

THE CHANGING PATTERN OF RAINFALL IN SOUTH EASTERN NIGERIA WITH
SPECIAL REFERENCE TO ENUGU AND CALABAR WITHIN THE YEARS 1975-2013: ITS
RELEVANCE IN LABOUR PRODUCTIVITY

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Abstract

Rainfall is an important climatic parameter that affects not only the way and manner man lives but also every facet of the ecological system. In this study, rainfall data of 38 years was supplied by the Nigerian Meteorological Services (NIMET) Lagos Nigeria. Two stations namely Enugu (Lat.6.5, Long.7) and Calabar (Lat.4.97, Long. 8.35) were analyzed. The data were on daily basis from which the yearly totals were subsequently analyzed using statistical tools such as standard deviation, decadal mean, mean total, mean deviation and Pearson Product Moment Correlation Coefficient (r). The result however showed that Calabar had a decadal mean of 2953.3mm and a decreasing trend in the first decade after which it experienced a rise throughout the other decades whereas Enugu had a decadal mean of 1777.8mm and a steady rise throughout the time of study. The result of this work can be useful for irrigation scheduling, global and regional climate modeling and for national agricultural planning for sustainable development especially in a COVID 19 ravaged economy.

Keywords: Climate, Rainfall, Modeling, Changing.

INTRODUCTION

Rainfall is a principal element of the hydrological cycle; therefore, understanding its behavior may be of profound social and economic significance. Rainfall is a climate parameter that affects the way and manner man lives. It affects every facet of the ecological system, flora and fauna inclusive. Hence, the study of rainfall is important and cannot be over-emphasized. Obot and Onyeukwu (2010). Aside from the beneficial aspect of rainfall, it can also be destructive; natural disasters like floods and landslides are caused by rain Ratnayake (2005). Recently, our country has not only lost a lot of material and human resources as a result of flooding from rainfall but has also been ravaged by COVID 19 pandemic, the joint effect of these two “giant killers” can be very devastating if not checked. It is against this backdrop that the researchers decided to examine and compare the rainfall patterns or trends of Calabar, a coastal city with Enugu for a period of 38 years (1975-2013) to ascertain the differences and similarities in terms of rainfall to enable us make useful findings that can help us to avert dangerous consequences of flooding.

The detection of the trends and oscillations in precipitation time series yields important information for the understanding of climate. There is always the need to evaluate the changes in the spatial and temporal patterns of rainfall to improve the water management strategies of a given region. Knowledge of trends and variations of current and historical hydro-climatological variables is pertinent to the future development and sustainable management of water resources of a given region especially within the context of global warming, water and energy cycles and the increasing demand for water due to population and economic growth Oguntunde (2006). Several studies have been carried out at different temporal scales and in different parts of the globe. For instance, Akinsanola (2014) conducted a research on the analysis of rainfall and

temperature variability in Nigeria using observations of air temperature ($^{\circ}\text{C}$) and rainfall (mm) from 25 synoptic stations from 1971-2000 (30years). He observed that rainfall decreases from the coast (Warri, Calabar) to the Sahel (Nguru, Katsina, Kano, Maiduguri) at all seasons. This result is in line with the work of Nicholson (1993), who reported that rainfall in West Africa generally decreases with latitude.

In another related research conducted by Ike (2012) on the assessment of the trend and projected future values of climate variables in the Niger Delta region, Nigeria, he adduced that there was an increasing trend in mean annual temperature but a decreasing trend in mean annual rainfall values in the Niger Delta from 1971 to December 2007. This type of rainfall trend is of utmost importance to government and farmers alike as Nigeria's population and economy are linked to climate -sensitive activities including rain-fed agriculture.

Also in Turkey, Partal and Kahya (2006) examined the trend within 64 year period (1929-1993) of rainfall for 96 stations and recorded that the trend in precipitation is downward though few of the stations recorded an increasing trend. In general, it has become very imperative that more studies on rainfall trends be conducted in other cities in Nigeria to forestall the dangerous consequences of flooding especially now that our society is highly ravaged by COVID 19 pandemic.

OBJECTIVES OF THE STUDY:

The purpose of this work is to:

- (i) Analyze the recent rainfall trends and fluctuations in the zone using precipitation data for the period (1975-2013) within two locations in the southeastern Nigeria namely: Enugu (lat. 6.5, long 7.00) and Calabar (lat. 4.97, long 8.35).

- (ii) Discuss the risks and opportunities resulting from the trends in the rainfall regime within these areas.
- (iii) Establish a correlation coefficient for rainfall patterns in these locations using the Pearson Product Moment correlation coefficient (r).

The result of this research will not only help Government to make realistic decisions that will encourage the sustainability of agricultural and rangeland production but will also help farmers to know areas with increasing rainfall trends to avert the harmful effects of flooding.

RESEARCH QUESTIONS:

The following research questions have been postulated:

- 1) What are the trends of rainfall in the areas within the rainfall regime (1975-2013)?
- 2) What are the risk and opportunities inherent in a decreasing or increasing rainfall pattern?
- 3) What is the correlation coefficient for rainfall patterns in these two locations?

METHODOLOGY:

The data for this work was sourced from Nigeria Metrological Agency (NIMET) Lagos. It covered about thirty-eight (38) years, spanning from 1975-2013. The data was made on a daily basis after which it was then converted to a monthly, yearly and decadal basis using the Excel package. These then were subjected to statistical analysis involving standard deviation (d), decadal mean total mean (\bar{x}), mean deviation $= (X - \bar{x})$, standardized anomaly and Spearman product correlation coefficient (r).

(i) Mean $\bar{x} = \frac{\sum X}{N}$

Where \bar{x} = rainfall variable, N = number of years

(ii) Standard deviation, $\sqrt{\frac{(X - \bar{x})^2}{N}}$ the mean value as is defined above.

In computing the deviation score and the standardized anomaly = $\frac{(X - \bar{x})}{STD}$

, the following formulae were used:

(iii) Deviation score = $(X - \bar{x})$

(iv) Standardized anomaly = $\frac{(X - \bar{x})}{STD}$

Where X is the decadal mean rainfall totals, \bar{x} is the total mean of the entire series and STD is the standard deviation from the mean of the series.

(v) The Pearson Product moment correlation coefficient

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}}$$

Where x and y are the decadal mean rainfall in two locations to be compared while \bar{x} and \bar{y} are their respective means.

The tables below show the statistical analysis of decadal rainfall in mm for the two locations:

Table 1.0 Calabar statistical Analysis of Decadal rainfall (mm)

Decades	Decadal total	Decadal mean	$[x - \bar{x}]$	SA
1975-1984	28432.7	2843.27	-109.93	-0.425
1985-1994	27776.0	2777.60	-175.60	-0.678

1995-2004	29765.5	2976.55	+23.35	+0.090
2005-2013	28943.8	3215.89	+262.69	+1.015

$\bar{x}=2953.2$, STD =258.8

Table 1.1 Enugu Statistical Analysis of Decadal rainfall in (mm)

Decades	Decadal total	Decadal mean (x)	$[x - \bar{x}]$	Standardized anomaly (SA)
1975-1984	16486.9	1648.69	-129.11	-0.639
1985-1994	17026.5	1702.65	-75.15	-0.361
1995-2004	18585.4	1858.54	+80.74	+0.396
2005-2013	17110.1	1901.12	+123.32	+0.604

$\bar{x}= 1777.8$, STD =204.2

Table 1.2 Coefficient of correlation of rainfall patterns in Enugu and Calabar

Decades	Enugu(x)	Calabar (y)	$(x - \bar{x})$	$(y - \bar{y})$	$(x - \bar{x})(y - \bar{y})$	$(x - \bar{x})^2$	$(y - \bar{y})^2$
1975-1984	1648.69	2843.27	-129.11	-110.03	14205.90	16669.39	12106.60
1985-1994	1702.62	2777.60	-75.18	-175.70	13209.13	5652.03	30870.49
1995-2004	1858.54	2976.55	80.74	23.25	1877.20	6518.94	540.56
2005-2015	1901.12	3215.89	123.32	-2631.41	324505.48	15207.82	6924318.

							58
	$\bar{x}=1777.80$	$\bar{y}=2953.30$			$\Sigma=353797.7$	$\Sigma=44048.$	$\Sigma=69$
					1	18	6783
							6.23

$$r = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\sqrt{\Sigma(x-\bar{x})^2 \Sigma(y-\bar{y})^2}} = \frac{353797.71}{\sqrt{44048.18 \times 6967836.23}} = 0.64$$

The coefficient of correlation of 0.64 between the two locations – Calabar and Enugu shows that there exists a high positive correlation between the two locations which means that both cities may be having the same rainfall experience.

Analysis/Discussion

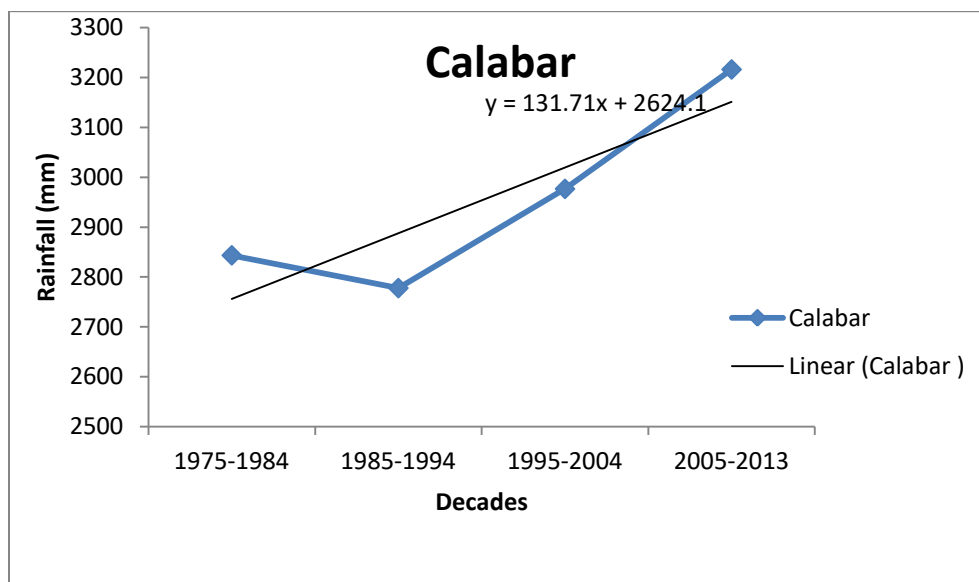


Fig. 1 Graph of Rainfall against decades for Calabar

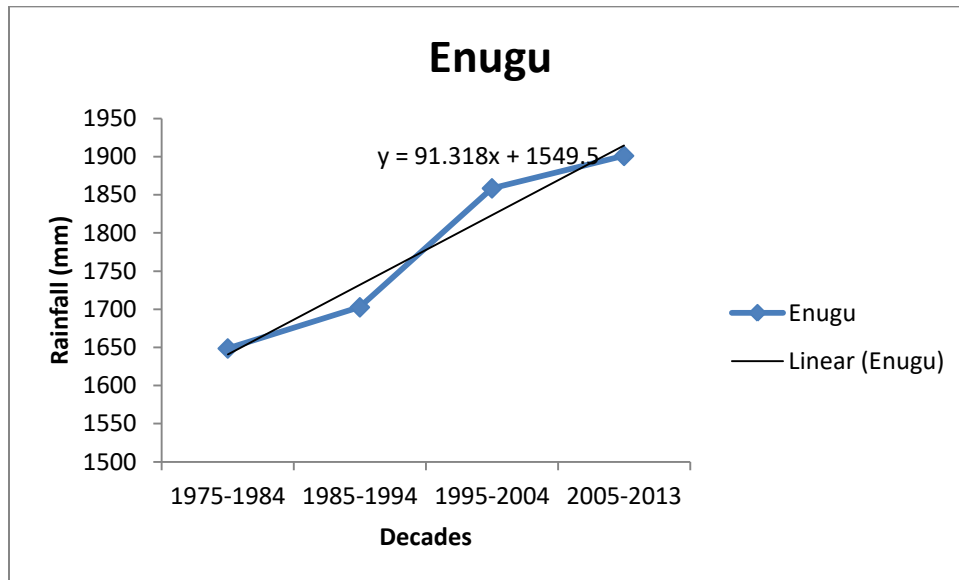


Fig. 1 Graph of Rainfall against decades for Calabar

Calabar (fig.1) started with a high rainfall value of 2843.27mm in the first decade and experienced a sharp drop to a value of 2777.6mm in the second decade after which it increases to 2976.55mm in the third decade and to 3215.89mm in the fourth decade. The equation of the trend reveals that Calabar has an increasing trend with a slope of 131.71mm/decade. Furthermore, Enugu (fig. 2) experienced a steady rise in the decadal rainfall pattern throughout the study period with a minimum value of 1648.7mm in the first decade to 1702.65mm in the second decade, 1858.54mm in the third decade and a maximum value of 1901.1mm in the last decade. There is also an increasing trend with a slope of 91.318mm/decade. It should be observed that the maximum decadal rainfall (1901.1mm) experienced by Enugu in the last decade is lower than the minimum decadal rainfall (2777.6mm) experienced by Enugu in the second decade.

Analysis using the Bar Chart

From fig.3 below, it can be seen that Calabar experienced a drop in rainfall trend from the first to the second decade and increased steadily in the third and fourth decades while on the other hand, Enugu (fig.4) had a continuous increase in rainfall trend from the first decade to the last decade as can be seen in the bar charts.

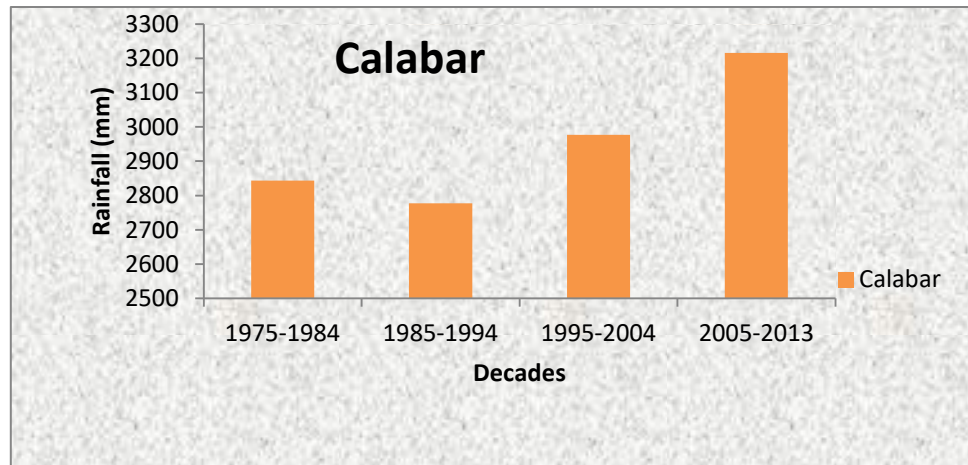


Fig. 3 Graph of rainfall (mm) against decades for Calabar

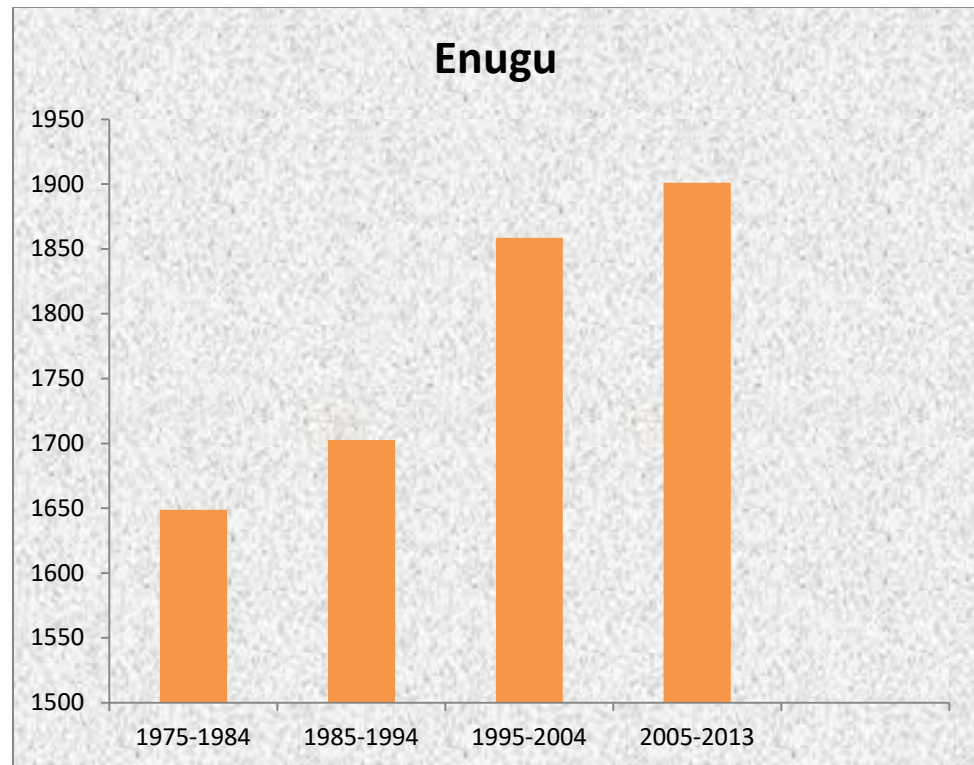


Fig.4 Graph of rainfall (mm) against decades for Enugu

CONCLUSION

Rainfall is highly variable in space and time and is subject to depletion or enhancement due to both natural and anthropogenic causes. It is clear from the results of the analysis that the general trend in the rainfall series for the two different stations was increasing trend throughout the period 1975-2013, for instance Enugu was always increasing while Calabar decreased after the first decade and increased steadily throughout the period in question. The stations however have a high positive correlation coefficient of 0.64 which implies that both stations may be having the same rainfall experience.

FINDINGS

A decadal decline in rainfall as noticed in the second decade for Calabar might have serious agricultural implications because most agricultural activities in this area rely on rainfall. It should be noted that people living in areas with increasing rainfall trends should be mindful of the hazardous effects of flooding (Akinsanola, 2014). Therefore good drainage systems should be built by government and individuals alike as poor drainage systems may lead to environmental degradation such as erosions and landslides (NIMET, 2007). Rainfall, though beneficial to agricultural practices, excess of it can have devastating effects on the crops that are planted (Oladipo, 2008).

There is a need for continuous studies to know the further extent of the change which just occurred so that relevant planning could be put in place especially now that our country is being ravaged by COVID 19, if not, our society may be made to face serious hunger arising either from flooding or COVID 19.

RECOMMENDATIONS

It is recommended that farmers in areas with declining rainfalls should overcome the problem by planting drought-resistant crops or early maturity species. Farmers should diversify the economic base of the populace with emphasis on reducing over-dependence on rain-fed agriculture is another way of coping with this problem. It is also recommended that government policies in the areas under study should be based on recent rainfall trends.

Government and non-governmental agencies should help to put to check the harmful or disastrous consequences of flooding in areas with increasing rainfall patterns by building good drainage systems. Finally, all the precautionary measures should be put in place to check further spread of the COVID19 virus so that it will not have a

multiplier effect on the disastrous consequences of flooding through compulsory certification of organizations who in one way or the other do work that affect the populace or the society.

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