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CLIMATE CHANGE GLOBAL WARMING EFFECTS AND IMPLICATIONS IN WARRI, NIGERIA

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ABSTRACT: Climate change phenomenon has negative impacts which are expected to intensify existing environmental problems and create new combination of risks with attendants factors of wide spread poverty, overdependence on rainfall and rain-fed agricultural practices, inequitable land distribution, limited access to capital and technology, inadequate public infrastructure (rail, roads),lack of long term weather forecast, damages to health sector; paucity of researches and increasing incidence of death and other critical environmental health challenges. There has been a steady rise in carbon dioxide content of the global atmosphere over recent years. At one time it was thought that this was due to the increasing use of fossil fuels but it now believed that only about half of the observed increased in carbon dioxide is attributable to this cause, the remaining 50per cent being due to the distruction of the world's forests especially Warri and environs and release of the massive amounts of carbons previously stored in their wood. The increasing global warming as experienced in Warri is largely due to human activities resulting from oil and gas production, transportation and industrial uses in Warri and its environs. Deforestation resulting from exploitation of timber for export and agricultural intensification is a major cause of increase in carbon dioxid. Warri is now experiencing an induced micro climate change. The various greenhouse gases notably carbon dioxide and nitric oxide manifest unusual high abnormities in temperature and heat. Data in this study were acquired from Nigerian Meteorological Agency Station at Warri. These are five year span record (2011-2015). These secondary sources of data on climatic variables include radiation, temperature, precipitation, relative humidity and evaporation. Temperature data, radiation derived heat were plotted with line graph and indicated increasing yearly trend in Warri to support global warming phenomenon. Data collected from secondary sources in this research include textbooks, journals, and Internet services are also used for the research work. The research warming impact resulted from anthropogenic activities of farming, bush burning, deforestation, Gas flaring and burning of oil to propel machines and vehicles. These activities release carbon dioxide ($C0_2$) the atmosphere. $C0_2$ contributes a greater percentage of heat than any other gases in the greenhouse effect. The major findings establish a consistent and persistent increase in temperature and heat in Warri metropolis due to greenhouse effect (heat trap by the atmosphere) and consequent warming across the globe. The oral interview are data collected from General Hospital, Warri specified sicknesses such as cholera, typhoid and yellow fever, acute headache, skin, kidney disease, heart, still birth and, kidney, challenges were listed in the interview response The micro - climate change in the study area is a pointer to the dwindling agricultural productivity in crops such as cassava, yam, cocoyam, potatoes and fish according to farmers and fishermen interviewed.

Key words: Climatic Change Effect, Greenhouse Gases, Global Warming, Radiation and Heat Energy.

I. INTRODUCTION

There are different climatic conditions prevailing and experienced in different areas of the world with significant variations in climate resulting in different micro-climatic types. Much debate still surrounds climate change in developing world and is globally amongst the most vulnerable contexts in which to confront climate variability (Guilermo and Paulo,2019).

Arthur et al (2004) reported that at approximately about 65 million years ago, a sudden cooling of the earth climate occurred, this is thought to be responsible of the disappearance or extinction of some 75% of existing floral and faura species. On the contrary, Cetis (2004) documented a pronounced warming trend, which began about 1880 in which global temperatures have been slowly rising. In addition it has been noted, reported that, the 20th century is the warmest century for the past 600 years, and the 1990's recorded, the hottest decade of the century.

In this context, Warri and its environment witness high heat and temperature that is becoming relatively unbearable and this is attributed to emissions of gases that trap heat energy in the atmosphere. According to Okebukola (1997), the total quantity $C0_2$ in the earth's atmosphere remained nearly constant until the 20th century, when the consumption of fossil fuels by automobile and for household uses (generators, stoves, etc) such as coal, fuel oil, petrol, kerosene, diesel and natural gas to release large quantities of carbon dioxide into the atmosphere. The greenhouse effects theoretically explain the accumulation of carbon dioxide, ozone.

Nitric oxide and other rare gases in the atmosphere, which prevent heat from radiating out into space. This is evident in Warri industrial city, where the daily human activities such as Oil and Gas Petroleum Refineries, have increased the amount of greenhouse gases in the atmosphere. Anthropogenic activities such as use of fossil fuel, gas flaring, massive deforestation and agricultural intensification are the major contributors to global warming and greenhouse effect in Warri, the study area.

Ayoade (1993) Fellow of the Royal Meteorological Society observed that the opaqueness of the atmosphere to infrared radiation relative to its transparency to short wave radiation is usually referred to as the greenhouse effect.

II. STATEMENT OF THE PROBLEM

Carbon dioxide is the essential primary greenhouse gas, whose volume is increased daily by human activities in the area located in the Niger Delta. It occurs naturally with excessive quantities of it from gas flaring for which the oil companies are noted for notoriety of flaring more than 95 of gas production.

(Friend of the Earth (2004) attributed greenhouse effect burning of fossil fuels/petroleum and natural gas in large volume to power machines in the industries and for driving vehicles. The combustion of fuels release carbon dioxide and water vapor. Warri forests have witnessed much deforestation through processes of logging, mineral exploration, oil spillage, clearing of vegetation for industrialization and urbanization. The greenhouse effect is more serious in an area when there are fewer plants to use carbon dioxide for photosynthesis to release oxygen. Bush burning releases Carbon dioxide to the atmosphere at an accelerated rate.

Carbon dioxide contribution to global warming is about 65% relative to other gases. Nitrous oxide for example, has 360 capacity times that of CO2 to trap heat, and methane is 24 times more potent than $C0_2$ in absorbing heat close to the earth. In light of the above, there is need for evaluating the trend of temperature, radiation and warming heat in the area and the possible effects and damages caused from the past. Furthermore, several diseases in the area are related to global warming effects. This study seeks to find solutions to the serious health challenges.

On global warming, environmental scientists agreed on certain consequences that could be avoided such as a warmer temperatures could cause ocean waters to slightly expand (thermal expansion) with devastating impacts. In addition, it hae been projected to cause increases in severity and frequency of global climatic change effect, with extreme weather conditions and related environmental disasters; such as heavy downpours, floods, hurricanes, heat and other negative effect experienced in soils and vegetation, a likely loss in biodiversity as vulnerable species are pushed to extinction, increases in water pollution as flooding contaminates water supplies with salt, raw sewage and animal carcasses.

There could be increases in respiratory illnesses due to higher ozone level; spread of common diseases; malaria, encephalitis and dengue fever. The warmer water weather conditions widen the range of disease carrying insects.

III. AIM AND OBJECTIVES

The aim of the study is to establish the trend of heat energy, radiation and temperature due to human activities (especially burning of fossil oil and gas flaring) in precipitating micro warming in Warri micro climate area using data that span for a period of five years (2011-2015). The aim would be achieved by examining the following objectives:

i.The causes of global warming (the greenhouse gases) in Warri and its environs.

ii. To present the extent of effects and possible damages inflicted on lives by continuous warming on the environment.

iii. To proffer solution to the problem in the area.

IV. STUDY AREA

Warri is located in Delta State Nigeria. It. is referenced at an intersectional point reference of latitude 5° 30'N and longitude 5° 45'E. It is situated along the Coast of Warri River in Warri South Local Government Area. (Figure 1a). The area experiences humid tropical equatorial climate with annual rainfall between 2500-

3000mm. Most of the rain falls during the long period of wet (rainy) season lasting from February to October with short August break (August hiatus).

The area witnesses double maxima rainfall with the first occurring when the South Easterlies is experienced in July and the other in September. The coastal location with attendant influence of monsoon wind, land and sea breezes and convectional rainfall characterized by lightning and thunderstorm, makes it possible that no month of the year is completely dry. The periods correspond with the passage of the inter-tropical discontinuity zone (ITD) which generates tropical continental (CT) air mass and tropical maritime (MT) air mass that blows North and South of the Equator. The dry season begins in November and ends at the beginning of February. The North East Easterlies wind (Harmattan} of extreme dry condition, does not exert sufficient influence on the climate of Warri. Hence, the Harmattan period lasts for only few weeks in December for which no rainfall is experienced during this period. The annual range of temperature fluctuates between 28-350C. Warri is located in the fresh water swamp vegetation belt. The vegetation is evergreen and water logged as most areas lies below sea level due to the heavy rainfall for attendant wetland found in most areas.

However, a significant part of the original forests have cleared for farming and timber exploitation resulting in secondary derived vegetation. The, flora diversity includes several species of the mangrove, oil palm, tropical hard wood such as Iroko, Mahogany, Opepe and many associated while the fauna diversity included species of mammals, birds, fish and invertebrates.

Conceptual Framework

The basic physical concepts relevant to greenhouse effect adopted for this study is, Plancks and Wein's radiation law of Green House effect. i. Green House effect.

The greenhouse effect theoretically explain the accumulation of carbon dioxide, ozone and other gases in the atmosphere to prevent heat from radiating out into space Ayoade (1993) (a fellow of the Royal Meteorological Society observed that the opaqueness of the atmosphere to infrared radiation relative to its transparency to short wave radiation, is usually referred to as the greenhouse effect. .

Planck's Radiation Law

According to quantum physics, the energy of an electromagnetic (EM) wave is quantized. i.e it can exist only in discrete amount. The basic unit of energy for an EM wave or energy of radiation is called photon. The energy of radiation.

According to Planck, the energy of radiation is proportional to the frequency of the wave generated by the radiation.

Thus Q=hv…………………(1)
Where Q = Radiation Energy
h = Planck's constant which equals 6.626 x 10-23 Joule second
v = Radiation frequency

The Wein's radiation law
The electromagnetic radiation (EMR) is to proportional to temperature (T). Heat energy has direct relationship with Q, and the values are used for T evaluation using Planck equation.

V. LITERATURE REVIEW

The United Nations Intergovernmental Panel on Climatic Change (IPCC), a group of 2000 scientists (physicists, geochemists, geographers, oceanographers, botanists, limnologists, paleontologist, and meteorologist) around the world was established in 1988, to study global warming and make recommendations. Several panel reports IPCC (1995, 1996, 1998, 2005, and 2007) amongst others were set up that specified climate variability change backed up with viable data change presentation.

The 1995 panel was on impacts adaptations and mitigation of climate change based on technical analysis as contribution to assessment report of the intergovernmental panel on climate change and the IPCC (1996) was on predicted regional impact of climate change assessment of vulnerability, the 1998 0n adaptation and vulnerability and IPCC (2007) and other UN Assemblies on climate change, include (China (2011), USA (2018), Germany (2018) and USA (2019). In 2001, the IPCC released its third assessment report, which projected a probable temperature increase of at least 1.4°C (2.5°F) by 2100. Under its 'worst case' scenario, the increase would be 5.8°C (10.4°F). It is established that, greenhouse effect occurs when there are increased CO_2 plus trace gases such as methane and nitrogen and this has led to a global climate warmer than any experienced in human history. Also, the additional anthropogenic greenhouse gases have been introduced into the atmosphere, increased infrared (IR) energy absorbed by the atmosphere, thereby exerting a warming influence on the lower atmosphere and the surface of the earth.

According to Miller (1999) on the greenhouse effect, was first proposed by a Swedish Chemist, Svante Arrhenius in 1896 and confirmed by numerous laboratory experiments and atmospheric measurements. It is therefore one of the most widely accepted theories in atmospheric science today. The young scientist, (1994) illustrated the phenomenon just like the panes of glass in a greenhouse, the earth let in infra-red radiation from the sun (due to depletion of Oxone layer) and the green house ashes) prevent it from escaping, making the climate inside a greenhouse hot. The earth's atmosphere invariably lets in sunlight and then traps the heat near the surface of the earth. This is greenhouse effect experienced in the earth. In effect. the earth's atmosphere behaves like the greenhouse and the surface of earth absorbs most of the radiation, reemitting it as infrared radiation, absorbed by ozone, Carbon dioxide, Nitric Oxide, Water Vapour and cloud in the atmosphere. It further explains that at night, the absorption of the radiation prevents the temperature form falling rapidly after a hot day, especially in regions with high atmospheric greenhouse gases content. Briffa et al (1998) posited that, several recent proxy temperature reconstructions have suggested global warming in the 20th century, is greater than any seen in the past 400 to 600 years and perhaps in 1200 to 1500 years.

A completely independent estimate based on analysis of subsurface (borehole) temperature measurements, supports the unusual character of the recent global warming in the last five centuries. Kattenberg et al (1996) stated that most model simulations of Earth's climate indicate that an increase in the atmosphere concentration of greenhouse gas will lead to increase in average surface air temperature of the globe. Strahier and Strahler (1983) stated that a significant fraction of ground radiation absorbed by the atmosphere is re-radiated back towards the earth's surface, a process called counter radiation.

Adger (2003) Batina (2006) Lema and Majule (2009) presentations on climate change in developing world, spelt out adaptation strategies in various sectors of livestock, Agriculture with its water vapour and carbon dioxide that blankets the return heat to the earth. Comhu and Malcom (2000) on effects of Global Climate on Agriculture concentrated on possible physical effect of climate change noted such changes in livestock and crop yield as well as the economic consequences of these potential yield changes to be dwindling or on negative turn of events. This made recommendation concerning the role of human adaptations in responding to climate change, possible regional impacts on global agricultural system and potential changes in pattern of food production and prices in developing countries. Akainagbe and Irohibe (2010) in their review work noted the tendency of climate change intensification of existing problems and create new combination of risk in particular in Africa. It also reviewed agricultural adaptation strategies adopted by farmers in different countries in African to cushion the effect of climate change.

Guilermo and Paulo (2019) writing on approaches to climate change and health in Cuba stated that, the US National Institute of Health predicted climate change will result in additional 250,000 deaths between 2030 and 2050 with damages to health loosing $2-4 Billion by 2030. They further developed climate change evidence base, set policy priorities and designed mitigation and adaptation actions specifically to address climate change and its effects, with well designed and implemented strategies for disaster risk reduction in Cuba. That much debate still surrounds climate change in Cuba's ecosystem. These are amongst the most vulnerable contexts in which to confront climate variability. Since 1990, Cuba has launched its research work on Climate Change.

Data Collection

The secondary data used for this research are collected documented reports of Nigerian meteorological (NIMET) Agency, Warn Station, Nigeria. (Appendix I) The five-year record temperature rainfall, radiation, evaporation, and relative humidity in Warri metropolis as recorded by the Nigerian Meteorological Agency Warri Station, between 2011 and 2015. Report on Data It is established that the average weather value for a month is considered incorrect (not suitable and not calculated for), if more than 3 days meteorological data are not used or omitted. Reasons attributed for
missing data include:

i. There was Nigeria Labour congress (NLC) strike from - 4th July 2013, hence there is no average record for that month.
ii. There is no record for August 2013 due to the ethnic crisis in Warri between 18th and 22' of that month.
iii. Record for December 2013 is said to be withheld by the Lagos NIMET Agency Office hence, it is also not available for the records.
iv. There was NLC strike from 11th - 14th October, 2014, hence there is no average record for the month.

Data Presentation

The data collected for the climate variables are shown in Table 1 (Temperature), Table 2. (mean Radiation) and Table 3 (Heat Energy) are relevant to this research work. The line graph (Isothem) (Fig 1a-1e) show increased yearly trend values.

Table 1.0: Mean Monthly Temperature in ^{0}C (2011-2015)

Year	Jan,	Feb.	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Range
2001	29.3	29.9	30.3	30.7	30.3	26.7	29.2	28.3	28.4	28.8	29.6	30.2	4
2002	29.6	28.9	30.4	30.4	30.3	29.6	29.2	28.2	28.5	28.6	29.3	29.7	2.2
2003	29.4	30.5	30.9	30.6	30.5	29.7	-	-	28.6	29.3	29.7	-	2.3
2004	29.5	24.4	30.9	30.6	30.2	29.4	28.3	27.5	30.4	-	27.3	28.1	6.5
2005	26.4	29.5	28.4	28.4	27.2	26.7	25.5	26.4	27.4	27.4	29.2	28.6	4

Temperature graphs of Warri (2011-2015)

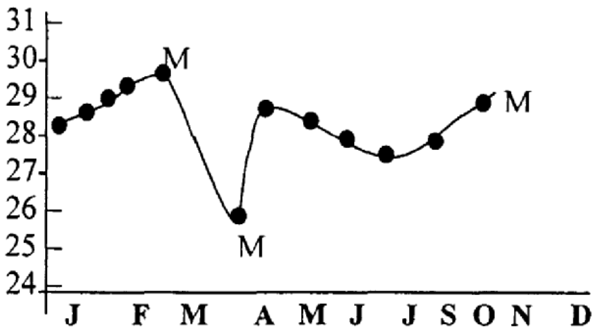

Fig: 1.0a Temperature graphs of Warri (2011)

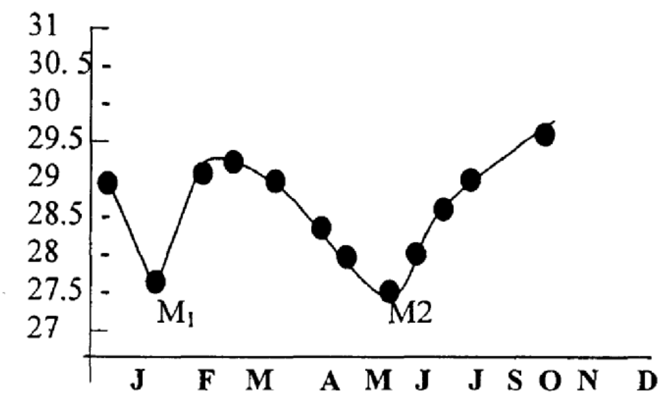

Fig: 1.0b Temperature graphs of Warri (2012)

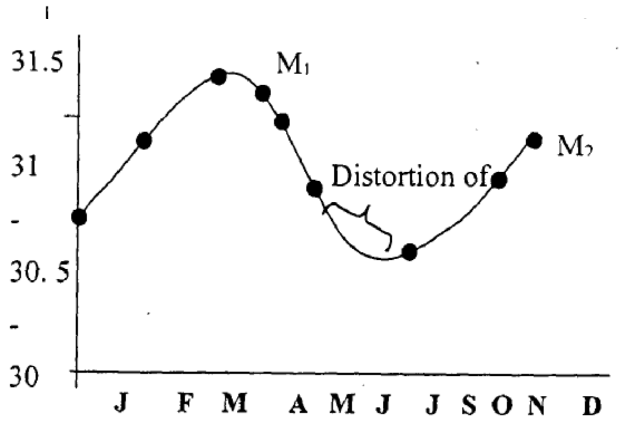

Fig: 1.0c Temperature graphs of Warri **2013**

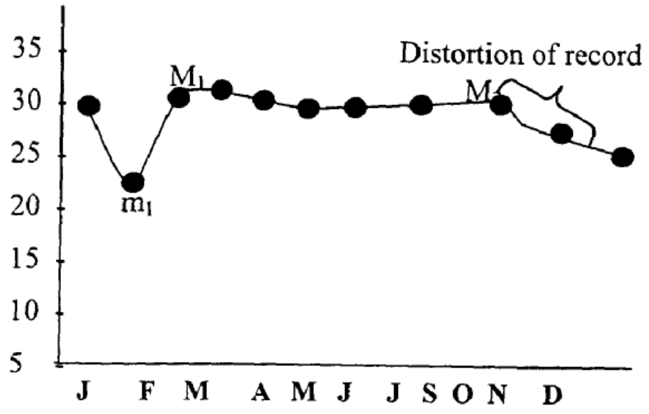

Fig: 1.0d Temperature graphs of Warri 2014

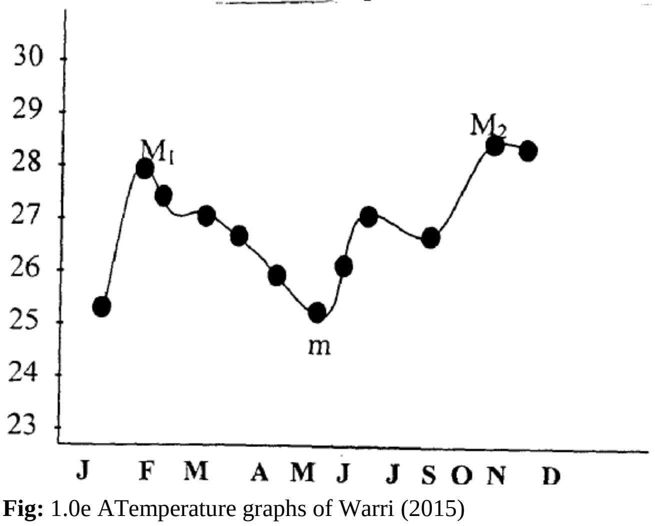

Fig: 1.0e ATemperature graphs of Warri (2015)

Table 3.3 Mean radiation heating rate (in K/y) of Warri (2011-2015)

Year	Jan,	Feb.	March	April	May	June	July	Aug	Sp	Oct	Nov	Dec	Range
2001	12.1	13.6	14.0	15.2	14.3	12.6	10.5	7.2	9.5	12.3	13.5	13.4	8
2002	12.2	14.5	13.0	14.3	14.9	13.2	11.4	9.7	11.3	12.3	13.9	14.9	5.2
2003	14.0	14.7	14.5	16.0	15.5	11.5	-	-	10.7	14.2	14.0	-	5.3
2004	12.5	15.0	16.0	15.7	14.3	13.5	10.0	10.4	13.6	-	14.6	14.0	6
2005	13.3	15.8	15.3	15.4	15.5	12.6	9.7	12.4	13.1	12.6	14.9	13.2	6.1

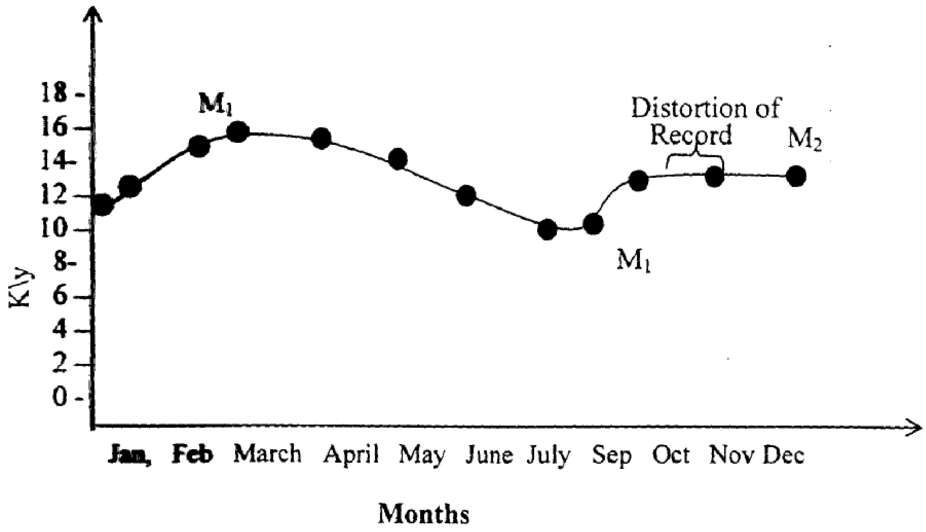

Fig. 2.0d: A radiation graph of Warri, 2014

TABLE .2.1: yearly radiation heat rate

Year	**2001**	**2002**	**2003**	**2004**	**2005**
Radiation Rate (K/y)	12.35	13.00	13.45	13.60	13.70

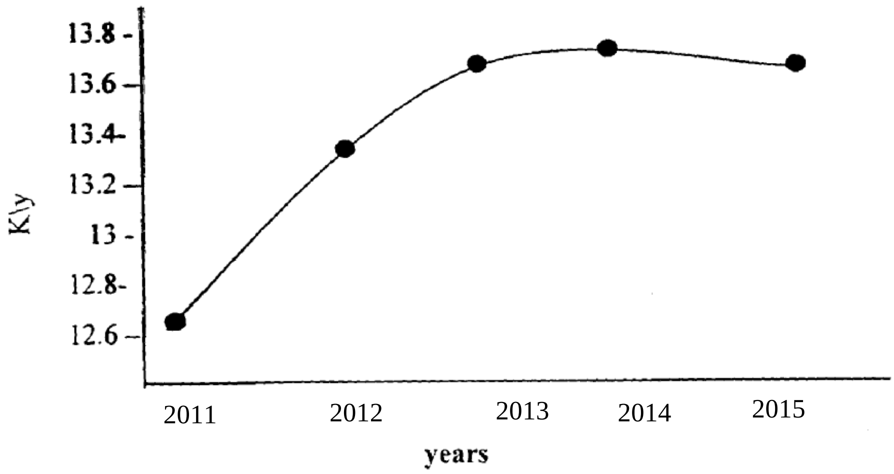

Fig. 2.0f: A graph of Warri showing radiation increase for the five years

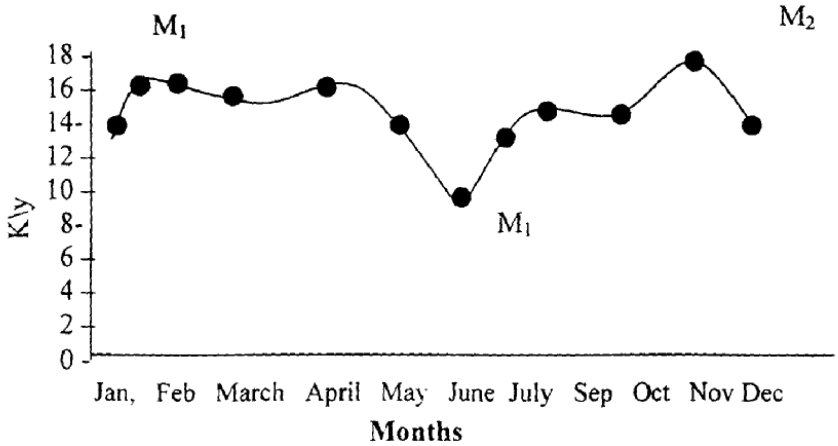

Fig. 2.0e: A radiation graph of Warri, 2015

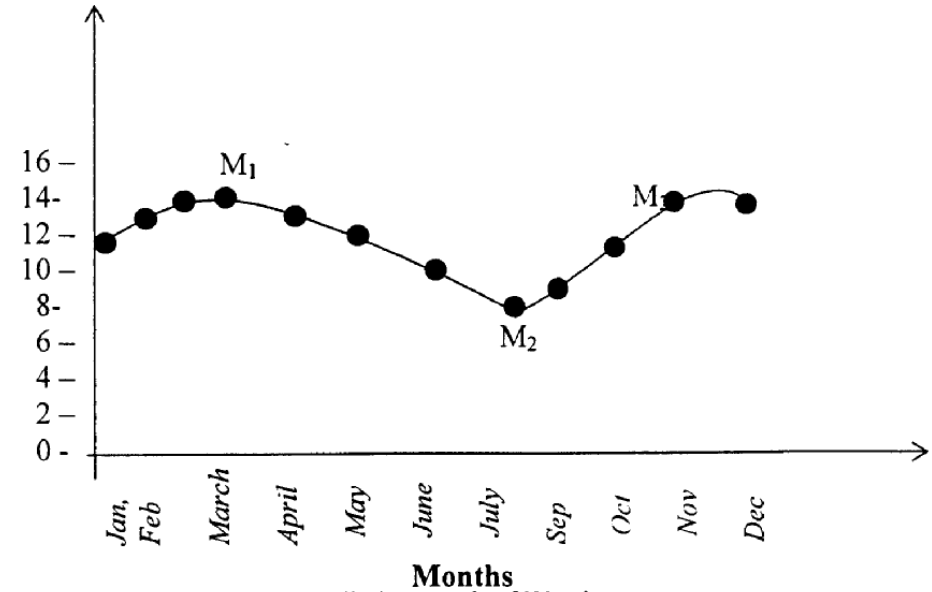

Fig. 2.0a: A radiation graph of Warri 2011

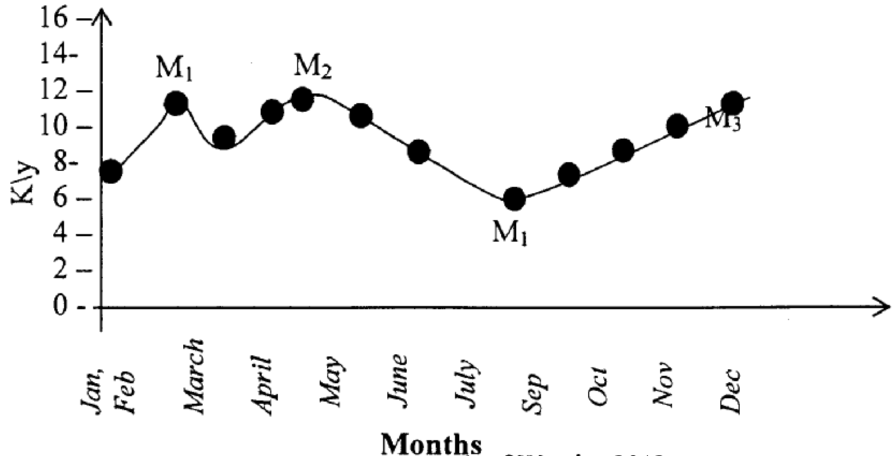

Fig. 2.0b: A radiation graph of Warri, 2012

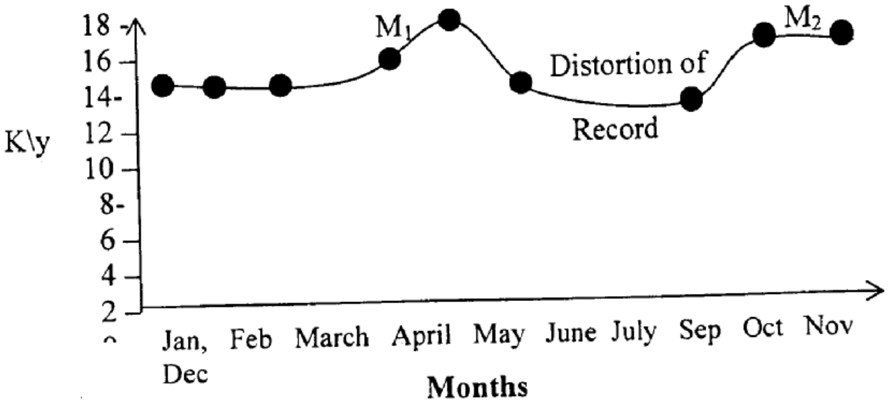

Fig. 2.0c: A radiation graph of Warri, 2013

Table 3.0a The heat generated (in Joules/second), 2001

Months	Jan,	Feb.	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Radiation Freq. (v)	12.1	13.6	14.0	15.2	14.3	12.6	10.5	7.2	9.5	12.3	13.5	13.4
Planck's Constant(h)	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}
Radiation Energy	8.02×10^{-33}	9.01×10^{-33}	9.28×10^{-33}	1.01×10^{-33}	9.48×10^{-33}	8.35×10^{-33}	6.96×10^{-33}	4.77×10^{-33}	6.29×10^{-33}	8.15×10^{-33}	8.95×10^{-33}	8.88×10^{-33}

Table 3.0b: The heat generated (in Joules/second), 2002

Months	Jan,	Feb.	March	April	May	June	July	Aug	Sp	Oct	Nov	Dec
Radiation Freq. (v)	12.2	14.5	13.0	14.3	14.9	13.2	11.4	9.7	11.3	12.3	13.9	14.9
Planck's Constant(h)	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}
Radiation Energy	7.64×10^{-33}	9.01×10^{-33}	8.14×10^{-33}	8.95×10^{-33}	9.33×10^{-33}	8.26×10^{-33}	7.14×10^{-33}	6.07×10^{-33}	7.07×10^{-33}	7.70×10^{-33}	8.70×10^{-33}	9.33×10^{-33}

Table 3.0c: The heat generated (in Joules/second), 2003

Months	Jan,	Feb.	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Radiation Freq. (v)	14.0	14.7	14.5	16.0	15.5	11.5	-	-	10.7	14.2	14.0	-
Planck's Constant(h)	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}
Radiation Energy	8.76×10^{-33}	9.20×10^{-33}	9.08×10^{-33}	1.00×10^{-33}	9.70×10^{-33}	$7..20 \times 10^{-33}$	-	-	6.70×10^{-33}	8.89×10^{-33}	8.75×10^{-33}	-

Table 3.0d: The heat generated (in Joules/second), 2004

Months	Jan,	Feb.	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Radiation Freq. (v)	12.5	15.0	16.0	15.7	14.3	13.5	10.0	10.4	13.6	-	14.6	14.0
Planck's Constant(h)	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}
Radiation Energy	7.83×10^{-33}	9.39×10^{-33}	1.00×10^{-33}	9.83×10^{-33}	8.95×10^{-33}	8.45×10^{-33}	6.26×10^{-33}	6.51×10^{-33}	8.51×10^{-33}	-	9.14×10^{-33}	8.76×10^{-33}

Table 3.0e: The heat generated (in Joules/second),2005

Months	Jan,	Feb.	March	April	May	June	July	Aug	Sp	Oct	Nov	Dec
Radiation Freq. (v)	13.3	15.8	15.3	15.4	15.5	12.6	9.7	12.4	13.1	12.6	14.9	13.2
Planck's Constant(h)	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}	6.626×10^{-34}
Radiation Energy	8.33×10^{-33}	9.89×10^{-33}	9.58×10^{-33}	9.64×10^{-33}	9.70×10^{-33}	7.89×10^{-33}	6.07×10^{-33}	7.76×10^{-33}	8.20×10^{-33}	7.89×10^{-33}	9.33×10^{-33}	8.26×10^{-33}

The total heat generated (joules/sec) table 3.0 (a-e)

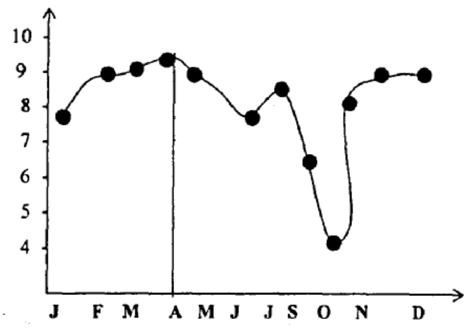

Fig 3.0a: A line graph showing heat generated in 2001.

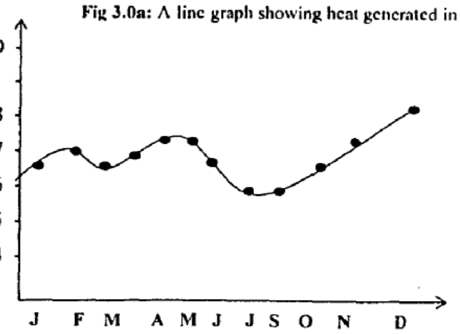

Fig 3.0b: A line graph showing heat generated in 2002

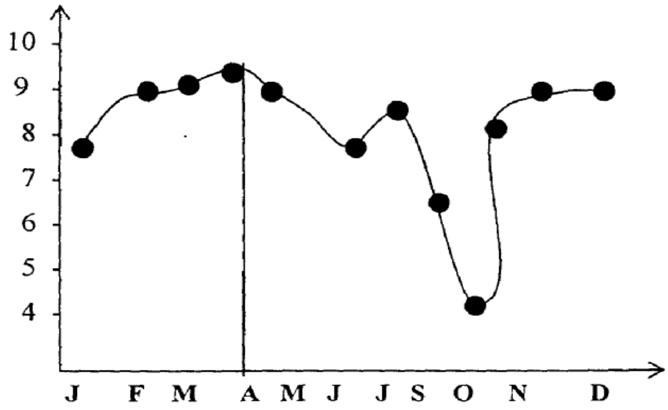

Fig 3.0a: A line graph showing heat generated in 2011

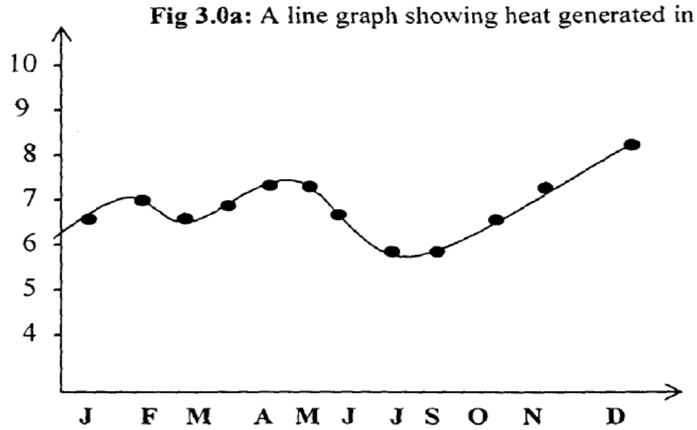

Fig 3.0b: A line graph showing heat generated in 2012

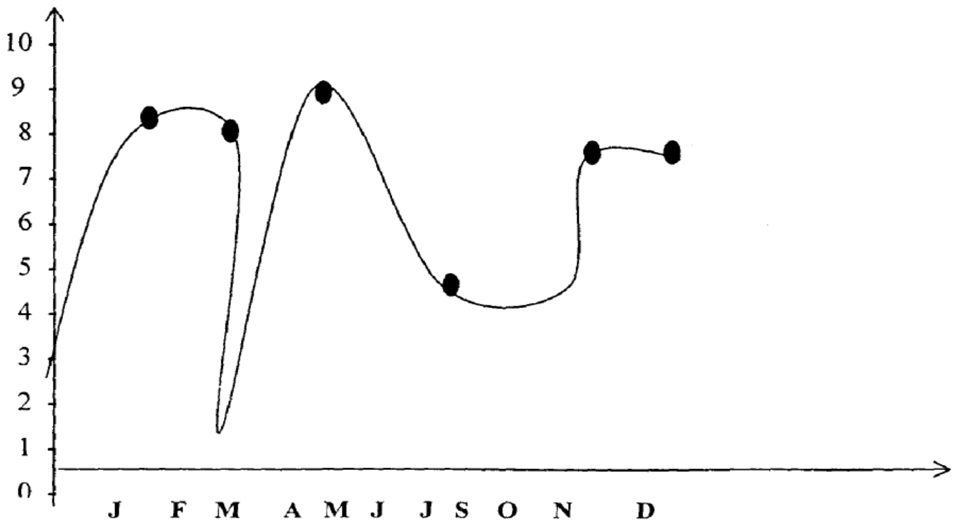

Fig 3.0c A line graph showing heat generated in 2013

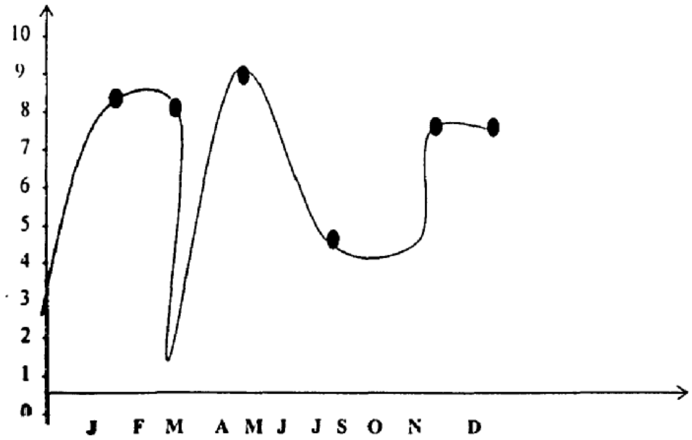

Fig 3.0c A line graph showing heat generated in 2014

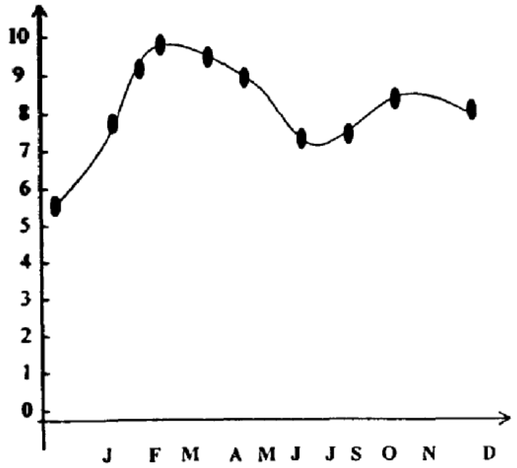

Fig 3.0c A line graph showing heat generated in 2014

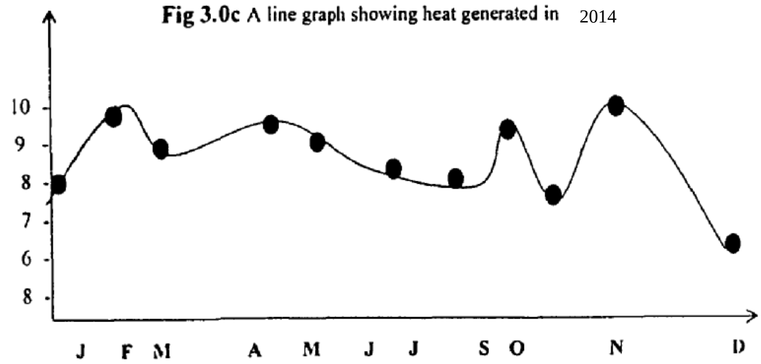

Fig 3.0c A line graph showing heat generated in 2014

VI. DATA ANALYSIS AND INTERPRETATION OF RESULTS

Thus, increasing trend in temperature is recorded (with exception of projected values for August 2013) for whose data were not available (recorded). The Radiation value recorded also show increasing values. The trend in temperature and radiation show a manifestation of increased greenhouse gases that can function with the amount of heat generated. The increasing yearly trend in heat generated. The heat graph (fig 3f) and also fig 3a-3e show increasing trend in heat generated by various anthropogenic factors in the area.

The data analysis is carried out using temperature radiation data and heat of NIMET Warri Station above. The research put premium on related climatic variables of Heat, temperature, radiation data was used to plot line graphs directly. It must be noted that radiation values are used in the estimation of heat energy rate before plotting. For those missing data, extrapolations were made (see plots). The graphs indicated M1-minimum values and M2 for maximum of data. The mean annual temperature goes beyond 27°C but not more than 30.05°C with two periods of high temperature recorded (double maxima). The differences in temperatures between the coolest month and the hottest month is as low as (2.2°C).

The mean annual radiation measures over l3kly with annual range of radiation as low as 5.2 units, while the mean monthly radiation goes beyond 9kly. The mean monthly rainfall of over 190mm and mean monthly annual rainfall is between 2,500 mm and 3 000mm The average annual relative humidity is over 83% and the evaporation rate is above 1.7mm. From the graphs presented, it can be deduced that Warri is characterized with consistent high radiation and heat. The difference between the coolest year and the hottest year is as low as 2.2°C.

Iloeje (1979) classified areas into 3 temperature zones: hottest. areas - over 27°C, moderately low areas- (24°C - 27°C), cool areas- less than 24°C for which Warri falls is under the hottest areas, with mean annual temperature for the five years if over 27°C. There is also an erratic rainfall throughout the year. This makes the relative humidity to be very high. Radiation and evaporation rate are also high measuring annually over l3kly and 1.7mm respectively. Four of five years examined, have mean radiation heating rate of 13kly which is relatively high.

Data for July and August (2013) are missing due to Warri ethnic crisis. These months usually have the highest rainfall and lowest radiation rate. Absence of these data suggests high radiation rate too. Hence, extrapolation was made to get the right value. According to Ayoade, about 18% of insolation is absorbed directly by ozone and water vapor. Ozone absorbs all ultraviolet radiation below 0.29um while Carbon Dioxide absorbs radiation with wavelengths greater than 4um. Carbon Dioxide is thus more potent in absorbing radiation than the ozone layer.

This is the condition in Warri metropolis, where anthropogenic activities produce greenhouse gases (especially Carbon Dioxide and Carbon Monoxide) in the environment thereby contributing significantly to global warming. Unless high temperatures are followed by high humidity, the weather condition will not be pleasant for human habitation. The higher the temperatures with high humidity, the more unpleasant the weather conditions as stated by Iioeje, (1979).

VII. RECOMMENDATIONS

To ameliorate the effects of greenhouse gases, there is need for reduction or total stoppage of gas flaring during oil production in Warri and its environs.

The use of fossil fuels should be phased out gradually and shift to renewable energy sources such as solar energy, wind energy and bio energy. Deforestation in any form should be discourage and afforestation initiatives should be pursued with vigor and enthusiasm. Unnecessary and wasteful gas flaring by the Oil companies during oil production should be discouraged and punishable as stated in Nigeria National Petroleum Company regulations.

The Oil companies should be forced by the Federal Government of Nigeria to comply and adhere to different International Organizations Action Plans relating to efficient and ethical behavior in Oil and Gas production activities, such as the Montreal Protocol of 1987, the 1979 convention on Long Range Trans Boundary Air Pollution, the Kyoto Protocol of 1997, the clean air act (1990), UNCED, (1992) and the U.S Congress Resolutions (2018) on Oil production and clean environment. In addition, Remotely Sensed Data such as Satellite data and computer simulation can be adopted in acquiring efficient, cost effective, reliable information to monitor the activities of Oil producing areas of the world for effective compliance with the desired clean environment initiatives of the modern world.

VIII. SUMMARY AND CONCLUSION

Global Warming in Warri results significantly from human contributions such as massive use of fossil fuels, uncontrolled gas flaring and massive and uncontrolled deforestation. The study has shown that there is a consistent and significant increase in temperature and radiation energy (heat) in Warri Metropolis over the years (see tables in Appendix II) It has been seen that there is a consistent increases in the temperature and radiation energy levels (heat) generated. Recommendations are made on the management of greenhouse effect and dramatic variability of weather conditions. This study seeks to contribute to the ever increasing pool of knowledge in the field of global warming and climate change.

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