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CLIMATE CHANGE AND PERCEIVED CLIMATE HAZARDS: A TREND ANALYSIS IN SOUTHEAST NIGERIA

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ABSTRACT: *Current global climatic trends show a deviation from historic trends and this has necessitated this study. The paper analysed climate change trend and the perceived climatic hazards in Southeast Nigeria. Proportionate sampling technique was used to select a sample of 260 food crop farmers for the study and 232 questionnaires were returned. Secondary time series data on mean annual climate variables for a period of thirty years (1984-2014) were collected from National Root Crop Research Institute Umudike and crop output data from National Bureau of statistics. Data were analysed using descriptive statistical tools like polygon/histograms and line graphs. Also, the extent of damage by climate hazards as perceived by respondents was obtained using likert scale. The rainfall volume variation showed a very unstable pattern with high volatility over years with slightly increasing trend in the study area. Result shows that temperature is significant at 1% level of significance while rainfall volume, rainfall days, relative humidity and sunshine duration were insignificant. Rain day was characterized by unsteady rise and fall trend pattern. The trend also indicated an unsteady change in the movements of the relative humidity and sunshine levels. The result for the occurrence of climate hazards as perceived by farmers show 86.2 %, 64.68%, 63.79%, 77.82% of the respondents perceived to a great extent the impact of flooding, sea level rise, longer period of dry spell and wind storm respectively. Based on the finding, it is concluded that the damaging and devastating effects of climate change is in the increase. It is recommended therefore that adequate adaptive measures and mitigations be put in place to cushion the effect of climate change.*

KEYWORDS: Climate Change, Temperature, Rainfall, Sunshine Duration, Relative Humidity, Climate Hazards

INTRODUCTION

Climate change is a global phenomenon and is increasingly becoming a worrisome issue and a threat to humanity. Extreme weather and climate events have constituted serious threat to global economic growth over the past few years, especially to the socio-economy of developing nations (Odjugo, 2010). The Intergovernmental Panel on Climate Change (2001) observed that the earth's climate has been alternating for at least the past million years. The increase in surface temperature in the northern hemisphere during the twentieth century is considered greater than for any century in the last 1000 years. More so, statistics show the global mean surface temperature increased by 0.6±0.2°C, the number of hot days in a year increased in many places and the number of cold days decreased in nearly all land areas. In Nigeria also temperature is increasing with annual mean of about 27°C according to report by Salami and Matthew (2009).These temperature variations are believes to be precipitated by changes in atmospheric gases known as greenhouse gases (IPCC, 2007).

Greenhouse gases are a natural part of the atmosphere that, through a natural process called the greenhouse effect, trap the sun's warmth and maintain the earth's surface temperature at the level necessary to support life. The enhanced greenhouse effect, sometimes referred to as global warming, is the impact on the climate from the additional heat retained due to the increased amounts of carbon dioxide and other greenhouse gases that humans have released into the earth's atmosphere since the industrial revolution. According to National Research Council (2010), changes in climate could have significant impacts on food production around the world. Apata *et. al.*, (2009) and Nwaiwu *et. al., (*2013a.) expressed that heat stress, droughts, and flooding events may lead to reductions in crop yields and livestock productivity. This is most likely because farmers, who constitute bulk of the poor, are already facing tragic crops failure, poor livestock performances, reduced agricultural productivity and increased hunger. It is projected that crop yield in Africa may fall by 10-20% by 2050 or even up to 50% due to climate change (Food and Agricultural Organization, 2006).

According to Nwafor (2007) and Namping (2008), the impact of climate change on food supply varies significantly by region and the risk is generally believed to be more acute in developing countries. Researches have shown that Nigeria is also being plagued with devastation arising from harshness of weather (Nigerian Environmental Study/Action Team (2003), Chindo and Nyelong (2005). Odjugo (2005) specifically observed erratic pattern of weather elements in Nigeria, Odjugo 2010 reported that while temperature increased by $1.1O^{C}$ for the 105 years, rainfall decreased by 81 mm and further observed that desert encroachment, coastal inundations, drying up of surface waters and shift in crops cultivated over time were becoming common. Nigeria is considered one of the mostly vulnerable countries to climate change in the world. Her economy is dependent on climate sensitive resources, with the agriculture, forestry and fishing sectors employing up to 70% of the workforce. This all important sector is a major source of livelihood for the poor, providing them with fuel, food and fibre for sustenance. Approximately 80% of the country is already prone to floods and erosion, rendering a minimum of 20% of Nigerians at risk of severe floods, windstorms, heat waves and several other extremities and these climate events have impacted negatively on its socio-economy (Raheem, 2011).

Study Justification

Agriculture in Southeast Nigeria is largely rain-fed. It is strongly influenced by annual variations in rainfall and is highly sensitive to the vagaries of extreme weather, especially heat stress (Zabbey, 2007). Literature (Chidiebere-Mark *et al.*, 2012, Hassan and Nhemachena, 2008) consulted compared farmers perceived variation in rainfall volume and sunshine intensity and other variables with the statistical data available but none of these especially in the study area assessed the negative effect of these changes on the environment. According to Smit *et al.*, (1988), crop yield analysis estimates the effects of altered environments on crop productivity levels. Assessing climate change from this point view helps to know the scale of adaptation to employ. This is because adaptation is gradually scaling up from farmers' level adaptation to regional level adaptation strategies. This goes to suggest that there exists a wide knowledge gap in the subject matter of impact of climate change and variability on agriculture in Southeast. On this premix, this study examined the trend of climate variables over the years and how climate hazards have impacted food crop farmers in the study area. With appropriate effective adaptation practices in place, the vulnerability of these farmers to climate change will be grossly reduced. The findings from this research will provide policy makers with a better knowledge to deal with issues of

climate change. For the researchers and academics, it will provide a platform for further research in the area.

MATERIALS AND METHODS

Both primary and secondary data were sourced. For primary data, multistage sampling techniques were adopted. Three states (Abia, Ebonyi and Anambra states) were purposively selected based topography and vegetative cover. Abia has three agricultural zones and seventeen LGAs, Ebonyi has three Agricultural zones and thirteen LGAs and Anambra has four agricultural zones and twenty-one LGAs. Based on the differences in the number of agricultural zones in each State, a proportionate random technique was used to select five (5) LGAs from Abia State, Four (4) from Ebonyi State and eight (8) from Anambra State in the second stage. At the third stage, 15 communities and 48 villages from Abia, 10 communities and 43 villages from Ebonyi and 27 communities and 78 villages from Anambra state were selected. Finally 2 food crop farmers each were selected from the sampled villages in Abia and Ebonyi States while 1 food crop farmers from each selected village in Anambra State. This gave a total sample size of 260 food crop farmers (96 for Abia State, 86 for Ebonyi State and 78 from Anambra). Following Nwachukwu (2006) the proportionate sampling was based on the formula given below:

$$nh = \frac{n}{N} Nh$$

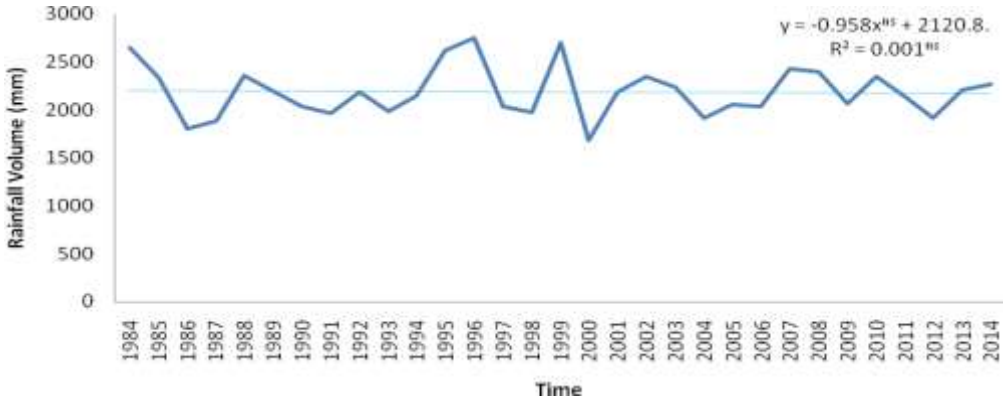
nh is the h^{th} stratum, n is the sample size, N is the population

Where = $\frac{n}{N}$ is sampling fraction

Primary data for this study were collected using of questionnaire /interview schedule. The data collected included number of occurrence and extent of climate events/hazards as perceived by the respondents. Climate data for a period of thirty years were collected from the Agro-Metrological unit of the NRCRI, Umudike.

RESULTS AND DISCUSSION

Climate Change Trend Variables



Nb: ns shows not significant

Figure 1: Trend of Rainfall variation in South East, Nigeria over the years (1984 – 2014)

The trend of the value of rainfall pattern over the time from 1984 – 2014 is expressed in figure 1. The rainfall variation showed a very unstable pattern with high volatility over years in the study area. It was about 2800mm in 1984, dropped to about 1800mm in the following year, rose to about 2200mm in 1987, but experienced unsteady rise and fall in the year after to the peak value of about 2850mm in 1996 and this movement continued with several short-lived rises in 1999, 2002, 2007, 2010 and 2014 and several interruptions of declining patterns in 1998, 2001, 2004 and 2013. The trend line has a positive trend coefficient. This indicates that rainfall volume in the area experienced slightly increasing trend. This result is substantiated with the findings of Babatunde *et al.* (2011), Onyeneke and Mmagu (2014), Nwosu *et al.* (2014) who assert that aggregate rainfall in the rainforest and coastal regions of Nigeria has not changed significantly

It could be indicated that the rainfall volume patterns were at the peaks in 1984, 1996 and 1999 and was lowest in 2000. This unsteady rainfall pattern could be due to effects of climatic change in the area as Arnell (1992) pointed out that climatic changes would result in changes in rainfall and it is consistent with the findings of Ammani *et. al.,* (2012) that rainfall distribution patterns could not be unconnected from the climate change experiences in the country.

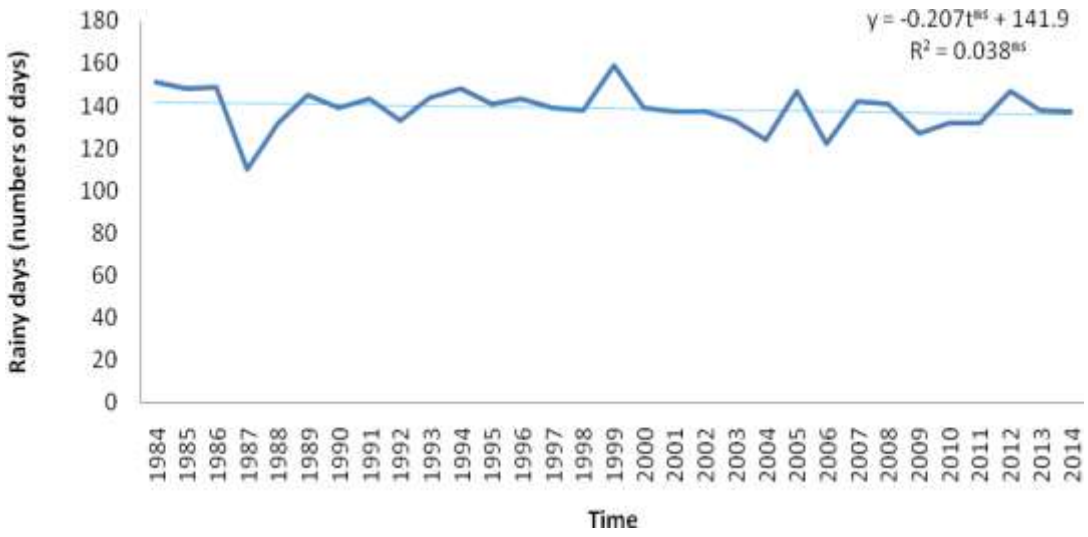
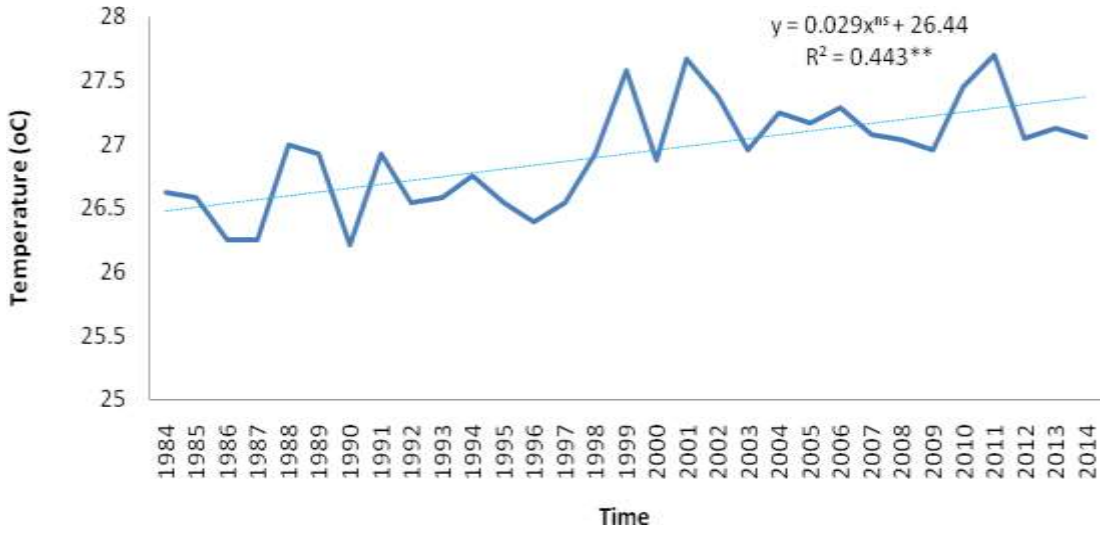


Figure 2: Trend of Rainy days variation in South-East, Nigeria over the years (1984 – 2014)

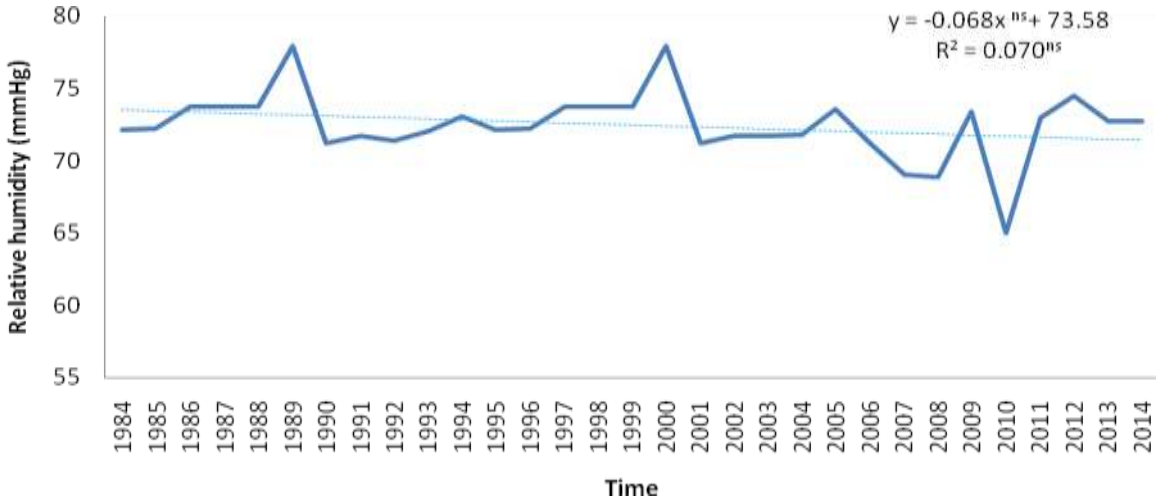
The figure 2 illustrated the rain day variation in the South East, Nigeria. In 1984, the rainy day was about 160 days in 1984, but dropped to about 100 days in 1987, only to rise to again to 145 days in 1989. The unsteady movements of rise and fall characterized rain day patterns, with the highest rain day period in 1999 and lowest in 1987. This observation indicates high volatility in the movements of rain day in the area and poses great difficulty in prediction as revealed by the insignificance of time in the rain day linear relationship with time. This result is supported by Babatunde *et al.* (2011),



*Nb: ** Significant at 1% level of probability*

Figure 3: Trend of Temperature variation in South-East, Nigeria over the years (1984 – 2014)

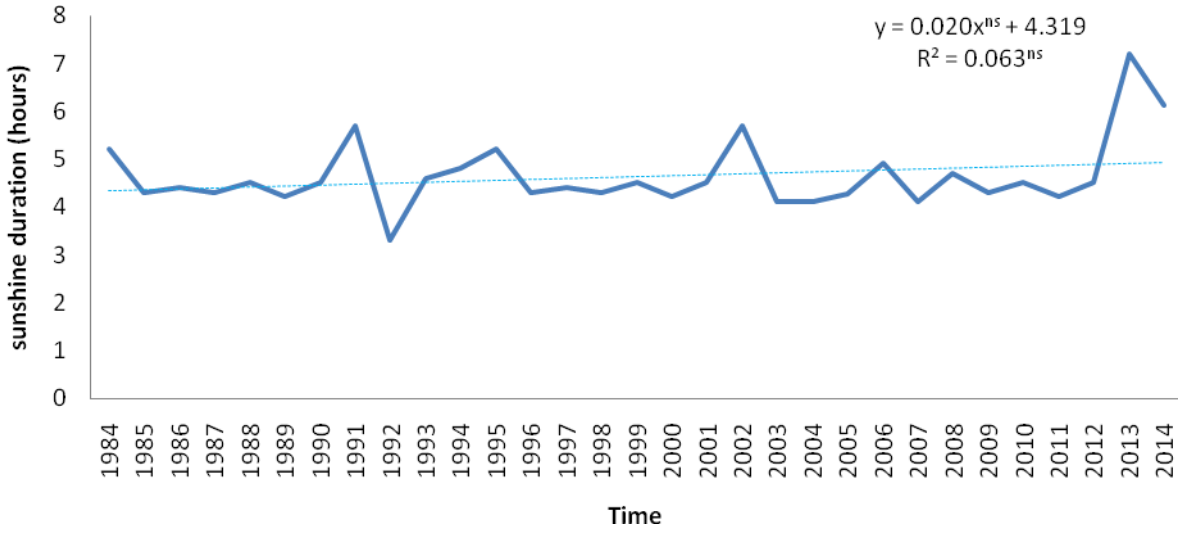
The figure 3 indicates the temperature variation for three decades in the study area. It was averaged about 26.7^{o}c in 1984, rises to 27^{o}c in 1988, 27.5^{o}c in 1999 and 2001, and 27^{o}c in 2011. The period of low temperature values were experienced in 1990, 1996 and 2009 with average temperature not falling below 26^{o}c. The positive significance of time in the temperature indicated a rising trend of temperature with time which is global warming effect of climate change. This is in line with the findings of Nwajiuba and Onyeneke, (2010), Chidiebere-Mark *et al.* (2014) and Nwaiwu *et al.*, (2013a) who observed the evidence of variation in the climate of southeast Nigeria is seen on steady increase in surface temperature.



Nb: ns shows not significant

Figure 4: Trend of Relative humidity variation in South-East, Nigeria over the years (1984 – 2014)

The figure 4 indicates the relative humidity variation in the area over three decade period. There is evident occurrence of high volatility in the trend of relative humidity over the year, with substantial fluctuations of the high humidity of about 78mmHg in 1989 followed by unsteady movements over the three decades, and a record low humidity of 65mmHg in 2010. This incidence is however unrelated with the time trend as illustrated in the line trend plot, but purely a result of climate change with its attendant uncertainty. This is consistent with the observations of Tologbonse *et. al.*, (2010); Nwaiwu *et. al.*, (2013a) who identified the changing trend of climate factors resulting from uncertainties in the climate of the country and the World in Nigeria.



Nb: ns shows not significant

Figure 4: Trend of Sunshine duration variation in South-East, Nigeria (1984 – 2014)

The figure 4.4 shows the trend of sunshine variation for the three decade period, It indicated an unsteady change in the movements of the sunshine levels, it was almost 5 hours sunshine duration per day in 1984, which rose slightly to 6 hours/day in 1991, 2002 and about 7.5 hours/day in 2013, This may be connected with rising trend of temperature as a result of global warming effect which has been the major feature in this new decade.

Forms of climate Change as perceived by Selected Food Crop Farmers in the study Area

The result shown in Table 1 reveals that, 86.2% of the respondents perceived to a great extent the incidence of flooding with weighted mean of 2.85 which exceeds the mean score of 2. Therefore, the respondents felt the impact of flooding to a great extent. According to Bhavnani et al., (2008), droughts and floods alone account for 80% of the loss of life and 70% of the economic losses in Sub Saharan Africa. The Table also revealed that 64.65% of the respondents felt the impact of sea level rise to a great extent, 34.48 of them perceived a little extent of the sea rise in the area. The weighted mean for this hazard was 2.63 was, exceeding the mean score of 2. Furthermore, Drying of streams/ponds was perceived to a little extent as a threat by 43.10% of the respondents and a percentage of 25.01% no likelihood of drying of streams and pond being a threat. This has a weighted mean of 2.07, a little greater than the mean score of 2.63.79%, 23.27% and 12.94% of the respondents

perceived longer period of dry spell to a great extent, little extent and no likelihood of threat respectively. This had a weighted mean of 2.51 and again greater than the overall mean score of 2. Frequent drought conditions have reduced the GDP growth of many African countries (World Bank, 2005a) and threatened their development gains (Hellmuth et al., 2007).

Following the same trend delay in the start of rain, heat stress and windstorm had weighted means of 2.29, 2.81 and 2.77 respectively. These results were supported by findings by Anselem et al., (2011) who posited that erratic rainfall, delay in the onset of rain, long period of dry season, thunderstorms, heavy winds, intense heat wave were on the increase. Khanal (2009) supporting this assertion noted that heat stress might affect the whole physiological development, maturation and finally reduces the yield of cultivated crop. For greater intense of sunshine all the responding food crop farmers perceived the hazard to a great extent. However, the table showed a weighted mean of 1.49 for landslide which is lower than the mean score of 3. This result may have impacted negatively on the performances of the respondents in terms of their income generation making them more vulnerable to future climatic threats.

Table 1: Perceived Forms of Climate Change by Respondents

EVENTS/HAZARDS	Great Extent	Little Extent	Not LIKELY	Mean
Flooding	200 (86.2)	30 (12.93)	2 (0.87)	2.85
Sea Level rise	150 (64.65)	80 (34.48)	2 (0.87)	2.63
Drying of streams/ponds	74 (31.89)	100 (43.10)	58 (25.01)	2.07
Longer period of dry spell	148 (63.79)	54 (23.27)	30 (12.94)	2.51
Delay in start of rain	108 (46.55)	84 (36.20)	40 (17.25)	2.29
Heat stress	200 (84.2)	20 (8.62)	12 (7.16)	2.81
Greater Intense of sunshine	232 (100)	0 (0)	0 (0)	3
Windstorm	180 (77.58)	50 (21.55)	2 (0.87)	2.77
Landslide	32 (13.80)	50 (21.55)	150 (64.65)	1.49

Source: Field Survey Data, 2015.

Climate system is indeed adversely changing based on statistical records from the meteorological center domiciled in the study area but until it is viewed through the lenses of the farmers the negative impact may not be properly addressed. These perceptions on effect of climate on the environment by food crop farmers therefore serve as a platform for addressing climate change from the right perspective.

CONCLUSION AND RECOMMENDATIONS

Agriculture is a key to economic growth and development. It is rated by most scholars as the most important sector in emerging economies, considering its role in income generation and job creation. However, changes in precipitation and temperature, driven by a changing climate, have significantly affected global agriculture in recent years. This paper analyzed the trend of some climate indicator over a period of 30 years (1984-2014) and how climate hazards as perceived by farmers have impacted on food crop production.The result showed an increase trend in temperature and rain day was characterized by unsteady rise and fall trend pattern. The trend also indicated an unsteady change in the movements of the relative humidity and sunshine levels. Based on the finding, it is concluded that the damaging and devastating effects of climate change is in the increase. This paper therefore suggests that appropriate measures be put in place to mitigate the effect of climate change in the study area.

REFERENCES

Anselm, A. E., Ignatius, I. M., Josephat, C. M., Anthony, N. O, Elizabeth, A. O and Fidelis. E. (2011) Indigenous Agricultural Adaptation to Climate Change: Study of Imo and Enugu States in Southeast Nigeria African Technology Policy Studies Network Working Paper Series No. 53: 6-23

Bhavnani, R., Vordzorgbe, S., Owor, M., and Bousquet, F. (2008). Report on the Status of Disaster Risk Reduction in the Sub-Saharan Africa Region. Commission of the African Union United Nations and the World Bank. Available from: http://www.unisdr.org/files/2229DRRinSubSaharanAfricaRegion.pdf

Ammani, A. A., Ja'afaru, A. K., Aliyu, J. A. and Arab, A. I. (2012). Climate Change and Maize Production: Empirical Evidence from Kaduna State, *Nigeria Journal of Agricultural Extension 16 (1): 1-8*

Apata, T.G., Samuel, K.D. and Adeola, A.O. (2009). Analysis of Climate Change Perception and Adaptation among Arable Food Crop Farmers in South Western Nigeria. Contributed Paper presented at the International Association of Agricultural Economists' 2009 Conference, Beijing, China, August 16-22,209.

Arnell, N.W. (1992). Impacts of Climatic Change on River Flow Regimes in the UK. *Water and Env. Management* **6**: 432-442.

Babatunde, J. A., Ayobami, T.S. and Mark, T. (2011). Developing Climate Change Scenarios: Biophysical Impacts and Adaptation Strategies in Nigeria. A final report submitted to Nigerian Environmental Study/Action Team (NEST) as part of the Building Nigeria Response to Climate Change (BNRCC) Project

Chidiebere-Mark, N.M.; C.C., Eze; O.O., Nwankwo; R.U., Onyeneke; J.C., Ukwandu; R.D., Ejike and C.O., Enyia (2014). Perception and Adaptation of Food Crop Farmers to Climate Change in Imo State, Nigeria. *Paper Presented at the 14th Annual National Conference of the Nigerian Association of Agricultural Economists*, Federal University of Technology, Akure, 24th – 27th February, 2014.

Food and Agricultural Organisation (2006): The State of Food Insecurity in the World 2006. Rome.

Hassan, R. and Nhemachena, C. (2008). Determinants of African Farmers' Strategies for Adapting to Climate Change: Multinomial Choice Analysis *Centre for Environmental*

Economics and Policy in Africa (CEEPA), University of Pretoria AfJARE 2 (1) March 2008

Hellmuth, M.E., Moorhead, A., Thomson, M. C. and Williams, A. (2007). Climate Risk Management in Africa: Learning from Practice, International Research Institute for Climate and Society (IRI), Columbia University, New York, USA

Intergovernmental Panel on Climate Change (2001).Working Group 2, Third Assessment Report Annex B: Glossary of Terms

Intergovernmental Panel on Climate Change IPCC (2007). The Fourth Assessment Report of the Intergovernmental Panel on Climate Change: The Physical Science Basis. (Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller, Editors). Contribution of the Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, pp 9-94

Khanal, R.C. (2009). Climate Change and Organic Agriculture. *The Journal of Agriculture and Environment, vol. 10 :100-110*

Namping, R. (2008). Commission on the Status of Women Gender: Perspectives on Climate Change, Fifty-Second Session New York

National Research Council (2010). Advancing the Science of Climate Change, the National Academies Press Washington DC, USA.

Nwachukwu, V. O (2006). Principles of Statistical Inference: Second Edition Zelcon Enterprises Owerri

Nwaiwu, I.U.O., Ohajianya, D.O., Orebiyi, J.S., Ibekwe, U.C., Lemchi, J. I., Onyeagocha, S.U.O., Odoemena, B., Utazi, C. O., Osuagwu C.O. and Tasie, C.M (2014). Climate Change Trend and Appropriate Mitigation and Adaptation Strategies in Southeast Nigeria *Global Journal of Biology, Agriculture and health sciences 3(1):120-125*

Nwajiuba, C. and R., Onyeneke (2010). Economic Effects of Climate on the Agriculture of sub-Saharan Africa: Lessons from Nigeria. *Paper presented at the 10th Global Conference on Business and Economics,* St. Hugh's College, Oxford University, June 28 – 29, 2010.

Nigerian Environmental Study/Action Team (2003). Climate Change in Nigeria :A Communication Guide for Reporters and Educators. Ibadan: NEST pp. 5-16.

Nwafor, J.C (2007). Global climate change: The driver ofmultiple causes of flood intensity in Sub-Saharan Africa. *Paper presented at the International Conference on Climate Change and Economic Sustainability held at Nnamdi Azikiwe University, Enugu,* Nigeria, Pp 12- 14

Nwaiwu I.U.O; Ohajianya, D.O; Orebiyi, J.S; Ibekwe, U.C; and Eze, C.C (2013a) Effects of Climate Change on Labour Time Allocation to Food Crop Production- A Case Study of Southeast Nigeria. Global Journal of Current Research. (GJCR) (CRDEEP) India 1 (4):108-115

Nwajiuba, C.U. and Onyeneke R. (2010). Effects of Climate Change on the Agriculture of Sub-Saharan Africa: Lessons from Southeast Rainforest Zone of Nigeria. Oxford Business & Economics Conference Program, June 28-29, 2010 St. Hugh's College, Oxford University, Oxford, UK.

Nwosu, C.S., Onyeneke R. U., Joshua B.N., Mmagu C.J., and Nwaodu K.T. (2014). Perception on and Adaptation to Climate Change by Farming Households in Etim Ekpo Local Government Area of Akwa Ibom State, Nigeria. *Paper Presented at the 14th Annual National Conference of the Nigerian Association of Agricultural Economists,* Federal University of Technology, Akure, 24th – 27th February, 2014.

Onyeneke, R.U. and Mmagu C.J.(2014). Crop Farmers' Understanding of Climate Change, and Adaptation Practices to Climate Change in Southeast Nigeria. *Paper Presented at the Conference in Commemoration of the 50th Birthday of Professor C.U. Nwajiuba, Held at Oak of Mamre Library, Imo State on July 19, 2014*

Odjugo P. A. O (2005). Analysis of Rainfall Pattern in Nigeria. *Global Journal of Environmental Science*, 4(2): 139-145.

Odjugo P. A. O (2010). General Overview of Climate Change Impacts in Nigeria *J Hum Ecol, 29(1): 47-55 Kamla-Raj 2010*

Raheem U. A. (2011). Climate Change Related Disasters and Vulnerability: An Appraisal of the Nigerian Policy Environment *Environmental Research Journal. 5 (3) pp 97-103*

Smit, B., Ludlow L. and Brklacich M. (1988). Implications of a global climatic warming for agriculture: A review and appraisal. *Journal of Environmental Quality* 17 (4): 519-27.

Salami, A.T and Matthew O. J. (2009). Challenges of Effective Climate Change Adaptation and Mitigation in Nigeria: The Role of Education. A paper presented at 5th World Environmental Education Congress (WEEC), May 10 -14, at Montreal, Canada

Tologbonse, E.B., Auta, S.J., Bidoli, T.D., Jaliya M.M., Onu, R.O. and Issa, F.O. (2010) Farmers' Perception of the Effects of Climate Change and Coping Strategies in Three Agro-Ecological Zones of Nigeria *Journal of Agricultural Extension* 14 (1): 125–136

World Bank (2005a). Managing Water Resources to Maximize Sustainable Growth: A Country Water Resources Assistance Strategy for Ethiopia Washington DC (2005

Zabbey, N (2007). Climate Change and Flooding: Fate of Riverine Communities in the Niger Delta. A paper Delivered on World Environment Day, Port Harcourt.