RESEARCH ARTICLE

ANALYSIS OF THE TRENDS OF CLIMATIC VARIABLES IN SOUTHEAST NIGERIA

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ABSTRACT

The study was conducted in Southeast Nigeria which is located in the rainforest zone of Nigeria and made up of five states Abia, Anambra, Ebonyi, Enugu and Imo state out of the 36 (Thirty Six) states in Nigeria. It analyzed the trends of climatic variables in Southeast Nigeria. The time series data on means of annual temperature and rainfall for a period of 42 years (1972-2014) in southeast Nigeria were collected from the Nigeria meteorological agency (NIMET) within the zone. Data collected were analyzed with trend analysis using Ms, Excel, Statistical package for social sciences (SPSS) version 15 and STATA. Results showed that there had been high inter-annual variability in rainfall volume over the years with insignificant correlation (0.049) between volume of rainfall and time. However, the trend of rainfall intensity over the period was significant at (p=0.01), with the correlation of (0.54) and trend coefficient (0.48). The trend of temperature within the period (1972-2014), shows an increasing trend and statistically significant at (P=0.01). The Coefficient of correlation of temperature and time was (78.7%) which indicates existence of warming in southeast Nigeria. These findings would guide farmers to take advantages of most favourable climatic condition (weather), for their farm activities, especially crops cultivation and solve the hitherto problem of unpredictability of the season amongst farmer in the region. However, the study recommends that periodical weather forecasts from meteorological agents of government should be made known to farmers.

INTRODUCTION

A region's climate could be seen as the collective expression of the location's many weather elements like temperature, rainfall, wind, humidity, cloud cover and sunshine. Climate change refers to ongoing change in the global climate system which is attributed to anthropogenic global warming due to increased and continuing emissions of Greenhouse Gases (GHGs) from energy production/consumption, industry, agriculture and loss of vegetation and other carbon sinks (FAO, 2008). However, the Intergovernmental Panel on Climate Change (IPCC) defines it as any change in climate over time due to natural climate variability or due to human activity (IPCC, 2007). All countries and ecosystems in the globe will face the consequences of the changing climate. However, the seriousness of the effects will definitely vary from country to country or across ecosystems. In Nigeria, for example, according to the National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) (FME, 2012) the adverse impacts of climate change are already having their toll on the livelihoods of people and on sectors of the economy. All these changes will aggravate the situation leading to increased vulnerability of the communities to the

impacts of climate change and affecting sectors of the economy, especially agriculture, water, energy, health and forestry. Climate change is expected to increase with increase frequency and intensity of extreme weather conditions in Southeast rainforest region of Nigeria (Babatunde *et al.*, 2011). The implications for the regions are that the region would generally experience wetter than average climate, more extreme weather conditions, particularly erosions, windstorms and floods. Agriculture remains the main source of livelihoods for most rural communities in the rainforest region of Nigeria. In the rainforest region of Nigeria where southeast Nigeria is situated, a combination of external and internal forces makes the climate of the region one of the most erratic in Nigeria (Babatunde *et al.*, 2011). Annual cycles of rainfall are strongly determined by the position of the inter-tropical convergence zone (WCRP, 1999). Many studies have characterized the trend of rainy season in Nigeria; most of them were based on decadal, monthly or total annual rainfall analysis (Nwajiuba *et al.,* 2008; Onyeneke, 2010; Nwajiuba and Onyeneke, 2010; WACDI, 2011) while others studies described the start and end of rainy season (RULIN, 2011; Ayanwuyi *et al.,* 2010; Apata *et al.,* 2009; Ishaya and Abaji, 2008; Omotosho *et al.*, 2000). A good understanding of seasonal variability patterns is of

critical importance because of the highly unstable onset of the rainy season and the high frequency of dry spells.

MATERIALS AND METHOD

This study was conducted in Southeast Nigeria which is one of the six geopolitical zones of Nigeria and is made up of five States out of the thirty six (36) States of the country, including the federal capital (Abuja). The five States are; Abia, Anambra, Ebonyi, Enugu and Imo. Southeast Nigeria is in the tropical rainforest and located within latitudes 5^0N to 6^0N and longitudes 6^0E to 8^0E with an estimated land mass of 10,952,400 hectares and population of 16,395,554 which is distributed thus; 2,845,389, 4,177,828, 2,176,947,3,267,836 and 3,927,563 for Abia, Anambra, Ebonyi, Enugu and Imo States respectively (FGN, 2006). The inhabitants of Southeast Nigeria are predominantly farmers which are mainly on subsistence level under rain-fed agriculture. The rainy season is more pronounced from May to October and the dry periods are witnessed from November to April. However, there seems to be no clear cut demarcation between the rainy season and dry season due to climate change which has made farmers to be un-predictive of the seasons. Though, the rainy periods are often more than the dry periods within the year, with annual rainfall between 2000 and 3000 mm and mean temperature of 28^0C(BNRCC, 2011).

More than 70 percent of the population in southeast are farmers and produce mainly staple food crops such as Cassava, Yam, Maize, Cocoyam, Vegetables, Rice, Bananas etc. (Akinyosoye, 1996). Also, there are abundance of fruit trees (oranges, mangoes, cashew, pears etc) and oil palms often growing wild in grooves (Akinyosoye, 1996; Osugiri, *et al*, 2006). Some farmers are engaged in livestock management especially poultry, piggery, sheep and goat production. The time series data on means of annual temperature and rainfall for a period of 42 years (1972-2014) in southeast Nigeria were collected from the Nigeria meteorological agency (NIMET) within the zone. Data collected were analyzed with trend analysis using Ms, Excel, Statistical package for social sciences (SPSS) version 15 and STATA.
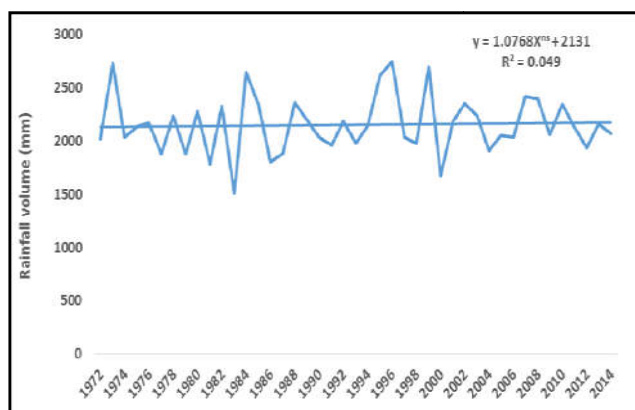
Nb: ns is not significant Source: Field Survey Data 2015.

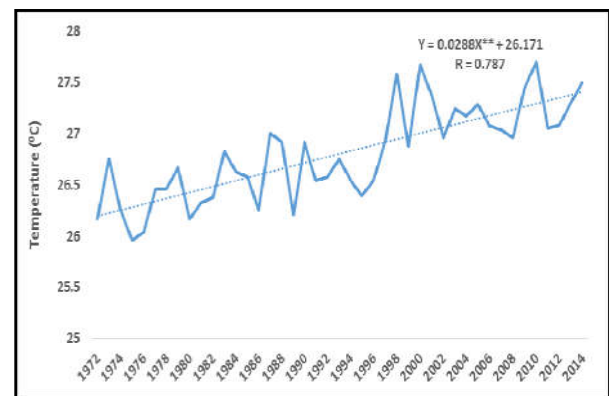**Figure 1. Trend result of rainfall volume in southeast Nigeria from 1972 – 2014**

The relationship of the trend analysis is express thus:
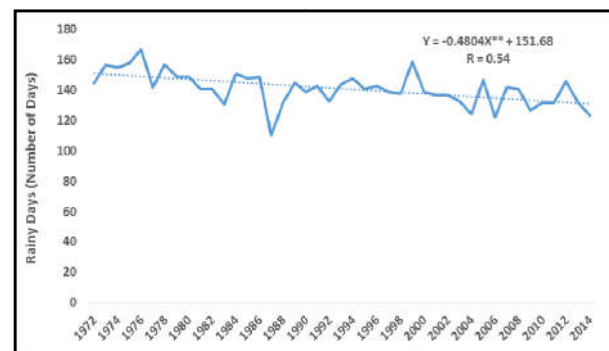$Y_1 = f(t)$
Where:
Y = Climate Variables
T = Time (Years). Gbetibouo, 2009.

Nb ** is Significant at 1% level of probability
Source: Field Survey Data 2015.

Figure 2. Trend result of temperature in southeast Nigeria from 1972 – 2014

Nb ** is Significant at 1% level of probability Source: Field Survey Data 2015.

Figure 3. Trend result of rainfall intensity in southeast Nigeria from 1972 – 2014

RESULTS AND DISCUSSION

Trend of Climatic Variables

Trend of Rainfall Volume in Southeast Nigeria: Aggregate volume of rainfall in the area (Fig 1), shows that there is high inter-annual variability in volume of rainfall from 1972 to 2014 which also resulted to a very low and insignificant correlation (0.049) between rainfall volume and time. Volume of rainfall in the area experienced increasing but insignificant trend. This result is in line with the findings of Onyeneke and Mmagu (2015) and Babatunde *et al.* (2011) who asserted that aggregate rainfall in the rainforest and coastal regions of Nigeria will not change but the intensity and pattern will change.

Table 1. Summary of the trends analysis of climatic variable, 1972-2014

Climate variable	Period of increase	Period of decrease
Rainfall(mm)	May-October	November April
Temperature(^{O}C)	November – June	July – October

Source: Field Survey data, 2015.

Trend of Temperature in Southeast Nigeria: Data on temperature from 1972-2014 shows an increasing and statistically significant trend (Figure 2). The coefficient of correlation of temperature and time is 78.7% and is statistically significant implying that temperature has significant positive relationship with time. Therefore, time is a major determinant for temperature changes.

This means that warming is real and significant in southeast Nigeria. This is in line with the findings of Onyeneke and Mmagu (2015); Chidiebere-Mark *et al.* (2014); Nwaiwu *et al.* (2013a); Okorie *et al.* (2012); Babatunde *et al.* (2011); Women and Children Development Initiative (WACDI) (2011); Nwajiuba and Onyeneke (2010) who observed that the evidence of variation in the climate of southeast Nigeria is seen on steady increase in surface temperature. The impact is very obvious as many crop farmers will record decreased yield and scorching of crops.

Trend of Rainfall Intensity in Southeast Nigeria: Figure 3 demonstrates that there has been significant reduction in number of rainy days between 1972 and 2014. However, the trend is very significant as well as the correlation (0.54). The trend coefficient is 0.48 implying that number of rainy days is likely to reduce by 4.8 days every ten years. This record supports Onyeneke and Mmagu (2015) and Babatunde *et al.* (2011) who observed that the pattern of rainfall in southeast Nigeria in terms of number of rainy days is experiencing and will continue to experience a decreasing and significant trend. This result implies that there could be increased occurrence of flood in the area because increasing volume of rainfall in decreasing number of rainy days will lead to hazards like flood and erosion as being experienced in the area. The result in Table (1) shows the monthly variation in over-all trend of climate variables observed annually (1972-2014). Data collected and analyzed on rainfall pattern for 42year (1972-2014) showed that there had not been any (Observable) wide gap in rainfall distribution over the months within the period, but there was (Observable) variation in the intensity of rainfall within the months in a year which causes sudden spells that have left farmers to be un-predictive of onset and / or reduction in rainfall in a year. It has now been revealed that rainfall intensity and duration increases from May to October and decreases from November to April. Conversely, temperature (°C) increase from November to June and decreases from July to October. These findings should be a guide to farmers on the most favourable period or months to start their farm activities especially cultivation of crops. This is specifically important as different crops are favoured or thrive better at definite thresholds of weather or climate conditions (NRCRI, 2014).

Conclusion and recommendation

The onset, intensity and spread of rainfall and rate of temperature are the basic climatic factors that affect the agricultural activities, mainly arable crops cultivation in Southeast Nigeria. This is particularly so, as each crop has its length of growing days (day length). Therefore, any crops cultivated outside the specified growing periods due to unpredictable weather conditions, would not thrive well and give poor yield. To ensure adequate and sustainable food crops production under rain-fed agriculture practiced in southeast Nigeria, a proper understanding of the trends of climate variables is required. The results of these findings shows that there have not been any significant change in the volume of rainfall in the area for the past 42 years, but the intensity has significantly decreased. It's intensity is experienced between May and October, but decreases between November and April. However there has been significant increase in temperature in the area over the period, leading to warming. The warming or increase in temperature is experienced more between November and June, but decreases between July and October. This findings would be a big relief to farmers in southeast Nigeria. Moreover, results of periodic forecast by Meteorological centre(s) in the zone should be extended to farmers by the agents.

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