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1st World Sustainability Forum
1-30 November 2011

www.wsforum.org

Article

Impacts of Climate Variability and Change on Environment: A Case Study of Imo State of Nigeria

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Received: / Accepted: / Published:

Abstract: This is the abstract section. One paragraph only. (M_abstract).

Keywords: keyword; keyword; keyword (M_abstract)

1. Introduction

Climate variability means natural changes in climate that fall within normal range of extremes for a particular region as measured by temperature, rainfall and frequency of events.

There have been growing awareness that the earth's climate is changing at an alarming rate and the fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) affirms that climate change is no longer in doubt but is now unequivocally apparent based on evidence from scientific observations of increases in global average air and ocean temperatures (IPCC, 2007).

As variations in climate occur at the global, regional and local (Imo State for example) scales, its associated disasters are not hidden. Every rainy season in Nigeria, wind gusts arising from tropical storms claim lives and properties worth millions of naira across the country. Flash floods from torrential rains wash away thousands of hectares of farmland. Dam bursts are common following such flood. In August 1988 for instance, 142 people died, 1800 houses were destroyed and 14,000 farms

were swept away when Baguda Dam in north eastern Nigeria collapsed following a flashed flood (IPCC, 2007, onlinenigeria, 2011). Also the same year (1988), urban flooding such as the Ogunpa disaster in Ibadan, southwestern Nigeria claimed over 200 lives and damaged property worth millions of naira (onlinenigeria, 2011). The evolving climate change coupled with increasing temperature has been observed to plunge some localities into experiencing extreme weather conditions (Ayoade, 2004). Available evidences show that climate change will be global, likewise its impacts, but the biting effects will be felt more by the developing countries especially those in Africa due to their low level of coping capabilities (Nwafor, 2007).). Nigeria is one of such developing countries. Researchers have shown that Nigeria is already being plagued with diverse ecological problems which have been directly linked to the on-going climate change (Adefolalu, 2007).

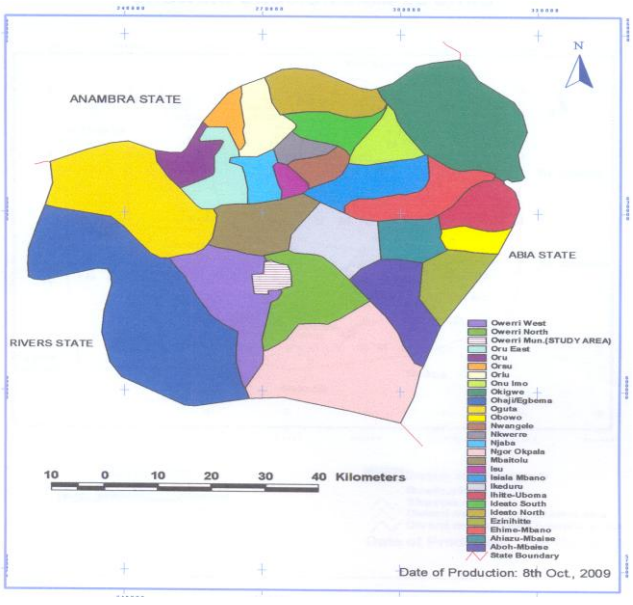
Imo State of southeastern Nigeria was not left out of the implications of climate variation and change following rainfall variability and fluctuations in temperature. Thus this study focused on impacts of the variability and change in the climate of Imo State.

2. Background Information of the Study Area

Imo State of the southeastern Nigeria is located between latitude $4^{o}45'$N and $7^{o}15'$E with an area of about 5,100sqkm. It lies within the humid tropics and generally characterized by a high surface air temperature regime year-round. Mean minimum temperature is 23.5^{o}C and mean maximum temperature is 32.1^{o}C. Two seasons, wet and dry are observed in the year. The rainy seasons begin in April and lasts till October.

The state has 27 Local Government Councils (Fig. 1) with 3 major political zones, Okigwe, Orlu and Owerri, and maintains its administrative capital at Owerri being the most populated, commercialized and industrialized city. The population of the state is about 3,927,563 with male, 1,976,471 and female, 1,951,092 (Okorie, 2010). The state is rich in natural resources including crude oil, natural gas, lead, zinc and some economic flora.

Figure 1. Map of Imo State showing her Local Government area.



Source: Field Survey, 2011.

3. Methodology

Mean monthly rainfall and monthly air temperatures (minimum and maximum) data from Owerri synoptic station between 1980 and 2009 converted to annual mean was collected from the Nigerian Meteorological Department, Lagos. Rainfall and temperature data used in this study indicates that the two parameters are key climatic variables. Also temperature was used because Afiesimama et al (1999) show that this climatic element actually determines the prospects as well as the ecological and socioeconomic problems of Nigeria. The research covers one climatic period of 30 years which provides a better platform to investigate the variability and changes in the climate systems in the study area.

The mean annual rainfall and temperature data were used to construct the rainfall and temperature charts of the state for the climatic period (Figs, 3 and 4). These were constructed using the Microsoft Power Point Software, and with these charts, the analysis of the pattern and trends of rainfall and temperature changes in the state was carried out.

Table 1. Rainfall and Temperature Data of Imo State 1980 – 2009.

Year	Total RF	Mean RF	% Mean RF (mm)	Mean Maximum Temp. ^{o}C	Mean Minimum Temp. ^{o}C	Average Temp. ^{o}C
1980	2398.2	199.9	3.4	31.57	23.31	27.4
1981	2432.7	202.7	3.4	31.56	23.17	27.4
1982	2404.3	200.4	3.4	31.53	23.08	27.3
1983	1557.9	129.8	2.2	32.26	23.68	28.0
1984	2153.2	179	3.0	32.15	23	27.6
1985	2396.1	199.7	3.4	31.45	23.14	27.3
1986	2482.9	206.9	3.5	31.54	23.08	27.3
1987	2075.5	173	2.9	32.58	23.35	28.0
1988	2563.7	213.6	3.6	31.82	23.54	27.7
1989	2581.5	215	3.6	31.87	22.89	27.4
1990	2961.3	246.8	4.2	31.81	23.72	27.8
1991	2567.4	210.6	3.5	31.56	23.45	27.5
1992	2424.1	202	3.4	31.72	22.91	27.3
1993	2182.8	181.9	3.1	31.73	22.98	27.4
1994	2626	219	3.7	31.75	22.26	27.1
1995	2622.3	219	3.7	31.89	22.36	27.2
1996	2705.5	225	3.8	32.47	23.04	27.8
1997	2891.4	241	4.1	32.28	23.47	28.0
1998	1640.1	136.7	2.3	33.13	23.64	28.4
1999	2515.4	209.6	3.5	31.84	23.65	28.0
2000	2337.2	195	3.3	32.18	23.63	28.0
2001	2304.3	192	3.2	32.34	23.81	28.1
2002	2053.7	171	2.9	32.29	23.73	28.0
2003	2327.8	194	3.3	32.37	24.13	28.3
2004	1762.3	147	2.5	32.38	28.89	30.7
2005	2236.6	186.4	3.1	32.8	24.1	28.5
2006	3209.1	267	4.5	32.9	24.3	28.6
2007	2361.6	197	3.3	31.72	22.15	27.0
2008	2470.2	205.9	3.5	32.68	23.71	28.2
2009	2092.8	174.4	2.9	31.53	22.65	27.1
		6110.5				

Source: Field Survey 2011
Source of Data: NIMET 2011, Lagos, Nigeria

4. Results and Discussion

This study established that there is a variability and change in the weather and climate system of Imo State and the entire Southeastern Nigeria as observed even at global scale. For example the mean average rainfall in table 1 from 1980, to 1982 was the same 3.4% but in 1983, there was sharp decline in rainfall with the mean 2.2%, but in 1984 it increased to 3.0%, 3.4% and 3.5% in 1985 and 1986 respectively. In 1987 it dropped to 2.9% and rose to 3.6% in 1988/89 then in 1990 it rained heavily with 4.2% and dropped to 3.5% in 1991, and remained high for 7 years till 1998 when it declined to 2.3% and the next year 1999 it moved to 3.5% and remained high above 3.0% throughout, except in 2002 with 2.9%, 2004 with 2.5% and in 2009, 2.9%. The data on the table 2 shows that the temperature remained steadily high throughout the 30 years under study and varied (27.0-30.7) from the least average of 27.0^{o}C recorded in 2007, followed by 27.1^{o}C average recorded in 1994 and in 2009, then in 1995 the average temperature was 27.2^{o}C. The rest years were very high in average surface air temperature but the highest was recorded in 2004 being 30.7^{o}C (Table 1 and Figure 2).

However, this research ascertained from its findings that the fluctuations in temperature regime and the variations in rainfall over the state within the period under study have shown some evidences of the variability and change in the climate of the area with regards to the negative impacts the shifts in the observed climatic parameters has created on both the natural landscape and the human beings. Example of this impact is shown by part of Ikenegbu road and works layout road in Owerri Urban destroyed by gully due to excessive rainfall (Figure 3). A recent study shows that about 16% of the erosion in Owerri Municipal of Imo State is caused by rainfall (Maduka, 2009). Figure 4 also shows coastal erosion with siltation in River Nworie in Owerri, Imo State as one of the impacts of climate change. This study also reveals that some people are currently displaced and buildings abandoned for about 7 years ago in Umuna area of Orlu Local Government of the State due to flooding and flood disasters following excessive rainfall (Figure.5).

This study also explained that increased diseases vectors such as mosquitoes which transmit malaria parasites can also be influenced by the variability in climate. Rainfall and high surface air temperature can cause high rate of mosquito breed and bite. For instance, information from Occupational and Epidemiological Unit, Primary health care division, Ministry of Health, Owerri, Imo State shows that in 2003 mean annual rainfall was 194mm, with high average temperature of 28.3^{o}C and malaria case was 75.8. In 2006 rainfall was very high with 267mm and temperature also increased by 0.1, then both increase attracted malaria case to 159.6 due to high rate of mosquito breed, this indicates that during the rainy season mosquitoes breed and bite at high rate and with increase in temperature (global warming) due to lack of power supply in Imo State, people are likely to be exposed to mosquito bites thereby contacting malaria parasites.

Figure 2. 30 years Average Temperature and Rainfall Variability Curve in Imo State.

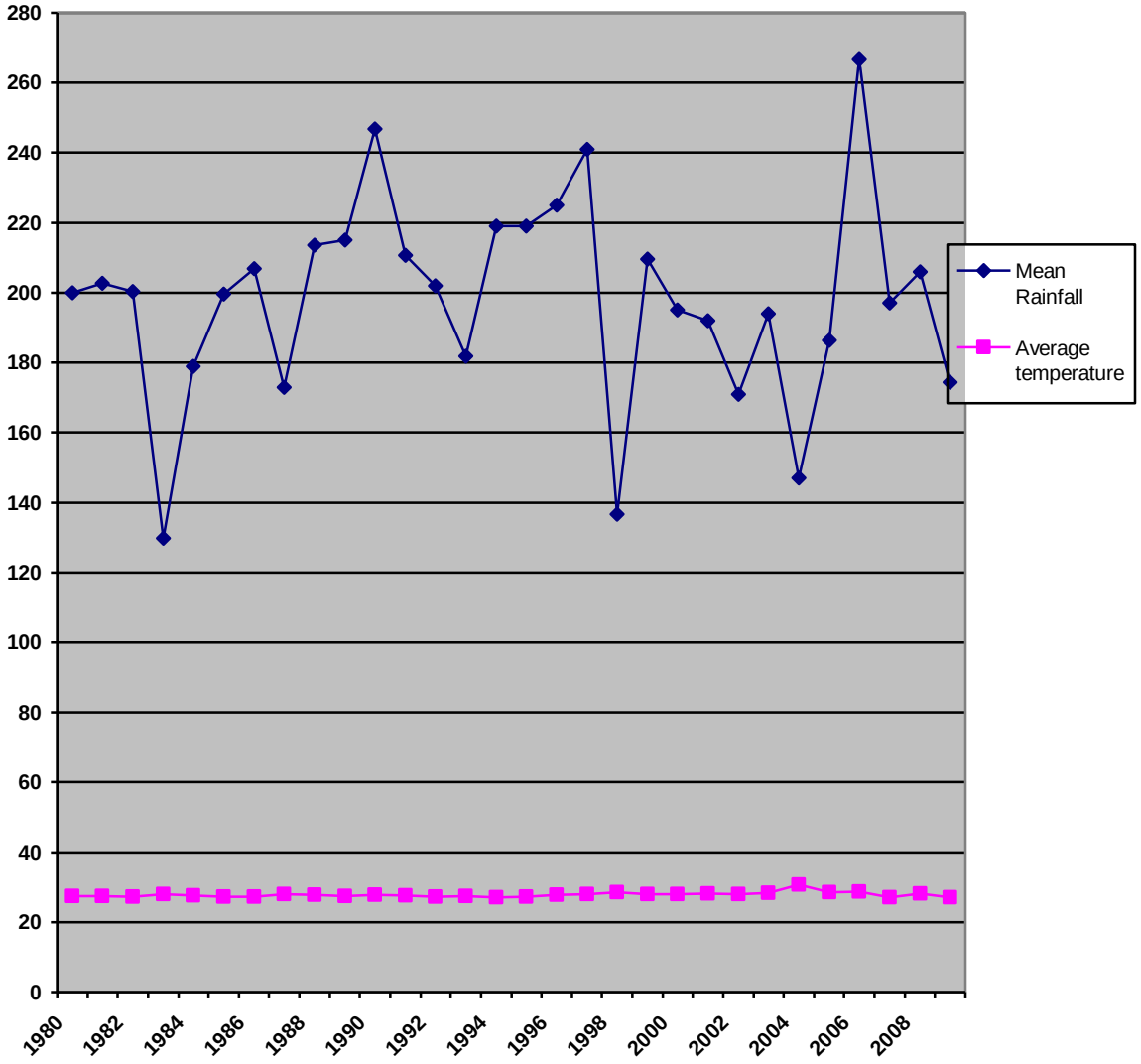


Figure 3. Ikenegbu road in Owerri, Imo State destroyed by gully erosion.

Figure 4. Coastal Erosion with siltation in Nworie River in Owerri, Imo State.

Figure 5. Abandoned Building destroyed by flood, in Umuna Orlu, Imo State.

5. Conclusion

The earth's history has shown that climate variation and change are components of inevitable planetary dynamics (Schneider, 1992 and Corell, 2006). The earth has experienced cycles of temperature and precipitation changes on a geological scale. As WMO (1979); Ojo (1987) and Nnaji (1998) have observed, it is certain that climate must change or vary over time. The overlying mechanism for the various changes in weather and climate system is related to restless atmospheric processes, which are always in a delicate state of equilibrium. Although some historical changes in climate have resulted from natural causes and variations, the strengths of the trends and the patterns of change that have emerged in recent decades indicate that human influences, resulting primarily from increased emission of CO_2 and other green house gases, have now become the dominant factor (Njoku, 2007). The rate and amount of these changes, their consequences on temporal and spatial patterns, are at present source of major concern to atmospheric scientists and allied researchers.

Imo State, southeast region, Nigeria and indeed other parts of the world have experienced climate variations and their consequences (see for example, Ojo (1987), Obioh (2002) and Muanya (2003).

Also Nnaji (1998) reported that variations in rainfall intensified for the different climatic regions and individual locations in Nigeria in the last three decades of the last century. Deforestation has triggered soil erosion in the state, which is compounded by heavy seasonal rainfall that has led to the destruction of houses and roads (see Fig. 3). Coastal erosion, flooding and flood disasters (including diseases and epidemics), land slides and land degradation and other climate related disasters are common place events in the area.

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