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Analysis of Empirical Rainfall Data Covering 1979-2020 as a Guide to Agriculture and Water Resources Management in Ondo State, Nigeria

[1]AUDU, EB; [2]FRANCIS, SD;[3]ABUBAKAR, AS;[4]EMIGILATI, MA;[5]AUDU, HO

*[*1] Government Secondary School, Abuja@ 30, Pegi, Federal Capital Territory, Nigeria*
[2]Dept. of Mathematical Sciences, Olusegun Agagu Uni of Sci and Tech, Okitipupa, Ondo State.
[3,4]Department of Geography, Federal University of Technology, Minna, Niger State, Nigeria
[5]Department of Geography, Federal University Kashere, Gombe State, Nigeria

**Corresponding Author Email: audu_ebamaiyi@yahoo.com*
Co-Authors Email: sabasdekaa@yahoo.com; drsadauki1@gmail.com; m.emigilati@futminna.edu.ng; mongareenho3@gmail.com

ABSTRACT: The aim of this paper was to evaluate daily empirical rainfall data covering 1979-2020 as a guide to agriculture and water resources management in Ondo, State, Nigeria by collecting data from the Nigerian Meteorological Agency, Abuja, using various standard methods. Results showed that, the area observed rainfall throughout the year with March (86.4 mm) as the rainfall onset, November (56.4 mm) was the cessation, double maximum rainfall occurred in July (254.2 mm) and September (282.1 mm) with the climatological mean of 1752.2 mm. Also, the percentage (%) difference rainfall showed seven (7) positive and four (4) negative occurrences. The highest positive % difference occurred in September (10.4), while the lowest occurred in July (2.6). The highest negative % difference was -26.5 (November), while the lowest was -5.9 (August). The stations deviation from zonal average monthly rainfall showed that, Igbokoda, Ilaje LGA deviated in all the months negatively, while Okitipupa, Okitipupa LGA and Oka-Akoko, Akoko South West LGA deviated positively in eleven (11) months each. The study concluded that, rainfall varied and had declined generally over the study area. Hence, it was recommended that, the Seasonal Climate Prediction (SCP) by Nigerian Meteorological Agency (NiMet) should be down-scaled early to serve as a guide to farmers and hydrologists; irrigation should be encouraged; hybrid crops should be cultivated and more water reservoirs should be constructed.

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Nigeria, as a tropical and agrarian country relies on sufficient, efficient and reliable rainfall at the beginning of farming season which allows for "serious" farming activities to commence. This sufficient, efficient and reliable rainfall at this period is described as its onset which is crucial in agriculture. Sometimes, the onset rainfall is always truncated with a "break" which Ibrahim *et al*. (2018) refers to a pentad with less than 5 mm of rainfall beginning from 1st May (25th pentad of the year from 1st January of a given year) in the Guinea Savanna Zone of Nigeria. Onset of rainfall varies across different agro-climatic zones. Audu *et al*. (2019) observed that, the onset of rainfall in Gombe and Dadin Kowa were 25th and 30th May with variability of ± 10 days for Gombe and ± 15 days for Dadin Kowa. If the onset of rain delays, farming activities delay as well because in Nigeria, agriculture is strongly tied to rainfall. Salawu *et al*. (2014) observed that, temperature and rainfall have greater impacts on human settlements and human activities both directly and indirectly than other elements in terms of development, health and agriculture. Umar (2016); Umar *et al*. (2021) both cited in Umar and Aliyu (2022) stated that, rainfall and

length of growing season (LGS) are the most important factors affecting the sustainability of rain-fed crop cultivation in the semi-arid areas of northwestern Nigeria. Rainfall varies over both space and time which affects agriculture and water resources. Writing about the correlation study on developmental stages in soya bean (*glycine max*) and prevailing agro-meteorological indices in forest savanna eco-climatic zone of Nigeria, Adetayo (2013) discovered that, relatively low amount of rainfall is required for fruiting, while occasional showers with high temperature is needed for ripening and drying for good quality seeds. Variability is an attribute of rainfall in Nigeria which also affects its derived parameters. Variability is observed in rainfall cessation and hydrological growing season which directly affect agriculture. The effectiveness of rainfall in terms of its onset, cessation, hydrological growing season (HGS), amount and distribution are crucial to the success of crop production. The alternation of these attributes is injurious to crop development, maturation and yields. A balanced rainfall condition is required in every cropping season for better growth, development and yield. However, these conditions are not always favourable on daily, pentad, monthly, annual and inter-annual basis due to the incidences of delayed onset, false onset, early and late cessations, shortened HGS, rainfall spells, dry spells, little dry season (LDS) and droughts in its various forms. In a study by Umar and Aliyu (2022), it was discovered that; the cultivation of drought resistant crops such as pearl millets and sorghum is being threatened by the occurrence of frequent dry spells and extended water deficient conditions in the semi-arid northwestern Nigeria. Audu *et al*. (2022) opined that, late onset and early cessation pentads rainfall shortened length of hydrological growing season (LHGS) thereby affecting effective cropping, growth of grasses for domestic uses, ground water recharging, river flow and other uses.

On water resources, rainfall is a major source of both surface and underground water. Evaporation from water sources and wet surfaces is an important ingredient in hydrological cycle (Abubakar, 2015). Adequate water resource is a panacea to irrigation. On the contrary, excessive rainfall has caused and still causing hydro-meteorological hazards in Nigeria. Annually, cases of massive water erosion, unprecedented flooding, huge landslides as well as severe water pollution are reported. Lawal *et al*. (2022) observed that, if past trends of rising global temperature continue; the type, frequency and intensity of precipitation storm characteristics are bound to change leading to extreme events such as severe drought, intense water shortages and in some cases, flooding. Matazu (2021) remarked that, in 2021; Nigeria like other countries of the world experienced some extreme weather events including flooding, dry spells and heat waves. These hazards are injurious to agriculture and water resources. Several studies have been carried out on rainfall attributes and the practice of farming in the Southwestern part of Nigeria. Adejuwon (2010) noted that, little dry season occurs in the midst of wet season in southwestern Nigeria. Onyejekwe *et al.* (2016) perceived that, in the last two (2) decades; there have been anomalies in the incidence and distribution of rainfall leading to very erratic onset, cessation, duration and distribution. Despite these studies, there is need for regular studies on rainfall as it relates to agriculture and water resources so as to ascertain its current state because weather is highly dynamic. This has called for this research with the aim of analyzing rainfall to guide farmers and water resources management in Ondo State, Nigeria. Hence, the objective of this paper was to evaluate daily empirical rainfall data covering 1979-2020 as a guide to agriculture and water resources management in Ondo State, Nigeria.

MATERIALS AND METHODS

Study Area: According to Akanbi (2022), Ondo State (study area) is one of the six (6) states that make up the South West geopolitical zone of Nigeria. It lies between latitudes 5º05'-7º10' North of the Equator and longitudes 4º30'-6º0' East of the Greenwich Meridian (Figure 1). Akinbode *et al*. (2006) stated that, Akure; the Ondo State Capital is located on longitude 5º18' E and latitude 7º17' N. It experiences humid tropical climate with average yearly rainfall of about 1500 mm. Average temperatures range between 26.2ºC and 30.4ºC, while its mean annual relative humidity is about 27.5 % and 98.2 %. Its vegetation is the tropical rainforest type. It has inter state boundaries with Ekiti and Kogi States to the north, Edo State to the east, Delta State to the southeast, Osun State to the northwest and Ogun State to the southwest. It covers about 15,500 km^2(6000 sq miles) with a projected population from 2006 census of about 5,185,120 (Akanbi, 2022).Awomeso *et al*. (2015) observed that, the study area is bordered by 80 km out of the 853 km total coastlines of Nigeria which is derived from the Atlantic Ocean.

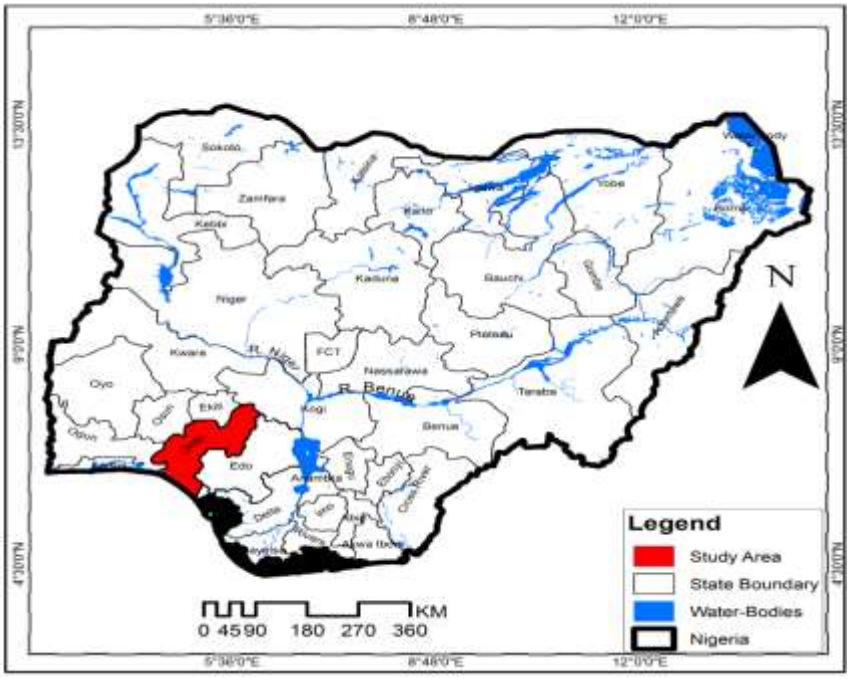

Fig 1: Map of Nigeria showing Ondo State
Source: National Space Research and Development Agency (NASRDA, 2023)

Materials: Daily empirical rainfall data which covered from 1979-2020 (42 years) for six (6) meteorological stations across Ondo State, Nigeria were collected from the Nigerian Meteorological Agency (NiMet), Abuja and analysed for this study. These stations include Iju-Itaogbolu and Owena in Rain Forest Zone; Igbokoda and Okitipupa in Mangrove Swamp Forest as well as Oka-Akoko and Isua-Akoko in Guinea Savanna Zone.

Methods of Data Analysis: To determine the monthly mean rainfall in the study area, daily empirical rainfall data were first computed to derive the monthly rainfall as follows:

$$m_j = \sum_{i=1}^{nm} RR_i \qquad 1$$

$$Where: \ j = 1,2, \ldots \ldots \ldots \ldots 12 \ (month) \ ; \ nm = number \ of \ days \ in \ a \ month$$
$$m_j = rainfall \ in \ month \ j \ ; \ RR_i = daily \ rainfall \ ; \ i = 1,2, \ldots \ldots nm$$

The station monthly rainfall was calculated using Equation 2, as follows:

$$s_k m_j = \sum_{i=1}^{nm} RR_i \qquad 2$$

$$Where: \ s_k m_j = station \ monthly \ rainfall \ ; \ k = 1,2, \ldots 6 \ (number \ of \ stations)$$

The station monthly mean rainfall was calculated using Equation 3, as follows:

$$\overline{s_k m_j} = \frac{\sum_{i=1}^{nm} RR_i}{nm} \qquad 3$$

$$\overline{s_k m_{j+1}} = \frac{\sum_{i=1}^{nm} RR_i}{nm}$$

$$\overline{s_k m_{j+2}} = \frac{\sum_{i=1}^{nm} RR_i}{nm}$$

$$\overline{s_k m_{j+11}} = \frac{\sum_{i=1}^{nm} RR_i}{nm}$$

$$Where: \ s_k m_j = station \ monthly \ mean \ rainfall$$

The regional monthly mean rainfall was calculated using Equation 4, as follows:

$$\overline{Z_{\overline{s_k m_j}}} = \frac{\sum_{i=1}^{ns} \overline{s_k m_j}}{ns} \qquad 4$$

$$Where: \ \bar{Z} = zonal \ mean; \ s = station; \ s_i = station \ 1 \ldots \ldots \ldots 6$$
$$m = month; \ m_j = 1 \ldots \ldots 12 \ (months); \ ns = number \ of \ stations \ (6)$$

The station monthly mean percentage (%) rainfall difference was calculated as:

$$\%\ difference = \left(\overline{s_k m_{J+1}} - \overline{s_k m_J}\right) x100$$

$$\left(\overline{s_k m_{J+11}} - \overline{s_k m_{J+10}}\right) x100 \qquad 5$$

Station deviation from zonal monthly mean rainfall was calculated as thus:

$$s_{k^{Dev}} = \overline{s_k m_J} - \overline{Z_{\overline{s_k m_J}}} \qquad 6$$

$Where: \quad s_{k^{Dev}}\ represents\ station\ deviation;$ $\overline{s_k m_J} and \overline{Z_{\overline{s_k m_J}}}\ are\ as\ defined\ in\ Equations\ 3\ and\ 5$

The determination of onset and cessation rainfall months are based on the method by Walter (1967) cited by Umar (2010). In this method, the actual onset rainfall month is as follows:

$$Days\ in\ a\ month\ \frac{51 - accumulated\ rainfall\ in\ the\ previous\ month}{total\ rainfall\ for\ the\ month} \qquad 7$$

The month under reference is that in which the accumulated rainfall is in excess of 51 mm. The cessation month of the rains is that in which not more than 51 mm of rain is expected.

RESULTS AND DISCUSSION

In Figure 2, Iju-Itaogbolu, Akure North LGA, Ondo State, Nigeria receives rainfall throughout the year. The onset and cessation rainfall months are March (82.1 mm) and October (199.8 mm). Least monthly mean rainfall is January (11.9 mm), highest is September (254.6 mm), double maxima in July (229.8 mm) and September, September peak (2nd peak) is higher than the 1st peak in July. There is little dry season (LDS) otherwise called "August break" with monthly mean rainfall of 190.6 mm which is lower than the two (2) peaks. There are eight (8) months (March-October) of wet season and four (4) months (January, 11.9 mm; February, 43.3 mm; November, 46.6 mm and December, 17.5 mm) of dry season.

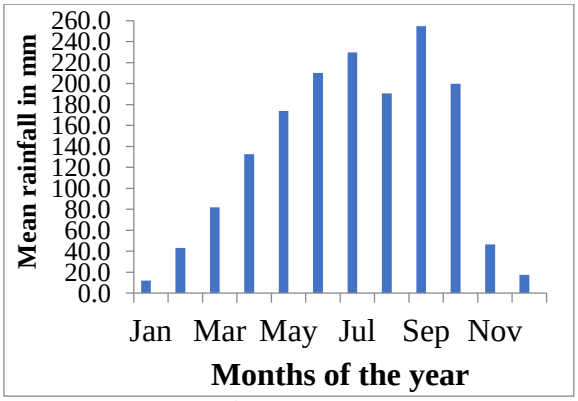

Fig 2: Monthly mean rainfall in Iju-Itaogbolu, Akure North LGA, Ondo State, Nigeria

Source: Authors' computation, 2023

Figure 3 indicates that, Owena in Idanre Local Government Area, Ondo State, Nigeria observes rainfall throughout the year. Onset and cessation rainfall months are March (83.5 mm) and October (180.2 mm). Lowest monthly mean rainfall is December (13.4 mm), highest is September (239.0 mm), double maxima occurs in July (230.1 mm) and September with September (2nd peak) higher than the 1st peak in July. There is a little dry season (LDS) otherwise called "August break" with monthly mean rainfall of 163.4 mm which is lower than that of the two (2) summits. Nine (9) months (March-November) of wet season and three (3) months (January, 15.1 mm; February, 30.7 mm; and December, 13.4 mm) of dry season exist.

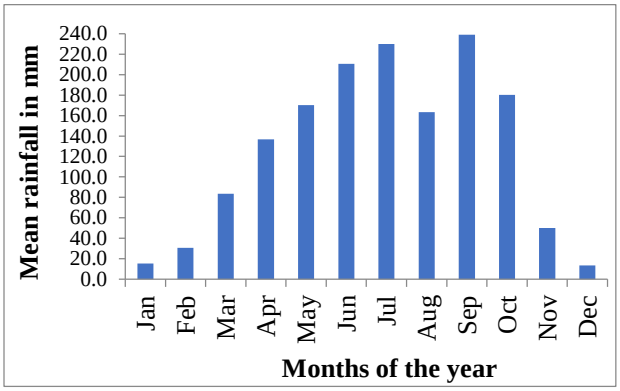

Fig 3: Monthly mean rainfall in Owena, Idanre LGA, Ondo State, Nigeria

Source: Authors' computation, 2023

In Figure 4, Igbokoda, Ilaje LGA, Ondo State, Nigeria receives mean rainfall throughout the year. Onset rainfall month is March (71.9 mm) and cessation is October (213.7 mm). Least mean rainfall is December (8.9 mm), highest is September (268.6 mm), double maxima in June (215.7 mm) and September, September peak (254.6 mm) is higher than the 1st peak in June. There is a little dry season (LDS) otherwise called "August break" which begins in July (208.3 mm) through August with monthly mean rainfall of 186.3 mm. These rains are lower than those of the two (2) peaks. There are eight (8) months (March-October) of wet season and four (4) months (January, 9.6 mm; February, 28.9 mm; November, 39.0 mm; and December, 8.9 mm) of dry season. In Figure 5, Okitipupa in Okitipupa LGA, Ondo State, Nigeria receives monthly mean rainfall throughout the year. The onset rainfall month is March (109.8 mm) and its cessation is November (64.8 mm). Least monthly mean rainfall occurs December (11.1 mm), highest is September (309.0 mm), double maxima in July (266.3 mm) and September with September peak (2nd peak)

higher than the 1st peak in July. There is a little dry season (LDS) otherwise called "August break" with monthly mean rainfall of 251.7 mm which is lower than July and September rainfall. Wet season lasts nine (9) months (March-November), while dry season lasts three (3) months (January, 15.6 mm; February, 48.1 mm and December, 11.1 mm).

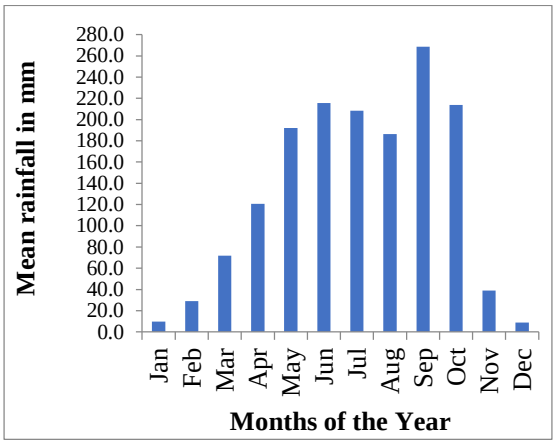

Fig 4: Mean monthly rainfall in Igbokoda, Ilaje LGA, Ondo State, Nigeria
Source: Authors' computation, 2023

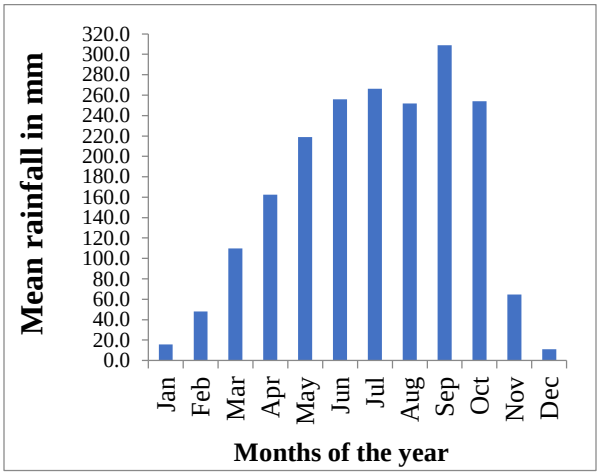

Fig 5: Monthly mean rainfall in Okitipupa, Okitipupa LGA, Ondo State, Nigeria
Source: Authors' computation, 2023

In Figure 6, Oka Akoko, Akoko South West LGA, Ondo State, Nigeria observes monthly mean rainfall throughout the year. Onset rainfall occurs in March (101.0 mm) and its cessation is November (94.1 mm). Least monthly mean rainfall is December (15.6 mm), highest is September (342.8 mm), double maxima in July (328.5 mm) and September (342.8 mm) with September peak higher than the 1st peak in July. Little dry season (LDS) also called "August break" occurs with mean rainfall of 283.8 mm which is lower than the July and September rainfall. Nine (9) months (March-November), observe wet season; while three (3) months (January, 17.3 mm; February, 32.5 mm; and December, 15.6 mm),are dry season months.

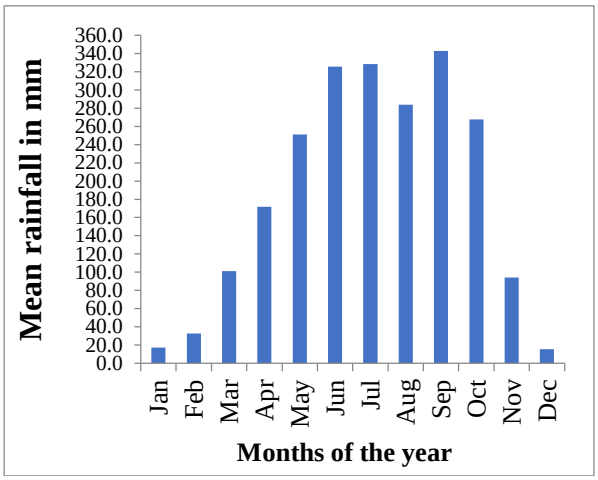

Fig 6: Monthly mean rainfall in Oka Akoko, Akoko South West LGA, Ondo State
Source: Authors' computation, 2023

In Figure 7, Isua Akoko, Akoko South East LGA, Ondo State, Nigeria receives monthly mean rainfall throughout the year. The onset rainfall occurs in March (70.1 mm) and its cessation is October (190.7 mm). Lowest monthly mean rainfall is January (11.8 mm), highest is in September (278.2 mm), double maxima are in July (262.1 mm) and September with September peak higher than the 1st peak in July. There is little dry season (LDS) otherwise called "August break" (236.8 mm) which is lower than the rainfall in July and September. Eight (8) months (March-October) make up the wet season, four (4) months (January, 11.8 mm; February, 36.1 mm; November, 43.9 mm and December, 16.5 mm) constitute the dry season months.

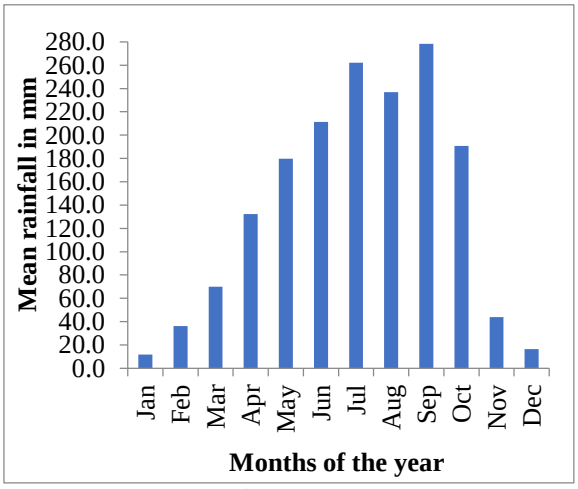

Fig 7: Monthly mean rainfall in Isua Akoko, Akoko South East LGA, Ondo State, Nigeria
Source: Authors' computation, 2023

In Figure 8, the regional outlook of monthly mean rainfall over Ondo State, Nigeria (study area) shows that, the area observes rainfall throughout the year giving it the characteristics of sub-equatorial climate. Meanwhile, not all months receive agriculturally-significant rainfall. In the result, three (3) months namely, January (13.6 mm), February (36.6 mm) and December (13.8 mm) monthly mean rainfall cannot support any meaningful farming without the aid of irrigation. These months are hence designated as dry season. March (86.4 mm) is the onset month of rainfall and November (56.4 mm)is its cessation. Monthly mean rainfall increases from January (13.6 mm) through July (254.2 mm) which is the 1st peak of rainfall. By August (218.8 mm), there is a decline in rainfall below those of June (238.3 mm) and July, but higher than those of January-May (197.7 mm). This decline in rainfall is termed as little dry season (LDS) commonly called "August Break" (218.8 mm) which is followed by the 2nd peak rainfall in September (282.1 mm). Regional climatological mean rainfall is about 1758.2 mm.

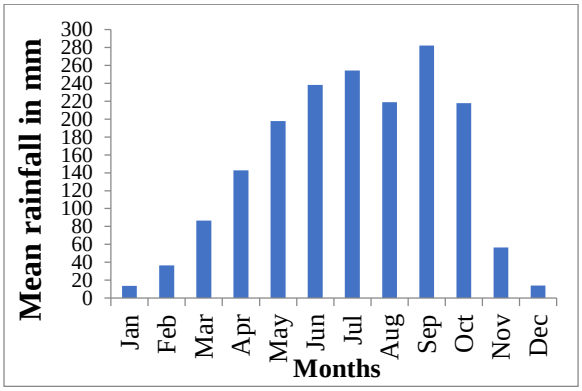

Fig 8: Regional monthly mean rainfall in Ondo State (regional), Nigeria
Source: Authors' computation, 2023

In Figure 9, the monthly state average percentage rainfall difference in Iju-Itaogbolu, Akure North LGA indicates both positive and negative differences. The positive value is higher in number (7), while the negative value is four (4). The highest positive value occurs in September (11.5), while the lowest is 3.5 (July). On the other hand, the highest negative difference is -27.5 (November), while the lowest is -5.2 (December). The negative percentage difference of -7.0 in August is a sign of little dry season (LDS). The monthly state average percentage rainfall difference in Owena, Idanre LGA indicates both positive and negative differences. The positive value is higher in number (7), while the negative value is four (4). The highest positive value occurs in September (13.0), while the lowest is 2.7 (February). On the other hand, the highest negative percentage difference is -22.3 (November), while the lowest is -6.3 (December). The negative difference of -11.5 in August is a sign of little dry season (LDS). Figure 9 shows monthly state average percentage rainfall difference in Igbokoda, Ilaje LGA has both positive and negative differences. The positive value is higher in number (6), while the negative value is five (5). The highest positive value occurs in September (14.3), while the lowest is 3.4 (January). On the other hand, the highest negative % difference is -30.2 (November), while the lowest is -1.3 (July). November and December are dry season months. The negative difference of -1.3 and -7.0 in July and August is a sign of little dry season (LDS). It means LDS begins in July at this station. The monthly state average percentage (%) rainfall difference in Okitipupa, Okitipupa LGA indicates both positive (7) and negative (4) differences. Highest positive value occurs in May (10.7), while the lowest is 0.4 (July). On the other hand, the highest negative difference is -23.4 (November), while the lowest is -6.0 (August) which is a sign of LDS. In Figure 9, the monthly state average percentage rainfall difference in Oka-Akoko, Akoko South West LGA indicates both positive (7) and negative (4) differences. The highest positive value occurs in September (11.5), while the lowest is 3.5 (July). On the other hand, the highest negative difference is -27.5 (November), while the lowest is -5.2 (December). November and December are dry season months. The negative % difference of -7.0 in August is a sign of LDS. The monthly state average percentage rainfall difference in Isua-Akoko, Akoko South East LGA shows both positive (7) and negative (4) differences. The highest positive value occurs in April (10.8), while the lowest is 4.2(February). On the other hand, the highest negative difference is -25.4(November), while the lowest is -4.4 (August) which is the LDS. The monthly average percentage rainfall difference in the Ondo State, Nigeria (study area) indicates both positive (7) and negative (4) differences. The highest positive value occurs in September (10.4), while the lowest is 2.6 (July). On the other hand, the highest negative difference is -26.5 (November), the lowest is -5.9 (August) and signifies the LDS. In Figure 10, all the data collection points do not observe zero (0) deviation which would have been a perfect result in this study. This implies that, all the stations deviate from the regional average both positively and negatively. Igbokoda deviates in all months negatively, while Okitipupa and Oka-Akoko deviate positively in eleven (11) months each. In both positive and negative deviations, the values that are large, high or far from zero (0) are the biased estimators of the zonal average monthly rainfall which cannot be relied upon. On the other hand, the good ones are those values close to zero (0) which are called unbiased estimators which can be relied upon.There

seems to be uniformity in the onset month of rain across the data collection points which is March. However, there is variability in the monthly mean rainfall across the six (6) data collection points in the onset and cessation months, rain amount, rain amount at the peak (September), months with the least rainfall and values as well as the value of rain during the LDS.

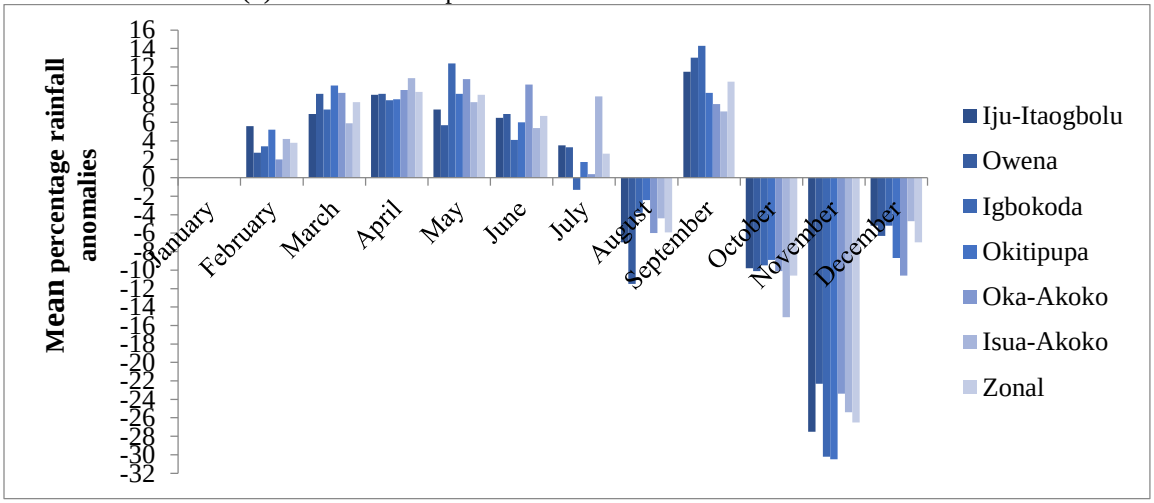

Fig 9: Monthly mean percentage rainfall anomalies in all the data collection points and zonal
Source: Authors' computation, 2023

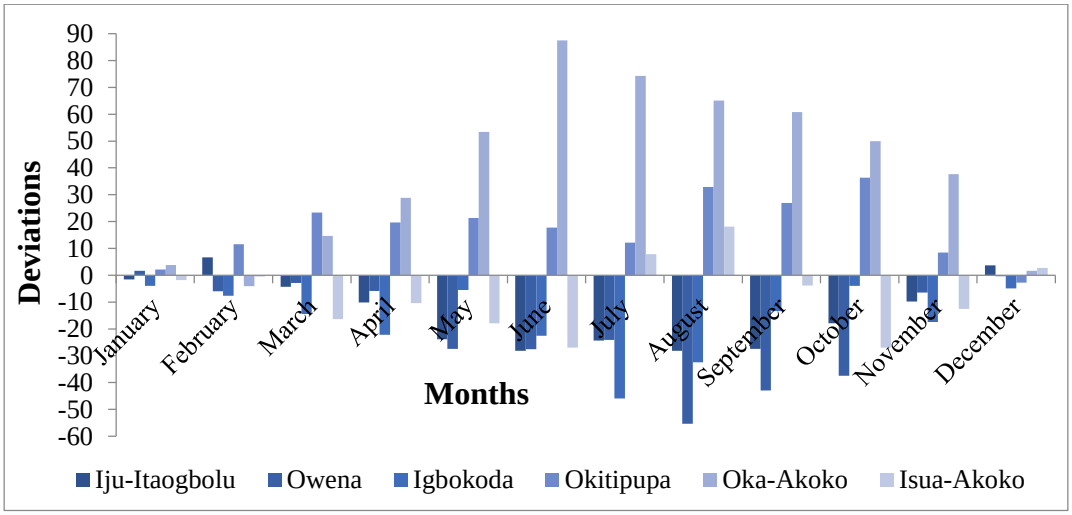

Fig 10: Stations deviation from zonal average monthly mean rainfall in Ondo State, Nigeria.
Source: Authors' computation, 2023

At onset, the amount of rain in Iju-Itaogbolu, Akure North LGA is 82.1 mm; Igbokoda, Ilaje LGA is 71.9 mm; Owena, Idanre LGA is 83.5 mm; Okitipupa, Okitipupa LGA is109.8 mm; Oka Akoko, Akoko South West LGA is 101 mm and Isua Akoko, Akoko South East is 70.1 mm. At onset, Okitipupa, Okitipupa LGA has the highest mean monthly rainfall of 109.8 mm which is the highest among the data collection points. This could be attributed to its proximity to the Atlantic Ocean than other stations. On the contrary, Isua Akoko, Akoko South East LGA has the least mean monthly rainfall of 70.1 mm among the data collection points. This result has corroborated the study of Ogunrinde *et al*. (2019) which observed that, Nigeria witnessed more annual rainfall totals, but with high variability within the months of the year. Regarding the cessation, Iju-Itaogbolu, Akure North LGA; Igbokoda, Ilaje LGA; Owena, Idanre LGA and Isua Akoko, Akoko South East LGA have their cessations in October with rainfall of 199.8 mm, 213.7 mm, 70.1 mm and 190.7 mm; while Okitipupa, Okitipupa LGA and Oka Akoko, Akoko South East LGA have their cessations in November with rainfall of 64.8 mm and 94.1 mm. At cessation, Igbokoda, Ilaje LGA has the highest rainfall of 213.7 mm and Okitipupa has the least of 64.8 mm. Ogunrayi *et al*. (2016) observed that, the period of the rainy season in Nigeria has been reducing since 1914 when the onset

and cessation were generally normal to 1971 when signals of late onset and early cessation of rainy season set in. It is worth nothing that, all the data collection points have their highest monthly mean rainfall in September with variability in the rain amounts. Okitipupa has the highest monthly mean rainfall at the peak of the rains which is September (309 mm), while Owena in Idanre LGA has the least of 239 mm. Iju-Itaogbolu in Akure North LGA has 254.6 mm, Igbokoda in Ilaje LGA has 268.6 mm, Oka Akoko in Akoko South West LGA has 267.7 mm and Isua Akoko in Akoko South East LGA has 278.2 mm. Regarding the month with the least mean rainfall, Iju-Itaogbolu in Akure North LGA and Isua-Akoko in Akoko South East LGA observe the least rainfall in January in the order of 11.9 mm and 11.8 mm. Igbokoda in Ilaje LGA, Owena in Idanre LGA, Okitipupa in Okitipupa LGA and Oka Akoko in Akoko South West LGA observe it in December in the order of 8.9 mm, 13.4 mm, 11.1 mm and 15.6 mm. This corroborated the findings of Eludoyin *et al*. (2017) which opined that, Ondo State received its highest monthly mean rainfall in September with the least in January. The little dry season (LDS) which occurs mainly in August also exhibits variability in mean rainfall amount across the data collection points. Iju-Itaogbolu in Akure North LGA has 190.6 mm, Igbokoda in Ilaje LGA has 186.3 mm, Owena in Idanre LGA has 163.4 mm (least), Okitipupa in Okitipupa LGA has 251.7 mm, Oka Akoko in Akoko South West has 283.8 mm (highest) and Isua-Akoko in Akoko South East LGA has 236.8 mm. These amounts of rains are clear indications that, LDS is not a total absence of rainfall or that the rains are insufficient for agricultural purpose. The study by AdeJuwon and Odekunle (2006) discovered the occurrence of LDS along the coast of Southwestern Nigeria from mid-July to mid-September. In this study, variability is detected in monthly and climatological averages, % difference as well as the deviation from mean values. The negative percentage difference is observed across all stations and at regional level in the month of August. Variability is a typical attribute of rainfall in Nigeria. The study of Tubosun (2022) discovered significant variations in rainfall mostly in 1994 and 2001 in Lower Niger River Basin Development Authority Catchment Area. The positive rainfall anomaly in the dry season months of January and February is an indication of increasing trend. Ishiyaku (2006) in a study discovered severe thunderstorms in January over Akure, Nigeria. This might have been responsible for the positive rainfall trend in the study area as observed in this study.

Conclusion: The study area observes rainfall throughout the year, March (86.4 mm) is the rainfall onset, November (56.4 mm) is the cessation, double maximum occurs in July (254.2 mm) and September (282.1 mm) and mean rainfall is 1752.2 mm. In conclusion, the area experiences variability and decline in rainfall. Hence, it is recommended that, NiMet should down-scaled the Seasonal Climate Prediction (SCP) early to guide farmers and hydrologists; irrigation should be encouraged; hybrid crops should be cultivated and more water reservoirs should be constructed.

REFERENCES

Abubakar, AS (2015). Hydrometeorology: Enhancing the Capacity for Hydroelectricity Generation in our Homes and Industries. Federal University of Technology, Minna, Inaugural Lecture Series 36, 27th August, 2021, Pg. 8

Adejunwo, JO (2010). Analysis of Rainfall Trend during the Little Dry Season in Southwestern Nigeria. *J. Met. Cli. Sci*. 8(2):64-70.

Adejuwon, JO; Odekunle, TO. (2006). Variability and Severity of the "Little Dry Season" in Southwestern Nigeria. *J. Cli*. 19(3):483-493.

Adetayo, AO (2013). Correlation Study on Developmental Stages in Soya Bean (*Glycine Max*) and Prevail Agro-meteorological Indices in Forest Savanna Eco-Climatic Zone of Nigeria. Nigerian Meteorological Society Book of Conference Proceedings on Global Climate change: lamentations and Leverages, 1-4 December, 2013, Abuja, Nigeria. Pp. 6-8

Akanbi, FR (2022). Effect of Socioeconomic and Demographic Factors on Malaria among Pregnant Women in Selected Relief Regions of Ondo State, Nigeria. In: Ekanade, O; Ajewole, OD; Ibrahim, SI; Afolayan, OS; Ajadi, BS (eds). Environmental Sustainability, Climate Change and Challenges of Indigenous Knowledge Perception in 21st Century. A Festschrift in Honour of Professor Lanre Tajudeen Ajibade. Published by Department of Geography and Environmental Management, University of Ilorin, Ilorin, Nigeria. Pp. 18-26.

Akinbode, OM; Eludoyin, AO; Ediang, AO (2006). A Note on the Spatial-temporal Variations in the Temperature and Relative Humidity over Akure, Ondo State, Nigeria. *J. Nig. Met. Soc*. 6(1):33-49.

Audu, HO; Bibi, UM; Garba, BG; Ibrahim, AK; Ali, H; Tarki, SK; Bulus, BG (2019). Determination of Onset, Cessation of Rains, and hydrological Growing Season in Dadin Kowa and Gombe for

Agricultural Planning. *Nig. Agric. J*. 50(1):133-141.

Audu, EB; Abubakar, AS; Ojoye, S; Musa, SD; Agye, AI; Sule, A (2022). Temporal Assessment of Pentad Rainfall in Abuja, Nigeria. In:Ekanade, O; Ajewole, OD; Ibrahim, SI; Afolayan OS; Ajadi, BS (eds). Environmental Sustainability, Climate Change and Challenges of Indigenous Knowledge Perception in 21st Century. A Festschrift in Honour of Professor Lanre Tajudeen Ajibade. Published by Department of Geography and Environmental Management, University of Ilorin, Ilorin, Nigeria. Pp. 187-195.

Awomeso, JA; Taiwo, AM; Oyetunde, OA; Sadiq, AY (2015). Application of Remote Sensing in Hydrological mapping: Examples from Northeast and Southwest, Nigeria. Nigeria Association of hydrological Sciences 6th International and Annual General Meeting ABU-2015 on Sustainable Water Management in a Changing Environment, 15th-18th September, 2015. Pp. 268-276

Eludoyin, AO; Nevo, AO; Abuloye, PA; Eludoyin, OM; Awotoye, OO (2017). Climate Events and Cropping Activities of Small-Scale Farmers in a Part of Southwest Nigeria. *Amer. Met. Soc*. 9:235-253.

Ibrahim, I; Emigilati, MA; Suleiman, YM; Ojoye, S; Yahaya, TI (2018). Effectiveness of Early-Warning Methodology and Standardized Precipitation Index for Drought Monitoring over Guinea Savanna Zone, Nigeria. *J. Sci. Technol. Math. Educ*. 14(2):1-8.

Ishiyaku, I (2006). Severe thunderstorms in January in Southern Nigeria- A case study over Akure. *J. Nig. Met. Soc*. 6(1):60-69.

Lawal, FO; Geoffrey, EO; Adebayo, MO; Wahab, S; Sani, WJ (2022). Climate Change and Water Security in Nigeria: A Review. In: Ekanade, O; Ajewole, OD; Ibrahim, SI; Afolayan, OS; Ajadi, BS (eds). Environmental Sustainability, Climate Change and Challenges of Indigenous Knowledge Perception in 21st Century. A Festschrift in Honour of Professor Lanre Tajudeen Ajibade. Published by Department of Geography and Environmental Management, University of Ilorin, Ilorin, Nigeria. Pp. 196-204.

Matazu, MB (2021). Forward. State of the Climate in Nigeria. Nigerian Meteorological Agency. Pg. vii.

National Space Research and Development Agency (2023). Map of Nigeria showing Ondo State.

Ogunrayi, OA; Akinseye, FM; Goldberg, V; Bernhofer, C (2016). Descriptive Analysis of Rainfall and Temperature Trends over Akure, Nigeria. *J. Geog. Reg. Plann*. 9(11):195-202.

Ogunrinde, AT; Oguntunde, PG; Akinwumiju, AS; Fasinmirin, JT (2019). Analysis of Recent Changes in Rainfall and Drought Indices in Nigeria, 1981-2015. *Hydrol Sci. J*. 64(14):1755-1768.

Onyejekwe, GO; Bello, NJ; Erruola, AO; Olasantan, FO (2016). Application of Moisture Agro-climatic Model to the Growth of Maize and Okra in Sole-Cropping and mixtures in Abeokuta, Nigeria. Conference Proceedings of the Nigerian Meteorological Society on "Climate Variability and Change: Impact, Science, Innovation and Policy." Federal University of Agriculture, Abeokuta, 21st-24th November, 2016. Pp. 523-532.

Salawu, E; Emigilati, MA; JIya, SN; Ibrahm, I (2014). Perception of Climate Change and Implications of the Livelihood of the People of Lavun-South (Doko Area) in Lavun Local Government Area of Niger State, Nigeria. *Dev. J. Sci. Techn.Res.* 3(1):94-106.

Tubosun, JO (2022). Temporal Assessment of Rainfall Variability in Lower River Niger Basin Development Authority Catchment Area. In: Ekanade, O; Ajewole, OD; Ibrahim, SI; Afolayan OS; Ajadi BS (eds). Environmental Sustainability, Climate Change and Challenges of Indigenous Knowledge Perception in 21st Century. A Festschrift in Honour of Professor Lanre Tajudeen Ajibade. Published by Department of Geography and Environmental Management, University of Ilorin, Ilorin, Nigeria. Pp. 169-176.

Umar, AY (2010). Rainfall Variability in Northwestern Nigeria and its Implications on Food Security and Livelihoods. In: OS Akpoghomeh (ed). *Nig. Geog. J, New Series*. 6(1 and 2):138-149

Umar, AU; Aliyu, H (2022). Rainfall Amount and Distribution and their Relationship with Drought Risk in the Semi-Arid NorthWestern Nigeria. In:Ekanade, O; Ajewole, OD; Ibrahim, SI; Afolayan, OS; Ajadi, BS (eds). Environmental Sustainability, Climate Change and Challenges of Indigenous Knowledge Perception in 21st Century. A Festschrift in Honour of Professor Lanre Tajudeen Ajibade. Published by Department of Geography and Environmental Management, University of Ilorin, Ilorin, Nigeria. Pp. 177-186.