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Gas flaring effects on temperature change in Amai Community area in Niger Delta region of Nigeria

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Abstract:*This paper discusses the effects of gas flaring on the average temperature change in Amai community in Niger Delta region. This study focused on effects of gas flaring on temperature change (notably climate change) and effects of environmental pollution on temperature change. The study was carried out in Amai area in Niger Delta region. This research is aimed at determining the effects of the rise in temperature due to the flaring of gas in Niger Delta. Using the available data and information on volume of oil explored, volume of gas flared and temperature within corresponding period. To keep record of data the impact of industrial activities (oil exploration and exploitation) have made on the temperature of the Amai community.*
Keywords: Temperature change, gas flared, Amai community, elevation and distance.

I Introduction

The negative effects of oil exploration and exploitation in Nigeria Delta have been very glaring. [1] Stated that "oil exploration and exploitation has over the last four decades impacted negatively on the socio-physical communities, massively threatening the subsistent peasant economy and the environment and hence the entire livelihood and basic survival of the people". Its implies that all over the world, the lives of people are affected negatively and the destiny of nations are determined by the result of oil explorations. Oil keeps the factors of the industrialized countries working and provides the revenues, which enable oil exporters to execute ambitions national and economic development plans.

The Niger Delta is located in the Atlantic coast of southern Nigeria where River Niger divides into numerous tributaries [4].

The region span over, 20,000 squares kilometers and it has been described as the largest wetland in Africa and among the three largest in the world. It lies within latitude 4 to 6 degrees north, and 5 to 8 degree east. The process of formation of the present Delta started about 75,000 years ago and over centuries accumulations of sedimentary deposits washed down the River, Niger and Benue. Politically, the Niger Delta cuts across Cross River States in southern Nigeria, which include; Akwa-Ibom, Bayelsa, Cross River, Delta, Edo, Imo,Ondo and Rivers. The region is divided into four zones namely: coastal inland zone, freshwater zone and low rain forest zone [5]. From the oil spills to round the dock gas flares and effluents from industrial wastes, the fragile ecosystem of Niger Delta is under constant assault. The temperature of this region has greatly changed with time due to persistent oil exploration and exploitation activities that have led to rise in the amount of carbon in the atmosphere and consequently a constant rise in temperature.

The location of gas flaring sites close to inhabited area is an important environment anomaly that was observed. Amai Community in Emuwa Local Government Area, of Delta state the community hosting ELF station: The flaring site was located about 250 meters from inhabited houses in the community. The community members complained of high ambient temperature resulting from the flaring site. In the host communities gas flaring is a cause of acid rains that corrode metal roofing sheets at the top houses, increase soil temperature and visibly damage vegetation near the flares.

The Niger Delta is highly susceptible to adverse environment changes cause by climate change and chiefly a change(s) in the temperature of the region. Niger Delta is located in the coastal region of the world coastal regions of the world are already experiencing flooding due to rise in sea level due to melting of polar ice a consequence of increase in temperature [2]. Undoubtedly, it is worthy of note that oil exploration and exploitation had adversely affected temperature change in Amai area of the Niger Delta. And indeed, this is going to form a focus to this research work.

- Gas flaring, which is the combustion of the unutilized excess gas during oil exploration which leads to the emission of carbon (iv)oxide, nitrogen(iv)oxide, nitrogen (ii)oxide, hydrogen sulphide,sulphur(iv)oxide sot, smoke, light and being an exothermic reaction also produces heat according to the equation below.

  $CH_4 + 2O_2 - 2H_2O + CO_2$ H = -890Kj

  Gas flare products are the gases that are emitted during gas flaring due to complete or

incomplete combustion of carbon compounds which are harmful to communities. [3]
Immediate impact of gas faring and venting manifest high and rising temperature in the communities close to flare sites and beyond, acidification of rainwater, deposits of black powder covers. These result in crop growth retardation, distortion of aquatic life and respiratory disorders, all of which combine to put health and livelihood at risk in the Niger Delta. Many different communities, including fishermen and farmers have for decades being confronted with difficulties arising from gas flaring.

II. Materials And Methods

Various materials and instruments were used in this study which include:Meteorological data on temperature, data for volume of gas flared (NNPC),data for volume of oil explored and exploited, Journals, government and non-governmental files.

2.1 Meteorological data on Temperatures: These are normally the wet and dry bulb thermometers. They are placed in a Stevenson's screen; this is a standard housing for meteorological thermometers. Here maximum and minimum readings are taken for the temperature of the atmosphere. Meteorological data for temperature averages within the periods with the instrument.

2.2 METHOD OF DATA ANALYSIS: The method of data analysis employed in this study is correlation analysis. Data for volume of oil explored and exploited and volumeof gas flared is compared with temperature averages within corresponding periods. This is to determine the relationship between the volume of oil exploited and volume of gas flared and temperature within the corresponding periods.

III Results And Discussion

Table 1; **Data Showing Gas Production, and total Flares in the Niger Delta (In Million Cubic Meters) from 1978 – 2000**

Years	Temperature maximum	Temperature minimum	Gas produced	Gas flared	Crude oil produced
1978	30.7	22.78	21306	19440	696324
1979	30.84	22.97	27619	26073	845463
1980	30.68	22.89	24551	22904	760117
1981	31.11	22.74	17113	14162	525291
1982	30.82	22.76	15382	11940	470538
1983	31.33	22.95	15192	11948	450961
1984	31.36	22.43	16255	12817	507487
1985	30.98	22.87	18569	14846	547088
1986	30.82	22.68	18739	13917	535929
1987	31.7	23.25	17085	12291	483269
1988	31.08	23.16	20253	14737	529602
1989	31.25	22.55	25053	18730	625908
1990	31.19	23.4	28163	21820	660559
1991	30.89	23.21	31587	24588	689850
1992	30.95	22.65	32465	25406	711340
1993	31.4	22.8	33445	25908	691400
1994	31.16	22.46	32793	26216	696190
1995	31.53	23.00	32980	26070	715400
1996	31.25	23.06	36970	26820	740190
1997	31.3	22.88	36754	26548	759710
1998	30.2	22.71	29645	13818	621 650
1999	30.46	23.10	30 631	23413	553 780
2000	31.50	22.40	22 512	14209	712 630

Table 2: Data Showing Gas Production, Utilization and total Flares in the Niger Delta (In Million Cubic Meters) from 1978 – 2000

Year	Production	Utilization	Flaring	Flaring %
1978	21306	1866	19440	91.24
1979	27619	1546	26 073	94.40
1980	24 551	1 647	22 904	93.29
1981	17 113	2 951	14 162	82.76
1982	15 382	3 442	11 940	77.62
1983	15 192	3 244	11 948	78.65
1984	16 255	3 438	12 817	78.85
1985	18 569	3 723	14 846	79.95
1986	18 739	4 822	13 917	74.27
1987	17 085	4 794	12 291	71.94

1988	20 253	5 516	14 737	72.76
1989	25 053	6 323	18 730	74.76
1990	28 163	6 343	21 820	77.48
1991	31 587	7 000	24 588	77.84
1992	32 465	7 058	25 406	78.26
1993	33 445	7 536	25 908	77.46
1994	32 793	6 577	26 216	79.94
1995	32 980	6 910	26 070	79.05
1996	36 970	10 150	26 820	72.55
1997	36 754	4 696	26 548	72.23
1998	29 645	15827	13 818	46.61
1999	30 631	7218	23 413	76.44
2000	22 512	8303	14 209	63.12
Average:	**25437.5**	**10450.4**	**28635.7**	**77.02**

Source: Nigerian National petroleum Corporation (NNPC)

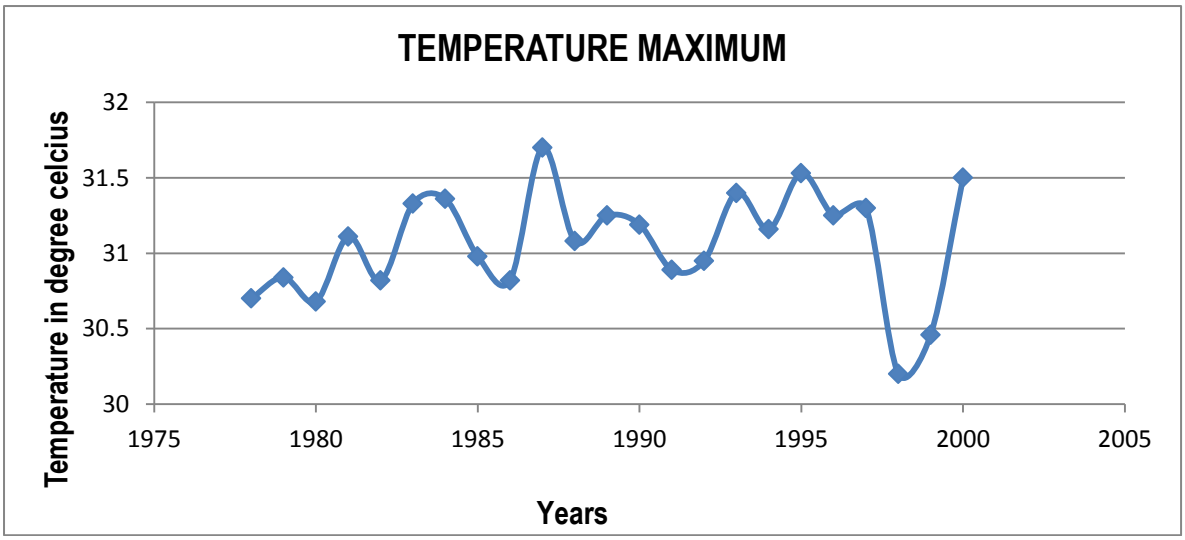

FIGURE 1.0: TEMPERATURE RISE

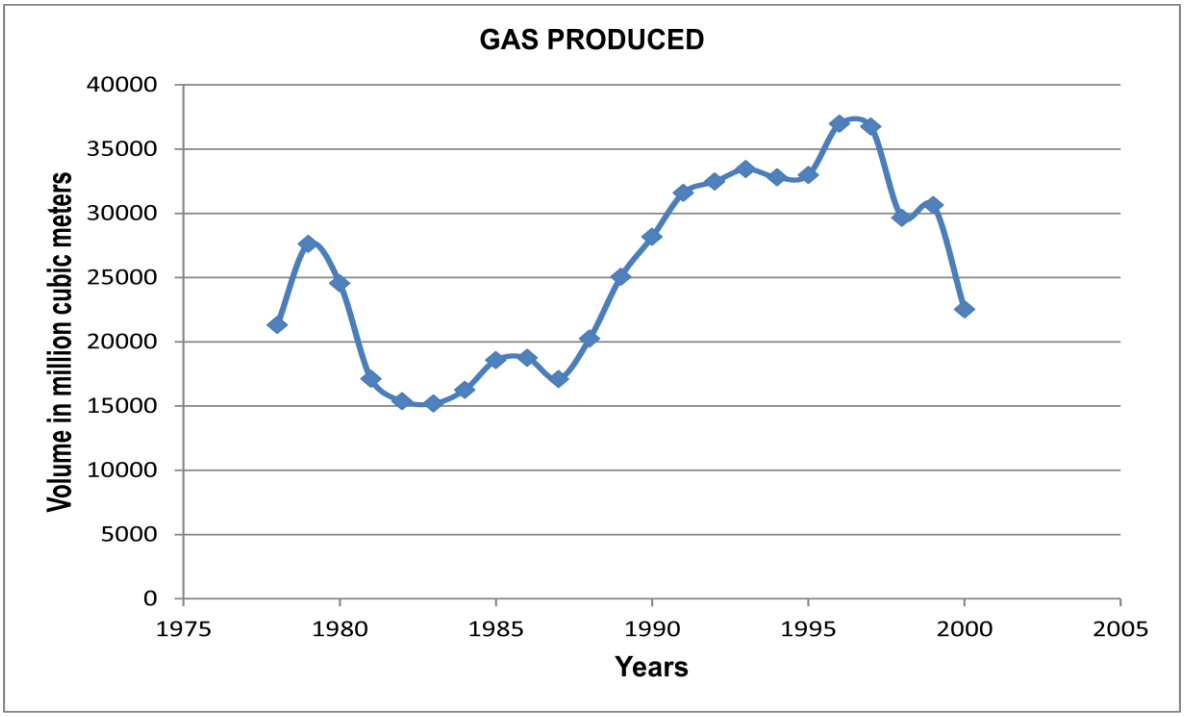

Figure 2.2: Volume of Gas Produced

Table 1, shows annual total gas, crude oil production, quantity of gas flared, and annual mean minimum and maximum temperature in the Niger Delta region between 1978 and 1997. From figure 1 and 2,it is observed directly that the distribution curve, the maximum and minimum mean temperature of the region as at 1978 was 30.7^0c and 22.78^0c respectively with an increase in 1979 to 30.84^0c and 22.97. The temperature of the region as shown in the distribution did not fall below 30.68^0c and 22.43^0c, but instead kept increasing with years.

The graph of gas produce between 1978 and 1997 shows an increase in quantity produced in 1979, a decrease in 1983, slight increase in 1986 and a decrease in 1987,then an even increase in the volume produced continues over the years or period. Indicating that the total volume of gas produced, 80.55% is flared to the surrounding environment, which is quite harmful.

In figure 2.4, the distribution curves shows and maintains the fact that the vast majority of natural gas found in Nigeria is associated, meaning that it occurs in crude oil reserves as free gas. This is clearly shown in the even relation and distribution correction coefficient that exist between them. This implies that the quantity of crude oil explored determines the volume of gas flared and hence affects the temperature of the region.

Table 4: Table showing Correlation between volumes of gasFlared and condensed temperature within corresponding period 1978 and 1997

Years	**Volume of gas flared(x)**	**Annual mean tempt(Y)**	**X^2**	**Y^2**	**XY**
1978	19440	26.74	377 913 600	715.0276	519 825.6
1979	26073	26.90	679 801 329	723.61	701 363.7
1980	22904	26.79	524 593 216	717.7041	613 598.16
1981	14162	26.93	200 562 244	725.2249	381 382.66
1982	11940	26.79	142 563 600	717.7041	319872.6
1983	11948	27.14	142 754 704	736.5796	234268.72
1984	12817	26.89	164 275 489	723.0721	344 649.13
1985	14846	26.92	220 403 716	724.6864	344 649.13
1986	13917	26.75	193 682 889	715.56864	399 654.32
1987	12291	27.48	151 068 681	715.5625	372 279.75
1988	14737	27.12	217 179 169	755.1504	337 756.68
1989	18730	26.9	350 812 900	735.4944	399 667.44
1990	21820	27.29	476 112 400	723.61	503.837
1991	24588	27.05	604 569 744	744.7441	595 467.8
1992	25406	26.8	645 464 836	731.7025	665 105.4
1993	25908	27.1	671 224 464	718.24	680 880.8
1994	26216	26.81	687 278 656	718.7761	702 106.8
1995	26070	27.27	679 644 900	743.6529	710 928.9
1996	26820	27.16	719 312 400	737.6656	728 431.2
1997	26548	27.09	704 796 304	733.8681	719 185.32
	Σ x=397181	$\sum Y = 539.92$	$\sum X^2 = 8554015241$	$\sum Y^2 = 145764854$	$\sum XY = 107112.94$

$$\sum \boldsymbol{X = 397181}$$
$$\sum \boldsymbol{Y = 539.92}$$
$$\sum \boldsymbol{X^2 = 8554015241}$$
$$\sum \boldsymbol{Y^2 = 145764854}$$
$$\sum \boldsymbol{XY = 10723112.94}$$

n = 20

The correlation coefficient of volume of gas flared, x and temperature y is given by

$$r = \frac{covariance\ (XY)}{\sqrt{S^2X.S^2Y}}$$

$$= \frac{S^2XY}{\sqrt{S^2X.S^2Y}}$$

But covariance is given as:

$$S^2XY = \frac{\sum XY}{n} - \frac{\sum X}{n}\frac{\sum Y}{n}$$

Putting the values obtained from the table above becomes;

$$S^2XY = \frac{10723112.94}{20} - \frac{397181}{20}.\frac{539.92}{20}$$

$$= \frac{107\ 23112.94}{20} - \frac{214\ 445965.5}{400}$$

$$= 536\ 155.647 - 536\ 114.9138$$

$$S^2XY = 40.7332 = covariance$$

Variance of X is;

$$S^2X = \frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2$$

$$= \frac{8\ 554\ 015{,}241}{20} - \left(\frac{397\ 181}{20}\right)^2$$

$$= \frac{8\ 554\ 015\ 241}{20} - \frac{15775274686.9}{400}$$

$$= 427\ 700\ 762.4 - 394381866.9$$

= 33 318 895.5

$$S^2x = 33\ 318\ 895.5 = Varianceofx$$

Variance of Y is;

$$S^2Y = \frac{\sum Y^2}{n} - \left(\frac{\sum Y}{n}\right)^2$$

$$= \frac{14\ 576.4854}{20} - \left(\frac{539.92}{20}\right)^2$$

$$= \frac{14576.4854}{20} - \frac{291513.6064}{400}$$

$$= 728.82427 - 728.784016$$

$$\therefore S^2Y = 0.040254 = VarianceofY$$

Then, the correction coefficient of x and Y is

$$r = \frac{S^2XY}{\sqrt{S^2X.S^2Y}}$$

$$= \frac{40.7332}{\sqrt{3318895.5\ x0.040254}}$$

$$r = \frac{40.7332}{\sqrt{1341218.819}}$$

$$= \frac{40.7332}{1158.11002}$$

$$= 0.035172133$$

$$\simeq 0.0352$$

$$\simeq 3.5x10^{-3} = coefficientofcorrelation$$

The value of r above is coefficient of correction of volume of gas flared and temperature within a corresponding period for 1978 to 1997.

From the results in table 2, the covariance of volume of gas flared and condensed temperature with the period is

$$S^2XY = 40.7332$$

The variance (s) of volume of gas flared and temperature (X and Y).

$$S^2X = 33.318\ 895.5$$

$$S^2Y = 0.04025$$

The correlation coefficient of volume of gas flared and condensed temperature is $r = 0.035172133\ or\ 3.5\ x10^{-3}$

IV. Conclusion

From the analysis carried out, the temperature of Amai community(Niger Delta region) of Nigeria is adversely affected by oil exploration and exploitation activities of multinational oil and gas companies in the region. Moreso, results shows that total crude oil produced in the region between 1978 and2000 is 631772.8. This is apart from the volume spilled to the environment both off shore and onshore. Of the total volume produced, about 90% is exported while 10% is for domestic consumption. Of the total gas produced as shown in the analysis, 75.55% is flared while about 19.985% is for domestic consumption.

Indeed, the factors that mediate oil pollution includes, oil spillage, gas flaring, and acid rain etc. The effects of these factors on temperature change include; increase in surface temperature and increase in relative humidity which of course affects greatly the ambient temperature of the region forming human discomfort indices. Change in temperature may lead to climate change and other ecological effects on flora and fauna of the region including effects on traditional and economic sources of livelihood of the inhabitants.

Analysis shows that, the temperature of the Amai community (Niger Delta) has risen from 30.7^0c to 31.3^0c and the minimum mean temperature has risen from 22.78^0c to 22.88^0cbetween 1978 and 2000. Implying that there is a reasonable change in temperature of the Niger Delta region.

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