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WET AND DRY SPELL OCCURRENCES IN LOKOJA AREA, KOGI STATE, NIGERIA

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Abstract

This study examined wet and dry spell occurrences in the Lokoja area, Kogi State, Nigeria. Daily data of rainfall (raining days) from 1985 to 2015 were used for this study. The double mass curve was used to test the data for normality. Indices of wet and dry spells such as mean, standard deviation, probability and frequency were determined. The results of the analysis indicate that as the tendency of wet days increased, the frequency of long wet spells also increased with a decrease in the trend in the frequency of long dry spells. The Mann-Kendall test (at 0.05 level of significance) was used to test whether there is a significant difference in the number of wet and dry spells during the study period. Results indicated no significant difference during the years of the study period.

Keywords: Occurrences, Dry spell, Rainfall, Wet spell

Introduction

In Nigeria, the study of rainfall characteristics from different perspectives such as amount variation, fluctuation, trend etc. has received huge attention from different scholars. Some of these studies such as Okorie (2015) analysed 30 years of rainfall variability in Imo State Southeastern Nigeria while Ogunjobi and Akinsola (2014) analysed rainfall and temperature variability over Nigeria. Also, a study of rainfall in Lokoja has been undertaken by several researchers. Such studies include evaluation of rainfall trends in Nigeria for 30 years (1978 to 2007) by Obot, Chendo, Udo and Ewona (2010). The study evaluated rainfall in Nigeria using the six geopolitical zones and the present study area inclusive. Also, Mage and Tyubce (2017) analyzed the temporal trend in daily rainfall intensity in changing climate in the middle belt region of Nigeria as well as the study of intensity, duration, frequency and annual exceedance probability and return periods of a rainstorm in Lokoja by Olatunde and Adejoh (2017 a& b). Undoubtedly those studies have provided some knowledge about rainfall characteristics in Lokoja, however, only scanty details are known about the occurrence of wet and dry spells in Lokoja. The wet (dry) spell can be defined as the number of consecutive rainy (non-rainy) days in an area during the rainy season. The knowledge of this is important as it helps to determine the likely amount of rainfall available and its effects on various human activities, for instance, the crop type to plant and at what time. The objective of this study, therefore, was to examine the occurrence of wet and dry spells in the study area.

The Study Area

Lokoja is a medium-size settlement in north-central Nigeria. It is the capital of Kogi state that is located between Latitude 70 45'N- 70 51'N of the equator and Longitude 60 41'E - 60 46'E of the Prime Meridian close to the confluence of Rivers Niger and Benue (Fig. 1). The population was estimated to be about 265, 400 in 2016 (National population commission, 2017). Lokoja is cosmopolitan and is made of tribes such as Bassa-Nges and the Oworos Kakanda, Kupa, Ganagana and Egan Igala, Hausa, Egbura, Yoruba, Igbo, Tiv and Idoma(Lokoja Masterplan 2009; (Olatunde and Adejoh, 2017 a & b; Akamisoko 2002)

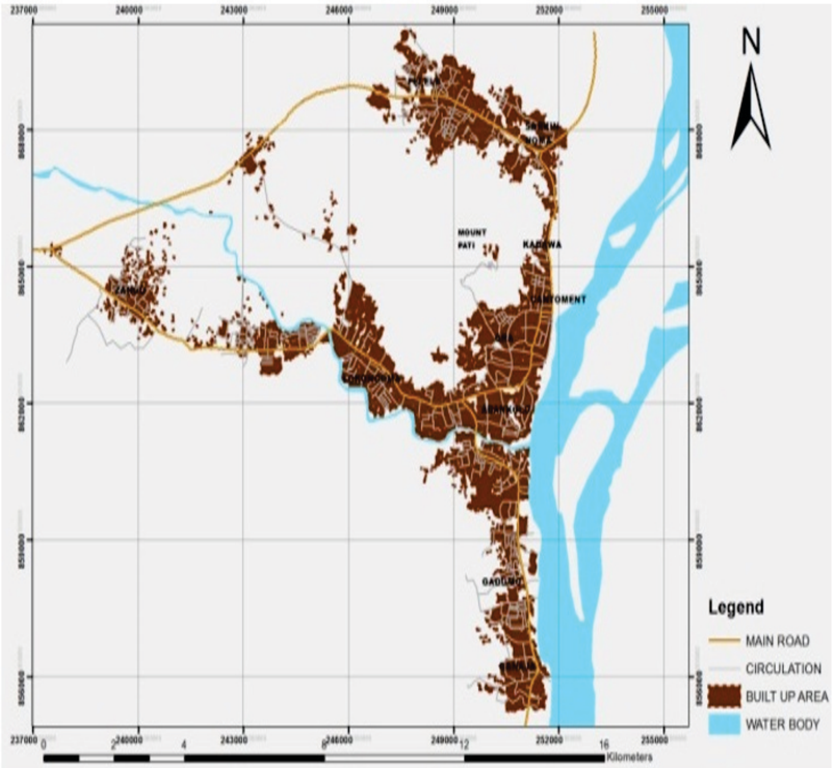

Figure 1: Lokoja, the Study Area
Source: Alaci, Olatunde and Onyebueke, 2019

The climate of Lokoja has been described as the tropical wet and dry type classified as Koppen's Aw climate. The rain begins in May and ends in October (Olatunde and Adejoh, 2017 a & b). The total annual rainfall ranges between 804.5mm to 17671mm. Rainfall onset is around March/April while cessation is around October/November, with a short break in August. The relative humidity is about 30% in the dry season and 70% in the wet season (Oliveraet 1995). The average annual temperature rarely falls below 30.7°C with February and March being the hottest months (Ifatimehin et al., 2010). The average daily wind speed is about 89.9 km/hr. or about 3.0 to 4.6 Knots in June/July and 1.5 to 3.7 Knots for December/January (Olatunde and Adejoh, 2017 a & b). The prevailing direction of wind for June/July and December/January are South to South Westerly and North Easterly respectively (Olatunde and Adejoh 2017 a & b).

Two major air masses that dominate the climate of the study area are the Tropical Maritime air mass and the Tropical continental air mass. The Tropical Maritime is formed over the Atlantic Ocean to the South of the country and is therefore warm and moist. It moves inland generally in a South-West to North-East direction. The Tropical Continental air mass is developed over the Sahara Desert and is therefore cool and dry and blows in the opposite direction, (north-east to south-west) (Olatunde, 2013).

The alluvial soils along the valleys of the rivers are sandy, while the adjoining laterite soils are deeply weathered and grey or reddish, sticky and permeable. The alluvial soils show light accumulations of organic matter but are often, under traditional management practices and are too wet during the rainy season for crops other than rice. The vegetation of the study area falls within the Guinea Savanna belt of Nigeria (Olatunde and Omachona, 2019). It is made up of tall grasses and some trees. These are green in the rainy season with fresh leaves and tall grasses, but the land is open during the dry season, showing charred trees and the remains of burnt grasses. This vegetation type has many variants, affecting both the floristic diversity and the structural appearance of the plant communities. Some of the notable economic trees that can be found in the reserves include Iroko, Mahogany and Obeche (Olatunde, 2013).

Methodology

Daily rainfall data of rain days in Lokoja were from 1985 to 2015 were used in this study. The data were obtained from earlier studies and researches (Olatunde and Adejoh, 2017 a & b; 2018; Olatunde and Love, 2018 and Sullaiman, 2018).

Homogeneity Test

In this study double mass curve was used to test the data homogeneity. The double mass curve has low data requirements and it is a graph of the accumulation of one quantity against the accumulation of another during the same period.

Analyses of the Occurrence of Dry and Wet Spells

The analyses focused on the occurrence of wet and dry spells of different duration. As mentioned above, a wet (dry) spell of duration "d" is defined as a period of d consecutive rainy (no rainy) days. The accumulated depth is the total amount of rainfall received in all the wet spells of a certain duration. The indices for dry and wet spells characteristics included the maximum consecutive number of dry (wet) days, mean, standard deviation and the frequency of various durations of dry (wet) spells length (Table 1).

To identify the changing nature of dry and wet spells, indices were computed annually. The changing of the indices of dry (wet) spells was traced using a non-parametric Mann-Kendall test. The slope of the linear trends for each of the indices was estimated using the ordinary least square method.

Test of Hypothesis

In the Mann-Kendall test, the indicator variable of interest, 1, for each element

xi (i=1, …, n) of the series where (i<j), is denoted as follows:

$$I\ (Xi<Xj) = \sum_{0}^{1} Xi \in Xj,$$

The test statistics Ʈ is given by

$$Ʈ = \sum_{i-1}^{n} \quad \sum_{i-1}^{n} (Xi < j)$$

In this present study, the null hypothesis will be rejected at 5% level, that is, /U(t)/>1.96.

Table 1: Indices of Dry (Wet) Spells Used

Measurement	Index name (dry)	Index name (wet)
Maximum number of consecutive dry (wet) days	MxD	MxW
Mean dry (wet) spells length	MnD	MnW
Standard deviation dry (wet) days	SdD	SdW
Probability of dry (wet) days	P(D)	P(W)
Probability of two consecutive dry (wet) days	P(D/D)	P(W/W)
Probability of three consecutive dry (wet) days	P(D/DD)	P(W/WW)
Frequency of short spells (1-4 days)	SSD	SSW
Frequency of medium spells (5-9 days)	MSD	MSW
Frequency of long spells (atleast 10 days)	LSD	LSW

Source: Sullaiman 2018

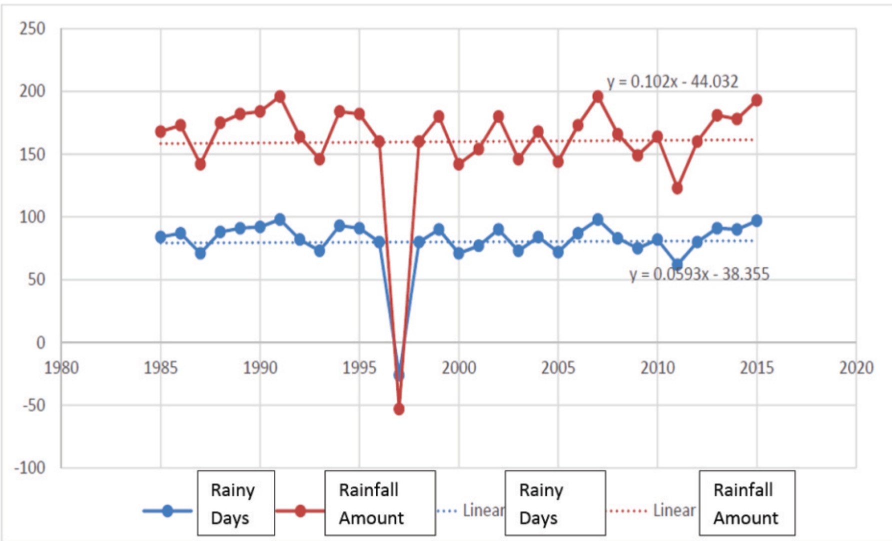

Figure 2: Double Mass Curve for Lokoja (1985 to 2015)

Table 2: Occurrence of Wet and Dry spells

Measurement	Index name (wet)	Indices (wet)	Indices (dry)
Maximum number of consecutive dry (wet) days	MxW	2 days	2 days
Mean dry (Wet) spells length	MnW	8.720988	0.232407407
Mean dry (Wet) spells length	MnW	8.720988	0.232407407
Standard deviation dry (wet) days	SdW	7.047891	0
Probability of day (Wet) days	P(W)	0.766667	0.233333
Probability of two consecutive dry (wet) days	P(W/W)	0.0079101	0.0528302
Probability of three consecutive dry (wet) days	P(W/WW)	0.0350242	0.026851
Probability of three consecutive dry (wet) days	P(W/WW)	0.0350242	0.026851
Frequency of short spells (1-4 days)	SSW	221 days	92
Frequency of medium spells (5-9 days)	MSW	209 days	11 days
Frequency of long spells (at least 10 days)	LSW	398 days	4 Days

Source: Authors' Data Analysis, 2018.

Results and Discussion

Frequency Distribution of the Series

Although the mass curves were strictly not of straight lines, they were not of major curves except for rainy days in 1997 and rainfall amount (mm) in 1998 (Fig. 2) indicating a departure from the series distribution. As a result, the data could be considered homogeneous.

The maximum number of consecutive dry and wet days stood at 2 each. The mean wet days were 8.720988 while it was 0.2324 for dry days. The standard deviation for wet days was 7.047891 and zero value for dry days. The probability of two consecutive wet days stood at 0.0079 while the probability of two consecutive dry days was 0.0528. The probability of three consecutive wet days stood at 0.03502 while the probability of three consecutive dry days was 0.0268. The frequency of short spells for wet days between 1-4 days was 0.03502 while the frequency of short spells for dry days between 1-4 days was 0.02685. The frequency of short spells for wet days between 1-4 days was 221 days while the frequency of short spells for dry days between 1-4 days was 92 days. The frequency of medium spells for wet days between 5-9 days was 209 days while the frequency of medium spells for dry days between 5-9 days was 11 days. The frequency of long spells (at least 10 days) for wet days was 398 days while the frequency of long spells (at least 10 days) for dry days was 4 days. These results of analyses carried out collectively point to the important fact of decreasing trends of dry spells and increasing trends for wet spells. The above findings are also in agreement with the findings of Stéphanie and Diedhiou (2017) in which they found out that the spatio-temporal variability of the wet and dry spells appears to be closely related to the spatio-temporal variability of the West African monsoon.

Hypothesis

H_0: There is no significant difference in the number of wet and dry spells within the study period.

Table 3: Mann-Kendall Test for Hypothesis

Series\Test	Kendall's tau	p-value	Sen's slope
JAN	0.052	0.272	0.000
FEB	-0.152	0.968	0.000
MAR	-0.158	0.980	0.000
APR	0.043	0.284	0.000
MAY	0.011	0.445	0.000
JUN	0.122	0.052	0.016
JUL	0.143	0.027	0.028
AUG	0.105	0.077	0.026
SEP	-0.058	0.781	0.000
OCT	0.054	0.235	0.000
NOV	-0.084	0.849	0.000
DEC	-0.189	0.985	0.000

Source: Authors' Data Analysis, 2018

The results of the Mann-Kendall test shows that there was a significant difference in the number of wet and dry spells for July at 0.03 while the test further reveals that there was no significant difference in the number of wet and dry spells for the remaining 11 months between the period 1985 to 2015. As the computed p-values were greater than the significance level, alpha=0.05, the null hypothesis H0 that says there is no significant difference in the number of wet and dry spells in the study period cannot be rejected. This means, there is no significant difference in the number of wet and dry spells from 1985 to 2015. This indicates that the study area is still favourable for crops production, especially for crops that can survive longer days with no rains.

Conclusion

The findings of this study indicated decreasing trends for dry spells and increasing trends for wet spells. The significance test revealed that there is no significant difference in the number of wet and dry spells in most of the months during the study period. This is likely to have several implications for socio-economic activities especially agriculture in the study area.

References

Adeoye, O.J, (2012) Spatio-Temporal Analysis of Land Use/Cover Change of Lokoja. *A Confluence Town. Journal of Geography and Geology* (4) 4 PP

Alaci, D.S.A, Olatunde, A.F and Onyebueke, V.O. (2019) Urban Planning Leverages in Climate Change Resilience Building. *Journal of The Nigerian Institute of Town Planners* Vol. XXV No. 1. PP 1-19

Akamisoko (2002) Samuel Ajayi Crowther in the Lokoja Area. Ibadan: Safer

Ifatimehin, O.O; Ishaya, S and Fanan U. (2010) An Analysis of Temperature Variations Using Remote Sensing Approach in Lokoja Area, *Nigeria' Journal of Production Agriculture and Technology (PAT)*, 6 (2) PP 35-44

Lokoja Master Plan, (2009) *The Lokoja Master Plan 2010 - 2035*, prepared by Aims Consultants Abuja for the Government of Kogi State

Mage, O.J. and Tyubee(2017) Temporal Trend in Daily Rainfall Intensity in a Changing Climate in the Middle Belt Region of Nigeria, *European Journal of Geography*.Vol.6 No.1 PP 257-271

Obot, N.I., Chendo, M.A., Udo, S.O. and Ewona, I.O.(2010) Evolution of Rainfall Trends in Nigeria for 30 years (1978-2007).International *Journal of the Physical Sciences, 5, 2217-2222*

Ogunjobi, K.O. and Akinsanola, A.A. (2014) Analysis of Rainfall and Temperature Variability over Nigeria*Global Journal of Human-Social Sciences*, Vol 14(1), 2249-2460

Okorie, F.C.(2015) Analysis of 30 Years Rainfall Variability in Imo State of Southern Nigeria'. Proceedings of 11th Kovacs Colloquium, Paris, France P366

Olatunde, A.F. (2013) Analysis of Drought Occurrences in Northern Nigeria: Implications for Agricultural Planning and Development, PhD. Dissertation, Department of Geography, Nigerian Defence Academy, Kaduna.

Olatunde, A.F. and Adejoh, I (2017a) Annual Exceedance Probability and Return Periods of Rainstorms in Lokoja, Nigeria. *International Journal of Social Sciences,* Vol. 11. No 3. PP 40 - 46. Available at socialscienceuniuyo.com

Olatunde, A.F. and Adejoh, I(2017b) "The Intensity, Duration and Frequency of Rainstorms in Lokoja, Nigeria". *Science WorldJournal,* Vol. 12. No 2 PP36–40, http://www.scienceworldjournal.org/issue/ view/1412

Olatunde, A.F. and Adejoh, I (2018) Rainfall Characteristics in Lokoja from 1981 to 2015". *Journal of Research and Development in Arts and Social Sciences,* Vol.2. PP 228-242,

Olatunde, A.F.and Love, J (2018) Recent Changes in Onset and Cessation Dates of Rainfall and their Effects on Farming Activities in Sub Urban Areas of Lokoja. *InternationalJournal of Social Sciences,* Vol. 12 No 2PP 34 – 54

Olatunde, A.F. and Ruth, O. (2019) Assessment of Relationship between the Trends of Temperature and Forest Changes in Lokoja Kogi State, Nigeria. A Chapter in Alaci (ed) festschrift: Functional Human Settlements In Nigeria: The Urban and Regional Planning Perspectives. PP 67 - 85

Olivera, F., Mckinney, D.C., Maidment, D.R., Zichuan, Y and Reeds, S.(1995). Predicting the Water Balance of Surface and Groundwater Resources over Large Areas. Retrieved from www.saprofs.tamu.edu/ folivera/utexas/ng-stdy.htm on 26th December 2015.

Stéphanie and Diedhiou (2017) Characteristics of wet and dry spells in theWest African monsoon system *Atmospheric Science Letters*Atmos. Sci. Let. 18: 125–131 (2017) Published online 21 February 2017 in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/asl.734

Sullaiman I.D. (2018) 'Analysis of Rainfall Changes from 1985 to 2015 in Lokoja, Kogi State. A B.Sc Project Submitted to Department of Geography, Federal University Lokoja. PP 28-38