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Analysis of Climate Variables and Resource Conflict in Benue State, Nigeria

Abugu Nkechinyere Anthonia, Odele Muyiwa, Ogah TA, Yaro Ahmed Bello

***Abstract*— There is sparse literature on climate variables and resource conflictin Benue State, Nigeria despite numerous link of climate change and resource conflict. The objectives were to assess the trends in temperature and rainfall in Benue State from 2010-2019; assess the trends in resource conflict resource conflict between farmers and herdsmen and relate the climatic pattern with the pattern of resource conflict between farmers and herdsmen. Data on frequency of resource conflict were collected from the report of Nigeria Police Force, Nigeria watch data base and Newspapers. Data on climate variables were collected from NiMET office in Benue State. Data were presented in tables and analyzed using statistical technique. Trend in climate variables and resource conflict were analyzed using range, mean, standard deviation, coefficient of variation, time series and regression while correlation coefficient and t test was used to relate climate variables to conflict occurrence. Result shows that the annual maximum temperature ranged from 30.52-37.06OC with mean of value 32.73 OC. The annual minimum temperature ranged from 19.98-23.01OC with mean value of 21.43 OC. The annual rainfall total ranged from 951.43-1818.70mm with mean value of 1358.88mm. The maximum temperature has a positive trend(Y=0.105x+ 32.73) while minimum temperature shows negative trend(Y= -0.054x+ 21.43). There were insignificant positive correlations between climate variables and occurrence of conflict. Thus, Ho "there is no significant relationship between climate variables and occurrence of armed conflict is accepted at 95% significant level further study should be conducted on other casual factors of climate change.**

***Index Terms*— Climate change, Temperature, Rainfall, Resource conflict, Farmers and Herdsmen.**

I. INTRODUCTION

Climate change and resource conflict are among the contemporary global challenges. There are growing recognition of the possible effects of climate change on the peace and security of regions especially the developing countries. This is for the fact that climate change reduces water accessibility and increases weather related hazards such as drought, flood and erosion thereby causing reduced economic activities and livelihoods leading to frustration(Burke *et al*., 2009). Conflict has been seen a secondary consequence of extreme weather event associated with climate change. According to the report of Swedish International Development Cooperation Agency (SIDA, 2017) extreme weather events may lead to food shortage, hardship and undermine the livelihoods of vulnerable households in an affected communities. Moreover, hot weather has been linked with aggression and crime (Theisen, 2012; Hendrix and Salehyan, 2012; Hsiang *et al.*, 2013; Alexander and Shaver, 2015). Growing natural resource scarcity may then lead to local competition which becomes unmanageable in the absence of institutions for conflict resolution. Concepts that link climate change and resource conflict are on the increase following speculations and recent researches on the relationship between climate change and migration/conflict. In the words of Maslin (2018), "The media has even started using terms such as "climate refugees" and "environmental migrants" to describe people fleeing their homes from these climate-driven conflicts". However, it not yet clear that climate causes or influence armed conflicts. Few literatures have linked climate variables like temperature, rainfall, wind, relative humidity with conflict occurrence (Notaras, 2009; Burke *et al*., 2009). Burke *et al*., (2009) found that "there is a relationship between past internal conflict in sub-Saharan Africa and variations in temperature (but not precipitation) and that there are "substantial increases in conflict during warmer years". According to (Notaras, 2009), "a 1% increase in temperature leads to a 4.5% increase in civil war in the same year and a 0.9% increase in the following year".

Resource conflict between mostly Fulani herdsmen and settled communities have been concentrated in north central Nigeria, particularly the states of Benue, Plateau, Kaduna and Nasarawa. Benue has been a flash point of deadly clashes between herdsmen and indigenes of the state especially those in the rural areas, who are mostly farmers (Ortom, 2015). These deadly clashes may be prevalence in a particular climatic condition (seasonal). Therefore, this research intends to find out the climatic influence on farmers-herdsmen conflict in Benue State, Nigeria

The issue of famers/ herdsmen conflicts is not new, conflict between different groups of Fulani herders and farmers have killed thousands of people in Nigeria since 2010. The Global Terrorism Index puts Fulani herders the world's fourth deadliest militant group (UKOJI *et al*.,2019), the menace posed by Fulani Herdsmen in the different communities they migrate to, for the purposes of grazing their cattle is quite alarming that most of the affected States had cried out for help from Federal Government, international communities and Non-Governmental Organizations. Their outcry had attracted the attention of researchers, Government and Non-Governmental Organizations (NGOs).

Thus, lots of findings have been made in relation to farmers/herdsmen conflicts. From a historical point of view, certain scholars refer to the fact that resource conflicts

Abugu Nkechinyere Anthonia, Geography Department Nasarawa State University Keffi, Nigeria
Odele Muyiwa, Geography Department Nasarawa State University Keffi, Nigeria
Ogah TA, His Geography Department Nasarawa State University Keffi, Nigeria
Yaro Ahmed Bello, Faculty of Natural and Applied Sciences Nigerian Army University BIU

resulting from cattle grazing have existed for as long as the practice of agriculture (Blench 2010; Abbass, 2012). 'However, the advancing nature and scope of farmers/herdsmen conflicts is worrisome'. The primary cause of these conflicts in Nigeria has be linked to southward migration of herders which has been largely attributed to climate change and the recent insecurity in the Northeast. Disagreements over the use of essential resources such as farmland, grazing areas and water between herders and local farmers are said to be the major igniting cause of the fighting (Adebayo and Olaniyi, 2008; Ofuoku and Isife, 2009; Abubakar, 2012).

The effects of resource conflict between farmers and herdsmen is well studied and include loss of lives, displacement of indigenous settlers, food insecurity, hardships and disruption of properties /livelihood sources, famine/mass starvation, reductions in farmland, loss of herds and so on. So many aspects of farmers/herdsmen conflicts such as the nature, causes, frequencies, effects and resolution mechanism have been well elaborated (Agbegbedia,2013) .

On the basis of possible causes, climate change has been linked to farmers/herdsmen conflicts on the presumption that climate change has slowly changed the landscape of Northern Nigeria leading to increasing draught and desertification which invariably forces herders to migrate southward (Dioha and Emodi, 2018; Elisha *et al.*, 2017). Moreover, studies have also shown that the Southern part of Nigeria is prone to flooding and erosion. For instance, Enete (2014) showed that "the durations and intensities of rainfall have increased, producing large runoffs and flooding in Enugu State, Nigeria.

This scenario made the middle belt or north central the safest zone for both farmers and herders. This also comes with its own consequence such as resource conflict between the local farmers and herders. The herders searching for a safe place in the middle belt especially Benue state that is dominated by farmers with their Slogan Food Basket of the Nation has been on resource conflict over the years.

The link between climate change and conflict is well pronounced by previous scholars but there is no agreement among earlier reports (Burke *et al.*, 2009; Sutton *et al.*, 2010; Gleditsch, 2012). It has been stated that "that hotter annual temperatures have led to increased civil war incidence in sub-Saharan African states" Burke *et al*., (2009). The sub-Saharan African area has been the primary geographic focus, given policy concerns over the region's vulnerability due to populations and heavy dependence on rain-fed agriculture (Gleditsch, 2012). The assumption by Burke *et al*., (2010) that increased temperature can lead to increase violence has been under critics (Sutton *et al*., 2010). Sutton *et al*.,(2010) suggested that such relationship should be subjected to measurement, dataset selection, and statistical analysis strategies (Buhaug, 2010).

Despite this notable link between climate change and conflict, few studies have statistically linked climate change with conflict (Burke *et al*., 2009; Gleditsch, 2012; Hendrix and Salehyan, 2012; Theisen, 2012A; lexander and Andrew, 2015). However, none of these was done in Benue state. Thus, this research bridged this gap as it statistically ascertains the relationship between climatic elements (rainfall and temperature) and occurrence of farmers/herdsmen conflicts in Benue State, Nigeria. Thus, the major issue in this study is the link between climatic factors and armed conflicts in Benue State Nigeria. The objectives were to:assess the trends in temperature and rainfall in Benue State from 2010-2019; assess the trends in resource conflict resource conflict between farmers and herdsmen in Benue State from 2010-2019 and relate the climatic pattern with the pattern of resource conflict between farmers and herdsmen. The null hypothesis "there is no significant relationship between climate variables and occurrence of armed conflict was tested at 95% significant level.

II. . Materials and Methods

A. The Study Area

The study area (Benue state) is located between Longitude 7° 47' and 10° 0' East, and Latitude 6° 25' and 8° 8' North, and is bounded to the North by Nasarawa state, to the West by Kogi State, to the East by Taraba state and the Cameroun Republic, and to the South by Cross-River and Enugu states (Figure 1).

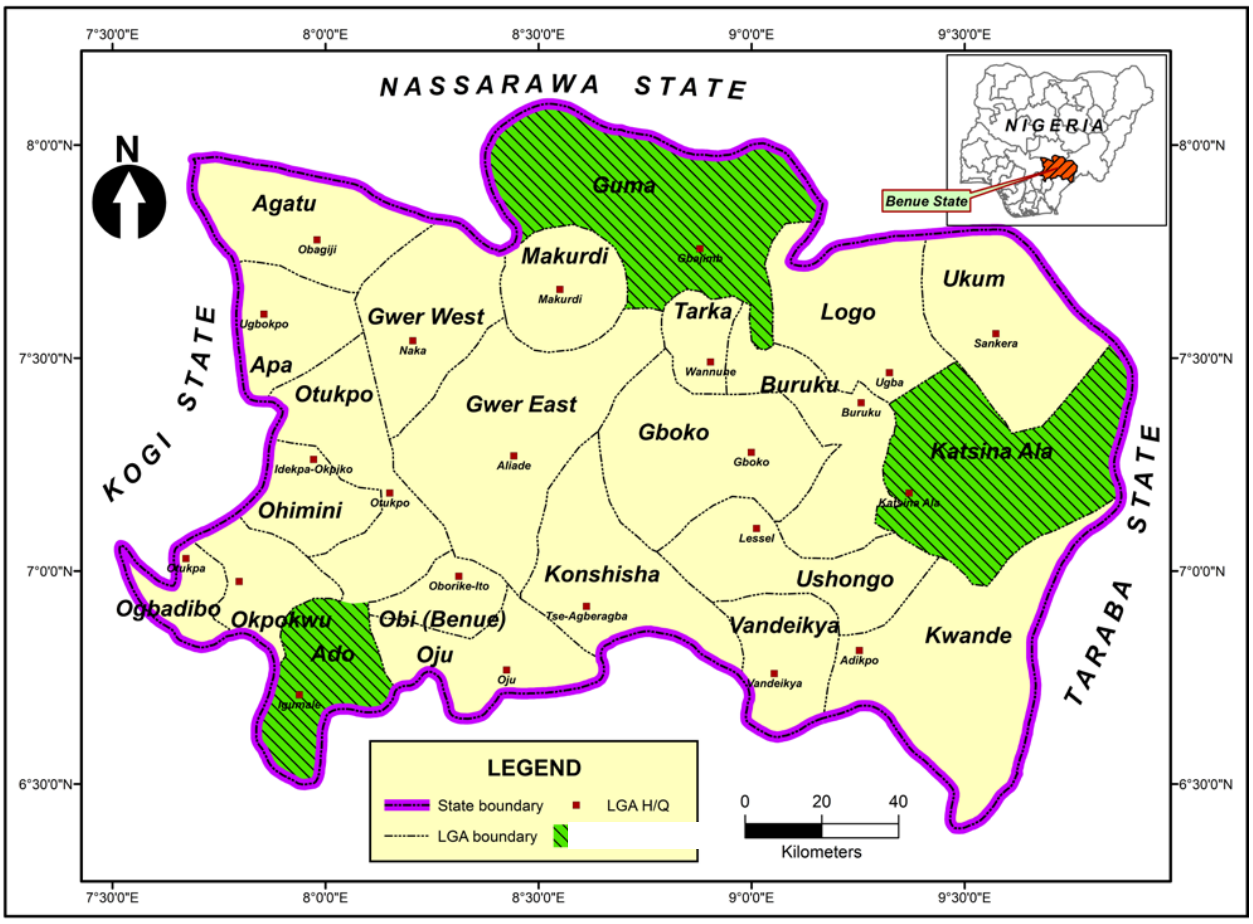

Figure 1: The Study Area

Source: Martins' Library

The study area has a tropical sub-humid climate, with two distinct seasons, namely wet and dry season. The wet season lasts from April to October with annual rainfall in the range of 1120 to 1500 mm. The dry season begins in November and ends in March (Alapa, 2019). There is, however, usually one or more heavy rain in the months of dry season (January, February and March). The climate is characterized by high temperature regime, ranging from 27-380C as mean annual. Benue is well drained as it hosts River Benue and its tributaries. Thus, there is abundant water resource for both crop farming and herd keeping. The availability of water and plain land makes the area good for farmer and herders' activities. But, if not well managed leads to resource conflict as both farmers and herders needs plain land and water resources. Benue state utilizes land for many socio economic activities including administrative, educational, recreational, commercial, agricultural, transportation and residential land uses. Among these various Land uses agricultural land use especially food cropping is the most recognized land use in Benue stateas the authorities like to refer to Benue State as the "food basket of the nation". Benue is a rich agricultural region; some of the crops grown there are potatoes, cassava, soya bean, guinea corn, flax, yams, sesame and groundnuts.

B. Data, Methods of Data Collection and Analysis

This study relied completely on secondary sources of data. Data on frequency of resource conflict and climate variables (temperature and rainfall) were collected for the study. Both climatic and conflict data were limited to 2010-2019 due to none availability conflict documentation prior 2010. Resource conflict data were collected from the report of Nigeria Police Force, Nigeria watch data base and Newspapers. Firstly, request was made to Nigeria Police Force Benue State headquarter for records of armed conflicts from 2010-2019 and report was complimented with Nigeria watch data base, Christian Association of Nigeria (CAN) conflict timeline and Newspapers review. Care was taken to ensure zero repetition of count as frequency and casualties were collected on monthly basis. Data on climate variables were collected from NiMET office in Markudi Benue State.

Data were presented in tables and analyzed using descriptive statistics and inferential statistics. Trend in climate variables and resource conflict were analyzed using descriptive statistics such as range, mean, standard deviation, coefficient of variation, time series and regression while correlation coefficient and t test was used to relate climate variables to conflict occurrence.

III. Result and Discussion

A. Trend in Climate Variables (Temperature and Rainfall)

The Annual Trend of Climate Variables (Temperature and Rainfall) and Armed Conflicts in Benue State.

The mean annual temperature and rainfall in Benue State from 2010-2019 are presented in table 1.

Table 1: The Mean Annual Temperature and Rainfall in Benue State (2010-2019)

	Temperature(^{O}c)		Rainfall Total(mm)
Year	Maximum	Minimum	
2010	33.38	21.48	1460.23
2011	35.73	20.91	1551.28
2012	35.95	20.77	1757.23
2013	34.28	20.13	1386.8
2014	32.94	20.38	1818.70
2015	35.95	20.27	1820.70
2016	37.06	20.11	1637.61
2017	32.72	20.04	1383.99
2018	35.86	19.90	1482.28
2019	34.62	19.98	1661.05
Range	30.52-37.06	19.98-23.01	951.43-1818.70
Mean	32.73	21.43	1358.88
Standard Deviation	5.01	0.96	357.35
Coefficient of Variation (%)	47	46	62

Table 1 present the mean annual temperature and rainfall in Benue State from 2010-2019 as follows: The annual maximum temperature ranged from 30.52-37.06^{O}C with value 32.73 ^{O}C and 47% coefficient of variation. The annual minimum temperature ranged from 19.98-23.01^{O}C with mean value of 21.43 ^{O}C and 46% coefficient of variation. The annual rainfall total ranged from 951.43-1818.70mm with mean value of 1358.88mmand 62% coefficient of variation. The coefficient of variations being 47% and 46% for annual temperature maximum and minimum respectively suggest that both max and min temperature varies among the years. It shows specifically that forty-seven per cent (47%) and forty-six per cent (46%) of maximum and minimum temperature respectively lie below or above the mean value. On the other hand, 62% of annual rainfall total lie below or above the mean value. Therefore, both annual temperature and rainfall in Benue state are not uniform among years. But the total annual rainfall in Benue State for the period of ten (10) years varies more than the temperature.

The Trends in Annual Temperature in Benue State from 2010-2019.

The mean annual maximum and minimum temperature are illustrated in figures 1 and 2 respectively.

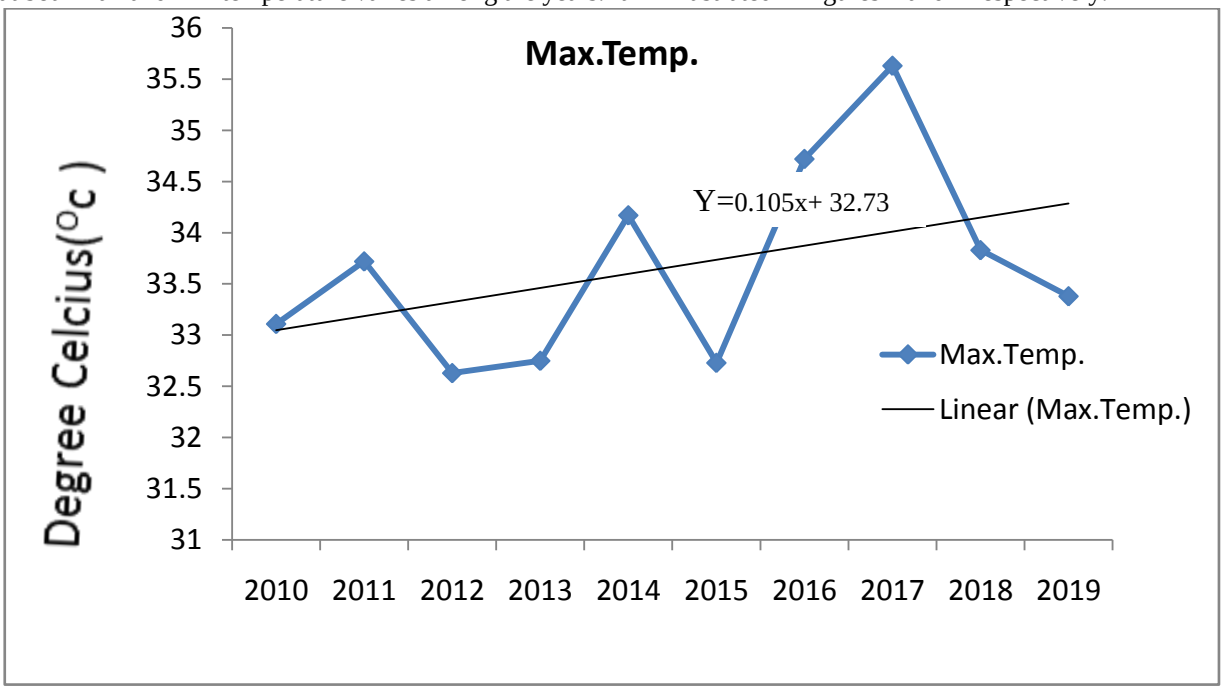

Figure 1: Trend of Annual Temperature $_{Max}$ in Benue State (2010-2019)
Source: Analysis of NiMET Daily Temperature Data (2010 – 2019)

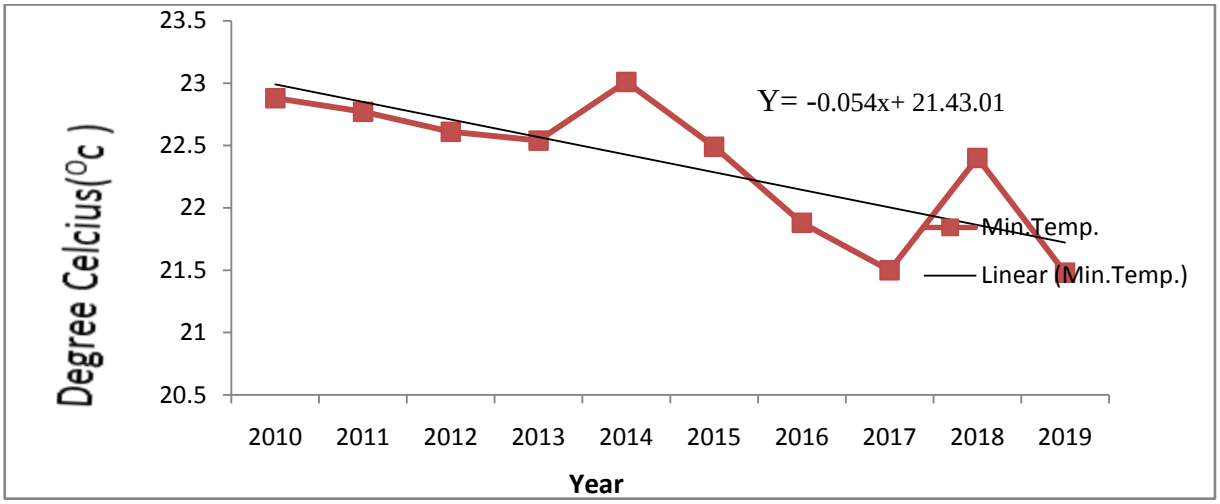

Figure 2: Trend of Annual Temperature $_{Min}$ in Benue State (2010-2019)
Source: Analysis of NiMET Daily Temperature Data (2010 – 2019)

The trend of annual mean temperature (maximum and minimum) in the study area during the study period as presented in figures 1 and 2 shows an upward trend in maximum temperature but downward trend in minimum temperature. In other words, maximum temperature has a positive trend(Y=0.105x+ 32.73) while minimum temperature shows negative trend(Y= -0.054x+ 21.43). The upward trends for maximum temperature in the study area were most noticeable in 2016 and 2017 that recorded downward trend. This suggests increased diurnal temperature in the study area.

This result is in line with Mahmood *et al.*, (2019), that reported eighty-four percent (84%) of the temperature time series indicated extremely strong signals of increasing trends of maximum temperature ($\alpha = 0.001$). This finding partially agrees with Dontwi *et al.*, (2012) who found that maximum and minimum temperatures increased by 2.5 and 2.2°C, respectively along the coast of Ghana between 1960 and 2001. Contrarily to Dontwi *et al.*, (2008) and similar to the finding of this study, many studies in Nigeria (Alexander *et al.*, 2006; Donat and Alexander 2012; Gbode, *et al*, 2019) have reported upward and downward trend in maximum and minimum respectively. There is peculiarity in temperature of Benue region due to factors such as the hydrology, geomorphology and population. The variation in the trend in maximum and minimum temperature in Benue State was slight compared to the report of Gbode, *et al*, (2019). This is probably because of large bodies of water in the area. Thus, theory of land and sea breeze mighty have moderate the variation in diurnal temperature.

The Trends in Annual Rainfall in Benue State from 2010-2019.

The trend in annual rainfall total in Benue State from 2010-2019 is presented in figure 3.

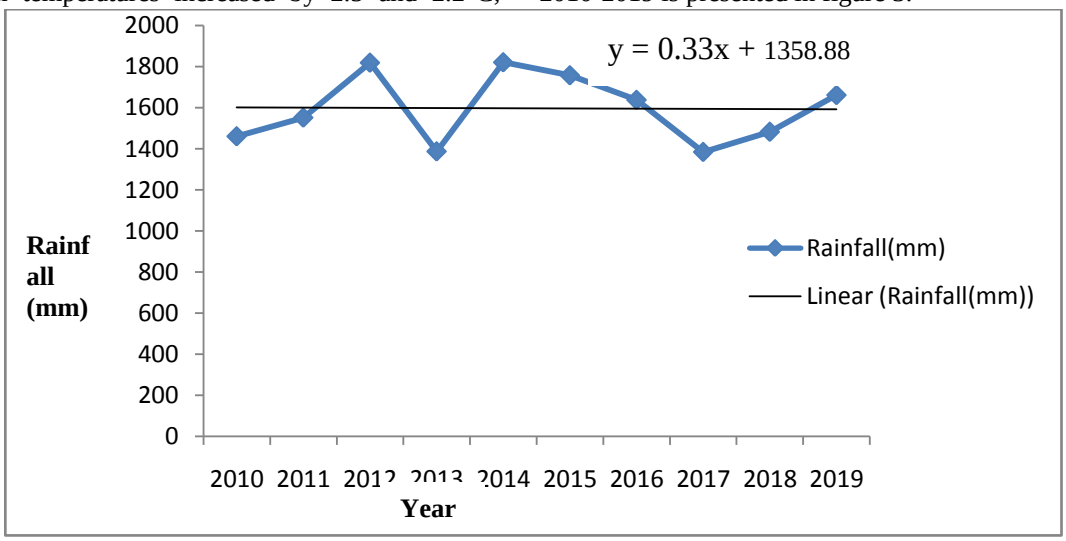

Figure 3: Trend of Annual Rainfall in Benue State (2010-2019)
Source: Analysis of NiMET Daily Rainfall Data (2010 – 2019)

Figure 3 presents the trend of annual rainfall in Benue State from 2010 to 2019. The mean annual rainfall depicts a slight upward trend with the highest amount (1818.70mm) recorded in 2014. The least amount 1383.99mm was recorded in 2017. The mean annual rainfall in Benue state maintained a relatively stable rising and declining pattern within the study period. It is obvious from the graph that rainfall indeed experienced a number of variations over the period studied (2010 - 2019). However, the trend equation and the trend line of the annual rainfall shows slight positive trend (y = 0.33x + 1358.88). This suggests that the total annual rainfall over the years (2010 - 2019) is increasing slightly at unsteady rate. This finding agreed with the assertion of (GFDL, 2007) that wet areas will be receiving more rainfall and dry areas receiving less rain fall (GFDL, 2007). However, the result contradicts the report of

Anufurom (2009) that rainfall is generally retreating in parts of the North Central Region of Nigeria. This may be due to the hydrological peculiarity of Benue state. It has more water bodies than any other state in the north central Nigeria (Dada, 2004).

Annual Occurrences of Armed Conflict in Benue State (2010 to 2019)

The annual occurrences of armed conflict in Benue State (2010 to 2019) are presented in Table 2.

Table 2: **Annual Occurrences of Armed Conflict in Benue State (2010 to 2019)**

Year	Frequency
2010	2
2011	3
2012	4
2013	7
2014	13
2015	7
2016	8
2017	4
2018	17
2019	3
Total	68
Range	**2-17**
Mean	**6.8**
Standard Deviation	7.84
Coefficient of Variation (%)	**67**

Table 2 shows the annual occurrences of armed conflict in Benue State (2010 to 2019) as follows: The total occurrence of armed conflict within the study period is sixty-eight (68) times. The frequency of armed conflict in Benue State (2010-2019) ranged from 2-17 times a per annum, with mean value of 6.8 times and 67% coefficient of variation. The least occurrence was recorded in 2010 and highest occurrence in 2018. The range and coefficient of variation being 2-17 times and 67% respectively, means that there is disparity in annual occurrence of armed conflicts in Benue state from 2010-2019. In others words, it more frequent in some years than others (Figure 4).

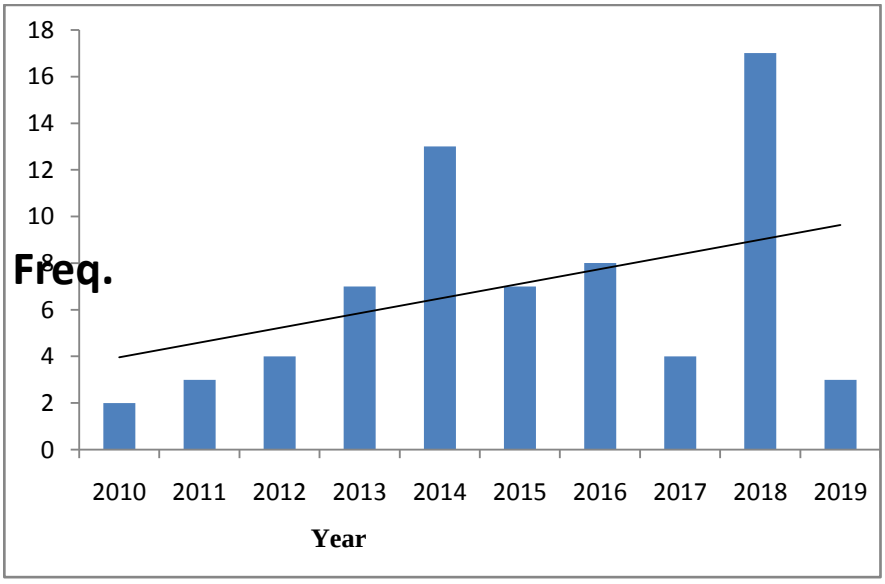

Figure 4: Annual Occurrence of Armed Conflict in Benue State (2010-2019)

Figure 4. shows a positive trend of annual occurrence of armed conflict in Benue State (2010-2019). It shows that armed conflict frequency in Benue State (2010-2019) increase from two (2) times in 2010 to seven times in 2013, thirteen (13) times in 2014 and declined to seven (7) times in 2015 and then escalated to its peak (17 times) in 2018. Thus, the year 2018 had the highest occurrence of armed conflict in Benue State within the study period (2010-2019).

The result that the total occurrence of armed conflict 2010-2019 is sixty-eight (68) times is in line with the reports of Omeje (2018) and EKPEI (26 July 2018), Omeje (2018) reported that the Benue State government has documented more than 50 attacks against farmers by the pastoralists. EKPEI (26 July 2018) reposted Forty-nine (49)violent incidents across fourteen of the twenty-three (23) local government areas in Benue state from 2012 to 2017.

The finding that 2018 had the highest occurrence is in accordance with the speculation that the implementation of a controversial state law in November 2017 that banned open grazing intensified the armed conflicts in Benue state. This is also true as the first day of the 2018 witnessed outrageous attack that claimed seventy-three (73) lives in Benue state (BBC, 26 April 2018).

The Relationship between Climate Variables and Armed Conflicts in the Study Area

Table 3 presentthe correlation coefficient between climate

variables (Temperature and Rainfall) and armed conflicts in the study area.

Table 5: The Correlation Coefficient Between Climate Variables and Armed Conflicts

Occurrence of Armed Conflicts	Temperature		Total Annual Rainfall
	Temp. Max	Temp. Min.	
Correlation Coefficient (r)	0.13	0.11	0.14
T test $(t = \frac{\sqrt{n-2}}{1-r2})$	2.88	2.24	2.87

Table 3 shows the relationship between climate variables (Temperature and Rainfall) and armed conflicts in the study area as follows:

The Relationship between Annual Maximum Temperature and Armed Conflicts

The correlation coefficient for the occurrence of armed conflict and maximum temperature is 0.13. This means that there is a weak positive relationship between the occurrence of armed conflict and maximum temperature in the study area within the study period. Moreover, since the calculated t value of 2.88 is greater than 0.05, it means that the weak positive correlation is not by chance at 95% confidence level. Therefore Ho "there is no significant relationship between climate variables and occurrence of armed conflict is rejected for maximum temperature at 95% significant level. Therefore, there is no strong relationship between maximum temperature and frequency of armed conflict in the study area within the study period. Therefore, an increase in maximum temperature leads to negligible increase in frequency of armed conflict in the study area.

The Relationship between Minimum Temperature and Armed Conflicts

The correlation coefficient between the occurrence of armed conflict and minimum temperature is 0.11. This means that there is also a weak positive relationship between the occurrence of armed conflict and minimum temperature in the study area within the study period (2010-2019). Therefore, an increase in minimum temperature leads to negligible increase in frequency of armed conflict in the study area. Moreover, since the calculated t value of 2.24 is greater than 0.05, it means that the weak positive correlation is not by chance at 95% confidence level. Therefore Ho "there is no significant relationship between climate variables and occurrence of armed conflict is rejected for minimum temperature at 95% significant level. Therefore, there is no strong relationship between minimum temperature and frequency of armed conflict in the study area within the study period.

It can be said hence that both mean annual maximum and minimum temperature have insignificant positive relationship with the frequency of armed conflict in Benue state from 2010-2019. Therefore, mean annual temperature has no strong influence on the occurrence of armed conflict in Benue state. As a result, 'temperature/aggression theory' that suggest that hot temperatures lead to an increase discomfort in individuals, and thus increase the likelihood of aggression and consequently crime cannot explain significantly the reason for the conflict on annual basis. This report corroborates and also contradicts some earlier researches. This result supports the assertion of SIDA (2017) that "there is no direct and linear relationship between climate change and violent conflict". It is also in line with the view of Adonteng-Kissi, (2015) that conflict is not a climatic accident, its dynamics results from actors' actions and understanding of the situation, of their representations of what is at stake (natural resources, honour, wealth, identity, life. On the contrary, it contradicts the finding of Alexander and Andrew (2015) that temperature level is significantly and positively correlated with incidence of conflict around the world. Though, it found a positive relationship between mean annual temperature and armed conflict, it is not significant as reported by Alexander and Andrew (2015) globally.

The Relationship between Annual Rainfall and Armed Conflicts

The correlation coefficient between the occurrence of armed conflict and rainfall is 0.14. This means that there is a weak positive relationship between the occurrence of armed conflict and annual rainfall in the study area within the study periods. Therefore, an increase in annual rainfall leads to an increase in frequency of armed conflict in the study area. Moreover, since the calculated t value of 2.87 is greater than 0.05, it means that the weak positive correlation is not by chance at 95% confidence level. Therefore Ho "there is no significant relationship between climate variables and occurrence of armed conflict is rejected for rainfall at 95% significant level. Therefore, there is no strong relationship between rainfall and frequency of armed conflict in the study area within the study period. This finding partially agreed with the report of Marshall, *et al.,* (2009) that "there is a relationship between past internal conflict in sub-Saharan Africa and variations in temperature but not precipitation.

IV. Conclusion and Recommendations

It was concluded that both climate variables (temperature and rainfall) and resource conflict have positive trends. Consequently, there is a positive relationship between climate variables (temperature and rainfall) and resource conflict. However, the positive relationship between climate variables (temperature and rainfall) and resource conflict is insignificant at 95% confidence level. Thus, climatic variables have no significant relationship in the annual occurrence of resource conflict in Benue state Nigeria from 2010 to 2019. There should be more research (es) on other possible factors that trigger armed conflict in Benue state. Further study should also consider the seasonality of resource conflict.

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