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Assessment of Gas Flaring and Temperature Variability in the Niger Delta: A Case study of Delta State

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Abstract:- The burning of Associated Gas produced alongside crude oil by the 29 gas flaring sites in Delta state constantly hurts nature's domain and constitutes a waste of assets which could be utilized to end the persistent energy failure faced by the power sector in Nigeria. The proclamation of Gas flaring as one of the major sources of anthropogenic CO^2 has become a disturbing issue for both scholars and host communities, hence, regarded as a catalyst to temperature change in the study area. It is against this background that this study carried out "an assessment of gas flaring as a major contributor to temperature change in Delta State". The study examined the pattern of total gas flared in the Niger Delta region and its impact on temperature variability in Delta State using satellite climate data and gas flaring data over the region. The Time Series Analysis was used to investigate the trends, variations and seasonality of total gas flared and temperature for six decades in R software. The standard deviation and coefficient of variation showed annual variability in temperature with respect to the mean with a downward trend of gas flaring within the period of review. Although there was positive relationship between temperature and gas flaring, other factors could have contributed to temperature variability in the region. The statistical indications were not enough to conclude that there is climate change in the study area, but one can conclude that there are slight indications of climate change in the study area. Thus, it is recommended that more synoptic weather stations be sited in all the oil producing communities in Delta State and Niger Delta region as a whole in order to have adequate up-to-date data of climate and weather pointers obtainable and accessible to scholars.

Keywords:- *Associated Gas, Gas Flaring, Temperature, Climate Change.*

I. INTRODUCTION

Gas flaring is considered as one of the greatest air pollutant in the world today. It is defined as the burning of Associated Gas (AG) in flow stations and refineries in order to dispose or relieve pressure from the petroleum processing plants (Ghadyanlou and Vatani 2015). Emam (2016) reports that about 150 billion standard cubic meters of AG is being wasted by oil and gas industries in the world, contributing about 400 metric tonnes of CO^2 to the environment yearly. According to World Bank (2018), Nigeria is ranked sixth on the Global Gas Flaring ranking and second in Africa after Algeria. Although, Nigeria has reduced flaring by 2 billion cubic meters between 2012 and 2015, but the country losses about 2.3 US dollars daily, and as such, the oil and gas industries are currently flaring 700 million Standard cubic meters of gas daily (World Bank 2018). This can be seen as a waste of non-renewable resources, which has environmental, economic and health implications in the form of environmental degradation, health issues and global warming by discharging significant amount of carbon dioxide.

The fact that Nigerian oil sector has affected the nation in so many ways can no longer be contested. Since the discovery of oil in the Niger Delta Region in 1956, the country has on one hand recorded significant economic advancement, and, on the other hand, suffered from varying degrees of environmental degradation through oil spillage and gas flaring (Abdulkareem et al., 2012). Odjugo (2010) claims that the development of the nation's oil sector as well as the huge population, and inadequate environmental regulation has resulted to the extensive degradation of the country's environment, specifically the Niger Delta region. For instance, the extensive flaring of AG from the 159 oil fields in the region during the production of oil and gas is the principal culprit making AG the major source of CO2 emissions in Nigeria (Okukpon, 2010).

The environmental impact of gas flaring is huge and exemplified in a World Bank report, that gas flaring is the single major contributor to greenhouse gases in atmosphere compared to other sources in the Niger Delta Region. IPPC (2014) claims that with the steady increase of CO^2 as well

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as other Greenhouse Gases (GHG), the climatic condition of the globe could get warmer. Flaring of AG is generally noticeable and releases heat and noise pollution. Currently, the globe is confronted with issues of global warming caused by $CO^{2,}$ CH^4, SOx, NOx, GHG, and VOC and, as such, when these gases are released into the atmosphere, heat is trapped (Rahimpou and Jokar 2012; Ghadyanlou and Vatani 2015). The trapped heat which amounts to about 45.8 billion Kilowatt of heat daily has increased the temperatures in the Niger Delta Region (Abdulhakeem and Chinevu 2014). A report release by NASA (2016) also attested to the fact that "the earth's average temperature rose by 0.9^0C between 1880 and 2015". While other international organizations such as the World Metrological Organisation reported that since the commencement of climate variability record-keeping, the earth in 2016 experienced its third sequential hottest year initiated by increase in GHC in the atmosphere (WMO 2017), IPPC (2018) claims that CO2 remains in the atmosphere for centuries and its natural degradation due to uptake by land and ocean is slow. This means that CO2 accumulates in the atmosphere, leading to a corresponding temperature rise. Currently, the earth absorbs about 816 terawatt of additional heat annually and indication of the absorbed heat is noticeable earth's documentary involving "increasing surface temperatures, heating oceans and melting of ice" (IPPC 2014).

In times past, the process of oil production in Delta state has persistently resulted to conflict from host communities nearer to various flow stations and the Warri Refinery Petrochemical Corporation. The host communities have continually asserted that the multinational oil companies adhere to best practices that will facilitate the abatement of gas flaring in the state, as inhabitants have to live with stacks that flare gas 24 hours daily at a temperature of $14{,}000^O$C Abdulkareem et al. (2012). Although, the Nigeria Government have attempted to implement polices to put an end to gas flaring, but this attempt have been unsuccessful resulting in the shifting of deadline date more than six times (Malumfashi 2007). The IPPC (2014a) warns that if gas flaring remains unabated, it could be devastating over the course of the twenty-first century. Hulme et al. (2001) conducted a study on Africa's climate variability. While, result reveals that global mean surface temperature is estimated to upsurge between 1.5^OC and 6^OC by 2100, sea level is estimated to rise between 15cm to 95 cm within the same year under investigation, and, as such, climate change signifies imminent warming across the African continent ranging from 0.2^OC to 0.5^OC per decade. Therefore, this warming will be at maximum over the interior of semi-arid of the Sahara and Central Southern Africa.

Nkwocha and Pat – Mbano, (2010) conducted a study gas flaring in Bayelsa Sate of Nigeria, result reveals that flaring from oil and gas production led to 49 premature deaths, 120, 000 asthmatic cases and 8 cases of cancer. Amaechi and Biose (2016) also carried out an investigation in the oil producing communities in the Niger Delta Region. In spite of the foregoing, studies on gas flaring are rare. It is worth mentioning that global warming is the short term effect of gas flaring on the environment, while climate change is the long term effect which could result to constantly increased temperature as well as heatwaves that could ultimately last for decades even if gas flaring is eradicated. These studies have indeed accelerated the amendment and implementation of policies towards gas flaring abatement in the region. Therefore, this study aims to analyze the trends of total gas flared in the Niger Delta region between 1986 and 2016, in order to ascertain whether it has contributed to the increased temperature in Delta State over the years. The outcome of this research will not only disclose the urgency with which the hazard requires to be tackled, it will also create policy direction and implementation, as Fischer (2019) notes that public backing or disapproval of a policy is generally influenced by the intuitions of the problem and how the policy will affect the people. Finally, the inhabitants residing close to gas flaring sites will have the opportunity to be part of the policy implementation.

II. STUDY AREA

Delta state located in the south-south geopolitical zone of Nigeria is one of the nine Niger Delta oil-producing states of Nigeria. It lies between longitude 5°00'E and 6°45'E and latitudes 5°N and 6°30'N, covering a land area of 16,842 km square of which over 50% is mangrove swamp (Efe, 2006). The area is interwoven with many rivers, namely Benin River, Escravos River, Forcados River, Ramos River, all in the western part of the state and the River Niger on the Eastern side (Efe, 2006). Delta state shares similar climatic features with other states in the Niger-delta. The general climate is characterized by a long rainy season from March/April through October. The area is characterized by tropical equatorial climate with mean annual temperature of 32.8 °C and annual rainfall amount of 2673.8 mm. The climate in Delta state shows latitudinal fluctuation in humidity ranging from the humid tropical in the south to the sub- humid in the north east. Lessening humidity towards the north is accompanied by an increasingly marked dry season. However, only a fraction of its land mass is used for agricultural production, because most of its areas are below sea level of the Atlantic Ocean, therefore prone to annual flooding (Chukwuji et al., 2006). Figure 1 shows the map of Delta state with water bodies, local government boundaries and gas flaring sites. Oil and gas exploration in Delta State started in the 1950s and till date an approximately amount of 2.3m barrels of crude oil is extracted daily, contributing to an estimated 25% of Nigeria's total oil output. Its natural gas reserve accounts for 40% of the total gas reserve in Nigeria. Delta State has 83 of 159 oil fields in the Nigeria and it is home to 1481 oil wells and 29 gas-flaring sites (Department of Petroleum Resources [DPR] 2016)

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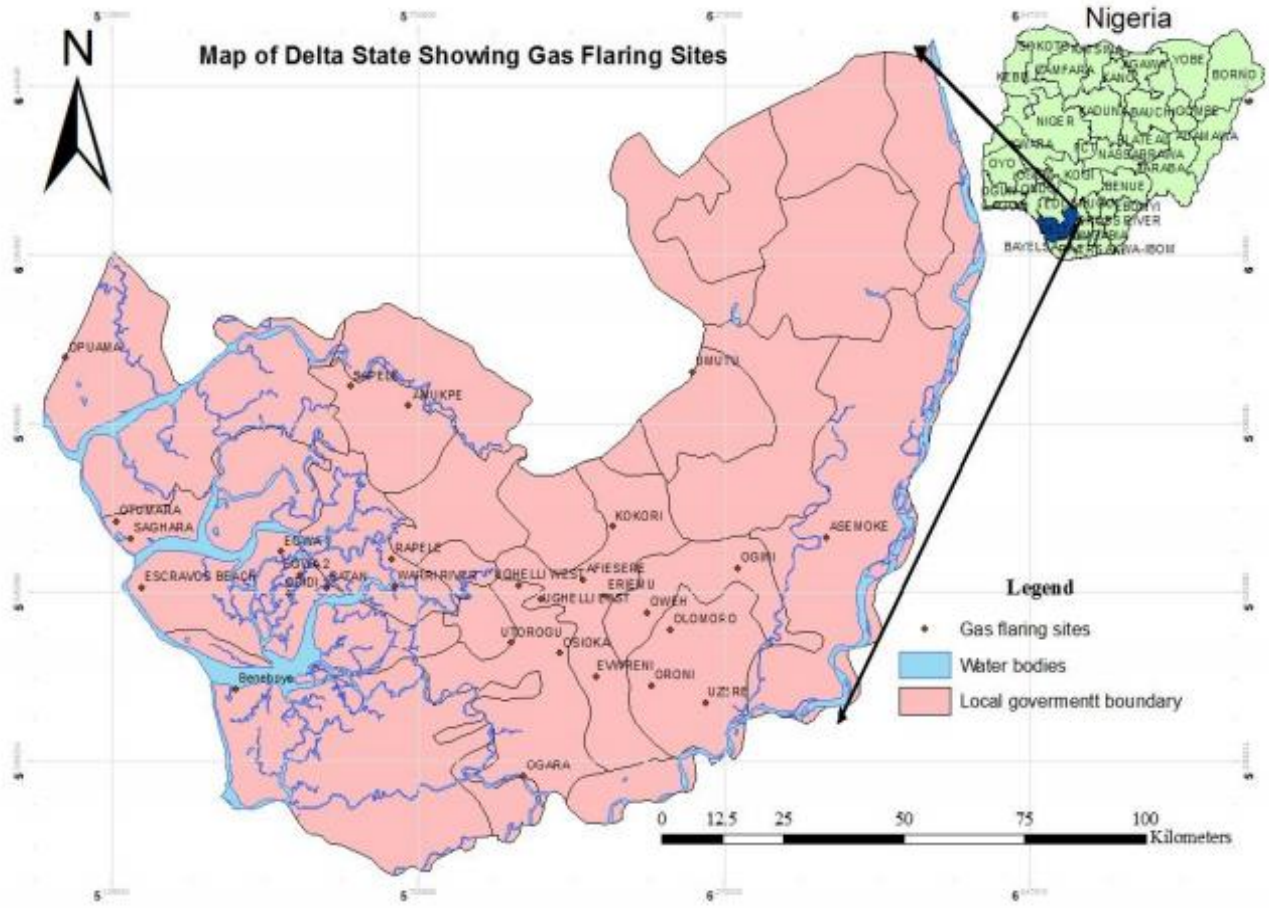

Fig 1:- Map of Delta State showing the 29 gas flaring sites
Source: Adole, 2011

III. METHODOLOGY

The climate data utilized for this investigation consist of high resolution daily satellite (temperature) data for Delta state from 1979 to 2014, which was extracted from the website of the Global Weather Data for SWAT in conjunction with the National Centers for Environmental Prediction (NCEP). One of the objectives of this research is acquiring measurable knowledge into the gas flaring patterns in the Niger Delta region. Gas flaring information was extracted from the Nigerian National Petroleum Organization (NNPC) annual bulletin. In order to determine temperature variability of Delta state over a period of 35 years, Time Series Analysis was used to investigate the trends and variations of total gas flared and temperature for four decades in R software.

IV. RESULTS AND DISCUSSION OF RESULTS

Environmental pollution has exceeded natural boundaries; stratospheric ozone depletion, global warming, the greenhouse effect, deforestation, acid rain and mega disaster are some of the various environmental problems attributed to pollution. “The potential effects of global pollution have necessitated global cooperation in order to secure and maintain a habitable global environment” (Odjugo, 2010). It has been reported that pollutants emitted from one country can easily cross political boundaries. People are beginning to recognize that pollutants can affect not just a region but the entire planets.

The Nigerian Government through its policy tagged “Nigerian Gas Flare Commercialization Programme” in 2018 (NGFCP) in a bid to reduce gas flaring and consequent contribution to greenhouse gases (GHG), introduced stiffer penalties to gas flaring thereby forcing drastic reduction in amounts of flared gas. Figure 3 shows continuous reduction in amounts of gas flared particularly from 2001 when gas flaring was at its peak of one trillion cubic feet to the most recent reduced level of 282 billion cubic feet in 2018. Since IPCC (2014) underscores climate variability as a result of both natural processes and anthropogenic forces, one can deduce that the amount of heat generated from decades of gas flaring must have immensely influenced the temperature of Delta state.

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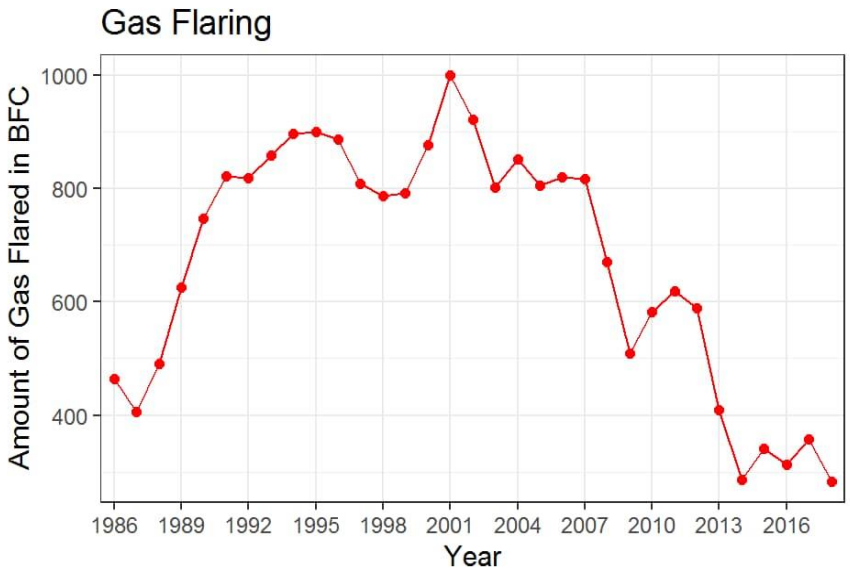

Fig 3:- Gas Flare Trend from 1986 to 2018

The Inter-Governmental Panel on Climate Change (IPCC, 2014a) affirmed that there is an increase of about 0.7 degrees Celsius in global temperature. Figure 4 shows seasonal variation in the average temperature of Delta state with an increase in the maximum temperature of the state from 28.5°C in 1979 to 31°C between 2007 and 2008 before the downward trend to below 29°C in 2009. The consistent rise in temperature of the state for about two decades can be attributed to the influence of climate change and other human activities essentially excessive gas flaring activities in the region. Therefore, comparing temperature variation in Delta state, one can easily argue that human activities in the region particularly continuous release of CO2 from gas flaring sites must have contributed to GHG creating heat-traps and consequent increase in the temperature of the state. If this current trend persists, it could lead to climatic change over a long period of years. The observed temperature increase can also be attributed to the growth of cities and increasing human activities in the Niger Delta region of Nigeria.

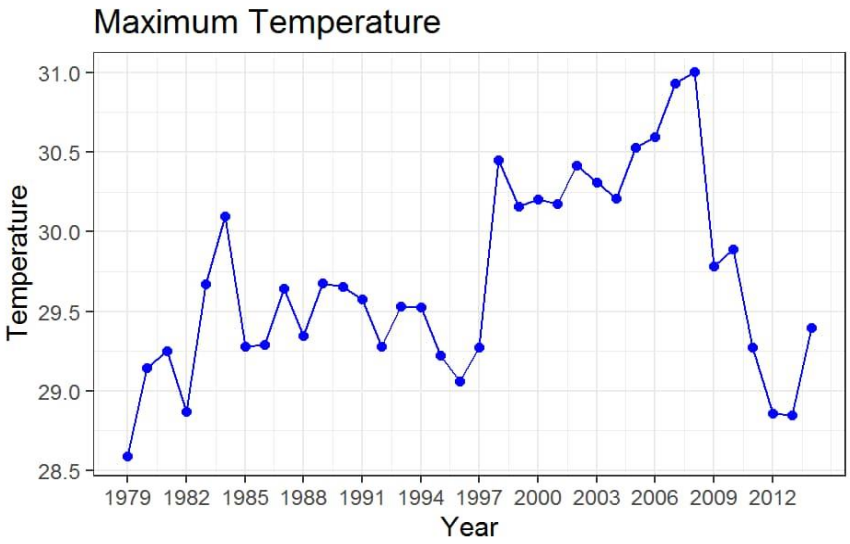

Fig 4:- Maximum Temperature Trend from 1979 to 2014

In the present study, the time series shows similar trend between quantity of gas flared and temperature. The period between 1990 and 2000 experienced a sharp increase in the quantity of gas flaring as well as a rise in maximum temperature; the upward trend persisted over the next decade between 2000 and 2010 with maximum quantity of gas flared in the region as well as highest record of maximum temperature value. From the R analysis, Figure 5 shows that gas flaring influences the maximum temperature and temperature variability in Delta state.

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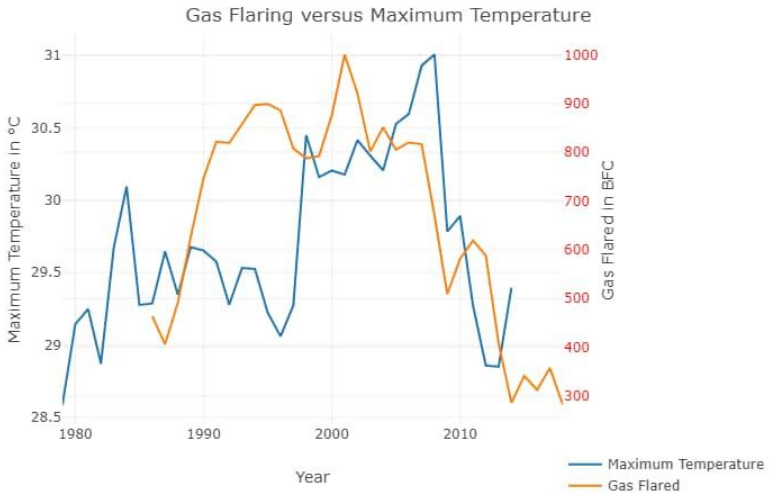

Fig 5

V. CONCLUSION

Gas flaring in Nigeria, in particular the Niger Delta region, has spanned many decades. This practice has continued in spite of the deleterious effects on the environment, human and plant life and the loss of revenue to both the government and the oil producing companies. Although the government has made efforts through legislation to control gas flaring, the laws in place have not been effective in controlling gas flaring in Nigeria. The assessment of gas flaring and temperature variability in the study area has been successfully conducted. Results revealed that temperature has been on increase over the period under study. The temperature fluctuations over Delta State could result to climate change if gas flaring remains unabated. The present temperature trends have contributed to the impact of which are already felt in the study area with attendant food insecurity and rising costs of extreme weather damage such flooding. Although, this study has been designed to cover Delta State alone, the result achieved which have been emphasized can still be regarded as insufficient for any conclusive generalization to be made about climate change in the region. Hence, it will be more reliable if further consideration is given to more stations in the region and the use of wide range of climatic parameters can still be included in other studies.

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