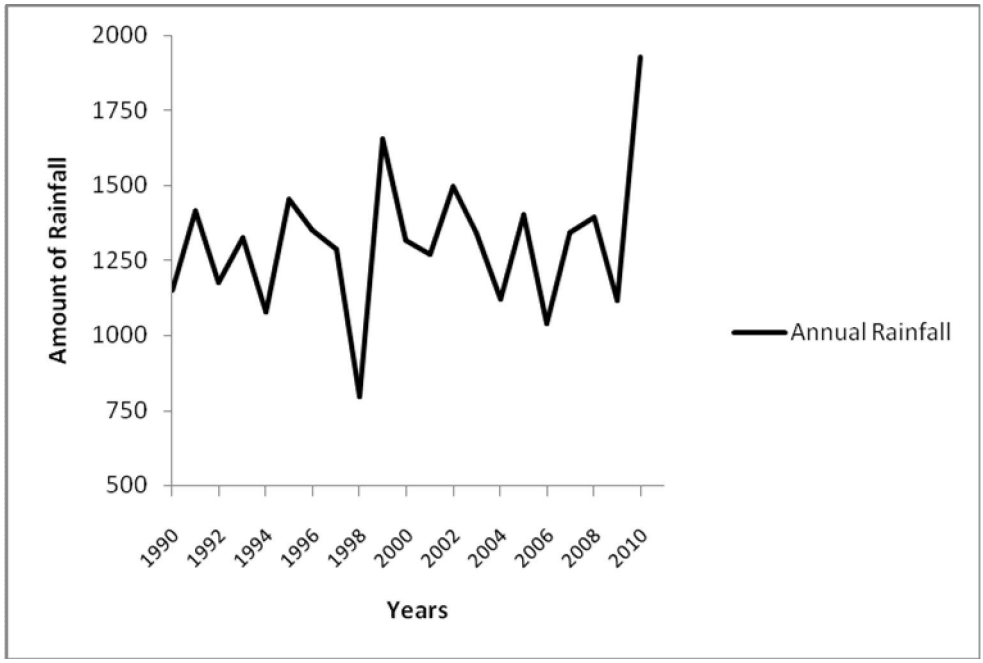

Figure 1: Annual Rainfall Distribution (mm) for Oyo State between the Years 1990 and 2009

3.2 Analysis of Variance in Rainfall Pattern

Analysis of variance shows no significant difference in the amount of annual rainfall at five years interval, the implication is that the current climatic conditions have not been seriously affecting the annual amount of rainfall though the rain may be late to start during the year as it occurred in recent years. It implies that the amounts of downpour each do not absolutely differ and may as such have little impact on crops yield.

Table 1: Analysis of Variance (ANOVA)

Annual rainfall	Sum of square	df	Mean square	F- value	P- value
Rainfall at five years interval	23176.858	3	7725.619	0.185	0.905
Residual	668268.98	16	41766.811		
Total	691445.84	19			

Source: Field Survey, 2011

3.3 The Results of Simple Regression Analysis

Table 2 represents the result of regression analysis for the four selected crops. It indicates a positive correlation between the annual rainfall distribution and crops output, because the annual rainfall coefficients are positive but insignificant with all the crops except for yam; it is significant at 10%. It implies that for each crop, 1% increase in annual rainfall would lead to 12.1%, 52.6%, 7.2% and 56.2% increase in seasonal output of maize, yam, cassava and cowpea respectively.

Table 2: The Results of Simple Regression Analysis

Variables	Coefficients	Standard dev	t-value	Sig
Maize				
Constant	11.516	1.589	7.250	0.000*
Rainfall	0.121	0.222	0.543	0.594
Yam				
Constant	10.004	2.008	4.983	0.000*
Rainfall	0.526	0.281	1.870	0.078*
Cassava				
Constant	13.646	2.802	4.871	0.000*
Rainfall	0.072	0.392	0.183	0.857
Cowpea				
Constant	4.955	3.024	1.638	0.119***
Rainfall	0.562	0.424	1.328	0.201

Significant at 10% *, Significant at 1% ***

Source: Field Survey, 2011

4. 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, 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.

5. Policy Recommendations

Based on the findings of this study, the following recommendations are 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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2/7/2013