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CLIMATE VARIABILITY AND FARMERS ADAPTATION STRATEGIES ON CROP PRODUCTION IN WUSHISHI LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

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Abstract

Climate variability is the way aspects of climate differ from an average. Temperature and precipitation are two most important climate parameters that are most studied in climate research because of their immediate impact in various socio-economic sectors. Climate date and crop yield records were acquired. Quantitative data was analysed using both descriptive and inferential statistics with the help of the IBM SPSS Statistics Software version 21 and the Microsoft Excel Software. Analytical tools such as frequency, percentages, Cross-tabulation, Chisquare and trend equations and graphs were used to analyse the quantitative data. The statistical analysis showed an annual increasing trend of 0.1339 which indicates about 13.39% annual increment with an R^2 value of 0.33. The lowest average annual temperature was recorded in the year 1992 with an average value of 34.37^{0}C, while the highest was recorded in the year of 2012 with an average value of 47.93^{0}C. The Mean for the thirty-five-year period was 39.71^{0}C, the Mean Deviation (MD) was 1.73 and the Standard Deviation (SD) was 2.34. The study concludes that there is strong positive relationship between climate and crop yield in the study area. It thereby recommends that there should be time to time awareness and enlightment campaign on the causes of climate change in various parts of the country.

Key Word: Climate Variability, Adaptation and Strategies

INTRODUCTION

Climate is seen as the state of the atmosphere of an area over a long period of time. It is the synthesis of weather over a long period of time at a given area (Ayoade, 2015). Climate variability is the way aspects of climate differ from an average. Climate variability occurs due to natural and sometimes periodic changes in the circulation of the air and ocean, volcanic eruptions, and other factors (Blaustein et al., 2010; Walls et al., 2013). Worldwide, the average global temperature is rarely exactly the same from year to year. One year might be though the long-term trend shows increasing temperature over time. There are many reasons for climate variability, including natural fluctuations like the ENSO (El Nino Southern Oscillation). Scientists are currently researching the impact that climate variability may has on rural migration.

Climate variability is often natural, is causing an increase in the probability of many extreme weather events, and those events contribute to climate variability.

Extreme events are specific weather events that depart from the average in some significant. A rainfall variation is the degree to which rainfall amounts vary across for a specific time interval, ranging from day, week, months and season of the year. The term is sometimes classified as short-term variations in rainfall amounts with time (Tong & Donald, 2012), which is said to be occurring at all season of the year (Woodruff, Guest & Garner, 2014). Temperature and precipitation are two most important climate parameters that are most studied in climate research because of their immediate impact in various socio-economic sectors (e.g. agriculture and hydrology), including human comfort (Sayemuzzaman *et al.*, 2014). Temperature and rainfall have therefore become important variables which can have direct and indirect effects on agricultural crops in general. Temperature increase and erratic rainfall patterns are two major parameters that have affected agriculture production in Nigeria. Increases in temperature coupled with more precipitation variations as a result of the changing climate, reduce productivity of crops, and these effects outweigh the benefits of increasing carbon dioxide (Walthall *et al.*, 2012).

According to Lee *et al.* (2012), the elasticity of annual climate variables indicates that warmer temperatures significantly decrease agricultural production including crops in Asia. It is estimated that when annual mean temperature increases by 1 percent, average agricultural production decreases by 0.346 percent. Also, the study of Waithaka *et al.* (2013) using crop modeling assessments of the potential effects of climate change have shown yield losses of maize in most parts of the Democratic Republic of Congo, Ethiopia, Tanzania, and northern Uganda. However, the study also shows an increase of sorghum yields in the western DRC, the highlands of Ethiopia, Kenya, Sudan, and Tanzania. Moreover, the study of Ayanlade *et al.* (2010) on the impact of climate variability on tuber crops in the Guinea Savanna part of Nigeria supports the extent to which climate variability affects crop production. According to their study, rainfall variability caused a reduction in yam yield during the periods of 1990/1991 in Nigeria.

Along similar lines, Lobell *et al.* (2011) cited in Chijioke (2011) argue that, for each degree that a crop spends above 30°C, there was a reduction of yield by 1 percent. They further revealed that, the availability of water has an important effect on the sensitivity of crops with yields decreasing by 1.7 percent for each degree day spent over 30°C under drought conditions. Extreme climate conditions, such as dry spells, sustained drought, and heat waves have been projected to have large effects on crops and livestock production (Walthall *et al.*, 2012).

Again, it has also been revealed that high temperatures impact on vegetable crops like lettuce, carrot and cucumber to the extent that the high temperatures suppress bisexual flowers, decrease the number of flowers and inhibit flower differentiation and development, which result in low yield (Masahumi *et al.*, 2011). At the local level, it is argued that the agricultural sector is the most vulnerable of all the other sectors. According to Sofoluwe *et al.* (2013) cited in Owombo *et al.* (2013), climate variability is the most important limiting factor to agricultural production that can cause serious threat to the sustainability of food production. However, it is important to note that the vulnerability of the agricultural sector is due to its reliance on rainfall (Walthall *et al.*, 2012).

As a result of the impact of changing climate on agricultural production, the debate has now shifted from high level advocacy on "the need to act" to country and regional level responses on "how to adapt" (Wilby, 2007 cited in Bagamba *et al.*, 2012). It is in the light of this that farmers in various countries continue to develop strategies to cope with the stress and damage the changing climate can impose on the countries agricultural sector (Pinto *et al.*, 2012). Thomas Staal, the mission director for the United State Agency for International Development (USAID) Africa Bureau, during the seventh African Development Forum in Addis Ababa in 2010, reiterated the need for countries to employ science and Technological innovation in adapting to the climate change situation (Sarr, 2010). The application of coping strategies varies from farmer to farmer depending on the type of crop, the type of soil and the resources available to the farmer. Beside farmers" efforts to adapt to the changing climate, governments through its institutions are also seeking ways of fashioning out policies to mitigate the impact to prevent food insecurity. The development and implementation of adaptation strategies will go a long way to help offset the unpredictable nature of the climate in order to sustain food production. In view of the relevance of agriculture in development of Niger State, there is the urgent need for research to be conducted to on climate variability and farmers adaptation strategies in Wushishi Local Government Area of Niger State to meet the urgent need of the society. Therefore, this study examine the trend of climate variability over the past 35 years (1983-2017) in Wushishi LGA.

Study Area

Wushishi local government area of Niger state, on the south eastern direction. The area lies between latitude 9°54'N and longitude 6°38'E of the equator according to 1:1,000,000 scale soil map of Nigeria. The area is highly traversed and well opened up and it is a Fadama land located in the flood plans of river Ubandawaki (Gakubo) and Bankogi irrigation water is supplied to the field by gravity flow from the reservoir of Tungan Kawo dam located in the upstream position of the scheme (MaxLock, 1981).

The project site is located about 50km away from Minna, the state capital was conceived as early as 1955 by the defunct Northern Nigeria Government. It was designed to serve as a solution to the frequent flooding of valuable agricultural land in the project area by river Ubandawaki (Gakubo) and Bankogi. The total area involved is about 800 hectares (MaxLock, 1981).

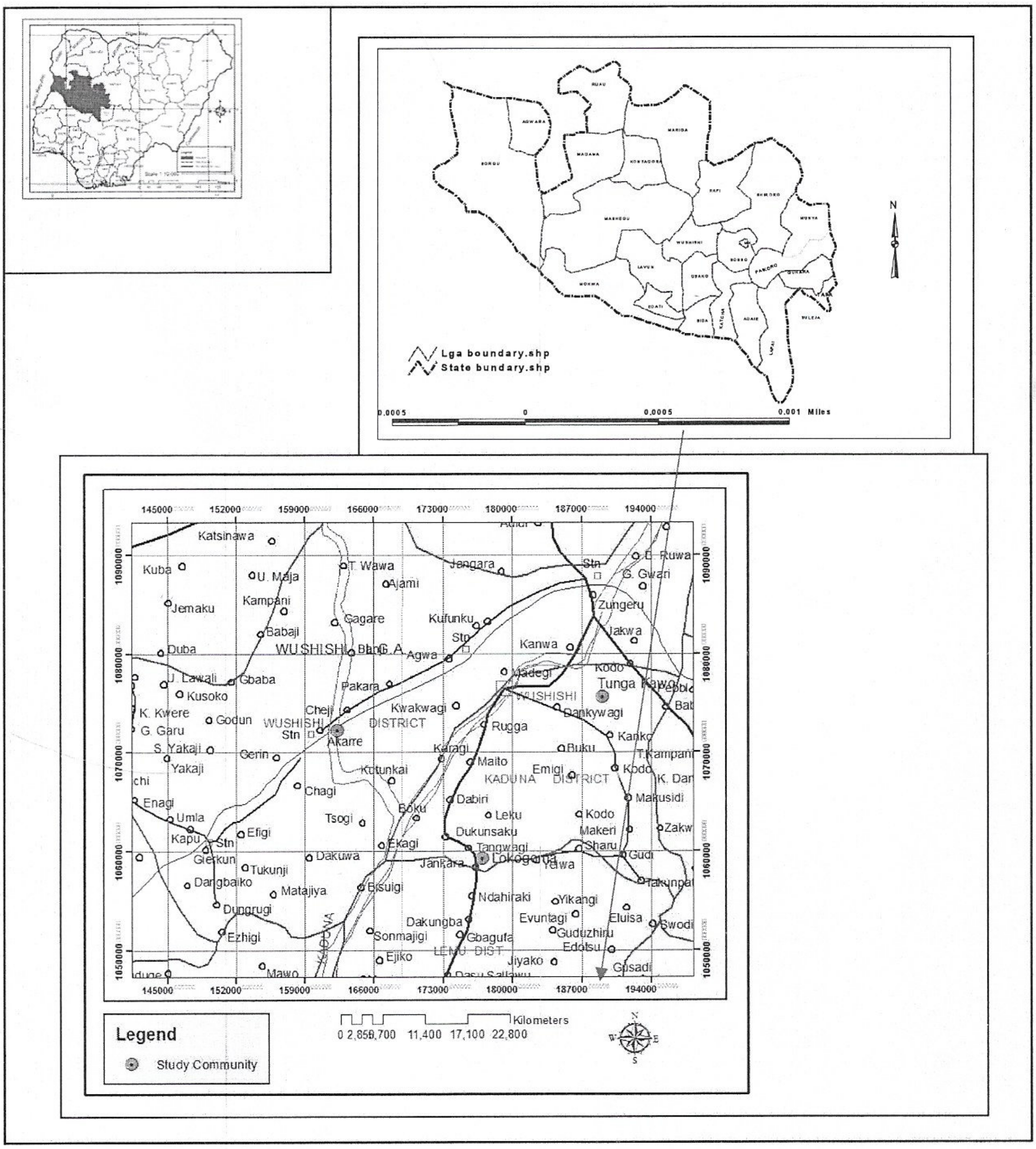

Figure 1.1: Study Area map (Source : NIGIS, 2019)

METHODOLOGY

The cross-sectional design was used for the study. Data were collected from both primary and secondary sources. Climate records was collected from NIMET station and crop yield Primary data was collected from farmers and Agricultural Extension Officers. The data was analysed quantitatively and qualitatively. The quantitative data was analysed using both descriptive and inferential statistics with the help of the IBM SPSS Statistics Software version 21 and the Microsoft Excel Software. Analytical tools such as frequency, percentages, Cross-tabulation, Chisquare and trend equations and graphs was used to analyse the quantitative data.

Results

Figure 2 depicts the inter-annual temperature trend over Wushishi as from 1983 – 2017. The inter-annual temperature trend of Wushishi for the past thirty-five years is positive with a fluctuating and irregular pattern. The statistical analysis showed an annual increasing trend of 0.1339 which indicates about 13.39% annual increment with an R^2 value of 0.33. The lowest average annual temperature was recorded in the year 1992 with an average value of 34.37^{0}C, while the highest was recorded in the year of 2012 with an average value of 47.93^{0}C. The Mean for the thirty-five year period was 39.71^{0}C, the Mean Deviation (MD) was 1.73 and the Standard Deviation (SD) was 2.34.

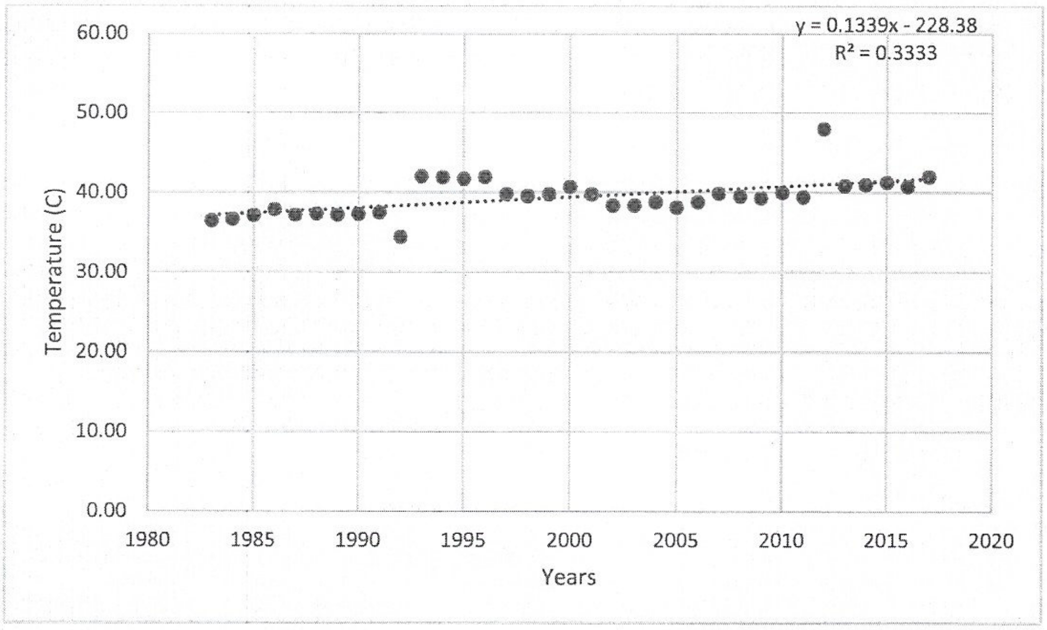

Figure 2: Inter-annual Temperature Trend over Wushishi (1983-2017)

Inter-annual rainfall variation is the broadest time scale over which precipitation varies. Sumner (1988) has observed that this scale is important since any long-term trends, be they a consistent decrease or increase, or a notable regular fluctuation may have a potentially catastrophic effect on the well-being of an area and its people. Such trends will have an impact over time spans of the order of decades; as was the case with the persistent droughts of the 1970s, 1980s and 1990s (Bunting *et al.*, 1976; Nicholson, 1985; Ingram, Roncoli and Kirshen, 2002). Thus, the inter-annual rainfall trend for Wushishi (1983-2017) is shown in Figure 3. From the Figure, the rainfall distribution over Wushishi for the past thirty-five years (1983 – 2017) shows that rainfall trend is negative (decreasing) with a fluctuating, inconsistent and irregular pattern. The statistical analysis shows an annual decreasing trend of -7.83 indicating an annual decrease in rainfall of about 7.83% with an R^2 value of 0.1347. The lowest rainfall amount was recorded in 2006 with an amount of 399.61mm while the highest rainfall was recorded in 1990 with an amount of 1118.60mm. For the period under study, the mean annual rainfall was 732.76mm, the Mean Deviation (MD) was 195.50 and the Standard Deviation was 215.43.

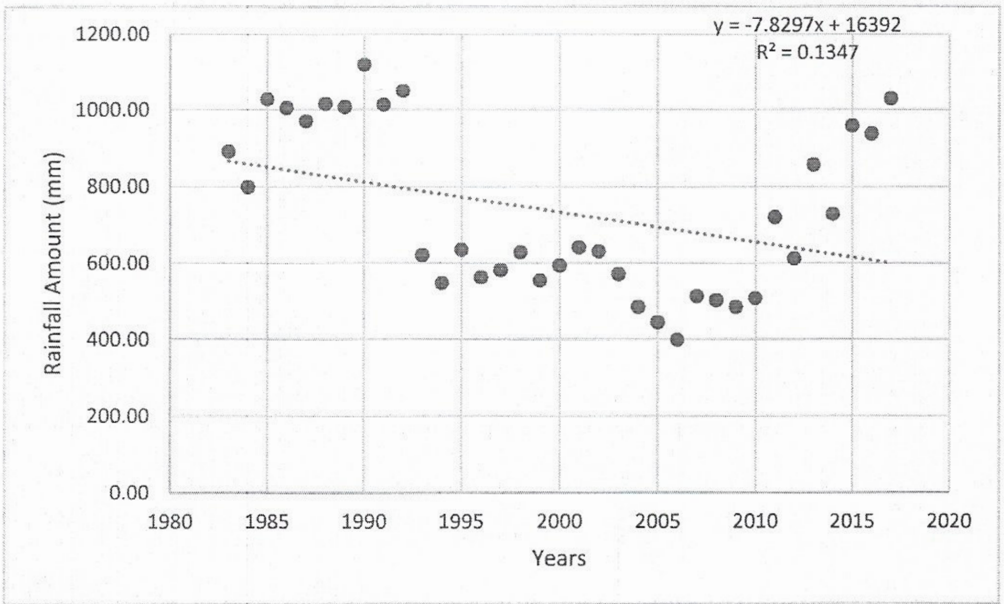

Figure 3: Inter-annual rainfall trend over Minna (1983 to 2017)

Climatic Indices for Temperature and Rainfall over Wushishi (1983 – 2017)

The Standardised Climatic Index (SCI) calculation used in Table 4.1 is based on the long-term precipitation and temperature record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SCI for the location and desired period is zero (Edwards and McKee, 1993). Positive SCI values indicate greater than median precipitation or temperature, and negative values indicate less than median precipitation/temperature. Because the SCI is normalised, wetter/hotter and drier/cooler climates can be represented in the same way, and wet/hot periods can also be monitored using the SCI.

Figure 4 thus presents the standardized rainfall indices over Wushishi from 1983 to 2017. It can be observed that there are more wet years than dry years (Table 4.1). But for the near normal range, 18 out of the 35 years under study are considered to have near normal precipitation distribution. Rainfall is primarily characterized by a multiple, non-symmetric cycle of anomalies with varying magnitudes. These observations confirm earlier findings by Bunting *et al.* (1976). The cycles vary from 3 to 5 years in some locations, and from 10, 20, and 30 to 40 years in others (Kalu, 1987).

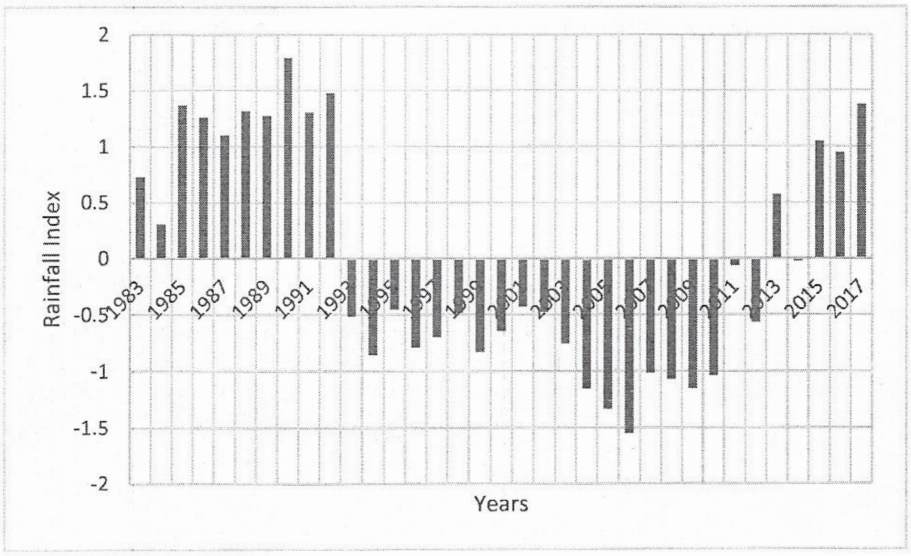

Figure 4: Standardised Precipitation Index over Wushishi (1983 – 2017)

Figure 5 presents the standardized temperature indices over Wushishi from 1983 to 2017. It can be observed that there are more hot years than cold years (Table 4.2). But for the near normal range, 27 out of the 35 years under study are considered to have near normal temperature distribution, with one extremely hot year (2012) and another extremely cold year (1992). Temperature is primarily characterized by a multiple, non-symmetric cycle of anomalies with varying magnitudes.

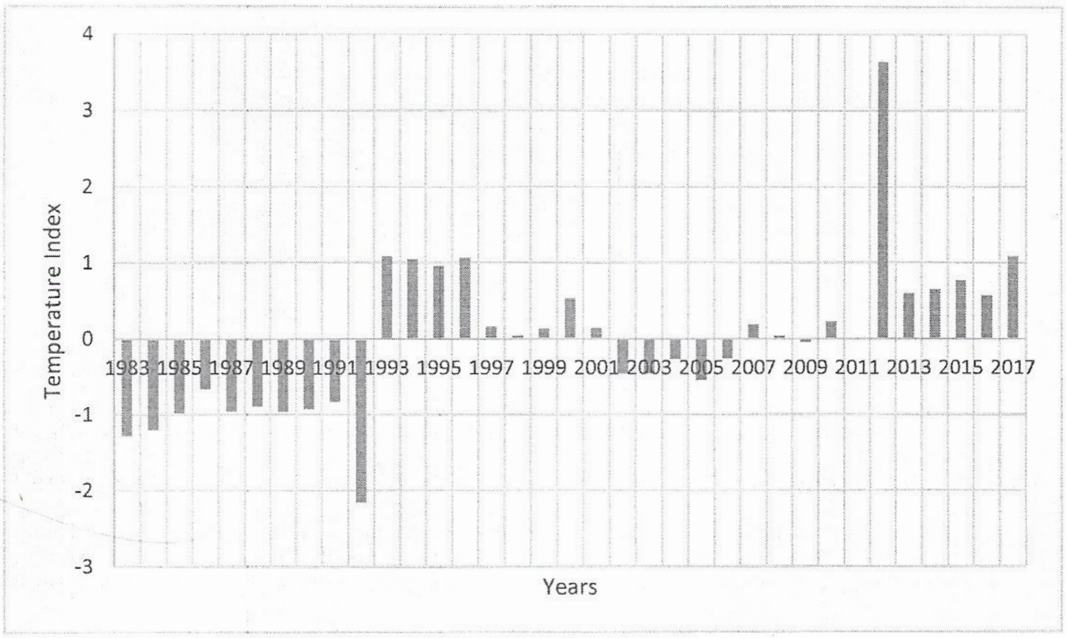

Figure 5: Standardised Temperature Index over Wushishi (1983 – 2017)

Conclusion

The rainfall trend of the study area for the past twenty (20) years shows that rainfall amount has been very variable (fluctuating). The lowest rain fall occurred in 2004 which was 473.7mm in total and 1.3mm in average, while the highest rain fall was recorded in 2001 which was 1789.4mm in total and 4.9mm in average. Indeed 4.9mm (the total of 1789.4mm) as the highest average of rain fall is still very low in agricultural production even with the short time crops. The mean maximum temperature trend of the study area for the period under study has been very variable (fluctuating). The lowest temperature was recorded in 2011 which was 11804.0^{0}C (in total) and 32.3^{0}C in average, while the highest temperature was recorded in the years of 2009 and 2013 which was 12488.9 ^{0}C in total and 34.4^{0}C in average. Truly even at this lowest average mean maximum temperature32.3^{0}C, is really high and uncomfortable for human being and for crop production also. This shows that the study area is a place of often. The study recommends that there should be climate monitoring stations for every agricultural zones of Nigeria.

REFERENCE

Ayoade, D. (2015), *"The perception of /and adaptation to climate change in Africa",* World Bank Policy Research Working Paper No. 4308.

Blaustein, M., Manyatsi, A. M., Mhazo, N. and Masarirambi, M. T. (2010), "Climate variability and change as perceived by rural communities in Swaziland", *Research Journal of Environmental and Earth Sciences*, Vol. 2, No. 3, pp. 164-169.

Chijioke, O. B., Haile, M. and Waschkeit, C. (2011), *"Implication of climate change on crop yield and food accessibility in sub-Saharan Africa"*, An inter- disciplinary term paper, Center for Development Research, University of Bonn.

Mary, A. L. and Majule, A. E. (2009), "Impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas of Tanzania: The case of Manyoni District in Singida Region, Tanzania", *African Journal of Environmental Science and Technology*, Vol. 3, No. 8, pp. 206-218.

Tong, J. and Donald G., (2012) *"Crop Production and Global Warming, Global Warming Impacts - Case Studies on the Economy, Human Health, and on Urban and Natural Environments"*, Stefano

Mengistu, D. K. (2011), "Farmers" perception and knowledge of climate change and their coping strategies to the related hazards: Case study from Adiha, central Tigray, Ethiopia", *Agricultural Science,* Vol.2, No. 2, pp. 138-145.

Masahumi, J., Masayuki, O., Toru, M. and Yutaka, S. (2011), *"Crop Production and Global Warming, Global Warming Impacts - Case Studies on the Economy, Human Health, and on Urban and Natural Environments"*, Stefano

Pinto, D. A., Demirag, U., Haruna, A., Koo, J. and Asamoah, M. (2012), "*Climate Change, Agriculture, and Food crop Production in Ghana",* International Food Policy Research Institute (IFPRI), Accra.

Wooddruff, G. and Garmer, M. (2014), "Sea level rise in Australia and the Pacific", *Climate Change Newsletter,* Vol. 12, pp. 7–10.

Sayemuzzaman, J.T., Ding, Y. & Griggs, D.J. (2014), "*Climate changes the scientific basis". Contribution of Working Group 1 to the third assessment report on climate change.* Cambridge: University Press, 2, 6.

Waithaka, M., Nelson, G. C., Thomas, T. S. and Kyotalimye, M. (2013), *Eastern African agriculture and climate change: A comprehensive analysis,* International Food Policy Research institute, Washington.

Walthall, L., W. P. & Naylor R. L. (2012) Prioritizing Climate change adaptation needs for food security in 2030 International journal of science 31 (9) pp. 60-71.