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Impacts of Gas Flaring on the Fertility Status of Agricultural Soil in an Oil and Gas Host Community in the Niger Delta Region of Nigeria

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ABSTRACT

Nigeria flares huge quantity of associated gas from oil fields during crude oil production. Gas flaring have direct and indirect consequences on the environment and its associated biota. This study evaluated the impacts gas flaring on the fertility of agricultural soil in an oil and gas host community in the Niger Delta region of Nigeria. The soil samples were collected radially at four cardinals of uniting flare station, East, West, North and South at 200m, 400m, 600m and 800m distances using soil auger at two depths (0-15cm and 15-30cm). In addition, samples were collected from a botanical garden of Federal University, Otuoke, to serve as control. The soil samples were sieved, processed and analyzed for some soil fertility determinant parameters (pH, calcium, magnesium, sodium, potassium, electrical conductivity, cation exchange capacity) following standard protocol. Results showed that there was significant variation ($p<0.05$) between the soil characteristics in flared location and the control for the each of the parameters. In addition, apparent decline in some of the parameters exist as the distance away from flare stack increased. This suggest possible effect of flare from oil field on soil characteristics. Since the parameters analyzed provide useful information on the nutrient composition of the soil, hence the decline may lead to reduction in soil fertility. Therefore, there is need to adopt zero tolerance for flaring of associated gas so as to minimize its effect on the environmental components and its associated biota.

Keywords: *Bayelsa State, Environmental chemistry, Gas glaring, oil and gas, Soil nutrients.*

INTRODUCTION

Nigeria is ranked among the 13th major producers of crude oil in the World. Following the discovering of crude oil in late 1950's, Nigeria shifted from the agrarian nation to a crude oil dependent nation. As such, income resulting from crude oil sales is used in financing a significant number of the nation's annual budgets. Authors have reported the crude oil and natural gas province of Nigeria to be in the Niger Delta (including Ondo, Edo, Delta, Bayelsa, Rivers, Abia, Imo, Akwa Ibom and Cross Rivers states) (Seiyaboh and Izah, 2017a), where they are found in both offshore (aquatic ecosystem) and onshore (land environment) (Seiyaboh and Izah, 2017a). During crude oil and natural gas production, there are adverse environmental and health related consequences. For instance, authors have reported that crude oil spill in the environment could lead to an alteration in the physicochemical characteristics of receiving soil (Aigberua et al., 2016a,b, 2017), water resources (Seiyaboh and Izah, 2017b) and ambient air quality (Seiyaboh and Izah, 2019; Uzoekwe and Ajayi, 2018). Cases of spills leading to fire which impacted on infrastructures and biodiversity have been reported in literature (Izah et al., 2017a).

Gas flaring is common in the Niger Delta. Studies have shown that in 2014, 2013, 2012, 2011, 2010, 2009, 2008, 2007, 2006 and 2005 approximately 289.60, 409.31, 588.67, 619.03, 581.57, 509.35, 617.62, 789.55, 799.99 and 812.333 BSCF, respectively of gas was flared into the Nigerian environment (Seiyaboh and Izah, 2017a). Though the report showed that the quantity of gas flared into the environment is on the decline, Atuma and Ojeh (2013) estimated that 35 million tons and 12 million tons of carbon dioxide and methane, respectively are released into the Nigerian environment from flared gas. In summary, about 11 – 42.54% of total natural gas produced are flared into the environment making Nigeria one of the highest gas flaring nations on global perspective (Seiyaboh and Izah, 2017a; Atuma and Ojeh, 2013). During gas flaring, nitrogen dioxides, sulphur dioxide, volatile organic compounds such as benzene, toluene, xylene, polyaromatic hydrocarbons, hydrogen sulphide, benzapyrene and dioxins (Donwa *et al*., 2015; Adamu and Umar, 2013), particulate and methane gas are released into the environment. The composition and quantity depends on the physical and chemical characteristics of the gas being flared. Atuma and Ojeh (2013) reported that carbon dioxide, methane, nitrous oxide, water vapour and sulphur dioxide as the major constituents of flared gas.

In Nigeria, vertical and horizontal flare stacks are used (Seiyaboh and Izah, 2017a) and authors have variously reported that gas flaring could impacts on infrastructures including roofing sheet, buildings/structures, artifacts, monuments and paints (Amadi, 2014; Olukoya, 2015; Donwa *et al*., 2015; Iyorakpo and Odibikuma, 2015; Anomohanran, 2012; Ubani and Onyejekwe, 2013; Nkwocha and Pat-Mbano, 2010). In addition, the impacts of gas flaring on health status of individuals residing close to gas flaring vicinity have been reported in literatures (Nriagu et al., 2016; Anomohanran, 2012; Donwa *et al*., 2015; Olukoya, 2015; Egwurugwu *et al*., 2013a,b; Egwurugwu and Nwafor, 2013) as well as vegetation cover (Seiyaboh and Izah, 2017a). Since, flared gas could impact on health status in humans and infrastructure; they may also affect other wildlife resources.

Gas flaring causes physical disruption on vegetation cover around the flare stack. Gas flares illuminates the environment day and night and prevent photosynthesis. In addition, they could also cause an alteration in the biochemical constituents of the plants within the vicinity. For instance, Ifemeje (2015) reported that variations in alkaloid, phytate, oxalate, Saponin, tannin and cyanogenic glycosides contents in some common vegetables used as food from gas flaring area as compared to the control. In addition, gas flaring could affect plants growth and productivity (Ozabor and Obisesan, 2015). This suggests that gas flaring has the tendency to alter the quality of the soil (Okeke and Okpala, 2014). In agricultural field there are some parameters that is used indicate soil fertility. These parameters include particle size, organic carbon, total nitrogen, soil pH, available phosphorus and cation exchange capacity (Atuma and Ojeh, 2013). Therefore, this study aimed at assessing the impacts of gas flaring on the fertility status of agricultural soil in an oil and gas host community in the Niger Delta region of Nigeria

MATERIALS AND METHODS

Study Area

Ogbia is one of the eight local government areas in Bayelsa. Geographically, Imiringi which is the case it is located between longitude E6^0 022’ and latitude N4^0 053’ (Figure 1). The community has an oil and gas facility for over 3 decades consisting of oil wells, flaring sites and manifold. Unwanted gas from the facility are flared into the environment. Like other Niger Delta region, the area is characterized by two predominant seasons i.e. wet (April to October) and dry season (November to March of the following year) (Agedah et al., 2015; Izah et al., 2017b). Based on the meteorological indicator, the relative humidity and temperature of the area is 50-95% and 28±8ºC, respectively all year round (Izah et al., 2017b).

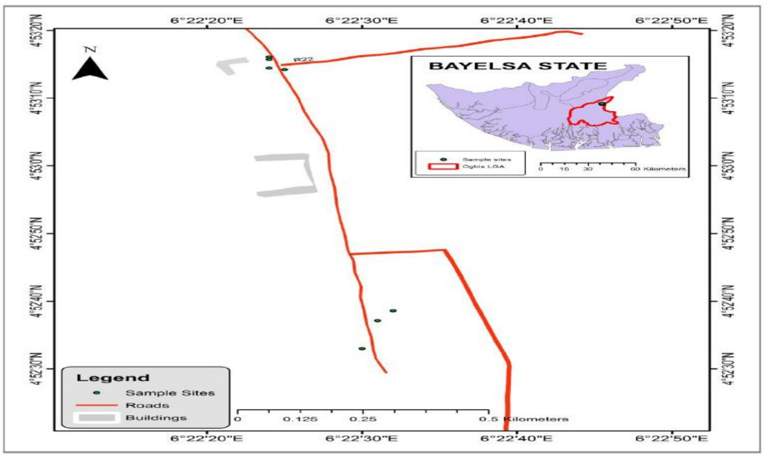

Figure1. *Map of Imiringi Town showing the sample points*

Sample Collection

Soil samples were collected radially at four cardinals of uniting flare station, East, West, North and South at distances of, 200m, 400m, 600m and 800m using soil auger at two depths (0-15cm and 15-30cm). In addition, samples were collected from a botanical garden of Federal University, Otuoke, to serve as control. The samples were packed and labeled accordingly and transported to the laboratory.

Sample Preparation and Laboratory Analysis

The soil samples were air dried and sieved through 2 mm mesh and the finely portion was further processed and used for the analysis. The parameters were analyzed following the methods previously described by authors including calcium, magnesium, potassium and calcium (Nwakaudu et al., 2012), electrical conductivity (Aigberua et al, 2016b), pH (Bates, 1954), particle size distribution (Aigberua, 2015) and cation exchange capacity was determined following ammonium acetate method.

Statistical Analysis

The data were expressed as mean ± standard deviation (n=4). One-way analysis of variance was used to show significant difference. In addition, Waller Duncan statistics was used to discern the source of the observed variations.

Results and Discussion

The particle distribution size and temperature of gas flaring location around agricultural soil around Imiringi, Bayelsa state, Nigeria is presented in Table 1. The Particle distribution size for 80.50% (sand), 4.55% (clay) and 14.95% (silt), and temperature of 48.0°C for the flare area, and 83.00% (sand), 6.10% (clay) and 10.90% (silt), and temperature of 31.1°C for the control area. The trend of particle distribution size and temperature observed in this study had some similarity with the findings of Atuma and Ojeh (2013) that reported percentage sand, clay and silts, and temperature as 81.04%, 3.45%, 15.62% and 48.47°C, respectively in gas flaring area, and 81.95%, 4.78%, 13.28% and 31.1°C, respectively in control area in Ebedei, Delta state, Nigeria. Higher flare temperature is associated to heat radiation from the flare stack. This heat has the tendency to affect biodiversity (including vegetation, wildlife, microorganisms, and insects among others) close to the stack. The particle distribution size indicates that the soil is characterized predominantly by sand, a trend that has been reported in different locations in the Niger Delta (Aigberua, 2015; Atuma and Ojeh, 2013).

Table1. *Particle distribution size and flare temperature around agricultural soil in Imiringi, Bayelsa state, Nigeria*

Soil type	flare location	Control
Sand, %	80.50%	83.00%
Clay, %	4.55%	6.10%
Silt, %	14.95%	10.90%
Soil temperature, °C	48	31

Table 2 presents the effects of gas flaring on agricultural soil around Imiringi, Bayelsa state, Nigeria. The pH of the soil at control, 200m, 400m, 600m and 800m from the stack were 6.500, 4.940, 5.003, 5.113 and 3.890, respectively at 0 – 15cm depth, and 5.948, 4.853, 5.008, 5.043 and 5.188, respectively at 15 – 30cm depth. Statistically there was significant difference ($p<0.05$) in the various experiment group. However, Waller Duncan statistics showed that there is no significant difference between the depths i.e. 0-15cm and 15-30cm for each of the distances. But on the overall, the significant variation in the mean of control and 800m distance at 0-15cm were the source of the observed variation. Apparently, the pH of the soil at 200m is more acid compared to others except for 0-15m at 800m distance, this suggests the possible effects of the gas flaring on the pH of the soil. This is line with the findings of Okeke and Okpala (2014) that reported that gas flaring alters the pH of the soil.

The electrical conductivity of the soil at control, 200m, 400m, 600m and 800m and depth of 0-30cm ranged from 0.031 – 1.120ms/cm, being not significantly different ($p>0.05$) except for the control at both depths 0 – 15cm and 15 - 30cm). The values reported that flared gas is having an impact on the electrical conductivity of the soil. The values reported in this study had some similarity with the findings of Atuma and Ojeh (2013) that reported electrical conductivity in the range of 0.020 – 0.053 ms/cm and 1.22 – 1.89 ms/cm at different distances in gas flare location and control, respectively.

The magnesium and sodium content of the soil at control, 200m, 400m, 600m and 800m and depth of 0-30cm ranged from 0.710 – 2.830meg/100g and 0.263 – 0.900 meg/100g, respectively, being not significantly different ($p>0.05$) except for the control at both depths (0 – 15cm and 15 -30cm) for each of the parameters. However, the Waller Duncan statistics showed that there is significant variation in the mean values of the various depth in the control result for each of the parameters. The observations of this study had some similarity with the findings of Atuma and Ojeh (2013) in gas flare location and control with a value of 0.40 – 1.01meg/100g and 2.83 – 3.01meg/100g, respectively (magnesium), and 0.17– 0.42 meg/100g and 1.67 – 2.41 meg/100g, respectively (sodium).

The potassium concentration of the soil at control, 200m, 400m, 600m and 800m from the stack were 0.775 meg/100g, 0.363 meg/100g, 0.323 meg/100g, 0.543 meg/100g and 0.458 meg/100g, respectively at 0 – 15cm depth, and 1.825 meg/100g, 0.323 meg/100g, 0.498 meg/100g, 0.595 meg/100g and 0.383 meg/100g, respectively at 15 – 30cm depth. Statistically there was significant difference ($p<0.05$) in the various experiment group. However, Waller Duncan statistics showed that there is no between the depths i.e. 0-15cm and 15-30cm for each of the distances. But the significant variation ($p<0.05$) exist in the mean of control at varying depth. In addition, the control was the source of significant difference ($p<0.05$) observed. The findings of this study had some similarity with the findings of Atuma and Ojeh (2013) in gas flare location and control with a value of 0.13 – 0.64meg/100g and 0.20 – 1.85meg/100g, respectively.

Table2. *Effects of gas flaring on agricultural soil around Imiringi, Bayelsa state, Nigeria*

Distance in metres	Depth in cm	pH	EC (ms/cm)	Total exchangeable ions (Meg/100g)				
				K^+	Mg^{2+}	Ca^{2+}	Na^+	CEC
Control	0-15	6.500±0.200c	1.083±0.005b	0.775±0.050d	2.000±0.817b	2.580±0.163de	0.580±0.163b	5.953±0.038c
	15-30	5.948±0.037bc	1.120±0.016a	1.825±0.050e	2.830±0.024c	2.680±0.245e	0.900±0.163c	7.405±0.287d
200	0-15	4.940±0.230ab	0.192±0.272a	0.363±0.051ab	0.483±0.052a	2.150±0.186ab	0.263±0.048a	3.245±0.190a
	15-30	4.853±0.240ab	0.034±0.006a	0.323±0.076a	0.645±0.126a	2.020±0.092a	0.318±0.022a	3.305±0.249a
400	0-15	5.003±0.216abc	0.042±0.012a	0.323±0.111a	0.675±0.165a	2.248±0.170abc	0.313±0.067a	3.560±0.307ab
	15-30	5.008±0.183abc	0.035±0.014a	0.498±0.128abc	0.753±0.157a	2.463±0.034cde	0.270±0.153a	3.928±0.267b
600	0-15	5.113±0.144abc	0.031±0.006a	0.543±0.148bc	0.710±0.295a	2.383±0.173bcd	0.285±0.093a	4.095±0.773b
	15-30	5.043±0.219abc	0.036±0.007a	0.595±0.168cd	0.823±0.153a	2.265±0.117abc	0.285±0.044a	3.998±0.152b
800	0-15	3.890±2.598a	0.045±0.008a	0.458±0.154abc	0.638±0.287a	2.200±0.200abc	0.260±0.064a	3.780±0.111ab
	15-30	5.188±0.193abc	0.128±0.168a	0.383±0.163abc	0.863±0.177a	2.213±0.192abc	0.283±0.134a	3.565±0.459ab

Data is expressed as mean ± standard deviation (n=4); Different letters along the column indicate significant variations (p<0.05) according to Waller Duncan statistics

The calcium concentration of the soil at control, 200m, 400m, 600m and 800m from the stack were 2.580 meg/100g, 2.150 meg/100g, 2.248 meg/100g, 2.383 meg/100g and 2.200 meg/100g, respectively at 0 – 15cm depth, and 2.680 meg/100g, 2.020 meg/100g, 2.463 meg/100g, 2.265 meg/100g and 2.213 meg/100g, respectively at 15 – 30cm depth. There was significant difference ($p<0.05$) in the various experiment group. However, Waller Duncan statistics showed that there is no significant different between the depths i.e. 0-15cm and 15-30cm for each of the distances. In addition, the observed significant difference ($p<0.05$) is from the control group. The findings of this study had some similarity with the findings of Atuma and Ojeh (2013) with a range of 1.46 – 3.11meg/100g and 2.78 – 4.01meg/100g, respectively in gas flare location and control area.

The cation exchangeable capacity concentration of the soil at control, 200m, 400m, 600m and 800m from the stack were 5.953 meg/100g, 3.245 meg/100g, 3.560 meg/100g, 4.095 meg/100g and 3.565 meg/100g, respectively at 0 – 15cm depth, and 7.405 meg/100g, 3.305 meg/100g, 3.928 meg/100g, 3.998 meg/100g and 3.565 meg/100g, respectively at 15 – 30cm depth, being significantly different ($p<0.05$) in the various experiment group. Waller Duncan test statistics showed that there is no difference between the depths i.e. 0-15cm and 15-30cm for each of the distances. The control group was the source of observed significant difference ($p<0.05$). The values observed in this study had some similarity with the findings of Atuma and Ojeh (2013) in gas flare location and control with a value of 2.01 – 5.17meg/100g and 3.20 – 5.11meg/100g, respectively.

Relative to few exceptions, there was no significant variations ($p<0.05$) in the characteristics of the soil at varying depth and distances for each of the parameters except for the control that showed a significant higher concentration than the samples from the gas flare locations. Though in some cases, there is an apparently increase in the soil characteristics as distance away from the gas stack increased. This is a typical characteristics of pollutant gases. For instance, Ojeh (2012) reported a decline in the concentration of some noxious gas as the distance away from flare stack increases. In addition, the effect of flaring can only be observed within 450m radius which depends on some parameters including volume of gas flared, wind speed, temperature, velocity of discharged and height and type of flare stack (Ojeh, 2012). The similarity across the various distances in this study may be associated to dispersion of the pollutants, which may have a close effect on the meteorological indicators (such as wind speed and wind direction) and seasonality. This an indication that gas flaring affects both air quality as well as the soil fertility status. As such if the soil nutrients are affected, it could alter the growth and productivity of plants in agricultural field around the study area.

CONCLUSION

In Nigeria, a substantial amount of associated gas or produce natural gas are flared into the environment. This study evaluated the effect of flaring of associated gas in agricultural farmland in Imiringi, Bayelsa state, Nigeria. The study found that there was significant variations ($p<0.05$) between agricultural farm land in Imiringi and the control with respect to pH, electrical conductivity, cation exchange capacity, calcium, potassium, sodium and magnesium. In addition, not significant variations between the depth at each location for most of the parameters. Based on distance, there was no significant variations ($p>0.05$) across all the distances except for the control. The lower values in the soil parameters in area close to the flare are suggest its impact on soil nutrients which may affect the productivity of vegetation being cultivated in the area. Hence, there is the need for the oil and gas company to adopt zero tolerance to flaring of associated gas in the area.

REFERENCE

[1] Adamu, H. and Umar, B.A. (2013).Occurrence and Chemistry of Co-contamination of Nitrate and Hydrocarbon Pollutants in Gas-Flared Areas of Niger-Delta, Nigeria. *International Journal of Environmental Monitoring and Analysis*,1(4): 139-146.

[2] Agedah, E.C., Ineyougha, E.R., Izah, S.C., and Orutugu, L.A. (2015). Enumeration of total heterotrophic bacteria and some physico-chemical characteristics of surface water used for drinking sources in Wilberforce Island, Nigeria. *Journal of Environmental Treatment Techniques*, 3(1): 28 – 34.

[3] Aigberua, A.O., Ekubo, A.T., Inengite, A.K. and Izah, S.C. (2016a). Evaluation of Total Hydrocarbon Content and Polycyclic Aromatic Hydrocarbon in an Oil Spill Contaminated Soil in Rumuolukwu Community in Niger Delta. *Journal of Environmental Treatment Techniques*, 4(4): 130 – 142

[4] Aigberua, A.O., Ekubo, A.T., Inengite, A.K. and Izah, S.C. (2016b). Seasonal variation of nutrient composition in an oil spill contaminated soil: a case of Rumuolukwu, Eneka, Port Harcourt, Nigeria. *Biotechnological Research*, 2(4):179-186.

[5] Aigberua, A.O., Ekubo, A.T., Inengite, A.K. and Izah, S.C. (2017). Assessment of some selected heavy metals and their pollution indices in an oil spill contaminated soil in the Niger Delta: a case of Rumuolukwu community. *Biotechnological Research*, 3(1): 11- 19.

[6] Aigberua, A.O. (2015). Evaluation of polycyclic aromatic hydrocarbons, heavy metals and physiochemical characteristics of naturally attenuated crude oil contaminated soil in Eneka, Rivers state, Nigeria. MSc thesis submitted to Post graduate school of the Niger Delta University, Wilberforce Island, Bayelsa state, Nigeria.

[7] Amadi, A.N. (2014). Impact of Gas-Flaring on the Quality of Rain Water, Groundwater and Surface Water in Parts of Eastern Niger Delta, Nigeria. *Journal of Geosciences and Geomatics*, 2(3): 114-119.

[8] Anomohanran, O. (2012). Thermal Effect of Gas Flaring at Ebedei Area of Delta State, Nigeria.*The Pacific Journal of Science and Technology*, 13(2):555 – 560.

[9] Atuma, M.I., and Ojeh, V.N. (2013). Effect of Gas Flaring on Soil and Cassava Productivity in Ebedei, Ukwuani Local Government Area, Delta State, Nigeria. *Journal of Environmental Protection*, 4, 1054-1066

[10] Bates, R. G. (1954). Electronic pH Determination. John Wiley and Sons Inc, New York.

[11] Donwa, P.A., Mgbame, C.O., Utomwen, O.A. (2015). Gas flaring in the oil and gas sector in Nigeria. *International Journal of Commerce and Management Research*, 1(1): 28-39

[12] Egwurugwu, J.N. and Nwafor, A.

(2013).Prolonged Exposure to Oil and Gas Flares Ups the Risks for Hypertension. *American Journal of Health Research* 1(3): 65-72.

[13] Egwurugwu, J.N., Nwafor A, Chinko BC, Oluronfemi OJ, Iwuji SC, Nwankpa, P. (2013a). Effects of prolonged exposure to gas flares on the lipid profile of humans in the Niger Delta region, Nigeria. *American Journal of Research Communication*, 1(5): 115- 145.

[14] Egwurugwu, J.N., Nwafor, A., Oluronfemi, O.J., Iwuji, S.C. and Alagwu, E.A. (2013b). Impact of Prolonged Exposure to Oil and Gas Flares on Human Renal Functions. *International Research Journal of Medical Sciences*, 1(11): 9-16

[15] Ifemeje, J.C. (2015). Effect of Gas Flaring on the Anti-nutritional Composition of Four Green Leafy Vegetables from Eleme in Rivers State, Nigeria.*Columbia International Publishing International Journal of Environmental Pollution and Solutions*, 3(1): 31-37.

[16] Iyorakpo, J., and Odibikuma, P. W. (2015). Impact of gas flaring on the built Environment : the case of Ogba/Egbema/Ndoni Local Govt Area, Rivers State, Nigeria. *European Scientific Journal*, 11(26): 83 – 95.

[17] Izah, S.C., Angaye, C.N., Aigberua, A.O., and Nduka, J.O.(2017). Uncontrolled bush burning in the Niger Delta region of Nigeria: potential causes and impacts on biodiversity. *International Journal of Molecular Ecology and Conservation*, 7(1): 1-15

[18] Izah S.C., Bassey S.E., and Ohimain E.I.(2017). Assessment of heavy metal in cassava mill effluent contaminated soil in a rural community in the Niger Delta region of Nigeria. *EC Pharmacology and Toxicology*, 4(5): 186-201.

[19] Nriagu, J., Udofia, E.A., Ekong, I., and Ebuk, G. (2016). Health Risks Associated with Oil Pollution in the Niger Delta, Nigeria. *International Journal of Environmental Research and Public Health*, 13, 346; doi:10.3390/ijerph13030346.

[20] Nwakaudu, M.S., Kamen, F.L., Afube, G., and Nwakaudu, A.A., Ike, I.S. (2012). Impact of Cassava Processing Effluent on Agricultural Soil: A Case Study of Maize Growth. *Journal of Emerging Trends in Engineering and Applied Sciences*, 3(5): 881-885

[21] Ojeh, V.N. (2012). Sustainable Development and Gas Flaring Activities: a Case Study of Ebedei Area of Ukwuani LGA, Delta State, Nigeria. *Resources and Environment*, 2(4): 169-174.

[22] Okeke, P.N., and Okpala C. Q. (2014).Effects of gas flaring on selected arable soil quality indicators in the Niger Delta, Nigeria. *Sky Journal of Soil Science and Environmental Management*, 3(1): 001 – 005.

[23] Olukoya, O.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.

[24] Ozabor, F. and Obisesan, A. (2015).Gas Flaring: Impacts on Temperature, Agriculture and the People of Ebedei in Delta State Nigeria. *Journal of Sustainable Society*, 4(2):5-12.

[25] Seiyaboh, E.I., and Izah, S.C. (2017a). A Review of Impacts of Gas Flaring on Vegetation and Water Resources in the Niger Delta Region of Nigeria. International Journal of Economy, Energy and Environment. 2(4): 48-55.

[26] Seiyaboh, E.I., and Izah, S.C. (2017b). Review of Impact of Anthropogenic Activities in Surface Water Resources in the Niger Delta region of Nigeria: A case of Bayelsa state. *International Journal of Ecotoxicology and Ecobiology*, 2(2): 61 – 73.

[27] Seiyaboh, E.I., and Izah, S.C.(2019) Impacts of Soil Pollution on Air Quality under Nigerian Setting. Journal of Soil and Water Science, 3(1):45-53

[28] Ubani, E.C. and Onyejekwe, I.M. (2013). Environmental impact analyses of gas flaring in the Niger delta region of Nigeria. *American Journal of Scientific and Industrial Research*, 4(2): 246-252.

[29] Uzoekwe S. A. and Ajayi E. D. (2018). Trace Metals Concentration Assessment in Yenagoa and its Environs. *Journal of Applied Sciences and Environmental Management*, *22*(1):134-140.

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