Thermal Effect of Gas Flaring at Ebedei Area of Delta State, Nigeria.

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ABSTRACT

This study investigates the thermal effect of gas flaring on the Ebedei community of Delta State, Nigeria. Measurements of temperature variation with distance from the flare point were obtained for both the wet and dry season. Results indicate that thermal pollution occurred within a distance of 2.15 km for the wet season and 2.06 km for the dry season. It is recommended that agricultural crops which respond negatively to high temperature variation should not be planted in this area. The government is also called upon to pass a legislation to end gas flaring in Nigeria.

(Keywords: gas flaring, thermal distribution, temperature, crude oil)

INTRODUCTION

Natural gas is routinely flared in the course of producing and processing of crude oil (Ebeniro and Avwiri, 1996). Gas flaring according to Aghalino (2009) is gas burnt off as unusable waste which is released by pressure relief valves during unplanned over pressuring of plant equipment. According to Avwiri and Ebeniro, (1995), gas flaring is the unscientific burning of excess hydrocarbons gathered in an oil/gas production flow station.

The reason while flaring is done is to act as a safety device to protect vessels or pipes from over-pressuring due to unplanned upsets. Ellen and Barry (2005) stated that flaring is a means of safely disposing of waste gases through the use of combustion. They noted that with an elevated flare, the combustion is carried out through the top of a pipe or stack where the burner and igniters are located.

The size and brightness of the resulting flame depends on the amount of released flammable material (Oseji, 2007). Gas flaring has become a tradition which is now practiced by almost every oil company in Nigeria and has become an integral part of oil producing communities in the Niger Delta region of the country.

This practice of burning off the associated gas when crude oil is processed has continued unabated since the discovery of oil in Nigeria. Report has it that about 75 percent of the gas produced in Nigeria is flared (Kindzierski, 2000). It is estimated that about two billion standard cubic feet of gas is currently being flared in Nigeria, the highest in any member nation of the Organisation of Petroleum Exporting Countries (OPEC). Going by this fact, Nigeria accounts for about 19 percent of the total amount of gas flared globally. This is far from what is obtainable in advance countries. For instance, Canada in 1996 was able to conserve 92% of gases produced while the remaining 8% was flared (Penner, 1999).

Orimoogunje et al. (2010) stated that gas flaring contribute to acid rain which apart from corroding corrugated aluminum roofs, acidify the soil, thereby causing soil fertility loss and damaging crops. The free disposal of gas through flaring generates tremendous heat, which is felt over an average radius of 0.5 kilometer thereby causing thermal pollution (Ikelegbe, 1993).

It is known that gas flaring in Nigeria has raised the average global temperature by about 0.5^0C (Penner, 1999). High temperatures create physical, chemical, and biological conditions which are harmful to human health, plant and soil micro-organisms. There is a great physiological impact of the high temperature on crops planted in the vicinity of the flare (Orimoogunje, et al., 2010; Oseji, 2007; Oseji, 2009).

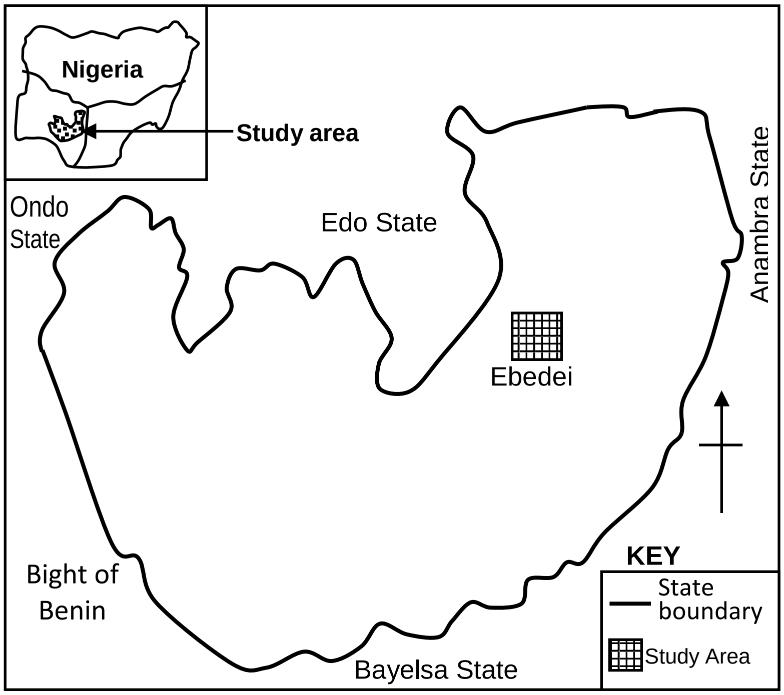

Figure 1: Map of Delta State Showing the Study Area.

Temperature is the primary factor that control how fast plants develop. Plants are known to respond to temperature constantly. They grow faster as temperature increases, and grow slower as temperature decreases (Challinor et al., 2005). As the temperature increases further, these plants begin to experience stress and the rate of crop development begins to decrease. Temperature difference also affect grain yield. Kalra et al. (2008) noted that winter crops are especially vulnerable to high temperature during reproductive stages and differential response of temperature change (rise) to various crops has been noticed under different production environments. For instance, corn yield increases almost linearly as a function of soil temperature between 15^0C and 25^0C. Above 25^0C, the yield decreases (IPCC, 2007). Oseji (2009) noted that the physical effects of increased surface air temperature include stunted growth, defoliation of leaves, wrinkling of leaves, withered leaves and premature ripening of fruits.

The main components of this flared include carbon dioxide, methane nitrous oxide, water vapor and sulfur dioxide. It is estimated that about 35 million tons of carbon dioxide and 12 million tonnes of methane are released annually into the atmosphere from Nigeria due to gas flaring. This implies that Nigerian oil industry probably contributes more than any other company in terms of these serious global environmental problems.

The presence of these gases in the air disrupts photosynthetic process which reduces growth and result in poor yields of crops (Ossai et al., 1997). Nwaogu and Onyeze (2010) observed that the environmental impact of gas flaring in Ebocha and Egbema communities reveals that the mean values of pH of soil samples collected from both communities have a high acidic value. High soil acidity creates chemical and biological conditions which may be harmful to plants and soil micro-organisms.

The flaring of associated gas in Nigeria has continued to have adverse effect on the environment. It is known to be a major contributor to environmental degradation and pollution of various magnitudes. The aim of this investigation is to determine the thermal effect of gas flaring on the Ebebei community to ascertain if the heat resulting from the flare has any significant impact on the temperature distribution of the area.

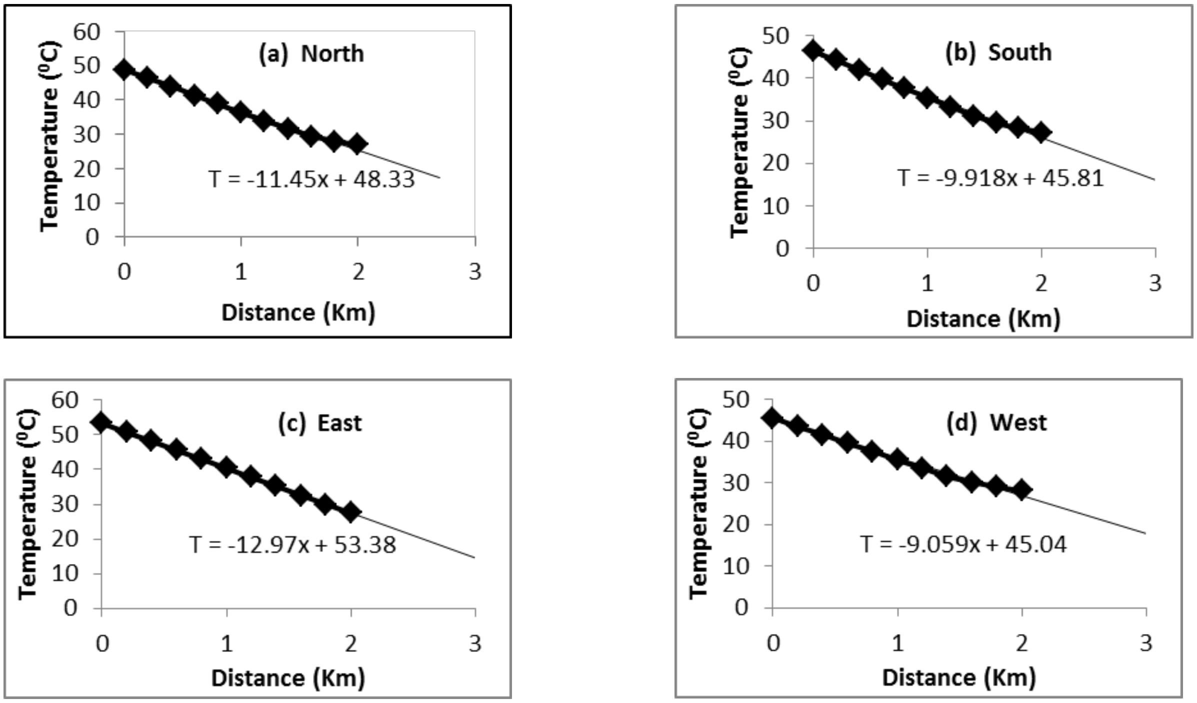

Figure 2: Variation between mean Temperature and Distance for the Rainy Season.

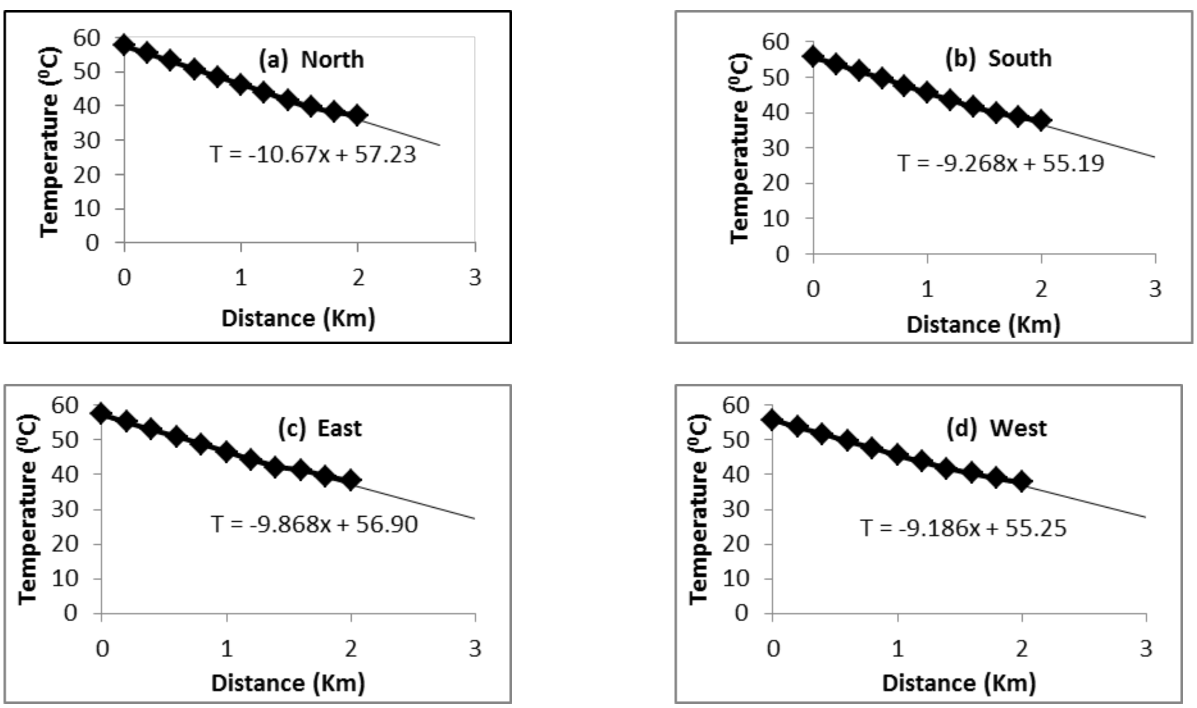

Figure 3: Variation between mean Temperature and Distance for the Dry Season.

MATERIALS AND METHOD

The study area Ebedei as shown in Figure 1 is a community in Ukwuani Local Government Area of Delta State, Nigeria. It lies within longitude 5.86 and 5.90^{0}E and latitude 6.20 and 6.24^{0}N. It is bounded in the North by Ethiope River which flows from the source in Umuaja; in the South by Ebedei-Uno, Akoku-Uno and Utagba-Uno; in the West by Owah Abbi and Obinomba and in the East by Umutu and Umuaja. The main occupation of the people of Ebedei is farming.

In carrying out this study, ten positions with spacing of 200 meters apart were marked on each of the four cardinal directions which are the North, South, East and West. The global positioning system of type GPS 310 which is a satellite receiver and navigator was used to identify the positions marked for measurements. The distance between the measuring points was done with the aid of a rubber measuring tape to check the effect of expansion. The surface temperatures for the marked positions were taken simultaneously using a high sensitive JUMBO digital thermometer. The measurements were taken five times in a day at an interval of two hours each. The satellite record of average daily temperature for the area was also read using the GPS and the values recorded. This procedure was carried out for 15 days within the peak of the wet season which falls within September and October and the dry season between the months of February and March. All measurements were carried out at a height of 1 m above the ground for uniformity.

RESULTS AND DISCUSSION

The temperature measured for each point along the various directions were plotted against the distance from the flare location as shown in Figure 2 for the wet season and Figure 3 for the dry season.

Figures 2 and 3 shows linear relationship between the temperature (T) and distance (x) as shown in Equation 1 for wet season and Equation 2 for the dry season.

$$\left.\begin{aligned} T &= -11.45x + 48.33 \\ T &= -9.918x + 45.81 \\ T &= -12.97x + 53.38 \\ T &= -9.059x + 45.04 \end{aligned}\right\} \quad \mathbf{1}$$

$$\left.\begin{aligned} T &= -10.67x + 57.23 \\ T &= -9.268x + 55.19 \\ T &= -9.868x + 56.90 \\ T &= -9.186x + 55.25 \end{aligned}\right\} \quad \mathbf{2}$$

The mean relationship between temperature and distance for the wet season is obtained as;

$$T = -10.849x + 48.140 \quad \mathbf{3}$$

while the mean relationship for dry season is obtained as

$$T = -9.748x + 56.143 \quad \mathbf{4}$$

The relationship as expressed in Equations 3 and 4 reveals that thermal pollution has occurred within a distance of 2.15 km for the wet season and 2.06 km for the dry season. Beyond these values, the direct effect of the heat from the flaring in the area will be insignificant.

The pattern of distribution of the temperature from the flare point for the wet season as well as the dry season is as shown in Figure 4 and 5, respectively. Both contours show a slit increase in temperature towards the north east direction. This is an indication that the wind direction in the area is towards the north east. The contour in Figure 4 shows a temperature range of 27^{0}C to 52^{0}C for the wet season. This when compared to the mean satellite average daily temperature of 24.8^{0}C for the area shows a temperature range of 2.2^{0}C to 24.2^{0}C higher than the daily average temperature for the area. Figure 5 shows a temperature range of 38^{0}C to 57^{0}C during the dry season. This shows a temperature range of 1.9^{0}C to 20.9^{0}C higher than the average daily temperature of 36.1^{0}C for the dry season.

The implication of this increase beyond the normal average daily temperature shows that most crops farmed in the area will not yield properly. This is in agreement with the findings of Orimoogunje et al. (2010) and Tashiro and Wardlaw (1990) that even moderate increases in temperature will decrease yields of corn, wheat, sorghum, bean rice, cotton and peanut crops. It also buttress the views of the International Protocol on Climate Change (IPCC) that an increases of 1 to 2^{0}C are likely to have a negative effect on yield for major cereals like wheat, maize and rice (IPCC, 2007). However, this is a blessing to farmers of crops that do well in the heat, such as melon and okra.

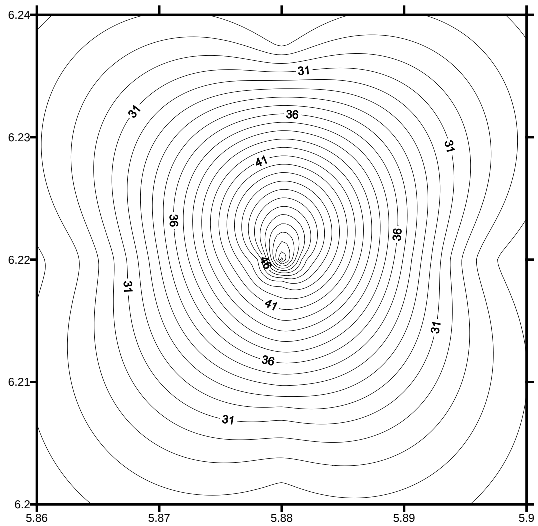

Figure 4: Mean Temperature Distribution of the area during the Rainy Season.

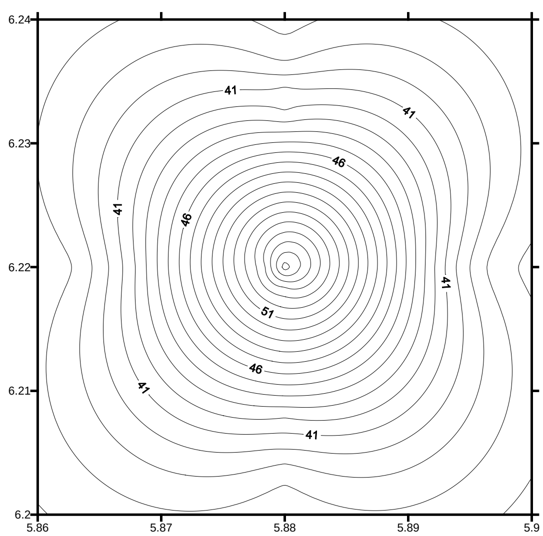

Figure 5: Mean Temperature Distribution of the area during the Dry Season.

The heat radiation resulting from this temperature increase will also affect pathogenic bacteria which are useful to man and aid soil fertility. It is capable of causing discomfort to residence of the area through excessive heat. It is also capable of affecting structures built in the area since it causes acid rain and because of excessive expansion. Beside gas flaring contribute significantly to the greenhouse gas emission and cause global warming.

CONCLUSION

This study has shown that the thermal effect of elevated temperature as a result of flaring gas in Ebedei community extends up to a distance of 2.15 km for the wet season and 2.06 km for the dry season. The study has revealed that the temperature value for the area ranges from 27^0C to 52^0C for the wet season and 38^0C to 57^0C for the dry season. It is recommended that structures which are not temperature resistant should not be planted within the distance of 2.15 km. It is also recommended that the government should do all it takes to end this monster called gas flaring by passing a legislation to stop flaring of gas in Nigeria. The oil company in Ebebei is urged to expedite the completion of the gas plant and put it into use as this will arrest the flaring of gas in the area. The localization of our gas should be enhanced to create the needed market for it within the nation. This will motivate companies to invest heavily in the sector.

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SUGGESTED CITATION

Anomohanran, O. 2012. "Thermal Effect of Gas Flaring at Ebedei Area of Delta State, Nigeria". *Pacific Journal of Science and Technology*. 13(2):555-560.