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Effect of Solid Waste Disposal on Ground Water Quality in Mgboji, NdokiOyigbo Local Government Area, Rivers State, Nigeria

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ABSTRACT

One of the spiteful impacts of landfill sites is the emission of leachates into ground water. The study examined the impact of landfill site on ground water in MgbojiNdokiOyigbo Local Government Area, Rivers State. The study sought to assess the quality of underground water in relation to WHO best standard. The study adopted a laboratory examination, assessing water quality parameters such as hardness, TDS, EC, DO, BOD, chlorine, zinc, pH, temperature, salinity, COD and copper. The study sampled 15 boreholes that are up to or less than 500m from the landfill site and another borehole at 1000m from the landfill site, which serves as a control point for the study. The paired sample t-test was adopted in analyzing the formulated hypotheses. The result of the study revealed that bore holes that are 500m or less are more contaminated than boreholes that are 1000m away from the landfill sites. Furthermore, water quality from boreholes that are 500m or less are unfit for human consumption because they do not meet the acceptable limit postulated by WHO, while boreholes that are 1000m away from the landfill are suitable for human consumption because they meet the acceptable limit by WHO. The study recommends that government should regulate human settlement and development within areas that are too close to landfill sites.

Key words: Waste management; Landfill site; Water quality; WHO standard

1. INTRODUCTION

Solid waste management constitutes one of the most crucial environmental problems facing cities of the world, especially African cities (Anestina, Adetola, &Odafe, 2014). The problems posed by improper and ineffective management of solid waste has become an issue of global concern over the past decades (Schwarz-Herion, Omran& Rapp, 2008). The impact of poor waste management impacted different components including but not limited to soil, water and to air quality (Shegow&Funwie, 2020). Furthermore, the magnitude of commercialization, industrialization and population expansion in many cities of the world has also aggravated the impact of waste management on the environment (Abur, Oguche&Duvuna 2014). Landfill waste management involves the designation of land for waste disposal in such a manner that it does not pollute the surrounding environment especially, groundwater (Ezechi, Nwabuko, Enyinnaya& Babington, 2017). However, the adoption of landfill sites for waste management has become more threatening to human lives mostly as a result of contaminant that leaches from the landfill sites (Akor, Ayotamuno, Aman &Enokela, 2013).One of the spiteful impacts of landfill sites is the emission of leachates into ground water. Leachate from landfills is usually highly concentrated with complex effluents which contain dissolved organic matter and inorganic matter (Hossain, 2014). Pollution due to heavy metals in ground water where it is used as drinking and the likely risk to population health has been studied extensively (Elumalai, Brindha, & Lakshmanan 2017). Thousands of lives are lost every year to environmental related diseases from consumption of polluted water resources. It is noted that the consumption of ground water resources located around these landfill sites are known to cause issues such as typhoid, dysentery, guinea worm disease, cholera, dengua, diarrhea, hepatitis and a host other water related disease (Solidarities 40, 2012).

The influence of landfill leachate on the ground water has given intense attention in many studies in current years as a result of the increasing emergency of underground water pollution from landfill sites (Nagarajan, Thirumalaisamy&Lakshumanan, 2012), a problem similarly observed inNdoki, Oyigbo LGA, River State, Nigeria. Hence, this study is designed to examine the impact of landfill site on ground water in MgbojiNdokiOyigbo LGA, Rivers State.

2. STUDY AREA

Oyigbo is a local government in River State and lies within the coordinates 4.8781°N and 7.1283°E. Oyigbo is bounded to the East by Abia State, to the South by Khana LGA, to the West by Eleme, Tai and ObioAkpo LGA and to the North by Etche LGA. The vegetation in Oyigbo is characterized by rainforest and it is equally rich in tropical biodiversity. The climate of Oyigbo LGA is a tropical climate. Rainfall is significant most months of the year, and the short dry season has little effect. The average annual temperature is 26.4 °C | 79.5 °F in Port Harcourt. Precipitation here is about 2708 mm or 106.6 inch per year. The driest month is January, with 36 mm 1.4 inch of rainfall. It has an elevation of just 139m above sea level, the landscape of the region comprises the coastal palms by a maze of swamps, creek and water ways (Ekeke, 2015). Oyigbo is located within the lower delta plain reported to have been formed during the Holocene of the quatemary period by the accumulation of sedimentary deposits In addition, the major geological characteristics are sedimentary alluvium. Oyigbo lies about 15-31 meters above sea level. The soil types are generally shallow, young, poorly drained soils and acid sulphate soils.

Oyigbo has an estimated population of about 222,687 people according to 2006 population census. Access roads are numerous in Oyigbo. Oyigbo is an industrial centre as it has a large number of multinational firms as well as other industrial concerns, particularly business related to the petroleum industry. It is one of the chief oil producing community in Rivers State in Nigeria. Also, inhabitants engage in farming as a dominant economic activity in Oyigbo L.G.A. Yam, cassava, vegetable are largely grown. Other forms of economic activities include trading and fishing.

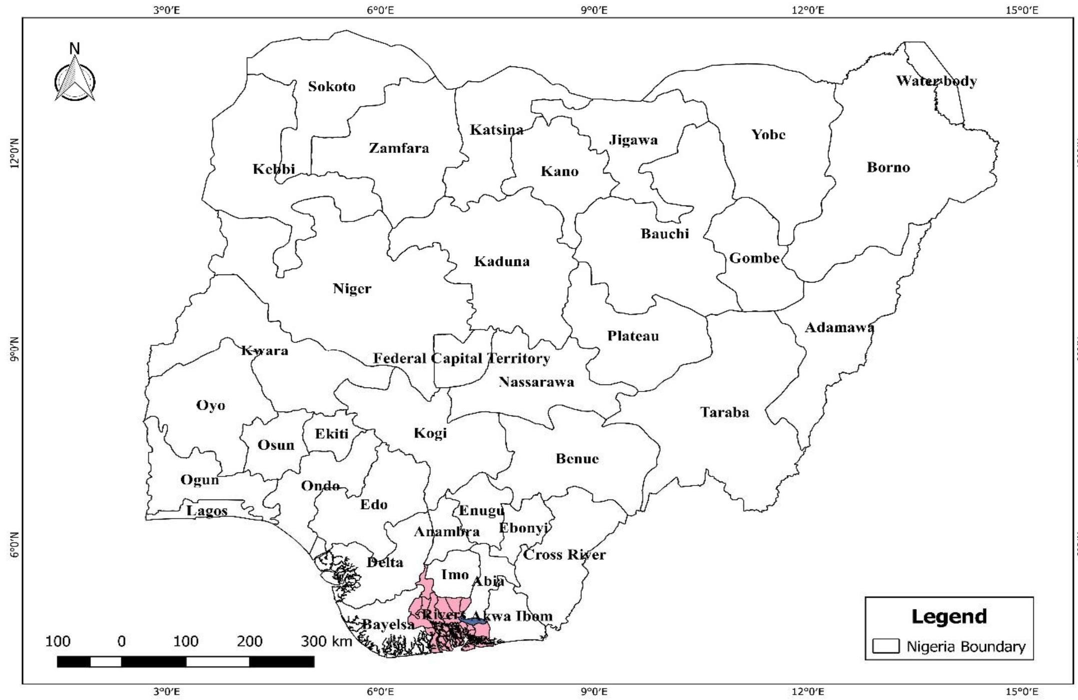

Figure 1: Map of Nigeria

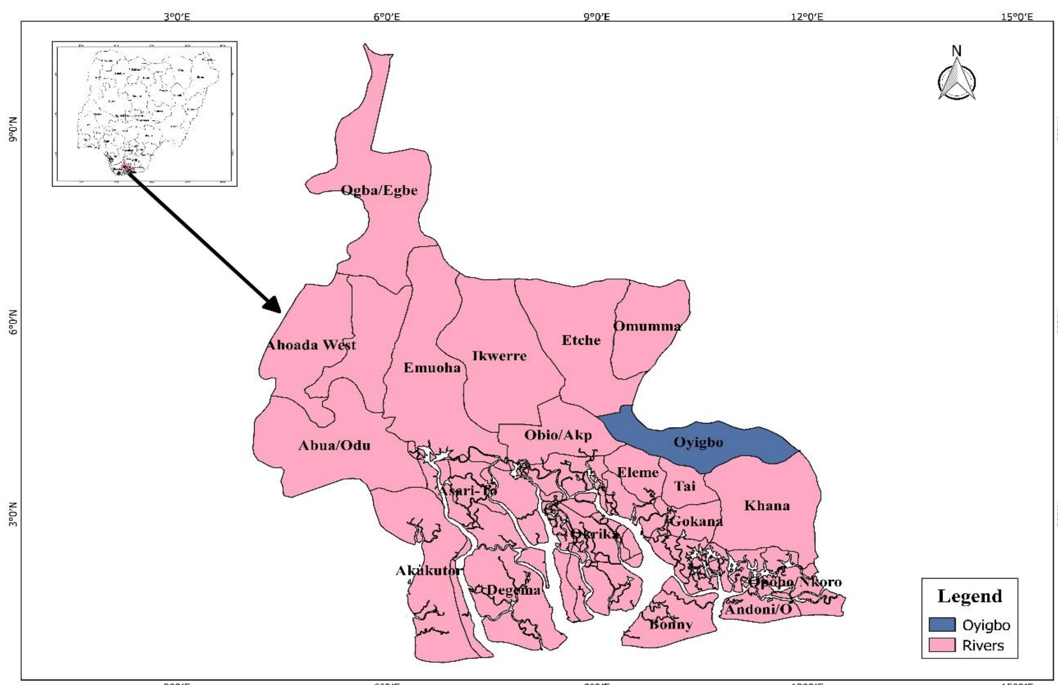

Figure 2: Map of River State showing Oyigbo LGA.

3. MATERIALS AND METHODS

The study adopted a laboratory experimental research design using a continuous data type obtained from primary sources. Water samples were collected from taps around boreholes located within households around landfill sites. As a rule of thumb, fifteen sampled boreholes were chosen from locations within the landfill sites. Another sample point was selected away from the landfill site to serve as the control point. Due to the nature of the research, water samples were obtained from a controlled environment. A receptacle was used in collecting water samples from boreholes located within the landfill sites and borehole located outside the land fill site. The receptacle was cleaned with water from the borehole and used in collecting water samples, which were then labelled and stored in a cool container before taken to the laboratory for analysis. Descriptive, inferential statistics was adopted to analyze data in this study. Descriptive statistics include maps, charts, percentages and frequency tables. The paired sample t-test was conducted in testing both hypotheses.

The formula for the paired sample t test is given as thus;

The student t-test formula is given as:

$$t = \frac{(\sum D)/N}{\sqrt{\frac{\sum D^2 - \left(\frac{(\sum D)^2}{N}\right)}{(N-1)(N)}}}$$

4. RESULT

Table 1 revealed that some of the physico – chemical parameters at borehole locations 4,5,6,7,8,12 and 15 were above the recommended WHO standard. Also their mean and standard deviation values also exceeded the WHO standard for drinking water.

Table 1: Physico-Chemical Parameter of Water Quality

BH Number	ph	temp (oc)	EC (uS/cm)	Salinity	TDS	DO	BOD	COD	Hard	Nitrate	Chloride	Copper	Zinc
GW1	6.2	29.85	18.3	0.009	3.59	6.34	7.8	18.6	85.9	0.003	50.03	0.002	0.56
GW2	6.7	29.4	19.2	0.002	7.28	4.53	5.7	8.6	108.9	0.14	102.4	0.08	0.89
GW3	6.8	29.6	10.4	0.06	6.06	5.02	6.7	12.5	217.4	0.88	75.6	0.16	1.89
GW4	6.3	28.99	13.6	0.01	13.54	5.32	6.8	10.9	96.4	0.68	60.89	0.2	0.78
GW5	5.7	28.31	15.8	0	45.9	4.88	7.8	7.9	108.7	0.59	112.65	0.15	1.05
GW6	6.9	27.9	20.5	0.003	155.9	4.98	5.3	6.5	120.5	0.76	77.67	0.19	0.67
GW7	6.4	27.6	18.7	0.003	205.8	6.01	8.2	12.4	87.4	1.06	124.23	0.06	1.88
GW8	7	28.6	10.2	0.06	88.3	5.53	6.9	7.5	99.6	0.56	73.95	0.12	1.67
GW9	6.4	28.6	10	0	75.12	5.68	6.5	8.4	55.6	0.06	213.6	0.04	1.23
GW10	7.1	29	19.3	0.02	378.3	6.09	7.5	10	77.9	0.88	220.5	0.07	0.66
GW11	6.8	28.8	20.1	0.004	330	5.3	6	7.5	70.4	0.45	121.4	0.0012	0.34
GW12	6.7	28.7	16.4	0.005	157.8	5.76	7.8	8.9	40.9	1.65	58.6	0.05	0.65
GW13	6	29.1	11.1	0	34.3	4.76	6.9	7.5	340.9	1.32	45.5	0.012	0.34
GW14	7.1	28.2	18.6	0.001	15.3	4.67	5.4	6.5	127.5	1.01	87.5	0.001	1.34
GW15	7	28.6	12.4	0.03	3.91	5.34	7	7.1	57	0.06	68.65	0.0015	1.03
CP	6.501	28.01	20	0.004	500	5.98	0.0021	40	450	4.2	250	1.48	2.98
Mean	6.630769	28.61538	15.16154	0.015077	116.1715	5.333846	6.830769	8.738462	115.4	0.766154	103.1338	0.081208	1.040769
SD	0.423365	0.610105	3.959762	0.020509	121.4728	0.549395	0.912767	3.195279	75.43228	0.484304	53.62262	0.071445	0.511271

Source: Researcher’s Fieldwork, 2021

- **Comparison of the quality of water samples from polluted area (<= 500m) with WHO Standard**

Tables 2, 3, 4, compares the quality of water samples from polluted area with WHO standard, the pair sample t-test was conducted for hypothesis one to achieve the second objective of the study. Based on the result of the paired samples correlation test, a significant value of *P=0.023* was achieved, which was less than the accepted level of significance that is, 0.05. From the result, a t value of 0.841 was achieved at a degree of freedom (df), 13. In addition, a level of significance (*P0.023< 0.05*) was achieved, hence the researcher rejected the null hypothesis in favour of the alternate hypothesis. There is a significant mean difference in water quality of the sample points in Mgboji, NdokiOyigbo LGA, Rivers State and WHO standard**.**

Table 2. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Water quality samples from at non-controlled point & WHO standard	14	-.607	.023

Source: Researcher's field work, 2021

Table 3 Paired Samples Test

		Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
					Lower	Upper
Pair 1	Water quality samples from at non-controlled point & WHO standard	104.74250	249.05539	124.52769	-291.56020	501.04520

Source: Researcher's field work, 2021

Table 4 Paired Samples Test

		t	df	Sig. (2-tailed)
Pair 1	Water quality samples from at non-controlled point & WHO standard	.841	13	.023

Source: Researcher's field work, 2021

- **Comparison of the quality of water samples from controlled point (>=1000m) with WHO standard**

Also, to compare the quality of water samples from controlled point with WHO standard, paired sample t-test was conducted for hypothesis two to achieve the second objective of the study. Based on the result of the paired samples correlation test, a significant value of *P=0.07* was achieved, which was more than the accepted level of significance of 0.05. From the result, a t value of 0.75 was achieved at a degree of freedom (df), 13. In addition, a level of significance (*P0.07> 0.05*) was achieved, hence the researcher accepted the null hypothesis against the alternate hypothesis. That is there is no significant mean difference in water quality from the controlled point in Mgboji, NdokiOyigbo LGA, Rivers State and WHO standard**.**

Table 5. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Water quality samples from controlled point & WHO standard	14	.872	.07

Table 6 Paired Samples Test

		Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
					Lower	Upper
Pair 1	Water quality samples from controlled point & WHO standard	134.23	321.02	154.9	-231.44	531.04520

Source: Researcher's field work, 2021

Table 7 Paired Samples Test

		t	Df	Sig. (2-tailed)
Pair 1	Water quality samples from at non-controlled point & WHO standard	.90	13	.07

Source: Researcher's field work, 2021

5. DISCUSSION OF FINDINGS

The findings of the study availed the comparison of water quality from boreholes collected at from different points that are 500m or less from the landfill sites with WHO standard. The result of the paired sample t-test showed that there is a significant mean difference in water quality at the polluted area and WHO standard, with the water quality at the polluted area being higher and lower than the WHO standard. This finding was similar to the findings of Ochekpe (2011) who noted that groundwater located within landfill sites get contaminated within leachates and becomes unpotable for consumption. On the other hand, the paired sample t test between control point and WHO standard showed that there is no significant mean difference between water quality at the controlled point and WHO standard. Similarly, this finding corroborates the findings of Ochekpe (2011).

6. CONCLUSION

The study thus concludes that landfill sites pose serious impact on the quality of ground water as a result of leachates that are emitted in to the water table. The emission of the leachates from the landfill sites causes alteration of water quality parameters, thereby making water unsafe for human consumption. Furthermore, the study thus concludes that the farther way borehole sources from the landfill site are usually not contaminated by the pollution from the landfill sites.

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