Review of Gas Flaring Activities in Niger Delta Area of Nigeria

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ABSTRACT - A review of Gas flaring activities in Niger Delta Area of Nigeria was carefully studied for period of 24 years. Result of the study suggest that while the people of the Niger Delta region may have benefited from oil and gas exploration, the adverse economic, environmental health, social urbanization impacts of the operations out weight the benefits. Oil and gas exploration and exploitation is one of the major reasons the atmosphere, land and sea as well as life's and plant therein are clearly being disturb. The data for the area (70,000Km^2) and population were collected from National population commission (NPC 2006) that of temperature records from 1989-20012 (Niger Delta Region) were collected from Nigeria Meteorological Agency (NIMET) data for gas production, utilization total flares, export and domestic consumption in barrels were collected from petroleum corporation (NNPC). Base on the data, descriptive analysis, multiple bar chart, pie chart, histogram and trend analysis {analysis of variance-SPSS) was used to show the grow and decline of oil spillage in Niger Delta with a high standard error 293.567. The trend analysis shows the equation y = 492x – 2061 and the correlation of R^2 = 0.131. The bar chart in fig. 3 recorded Nigeria as the highest in flaring of gas production among the comparism countries indicated in table 3.The results revealed that environmental pollution due to heat radiation from gas flaring stations in the Niger-Delta area of Nigeria has been identified as one of

the major causes of temperature change which lead to an increase in the effective temperature of the Earth. Advice on how Nigeria (Niger Delta will reduce gas flaring is included).

Keywords: Gas flaring, Temperature, Niger Delta, crude oil.

INTRODUCTION

The Niger Delta covers a field of about 70,000 Km^2 and 20,000 km^2 within wetlands formed primarily by sediment deposition, which houses Nigeria's proven gas reserves, estimated to be 120 trillion cubic feet [1]. Homes of 20 million people and 40 different ethnic groups, this flood plain makes up 7.5% of Nigeria's total land mass. It is the largest wetland and maintains the third-largest drainage in Africa. It has 5.361^0N and 6.708^0E.However, while the exploitation and exploration of oil has created some fortunes and contributed positively to the economic and technological advancement of Nigeria as a whole, the accompanying socio-economic and ecological fallout remain problematic [2].

In Nigeria, burning off the associated gas (AG) has been illegal since 1984 and the Nigerian government has set up several deadlines to end the practice, but gas flaring continues till date. According to 2005 friends of the earth report, about 2.5 billion cubic feet of gas associated with crude oil is flared in this way everyday. 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. The flares have contributed large volumes of green house gases than all of sub Saharan Africa combined as well as several dangerous toxin released into the atmosphere, polluting the soil and thereby affecting the health and well being of the nearby Niger Delta communities, exposing the residents to an increased risk of premature death respiratory illnesses such as Asthora and cancers. The public considers the oil-producing companies operating in the Niger Delta companies responsible for polluting the environment by way or relentless flaring and venting of gas into the environment, heat radiation, noise radiation, oil spillage, water

pollution, site clearing, deforestation and destruction of the flora and fauna and consequences disturbances of the ecosystem in the 70,000 square kilometers of Niger Delta wetland [4].

[21], pointed out that the total number of incidents of oil spillage from 1976 to 2005 was 9092 in line with table 1 of [45]. These is a major source of climate change which is creating increased uncertainty about the future temperature and precipitation regimes which makes investments in agriculture and other weather – dependent livelihoods inherent more risky (FAO, 2008).

[3], in line with [10], suggested that climate is closely associated with the burning of oil, coal or gas .They also pointed out that, one important feature observed in the region is the almost complete absence of primary forests except perhaps in Cross River State where conservation efforts by both federal and state governments have left a stretch of rainforest. This has been attributed to climate change in part and mainly due to human activities in the other hand.

According to [5], [9], [18], refer to climate changes as "change in modern climate which are 90-95% likely to have been in part caused by human action. Climate change is defined as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is addition to natural climate variability observed over comparable time period". (Unite Nations Framework Convention on Climate change [6].

Uncontrolled logging, agricultural activities, acid rain, oil exploration and exploitation, urbanization and mining activities have contributed immensely to lose of vegetation. [3], which is one of the major contributor to the climate change.

In line with [13] ,[21], [48], [49], [50], [51], emphasized that no two climate can be exactly the same. However, similar or close the two locations may be geographically. The World Health Organization advised that Nigerian government should address the problem of gas flaring by paying close attention to the activities of companies engaged in flaring and the environmental problems associated with their exploratory methods and to invite experts from developed countries to work with Nigeria professional and environmentalist to proffer remedy (Global gas reduction initiative, 2002:

world bank report, 2004). [31], [34],[39], [45], noted that, in spite of advances in technology and the potential to convert the flared gas into a source of enormous nation revenue, the practices has continued in Nigeria, Ostensibly underscoring the problems of our national development [2]. combustion of associated gas during flaring also releases heat into the environment. The heat radiation from gas flaring greatly affects the surrounding environment and particular crops planted within the vicinity of gas flare stations [8].

According to the United states Environment Protection Agency (U.S. EPA) “many scientific studies have linked breathing particulate matter to a series of significant health problems including aggravated asthma, increases in respiratory symptoms like coupling and difficult or painful breathing, chronic bronchitis, decreased lung function and premature death. “it has also accepted that exposure to benzene and its metabolites causes acute non lymphocyticleuvemia and a variety of other blood-related disorders in humans.

[19] suggested that since emphases is laid on environmental problems, the need for a major shift to a global energy system based on high level of energy efficiency world wide and rapid growing role for renewable energy is paramount. The basic sources of oil pollution at the coastal waters of the Republic of Nigeria are accidents at the extracting platforms, accidents by tankers transporting crude or refined oil pipelines. All these lead to an increase in the counter radiation which increases the average temperature of the earth.

POLLUTION

Pollution is a term that defines any environmental state or manifestation which is harmful or unpleasant to life, it can also be defined as the introduction of natural and artificial caused due to man’s failure to achieve control over the physical, chemical, or biological consequences or side effects of his scientific industrial and social habit, [45]. Industrial source of pollution is a result of release of hazardous waste and huge mass of unclear gases and other airborne particles produced as by-products in

process industries. The degree of the increase of process industries is increasing drastically, this improvement as change man's way of life remarkably, however the advantage derived have not being without a price which is basically the effect of pollution on the environment, [23]., Pollutants are emitted into the atmosphere as either or particles, and are eventually removed by natural self cleansing processes [33]., [28]. The waste mostly originates from the burning of fossil fuels and the processing of materials by industries [32], [45]. Other sources include waste from burning engines in cars, fuel use in domestic sectors, oil boom, gas flaring, agriculture processes, but of all these the process industries have been recognized as the major source of air pollutants. So much damage is being done to the environment through gas flaring, that if nothing is done in a few years from now, serious environmental and health problems such as premature death and diseases will emerge with respect to gas flaring, its effect on vegetation, health and the micro-climate are equal searing. Apart from the noise produce from the fire at the flare sites, the thick rain and eventually poison streams, lakes, lagoons and rivers thereby destroying aquatic organism and making the water unhealthy for drinking. It has been proven that gas flaring generates heat which is felt over an Average radius of 0.5 kilometres thereby causing thermal pollution [7], [26], [27]. Gas flaring cause green house effect, thereby producing global warming and green house gases which include: water vapour, carbon dioxide, Methane, nitrous oxide; ozone, carbon monoxide and nitrogen oxide, [12], [14], [15], [35], [36].

The fear of the known "unknown" environmental pollution has transcended natural boundaries stratospheric ozone depletion, global warming, the green house effect, deforestation, acid train and mega disaster are some of the various environmental problems associated to pollution. The potential effects of global pollution have necessitated global cooperation in other to secure and maintain a liveable global environment [40]. It has been reported that pollutants emitted from one country can easily cross political boundaries. People are beginning to recognize that pollutants can affect not just a region but the entire planets. As the excess $C0_2$rises into the atmosphere, it acts as absorptive body, which trap heat reflected from the earth surface. Scientists accept that green house effect from increased level of $C0_2$ and other

heat trapping gasses eventually will cause an increase in global temperature. Some predicted that the temperature will rise significantly within the next century and that global pattern could be drastically disrupted. Air pollution is not restricted to outdoor air, although relatively little attention is given to the hazards of many substances found in indoor air most especially in the developing nations where there is no proper regulation in place to combat air pollution. But it is however well established that people may spend as much as 80-90% of their time indoor. The sources of indoor pollution are different for developing and industrialized country, [32], [38], [43].

In developing countries, indoor pollution comes mainly from using biomass fuels (Wood, agricultural waste, dung etc.) for cooking and heating. The majority of the world's population depends on biomass for most of their energy supply. It is estimated that 400-500 million people mainly in the rural area of developing countries and primarily women and children may be adversely affected by indoor pollution [56], [57], [58], [59], [60]. The fuel is burnt inefficiently in rooms that are poorly ventilated. Biomass smoke contains numerous substances, the most hazardous of which include suspended particulate matter, nitrogen dioxide, carbon dioxide, and sulphur dioxide [11], [24], [25], [30]. It also releases a number of adehyde. While the key indoor pollutants in an industrialized countries are nitrogen dioxide, carbon monoxide, radon (from building material), formaldehyde (from insulator, asbestos, mercury, manmade fibers etc. Also polluting the environment is the heat radiated as result of these indoor activities and process industries. The released may be harmful to plant and animal. In Nigerian context, gas flaring from the oil exploitation and exploration in the Niger-Delta area of the country has been considered as the major sources of environmental pollution. Every day in southern Nigeria, almost 2million cubic feet of natural gas is burnt (flared) during crude oil production, more than is flared anywhere else in the world [20], [22], [41]. Hence, gas flaring is not only waste of valuable resources, but is also a major cause of environment pollution in the Niger-Delta, where most of Nigeria's oil output is produced. Nigeria has a population of over 170 million people and an abundance of natural resources especially hydrocarbons. The Nigerian economy is largely dependent on its oil

sector which supplies 95% of its foreign earnings. While the exploitation and exploration of oil has created some fortune and contributed positively to the economic and technological advancement of Nigeria as a country, the accompanying socio-economic and ecological fallouts remain problematic. The public considers the oil producing companies operating in the Niger-Delta oil fields responsible as major environmental pollutants by way of relentless flaring and venting of gas in the environment, oil spillages, site clearing, deforestation and destruction of flora and fauna, and disturbances of the ecosystem in the70,000 square kilometers Niger-Delta wetland [16], [17], [29].

ACID RAIN FORMATION

Acid rain is commonly used to describe the deposition of acidic components in rain, snow, fog, dew or dry particles. [43], [44], [52], [53]. The primary sources are sulphur dioxide, carbon dioxide and oxide of oxides of nitrogen. A variety of industrial processes, such as the production of iron and steel, utility factories, oil producing companies are responsible for the emissions of obnoxious gases that resulted into acid rain. It has been reported that acid rain is one of the most discussed modes of environmental pollution in recent years [38], [39], [42], [45]. Although, acid rain usually consists of relatively mild acids, they are sufficiently caustic to do great harm over time to certain natural ecosystems. Already there is much evidence that deposition of acid lead to lakes and stream acidification, stunted growth of flora while acid sensitive crops leads to lakes and stream acidification, stunted growth of flora while acid sensitive crops will die in affected areas [45]. In cities, the corrosions of buildings and monuments are both exacerbated and accelerated [39]. To some extent acid rain has always been present in certain humid environment, originating from natural events as volcanic eruption, forest fires and even the bacterial decomposition of dead organism [45], [54], [55].

TABLE 1: Stages in Niger Delta Region, Land Area and Population.

State	Land Area (km^2)	Production
Abia	4,877	2,833,990
AkwaIbom	6,806	3,920,208
Bayelsa	11,007	1,703,358
Cross River	21,930	2,888,966
Delta	17,163	4,098,391
Edo	19,698	3,218,332
Imo	5,165	3,934,899
Ondo	15,086	3,441, 014
River States	10,378	5,185,420
Total	112,110	31,224,587

TABLE 2 Analysis of oil spill in the Niger Delta

S/N	Year	No of spill	Quantity spilled (barrels)	Quantity recovered barrels	Net volume lost to the environment
1	1989	228	5956	2153	3803

2	1990	166	14150.35	2785.96	11364.39
3	1991	258	108367.01	2785.96	105581.05
4	1992	378	51187.9	1476.7	49711.2
5	1993	453	8105.35	2937.08	5168.27
6	1994	495	35123.71	2335.93	32787.78
7	1995	417	63677.17	3110.02	60567.15
8	1996	158	39903.667	1183.807	38719.86
9	1997	144	29811	1128	28683
10	1998	155	43201	21202	21999
11	1999	168	62009	35018	26991
12	2000	261	49556	23323	26233
13	2001	129	51178.1	2456	48722.1
14	2002	412	25813.1	815.6	24997.5
15	2003	314	43718.01	1216.9	42501.11
16	2004	256	63191.32	2813.4	60377.92
17	2005	270	53451.61	1813.7	51637.91
18	2006	481	62125.9	3706.1	58419.8
19	2007	450	54813	3001.2	51811.8
20	2008	492	45678.03	1200.8	44477.23
21	2009	360	46012.01	2000	44012.01
22	2010	427	57813.02	2181.7	55631.32
23	2011	410	57408.56	3001.91	54406.65
24	2012	350	67891.61	3413.02	64478.59
	TOTAL	7632	1140142.42	127059.78	1013082.64

Descriptive Statistics

	N	Mean	Std. Deviation	
	Statistic	Statistic	Std. Error	Statistic
No of spill		610.	293.5	1467.8
Quantity spilled (barrels)		9.121139	4.3910905	2.1955452
Quantity recovere barrels		1.016478	5.1482395	2.5741197
Net volume lost t the environment		8.104661	3.9077264	1.9538632
Valid N (listwise)				

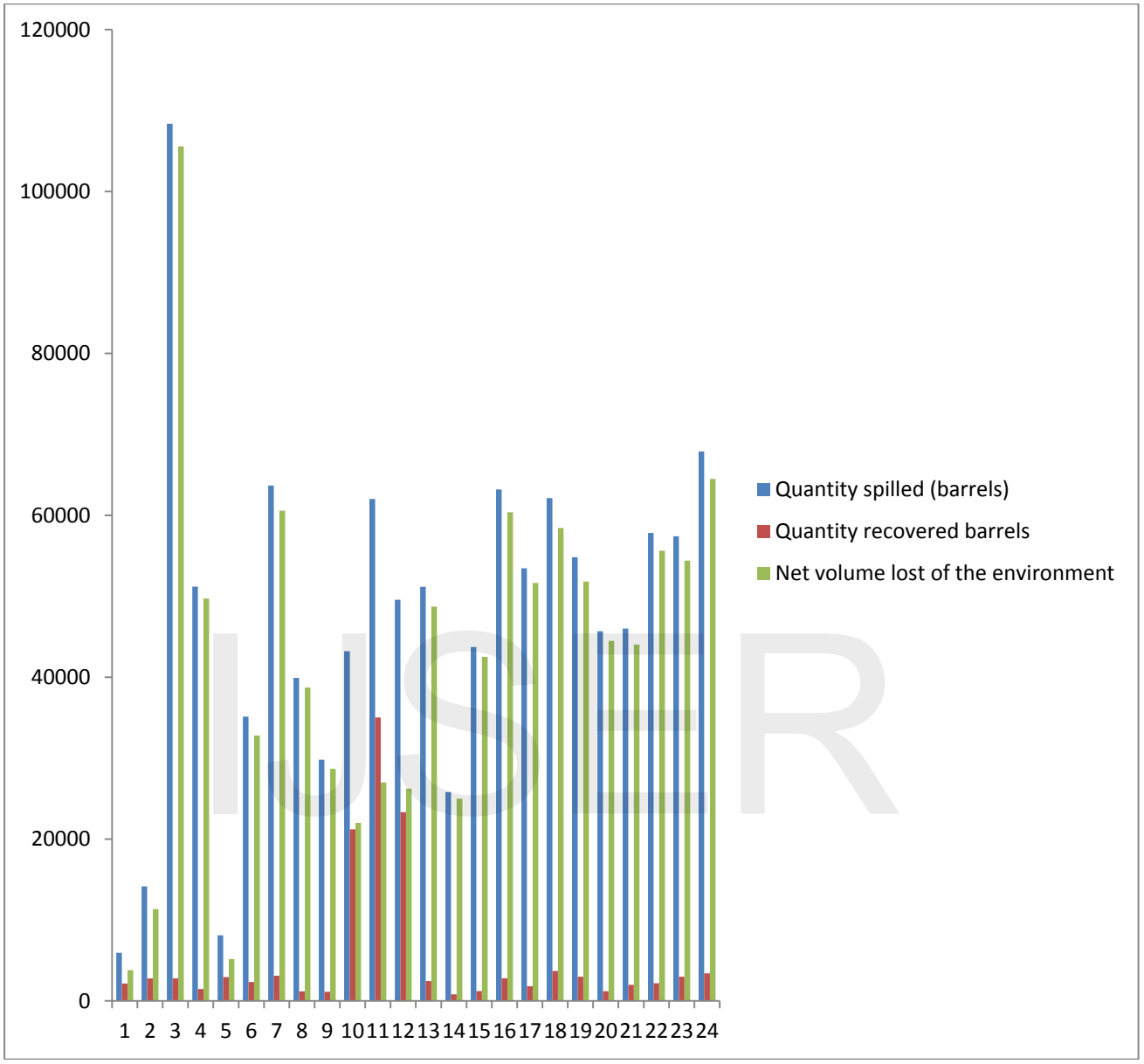

Fig i.**Multiple bar chart**

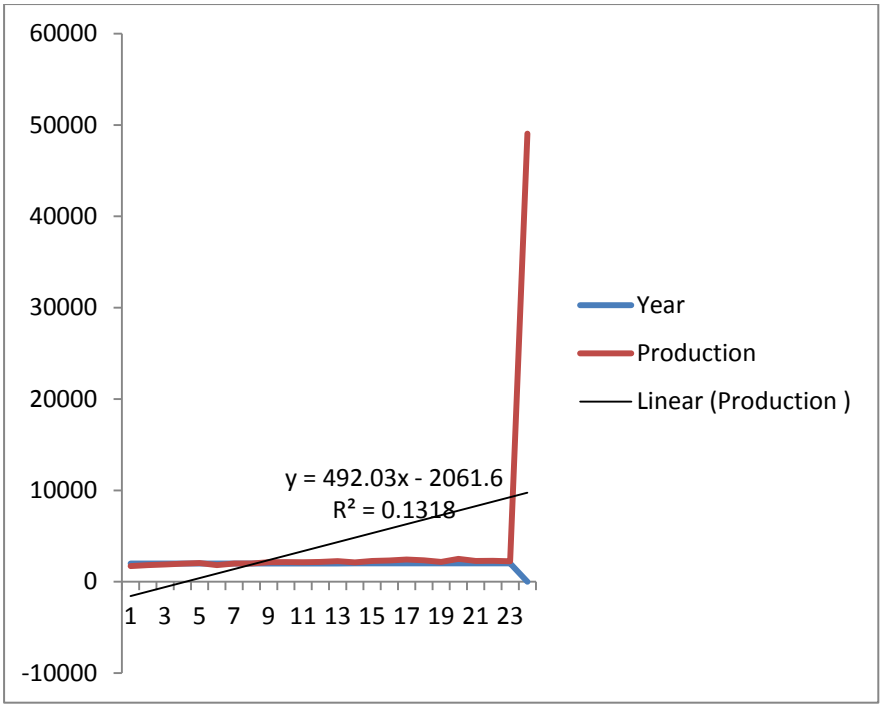

Fig. ii. THE TREND ANAYSIS OF NUMBER OF OIL SPILL (1989-2012)

Table 3: flaring of natural gas in major producing countries

Position	Country	% gas production flared
1st	Nigeria	76.0
2nd	Librya	21.0
3rd	Saudi Arabia	20.0
4th	Iran	19.0
5th	Mexico	5.0
6th	Britain	4.3
7th	Algeria	4.0
8th	Former USSR	1.5
9th	USA	0.6

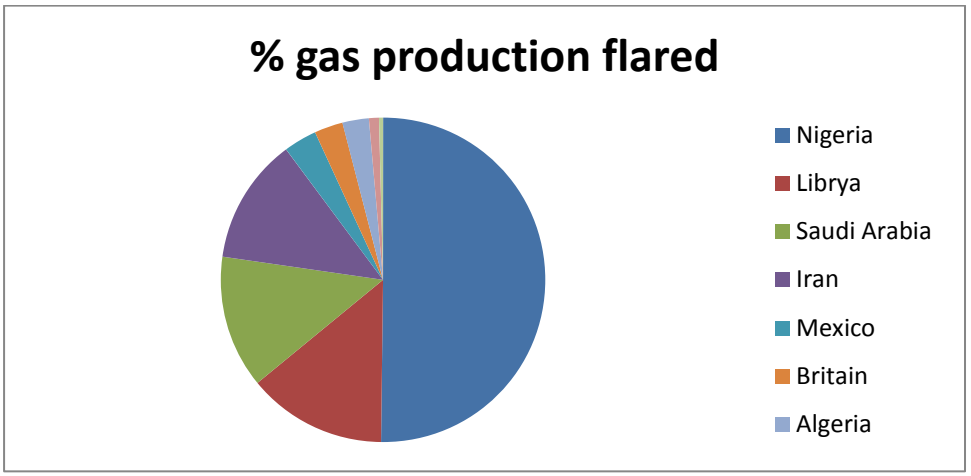

Fig.iii. PIE CHART OF GAS PRODUCTION FLARED

Table 4: Data showing crude oil production, export and domestic consumption (in Barrels) in the Niger Delta from 1989-2012

Year	Production	Export in (barrels)	Domestic consumption (in Barrels)
1989	1715	873	842
1990	1810	807	1003
1992	1892	1200	692
1993	1981	980	1001
1994	2050	1300	750
1995	1816	906	910
1996	1993	1003	990
1997	2000	920	1032
1998	2132	1100	1156
1999	2154	998	129

2000	2129	2000	185
2001	2165	1980	1056
2002	2256	1200	568
2003	2118	1550	656
2004	2276	1620	1349
2005	2329	980	827
2006	2440	1800	1920
2007	2350	520	1680
2008	2165	980	1185
2009	2493	984	1529
2010	2274	1600	1210
2011	2293	1290	1148
2012	2234	1008	1318
TOTAL	49065	27599	23136

Residuals Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1156.	48966.	4088.	9572.2	
Residual	-1123.6	997.2	.0	432.3	
Std. Predicted Value	-.3	4.6	.0	1.0	

ANOVA[b]

Std. Residual	-2.4	2.2	.0	.9	

a. Dependent Variable: PRODUCTION

Co coefficients

Model		Unstandardized Coefficients		Standardized Coefficient	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.9	100.7		.0	.9
	EXPORT	1.0	.1	.5	7.1	.0
	DOMEST CONSUM TION	.8	.1	.4	5.0	.0

a. Dependent Variable: PRODUCTION

Model		Sum of Squares	df	Mean Squa	F	Sig.
1	Regress n	2.107		1.054	5146.0	.0
	Residua	4299966.2		204760.2		
	Total	2.112				

a. Predictors: (Constant), DOMESTIC CONSUMPTION, EXPORT

b. Dependent Variable: PRODUCTION

Descriptive Statistics

	N	Range	Mean		Std. Deviatio
	Statistic	Statistic	Statistic	Std. Err	Statistic
EXPORT		270	2299.	1102.6	5401.9
PRODUCTION		473	4088.	1955.9	9581.9
DOMESTIC CONSUMPTION		230	1928.	925.8	4535.9
Valid N (listwise)					

Table 5: Data showing crude oil production, export and domestic consumption (in Barrels) in the Niger Delta from 1989-2012

Year	Production in (Barrels)	Utilization in (barrels)	Flares (M^3)

1989	2556.67	178.59	3379.06
1990	2286.93	302.88	2878.93
1991	1594.08	472.13	1745.71
1992	1993.51	320.62	1547.42
1993	1415.14	420.62	1548.46
1994	2106.13	445.57	1660.57
1995	2406.54	602.25	1804.29
1996	2428.45	624.8	1803.65
1997	225.23	644.89	1580.34
1998	3280.5	892.02	2387.88
1999	4070.25	1021.09	3045.01
2000	10234.8	1950.48	7260.84
2001	25482.6	5508	19974.6
2002	25988.04	6081.48	19905.76
2003	27280.08	6407.1	20873.7
2004	27280.3	5483.7	21797.1
2005	28431	1572.34	25858.66
2006	57429	14353.2	43075.8
2007	60183	14820.48	45362.8
2008	57888.44	17636.2	40742
2009	27481.2	6348.1	2094.1
2010	27632.4	6279.5	2100.2
2011	26940.05	6394	2095.33
2012	27734.12	6007.62	2184.5

TOTAL	454348.46	104767.66	276706.71

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.971[a]	.943	.938	4789.40	.943	174.202	2	21	.000

a. Predictors: (Constant), FLARES, UTILISATION

b. Dependent Variable: PRODUCTION

ANOVA[s]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.992		3.996	174.2	.0
	Residual	4.817		2.294		
	Total	8.474				

a. Predictors: (Constant), FLARES, UTILISATION

b. Dependent Variable: PRODUCTION

Coefficients

Model	Unstandardized Coefficien	Standardized Coefficients	T	Sig.

		B	Std. Error	Beta		
1	(Constant)	2618.2	1311.3		1.9	.0
	UTILIZATIO	2.9	.3	.7	8.1	.0
	FLARES	.3	.1	.2	2.4	.0

a. Dependent Variable: PRODUCTION

Residuals Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4031.	66734.	18931.	18640.5	
Residual	-8845.9	13284.0	.0	4576.4	
Std. Predicted Value	-.7	2.5	.0	1.0	
Std. Residual	-1.8	2.7	.0	.9	

a Dependent Variable: PRODUCTION

Fig. iv: histogram **showing crude oil production, export and domestic consumption (in Barrels) in the Niger Delta from 1989-2012**

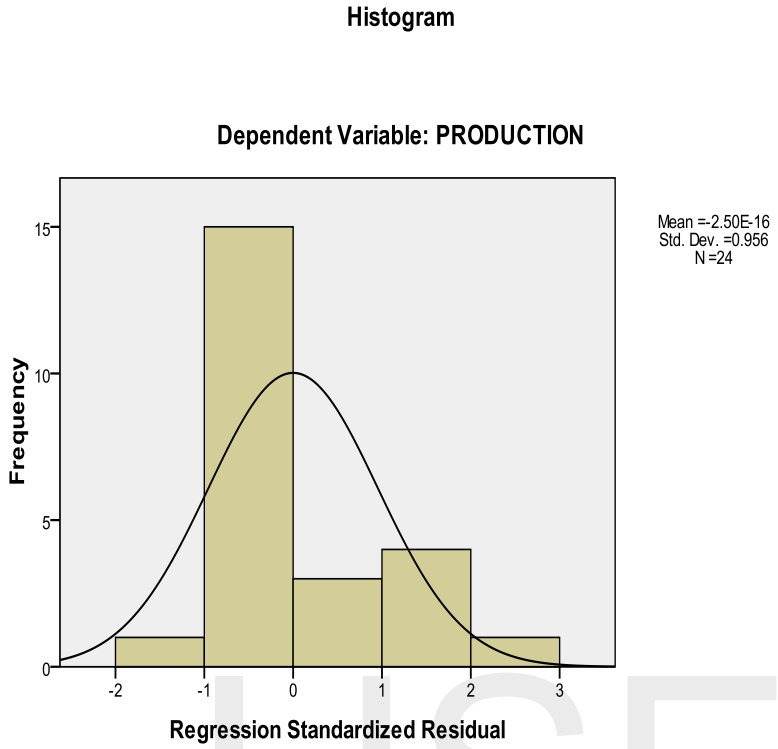

Table 6: Data showing crude oil production, export and domestic consumption (in Barrels) in the Niger Delta from 1989-2012

Year	Maximum 0c temperature	Minimum 0c temperature s	Mean0c temperature
1989	30.7	22.78	26.74
1990	30.84	22.97	26.9
1991	30.68	22.89	26.79
1992	31.11	22.74	26.93
1993	30.82	22.76	26.79
1994	31.33	22.95	27.14
1995	31.36	22.43	26.89

1996	30.98	22.87	26.92
1997	30.82	22.68	26.75
1998	31.7	23.25	27.48
1999	31.08	23.16	27.12
2000	31.25	22.55	26.9
2001	31.19	23.4	27.29
2002	32.16	23.21	27.31
2003	30.95	22.65	26.8
2004	31.4	22.8	27.1
2005	32.16	22.46	27.31
2006	31.53	23	27.27
2007	31.25	23.06	27.16
2008	31.3	22.88	27.09
2009	31.51	22.75	27.13
2010	31.92	22.98	27.45
2011	32.08	23.04	27.56
2012	32.12	23.16	27.64
TOATL	752.24	549.42	650.46

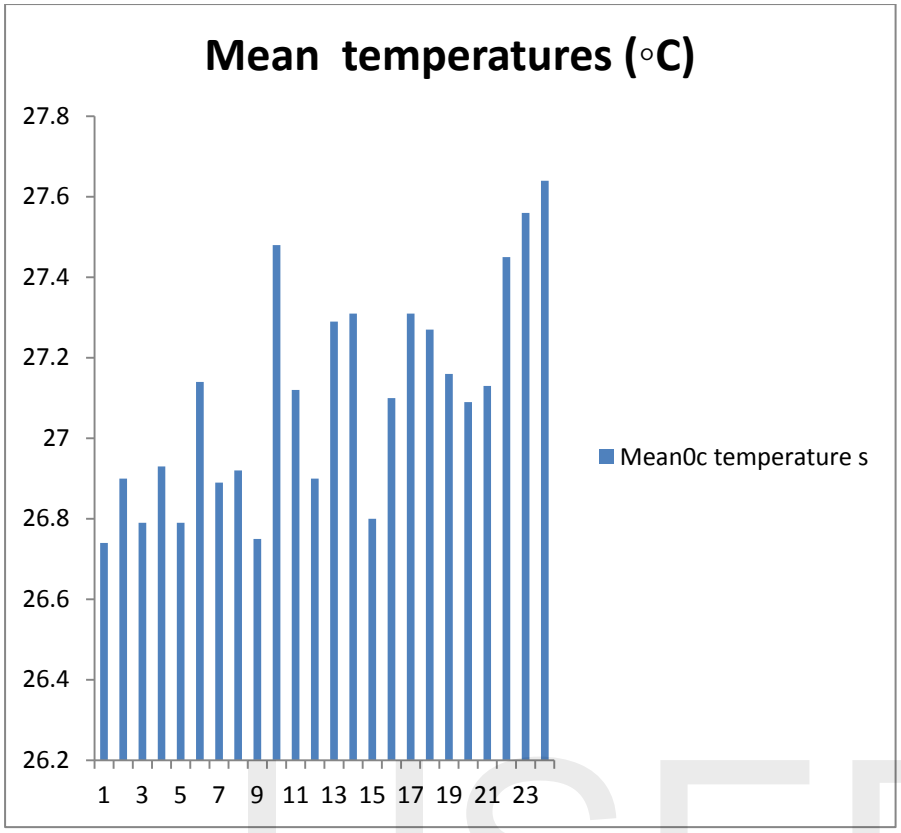

Fig.v THE MEAN TEMPERATURE

RESULT AND DISCUSSION:

The table 1. Indicates the Niger Delta Regions, land area and the population of which River state appears the largest (5,185,420). From the analysis of the oil spill in Niger Delta (table 2). The descriptive analysis indicates very high standard error of $4.39x\ 10^4$ in quantity spilled (barrels), $5.148\ x\ 10^3$ in quantity recovered (barrels). Also the net volume lost to the environment indicates $3.907x10^4$ (fig 1). Multiple bar chart on (table 2), indicates that quality spilled (barrels) over the years was highest.

Fig2: trend analysis shows the equation

Y=492x-2061

and the correlation determination of (R^2=0.131) which is low to the study.

Fig 3.(Pie chart), indicates that Nigeria was the highest in the flaring of gas production in 2

Further, analysis was carried out using multiple regression analysis on table 4, where, Y = production, X_1 = export in barrels, X_2 = domestic consumption in (barrels).The model specification, $y = B0 + B_1X_1 + B_2X_2$.

$$y = 8.984+1.036x_1+0.880x_2$$

The analysis of variance on the study indicates that there exist a significance difference on the crude oil production, exportand domestic consumption (in barrels) in Niger Delta over the years of study. The residual indicates high and positive change of 0.956 (96%.).The standard error for production is very high (1955.910), std error for export (1102.165) and that of error for domestic consumption 925.898 respectively:

Analysis on (table 5) indicates the model:

$$\mathbf{y = 2618.253+2.927x_1 + 0.307x_2}$$

where: x_1 – utilization in barrels, x_2 – flares (m^3) and y - production.

And there existed a significance difference in the study, and a high correlation determination (R^2 = 0.943). The histogram (fig iv) shows the distribution production of crude oil, while (fig. v) represent the mean temperature during the study period.

SUMMARY/CONCLUSION

Environment pollution due to heat radiation from gas flaring stations in the Niger-Delta area of Nigeria has been identified as one of the major causes of strives, demonstration and sometimes- violent protest between the oil exploitation companies and habitants of Niger-Delta area of Nigeria. The result also clearly show that continuous gas flaring irrespective of the quality deposited in the immediate environment will in the long run lead to change in the physicochemical properties of environment due to the quantity of heat radiated, which influence the temperature change negatively. Gas flaring in Nigeria today possesses an environmental hazard to the nation at large. So much damage is being done to the

environment through gas flaring, that if nothing is done in a few years from now, serious environmental and health problems such as lost of vegetation and diseases such as asthora, cancer, premature death, ,etc will emerge. And as such lead to an increase in effective temperature of the earth. If gas flaring is not stopped or converted to a source of enormous revenue for the nation. The human race will be responsible for cooking the atmosphere to a point unbearable for man existence.

Finding solutions to these and other environmental problems isn't always easy, and required agencies, environmental organizations, industry, Governments and the public, to work together to ensure environmental safety . The department of Health work closely together with Government agencies, the public and other who are concerned about environmental safety have to; 1. Provide consultation, trainings, and presentations of schools, local health agencies, regulated parties, and others regarding a variety of environmental safety issues. 2. Enforce the stop of burning off the associated gas (AG) which has been illegal since 1984. 3. Conduct site-specific assessments of health risks from pollutants emitted by industries, hazardous waste sites, feedlots, and other pollution sources. 4. Evaluate the effects of pollution on vulnerable populations, such as children and people with respiratory diseases so that risk assessment methods are adequately protective of human health. 5. Develop Health-Based Rules and Guidance for environmental used for site-specific assessments and environmental permit reviews. 6. Track research about the health effects of envionmental pollutants on an ongoing basis, and incorporate new methods and data into health risk assessments and best practices guidelines. 6. Increase more Meteorological Agencies.

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