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NEGATIVE IMPACT OF GAS FLARING ON THE TEMPERATURE, SOIL, CLIMATE AND ON THE PEOPLE OF UMUEBULU IN ETCHE LOCAL GOVERNMENT AREA OF RIVERS STATE, NIGERIA.

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ABSTRACT

Owing to the malady of global climatic change which is an omniscient challenge of our contemporary world, gas flaring as an abnormality has procured prime significance over the last few decades. This study is about gas flaring and its negative impacts on temperature, soil, climate and on the people of Umuebulu in Rivers State, Nigeria. The study utilized empirical research design. The stratified sampling technique was used to stratify the area into six layers using distance from the flare site as a yardstick, thus the strata includes 100m, 200m, 300m , 400m, 500m, 600m from the flare site. Analysis of variance (ANOVA) was used for the analysis of data. Findings include majority of respondents (92.0%), suggested that the temperature in Umuebulu was cooler than it was now as compared to the (8.0%) that responded otherwise. The negative impact of gas flaring on the environment include; acid

Introduction:

Gas flaring has been a challenge in Nigeria ever since the commercial production of crude oil commenced in the early 70's. It was purported as a means of stimulating the economic growth of the nation. However, like every other similar activity in the country, holistic attention is drawn to the secular benefits it offers without minding the negatives. In Nigeria today, gas flaring has overshadowed the fiscal advantages it draws to the governments of the day. Vehement decline has been witnessed in the life expectancy of the people of Niger Delta region ever since the discovery of commercial scale of crude oil in the community. Generally, the life expectancy in Nigeria is

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rain (75.3%), air pollution (93.1%), temperature rise (84.3%) and deforestation (85.1%). The following crops were currently being affected by gas flaring in Umuebulu, Yam (99.0%), Cassava (85.3%), Okro (96.0%), Plantain (54.0%), Potatoes (7.3%) and maize (100%). Locations Closer to the flare site were hotter than locations further from the flare site (mean annual temperature at 100m from the site was 29.1 ^{0}c at 600m at 28.1 ^{0}c). It is also responsible for the health problems of the people of Umuebulu, which includes bronchitis, asthma, cancer and many other gruesome ailments. The ANOVA model was significant at P> 0.00. This implied that the variation in temperature in terms of distance from the flare site within Umuebulu area was significant.

Keywords: Umuebulu, gas flaring, Health problems, Niger Delta, Nigeria, Temperature, Soil, Acid rain.

Assumed to be 52.34 years WHO (2012), but in the Niger Delta area of Nigeria, it is deduced as 49.44 years (Effiong and Etowa, 2012; Ajugwo, 2013 and Bassey 2008). Respiratory tract related problem is accountable for 19% of death related annually (Center for Disease Control and Prevention CDC, 2015).

Due to oil and gas exploration, exploitation and production in Umuebulu and its environments, the environment is being degraded, deteriorated and destroyed as in other parts of Niger Delta. This fragile environment is being polluted by the introduction into it of substances and energy that are liable to cause hazards to human health, harmful to living organisms, resources and ecological systems as well as interference with legitimate uses of the environment. Oil production activities are detrimental to man and its environment through gas flaring and oil spillage. It seriously affects the environment such as soil, water bodies, vegetation, wild life and the atmosphere (Turner, et al., 1990). Thermal pollution causes a distinct micro-climate around the vicinity of operation (Otunkor and Ohwovorione, 2006). Gas flaring affects soil fertility, agricultural potentials, other related activities and practices in Umuebulu. Its vegetation and health of the people are not speared from the detrimental effects of gas burning.

Umuebulu is found in the Niger Delta Region and the Niger Delta Region is located in the Southern half of Nigeria. This area is the center of oil and gas production and associated activities in Nigeria. Ukpaka, (2012) and Iwuji and Alagwu, (2013), the region is also said to be the richest portion of Nigeria in relation to natural resources such as oil and gas deposits, widespread forests, agricultural lands for sustainable agriculture and abundant fish resources (Ukpaka, 2012 and Ana, 2011). The region has the biggest natural gas reserve in Africa and has the second largest oil reserve in Africa and is the African continent's primary oil producer (Kadaya, 2012 and Egwurugwu et al., 2013).

Furthermore, it has more than 123 flaring sites, thus making Nigeria one of the top emitter of green house gases in Africa (Onuoha, 2008). It has therefore been asserted by Witter, Stinson, Sacket, Putter, Kinney, Titelbaun and Newman (2008); Egwurugwu, et al. (2013), that exposure to dangerous substances, emissions and toxins related with oil and gas production is more likely to affect those that live close to the facilities, than those that live far from it. Atuma and Ojeh (2013); Nwaogu and Onyeze (2010), have explained that, the danger to human, animals and plants life posed by pollution as a result of gas flaring cannot be under estimated. The effect of gas flaring has generated both global and national concerns (Abdulkareem, 2005). Gas flaring is the irrational burning of superfluous hydrocarbons gathered in an oil/gas production flow domain.

In some previous studies, Atuma, and Ojeh (2013), had confirmed that soils found in the Niger Delta region are some of the worst soils in Nigeria and that this poor soils come about as a result of the environmental pollution through oil industry activities in the Niger Delta region. However, soil is basic for life and productivity in the ecosystem, especially in an agrarian society. Furthermore, the vegetation and wildlife depend on such for support and effective productivity (Ojeh, 2012). However, oil production entails the discharge of constituents and elements that are noxious and have negative impact on the environment so that the people living near flare points are seriously affected.

Umuebulu is plagued with problem of gas flaring which is carried out every hour around the clock everyday and this is already having effects on man

and agriculture in the area through temperature rise and discharge of green house gases. According to Atuma and Ojeh (2013) and Ozabor and Obisesan (2015), introduction of green houses gases into the atmosphere causes a different micro-climate around the area where such gases are flared and this has manifested by rendering the farms, vegetation and animals in Umuebulu unproductive. So that at a mere glance at the vegetation, and plant cover (especially around the flare site) shows that the plant are malnourished. Rather than solve the problem, the government and the company contracted to handle operations in the area are playing cheap politics with the lives and livelihood of the people living there by postponing the date of stoppage of gas flaring; and bribing of community leaders, so that they could help prevent riots. Several studies have investigated the impact of gas flaring on micro and macro climate elements, vegetation, soil, air and water qualities at different flaring sites (Obidiegwu, (2018); Tanee and Albert (2013); Elkanem, (2001); Efe (2003); Oghifo, (2001); Oniero and Aboribo, (2001); Atuma and Ojeh (2013). None of these studies attempted a questionnaire survey in the area. This current study is thus investigated to go beyond mere measuring of the temperature variation in Umuebulu, but to carry out a questionnaire survey, so that other effects of the gas flaring on the soil, micro climate and on the people of Umuebulu can be documented.

STUDY AREA

The area of study is in the vicinity of Umuebulu village and umuebulu gas flaring station in Etche Local Government Area of Rivers State, Nigeria. The climate of the area is typical of tropical rain forest. The area lies within the coastal plains of Eastern Niger delta, characterized by two seasons (wet and dry season). Etche is an ethnic group located in the North East of Rivers States. It is bound in the East by Abia State, in the North by Imo State, in the West by Obio-Akpor Local Government Area of Rivers State. It s land mass comprises of 97,500 hectares (376.5 square meters) with a population estimated to be about 600,000. Etche is made up of two local government areas in Rivers State. Etche and Omuma Local Government Areas, made up a National Assemble Constituency (Nwokogba, 2013). Etche is located between latitude 4^0 05 50 and 50 07 20 North and Longitude 6^0 38 30 and 70 09 20 East. Etche communities include Akwu/ Obiuor, Chokocho,

Chokota, Okehi, Egwi, Afara, Mba, Ikwerengwo, Okomoko, Ulakwo, Umuakonu, Umuebulu, Umuechem, Egbeke and Igbodo. The land is huge with green and black amble land for agriculture and reserves oil and gas with attendance oil and gas activities. Due to its fertile land crisscrossed by major fresh water rivers (Otamiriche, Ogueche and Imo), farming is a major occupation of Etche people; which accounts for the naming of Etche as the "bread basket" of River State. Oil and gas activities are life in Etches exploration, production and domicilation of oil and gas assets such as oil wells in (Agbada, Imo River, Nkalu, Otamiri, Oyibo North and Umuechem), crisscrossing pipelines, flow-station and gas processing plants. Oil and gas activities produce various negative and inescapable effects on its immediate environment such as oil spills and pollution of fresh water and rivers. The effects of gas flaring include acid rain and diminishing crop yields' restiveness and violent confrontations, insecurities and health hazards (Nwokogba, 2013).

Fig. 1 (Map showing study Area). Source:

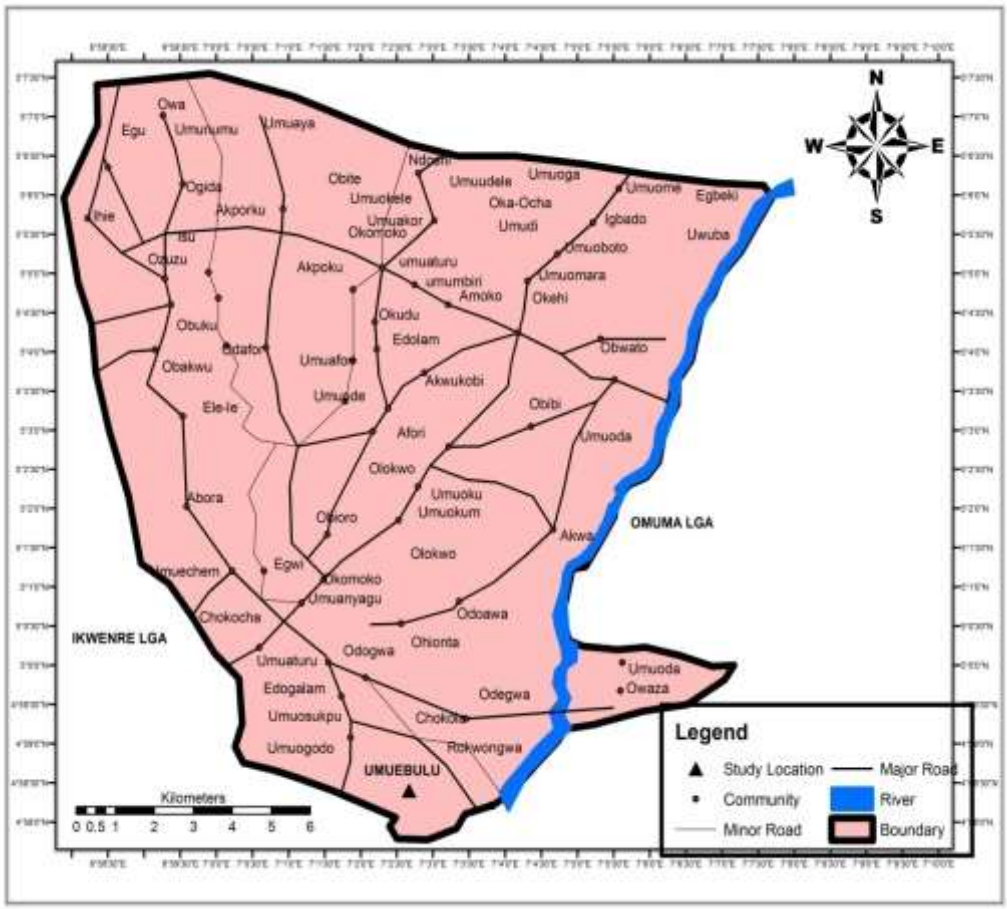

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Figure 2: Map of Etche Local Government Showing Umuebulu (The Study site)

Source: Etche Local Government Area Town Planning Unit.

MATERIALS AND METHODS:

The concept of the distance decay is employed to pilot this study. The distance decay concept has been used for spatial process analysis in the past and more recently, researchers have found the concept relevant in both climatologically and environmental studies (Efe, 2010, Ozabor and Obaro, 2015). The crux of the distance decay concept is that as distance measures from center of influence, interaction will reduce. This concept has been a while ago termed one of the most important geographic concept, Zhao, Lui, Peng and Wang (2015), since it summaries the "first law of Geography": Everything is a related to everything, else but near things are more related than distant things (Tobler 1970: Sui, 2004). This law proposes that the comparisons among two interpretations often reduce or decay as the distance between them rises (Zhao, et al., 2015: Nekola and White, 1999). The early study of distance decay raised great interest among researchers in spatial auto correlations and led eventually to the field of geo-statistics (Zhao, et al, 2015).

In this study, the application of the distance decay concept relate to the fact that places nearer to the gas flaring plant (whether farm or people) will receive more impact from the flares than place further away from the gas plant. In terms of methods of study, the study utilized the empirical research design. Types of data used for this research work includes primary and secondary data. The primary data were generated through empirical measurements using thermometer (to generate air temperature): and administration of questionnaire (to generate the impact of the gas flaring on agriculture and the people of Umuebulu). The stratified sampling technique was used to stratify the area into six layers using distance from the flare site as a yardstick, thus the strata include 100m, 200m, 300m, 400m, 500m, and 600m from the flare site. This method of stratification has been used in the same area by Ojeh, (2012) with reasonable result revealed. Based on the assertion that the effect of gas flaring reduce with distance of at least 1500 – 2000m (Onouha, 2008; Odjugo, 2007 and Ojeh 2012), control site was picked at Umuechem (Ikwere LGA (2200m)away from the flare site). The need to select a control site arose from the fact that the researchers wanted to be able to

show how gas flaring can change the weather characteristics of a place even if they belong to the same climatic belt. On the basis of these stratifications, minimum and maximum thermometers were placed in the area to decipher the daily temperature reading for a period of one year (reading were taken hourly based on the world Metrological Organization (WMO Standard). On the other hand 300 questionnaires were administered in the area stratified to help generate information on the effects of gas flaring on both soil and people of Umuebulu. 300 questionnaires were administered because it represents 10% of the total households within the area stratified.

The data for the study were presented in the statistical diagram and tables and the arithmetic means; Analysis of variance (ANOVA) was used for the Analysis of generated data.

DATA PRESENTATION AND DISCUSSION OF RESULTS

Table 1. Sex Distribution of Respondents

Sex	No	%
Male	173	57.76%
Female	127	42.3%
Total	300	100%

Source: Authors field work, 2019

From table 1 above, the male respondents are more (57.7%) than the female respondents (42.3%). This implies that there are more male in the area than female.

Table 2: Marital status Respondents

Options	No	%
Single	58	19.3%
Married	200	66.7%
Divorced	42	14.0%
Total	300	100%

Source: Authors field work, 2019

From table 2, 19.3% of the total respondents are single, 66.7% are married and only 14.0% are divorced. The implication of this is that majority of the respondents are married. And thus need food for sustenance both for their children and for themselves.

Table 3: Education Distribution of Respondents

Options	No	%
Primary	60	20.0%
Secondary	125	41.67%
Tertiary	60	20.0%
No formal Education	55	18.3%
Total	300	100%

Source: Authors field work, 2019

From table 3, the education distribution of respondent is presented. From it, 20.0% of the respondent has primary education, secondary education accounts for 41.67%, tertiary education accounts for 20.0% while no formal education accounts for 18.3%. This implies that majority of the total respondents had secondary education holders. This also play a significant role in the type of occupation that engages them in Umuebulu.

Table 4: Occupation Distribution of Respondents

Options	No	%
Farming	143	48.0%
Business	40	13.3%
Trading	70	25.3%
Craft	47	15.4%
Total	300	100%

Source: Authors Field work, 2019

From table 4 above, 48.0% of the total respondents are farmers. While business men accounts for 13.3% of the total respondents, trading accounts for 25.3% of the total respondents and craft accounts for only

15.4% of the total respondents. It is therefore evident from the table above that the majority of the respondents are mainly farmers (48.0%) and traders (25.3%). Thus the effects arising from the gas flaring in the area (Umuebulu) are high on the people as the environment they have to rely on to go about their daily activities is now being affected by gas flaring.

Table 5: State of Temperature in Umuebulu before the siting of the gas plant

Options	No	%
Hotter Temperature	25	8.0%
Cooler temperature	275	92.0%
Total	300	100%

Source: Authors Field work, 2019

From table 5, the perception of the respondents on temperature before the siting of the gas plant is shown. From the table, majority of respondents (92.0%) agree that the temperature in Umuebulu was cooler than it is now (before the siting of the gas plant) as compared to the 8.0% that responded otherwise. This means that the gas plant has some impact on the temperature characteristics of Umuebulu this findings is in agreement with Obidiegwu (2018), findings in terms of coolness of Umuebulu before the siting of the gas plant.

Table 6: Perception of the people of Umuebulu on the cause of temperature rise

Options	No	%
Gas Plant	253	84.3%
Not Gas Plant	47	15.7%
Total	300	100%

Source: Authors Field work, 2019

From table 6, majority of respondents suggests that the gas plant is responsible for the increasing temperature in Umuebulu, while 84.3% of

the total respondents agree that the gas plant is responsible for the increase in temperature, only 15.7% disagrees that the gas plant is responsible for the increase in temperature.

Table 7: Effect of gas flaring on the Environment of Umuebulu

Options	No	%
Acid Rain	226	75.3%
Air Pollution	281	95.1%
Temperature rise	253	84.3%
Deforestation	257	85.1%

Source: Authors Field work, 2019

From table 7 above, effect of gas flaring on the environment of Umuebulu is displayed. From the table the effects of Gas flaring on the environment include acid rain (75.3%), air pollution (95.1%), temperature rise (84.3%), and deforestation (85.1%). Thus from the perception and experience of respondents, the gas plant already has impacts on the environment of Umuebulu.

Table 8: Effect of Gas flaring on crop yield

Options	No	%
Has effect on crop yield	260	87.0%
Has no effect on crop yield	40	13.0%
Total	300	100%

Source: Authors Field work, 2019

From the table 8, the effect of gas flaring on crops is identified from the table 87.0% of the total respondents agree that the gas plant has effects on crops in the area. While only 13.0% of the respondents disagree that the gas plant has no significant effects on crop yield.

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Table 9: Crops affected by gas flaring in Umuebulu

Options	No	%
Yam	297	99.0%
Cassava	256	85.3%
Okro	287	96.0%
Plantain	161	54.0%
Potatoes	22	7.3%
Maize	300	100%

Source: Authors Field work, 2019

From table 9, crops affected by gas flaring in Umuebulu was presented. From the table 99.0% respondents accounts for yam, cassava accounts 85.3%, okro 96.0%, Plantain 54.0% respondents, while potatoes are only 7.3% and finally maize was 100% respondents. Therefore the in habitants of Umuebulu are seriously being affected by the gas plant, since the major occupation of the people is farming. Similarly, this partly explains the high prices of commodity in the market in the area and the hunger experience in the area.

Air Temperature Characteristics in Umuebulu.

Table 10: Mean monthly temperature characteristics in Umuebulu in ^{0}C

MONTHS OF THE YEAR	100M	200M	300M	400M	500M	600M	CONTROL UMUECHEM
January	29.8	29.3	29.0	28.7	28.5	28.2	26.9
February	29.4	29.1	29.1	28.8	28.6	28.0	26.8
March	29.2	29.2	29.0	28.9	28.4	28.1	26.7
April	29.6	29.4	29.1	28.7	28.5	28.0	26.8
May	29.1	29.2	28.8	28.6	28.3	28.1	27.4
June	29.5	29.0	29.0	28.7	28.2	28.1	27.6
July	29.0	29.2	28.7	28.6	28.7	28.0	27.0
August	29.1	28.9	28.9	28.6	28.6	28.4	26.3
September	28.7	29.0	28.9	28.0	28.0	27.9	27.2
October	29.2	29.2	29.0	28.7	28.7	28.5	27.0
November	29.1	29.1	28.7	28.5	28.3	28.1	27.1
December	29.4	29.0	29.0	28.7	28.6	28.4	27.0
Mean	29.2	29.1	28.9	28.6	28.4	28.1	26.9

From the table 10, the temperature variation of Umuebulu area was displayed. From the table, it is evident that places closer to the flare site are hotter than places further from the flare site. For example, while mean annual temperature at 100m from the site is 29.2 at 600m, it is 28,1^{0}c (see fig 2 below). This finding agrees with Ojeh (2012), findings in terms of variation in the temperature as one move away from the flare site. On the other hand, the finding differs with Ojeh

(2012), since temperature observer using the same strata varies (Ozabor and Obisesan, 2015).

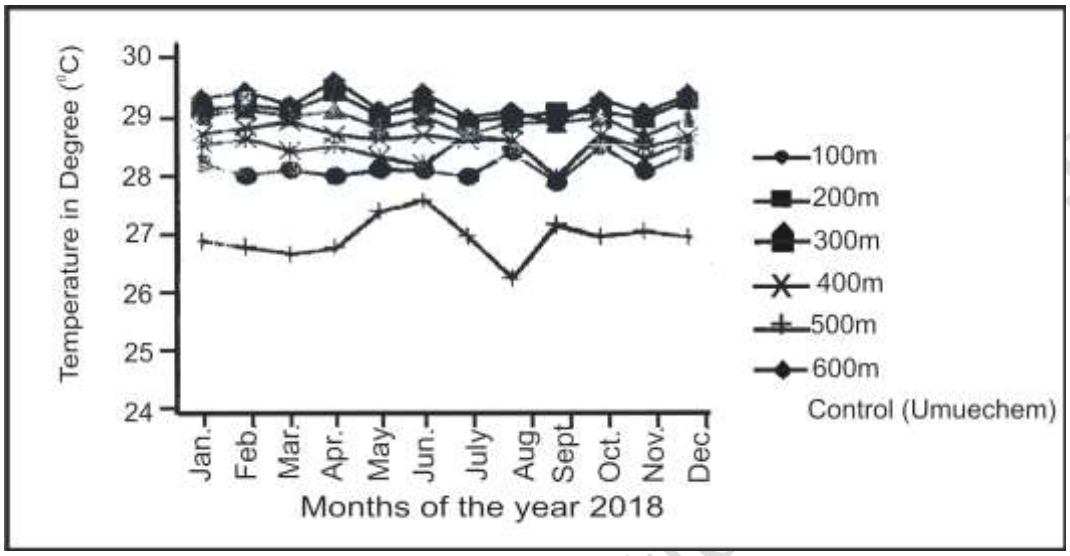

Figure 2: Monthly Distribution of Temperature in Umuebulu Based on Distance.
Source: Authors field work, 2019

Table 11: Output of the ANOVA Statistics

Distance from site	Sum of squares	DF	Mean square	F	Sig
Between Groups	42.561	6	7.093	153.894	.000
Within Group	3.549	77	046		
Total	46.110	83			

Source: Authors field work, 2019

In table 11, the model is significant at P> 0.000, this implies that the variation in temperature in terms of distance is significant. So that as one move away from the flare site, temperature reduces vice-versa. This finding agrees with that of Ozabor and Obisesan (2015) and Ojeh (2012). It is also supported by the distance decay concept. However, the Duncan Statistics table below showed how the spatial variation of the temperature of the area is placed. In the table, other sample points are varied from each other except that of 100m and 200m from the flare site as the variation within them are not statistically significant at P<0.18.

Table 12: Output of the ANOVA Statistics Duncan)
Duncan[a] Distance from site

Identifiers	N						
		1	2	3	4	5	6
2200m (control)	12	26.9833					

600 m	12	28.1500
500 m	12	28.4500
400 m	12	28.6250
300 m	12	28.9333
200 m	12	29.1167
100 m	12	29.2333
Significance	0	1.000 1.000 1.000 1.000 1.000 .187 Mean for groups in homogenous subsets are displayed. a=uses Harmonic mean sample size = 12.00

Source: Authors field work, 2019

PREVALENCE OF DISEASES

According to a twelve months survey which was initiated on 1,079 people in Umuebulu village IUCN (2013), the most prevalence ailments were shown in table 13.

Table 13: Prevalence of Diseases in Umuebulu

Disease	Number of cases
Hepatitis	24
Typhoid	159
Malaria	300
Cholera	70
Bronchitis	135
Respiratory tract Infection	170
Conjunctives	74
Cataracts	79
Asthma	64
Infection	170
Total	1,079

Source: Authors field work, 2019

As shown in table 13, respiratory related ailments are the most prevalent diseases in Umuebulu. Asthma, bronchitis, conjunctivitis, respiratory tract infections are responsible for ailments in 369 people. Ostensibly, 79 of the people had cataract which was one of the problems associated with these obnoxious gases flared (Olukoya, 2015).

CONCLUSION

As pointed out in the discussion, it can be realized that the effects of gas flaring on the health, climate and food crops of the people of Umuebulu is not a mere

abstraction or hypothesis, but can be linked with empirical realities. The declination in the life expectancy in this community is direct result of the composition of the flared gases. This study showed that gas flaring does not only have effect on thermal pollution (rise in temperature as distances progress from the flare area) in Umuebulu, but also on the people and their farms, since the following crops are currently being affected by Gas flaring in Umuebulu: Yam 99%, Cassava 85%, Okro 96%, Plantain 54%, Potatoes 73% and Maize 100%, this is in agreement with the work of Obidiegwu (2018). The study also confirmed the applicability of the distance decay concept (as mean annual temperature at 100m from the flare was 29.1^0c from the flare site), as different from 600m, which was 28.1^{0c} from the flare site) as a relevant concept in planning for an area played with gas flaring problem, since the problems of gas flaring will reduce as distance increases from the flare site. This result corresponds with the result of Ozabor and Obisesan (2015) and Ojeh (2012), in their research work in a gas flaring site in Ebedei in Delta State, Nigeria. The study also pointed out the prevalent diseases in the study area. It showed study on 1,079 people with Hepatitis 24, typhoid 159, Malaria 300, Cholera 70, conjunctivitis 74 and respiratory related tract infections which are responsible for ailments in 369 persons, with the highest number due to the effect of gas flaring on the area, this result were in agreement with Olukoya (2015) who got similar results in his work in Ogbia community, Bayelsa State.

RECOMMENDATIONS:

It is obvious that the Nigerian Government wouldn't encourage the stoppage of gas flaring as a result of their political gains. Hence strict policies to stop this flaring activity had not gone beyond paper works because of the fiscal benefits the government derive from the activities, so government should restrict the people of Umuebulu from sitting around the flare sites at least at 600m from the flare site, while plans on how to stop flaring by government should be enforced.

Health care industry should sensitize, encourage the residents to stay away from the flaring point and administer preventive drugs for indigenous of this community. People of Umuebulu should be taught through seminars, public orientation and bill distribution in English and local languages on the danger of living and farming near the flare sites.

Plants species in the area should be reviewed to suit the current temperature pattern in the area, since there seem to be a prevalence of micro-climate in the area.

REFERENCES

Abdulkareem, A.S. (2005). Evaluation of Ground Level Concentration of Pollutant Due to gas Flaring by Computer Simulation. A case Study of Niger-Delta Area of Nigeria. *Leonardo Electronic Journal of Practices and technologist*, Vol. 6, No. 1. Pp. 29-42.

Ajugwo, A.O. (2013). Negative Effects of Gas Flaring: *The Nigerian Experience Journal of Environment Pollution and Human Health,* Vol. 1, 6-8. Pp. 6-7.

Ana, G. C. (2011). Air Pollution in the Niger Delta Area Scope. Challenges and Remedies. The Impact of Air Pollution on Health. Economy, Environment and Agricultural Sources. Dr. Mohammed Khallaf (Ed.), ISBN:978-953-307-528-0, In Tech, Available from: http//www.intechopen.com/books/theimpact-ofairpollution-on-health-economy-environment-andagricultural-sources/air-pollution-in-th-niger-delta-areascopechallenges-and-remedies.

Atuma, M.I and Ojei, V.N. (2013). Effects of Gas Flaring on soil and cassava Production in Ebedei Ukwuani Local government Area, Delta State, Nigeria. *Journal of Environmental Protection 4, 1054 – 1066. http://dxdoi.org/10.4236/jep.201341-021.*

Bassey, N. (2008). Gas Flaring Assaulting Communities, jeopardizing the world retrieved from *http://www.eraction.org/publications/presentations/gas-flaring-ncc-abuja.pdf.*

Center for Disease Control and Prevention (CDC). (2015). Global Health Retrived from http://www.cdc.gov/globalhealth/countries/nigeria/.co

Efe, S.I. (2003). Effects of Gas Flaring on Temperature and Adjacent Vegetation in Rainwater Harvesting in the Oil- Producing Region of Nigeria. *Natural hazards*, 55(2): 91-101.

Efe, S.I. (2010). Spatial variation in acid and some heavy metal composition of Rainwater harvesting in the oil producing region of Nigeria." Natural Hazards 55(2), 307-319.

Egwurugwu, J.N.I., Nwafor, A. Oluronfemi, O.J. Iwuji, S.C and Alagwu, E.A. (2013). Impact of prolonged exposure to oil and Gas Flares on Human renal functions. *International Research Journal and Remedies" James Baker Institute of Public Policy, Rice University, Pp.73.*

Ekanem, I.N. (2001). Effects of Gas Flaring on the Soil, Air and Water Quality of Obigbo North. Center for Environmental and Science Education. Lagos State University, Pp.153.

International Union for Conservation of Nature (IUCN) Niger-Delta Panel. (2013). spill sites in the Niger delta: Main reports including recommendations for the future: In a Report by the independent IUCN-Niger Delta Panel (IUCN-NDP) to the Shell Petroleum Development Company of Nigeria (SPDC). Glands, Switzerland: IUCN. ISBN: 978-2-8317-1617-6. Pp.73.

Kadaya, A.A. (2012). Oil exploration and spillage in the Niger-Delta of Nigeria. *Civil and Environmental research*, 2(3):35-45.

Nekola, J.C and White, P.S. (1999). The distance decay of similarity in biogeography and ecology. *Journal Biogeology 26(4): 867-878.*

Nwaogu, L.A and Onyeze, G.O.C. (2010). Environmental Impact of Gas Flaring on Ebocha-Egbema, Niger-Delta, *Nigerian Journal of Biochemistry and Molecular Biology. Vol. 25, No. 1.Pp. 25-30.*

Nwokogba, A. (2013). Etche and NDDC: A consideration. Update this day newspaper live. Monday 24 November, 2014. http://theneighbourhood.com.ng/opinionnew/157-etche-and-nddc-aconsideration.html9browsed 9-8-2013).

Obidiegwu, C.P. (2018). Gaseous Pofile and Air Pollution Tolerance Indices or Some Indigenous Plants Around The Gas Flaring Site in Umuebulu Community In Etche

Local Government Area, Rivers State, Nigeria. Project for Award of Ph.(D), University of Nigeria Nsukka.

Odiugo, P.A.O. (2007). Some effects of Gas Flaring on the Micro-climate of yam and cassava production in Erhorike and Environment, Delta State, Nigeria. *Nigerian Geographical Journal, 5: 43-54.*

Oghifo, B. (2001). Nigeria loses $6bn yearly to gas flaring in Nigerian. *Journal of Environmental Science*, 24 (3): 18-24.

Ojeh, O. (2012). Sustainable Development and Gas Flaring activities: A case study of Ebedei Area of Ukwuani Local Government Area, Delta State Nigeria. Vince*nt Resources and Environmen*t, 2(4): 169-174.

Olukoya, A.P. (2015). Negative Effects of Gas Flaring on Buildings and Public Health in Oil Producing Communities: The Ogbia Community, Bayelsa State Case. International Journal of Environmental Monitoring and Protection, 2(5): 52-61.

Onuoha, F.C. (2008). Oil Pipeline Sabotage in Nigeria Dimensions, Actors and Implications for National Security L/C African Security, *Review Institute for Security studies*, 17(3):16-18.

Oniero, S.B.R. and Aboribo. I. (2001). Environmental Pollution: The hidden hand of dead in warm milieu. A paper presented at a Conference organized by Economics Department, Delta State University, Abraka, October 2000.

Otunkor, O.O and Ohwovorione, P.A. (2016). The Impact of Gas Flaring on Heavy metal Concentration in Okpai Soil, Ndokwa East Local Government Area, Delta State, Nigeria. *Standard Scientific Research and Essays*, 4(7): 236-243.

Ozabor, F and Obisesan. (2015). Gas Flaring: Impact on temperature, Agriculture and the People of Ebedei in Delta State Nigeria. *Journal of Sustainable Society,* 4, (2):5-12.

Tanee, F.G.G and Albert, E. (2013). Air Pollution Tolerance Indices of Plants Growing Around Umuebulu Gas Flare Station in Rivers State, Nigerian. African *Journal of Environmental Science and Technology*, 7(1): 1-8.

Sui, D.Z (2004). Tobler's first law of geography: a big idea for a small world" Annual Association, *Am Gregor* 94(2): 269-277.

Tobler, W.R.(1970). A computer movie simulating urban growth in the Detroit region. *Economics Geography*, 46:234-240.

Turner, B.L., Kerperson, R.E., Meyer, W.B., Dow, K.M., Golding, D., Mitchell, R.C and Ratick, S.J. (1990) "Two types of Global Environmental Changes, Definition of Spatial issues in their human Dimensions," *Global Environmental change*.1(1), 14-22. htt://dx.doi.org/10.1016/0959-3780, (90) 90004-5.

Ukpaka, C.P. (2012). Characteristics of produced water from an oil terminal in Niger-Delta Area of Nigeria, *Journal of research in Environmental Science and Toxicology, 1(5), 115-130.*

Witter, R.,Sinsonn, k., Sacket, H., Putter, S., Kinney, G., Teitelbaun, D and Newman, L. (2008). Potential exposure-related human health effects of oil and gas development: a literature review (2003-2008),www.ccag.og.au/image/stories/pdfs/literaturevie-wwitter et al2008.pdf.

Zhao, Z, Li, S., Lui, J. and Wang, Y. (2015). The distance decay of similarity in climate variation and vegetation dynamics: *Environmental Earth Science,* 73: 4659-4670: DOI: 10,1007/s12665-014-3751-2