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ENVIRONMENTAL IMPACT OF GAS FLARING ON EBOCHA-EGBEMA, NIGER DELTA, NIGERIA

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ABSTRACT: *The impact of gas flaring on Ebocha-Egbema environment in the Niger Delta area of Nigeria was investigated. Mbutu Mbaise which has no oil-drilling or gas flaring site, was selected as the control environment. Concentrations of air quality indices: carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), methane (CH_4) and particulate were determined. Air quality measurements in Ebocha were made, at least, 500 meters from the flaring site. Values of important indices of soil physico-chemical parameters: pH, nitrate (NO_3), sulphate (SO_4) and percentage carbon were determined for the two environments. Water samples from the two environments were analysed for their physico-chemical parameters. Results obtained revealed that the mean values for air quality indices, soil and water physico-chemical parameters for Ebocha were substantially higher than those for Mbutu Mbaise except pH values obtained for soil and water, indicating that gas flaring exerts adverse ecological effect on the air, soil and water environments in Ebocha.*

KEYWORDS: air quality, environmental impact, gas flaring. Physic chemical parameters.

INTRODUCTION

The threat to human, animal and plant life posed by pollution due to gas flaring cannot be over-emphasized. Oil companies have long been implicated in the discharge of gaseous pollutants into the environment. Nigeria, being a major producer of crude oil benefits, as well as suffers, from its positive and negative effects due to crude oil drilling and gas flaring respectively ([1]. Over 1.2 billion of world's city dwellers breath highly polluted air, 10% of world's rivers are heavily polluted with discharges from food and allied industries and users of these rivers and streams are constantly exposed to health related risk due to indiscriminate discharge of untreated wastes [2].
Gas flaring is the unscientific burning of excess hydrocarbon gathered in an oil/gas production flow station/site. The most flaring sight in gas production flow station is the ten-meter-high flame that burns continuously from vertical pipes at the many facilities owned by oil companies. One of such is located at Ebocha in Egbema in the Niger Delta. There, the vertical pipes are fed with gas given off during production. The burning of such gases releases huge volumes of green house gases into the atmosphere, while emitted sulphur dioxide returns to the soil as acid rain [3].

Nigeria tops the list of ten countries responsible for 75% of gas flaring emission in the world. She flares 16% of the total associated gas, the highest amount by any country in the world after Russia [5]. These gases are mostly emitted in the Niger Delta area of Nigeria. Inhabitants of the region

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complain of health problems mainly respiratory tract diseases as well as damage to wild life and vegetations [3, 4, 5]. The present study was therefore designed to assess the impact of gas flaring on air, soil and water on Ebocha in Egbema.

METHODOLOGY

Study Area

Air Quality Measurement

Ebocha in Egbema, which houses a gas production flow station and Mbutu Mbaise , which has no flow station, were selected for this study. The study was under taken during the dry season in the month of February. Concentrations of air quality indices were measured 500m, 1000m, 2000m and 5000m away from gas flaring site in Ebocha using Gasman Air Monitor model CE 89/336/EEC which has been pre-calibrated using air cylinder standard for the direct detection of CO, NO_2, SO_4 and CH_4, while that of particulate was measured using Haz Dust Air Particulate Monitor model (HD 1000). Five control locations (A-E) were selected for Mbutu, Mbaise and the concentrations of the indices were measured at each location at 15 minutes interval for CO, NO_2, SO_4, CH_4 and particulates at a distance of 1000m apart.

SAMPLE COLLECTION

Soil Samples. Top soil samples were collected from the two environments using augur and transported to the laboratory for analyses.

Water Samples. Water samples were collected from the two environments using sterilized 1.5litre transparent plastic containers. All samples were transported to the laboratory for analyses within two hours of collection.

Sample Preparation and Analyses

Soil samples were collected, air-dried and sieved using a 2mm (No.10 mesh) sieve. Coarse primary particulates were discarded and the fraction that passed through the 2mm sieve was the fine soil samples used for the analyses. Soil physicochemical parameters determined included pH, nitrate, sulphate and percentage carbon. pH of the soil was determined using Beckman Zerometric pH meter (Model 55-3) with fresh soil sample dispensed in water in the ratio of 1:25. Nitrate and sulphur concentrations were determined using the Palin test methods, while percentage carbon was determined using the method of Walkley and Black as described by [6].

Water physicochemical analyses

Parameters analysed include pH, total dissolved solids (TDS), total suspended solids (TSS), total solids (TS), calcium hardness, total hardness, alkalinity (bicarbonate), sulphate (SO_4), nitrate (NO_3), chloride (Cl^- and phosphate (PO_4). The pH was measured using micro meter (pH-600 Milwaukee) standardized with buffer solutions to between pH 7 and 14 as described by [7]. Alkalinity, total dissolved solids and total suspended solids were determined as described by [2]. Total solids determination was carried out gravimetrically using evaporating dish as described by [8]. Nitrate, sulphate, phosphate and chloride concentrations were determined as described by [2].

Table 1: **Results for air quality assessment**

	Ebocha (Egbema)				**Mbaise Locations**					
Parameters (mmol/L)	500 (m)	1000 (m)	2000 (m)	5000 (m)	A	B	C	D	E	FEPA Std. (mmol/L)
CO	20.00± 0.010	15.00± 0.012	12.00± 0.012	10.0 ± 0.018	0.00	0.00	0.00	0.00	0.00	10.0
NO_2	0.50 ± 0.05	0.50 ± 0.02	0.40 ± 0.01	0.30 ± 0.01	0.01	0.00	0.00	0.01	0.00	0.04-0.06
SO_2	0.40 ± 0.005	0.40 ± 0.012	0.30 ± 0.009	0.20 ± 0.009	0.00	0.00	0.00	0.00	0.00	0.01
CH_4	0.50 ± 0.009	0.50 ± 0.009	0.40 ± 0.012	0.30 ± 0.009	0.00	0.00	0.00	0.00	0.00	10.0
Particulates	1.60 ± 0.015	1.50 ± 0.012	1.30 ± 0.012	1.50 ± 0.012	0.02	0.02	0.02	0.02	0.02	0.1

Key: A = Enyiogugu, B = Mbutu, C = Uvuru, D = Ahiara junction, E = Ogbe Ahiara

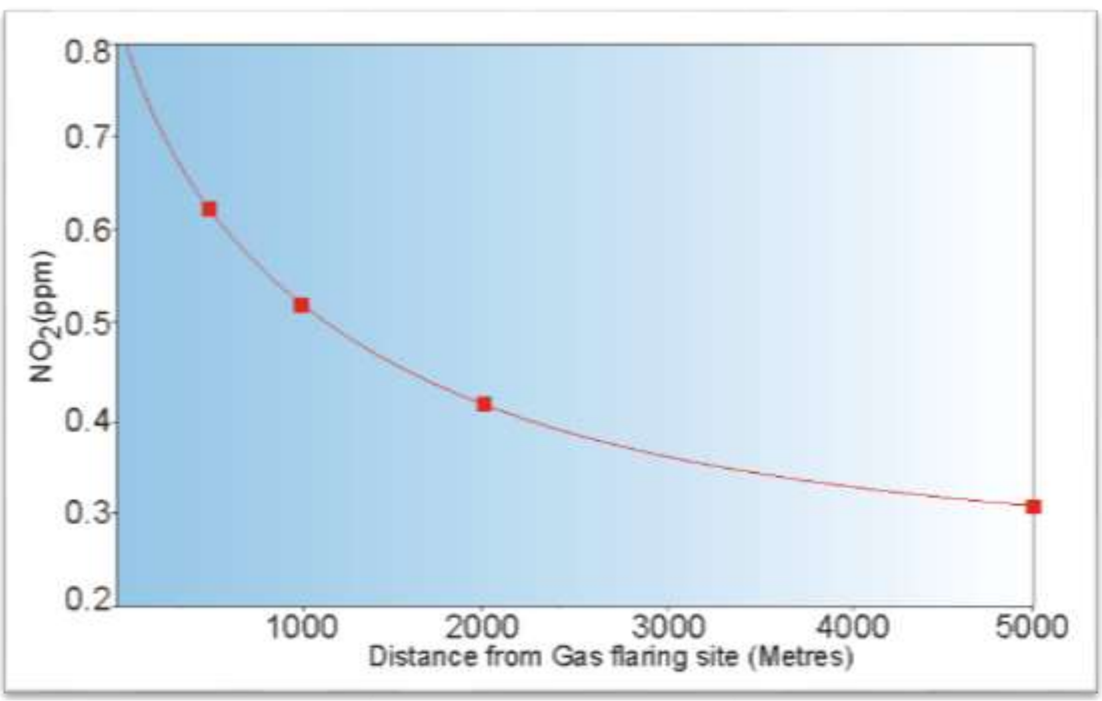

Figure.1: Carbon monoxide concentration at Ebocha in Egbema.

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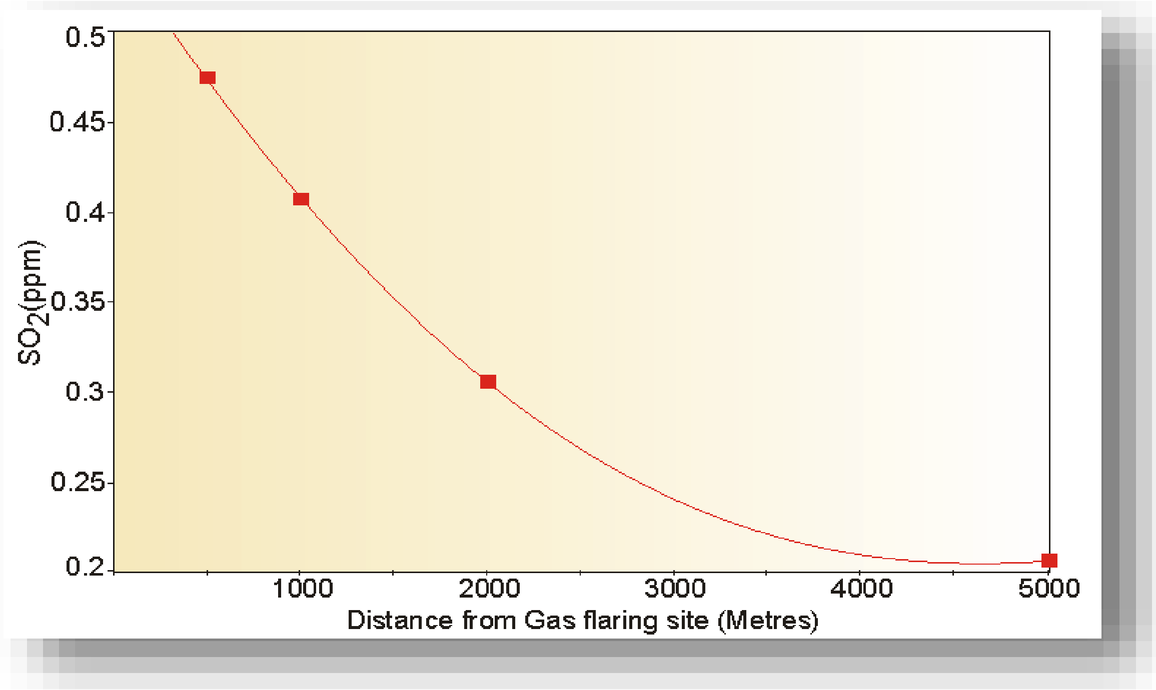

Figure 2: Sulphur dioxide concentration at Ebocha in Egbema

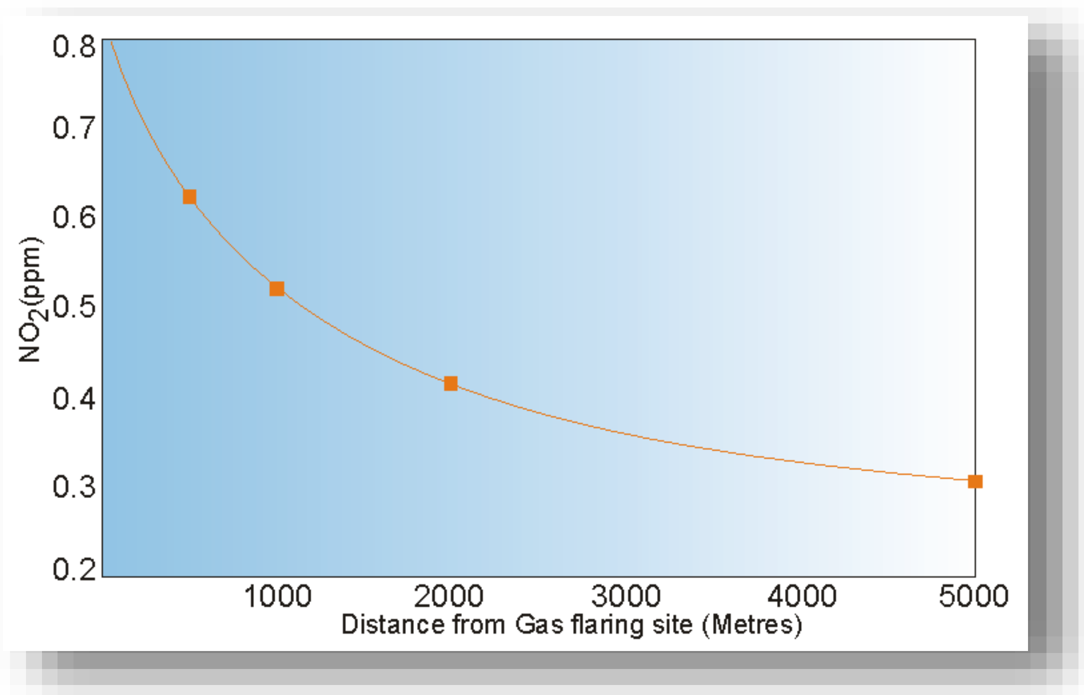

Figure 3: Nitrogen dioxide concentration at Ebocha in Egbema

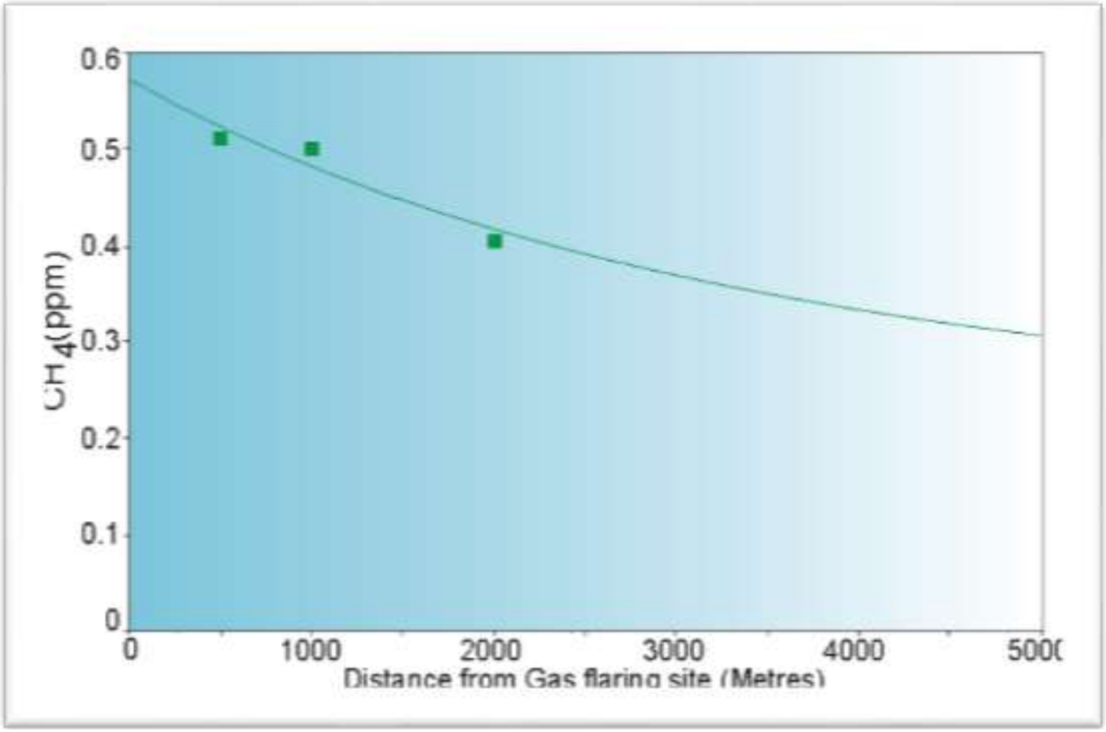

Figure 4: Methane concentration at Ebocha in Egbema.

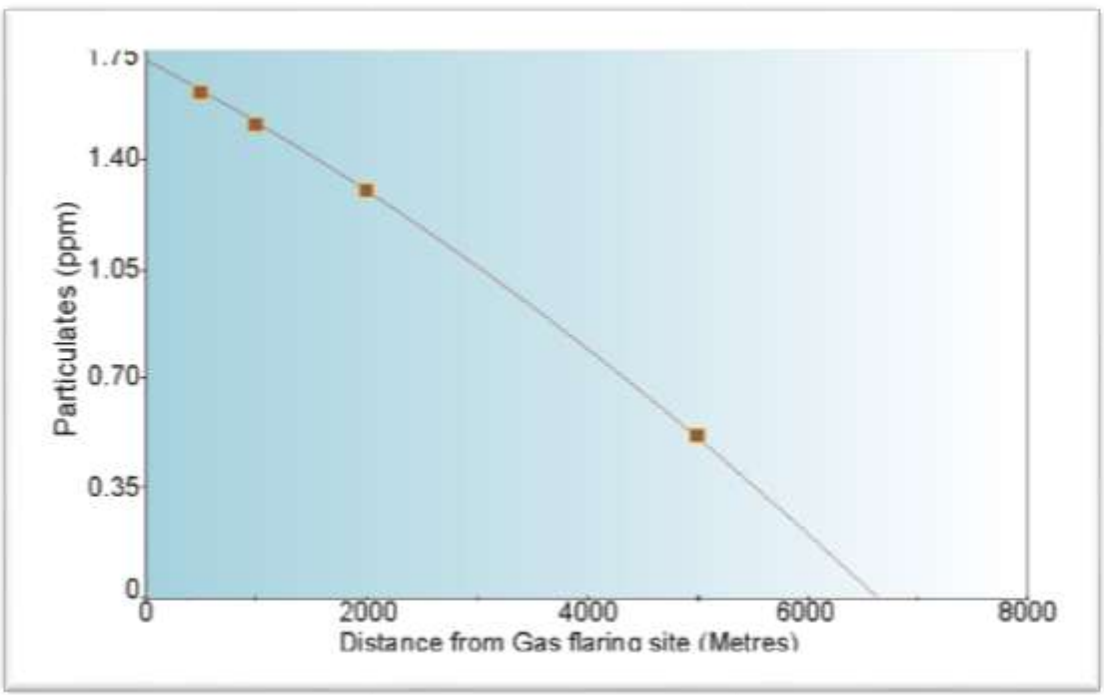

Figure 5: Concentration of particulates at Ebocha in Egbema,

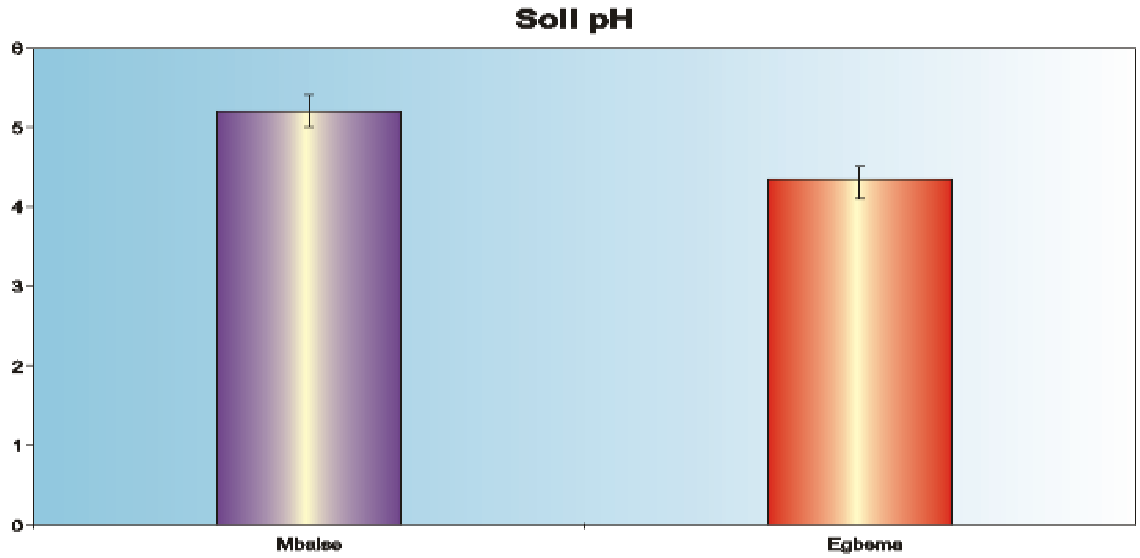

Fig. 6: pH of soil samples from Mbaise and Egbema.

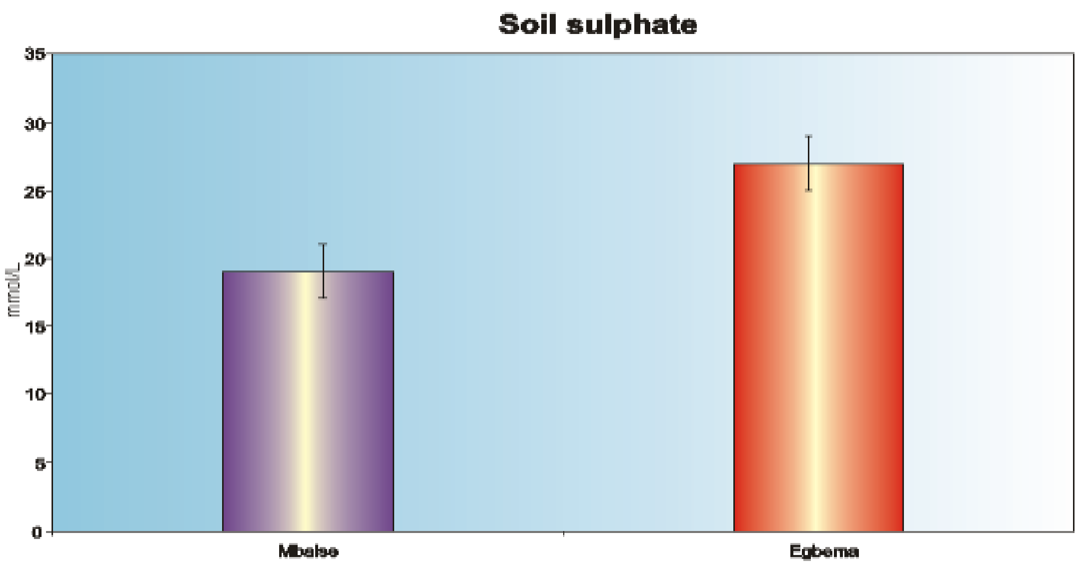

Fig. 7: Sulphate concentrations of soil samples from Mbaise and Egbema

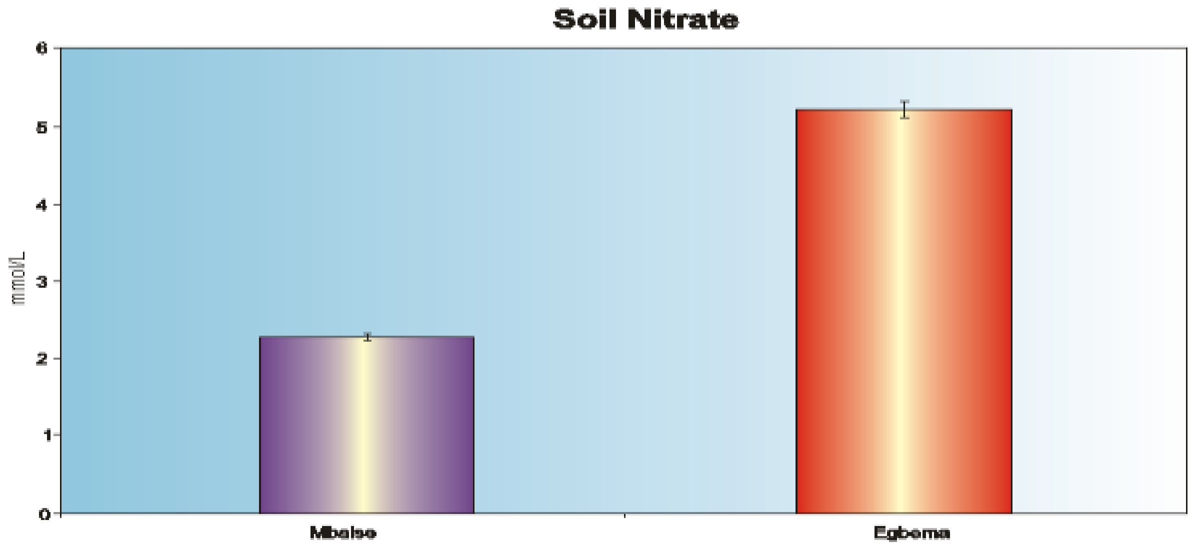

Fig. 8: Nitrate concentrations of soil samples from Mbaise and Egbema

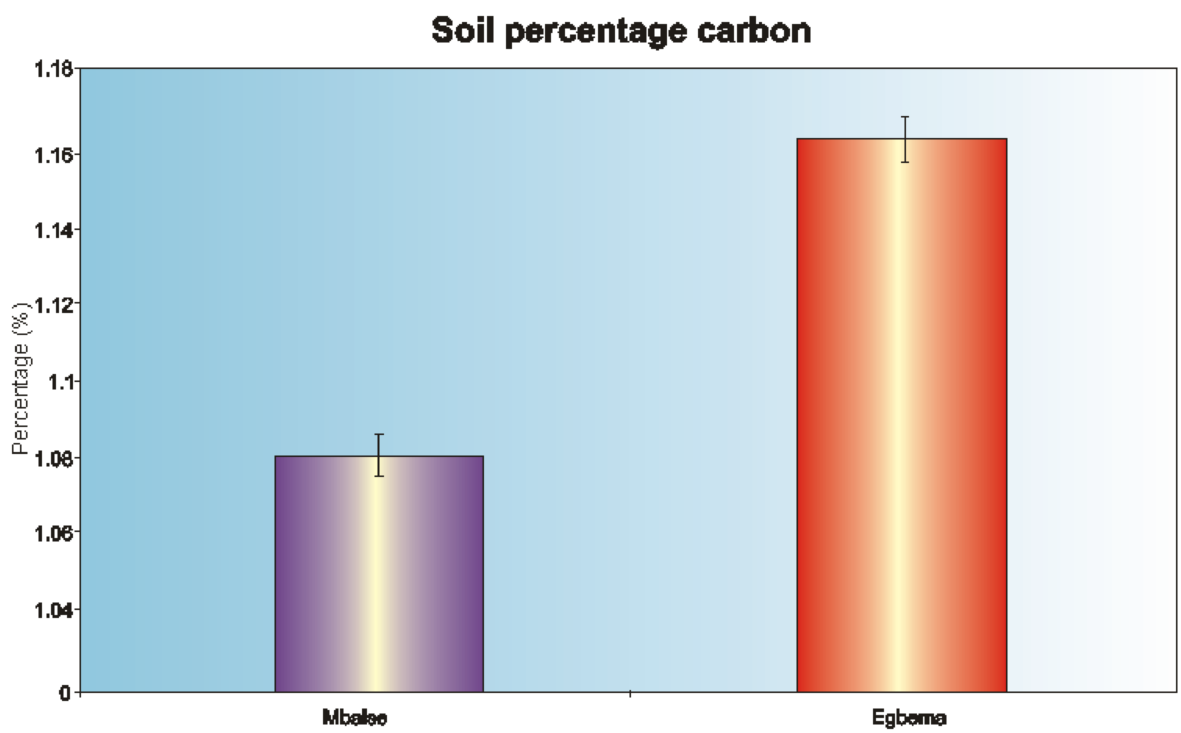

Fig. 9: Percentage carbon contents of soil samples from Mbaise and Egbema.

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Table 2: Values of water physicochemical parameters and WHO/FEPA Standard

Physicochemical parameters (mg/l)	Water samples		WHO/FEPA Standards
	Ebocha	Mbutu	
pH	5.2	6.58	6.5 – 8.5
Total hardness	192±1.20	40.0±1.40	0 - 0.5
Calcium hardness	160±1.30	12.0±1.25	No limit
Total solid	800±10.0	70.0±2.22	No limit
Chloride	56.74±2.50	1.28±0.03	250
Total dissolved solid	600±5.20	66.0±1.30	100 – 1000
Total suspended solid	200±2.50	4.0±0.25	No limit
Alkalinity	73.75±3.25	2.25±0.22	No limit
Sulphate	12.0±1.22	2.50±0.25	250 -500
Phosphate	0.126±0.02	0.008±0.002	<5.0
Nitrate	8.00±0.02	2.00±0.01	10

Values are means ±S.D. of three determinations

RESULTS AND DISCUSSION

Gas flaring for about four decades has contributed to the high pollution level in Ebocha, Egbema. Definitely, the ecosystem has received the impact of the pollution. Soots were seen on the vegetation within the communities around the flaring site. That was a strong indication of environmental pollution.The results of air quality measurements taken at varying distances away from the gas flaring site are presented in Table 1 and Fig. 1. Values obtained for all the parameters (CO, NO_3, SO_4, CH_4 and particulates) from Ebocha were above the [9, 10] standard/permissible limit for normal environment, and were markedly higher when compared to values for communities in Mbutu Mbaise. The mean values of all the air quality indices decreased as the distance from the flaring site increased indicating that gas diffusion increased with increasing distance. This collaborates the work of [11].

The results for soil physicochemical parameters (pH, sulphate, nitrate, and percentage carbon) are presented in Fig. 2. The mean values of pH of soil sample from both environments revealed that the sample from Ebocha was more acidic (pH 4.34) than that from Mbutu Mbaise (pH 5.21). High soil acidity creates chemical and biological conditions which may be harmful to plants and soil microorganisms. One of such conditions is the reduction in the capacity of plants to absorb cations [12]. The higher acidic nature of soil from Ebocha is attributable, at least in part, to the high concentrations of sulphur dioxide and particulates from the gas flared into the atmosphere which is washed back to the soil as acid rain. This observation agrees with the reports of [13] who noted that gas flaring increased soil acidity.

Sulphate is essential for normal plant growth. Crops grown on soil with low sulphur content exhibit sulphur deficiency. Nitrate is also an important plant nutrient, which promotes foliage growth and increase crop yield [13]. There were significant ($p<0.05$) in the concentrations of sulphate and nitrate from Ebocha soil when compared to those obtained for the anions from Mbutu Mbaise soil. This observation is attributed to the high pollution level due to gas flaring in Ebocha, although the values for both NO_3 and SO_4, are below [9, 10] soil standards.

Organic carbon content of soil is a major component of the soil organic matter. Organic matter from soil is derived from residual plant and animal materials synthesized by microorganisms and decomposed under the influence of temperature, moisture and optimum soil conditions [13]. The result of percentage carbon content from Ebocha soil was higher (1.16%) than that from Mbutu soil. This is due to high petroleum hydrocarbon pollution as a result of gas flaring in Ebocha when compared to Mbutu Mbaise.

Table 2 shows the values of the physicochemical parameters of the water samples from the two environments. The pH of the samples ranged from 5.42 for Ebocha to 6.58 for Mbutu. The Institute of Public Analysis of Nigeria (IPAN), reported that the pH of water is one the most important water parameters. An optimal pH range is very important for clarification of portable water, while a range outside the acceptable standard could lead to objectionable taste. Water samples from Ebocha (a polluted area) deviated from [9. 10] permissible pH range of 6.6-8.0. Thus, the water from Ebocha was found to be quite acidic (5.42), a value that could cause a shift in normal metabolism of living things within an ecosystem.

The water sample from Ebocha had higher values for phosphate, sulphate and chloride when compared to that from Mbutu. This result agrees with the report of [14] who studied the physicochemical parameters and heavy metal contents of water from mangrove swamps. These compounds are essential for normal metabolism in plants and animals, as they serve as nutrients. When the plants eventually die, their debris undergoes aerobic biodegradation leading to anoxic conditions in water, which could have detrimental effects on aquatic organisms that require dissolved oxygen.

The concentration of calcium and total hardness in water sample from Ebocha were high when compared to the values obtained for water from Mbutu. The difference is attributable to the detrimental effects gas flaring has on the portal water consumed in Ebocha and its environs.This collaborates the report of [14] who worked the physicochemical parameters and heavy metal contents of water from mangrove swamps of Lagos, Nigeria.

CONCLUSION

Based on the results from the present study, it was concluded that pollution due to gas flaring has negative impact on Ebocha environment (air, soil and water). This is obvious from the results of air quality indices and those of soil and water determined. Values higher than the WHO/FEPA permissible standard were obtained for air quality indices. This portends adverse consequences on the inhabitants around the flaring site. Communities living around the environment should be enlightened on the dangers inherent in exposure to gas flaring, while oil companies should be compelled to stop gas flaring through legislation so as to reduce the detrimental effect of green house gases on the health and well being of the inhabitants of areas harboring the gas flare stations.

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