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A Descriptive Analysis of Rainfall for Agricultural Planning in Lokoja Local Government Area of Kogi State, Nigeria.

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ABSTRACT

The ever - increasing anthropogenic activities which have led to global warming, climate variation and consequently, climate change is altering rainfall characteristics / pattern across the globe, Nigeria inclusive. For this reason, this paper seeks to give a descriptive analysis of rainfall in Lokoja Local Government Area (LGA), Kogi State; Nigeria with a view to offering useful suggestions for proper agricultural planning in order to ensure food sufficiency. Daily rainfall of 1981 – 2010 (30 years) obtained from the Nigerian Meteorological Agency, Oshodi, Lagos, Nigeria is used for this study. The rain days were also obtained from the Nigerian Meteorological Agency, Oshodi, Lagos. Results are presented in tables and subjected to statistical analysis using measures of central tendency such as mean, mean deviation and median; measures of dispersion such as range, variance and standard deviation as well as a measure of relationship (coefficient of variance). The findings indicate that April and October are the onset and cessation months (dates) of rains for the study area. Long – term mean annual rainfall is about 1216.83mm, while the mean rain days and long – term monthly rainfall stood at 81.8mm and days respectively. The decadal mean rainfall and rain days are1263. 26mm and 81.9days, minimum rainfall was recorded in 1982 (804.5mm), maximum was in 1999 (1767.1mm), range is 962.6mm, variance is 1, 400, 630.35, mean deviation is 35, 288.04, median is 1, 182.85mm, standard deviation is 1, 183.48 while coefficient of variance is 97.26%. These results indicate that the study area is still very favourable to crop farming despite the observed frequent dry spells. It is therefore suggested that crops which can withstand longer days of absence of rainfall should be planted early such as melon. Hybrid crops should be introduced while the use of irrigation should be given an aggressive attention in order to boost crop production, ensure food security and alleviate poverty.

Keywords: *Rainfall, agricultural planning, onset, cessation, food security and rain days.*

I. INTRODUCTION

There are so many problems facing agriculture in Nigeria with particular reference to Lokoja Local Government, Kogi State. Some of these problems include reduction in land area due to rapid urbanization, incidences of pests and diseases, poor soil nutrients, rural – urban migration, poverty, use of crude tools as well as unreliable rainfall among others. Of these problems, the most important is the climatic factor among which is rainfall [1].

Living organisms (both plants and animals including man) cannot survival without optimum water supply. Although, it has been argued that rainfall (water) and temperature are the most important climatic determinants of crop survival and production especially in Nigeria. However, generally; temperature has remained favourable to crop production especially during the growing season, but rainfall is not only disappointing, but also erratic, highly unreliable and unpredictable. The era in which rainfall was highly relied upon by farmers for sufficient crop production is gone. Meanwhile, Nigeria which still practices rain – fed agriculture rely on the "mercy of nature" to produce adequate food and the needed raw materials for the few agro allied industries. [2] Apart from the socio - economic problems facing Nigerian farmers, climatic variability constitutes a major limiting factor in crop production due to the practice of rain - fed agriculture. Due to changes in the characteristics of rainfall occasioned by global warming which has led to rainfall variability, uncertainties surround the reliabilities of the onset, duration, cessation, total annual amount of rainfall, intensity and its general or favourable distribution across the growing season months. [3] There are variations in the onset and cessation of rains in Kaduna, Kano and Sokoto, 1961 – 2007.

In the field of agriculture, rainfall is the most important climatic factor in Nigeria [1]. This is because its onset ushers in planting season, its duration and distribution ensures crop sustainability and favourable yield, while its cessation marks harvesting and storing season. Whenever there is late onset, hunger, temporal unemployment and poverty loom. Dry spells and droughts which are related to rainfall and occur annually in Nigeria [3] [4] are injurious to crops leading to crop failure. The early and late cessations also destroy the late crops [3]. [5] Rainfall is one of the indices of agro – meteorological moisture.

Every year, farmers in Nigeria are usually in high spirit to plant their crops in anticipation that yields would be favourable. Though as it may, this is not usually the case as crop failure is witnessed annually. This situation threatens food availability and security and leads to not only poverty, but also hunger among the farmers and other Nigerians who depend on them for food. This eventually leads to shortage of food, increasing importation of "common" foodstuffs especially rice [6], hike in the prices of foodstuffs, mal nutrition and so on.

[7] The most critical weather and climate dependent sectors of any West African and particularly Nigerian economy are agriculture and water resources. Rainfall characteristics determine crop yield. Where rainfall is optimum, crop yield is high; if low, low crop yield and if too high, poor yield partly due to flooding [8]. In general therefore, optimum rainfall which is well distributed throughout the growing season is required

for a good harvest, abundant food crops and availability of raw materials for the few agro – allied industries as well as to guarantee food security. This is partly necessary so as to curb the prevailing circumstance in which Nigeria which is a tropical country faces acute food shortage annually to the extent that huge sums of money is usually budgeted for the importation of foodstuffs, a situation which is becoming unacceptable to both the people and government of Nigeria.

II. OBJECTIVES OF THE STUDY

Global warming, climate variability and climate change have adverse effect on the hydrological growing season and consequently, crop production. This paper has the following objectives:

i. to analyze the attributes of rainfall in the study area,
ii. to determine the suitability of rainfall for agricultural policy, planning and implementation; and
iii. to suggest measures of complementing rainfall for adequate crop production so as to ensure food security

The Study Area

The study area, Lokoja LGA; which is expanding and increasing in population at alarming rate, is located between latitudes $7^{o}46^{1}$N - $7^{o}52^{1}$ and longitudes $6^{o}38^{1}$E – $6^{o}48^{1}$. Lokoja derived its name from two (2) Hausa words, a tree and a colour. "Loko", which means "Iroko" and "ja", which means red. So, the name Lokoja means, Red Iroko (tree). Kogi is also a Hausa word which means a river. Lokoja is the Headquartres of Lokoja LGA, the Capital of Kogi State and the confluence town of not only Kogi State, but also Nigeria. The area enjoys both wet and dry seasons with the total annual rainfall ranges between 1000mm – 1500mm. Mean annual temperature is about 27.7^{o}c and a relative humidity of 30% in dry season and 70% in wet season [9] [10]. Average daily wind speed is 89.9 km/hr. Wind speed is usually at its peak in March and April. Average daily vapour pressure is 26 Hpa [9]. The most important hydro – geological feature is the River Niger and the confluence of Rivers Niger and Benue [9]. At Lokoja, there is a wide flood plain along the River Niger, which is more than 1,600m wide [9]. This flood plain is intensively used for dry season farming (okra, tomatoes, sweet potato, vegetables and maize), fishing site, a grazing field for cattle in dry season and recreation.

Lokoja LGA falls within the Precambrian age as well as the various sedimentary rocks [9]. It is also found in Guinea Savanna with the presence of gallery forest along water courses [9]. The land rises from about 300m along the Niger valley to between 300 – 900m above sea level in the uplands [9]. The dominant primary activities are fishing, farming, trading, hunting with low percentage of tertiary activities [9]. The area is another tourist haven in Nigeria, but only little attention is paid to this at present. The major means of transportation is by road which leads to traffic congestion during the rush hours (mornings and evenings) and on Lokoja market days. The largest river in Nigeria, River Niger flows through Lokoja LGA; but it is under – utilized for transportation and even irrigation. On the other hand, due to the hilly nature of the area, cable car and under – ground train are other possible means of transportation.

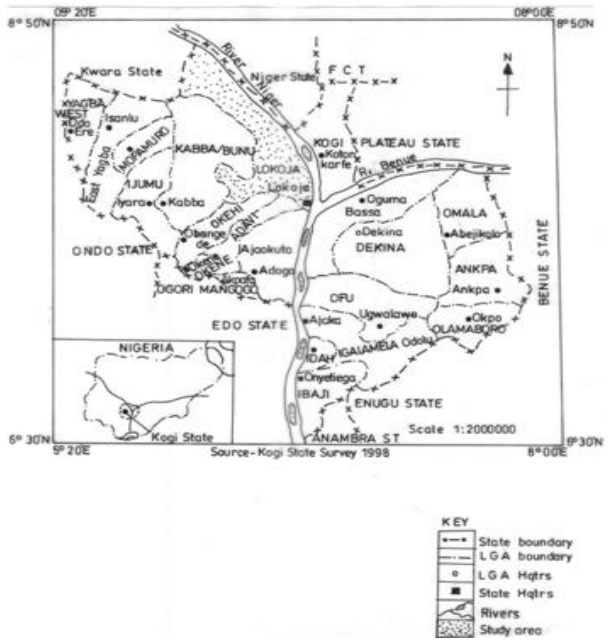

Fig. 1: Map of Kogi State showing the Study Area

Lokoja LGA had a total population of 82, 483 in 1991[10]. In 2006, the population of the LGA stood at 196,643[11]. Lokoja LGA comprises of many ethnic groups such as the Hausa, Nupe, Kupa, Kakanda, Oworo, Ganagana, Bassa and Egburra.

III. MATERIALS AND METHOD

Daily rainfall data of 1981 – 2010 (30 years) were used for this study. The data were obtained from the Nigerian Meteorological Agency (NIMET), Oshodi, Lagos. Results are presented in tables to aid quick understanding. The data were subjected to statistical analysis using measures of central tendency such as mean, mean deviation and median; measures of dispersion such as range, variance and standard deviation as well as a measure of relationship (coefficient of variance). The aim of this is to look at the characteristics of rainfall in the area.

IV. RESULTS AND DISCUSSION

The results of this study are presented in tables 1 – 5.

Table 1: Annual Rainfall, Mean and Rain days, 1981 – 2010 (30 years)

Year	Total Rainfall (mm)	Mean (mm)	Rain days
1981	1144.6	95.4	88
1982	804.5	67	53
1983	853.7	71.1	60
1984	1147.7	95.6	80
1985	965.7	80.5	84
1986	1281	106.8	87
1987	1170.8	97	71
1988	1330.9	110.9	88
1989	1519.7	126.6	91
1990	1136.3	94.7	92
1991	1492.7	124.4	98
1992	1083.1	90.3	82
1993	995.6	83	73
1994	1194.9	99.6	93
1995	1291.1	107.6	91
1996	1240.7	103.4	80
1997	1410.5	117.5	83
1998	1031	85.9	80
1999	1767.1	147.3	90
2000	1010.7	84.2	71
2001	1003.8	83.7	77
2002	1276	106.3	90
2003	923.6	77	73
2004	1335.4	111.3	84
2005	939.4	78.3	72
2006	1684.1	140.3	87
2007	1501.4	125.1	98
2008	1239.5	103.3	73
2009	1653.3	137.8	83
2010	1076.1	89.7	82

Source: Author's computation (2012) * Rain days were obtained from NIMET, Oshodi, Lagos.

Table 2: Simple Measures of Rainfall Variability in Lokoja, 1981 – 2010

Statistics	Values
N	30
Minimum	804.5mm
Maximum	1767.1mm
Range	962.6mm
Mean	1216.86mm
Median	1, 182.85mm
Mean Deviation	35,288.04mm
Variance	1,400,630.35
Standard Deviation (SD)	1,183.48
Coefficient of variability (CV)	97.26

Source: Author's Computation (2012) from table 1.

Table 3: Monthly and Mean Monthly Rainfall (mm), 1981 – 2010 (30years)

Month	Rainfall	Mean
January	33.1	1.1
February	241.2	8.0
March	661.3	22.0
April	3128.7	104.3
May	4698.3	156.6
June	5081.9	169.4
July	5988.5	199.6
August	6120.1	204.0
September	6443.7	214.8
October	4003.7	133.5
November	87.1	2.9
December	17.1	0.6
Total	**36,504.7**	**101.4**

Source: Author's computation (2012).

Table 4: Monthly and Mean Monthly Rain days, 1981 – 2010 (30 years)

Month	Rainfall (mm)	Mean (mm)
January	07	0.23
February	17	0.57
March	68	2.27
April	117	3.9
May	284	9.47
June	335	11.17
July	412	13.73
August	421	14.03
September	423	14.1
October	273	9.1
November	36	1.2
December	0.1	0.033
Total	**2, 393.1**	**79.8**

Source: Author's computation (2012).

Table 5: Decadal Mean Rainfall and Rain days (mm), 1981 – 2010 (30 years)

Year	Rainfall Mean	Rain days
1981 - 1990	1135.49	79.4
1991 - 2000	1251.74	74.3
2001 - 2010	1263.26	81.9

Source: Author's computation (2012).

Considering tables 1 and 2, the mean rainfall is 1216.86mm. Even though the numbers of years with rainfall below the mean are equal to the number of years above it, the values of those

above the mean are very alarming especially 1989, 1991, 1997, 1999, 2006, 2007 and 2008 which could lead to flooding and erosion [3] [12]. This confirms global warming in the study area. Also, this abnormal rainfall could be harmful to the type of crops grown in the area. Arguably, the surplus rainfall above the annual total and long – term mean for the station could be said to be near decadal. The annual rainfall at the station favours the growing of cereals and root crops such as rice, millet, groundnut, cassava, yam and so on as well as cattle rearing since it is sufficient to provide adequate surface water especially during the wet season and the growth of grasses. Further, the number of rain days (table 1) is more favourable for single cropping and unsuitable for double cropping except a shorter duration crops (hybrid) and / or the use of irrigation. This does not support adequate food supply throughout the year. The minimum rainfall is 804.5mm which occurred in 1982 and corresponded with the drought period in Nigeria. The highest rainfall of 1767.1mm occurred in 1999. The mean deviation which is above the mean for the study area, median, variance, range, standard deviation which are large and the CV of 97.26% also confirms rainfall variability, although low. August and September recorded the highest rainfall while the highest rain days occur in July, August and September (tables 3 & 4).

Table 3 shows the monthly and mean monthly rainfall and indicates that April is the ideal month for planting (onset) and October is the cessation (harvesting period) due to rainfall sufficiency. The long – term mean is also favourable for the earlier mentioned crops. [14] The onset of rain is the month in which accumulated total rainfall is in excess of 51mm, while the cessation is the date after which no more than 51mm of the rain is expected. Based on this, month with a long – term mean rainfall totaling 102mm and above marks the onset and cessation of rains respectively. So, for Lokoja LGA, the months of April and October mark the onset and cessation of rains.

Table 4 shows total rain days which agree with monthly and mean monthly rainfall in aspects of the onset and cessation of rains at the station, that is, April and October respectively. The mean rain days are also favourable to crop production. The long – term mean monthly rain days can also be used to determine the onset and cessation of rains. Long – term monthly mean rain days up to half or greater than the long – term annual mean could be regarded as the onset and cessation of rains. The number of years to be considered should not be less than thirty (30) years [14].Therefore, the months of April and October mark the onset and cessation of rains for the study area.

Table 5 shows the decadal rainfall which agrees with the annual and long – term mean hence favourable to agriculture. In the first decade (1981 - 1990), rainfall is less than the mean for 1981 – 2010 (30 years) because the station witnessed a decline in rainfall in 1982, 1983, and 1985. 1982 and 1983 coincided with the period of severe drought which ravaged the country [15]. The effect of these droughts reflected in the mean for that decade, but did not affect the number of rain days (see appendix 1) which therefore means that the total annual rainfall may not determine the total number of rain days. On the other hand, rainfall increased from the first decade to the third decade which confirms the meteorological effect of global warming at the study area.

V. CONCLUSION & RECOMMENDATIONS

From the fore – going, despite the fact that climate is changing; rainfall duration and rain days are still very favourable for agricultural activities in the study area. Although, late onset, early cessation, fluctuation / deficit in annual total as well as dry spells are very common at the station. Therefore, it is expected that farmers should be advised on the annual dates of onset and cessations of the rains (April and October), crops to be planted early such as melon which can withstand long period of absence of rains, hybrid cropping as well as the use of irrigation. Irrigation is very important not only due to high unpredictability of the rains and frequent dry spells [3] [16], but also to support all – year - round cropping so as to ensure steady food supply [17] for the ever – growing population of not only the study area, but also Nigeria at large. This would ensure food security and aid poverty alleviation in view of the fact that majority of Nigerians are farmers. It is unfortunate that Nigeria still practices rain - fed agriculture. Countries that produce surplus food for consumption, industries and export have transformed agriculture from traditional to modern (mechanized). China, Israel, Java Island, Thailand, India, just to mention a few are good examples. A nation which still depends on traditional agricultural practices would not only face scarcity of food, high cost of foodstuffs, inadequate raw materials for agro – allied industries and unemployment, but would also be poor due to high importation of foodstuffs and experience economic insecurity. [18] Hot climate and little rain are experienced in the extreme northern states of Nigeria where desertification is fast encroaching on arable lands and agriculture is highly dependent on irrigation. Again, if irrigation is properly practiced in Nigeria especially in dry season, abundant and quality crops would be harvested due to abundant sunlight for high temperature and photosynthesis. Nigeria therefore, needs to rise up towards the commercialization of agriculture and agricultural produce in order to bring back the loss glory and the era in which agriculture was the back bone of its economy. A country which can produce enough food for local consumption is a wealthy nation. Agricultural policies should be more realistic and achievable. More Agricultural Research Institutes should be established not only in the study area, but also in the entire state to develop hybrid crops, establish more scientific and research farms as well as embarking on seminars to enlighten the farmers on the current trend in farming system. Meteorological

services should also be localized in the area. In addition, mixed farming should be emphasized and encouraged so as to reduce the rate at which farmers wait endlessly for the government to provide fertilizers which they can hardly afford and also due to the negative effect of chemical fertilizers on human health as a result of the chemicals used in manufacturing them though chemical fertilizers aid mass production of crops.

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