

AN ASSESSMENT OF THE IMPACT OF LINESQUALLS AND THUNDERSTORM ACTIVITIES OVER YOLA, ADAMAWA STATE, NIGERIA

¹BINBOL, N.L.I. AND ²HENRY, M.S.2

¹. Department of Geography, Nasarawa State University, PMB 1022, Keffi.

². College of Agriculture, Jalingo

Abstract: The impact of extreme weather and climate events are manifested in various ways. In Yola, Adamawa State, the incidence of linesquall and thunderstorm activities were analysed with a view to assessing its socio-economic impact. Meteorological data on linesquall and thunderstorm occurrence, precipitation amount associated with the two systems and total precipitation for the period under review were obtained from the Nigerian Meteorological Agency of the Federal Ministry of Transport and Aviation, Yola. Questionnaires were administered to assess the level of awareness and socio-economic impact of the weather variables on the people in the study area. Product moment correlation analysis was used to test the relationship between the two systems and precipitation occurrence in the area. The result obtain shows a positive relationship between the two systems and between the systems and precipitation occurrence. Both were significant at the 99% confidence level. The result further shows that 98% of precipitation occurrence in Yola is associated with linesquall and thunderstorm activities. A greater percentage of the respondents were aware of both weather systems, while estimates of properties lost in damage runs into millions of naira. Discussions and recommendations were made for the study area.

Keywords: Extreme Weather, Linesqualls, Thunderstorms and Socio-economic impact

INTRODUCTION

Observed global trends of some climatic variables has been interpreted by some Inter governmental Panel on Climate Change (IPCC) scientist as a sign of the impact of climate change due to global warming. The manifestation of these extreme events and its climatic implications will be appreciated better in the study of climatic variability at local levels.

Global climate changes and their socio-economic impact/importance have been discussed (Obasi, 2000; Ojo et al, 2000; Akeh and Gbuyiro, 2006). In a recent compilation of overall socio-economic impact of extreme weather events globally between the years 1998 – 2003, Guyondet (2006) reported a total of about 95,238 weather related fatalities. He also reported a lost of about US\$ 141.1 billion within the same period.

Linesqualls and thunderstorms are regular phenomena within the tropics that. They are often accompanied by rains, destructive violent winds, lightning, thunder and sometimes hail, thereby posing serious hazardous problems to man and his socio-economic activities.

Although, Omotosho (1985) said west African linesqualls and thunderstorms are not as violent as their united states counterparts, they are none the less studied because of their socio-economic importance. Apart from contributing to more than half of the total annual precipitation where they occur, thunderstorm has been a great threat to man

especially in the area of shelter, agriculture and aviation. With turbulence and icing within well developed cumulo-nimbus clouds, the strong winds, heavy rains, hails and lightning constitutes additional danger to both flight and humans.

What is taken as linesquall differs from one author to another depending on the statistic chosen. For example, Hamilton and Archbold (1945) consider only the longest-lived thunderstorms with squalls (maximum surface gust) of over 15m/sec as a genuine linesquall, whereas Eldridge (1957) in Ogunjobi et al(2008) and Obasi (1975) used the North South extent as well as the life span of systems as the important criteria. Both linesqualls and thunderstorms are stormy conditions associated with heavy rains, but differ slightly with violent winds accompanying the later. (Binbol, 2005). However, simultaneous occurrence of both is most common. Thunderstorms are frequent in the tropics and especially in the afternoon, but if a suitable degree of instability and humidity exist, and a suitable impulse or trigger action is produced, a thunderstorm may develop at any hour of the day or night, Binbol (2005; 2007). Thunderstorms may be classified into various types based on the mechanism or cause of initial lift of the air column that sets off the spontaneous growth of the storm. One common type is the thermal or air mass thunderstorm which is set off by thermal convection caused by solar heating of the near surfacer air layer. Others are orographic thunderstorm and frontal thunderstorm. Thunderstorms of all types have the same

fundamental characteristics.

This study will adopt the World Meteorological Organization (WMO) observing regulation of a sudden increase in the wind speed of at least 8m/sec with the speed rising to 11m/sec or more and lasting for at least one minute. This criterion is chosen mainly because all data on linesquall and thunderstorm are from meteorological station records.

STUDY AREA

Yola is located on latitude 9° 14'N and longitude 12° 38'E of the Greenwich meridian. It has an average altitude of about 185 meters above sea level. Yola lies within the Benue trough consisting of undulating flood plains. It has an area of 8,068 sq/km and a population of 3,166,101 inhabitants for the entire state (NPC, 2006) provisional census figure. Yola lies within the Sudan savannah vegetation classification characterized by tall grasses and sparsely distributed trees mostly of economic value such as shear butter, locust bean, baobab, gum Arabic, balanite etc. in terms of climatic classification, Yola falls under the Koppen's Aw class. That is, tropical savannah climate with distinct dry season in the low sun period. The dry season is strongly developed for about five months, beginning from October ending to late March. Rainfall is about 958.99mm per annum with highest down pour occurring between August/September. Yola has an average minimum temperature of 15.20 C and an average maximum of 39.70 C. the hottest months are March/April with maximum temperature of 42.70 C while the coldest months are November/December with minimum temperature of 11.110C.

Agriculture and cattle rearing are among the major economic activities of the people in the study area. Crops grown include Cotton, Groundnuts, Rice, Millet, Maize, Beans and Guinea corn. Cows, Sheep and Goats are reared while the river Benue is exploited for fishing and dry season cultivation.

Yola, the capital of Adamawa state experienced an extreme weather event in the form of linesquall/thunderstorm which the daily media reported as causing human and animal deaths as well as destruction of properties worth millions of naira (NNN, 1997). Trewartha and Horn (1980) reported a tremendous thunderstorm event between Mississippi river and the Appalachian mountain in which 315 deaths, 6142 injuries and 650 million dollars in properties damaged were lost to the storm. It is against this background that this paper is geared towards assessing the impact of linesqualls and

thunderstorm activities over Yola, Adamawa state for a period of ten years (1986-1995).

2. MATERIALS AND METHODS

Data source

The study made use of both primary and secondary data. Secondary data on linesquall and thunderstorm occurrences, rainfall amount associated with the occurrence of the two conditions and total precipitation for the period of ten years (1986-1995) were obtained from the meteorological services department of the federal ministry of Transport and Aviation, Yola. The time of occurrence of linesquall and thunderstorms are indicated and they are coded symbolically in the weather form, duration of their occurrence is also stated.

According to Omotosho(1985), if a rain commences 30 minutes before or after the arrival of the two systems, the rain is recorded for either of the system. Where the associated system changed to ordinary rain, the rain is still put against linesquall or thunderstorm provided the time is not more than six hours after the arrival time of the system. Beyond six hours any further precipitation is recorded as monsoon rain. In order to assess the level of awareness of the people to the two systems as well as to investigate the impact of linesquall and thunderstorm on the life and properties of the respondents, Jimeta-Yola was divided into ten wards and a hundred questionnaires were administered at ten questionnaires to each ward.

Data analysis

Graphical and statistical approaches were used in data analysis. Correlation analysis was employed to test the magnitude and direction of relationship between the two systems, while simple descriptive statistic of mean and percentage score was used to assess the level of awareness of respondents to the two systems.

RESULTS AND DISCUSSION

Seasonal Variation in Linesqualls and Thunderstorms

The seasonal variation in linesqualls and thunderstorms in Yola is shown in table 1. The table shows that Yola has a mean monthly total of 20 squall days and 73 thunderstorm days within the period of study (1986 – 1995). Both occurring within a period of 9 months (April – October)

Table 1: Monthly Linesquall and Thunderstorm Variation

Variables	J	F	M	A	M	J	J	A	S	O	N	D	
Linesquall	0	0	0	3	4	5	2	2	3	1	0	0	20
Thunderstorm	0	0	0	6	10	11	13	15	12	7	0	0	73

The variation observed from table 1 shows that while linesquall increased steadily up to June, it dropped slightly in July/August to rise again in September and die out in November. This finding supports Nnodu (1983) who demonstrated that a double maxima exist in linesquall occurrence for inland areas north of 8°N. Yola is located on 9° 14'N. Omotosho (1985)

confirmed that the double maximum is valid to 12°N with single annual peak confined only to the extreme north of the country. The July/August break is attributed to the movement of the Inter Tropical Discontinuity (ITD), which is at its northern most position of 22° N, (Omotosho, 1985).

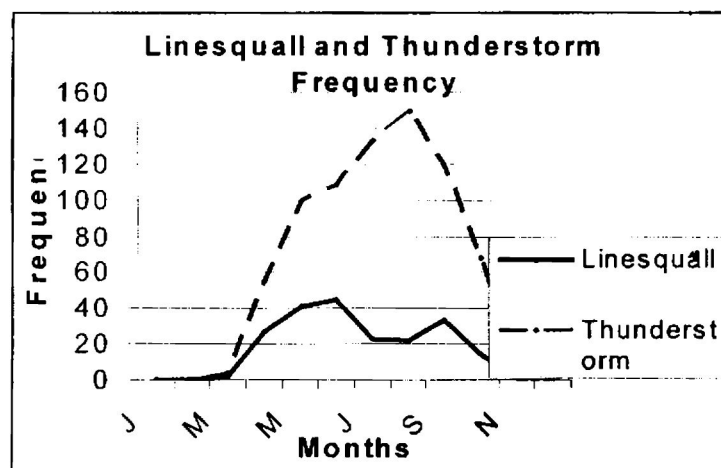


Figure 1: Linesquall and Thunderstorm Frequency on Monthly bases (1986 – 1995)

Thunderstorm on the other hand shows a single maximum with its peak occurrence in August. This indicates that the seasonal variation in thunderstorm in Yola is directly related to the movement of the ITD. When the ITD is at its northern most position of 22° N that is when the northern part of the country receives their highest rainfall courtesy of the meeting of the two air masses (mT and cT). By the nature of Yola's topography these air masses are further lifted to encourage rapid condensation hence the stormy nature of rains in Adamawa and Obudu.

Socio Economic Importance of Linesqualls and Thunderstorms

Investigations have revealed that linesqualls and thunderstorms contribute a substantial amount of rainfall where they occur. In order to assess the socio economic importance of the two systems to the study area, precipitation associated with the two systems were compared against Total Monthly Precipitation (TMP) and total annual percentage contribution determined. Table 2 shows the precipitation amount associated with the systems and the TMP.

Table 2: Precipitation amount associated with Linesquall and Thunderstorm (Ls/Thdst) and Total Monthly Precipitation (TMP) 1986 – 1995.

Variables	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ls/Thdst	0	0	1.5	385.0	752.2	631.3	1450.8	1662.4	1013.6	442.3	6.6	0	346.2
TMP	0	0	27.6	413.8	1082.3	1105.3	1954.2	2208.9	1532.3	647.7	13.6	0	979.9
Perc (%)	0	0	5.4	92.0	69.5	57.1	74.2	75.2	66.6	68.3	48.5	0	70.6

Table 2 shows that linesqualls and thunderstorms activities contribute quite a substantial amount of rain occurring over Yola. The onset of rains in Yola is in April, based on data collected, this research has shown that linesquall and thunderstorm activities contribute 92% of the early rains (April). This is higher than the 55% reported by Eldridge in Oguntoyinbo *et al* (1978) for early and late summer rains in Ghana. Obasi (1965) reported 62% for March/April rains over Lagos in 1962, while Omotosho (1985) reported 70% or more for areas north of 110N. The percentage monthly contribution

of precipitation from linesquall and thunderstorm over Yola varies from as low as 5.4% for March rains to as high as 92% for April rains (see fig. 2). On the overall, the average annual contribution of linesquall and thunderstorm precipitation to total annual precipitation stands at 70.6%. This high contribution is of great importance to the people in the study area because their primary occupation is farming. The implication here is that seasonal and geographical variations in thunderstorm frequency are excellent indicators of the effect of insolation as modified by the shift in the large scale circulation pattern.

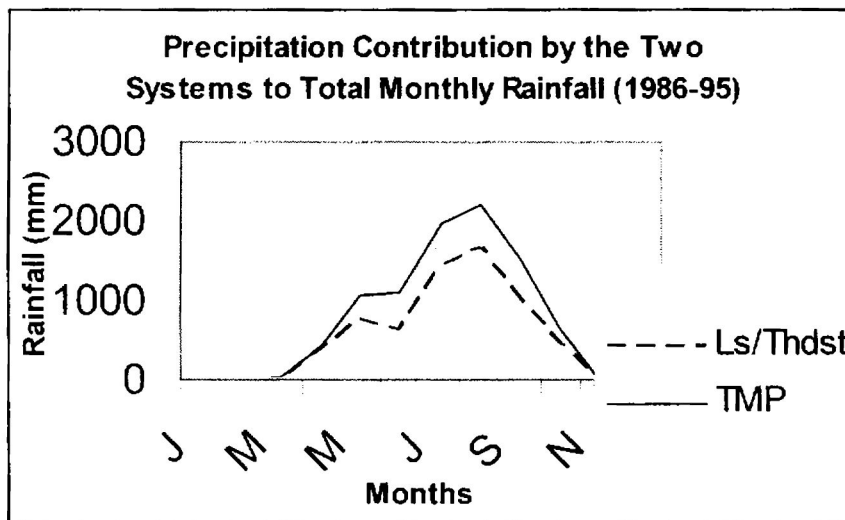


Figure 2: Precipitation contribution on monthly bases (1986 – 1995)

Impact Assessment

In order to critically assess the impact of linesquall and thunderstorm on the people and economy of Yola, Adamawa state, questionnaires were administered to generate needed impact information and results were analyzed for likely impact scenario. Result of questionnaire administration shows that 98% of respondents are aware of the existence of the two systems. 60% agreed it occurs mostly at the beginning of the rains. There was a 100% positive response in respect of impact/effect of the two systems. Being specific on the nature of effect, 57% said it has removed their roofing sheets and damaged

their buildings. 19% said it collapsed their fence, while 20% said it felled electricity poles around their vicinity and 4% claimed lost of life (human/animals). This lend credence to the New Nigerian report of 17th April, 1997, which reported one person killed and the destruction of properties worth millions of Naira in the storm of 14th, April, 1997. A greater percentage of the respondents (81%) agreed that 1997 was their year of worst experience. 97% of the respondents agreed that linesquall and thunderstorm were natural phenomena and therefore advised the government to plant more trees to act as shelter against high winds.

The implications of these findings are that the double maxima in linesquall show that they are not only destructive at the beginning of the rains but also towards the end. Because of the exposed nature of the northern environment, the first blast of squalls tends to blow away top soil thereby removing the rich humus layer which could have boosted agricultural yield. The lost of top soil means farmers have to intensify more fertilizer application in order to enhance meaningful yields. The second peak which occurs after the August break constitute a great threat to trees and crops. It destroys trees that serve aesthetic, protective and economic needs. The impact is worst on crops because after August when the cessation process commences, grains and cereal crops are at ripening stage. Though they may look stocky and strong, but at this stage they are equally brittle (Binbol et al, 2006), and could break easily.

CONCLUSION

The study has attempted an assessment of the impact of linesqualls and thunderstorms activities in Yola. The relationship between the two systems was acknowledged and quantified, their precipitation contribution to the study area as well as the impact of the systems on the life and economy of Yola, Adamawa state have been analysed. The result of the study showed that although linesqualls and thunderstorms contributes significant amount of rainfall to areas where they occur, they have strong negative impact on human structures, agriculture and soils. Proactive preventive measures should be put in place so that maximum benefits could be derived from them.

REFERENCES

- Akeh, L.E and Gbuyiro, S.O (2006) Climate change detection and its socio-economic impact Nigeria situation. The journal of Nigerian meteorological society, Vol. 6, No. 1, 82-88.
- Adebayo, A.A (1999) Climate II: Rainfall in Adebayo and Tukur (Eds) Adamawa State in Maps. Paraclete Publishers, Yola.
- Binbol, N. L. (2005) Seasonal Variation in Linesqualls and Thunderstorm Activities over Yola. Journal of Natural and Applied Sciences, Vol. 1, (1), 59-65.
- Binbol, N. L; Adebayo, A. A and E. H. Kwon-ndung (2006) Influence of Climatic Factors on the Growth and Yield of Sugar Cane in Numan, Adamawa State, Nigeria. Climate Research, 32, 247-252.
- Binbol, N.L and Zemba, A.A (2007) Analysis of rainfall data for effective agricultural production in Adamawa state, Nigeria. Multidisciplinary Journal of Empirical Research, Vol. 4, No. 1, pp 169-175.
- Guyondet, C. (2006) Overall Socio-economic impact of Extreme Weather Events, 1998-2003. WMO Bulletins No. 48, 49, 50, 51, 52 and 53.
- Hamilton, R. A and Archbold, J. N (1945) Meteorology of Nigeria and Adjacent Territory. *OJRM* sec 71
- Louis, J. B (1973) Radar Observation of Atmosphere. John Wiley and sons, New York
- New Nigerian Newspaper (1997) Storm in Yola. (10) 198, Thursday April 17th, Kaduna.
- Nnodu, I. D (1983) Frequency and Seasonal Variation of Linesquall over Nigeria. Unpublished M.Sc Dissertation, University of Ibadan.
- Obasi, G.O.P (1975) Atmospheric, Synoptic and Climatological features of the West African region. Nigerian Meteorological Survey Tech Notes 28.
- Obasi, G.O.P (2000) Climate change-the role of WMO and National meteorological and Hydrological services, 52pp
- Oguntoyinbo, J.S; Areola, O.O and Filani, M. (1978) A Geography of Nigerian Development. Heinemann, Ibadan.
- Ojo, S; Ojo, K and Oni, F (2000) Fundamentals of Physical and Dynamic Climatology. SEDEC-Publishers, 477pp.
- Omotosho, J.B (1985) The separate contributions of linesqualls, thunderstorm and the monsoon to the total rainfall in Nigeria. Journal of climatology, 15, 543-552
- Trewartha, G. T and L. H. Horn (1980) An Introduction to Climate. McGraw-Hills, New York.