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THERMAL EFFECT OF GAS FLARING ACTIVITIES IN OGBA-EGBEMA-NDOMI COMMUNITY, RIVERS STATE, NIGERIA

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ABSTRACT: *This paper presents some negative environmental impact resulting from one of the gas flaring station in Ogba-Egbema-Ndomi Community, Rivers State, Nigeria. The variation of Surface temperature with distance from the gas flaring station in the study area was investigated. The result shows that Atmospheric Temperature T_a (^oC) and Soil Temperature T_S (^oC) from the flare station to a distance of about at 1800m from the station were above the acceptable temperature convenient for plants and animals to grow well. The temperature tends to normalized at about 29^0C at about 2000m away from the flare point. Hence the inhabitance of Ogba-Egbema-Ndomi and environs are advised to start their farming activities from about 2000m away from the flare station located in their locality. This increase in temperature also has other negative effects on the inhabitants of the area*

KEYWORDS: Environmental impact, Temperature, Distance, Gas flare, Inhabitants.

INTRODUCTION

Environmental contamination of air, water, soil, food and properties has become a threat to the continued existence of many plants and animal communities and ultimately threatens the very survival of the human race, Nwaichi et al (2011). Several studies are known to have been carried out about the health impacts of gas flaring on communities in the Niger Delta Area, Avwiri (2003). It is now very obvious, even to those who had initial doubts about the veracity of the claim by scientists that flaring of gas has a negative impact on the environment. The negative effects of gas flaring on the environment includes, acid rain formation, greenhouse effect, global warming and ozone depletion, Oculi et. al. (2007), Abdulkareem (2010). Even the rural dwellers know and believe that the flaring of gas is damaging their health, reducing crop production, destroying the rivers and streams and damaging their homes.

Study Area

Ogba-Egbema-Ndomi is a Local Government Area in Rivers State, Nigeria, with its capital at Omoku. The list of communities in Ogba-Egbema-Ndomi LGA are: (1) Oboburu, (2) Ohiuga, (3) Okposi, (4) Ikiri, (5) Erema, (6) Ede, (7) Obigwe, (8) Okpurupuali, (9) Okansu, (10) Ogbidi. Rivers State in Nigeria is one of the states in Niger Delta Area. Home to 20 million people and 40 different ethnic groups, this floodplain makes up 7.5% of Nigeria's total land mass. It is the largest wetland and maintains the third-largest drainage basin in Africa, Abdulakreem et al (2010),

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Fig.2: Map of Nigeria Showing Rivers State, Nigeria.

Fig.3: Map of Rivers State showing Ogba Egbema Ndomi

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Source of Natural gas

Natural gas is a subcategory of petroleum that is naturally occurring. It is a complex mixture of hydrocarbons with a minor amount of non-hydrocarbon gases, Penner (1999). The discovery and extraction of natural resources have brought different consequences to countries that are endowed with such resources. Gas flaring is the burning off of gas into the atmosphere, Osang et al (2013), Abdulkareem et. al. (2010), Jike, (2004).

Fig.1: Burning off the Natural Gas into the Atmosphere in Ogba Egbema Ndomi in River State, Ngeria (Picture taken by Osang, Jonathan E. during data collection).

In Nigeria, the discovering of crude oil was in 1958, while the extraction and gas flaring activities of these natural resources started since 1961, Yusuf (2008), Nyong et. al. (2007). The burning off of gas became illegal since 1984 and the Nigerian government has set up several deadlines to end the practice, but gas flaring continues till date, Avwiri (2003), Obi et al (2013). According to friends of the earth report, in 2005, about 2.5 billion cubic feet of gas associated with crude oil is flared into the atmosphere everyday in Nigeria. This is equal to 40% of all African natural gas consumption in 2011 and represents a financial loss to Nigeria of about 2.5 billion USD. It is now very obvious, even to those who had initial doubts about the veracity of the claim by scientists of the resultant effects of gas flaring activities that the damaging effect of the environment due to acid rain formation, green house effect, global warming and ozone depletion are real, Abdulkareem et al (2010).

Temperature

Temperature is the degree of hotness or coldness of a substance. It is commonly expressed in degree Celsius or centigrade (^{0}C) and degree Fahrenheit (^{0}F). This climatic factor influences all plant growth processes such as photosynthesis, respiration, transpiration, breaking of seed dormancy, seed germination, protein synthesis, and translocation**,** Baroutian et al (2006).

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Atmospheric temperature is a measure of temperature at different levels of the Earth's atmosphere. It is governed by many factors, including incoming solar radiation, man induced radiation, humidity and altitude. **Soil temperature** is simply the measurement of the warmth in the soil. Ideal soil temperatures for planting most plants are 65 to 75 F. (18 to 24 ^{0}C.). Night time and day time soil temperatures are both important, Adebayo (1991).

Effects of Temperature on Crop production

Crops grow best under acceptable temperate conditions. The Intergovernmental Panel on Climate Change predicts that subjecting crops to temperatures above 30 °C for a long time can have a range of negative effects on crops production. These effects can reduce production in crop yields in the future, Alameddine et al, (2005).

Soil temperature depends on the ratio of the energy absorbed to that lost. It depends on the temperature of the surrounding atmosphere. Soil temperature regulates seed germination, plants and roots growth and the availability of nutrients. Soil temperature has important seasonal, monthly and daily variations. Fluctuations in soil temperature are much lower with increasing soil depth. Heavy mulching (a type of soil cover) can slow the warming of soil, and, at the same time, reduce fluctuations in surface temperature. There are various factors that affect soil temperature, such as water content, soil color, and relief (slope, orientation, and elevation), and soil cover (shading and insulation). The color of the ground cover and its insulating properties has a strong influence on soil temperature. Whiter soil tends to have a higher albedo than blacker soil cover, which encourages whiter soils to have cooler soil temperatures, Awosika (1995).

Acceptable Temperature limits for Human Existence/Comfort

There is a range of temperature within which humans can live comfortably. Temperatures above and below this range brings various degrees of discomfort. For a given temperature, the temperature increases as the relative humidity (moisture content) of the air becomes higher. The following table gives ranges of temperature for various degrees of thermal effect on people in the environment, Vereecken et. al. (2008), Emoyam et. al. (2008).

Table 1: Acceptable Temperature limits for Human Comfort

Temperature (°C)	Degrees of Comfort
20 - 29	Comfortable
30 - 39	Varying degrees of discomfort
40 - 45	Uncomfortable
46 and Over	Many types of labour must be restricted

Source:-Canadian Centre for Occupational Health & Safety (1997-2014) Http://Www.Ccohs.Ca/Oshanswers/Phys_Agents/Hot_Cold.Htm

Ideal Soil Temperatures for Planting

The perfect temperature for planting vegetables or fruits varies depending upon the variety of vegetables or fruits. Planting within unacceptable temperature limit will reduce fruit yield, cause stunted plant growth, cause the leaves to be yellowish and prevent or reduce seed germination, Yusuf & Oyewunmi (2008), Oseji (2010). Plants such as tomatoes, cucumbers and snap peas grow well from soils at about 60 ^{0}F (16^{0}C.). while Sweet corn, lima beans and

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some greens need 65 ^{0}F (18^{0}C.), crops like watermelon, pepper, squash, okro, and sweet potatoes grow very well between temperatures of 20 ^{0}C to 29 ^{0}C, Vereecken et. al. (2008), Emoyam et. al. (2008).

Table 2: Acceptable Temperature limits for crop/plant Comfort

Temperature (°C)	Degrees of Comfort
16 - 27	Comfortable
28 - 33	Varying degrees of discomfort
34 - 38	Uncomfortable
38 and Over	Many types of labour must be restricted

Source:-Canadian Centre for Occupational Health & Safety (1997-2014)
Http://Www.Ccohs.Ca/Oshanswers/Phys_Agents/Hot_Cold.Htm

MATERIALS AND METHODS

A list of all gas flare locations was made in Ogba-Egbema-Ndomi (Onelga-Okwuzi Community Ikwere L.G.A, River State Ngeria. Several visitations were made to most of the gas flare locations in a bid to achieve the objectives of the study. Measurements were carried out within a radius of 200m away from the flare station for safety reasons. The use of a metal tape was excluded in this research to avoid errors that may arise from the expansion and contraction of the metal due to high temperature of the environment. During the cause of this study, temperature readings were taken with the aid of a thermometer and distance measured with a fibrous tape. Temperature measurements were carried out at a constant height of 1.68m from the ground level and between 9.00h and 11.00h GMT to minimize the effect of vertical temperature gradient and for uniformity of weather conditions respectively. The parameters monitored at each sampling location included, the Atmospheric temperature and soil temperature. The measurements for each parameter were carried out as follows:-

Atmospheric Temperature Measurement: The Atmospheric temperature in each location was determined with Mercury-in-glass thermometer. The thermometer was left for 1 minute to stabilize and read before withdrawal. This was done at the site of the data collection.

Soil Temperature Measurement: The temperature of each soil sample in each location was determined with Mercury-in-glass thermometer, which was placed 2-3 cm into the soil. The thermometer was left for 5 minutes to stabilize and read before withdrawal. This was done at the site of collection.

Data Analysis

Based on the data, simple descriptive analysis was used to show the impact of gas flaring activities in the Ogba-Egbema-Ndomi in Rivers State of Nigeria.

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RESULT

Table 3: Average value of Atmospheric Temperature T_a (°c) in Ogba-Egbema-Ndomi Community River State for Dry season (Oct.2013-March2014)

	Temperature (0C)									
Months	200m	400m	600m	800m	1000m	1200m	1400m	1600m	1800m	2000m
October	49	47	45	42	40	38	35	32	29	28
November	50	49	47	44	41	39	38	37	30	28
December	48	47	45	44	42	38	36	34	33	29
January	50	49	48	45	41	37	37	35	32	30
February	50	48	46	43	40	39	37	36	35	29
March	50	49	47	45	43	40	38	37	34	31

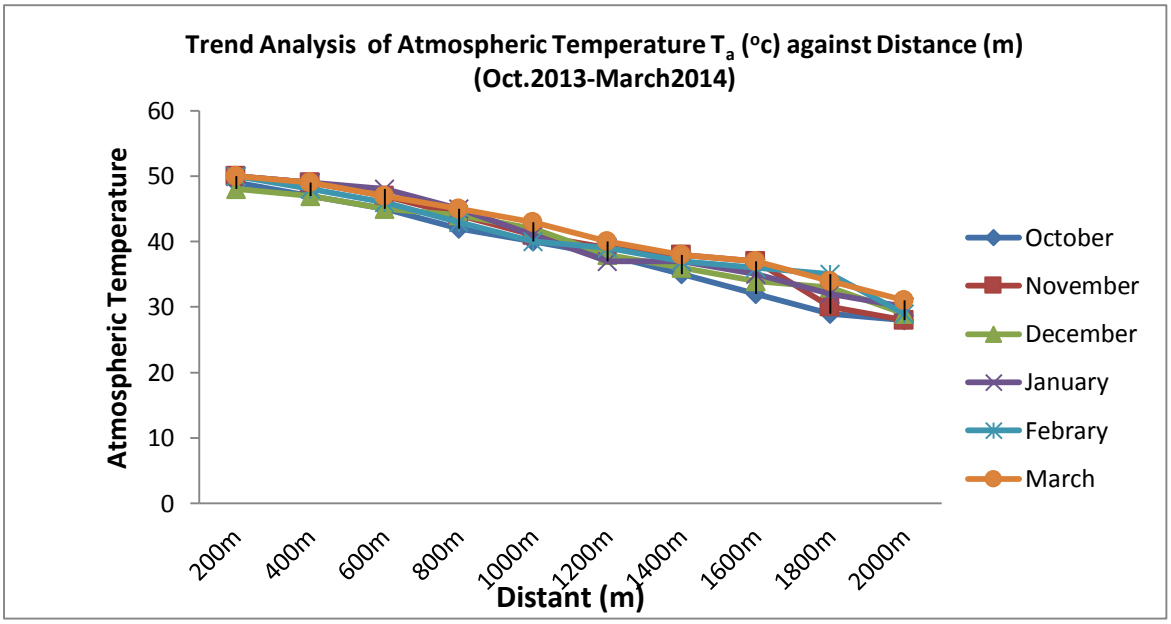

Fig. 4: Trend Analysis of Average Atmospheric Temperature T_a (°C) in Ogba-Egbema-Ndomi Community River State for Dry season (Oct.2013-March2014)

Table 4: Average values of Soil Temperature T_S (°C) Parameters in Ogba-Egbema-Ndomi Community Rivers State for Dry season (Oct.2013-March2014)

	Temperaure (0C)									
Months	200m	400m	600m	800m	1000m	1200m	1400m	1600m	1800m	2000m
October	33	32	31	30	30	30	29	29	28	27
November	32	31	30	29	29	29	29	28	28	28
December	34	33	31	30	30	30	29	29	28	27
January	34	31	30	28	28	28	28	27	27	27
Febrary	35	32	32	30	30	30	29	29	28	27
March	35	34	32	32	32	31	30	30	29	28

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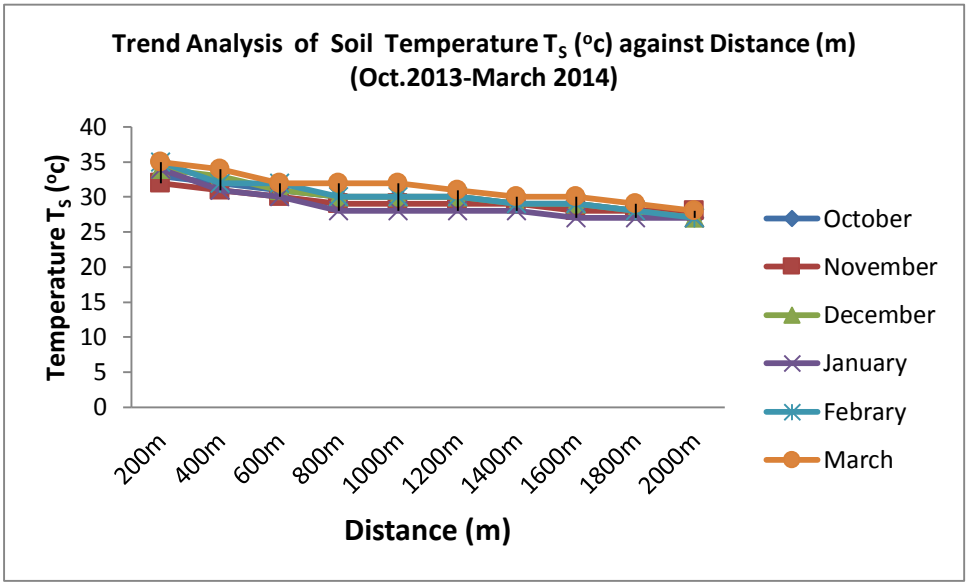

Fig. 5: Average values of Soil Temperature T_S (°c) in Ogba-Egbema-Ndomi Community River State for Dry season (Oct.2013-March 2014)

Table 5: Average values of Atmospheric Temperature T_a (°c) in Ogba-Egbema-Ndomi Community Rivers State for wet season (April.2014 - Sept. 2014)

	Temperature (0C)									
Months	200m	400m	600m	800m	1000m	1200m	1400m	1600m	1800m	2000m
April	50	48	47	45	40	38	34	31	30	29
May	49	48	48	48	47	45	44	43	30	28
June	50	49	48	48	47	46	43	43	33	29
July	49	49	49	48	48	47	44	40	35	30
August	48	52	50	49	46	45	44	39	34	29
Sept	48	53	52	49	47	45	45	40	40	31

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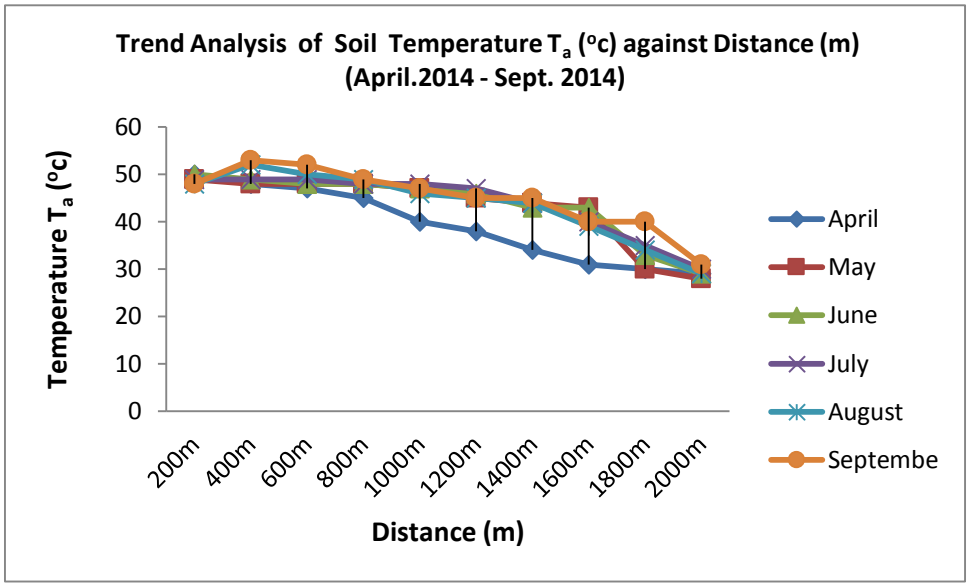

Fig.6: Comparative Trend Analysis of Atmospheric Temperature T_a (°C) with Distance (m) in Ogba-Egbema-Ndomi Community Rivers State for wet season (April.2014 - Sept. 2014)

Table 6: Average value of Soil Temperature T_S (°C) in Ogba-Egbema-Ndomi Community Rivers State for wet season (April 2014-Sept. 2014)

	Temperature (0C)									
Months	200m	400m	600m	800m	1000m	1200m	1400m	1600m	1800m	2000m
April	30	30	29	29	29	28	28	28	28	27
May	31	31	31	30	30	29	29	28	28	27
June	32	32	32	31	30	30	29	28	28	28
July	32	31	31	30	30	29	29	28	27	27
August	33	32	32	31	31	30	29	29	28	28
Sept	32	32	32	31	31	31	30	29	29	28

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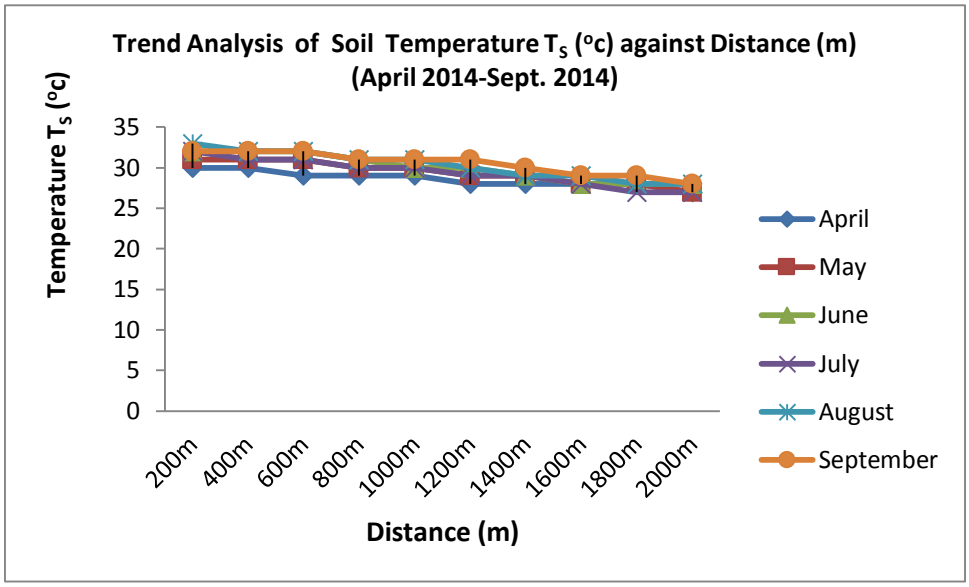

Fig. 7: A Comparative plot of Soil Temperature T_S (^oC) with Distance (m) in Ogba-Egbema-Ndomi Community River State for wet season (April 2014-Sept. 2014)

DISCUSSION OF RESULT

Based on the analyses of the Soil Temperature and Atmospheric Temperature in Ogba-Egbema-Ndomi Community, the trend curves revealed a decrease in temperature with increasing distance away from the flare point. The decrease in temperature with increasing distance obeys the known theory of temperature distribution associated with heat transfer over a temperature gradient. The atmospheric temperature is higher within the vicinity of Ogba-Egbema-Ndomi gas flaring plant when compared with the acceptable temperature value for most plants to grow well. The standard value of temperature for planting most crops is between 16 ^{0}C to 27^{0}C and acceptable temperature limits for human comfort is between 20^{0}C -29^{0}C. Hence the thermal equilibrium has been altered. This increase in temperature has enormous influence on the socio-economic lives and activities of the inhabitants. Some of the general effects of the gas flared at Ogba-Egbema-Ndomi gas plant include stunted growth and red leaves observed in the cassava, plantain, palm trees, yam and other crops that were planted within 2000m to the flare station. It was also observed that, majority of the inhabitants who are farmers in Ogba-Egbema-Ndomi Community always migrate to communities that do not flare gas for settlement in order to meet up what their farming profession.

CONCLUSION

The result shows that Atmospheric Temperature T_a (^{o}c) and Soil Temperature T_s (^{o}c) tends to normalize at about 29^{0}C and 27^{0}C at 2000m respectively away from the flare point . Hence the thermal equilibrium within Ogba-Egbema-Ndomi environs has been altered. This increase in temperature has negative effect on man and his environment, especially on the socio-economic activities of the inhabitants. Physical observation revealed that most building in Ogba-Egbema-Ndomi, especially those with corrugated iron sheet roof experienced massive damage resulting in frequent changes and leakages. Apart from the burning and “die-back” effect of gas flare

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and hydrocarbon, which were visible in cassava, plantain and yam leaves, Irritations of the eye and body were also experienced. It is therefore recommended that the gas obtained should either be used by a gas turbine for electric power generation or processed for domestic and industrial purposes. Furthermore, the Environmental law Enforcement Agencies, especially DPR (Department of Petroleum Resources), should be more involved in enforcing all existing environmental laws on gas flaring so as to take care of the community's basic amenities and advise for a strong technological bases that harness Nigeria's gas potentials. Also, Chemical analysis of the roofing sheets and water analysis should be carried out to determine the extent of corrosion and ascertain the state of their drinking water.

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