ANALYSIS OF SOME CLIMATIC PARAMETERS IN GBOKO LOCAL GOVERNMENT AREA OF BENUE STATE, NIGERIA

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Abstract

The study was undertaken to analyze some climatic parameters in Gboko Local Government Area, Benue State Nigeria. Data for this study were collected from the Nigerian Meteorological Agency (NIMET), AirForce Base, Makurdi.. The rainfall pattern analysis was carried out through the use of rainfall data which was subjected to computer software, The Arc Map was used to designed isoline maps which shows communities that have the same amount of rainfall pattern in the Study Area. The analysis looked into areas that normally experienced low and high amount of rainfall in the study area, which indicated that different months has different amount of rainfall based on the pattern considered. The study also established that the high and low amount of rainfall in Gboko Local Government Area shown different patterns in different months. The trend analysis was used to shows the trends in rainfall, temperature and relative humidity using thirty years data. The analysis shows that most years under study experienced total dry spell with high temperature and low relative humidity while other years experienced heavy rainfall with low temperature and high relative humidity. It was also discovered that rainfall in the study area is not evenly distributed and perhaps results in dry spells and heavy floods which resulted to the suffering of the people in the study area. It was therefore recommended that Weather Forecasting Agencies such as the Nigerian Meteorological Agency (NIMET) should intensify more effort on seasonal forecasts of dates of rainy season, onset, cessation, duration of rainy season as well as daily temperature and relative humidity down to the Local Government level so as to be prepared them for any emergency.

Key Words: Rainfall Pattern, Climatic parameters, Geographic Information System, Arc Map, Isoline Map

Introduction

Climate simply means the mean state and behavior of the atmospheric condition over a long period of time. The constituents of climatic parameters include Rainfall, Temperature, Relative humidity, Sunshine, solar radiation etc. In most of the researches carried out by many scholars the emphasis has been on rainfall, this is because people belief that rainfall is the most important natural factor that determines the agricultural production in Nigeria, particularly in the Northern part of Nigeria. Relative humidity and temperature are also two climatic parameters that have direct and significant effect on crop production. Potential crop yield varies across locations due to the temperature and relative humidity regime. The variability of rainfall and the pattern of extreme high or low precipitation are very important for agriculture as well as the economy of the state. It is well established that the rainfall, temperature and relative humidity is changing on both the global and the regional scales due to global warming (Hulme, 1998). As the moves to encourage agriculture to ensure food security continues to gain ground and acceptability, information on rainfall, temperature and relative humidity pattern is vital for the design of water supply, supplement irrigation schemes, evaluation of alternative cropping and soil water management plans. Such information can also be beneficial in determining the best adapted plant species and the optimum time of seeding to re- establish vegetation on deteriorated rangelands. Much as long rainfall records are mostly available in many countries, little use is made of this information because of the unwieldy nature of the records (Fisher, 2005). The current pattern of rainfall, temperature and relative humidity in Benue State has been a source of concern to the inhabitants, especially those who rely on it for their economic activities. Rainfall pattern is increasingly becoming a source of concern, particularly in the rain fed agricultural regions of the world, this is due largely to its variability, distribution and seasonality.

A typical rain fed agricultural region, where the scarcity of water and uncertainties in both the amount received and in spread, have continued to pose major threat to the development of agriculture and have contributed significantly to the poor yield and high variability in crop production from year to year. According to Fakorede (1993), it is clear that, of the climatic factors which influence the pattern and productivity of rain fed agriculture in Nigeria, the availability of water and temperature to crops is by far the most important. Generally, based on rainfall distribution, certain patterns are found at a different geographical location. Nyagba (1995) pointed out that rainfall distribution pattern explains why the drought resistance crops such as millet and sorghum are grown largely in different parts of the study area while crops that are more moisture demanding such as and maize are grown extensively. To date, much of the effort to analyze rainfall variability in Nigeria with respect to agriculture has generally focused on the exploitation of the seasonal rainfall (Adefolalu, 1986). For a better understanding of the issue of water availability in tropical rain fed agriculture, more attention had been given to the quantification of season rainfall variability. The importance of the knowledge of rainfall pattern has necessitated many researchers to carryout studies on the subject and the findings that some regions have experienced marked decline in rainfall, temperature and relative humidity patterns depending on the location. For state whose economy largely depends on efficient and productive rain-fed agriculture, rainfall patterns and trends are often quoted as one of the major causes of several socio-economic problems like food insecurity in the state. The present study therefore examined rainfall and some climatic parameters in Gbokk Local Government area Benue State

The Study Area

Gboko LGA is located in the north-eastern part of Benue State between latitudes 7°13'N and 7°35'N, Longitudes 8°30'E and 9°03'E Nyagba (1995). It collected lies on Latitude 7°26'N and Longitude 8°55'E. Gboko LGA is bordered to the north by Tarka and Buruku LGAs, to the South by Konshisha LGA, to the west by Gwer LGA and to the south-east by Ushongo LGA. It comprises of five districts, Mbatierev, Mbayion, Mbatiav, Yandev and Ipav The area experiences the Aw tropical wet and dry cli- mate type. Rainfall occurs between April to October with maximal peaks in July and September while the dry season occurs between November and March. Mean annual rainfall is about 1300 mm per annum. Mean monthly temperature ranges between 25°C to 30°C with February and March being the hottest months while relative humidity is about 75%. The relief of the area consists generally of rolling plains with Mkar Hills to the east and Gboko Hills to the north. The area is drained by the several streams and rivers including Kontien, Ahungwa, Ambor, Ngo, Nguembi and the head stream of River Konshisha. The main soil type in the study area is tropical ferruginous. It is generally well drained, low in organic matter, bases and cation exchange capacity. Also, hydromorphic soils are found along the major streams and river courses. These soils are generally suitable for the cultivation of certain crops including maize Nyagba (1995). The people in the study area are Tiv and predominantly farmers who specialize in the cultivation of crops such as yams, cassava, maize, guinea-corn, tomatoes, pepper, rice, citrus, mango and cashew. Farming is climate-dependent, especially on rainfall. Climate influences all farming activities in the area, hence crop production takes place within the rainy season.

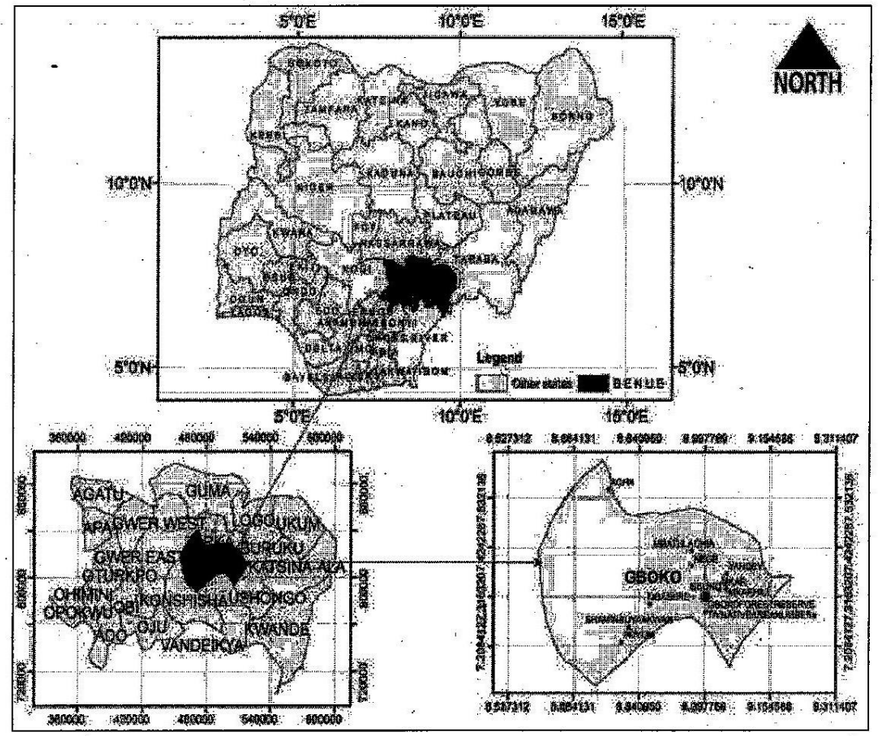


Figure 1. Gboko LGA, Benue State, Nigeria
Source: (Benue State Ministry for Lands and Survey, 2015).

Materials and Methods

Base map of the area was obtained and a hand hold GPS was used to take coordinate of the various communities captured in the study area. Arc map was used to produce the Isoline map of the communities that shown different amount of rainfall pattern.

The data used for the study were archival data on rainfall (mm), Temperature (0^0C) and relative humidity (mm). Rainfall, Temperature and Relative humidity data were obtained from the Nigerian Meteorological Agency (NIMET), AirForce Base, Makurdi from 1985- 2014.

Methods of Data Analysis

The arithmetic mean of a set of value, $xi, x2, x3 \ldots\ldots\ldots\ldots\ldots Xn$, is equal to the sum of the measurement divided by n were used for calculating daily rainfall, temperature and relative humidity express as formula:

$$\bar{X} = \frac{\sum Xi}{n}$$

Where;

Xi = Annual rainfall, temperature and relative humidity for a given period or year

n = total number of year under consideration

$\sum$ = summation of all value of variable

Standard Deviation was used to analyzed the daily data collected on rainfall, temperature and relative humidity. It can be express as:

$$\alpha = \sqrt{\frac{\sum(xi - \bar{x})}{n}}$$

where:

$\bar{x}$ = mean value

xi= class mark value

n = number of observation

$\sum$ = Greek symbol meaning sum of the value

Trend Analysis

Trend analysis was used to show differences in yearly amount of rainfall, temperature and relative humidity over a period of 30 years.

Rainfall pattern analysis

Rainfall pattern were analysed through the use of rainfall data which was subjected to Arc Map to produce isoline maps which shows communities that have different amount of rainfall pattern in the Study Area

Results and Discussion

This section discusses the analysis of climatic parameters in Gboko Local Government Area of Benue State. . Rainfall pattern and Trend analysis of climatic parameters such as rainfall, temperature and relative humidity were analyzed.

Analysis of Trends of some climatic variables in the study area

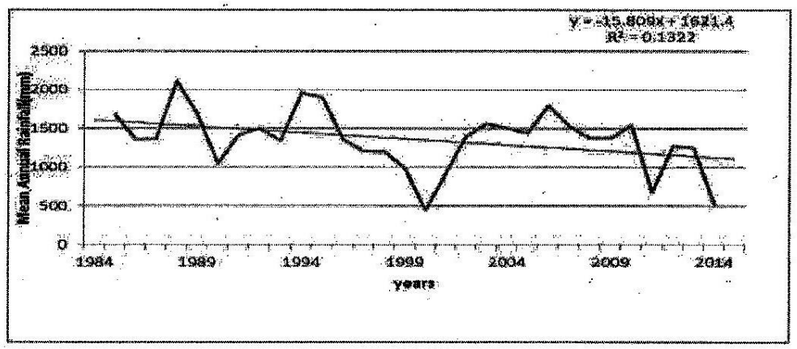


Figure 1. Trend analysis of Annual Rainfall for Gboko from 1985-2014

The trend of annual rainfall from 1985- 2014 in Gboko Local Government Area of Benue State shows an increasing and decreasing trend over the years. From 1985- 2014 shows an increasing trend in most of the years which have the average annual rainfall of above 1500mm, such years includes 1985 and 1988 respectively. Furthermore, 1994, 1995, 2003, 2006 and 2010 had an upward trend of annual rainfall of above 1500mm. The downward trend of 1999, 2000, 2001and 2011 indicated low amount of rainfall which is below 1500mm. the figure shows that there is an upward trend in the rainfall with an indication that there is about 13.2% ($R^2 = 0.1322$) which shows a positive correlation with most of the years. In summary, the trend of annual rainfall in the study area fluctuated over the years. According to Nyagba (1995), this fluctuation explains why most years in the study area experienced drought which resulted to poor yield and other years experienced high rainfall which resulted to flooding.

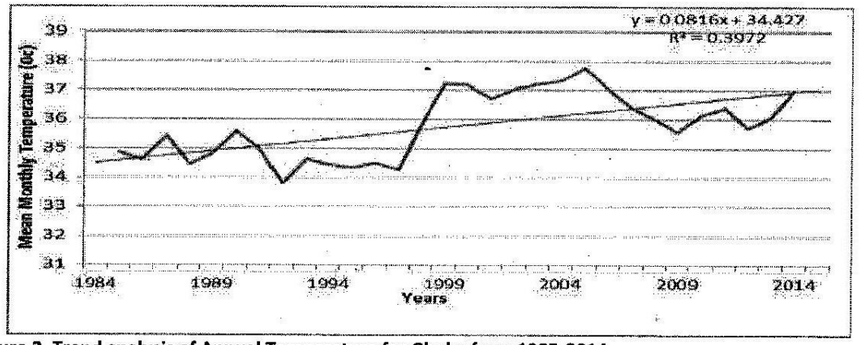


Figure 2. Trend analysis of Annual Temperature for Gboko from 1985-2014

Looking at the temperature trend in the study area from 1985- 1998 exhibited a similar trend where the annual temperature is between 34^0C-35^0C which does not show much differences, from 1999- 2006 there is an upward trend in annual temperature between 36^0c and above, this shows a reflection of global warming resulting into general increase in the earth's temperature (Adebayo, 2012). The graph shows an upward trend with about 39.7% ($R^2 = 0.3972$) at 95% level of significance

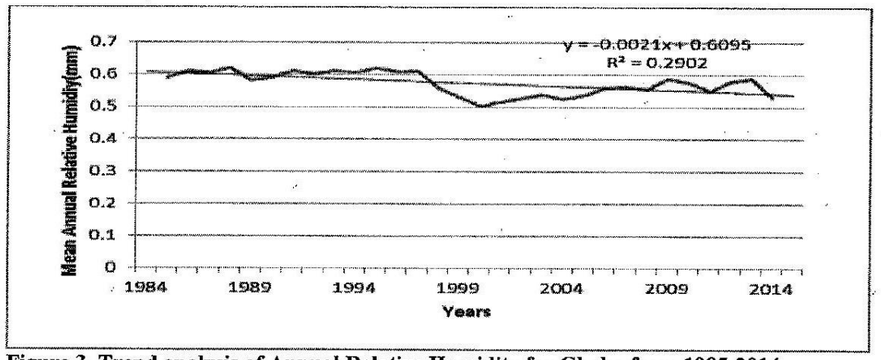


Figure 3. Trend analysis of Annual Relative Humidity for Gboko from 1985-2014

The trend of relative humidity exhibited fluctuations with a corresponding increased and decreased graph, for instance, 1984- 1998 experienced a gentle slope with an increased in relative humidity from 0.6mm and above. While a downward trend occurred from 1999- 2006 with indication that the study area experienced little dryness where the relative humidity is below 0.6mm. Furthermore, 2008-2014 experienced an upward trend of relative humidity that is above 0.6mm indicating wetness in the study area. The graph shows an upward trend with about 29% ($R^2 = 0.2902$) at 95% level of significance. Based on the above trend of relative humidity, most years which experienced less than 0.6mm of relative humidity brought about total dryness which imposed sufferings on people in the study area according to Nyagba (1995).

Analysis of Rainfall pattern experienced in Gboko

Mean Monthly Rainfall

Gboko Local Government Area experienced a similar mean monthly rainfall as compared to most of the areas in Benue State and beyond. These are the dry and wet seasons. These seasons correspond to the period when the Tropical Maritime and Tropical Continental air- masses along with their associated winds respectively influence the study area and other parts of Nigeria.

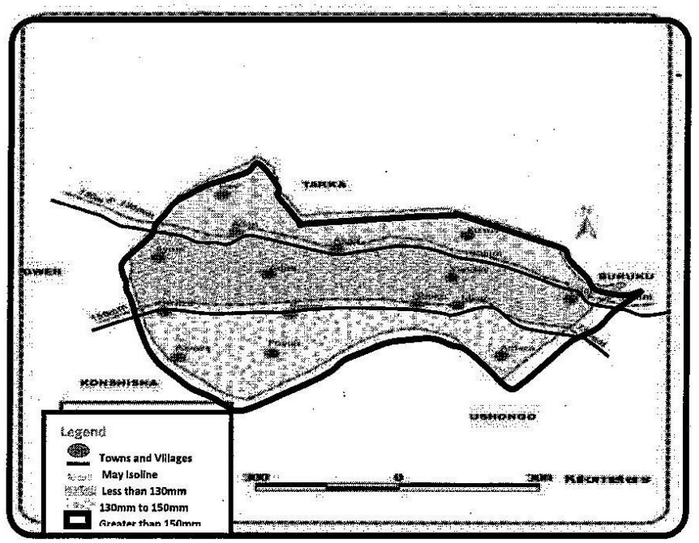
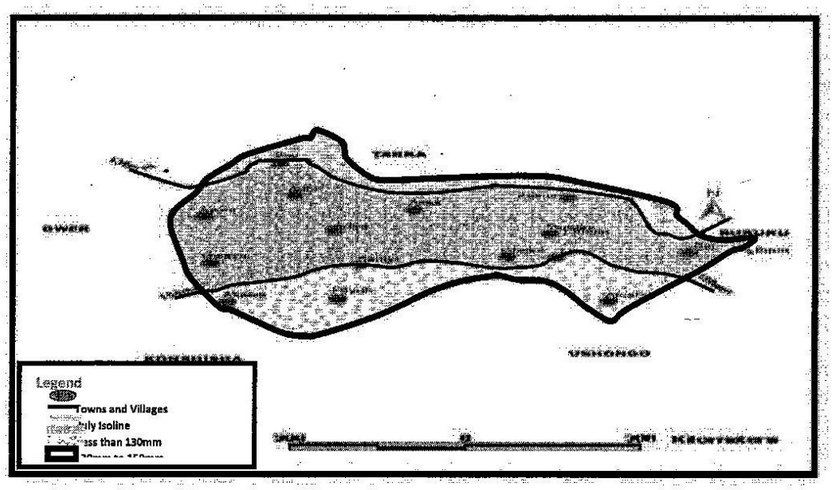


Figure 4. Mean monthly rainfall (mm) in May in Gboko

Source: Field work survey (2015)

Rainfall in the month of May increase from the South towards the North. For instance, settlement such as Akawe, Sango, Amera and Bango receive more than 150mm. Therefore most villages from the southern part experience rainfall on high amount and this boost their agriculture production. This explain while According to (Fakorede, 2001), agriculture largely depends on climate to function, hence, precipitation, solar radiation, wind, temperature, relative humidity and other climatic parameters affect and solely determine the global distribution of crops



Source: Field work survey (2015)

Figure 5. Mean monthly rainfall (mm) in July in Gboko

Rainfall in July increase northward as the ITCZ continues to shift northward and most areas in the north experienced more rainfall as compared to the Month of May. During the month of July, only Pev in the northern part receive the lowest rainfall of less than 130mm, which is being subjected to little drought than other settlement. The highest rainfall was recorded in the South- Eastern part of the study area. The Month of July receives between 140mm and 150mm.

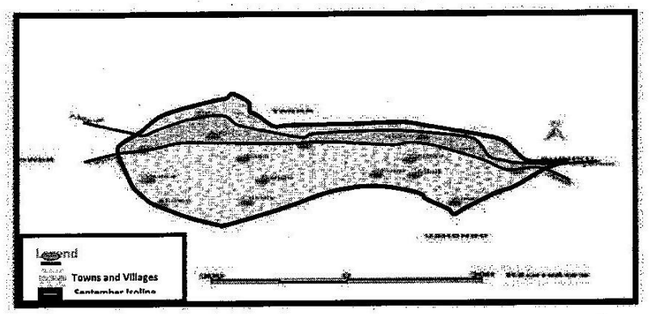


Figure 6. Mean monthly rainfall (mm) in September in Gboko
Source: Field work survey (2015)

September month experienced an increase in the amount of rainfall from the southern part towards the north. In September, rainfall amount has increased relatively. The amount of rainfall in September ranges above 150mm southward in places which include Akawe, Mkar, Yandev, Gboko and Gwazo, this explains why floods occurred in these areas during this month while the remaining settlement northward experienced the amount of rainfall from 150mm and below in the study areas. Rainfall pattern determines decision making to water users.

Conclusion

The study concludes that rainfall trend and pattern of the study area differs in different months and years in different localities as most areas receives rainfall earlier than other areas and it is largely dependent on rainfall amounts, this explains why most settlements experienced drought while others experienced flooding. Increasing rainfall means increasing recharge of the various surface and underground water resources. This increase can create adequate water storage against periods of shortage in the study area.(Nyagba, 1995)

Recommendations

This study therefore advocates for an alternative technology by way of advanced water supply to ensure regular pattern for a more reliable rainfall. This will go a long way to ensure that government's effort to improve on agriculture to ensure food security and economic development will not be a fruitless venture (Fakorede, 2001).

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