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EFFECTIVENESS OF WATER QUALITY INDEX IN ASSESSING WATER RESOURCES CHARACTERISTICS IN IZOMBE, OGUTA LOCAL GOVERNMENT AREA OF IMO STATE, NIGERIA

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ABSTRACT
The study was carried in Izombe of Niger Delta Region where gas flaring is incessant in order to establish pollution level in rainwater and boreholes as the two major sources water supply in the area. The level of pollution between the sampled water resources was made by comparing the result of physicochemical tracers to WHO STD for drinking water. This was summarized by the use of correlation coefficient. And the overall water resources were assessed by the application of water quality index (WQI). The result that was assessed in the light of WHO indicated temperature, colour, and appearance in rainwater were above WHO STD for drinking water. In terms of pH, sampled water resources in the area shown acidity that ranged between 5.1 – 6.4, with the mean value 5.8, signifying that rainwater is more acidic than borehole. Also phosphate, iron and lead were above WHO STD for drinking water. The correlation coefficient shows that the source of pollution of water resources in the area is the same, which is from non-point source (NPS).The overall water quality index implies that the calculated value of the water resources was more than critical value 0.1 indicating that sampled rainwater and boreholes are greatly polluted, hence frequent water quality monitoring, education on the danger of drinking polluted water, water treatment , gas-reinjection, gas revolution, and enforcement of environmental laws and order for compliance.

KEYWORDS: Rainwater, Borehole, Water Quality Index

INTRODUCTION

Every life on earth revolves around water for their survival, but through human activities in environment water resources have been seriously contaminated. According to Efe (2001), water resources is one of the environmental resources that are under threat either from over exploitation or pollution exacerbated by human activities on the earth surface. Water resources problems are of three main types: too little, too much and water pollution(Ayoade, 1988 ; Adebola, 2001).The principal chemicals that produced water resources pollution in form of acid precipitation are SO_2, NO_2 and CO_2, and human activities are responsible for the production of atmospheric pollutants (Radojevic and Harrision, 1992; Ibe and Njoku, 1999; Efe, 2000). According to Walk and Godfrey (1990), acid rain has a negative impact on surface water and groundwater, water bodies are well known to be affected by atmospheric deposition and trace elements due to gas flaring. In Nigeria, many studies have shown that water resources are easily contaminated from anthropogenic activities in most cities (Akintola and Amadi, 2003). It is also observed that groundwater and rainwater which are the main sources of water supply have been naturally made pure , but due to indiscriminate human activities of different types have made the natural pure water to be highly contaminated (Efe, 2003). The presence of unacceptable level of foreign gaseous and particulate matters in the atmosphere and on earth surface is as a result of gas flaring (Odigure, 1999; Ubuoh *et al*., 2011). However, estimates show that more than 100 billion cubic meters of gas is still flared or vented worldwide annually (Christen 2005). In fact Nigeria flares the highest of 17.7% (Nnimmo, 2008).

The percentage of gas flared in Nigeria, which is about three times the OPEC average, is about 16 times the world average (Abdulkareem, 2006.). It is now aware that gas flaring is one of the human activities that has contributed to degradation of water soil and air (Ubuoh, 2011). In many areas in Niger Delta Region where such activities are carried out, environmental quality is seriously affected. This has in turn affected human health resulting from drinking of polluted water from rainwater and bore holes, especially in Izombe town of Imo State where gas flaring is the order of the day. Application of water quality index (WQI) has been used by Egereonu and Ozuzu (2005) to assess the level of pollution in the River Niger and observed that the river was heavily polluted and needed treatment. The research therefore focus on the comparison of water quality in gas flaring affected areas for the purpose of knowing the susceptibility of water resources to atmospheric pollutants due to petroleum exploitation. This is because water meant for human consumption should be free from pollutants of high concentrations.

METHODOLOGY

(a) Study Area

The study area is Izombe, Oguta Local Government Area of Imo State. It is located with Latitude 5^0 12’ and 5^0 56’ N, and Longitude 60 38’ and 7^0 20’ E of the Greenwich Meridian, and covers the area of about 590 km^2 with the population of 86,565 people (National Census, 1991). It has an annual rainfall value of 232 mm, while thes mean monthly rainfall varied between 10.33 – 382.6 mm, with mean temperature of 31.7^{0}C and annual minimum and maximum temperature variation of 23 – 31^{O}C. They are composed of recent alluvium. The alluvium of marine detailed deposit of very recent time which composed of dark-grey bull site clay, silt and sand with occasional gavels. The soil type is classified under USDA as typical paleudit (Dystric Acrisol), Arenic paleudit Dystric, Nitosol, Oxic Dystiropets (Dystric Cembisol) (FDALR, 1985). Above all, the area has many oil industries like Agip, Chevron and NNPC Ventures that are operating in the area that lead to incessant gas flaring destroying environmental qualities (Ubuoh, 2010b).

(b) Water Sample Collection

Water samples were collected from 10 sampled boreholes and atmospheric rainwater from 10 locations for the comparison for the quality assurance with respect to gas flaring impact on water resources. Samples of water resources were collected in properly labeled 2 L PLASTIC containers. Prior to the collection of the samples, ten plastic containers were thoroughly washed and filled with 5% HCL and left to dry. Thereafter, each of the containers was washed with the bore hole and rainwater before harvesting the samples, corked and put in coolers with ice block under temperature of 4^{0}C. The coolers with samples were then transported to Imo State Environmental Protection Agency (ISEPA) for physico-chemical analysis, after then the results were used for comparison with World Health Organization Standards (WHO, 2006), and Water Quality Index (WQI) was established. Coefficient of variance was also calculated for inference between boreholes and rainwater.

(c) Selected Physico-chemical Analysis for Analysis

Selected physical parameters tested for include Temperature, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Odour, Colour, Appearance, and Turbidity. And selected chemical parameters include, pH, Electrical Conductivity, Sulphate, Nitrate, Free chlorine, Iron, Copper and Manganese.

(d) Laboratory Analytical Techniques

All reagents used for the analysis were of analytical grade quality. For the customized reagents, as in HACH methods, reagents used were those within the validity period. Physical parameters were analyzed with the methods prescribed by Iro and Chukwudi (2009). pH was measured using a digital HANNA micro computer pH meter (Model HI 9025) and conductivity determined with HANNA Conductivity meter Model HI 9835. Sulphate and Nitrate were measured by the Turdimetric ALPHA - 427^{o}C standard method. Metal like copper, Iron and Manganese. Metals analysis was carried out using Atomic Absorption Spectrophotometer (AAS) (UNICAM Model 969 AA). This involved direct aspiration of the water samples into an air/acetylene or nitrous oxide/acetylene flame generated by a hollow cathode lamp at a specific wavelength peculiar only to the metal programmed for the analysis.

(e) Application of Water Quality Index (WQI):

Water quality index expressed the pollution level of water bodies developed and used by Horton (1965). This is expressed mathematically:

$$P_{ij}= (maxCi/Lij)^2+ (meanCi/L \ldots\ldots\ldots (1)$$

Horton (1965), used multiple items of water qualities as expressed as *Ci's* and permissible levels of the respective items expressed as L_{ij}*'s*. Then the pollution index, Pij may be expressed as a function of the relative values of Ci/L_{ij} (Horton, 1965). Here *i* is the number of the *ith* item of the water quality and j is the number of the j-th water use. Each value of (Ci/L_{ij}) shows the relative pollution contributed by the single item. A value of 0.1 is the critical value for each (Ci/L_{ij}). Values greater than 0.1 indicate that the water requires some treatment prior to use for specific purpose. Combining the mean value of Ci/L_{ij} into a common index, values over 1.0 signify a critical condition under which a proper treatment is needed for potable water.

Horton proposed that, the pollution index of water can be computed using the multiple items of water qualities and permissible level of the respective items for use. If Pij is the pollution index then:

$$P_{ij} = F\{C_i /L_{ij}, C2/L_2j. C_3/L_j \ldots\ldots\ldots C_i/L_{ij}\} \ldots\ldots \quad (2)$$

This is then applied in the study of water resources to know the pollution level and the treatment expected.

RESULTS AND DISCUSSION

Table 1 and Table 2 give the mean concentrations of different parameters of the water samples from boreholes and rainwater within the gas flared areas. And for water to be potable, the concentration must reflect desirability of the concentrations and must not exceed the levels set by World Health Organization (WHO) (2006).

TABLE 1: Results of Mean Concentrations of Physical Characteristics of Boreholes and Rainwater from selected Location in IZOMBE.

Physical Tracer	Unit	Water Resources		Mean	WHO
		Boreholes	Rainwater		2006
Temperature	^{o}C	22	32	27	25
Odour	Sensory Organ	Odourless	Odourless	odourless	0dourless
Colour	Pt/co	10	33	22	15
TDS	Mg/l	22	38	30	250
TSS	Mg/l	3	8	6	50
Appearance	Sensory Organ	Clear	Not clear	-	Clear
Turbidity	NTU	3	6	4.5	50

Source: Laboratory Analysis, 2011

(f) Variation of Mean Concentrations of Physical Characteristics of Boreholes and Rainwater from selected Location in IZOMBE

From Table 1, the results shown that temperature of sampled water resources ranged between 22 – 32^{O}C with mean value of 27^{O}C above the 25 WHO for drinking water. And rainwater has the highest value of 32^{O} C above the WHO STD. High temperature usually stimulates growth of taste and odor, producing organisms which later affects human health by causing intestinal irritation (Ezemonye, 2009). The result also indicates that water resources in the area recorded odourless and their colour ranged between 10 – 33 Pt/co with the mean value of 22 Pt/co above the 15 Pt/co WHO STD, and rainwater having the highest value of concentration due soot from gas flaring (Ubuoh, 2010b). Odour is capable of affecting palatability of water, because water should be odourless. Total dissolved solids (TDS) and total suspended solids (TSS) ranged between 22 – 38 mg/l, 3 – 8 mg/l, with mean values of 30 mg/l, 6 mg/l and were all below the 250 mg/l and 50 mg/l respectively, with rainwater having the highest concentration below the WHO STD. Rainwater did not have clear appearance suspected to be the soot released to the atmosphere due to gas flaring. And the turbidity ranged between 3 – 6 NTU, with the mean value of 4.5 NTU below the 50 NTU WHO STD for potable water, and rainwater having the highest value below the WHO STD.

TABLE 2: Results of Mean Concentrations of Chemicals Characteristics of Boreholes and Rainwater from selected Location in IZOMBE.

Chemical Tracer	Unit	Water Resources		Mean	WHO
		Boreholes	Rainwater		
pH	-	6.4	5.1	5.8	6.5 -8.5
Elec. Conductivity.	µ/Scm	44	76	60	100
Sulphate	Mg/l	1.0	6.0	3.5	250
Phosphate	Mg/l	6.0	5.3	5.6	1.0
Potassium	Mg/l	2.2	3.5	2.9	20
Nitrate	Mg/l	43	0.9	22	40
Total Hardness ($CaCO_3$)	Mg/l	5.0	7.1	6.05	100
Copper	Mg/l	0.16	0.19	0.18	1.0
Iron	Mg/l	0.25	0.76	0.51	0.3
Manganese	Mg/l	0.20	0.40	0.3	0.5
Calcium	Mg/l	0.30	0.28	0.43	75
Zinc	Mg/l	0.82	0.1	0.46	3.0
Free Chlorine	Mg/l	0.0	0.46	0.46	0.30
Lead	Mg/l	0.06	0.08	0.07	0.01

Source : Fieldwork and Laboratory Analysis, 2011

(g) Variation of Mean Concentrations of Chemical Characteristics of Boreholes and Rainwater from selected Locations in IZOMBE

From Table 2, the results indicated that pH concentration in water resources ranged between 5.1 – 6.4, with the mean value of 5.8 above the 6.5 – 8.5 WHO STD, and rainwater was more acidic than boreholes rendering water resources unfit for drinking . This is suspected to be caused by gas flaring releasing obnoxious gases that lead to the release of hydrogen ion to the atmosphere. The result is consistent with the findings of Ubuoh *et al.* (2011) in Akwa Ibom State of Nigeria. Electrical conductivity depends on the amount of dissolved ions and is ability of a substance to conduct an electric current at a specified temperature usually 20^{0}C or 25^{0}C (Egerenonu, 2006). The mean electrical conductivity of the water resources in the area ranged between 44 – 76 µ/Scm, with the mean value of 60 µ/Scm below the 100 µ/Scm WHO STD for drinking water. But electrical conductivity was more in rainwater than borehole which is suspected to be the amount of dissolved salts from gas flaring in the area. The sulphate ranged between 1.0 – 6.0 mg/l, with the mean value of 3.5 mg/l below the 250 mg/l WHO STD, and sulphate was recorded more in rainwater than borehole. Phosphate recorded concentrations ranging between 5.3 – 6.0 mg/l, with the mean value of 5.6 mg/l above the 1.0 mg/l the WHO STD for potable water, with boreholes having the highest concentration. Potassium concentrations ranged between 2.2 – 3.5 mg/l, with the mean value of 2.9 mg/l, and rainwater with higher concentration below 20 mg/l WHO STD for drinking water. Nitrate ranged between 0.3 – 0.9 mg/l, with the mean value of 0.6 mg/l, total hardness ($CaCO_3$) ranged between 5.0 – 7.1 mg/l , with the mean value of 6.1 mg/l. and rainwater recorded highest values below the 40mg/l, 100mg/l WHO STDs for drinking water. Copper ranged between 0.16 - 0.19 mg/l ,with the mean value of 0.18 mg/l below the 1.0 mg/l WHO STD, and this result is consistent with the finding of Dailfullar and Shakour (203), who explained that rainwater with low pH can increase the level of toxic metal like copper in untreated rainwater meant for drinking than underground water.

When iron in water exceeds the 0.3 mg/l limit, red brown, or yellow staining of laundry, glassware, dishes, and plumbing fixtures occurs (Colter and Mahler, 2010). Iron ranged between 0.25 -0.75 mg/l, with the mean value of 0.51 mg/l above the 0.3mg/l WHO STD in rainwater. The effect of high concentration of Fe in rainwater is detrimental in terms of taste and appearance rather than on any detrimental health effect (Colter and Mahler, 2010), and small concentrations of iron in water are vital to human health. It helps in transporting oxygen in the human blood (Colter and Mahler, 2010).

Manganese ranged between 0.20 – 0.40 mg/l, with the mean value of 0.3 mg/l below the 0.5 WHO STD. Calcium ranged between 0.28- 0.30 mg/l, with the mean value of 0.43 mg/l below the 75 mg/l WHO STD, zinc ranged between 0.1 – 0.81 mg/l, with the mean value of 0.46 mg/l below the 3.0 mg/l WHO STD Free chlorine ranged between 0.0 - 0.46 mg/l, with the mean value of 0.46 mg/l above the 0.30 mg/l WHO STD suspected to originate from gas flaring and lead ranged between 0.06 – 0.08 mg/l, with the mean value 0.07 mg/l above the 0.01 mg/l WHO STD. High concentration of lead in water is capable of reducing growth and development, cancer, organ damage in males (sterility), nervous system damage (Riba *et al*., 2003; Asuquo *et al*., 2004; Yilmaz, 2005).

The relationship existing between water samples from boreholes and rainwater shown that there is relationship existing between physicochemical pollution. The coefficient of physical parameters in sampled rainwater and borehole is r^2 = 0.254 at 0.05, with the coefficient variation being 0.866, and chemical parameters recorded r^2 = 0.246 at 0.05, with coefficient variation being 0.967. These then signified that there are strong correlation existing between rainwater and borehole pollution, which means that the source of rainwater pollution is also the source borehole pollution which is suspected to be incessant gas flaring in the area.

TABLE 3: Composition of Pollution Index of Sampled Water Resources

Water Tracer	Unit	Quality (*Ci*)	Permissible Level (WHO) *Li*	Ci/ Lij
Temperature	^oC	27	25	1.08
Colour	Pt/co	22	15	1.47
TDS	Mg/l	30	250	0.12
TSS	Mg/l	6	50	0.12
Turbidity	NTU	4.5	50	0.09
pH	-	5.8	8.5	0.68
Elec. Conductivity	µ/Scm	60	100	0.6
Sulphate	Mg/l	3.5	250	0.014
Phosphate	Mg/l	5.6	1.0	5.6
Potassium	Mg/l	2.9	20	0.145
Nitrate	Mg/l	22	40	0.55
Total Hardness ($CaCO_3$)	Mg/l	6.05	100	0.061
Copper	Mg/l	0.18	1.0	0.18
Iron	Mg/l	0.51	0.3	1.7
Manganese	Mg/l	0.3	0.5	0.6
Calcium	Mg/l	0.43	75	0.006
Zinc	Mg/l	0.46	3.0	0.153
Free Chlorine	Mg/l	0.46	0.30	1.533
Lead	Mg/l	0.07	0.01	7

Source: Fieldwork, 2011

From the calculation of water pollution index (WPI) in Table 3, it is observed that rainwater and groundwater in the study area recorded 23.78 which indicated that selected water resources in the area are heavily polluted with physicochemical tracers because the calculated value is more than critical value of 1.0 used for the judgment of unpolluted water.

SUMMARY AND CONCLUSION

Water for drinking should be free from contaminants as stipulated by World Health Organization standards for drinking water (WHO, 2006). Whether natural or man-made, pollution makes water unsafe and caused water-related diseases (Moss, 2007). From the results, temperature, colour, and appearance in rainwater were above WHO STD for drinking water. Also, the two sources of water supply were acidic, with rainwater being more acidic than borehole. Phosphate concentration was more in borehole than rainwater above WHO STD. Iron and lead were above WHO STD in rainwater and borehole sampled water, with rainwater having the highest concentration alongside free chlorine and borehole having none. The result also indicated that sampled water resources sampled were closely correlated in pollution level which signifies that the source of water resources pollution is from the same non-point which is gas flaring. The overall water quality index implies that the calculated value of the water resources was more than critical value indicating that sampled rainwater and boreholes are greatly polluted in the area which the calls for policy implementation and water quality maintenance. The result finally confirmed that WQI is an appropriate tool for study water resources because it takes care of water characteristics as a whole, while WHO is dealing with only the standards. Based on the results the following recommendations are made:

1. Water resources monitoring in the area should done on regular basis in order to check pollution levels in order to check the spread of water related problems.
2. There must a medium to create on the danger of drinking polluted water due to incessant gas flaring
3. In case of doubtful water quality, treatment is recommended through boiling, filtration, and the use of additive (alum, liming, chlorine), thereby minimizing the risk of water-related problems.

4. Lastly gas flaring should be re-injected and revolutionalized in order to finally stop gas flaring for sustainable development, and this should be done by enforcement of environmental laws and order by the department of petroleum resources (DPR) for compliance and penalties attached for non-compliance within a stipulated time frame.

REFERENCES

Abdulkareem, A.S. (2006) Evaluation of Ground Level Concentration of Pollutant Due to Gas Fla r i n g by Computer Simulation: A Case Study of Niger – Delta Area of Nigeria. Retrieved from: http://www. micdirect.org /A06/29_42.htm (Accessed date: June, 2010).

Adebola, K.D. (2001) "Groundwater Quality in Ilorin Township Environment", Review *African Journal of Environmental* Studies (2) page 46.

Akintola F. O. and Amadi (2003*) Effects of Pollution on Physico-chemical Properties of Soils in Izombe, Oguta L.G.A, Imo*, Field Report, pp. 23 -34.

Asuquo, F. E., Ewa-oboho, I., Asoquo, E.F., and Udo, O.J. (2004) "Fish Species used as Biomarkers for Heavy Metals and Hydrocarbon Contaminations for the Cross River, Nigeria*". Environmentalist* 24: 29-37.

Ayoade, J.O. (1988) *Human Impact on the Environment in Filani et* al (eds) Ibadan Region Ibadan Rex Charles Pub.

Christen, K (2005) Environmental Impacts of Gas Flaring Venting Up."*American Chemical Society p. 1 of 3.*

Colter, A. and Mahler, R. L. (2006) Drinking Water: *Iron in Drinking Water*. PNW 589, Online, pp 1 – 10.

Daifullah, A.M. and Shakour, A. A. (2003) "Chemical Composition of Rainwater in Egypt". *AJEAM –RAGEE,* Volume 6, pp. 32 -43.

EFE, S.I. (2006) "Quality of rainwater harvesting for communities of Delta State, Nigeria". *Journal of the Environment*:, vol. 26 pg 175 -181.

Efe, S. I. (2000) *An Appraisal of the Quality of Rain and Groundwater in Nigerian City.A Case Study of Warri Metropolis*. A Ph.D Seminar Paper Presented to the Department of Geography and Regional Planning,Delta State University, Abraka, pp. 1- 19.

Egereonu, U.U. and Ozuzu, C. I. U. (2005) "Physicochemical Analysis of the River Niger at Onishia Bank", Nigeria. *J. Chem. Soc. Nigeria,* Vol. 30. No. pp. 197 – 203.

Ezemonye, M. N. (2009) *Surface and Groundwater Quality of Enugu Urban Area*.Unpublished Ph.D Thesis, Department of Geography, University of Nigeria, Nsukka.

Federal Department of Agricultural Land Resources (1985) *Reconnaissance Survey of Imo State at a Scale of 11250*, FMA & RD, Abuja.

Horton, R.K.(1965) "An Index Number System for Rating Water Quality"*, Journal of Water Pollution Control Fe*d. 37 (3).

Ibe, K. M.and Njoku, J.C. (1999) "Migration of Contaminants in Groundwater at a Landfill Ste, Nigeria". *Journal of Environmental Hydrology*, Vol. 7. Paper 8, pp. 1 -9.

Iro, S. I., and Chukwudi, B. C. (2009) *Surface Water Supply for Domestic Use in Rural Environments: Analysis of Some Streams in Ihitteafoukwu, Ahiazu Mbaise L. G.A.,Imo State*.pp. 151 – 157 in Uzo, M. Igbozuike,M. A. and E.C. Onyenechere (editors), Rural Water Supply in Nigeria. Owerri Cape Publishers Int. Ltd.

Moss, J. (2007) New Web Site Targets World's Unsafe Drinking Water", *Voice of America,* 16 September.

Nnimmo, B. (2008) *Gas Flaring: Assaulting Communities, Jeopardizing the World*. A paper Presented at the National Environmental Consultation, Environmental Rights Action in conjunction with the Federal Ministry of Environment at Reiz Hotel, Abuja 10-11 December 2008.

Odigure, J.O. (1999): *Safely, Loss Prevention and Pollution Prevention in Chemical Processing Industries, Jodigs and Associate*, Minna, Nigeria, pp 89.

Rabi, I. Garcia- LuguE, E. Blasco,J., Delvallsi, T.A. (2003) "Bioavailability of Heavy Metals Bound to Estuarine Sediments as a Function of pH and Salinity Values*". Chem. Speciation Bioavailability* 15:101 -114.

Radojevic, M. and Harrison, R.M. (1992): "Atmospheric Acidity, Sources, Conaequences and Abatement", *Elservier Applied Science*, London and New York.

Ubuoh, E.A. (2009) *Harvested Rainwater Quality in Selected Parts of Akwa Ibom State, Nigeria.* A Ph.D Seminar 111 (Results) Presented to the Department of Geography, University of Nigeria, Nsukka, pp. 23 -78.

Ubuoh, E. A, Akande, S.O. Anyadike, R.N.C. Akhionbare, W. N. Igbojionu, D.O. NJOKU, J.D. and Akhionbare, S.M.O. (2010b) "Atmospheric Corrosion of Roofs in Selected Parts of Akwa Ibom State, Nigeria". *Global Journal of Science and Technology,* Vol.3, Number 2,, pp. 317 –324.

Ubuoh E. A. (2011a) "Characterization by factor analysis of the atmospheric rainwater from Two Rain Gauged Stations in Akwa Ibom State", *Journal of Environmental Sciences and Resource Management, Volume 3, PP.45-56.*

Walk, M.F., and Godfrey, P. J. (1990) "Effects of Acid Deposition on Surface Water," *Journal Of New England Water Works Association*, Vol.104 (4), pp. 248 – 251.

World Health Organisation (WHO) (2006) Environmental Health Criteria 134 – Cadmium International Programme on Chemical Safety (IPCS) Monograph.

Yimaz, A.B. (2005) Comparison of Heavy Metals of Grey Mullet (M.Cephalus L.) and Sea Bream S. (S. Arurata L.). Caught in Iskenderun Bay (Turkey). *Turk. Journal Vet. Animal Sci*. pp. 257 -262.