A STUDY OF THE VARIATION IN MINIMUM TEMPERATURE AND PRECIPITATION AND ITS IMPLICATIONS IN SOME PARTS OF NORTH CENTRAL NIGERIA.

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Abstract

Variability in weather and climate inherently leads to the occurrence of extreme weather or climate events. These events, more unusual and more severe than normal or average weather, include for example heat waves (high-temperature events), cold waves (low-temperature events). The study aim to characterize the weather parameters in the study area, determine the variability and trend of the elements of weather using descriptive and inferential statistics. Among all the stations analyzed, the results show that Minna has highest mean maximum temperature of 33.483^{0}C followed by Lokoja with 33.383^{0}C. Ilorin has lowest maximum temperature with 32.950^{o}C as compared to normal temperature of 30- 36^{0}C. From the observed values of rainfall, Lokoja has highest rainfall (mm) of 195.025 follow by Ilorin with 182.917. Minna has lowest rainfall (mm) with 97.517 as compared to normal rainfall of 120 – 200mm. The various minimum and maximum should be monitored to avoid going beyond the extreme which could detrimental to human health, livestock production and crop yield.

Keywords: Climate, Weather, Trend, Variability, Extreme, Precipitation.

Introduction

Weather is incessantly changing periodically from week to week, month to month, and at times seasonally. It is a term that refers to the state of the environment at a definite time and place. Whereas changes in weather are steady and sometimes randomly, it is nevertheless possible to arrive at an overview of the variations. An overall weather patterns is termed climate (Awkash et al., 2016; Herring et al., 2019).

Variability in weather and climate inherently leads to the occurrence of extreme weather or climate events. These events, more unusual and more severe than normal or average weather, include for example heat waves (high-temperature events), cold waves (low-temperature events), downpours (heavy-precipitation events) and droughts (low-precipitation events). Societies and natural ecosystems are increasingly at risk of such extreme weather events (Karin and Richard, 2020; Mohammed et al., 2020).

Under the background of global warming mainly due to climate change, the present of temperature warming trends, resulting in the heat resources of agricultural climates increase, has a major impact on agricultural production (Oyeleke and Olawale, 2015; Wexler, 1950).

To study climatic pattern due to variation of atmospheric parameters, long time period of data is required while for perspective point of air pollution, annual average weather parameters are almost the same.

Atmospheric parameters are important for understanding the trend in its variation associated with the dynamics of air pollution. Temperature, humidity, cloud cover, rain fall, wind speed and direction are atmospheric characteristics which represent weather for a small period. Temperature inversion makes low and high boundary layer height from the surface and varies the concentration of air pollutant. Lower value of relative humidity causes air pollution. Cloud covers also a factor of air pollution. Lower wind speed causes less dispersion and increased air pollution level. Many studies have been done to quantify and contrast the variation of weather parameters over several regions (Zhigua et al., 2021; Micheal 2008).

Heat and Temperature

Heat is a form of energy that is transferred from one region to another as a result of temperature difference, it is the measure of the internal energy of a region it is transferred from a hot region to a cold region. Temperature is a measure of the hotness or coolness of a region. These two quantities are related through the specific heat equation, given as

$$Q = m\,c\,\Delta T \quad \ldots\ldots(1)$$

Where Q is quantity of heat, m is mass of rainfall, c is specific heat capacity of water, ΔT is temperature change (Somoye et al., 2020).

Methodology

Methods of Data Collection

The work covers three (3) states in North central Nigeria, for twelve (12) months. Series of Statisti cal analysis were carried out to achieve our stated objectives. This study used secondary data collected from the Nigerian Meteorological Agency. Necessary adjustments were made for cases of missing data such as averaging and interpolation.

Fig.1 Map of North Central Nigeria.

Weather Parameters

Atmospheric Pressure (P): Atmospheric Pressure (P) is the force per unit area exerted on a surface by the weight of air above that surface in the atmosphere of Earth. It is closely approximated by the hydrostatic pressure caused by the weight of air above the measurement point. Thus, it should depend on the nature and constituent of the air.

Ambient Temperature (Wet and Dry Bulb): The wet-bulb temperature is the temperature a parcel of air would have if it were cooled to saturation (100% relative humidity) by the evaporation of water into it.

Wet-bulb temperature is largely determined by both actual air temperature (dry-bulb temperature) and humidity. The dry-bulb temperature is the temperature of air measured by a thermometer freely exposed to the air but shielded from radiation and moisture and usually thought of as the air temperature. Temperature according is one of the most important climate variables for human comfort and building energy efficiency.

Relative Humidity*:* Relative humidity is the ratio between the amount of water the ambient air actually holds and the amount it could hold at the same temperature.

Amount of Rainfall*:* Rain is liquid water in the form of droplets that have condensed from atmospheric water vapor and then precipitated. Rain is a major component of the water-cycle and is responsible for depositing most of the fresh water on the Earth and provides suitable conditions for many types of ecosystems. The standard way of measuring rainfall or snowfall is the standard rain gauge, which can be found in 100-mm plastic and 200-mm metal varieties.

Wind Speed /Direction*:* Wind is characterized by its direction and velocity. Wind direction refers to the direction from which the wind is blowing. For the computation of evapotranspiration, wind speed is the relevant variable. As wind speed at a given location varies with time, it is necessary to express it as an average over a given time interval. Wind speed is given in meters per second (m s-1) or kilometers per day (km day-1). Wind speed is measured with anemometers (Micheal 2008).

Methods of Data Analysis

Descriptive and Inferential statistics

The descriptive statistics such as the Mean, Median, Range, Minimum, Maximum and Sum and inferential statistics such as Pearson Correlation Coefficient were computed for each of the selected weather parameters and were in turn used to study the variability of the weather parameters in the three (3) states of North Central Nigeria. The standard formulae were used to compute the various measures.

Results and Discussion

Descriptive Statistics		Ilorin	Lokoja	Minna
N	Valid	12	12	12
	Missing	0	0	0
Mean		21.792	23.150	21.817
Median		22.250	23.450	21.750
Range		6.5	8.4	4.8
Minimum		17.3	17.9	19.4

Maximum	23.8	26.3	24.2
Sum	261.5	277.8	261.8

Table 1. Descriptive Statistics on Minimum Temperature.

The average minimum temperature recorded in Table 1. for Ilorin, Lokoja and Minna (January – December, 2018) were 21.792, 23.150 and 21.817 respectively. The result shows that Lokoja has highest minimum temperature of 23.150 follow by Minna with 21.817. Ilorin has lowest minimum temperature with 21.792. The median minimum temperature for Ilorin, Lokoja and Minna were 22.250, 23.450 and 21.750 respectively. The result shows that Lokoja has highest minimum temperature of 23.450 follow by Ilorin with 22.250. Minna has the lowest median minimum temperature with 21.750. Lokoja has the highest range with 8.4 follow by Ilorin with 6.5. Minna has the lowest range with 4.8.

Descriptive Statistics		Ilorin	Lokoja	Minna
N	Valid	12	12	12
	Missing	0	0	0
Mean		182.917	195.025	97.517
Median		171.800	128.400	86.800
Range		542.7	516.6	262.1
Minimum		.0	.0	.0
Maximum		542.7	516.6	262.1
Sum		2195.0	2340.3	1170.2

Table 2. Descriptive Statistics on Amount of Rainfall (mm).

The average rainfall (mm) recorded Table 2. for Ilorin, Lokoja and Minna (January – December, 2018) were 182.917, 195.025 and 97.517 respectively. The result shows that Lokoja has highest rainfall (mm) of 195.025 follow by Ilorin with 182.917. Minna has lowest rainfall (mm) with 97.517. The median rainfall (mm) recorded in table 3.2 for Ilorin, Lokoja and Minna were 171.800, 128.400 and 86.800 respectively. The result shows that Ilorin has the highest rainfall (mm) of 171.800 follow by Lokoja with 128.400. Minna has the lowest median rainfall (mm) with 86.800. In Table 2, Ilorin has the highest range with 542.7 follow by Lokoja with 516.6. Minna has the lowest range with 262.1.

Correlations		Ilorin	Lokoja	Minna
Ilorin	Pearson Correlation	1	.965**	.772**
	Sig. (2-tailed)		.000	.003
	N	12	12	12
Lokoja	Pearson Correlation	.965**	1	.836**
	Sig. (2-tailed)	.000		.001
	N	12	12	12
Minna	Pearson Correlation	.772**	.836**	1
	Sig. (2-tailed)	.003	.001	
	N	12	12	12
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 3. Correlation Coefficient Statistics on Minimum Temperature

In table 3, the result of correlation coefficient indicates that minimum temperature recorded in Ilorin has positive strong correlation coefficient with Lokoja and Minna with 0.965 (96.5%) and 0.772 (77.2%) respectively while Lokoja and Minna also has positive strong correlation coefficient of 0.836 (83.6%).

Correlation		Ilorin	Lokoja	Minna
Ilorin	Pearson Correlation	1	.830**	.946**
	Sig. (2-tailed)		.001	.000
	N	12	12	12
Lokoja	Pearson Correlation	.830**	1	.914**
	Sig. (2-tailed)	.001		.000
	N	12	12	12
Minna	Pearson Correlation	.946**	.914**	1
	Sig. (2-tailed)	.000	.000	
	N	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4. Correlation Coefficient Statistics on Rainfall (mm)

From the Table 4. above, the result of correlation coefficient indicates that rainfall (mm) recorded in Ilorin has positive strong correlation coefficient with Lokoja and Minna with 0.830 (83.0%) and 0.946 (94.6%) respectively while Lokoja and Minna also has positive strong correlation coefficient of 0.914 (91.4%).

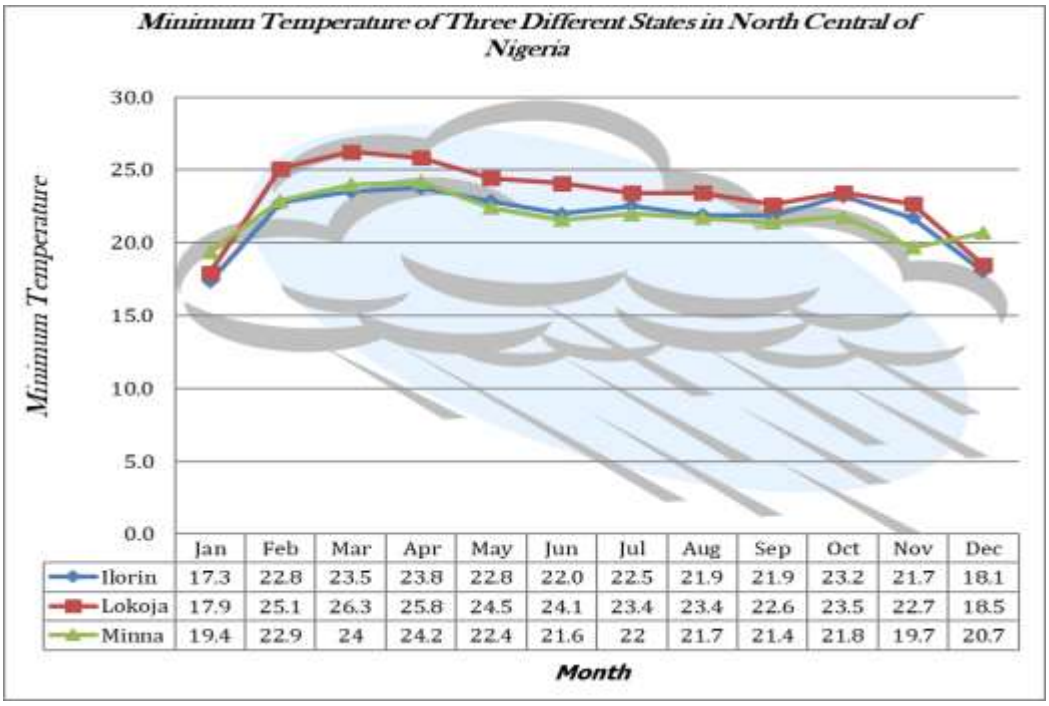
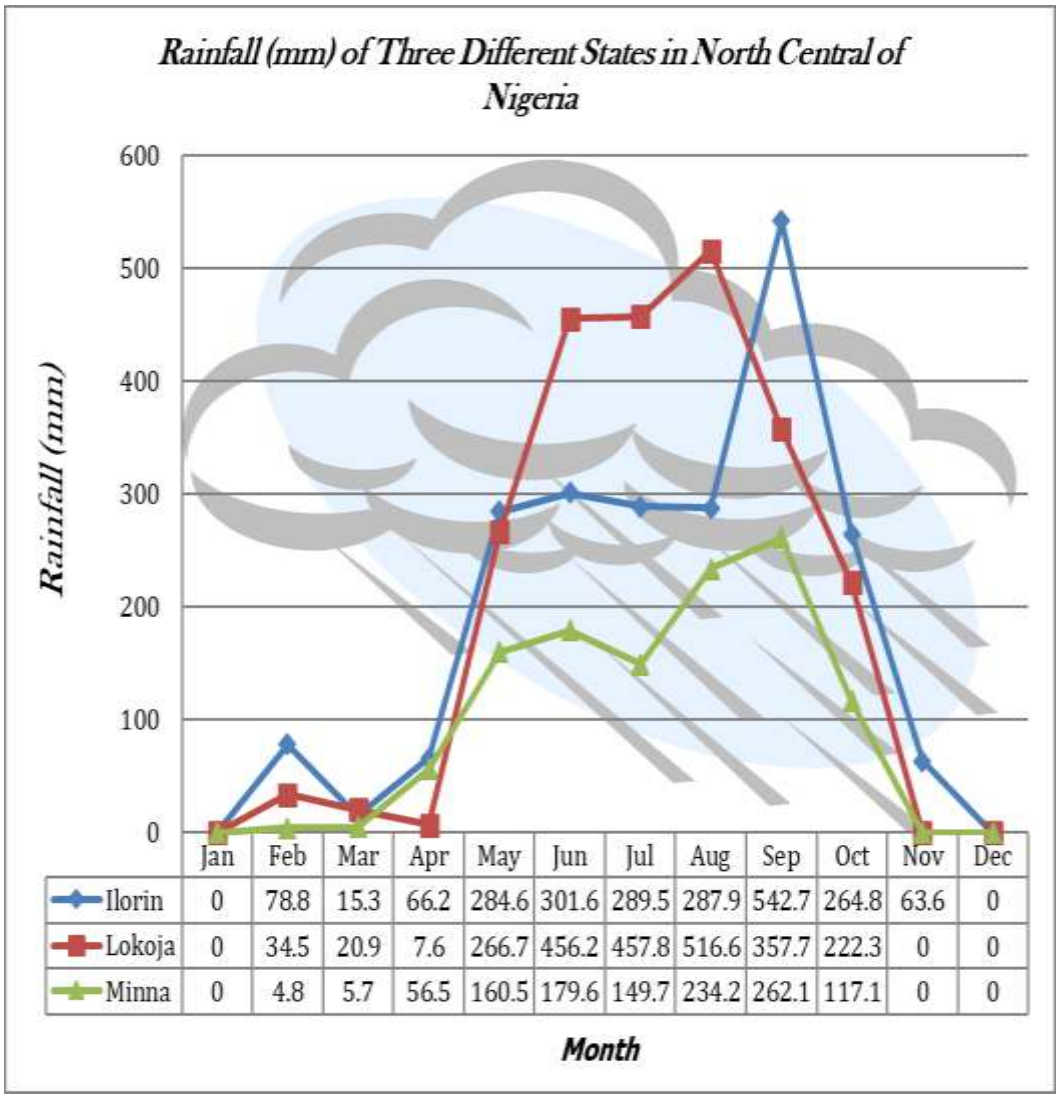


Fig. 1 Time Series Graph of the Monthly Minimum Temperature

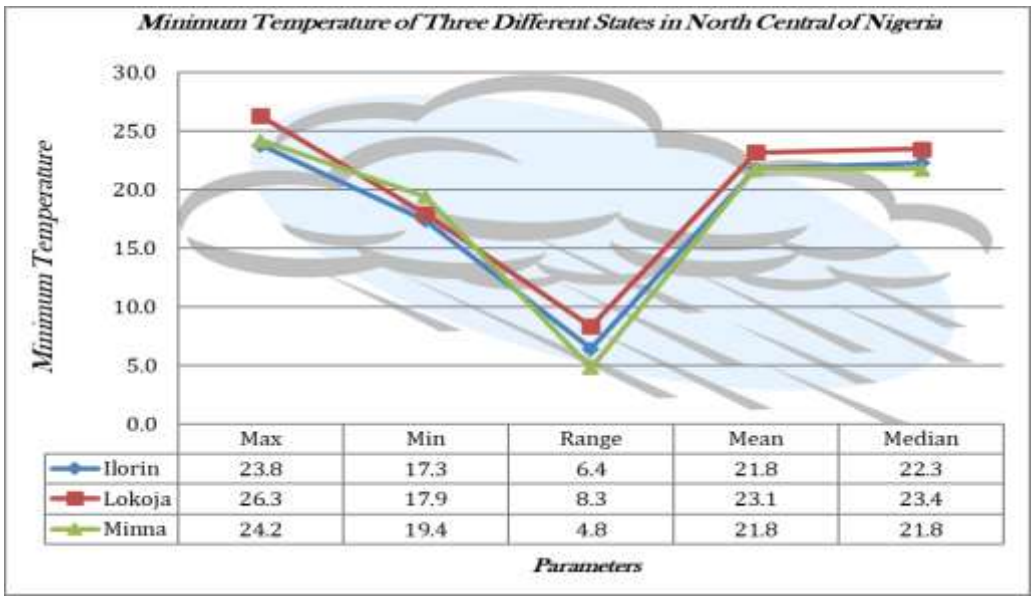
Fig.1 shows the time series graph of the average minimum temperature of the three selected state capital in central north of Nigeria. The variation or changes that occurred in the minimum temperature has the same pattern from January to April while declined in the month of May till July then picked up in month of October and finally declined to till December.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ilorin	0	78.8	15.3	66.2	284.6	301.6	289.5	287.9	542.7	264.8	63.6	0
Lokoja	0	34.5	20.9	7.6	266.7	456.2	457.8	516.6	357.7	222.3	0	0
Minna	0	4.8	5.7	56.5	160.5	179.6	149.7	234.2	262.1	117.1	0	0

Fig.2 Time Series Graph of the Monthly Rainfall (mm)

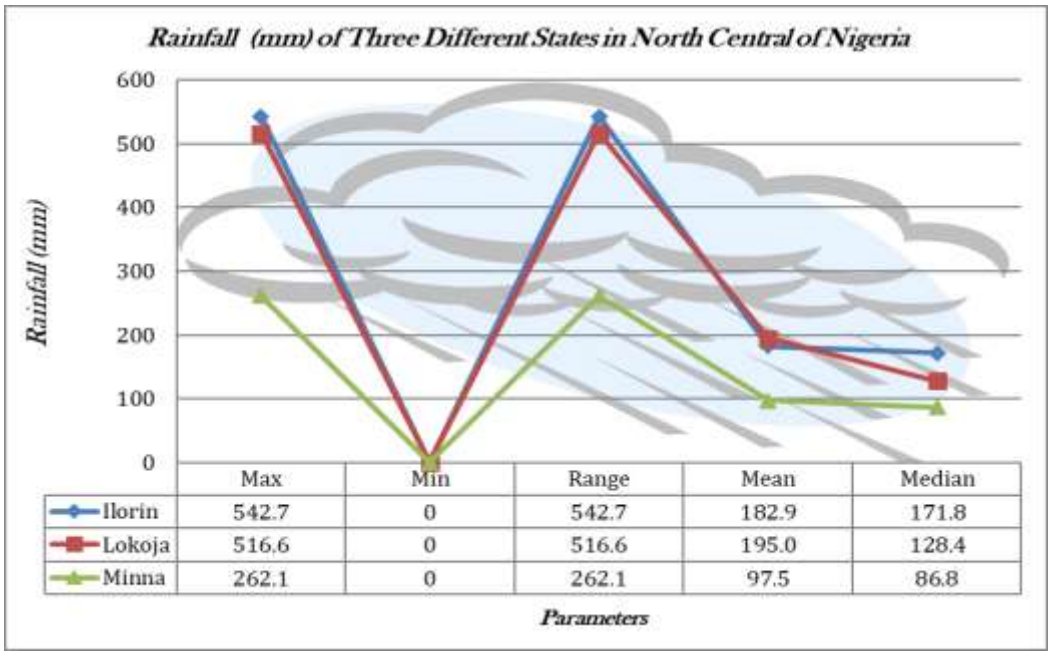
Fig.2 shows the time series graph of the rainfall (mm) of the three selected state capital in central north of Nigeria. The variation or changes that occurred in the amount of rainfall (mm) picked up from February with 78.8 in Ilorin and 4.8 in Minna and declined in March with 20.9 in Lokoja and later picked up till June with highest amount in July and August with 457 and 516 respectively. There is an increase in amount of rainfall recorded in month September in Ilorin and later declined till December where there is no record.



	Max	Min	Range	Mean	Median
Ilorin	23.8	17.3	6.4	21.8	22.3
Lokoja	26.3	17.9	8.3	23.1	23.4
Minna	24.2	19.4	4.8	21.8	21.8

Fig.3 Time Series Graph of the Monthly Minimum Temperature

Fig.3 shows the time series graph of the minimum temperature of the three selected state capital in central north of Nigeria. The graph shows that Lokoja has highest range, mean and median with 26.3, 23.1 and 23.4 respectively follow by Ilorin that has range, mean and median with 6.4, 21,8 and 22.3 respectively. Minna has the lowest range and median with 4.8 and 21.8 respectively.



	Max	Min	Range	Mean	Median
Ilorin	542.7	0	542.7	182.9	171.8
Lokoja	516.6	0	516.6	195.0	128.4
Minna	262.1	0	262.1	97.5	86.8

Fig. 4.4: Time Series Graph of the Monthly Rainfall (mm)

Fig.4 shows the time series graph of the rainfall (mm) of the three selected state capital in central north of Nigeria. The graph shows that Ilorin has highest range and median with 542.7 and 171.8 respectively follow by Lokoja with highest mean of 195. Minna has lowest median of 86.8.

Conclusion

Although anyone at any time can suffer from heat-related illness, some people are at greater risk than others, Heat-induced illness can cause a person to become confused or lose consciousness. Electric fans may provide comfort, but when the temperature is high they will not prevent heat-related illness. Taking a cool shower or bath or moving to an air-conditioned place is a much better way to cool off. Use your stove and oven less to maintain a cooler temperature in your home. Also, proper drainage should be monitored in case of high precipitation also known as flooding,

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