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# Evaluating the Thermal Impact of Gas Flaring in Kokori, Southern Nigeria

Ochuko Anomohanran[1]

[1] Physics Department, Delta State University, Abraka, Nigeria

Correspondence: Ochuko Anomohanran, Physics Department, Delta State University, Abraka, Nigeria. Tel: 234-803-948-8655. Email: mrochuko@yahoo.com

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**Abstract**

The purpose of this survey is to evaluate the thermal impact of gas flaring in Kokori, Nigeria. This was carried out by measuring the temperature of the study area as a function of distance from the gas flare using a Jumbo digital thermometer. The average daily temperature of Kokori and the surrounding communities was also determined. Result showed that the temperature with respect to distance from the gas flare decreases by a factor of 0.06 °C/m and 0.012 °C/m for both the rainy and the dry seasons respectively. Result also showed that the average difference between the temperature in the gas flaring community and the neighbouring communities is 1.54 °C for the rainy season and 2.70 °C for the dry season. Analysis of the result from this study revealed that the study location has a higher background temperature than the neighbouring communities. This suggests that the study location is thermally affected by the flaring of gas in the area. It is suggested that the flaring location in all oil and gas installations should be located very far from residential communities, while the government is called upon to urgently stop this menace called gas flaring in the country.

**Keywords**: gas flaring, associated gas, greenhouse effect, carbon emission, Kokori

## 1. Introduction

Gas flaring is explained as the burning off of natural gas which is associated with crude oil during extraction. This activity usually occurs in places where there are no capacities or infrastructures to trap and make use of the gas. The process is carried out using a gas flare or flare stack which is an elevated stack that may be vertical or horizontal (Atuma & Ojeh, 2013; Abdulkadir et al., 2013). The primary purpose of flaring the associated gas resulting from crude oil extraction and other gas producing plants is to protect the pipes or vessels from overpressure (Pourhassan & Taravat, 2014).

Natural gas is known to have high economic values and can find relevance either in their raw forms as solvents, feedstock for production of various chemicals and liquid fuels or fractionated into their components (Abdulkadir et al., 2013). This notwithstanding, the major interest of the oil industry is to maximize its monetary profits from oil production. Hence, oil companies find it economically expedient to flare the natural gas and sometimes pay the insignificant fines attached to gas flaring than processing the gas for economic gain for the nation or to re-inject the gas back into the oil wells (Ajugwo, 2013). Gas flaring has been known to account for over 14 billion dollar lose in revenue to Nigeria annually (Anomohanran, 2012). Despite this huge lose in revenue, it has also accounted for the degrading of our environment. Report has shown that Nigeria currently flare about 13 million cubic meters of gas annually (Anomohanran, 2012). This has contributed to the quantity of carbon dioxide emitted into the atmosphere thereby contributing in no small measure to the global warming which has become of great concern to the world at large (Anomohanran, 2011).

The experiences of developed countries in the field of reducing the amount of flared gas reflect the determination and importance the various governments have attached to this issues. These countries by enacting the appropriate laws and regulating standards have been able to reduce the waste of associated gas and convert it to economic fortune for their countries (Pourhassan & Taravat, 2014).

One of the significant effects of gas flaring is its contribution to climate change. Gas flaring has led to the warming up of the world, a situation which is expected to get even worst. Nigeria is one of the highest emitter of greenhouse gases in Africa and among the highest carbon dioxide emitters in the world (Orimoogunje et al., 2010). Report has

it that more than 26 million metric tons of carbon dioxide is emitted from gas flaring in Nigeria every year (Anomohanran, 2011).

Ovuakporaye et al. (2012) noted that gas flaring could impact negatively in agricultural, environmental, health and the economic sectors. Agricultural activities on the one hand, have always included adaptation to a number of environmental variables. Climate and weather conditions are good example of factors which are even more significant with climate change. These changes in weather and climate conditions have been recognized as key determinants for success in the agricultural food sector (Orimoogunje et al., 2010). This is why the flaring of gas has affected agricultural yield in such areas.

Ismail and Umukoro (2012) asserted that gas flaring has negative effects on the immediate environment, particularly on plant growth and wildlife. They also observed that natural gas is an important constituent of the world's supply of energy and one of the safest, cleanest and most useful of all energy sources. They said flaring it will degrade energy while mitigating it will stop its resulting environmental degradation. It is noted that the quantity of flared gas in the world is equal to approximately one quarter of the current power consumption of the African continent (Ajugwo, 2013).

Gas flaring is known to result in the release of sulphur dioxide and nitrogen oxides which combines with the atmospheric moisture to form sulphuric acid and nitric acid respectively. The impact of this is that the resultant rain damages vegetation and affect and cause decay of building materials such as paints and roof. Also, the release of the oxides of nitrogen, carbon and sulphur causes the soil to be acidic and thus deplete the soil nutrient (Ajugwo, 2013).

The residents of Kokori have long been exposed to the presence of flared gas in the locality, hence it has become important that a study to find out the effect of the gas station in the community be carried out. This study will thus provide information on the impact of the flaring on the host community, Kokori and will serve as a base for future assessment and mitigation.

## 2. Materials and Methods

The study is carried out in Kokori Gas Station situated in the Niger Delta area of Nigeria, West African. It is located along latitude 5.6312° North and longitude 6.0351° East (Figure 1). It has an elevation of about 15 m while the topology is generally flat. The people of the area are mainly farmers with a handful, working in the gas station. The area is characterised by two seasons namely the rainy season which runs from April to September and the dry season which runs from October to March every year. In carrying out this study, measurement of temperature of the surrounding was taken using a Jumbo Digital Thermometer which is known to be very sensitive to environmental temperature changes. Some predetermined positions from the flare point was noted and marked for the measurements along the four cardinal points of north, east, west and south. This is to enable a fair determination of the temperature distribution in all directions. The temperature distribution was taken at these positions for seven days during the dry season and another seven days during the rainy season. The values obtained were average for each location to obtain the average daily temperature for each particular measuring point. The temperature at the residential area in Kokori was also measured and compared with temperatures of the neighbouring communities to evaluate the difference in temperature and to ascertain the thermal effect of gas flaring if any on the host community.

## 3. Results and Discussion

The record of the temperature at various distances from the flare point for the four cardinal positions of north, east, west and south is presented as shown in Figures 2 and 3. Figure 2 is the record of temperature and distance measured during the rainy season while Figure 3 represents the data collected during the dry season. The data in Figure 2 shows that the rainy season temperature along the north, east, south and west range between 32-52 °C; 33-48 °C; 33-51 °C and 31-49 °C respectively. In the same vein, the data in Figure 3 shows that the dry season temperature along the north, east, south and west range between 36-59 °C; 36-61 °C; 34-58 °C and 37-56 °C respectively.

Analysis of Figures 2 and 3 indicate that the temperature difference within the distance of measurement during the rainy season is 18 °C while the temperature difference within the same distance during the dry season is 23 °C. This is an indication that the temperature will seriously affect the environmental stability of the area around the flare. This high temperature is capable of affecting agricultural yield of many cash crops grown in the area. Analysis of Figure 2 shows that the decrease in temperature with respect to distance from the flare location during the rainy season is 0.060 °C /m while the decrease in temperature with respect to distance from the flare point during the dry season is 0.012 °C/m.

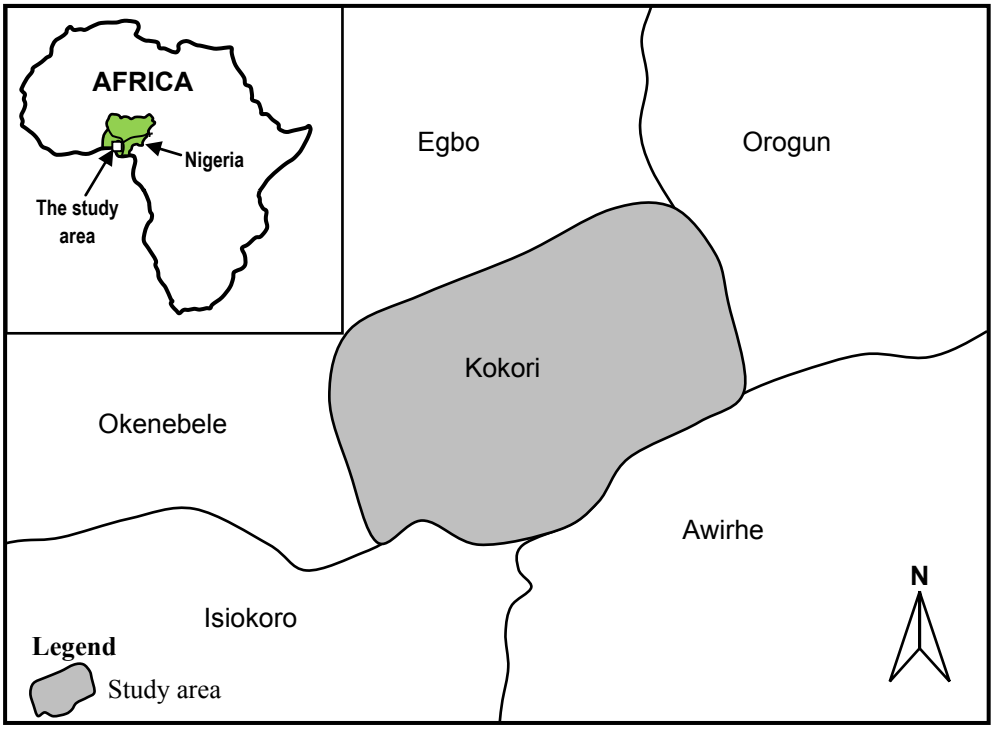


Figure 1. Map showing the study area

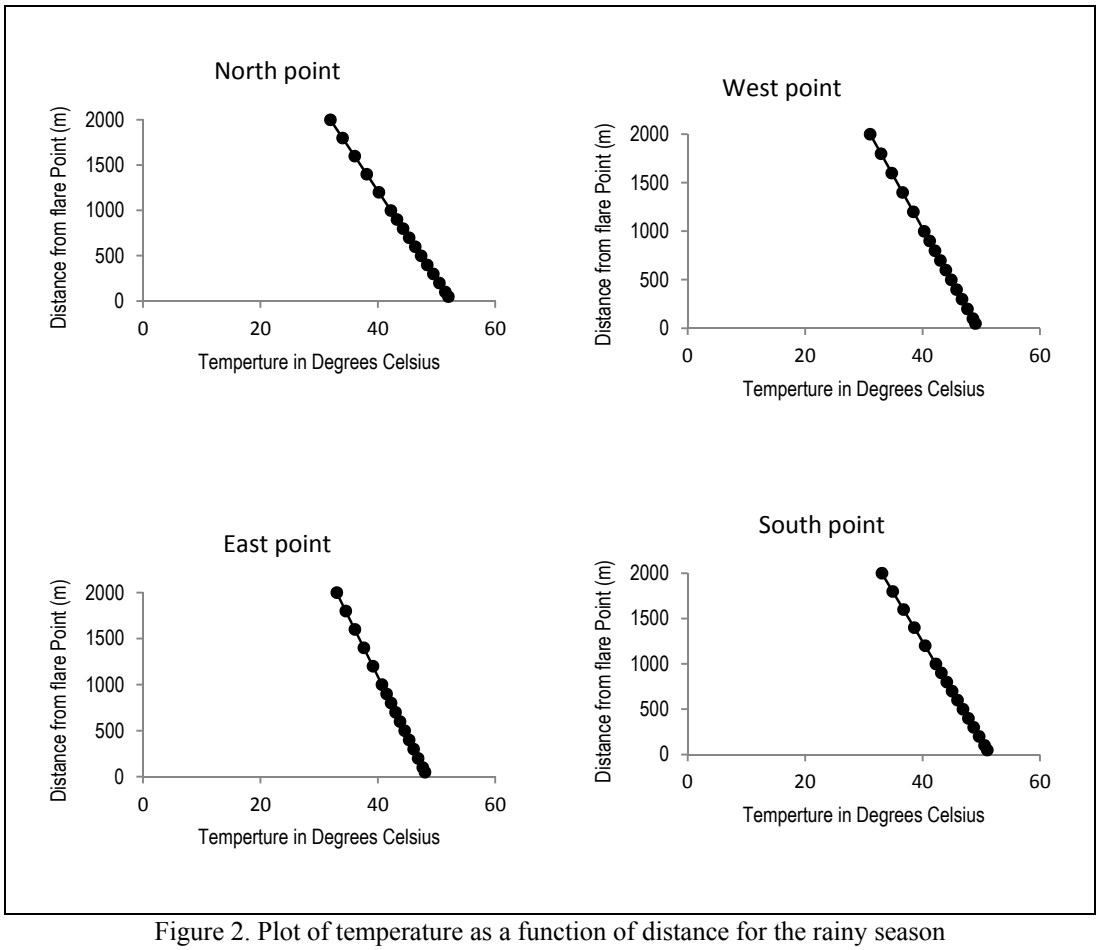


Figure 2. Plot of temperature as a function of distance for the rainy season

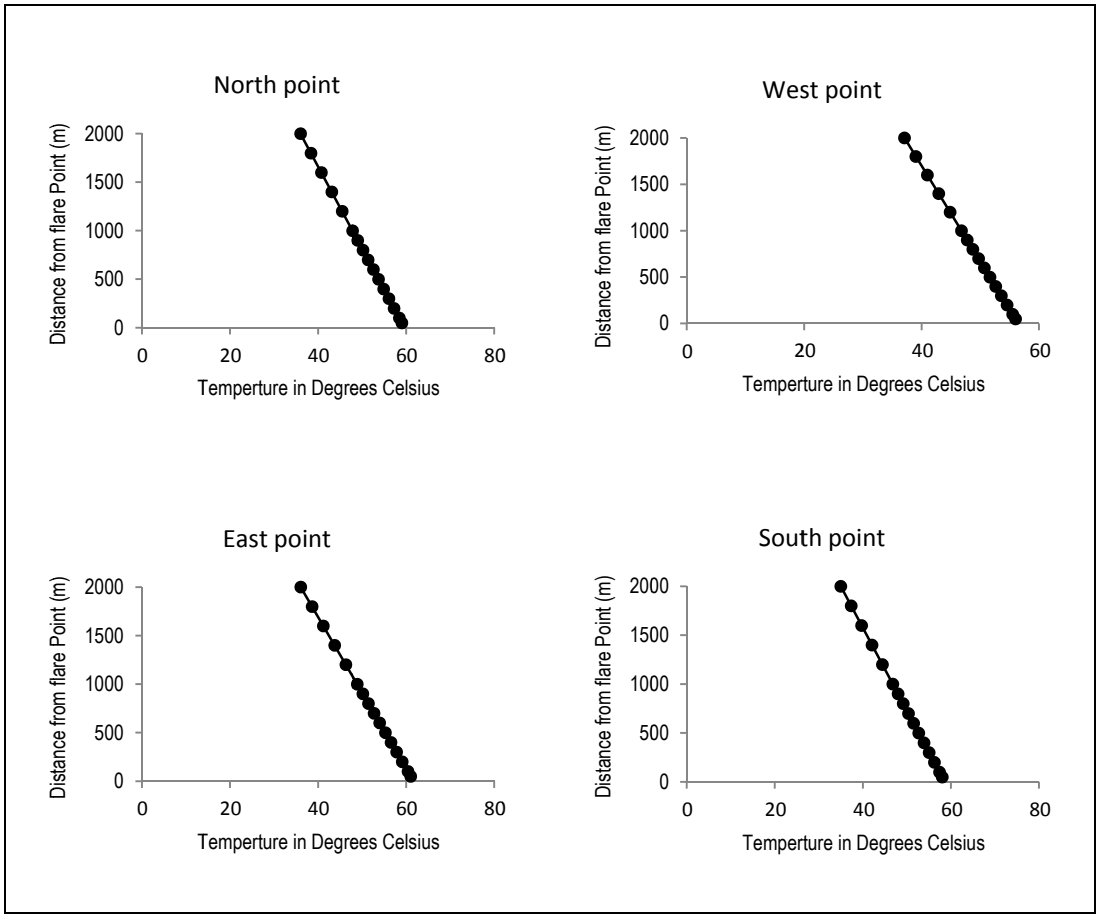


Figure 3. Plot of temperature as a function of distance for the dry season

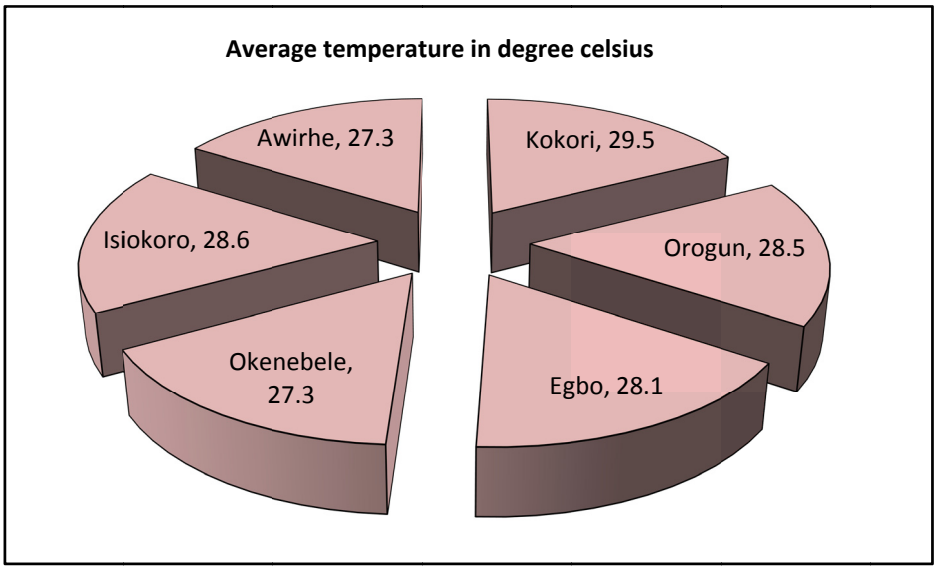


Figure 4. Plot of average daily temperature of Kokori and the surrounding communities for the rainy season

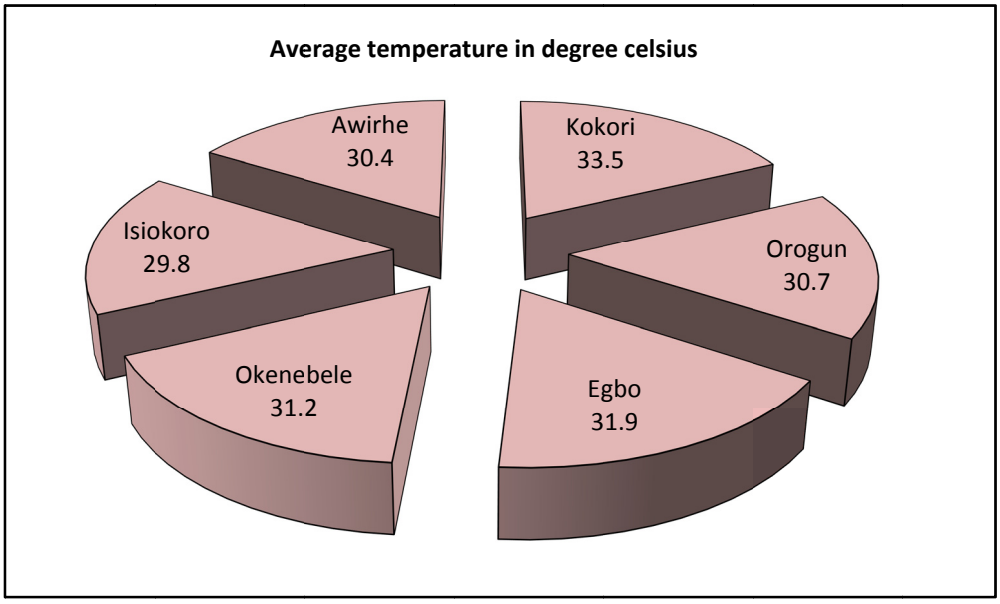


Figure 5. Plot of average daily temperature of Kokori and the surrounding communities during the dry season

The average daily temperature of the study area and the surrounding communities for the rainy season is as shown in Figure 4 while that of the dry season is presented as shown in Figure 5. These two figures show that the average daily temperature for the study area is higher than those of the neighbouring communities. This is an indication that the gas flaring which is done some distance away from the residential area affects the temperature of the host community. This implies that the people of the area may experience excess heat, acid rain, corrosion of metallic roofing sheets, poor yield of some cash crops grown in the area and heat related diseases. Some pathogenic organisms which are useful to human and plants alike may also be affected. This assertion agrees with the findings of Atuma and Ojeh (2013) that gas flaring affects agriculture. This finding also support the opinion of Ghorbani et al. (2008) that gas flaring affects the immediate environment where the flaring occurs and has a negative effect on the overall environment.

## 4. Conclusion

The effect of gas flaring in Kokori, Delta State, Nigeria has been carried out by physical measurement of temperature at some designated distances from the flare point. The average temperature of the host community and all the neighbouring communities were determined. The findings show that the decrease in temperature with respect to distance from the gas flare is 0.060 °C/m for the rainy season and 0.012 °C/m for the dry season. The average difference between the temperature in the host community and the neighbouring communities is 1.54 °C for the rainy season and 2.70 °C for the dry season. The study has therefore shown that the study area has a higher temperature than the surrounding communities. This is an indication that the presence of a gas flaring installation in the area has some thermal effect on the temperature of the community. It is therefore suggested that all gas flaring points in Nigeria should be located far from residential communities. The government is also called upon to do everything possible to eradicate this menace called gas flaring in the country.

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