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A COMPARATIVE STUDY OF THE EFFECTS OF DUMPSITES ON GROUNDWATER QUALITY IN UYO METROPOLIS OF AKWA IBOM STATE

Uchacha N. D.[1], Usoh G. A.[1], Olatunji O. M.[1], Afangideh C. B.[2], and Sam E. O.[1]

[1]Department of Agricultural Engineering, Akwa Ibom State University, Ikot Akpaden.

[2]Department of Civil Engineering, Akwa Ibom State University, Ikot Akpaden, P.M.B., 1167, Uyo, Nigeria.

[*]Corresponding Author's Email: godwinusoh@aksu.edu.ng; Tel.: +2348035408924

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ABSTRACT: *The study was conducted to compare the effects of dumpsites on groundwater quality in Uyo Metropolis of Akwa Ibom State. It aimed at examining the effect of dumpsites from physicochemical and heavy metal content of borehole water and determining the water quality rating of boreholes in the study areas. Three (3) dumpsites, namely Uyo Village Road Dumpsite (UVD), Atiku Road Dumpsite (ARD) and Ediene Uyo Dumpsite (EUD) were used for the study. The triangular sampling method was used to select three boreholes in each dumpsite area, giving a total of thirty-six (36) samples on replication for the three dumpsites and control. The water samples were collected in well-labeled pretreated 1-litre plastic bottles and were immediately transported to the laboratory for analysis. Data obtained were analyzed using descriptive statistics and means of significant parameters were separated using the Duncan multiple range test at 5% level of probability. The result showed that mean pH was 7.49 in control, significantly lower than 8.22–8.66 in the study areas. Electrical conductivity was 245.33–580.67 µs/cm with 335.00 µs/cm as control. Mean temperatures were 28.53–28.67 °C and 28.0 °C for control. Also, values obtained for turbidity were 3.47–4.21 and 3.47 in control. DO in control borehole water was 3.07 mg/l while that of dumpsites was 3.18–3.37 mg/l. The calculated water indices were 1871.92, 33492.86 and 32288.10 for UVD, ARD and EUD respectively. The findings revealed that mean values in water quality parameters like Magnesium, Dissolved Oxygen, Lead, Cadmium, Nickel and Zinc were above the permissible limit of the World Health Organization for drinking water, indicating higher evidence of groundwater pollution in the study area. The study generally showed that borehole water samples from the three dumpsites were unsuitable for drinking. Public awareness among borehole owners and users within the dumpsite environment on ground water contamination by dumpsites was recommended among others in the study area and the water should be treated before human consumption.*

KEYWORDS: Groundwater, Percolation, Dumpsites, Contaminants, Water quality.

INTRODUCTION

Environmental pollution has been a major problem in some states and other urban areas in Nigeria and other parts of the world due to improper waste management systems which have contributed to environmental degradation (Usoh *et al.*, 2023a). Dumpsites have been one of the forms of waste disposal management as they reduce environmental unfriendliness mostly for reducible, recyclable and combustible wastes. According to Adeoti *et al*. (2011), dumpsites are abandoned burrow pits and acquired areas which mostly were not chosen based on legal environmental impact assessment studies. These waste dumpsites become hazardous and potential threats to the soil and groundwater as a result of percolation of leachates with time. Nta *et al.* (2017) and Usoh (2023) noted that various forms of solid waste generated at various dumpsites have destroyed most water bodies and aquatic lives and have as well as caused human death. Inappropriate management of dumpsites has major negative effects on water bodies and human health (Usoh *et al.,* 2022) and lack of appropriate water conservation measures has led to the degradation of natural resources like water (Ahuchaogu *et al.,* 2022).

Groundwater is an important source of fresh water in both the urban and rural areas of Nigeria and communities around the world (Jha, 2020). It is a valuable source often considered for industry, commerce, agriculture, and domestic uses (most importantly for drinking). Increase in population growth has created increasing demand for potable water (Usoh *et al.,* 2023b). Glawe and Visvanathan (2010) stated that good water quality and its availability supports livelihoods in various ways. Usoh *et al.* (2017) noted that water availability with good quality and soil with nutrients, together with conducive climate usually ensures optimal crop yield and food security. Various works of literature have established a close relationship between land use and groundwater quality (Chiedozie *et al.*, 2022). Based on land use, especially for dumpsite, sources of groundwater contamination include leachate from municipal dumpsite, industrial discharge (liquid waste), domestic waste, salt water intrusion, application of agricultural chemicals, oil spillage and pipeline vandalized and geological formations (Abanyie *et al.*, 2023).

The issues of micro leachate represent a matter of concern because groundwater can be contaminated by such as they are laden with bacteria, viruses, nitrogen (N), phosphorus (P) (Olujimi *et al.*, 2016) and other toxic substances resulting from the decay of coffin material (Ali *et al.,* 2014). These may be transported from the graves through seepage and percolate into surrounding soils, and from there, they may leach into groundwater and cause potential health risk to the residents depending on the contaminated water for various uses. Majorly, a leachate that escapes from dumpsites may migrate through the unsaturated zone or be transported through the saturated zone to a point of discharge, thereby causing contamination of water bodies. The soil and water quality depend on the concentration of various physicochemical constituents which are mostly achieved through experimental approach; this is the submission of several researchers (Namuduri *et al.,* 2008; Bretzel & Calderisi, 2011). Therefore, this research work aimed at examining the effect of dumpsites from physicochemical content of boreholes and determining the water quality rating of boreholes around dumpsites.

MATERIALS AND METHODS

Study Area

The study was conducted in Uyo metropolis, Akwa Ibom State, Nigeria. Uyo is the State capital of Akwa Ibom, an oil-producing State in Nigeria. The city became the capital of the state on September 23, 1987 following the creation of Akwa Ibom State from Cross River State. Uyo lies between latitudes $4^0$30" and $5^0$30"N and longitudes $7^0$30" and $8^0$30"E. The initial population of Uyo as at 1991 was 205,790 and it later increased to 498,622 in the year 2006, showing 9.49 percentage growth rate (NPC, 2006). With its location within the tropical rainforest and dense population, Uyo, like other major cities in Nigeria generates enormous municipal solid waste which is not adequately managed. Uyo has different Municipal Solid Waste Dumpsites but the major one is located in Uyo Village Road (Plate 1). This is used by the Environmental Protection and Waste Management Agency for waste disposal. Most of the wastes disposed are domestic and household wastes. These dumpsites are operated as open waste dumpsites. The waste dumpsites have functioned efficiently for about twenty years and there are boreholes within the vicinity of these waste dumpsites.

Plate 1: Municipal Solid Waste Dumpsite at Uyo Village Road

Collection of Borehole Samples

The triangular research method was adopted for sample collection. Samples of borehole water were collected with pretreated containers using standard methods from three boreholes around the waste dumpsites into well-labeled 1-litre plastic bottles. The samplings were replicated thrice in a month and a total of 36 samples were collected from the study area, transferred to the laboratory and refrigerated at 4°C, till physicochemical analysis were done at Akwa Ibom State Ministry of Science and Technology. The properties analyzed include the following: pH, Electrical Conductivity, Temperature, Turbidity, Dissolved Oxygen, Phosphate, Sodium, Total Dissolved Solid, Total Suspended Solid, Sulphate, Nitrate, Calcium, Magnesium, Lead, Cadmium, Nickel, Copper, and Zinc.

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Statistical Method

The data generated were analyzed using descriptive and inferential statistics. Descriptive statistics that were employed include mean and standard error while inferential statistics that was used include Analysis of Variance (ANOVA). Significant different means were separated using the Duncan multiple range test at 5% level of probability.

RESULTS AND DISCUSSION

Effect of Dumpsite on Borehole Water Quality in the Study Area

The physicochemical properties and heavy metal content of borehole water from the control and dumpsite environments are as presented in Table 1.

pH

The mean pH in the control was 7.49, significantly lower than 8.22, 8.66 and 8.34 in Atiku Road Dumpsite (ARD), Uyo Village Road Dumpsite (UVD) and Ediene Uyo Dumpsite (EUD) respectively. The results showed that the pH of borehole water from the control and dumpsite environments were significantly different ($p<0.05$). Borehole water from the control environment had less alkaline than borehole water from the dumpsite environments. Generally, the pH of natural water changes as a result of biological activities and industrial contamination. Hence, differences in pH among these boreholes suggest that the level of contamination of these boreholes was not the same. Also, high pH in these boreholes suggest that the dumpsite leachate may not be easily transported into the boreholes to influence its pH as the soil could filter the leachate changing its concentration before it gets to the ground water. This agrees with the finding of Adeoti *et al.* (2011) who reported that degradation of surface waters has rendered most water bodies unsuitable for their multi-purpose usage.

Electrical conductivity (EC)

The mean EC values were 335.0, 245.33, 333.0 and 580.67 µs/cm in control, ARD, UVD and EUD respectively. However, the difference was significant ($p<0.05$). The distribution of borehole water EC among the four locations revealed that EUD had the highest mean EC, followed by the control, while ARD had the least. The high EC in EUD may reflect the nature of the area, which has high salinity levels because of the influence of the radioactive substance. However, the mean EC in the control and dumpsite boreholes were below WHO standard of 1000.0 µs/cm. Just like pH, the significant difference in EC of these three environments agrees with the finding of Udo et al. (2009) who stated that dumpsites have a significant effect on borehole water EC.

Temperature

The values of temperature obtained in borehole water of the four locations were 28.67, 28.20, 28.53 and 28.40 °C for the control, ARD, UVD and EUD respectively. The results showed that a rise in temperature of water speeds up chemical reactions in water, reduces solubility of gases and changes the taste and odor of water, and this agrees with the finding of Adeoti et al. (2011). There was no significant difference in mean temperature of the dumpsite environment ($p>0.05$).

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Turbidity

The values of turbidity obtained in borehole water of the four locations were 3.47. 3.59, 4.21 and 3.15 for the control, ARD, UVD and EUD respectively. The values revealed that UVD had the highest turbidity value followed by ARD while EUD had the least, and the difference was significant ($p>0.05$). Turbidity has no direct health effect but can harbor microorganisms protecting them from disinfection and can entrap heavy metals and biocides (Nta *et al*., 2020).

Dissolved Oxygen (DO)

The DO obtained in the control borehole water was 3.07 mg/l while that of ARD, UVD and EUD were 3.33, 3.37 and 3.18 respectively. Borehole water from the dumpsite environments had the highest DO and the difference was significant ($p<0.05$). DO concentrations indicate whether aerobic or anaerobic conditions exist in groundwater, and therefore provide useful information to assess the potential for biodegradation or biotransformation of chemicals of potential concern. DO is also an indication of the level of pollution of a water body. Low DO value is a positive indication of water pollution and *vice versa.* According to Omer *et al.* (2019), oxygen can be rapidly removed in water by discharge of oxygen demanding wastes. However, the DO in control and dumpsite environments were within the permissible level of 5.0–7.5 mg/l by WHO (2015) implying that there may be no transport of dumpsite leachate to borehole water to pollute the water source for human consumption.

Phosphate (PO^-_4)

The borehole water phosphate was 3.39 mg/l in the control environment while ARD, UVD and EUD were 3.75, 4.07, and 4.24 mg/l respectively, and the difference was significant ($p<0.05$). The distribution of Phosphate among the four boreholes showed that the highest Phosphate was obtained in UVD followed by EUD, while the control borehole had the least. However, the values of Phosphate obtained in these boreholes were below the permissible limit of less than 350 mg/L reported by WHO (2015) for safe drinking water quality.

Sodium (Na)

The mean concentration of Na in the control was 23.13 while ARD, UVD and EUD were 20.77, 25.40, 29.87 mg/l respectively, and the difference was significant ($p<0.05$). The distribution of Na among the four boreholes showed that the highest Na was obtained in UVD followed by EUD, while ARD borehole had the least. The values of Na obtained in these boreholes were below the permissible limit of less than 175–200 mg/l reported by WHO (2015) for safe drinking water quality.

Total Dissolved Solid (TDS)

TDS obtained in control borehole water was 161.33 mg/l while that of ARD, UVD and EUD were 124.00, 169.33 and 291.33 respectively. The distribution of TDS among the four borehole water samples showed that EUD had the highest followed by UVD while ARD had the least, and the difference was significant ($p<0.05$). However, the TDS in the control and dumpsite environment were within the permissible level of 500 mg/l by WHO (2015).

Total Suspended Solid (TSS)

The TSS values of the four boreholes were almost constantly distributed with 0.01 mg/l, except EUD with TSS value of 0.00 mg/l and the difference was significant ($p<0.05$). However, the values were below the permissible limit of 10 mg/l reported by WHO (2015) for safe drinking water quality.

Sulphate (SO_4^{2-})

The mean Sulphate was 0.02 mg/l in the control, 0.07 mg/l for ARD and EUD, and 0.04 mg/l for UVD. The result shows that EUD has the highest Sulphate content than others and the difference was significant ($p<0.05$). However, the values were far less than the permissible level of 250–400 mg/l by WHO (2015).

Nitrate (NO_3^-)

The values of Nitrate varied slightly among the four boreholes with the highest obtained in UVD (2.90 mg/l) followed by EUD with 2.19 mg/l and then the control (2.10 mg/l), while ARD had the least with 1.91 mg/l and the difference was significant ($p<0.05$). Nitrate is the most important nutrient in an ecosystem. Generally, water bodies polluted by organic matter exhibit higher values of nitrate than those with low organic matter. However, the Nitrate content of the four boreholes were within the permissible level of 45–50 mg/l by WHO (2015) for safe drinking water.

Calcium (Ca)

The values of Ca obtained in the study were 41.67, 36.67, 52.67 and 48.33 mg/l for the control, ARD, UVD and EUD respectively. The results showed that UVD had the highest Ca followed by EUD and then the control, while ARD had the least and the difference was significant ($p<0.05$). Higher concentrations of Ca in water may suggest evidence of water pollution. This agrees with the finding of Olujimi *et al.* (2016) who reported that increased nutrient concentrations in water is mostly an impact of pollution. This is because municipal and industrial discharges usually contain nutrients and overland flow from developed watersheds which contain nutrients from lawn and garden fertilizers as well as the additional organic debris so easily washed from urban surfaces. Hence, dumpsite leachate has an effect on nutrient load in surface water but may not be a threat in borehole water, although a small concentration of Ca is beneficial in reducing the corrosion in water pipes and contributes to hardness of water. The Ca content of the four boreholes were within the permissible level of 75–100 mg/l reported by WHO (2015) for safe drinking water quality.

Table 1: Physicochemical properties and heavy metal content of boreholes in the study area

Parameters	Control	ARD	UVD	EUD	WHO Limit, 2015
Ph	**7.49**	**8.22**	**8.66**	**8.34**	6.5 - 8.5
Electrical conductivity (µs/cm)	**335.00**	**245.33**	**333.00**	**580.67**	1000
Temperature (^oC)	**28.67**	**28.20**	**28.53**	**28.40**	27.0 – 29.0
Turbidity NTU	**3.47**	**3.59**	**4.21**	**3.15**	5.0
Dissolved Oxygen (mg/l)	**3.07**	**3.33**	**3.37**	**3.18**	5.0 – 7.5
Phosphate (mg/l)	**3.39**	**3.75**	**4.87**	**4.24**	350
Sodium (mg/l)	**23.13**	**20.77**	**25.40**	**29.87**	175 – 200
Total Dissolved Solid (mg/l)	**161.33**	**124.00**	**169.33**	**291.33**	500
Total suspended solid (mg/l)	**0.01**	**0.01**	**0.01**	**0.00**	10.0
Sulphate (mg/l)	**0.02**	**0.02**	**0.04**	**0.07**	250 – 400
Nitrate (mg/l)	**2.10**	**1.91**	**2.90**	**2.19**	45.0 – 50.0
Calcium (mg/l)	**41.67**	**36.67**	**52.67**	**48.33**	75.0 – 100
Magnesium (mg/l)	**24.40**	**22.13**	**31.94**	**29.37**	30.0 – 150
Lead (mg/l)	**0.06**	**0.83**	**0.22**	**0.06**	0.05
Cadmium (mg/l)	**0.04**	**0.06**	**1.15**	**1.09**	0.003
Nickel (mg/l)	**0.07**	**0.06**	**0.09**	**0.06**	0.05
Copper (mg/l)	**0.57**	**0.78**	**0.99**	**0.72**	1.0
Zinc (mg/l)	**3.94**	**4.07**	**5.07**	**4.30**	5.0

Magnesium (Mg^{2+})

The values of Mg were 24.40, 22.13, 31.94 and 29.37 mg/l for the control, ARD, UVD and EUD respectively. The results showed that UVD had the highest Mg followed by EUD and then control, while ARD had the least and the difference was significant ($p<0.05$). Mg contributes to hardness of water and it is reported that Magnesium hardness associated with sulphate ions has a laxative effect on persons (Khursid, 2023). Just like Ca, a higher Mg concentration in these boreholes suggests that there is a flow of nutrients into the water, which could result from the leaching action of cations from the soil surface. Hence, the soil is likely to be one of the sources of transport of Mg into the borehole water. This implies that dumpsites leachate has an effect on borehole water quality.

Lead (Pb)

The concentration values of Pb in the four boreholes were 0.06, 0.83, 0.22 and 0.06 mg/l for the control, ARD, UVD and EUD respectively. The distribution of Pb among the four borehole water samples showed that ARD had the highest followed by UVD while the control and EUD had the least, and the difference was significant ($p<0.05$). Nevertheless, the Pb content of the three boreholes exceeded the permissible level of 0.05 mg/l by WHO (2015) for safe drinking water quality.

Cadmium (Cd)

The concentration values of Cd in the four boreholes were 0.04–1.15 mg/l for the control, ARD, UVD and EUD respectively. The distribution of Cd among the four borehole water samples showed that UVD had the highest followed by EUD, while the control had the least and the difference was significant ($p<0.05$). However, the mean values were above the permissible level of 0.003 mg/l by WHO (2015) for safe drinking water quality.

Nickel (Ni)

The concentration values of Ni in the four boreholes were 0.06–0.09 mg/l for the control, ARD, UVD and EUD respectively. The distribution of Ni among the four borehole water samples showed that UVD had the highest followed by the control, while ARD and EUD had the least and the difference was significant ($p<0.05$). The mean values were slightly above the permissible level of 0.05 mg/l by WHO (2015) for safe drinking water.

Copper (Cu)

The concentration values of Cu in the four boreholes were 0.57–0.99 mg/l for the control, ARD, UVD and EUD respectively. The distribution of Cu among the four borehole water samples showed that UVD had the highest followed by ARD and then EUD, while the control had the least and the difference was significant ($p<0.05$). The mean values were below the permissible level of 1.0 mg/l by WHO (2015) for safe drinking water.

Zinc (Zn)

The concentration values of Zn in the four boreholes were 3.94–5.08 mg/l for the control, ARD, UVD and EUD respectively. The distribution of Zn among the four borehole water samples showed that UVD had the highest followed by EUD and then ARD, while the control had the least and the difference was significant ($p<0.05$). However, the means were below the permissible level of 5.0 mg/l by WHO for safe drinking water except UVD which was slightly above the permissible limit.

Generally, the borehole water samples have high heavy metal slightly above the WHO (2015) permissible limit, especially UVD and EUD, and this could pose a threat to the health of these borehole users. Pb, Cd and Ni were above their permissible limits of 0.05, 0.003 and 0.05 mg/l respectively in drinking water standard, which is a clear manifestation of the presence of toxic substances in the water samples. High values of Pb may cause cancer and interference with vitamin D metabolism, affect mental development in infants, and is toxic to the central and peripheral nervous systems on the health status of borehole users in the host communities (WHO, 2015). This is also in line with the report of Maddock and Taylor (2007) who stated

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that Pb may cause anemia, brain damage, anorexia, mental deficiency, vomiting and even death in human beings (Nta et al., 2017). High levels of Cadmium have been reported to cause agonistic and antagonistic effects on hormones and enzymes, leading to lots of malformations like renal damage; it is toxic at low concentrations (Aliyu & Amadu, 2017) to the kidney (WHO, 2015).

Rating of the Borehole Water Quality in the Study Area

Water quality index (WQI) indicates the quality of water in terms of index number, which represents overall quality of water for any intended use. Table 2 shows WHO standards and unit weights for selected water quality parameters used in the computation of WQI. The unit weight (W_n) is a factor which measures the importance of a parameter in the calculation of the WQI. The results revealed that parameters that weighed high according to their standard values include pH, DO, TSS and the heavy metals. Table 3 presents the water quality rating (qn) of the three borehole water samples in the study area while Table 4 shows the rating of water quality indices. Water quality rating represents a relative value of the water quality, specific to each parameter. The result of the rating showed that parameters with a very high rating in the three boreholes include pH, temperature, turbidity, DO, Calcium and the heavy metals. The ratings were higher in UVD than EUD and ARD. Also, Table 5 shows the WQI of the three borehole water samples. The highest WQI was obtained in UVD with 33492.86 followed by EUD with 32288.10 and ARD with 1871.919. Table 6 presents the status of water quality based on water quality index (Table 5). Comparing the values of WQI obtained in the study with the rating of water quality, the results showed that borehole water quality in the three study areas were unsuitable for drinking. This may be attributed to the effect of the presence of heavy metals in the water which may suggest that wastes and leachates may easily be transported to the ground water, resulting in the contamination of borehole water quality. This is similar to the result obtained by Nta *et al*. (2020) who obtained WQI of 1243.910, 2297.840, 3034.500 and 2963.800 from boreholes in four different locations around the waste dumpsite in Uyo.

They attributed the high index values to percolation of leachates into groundwater which eventually led to water pollution. The quality of water may be described in terms of the concentration and state of some organic and inorganic materials present in the water together with certain physical characteristics of the water. Dumpsite wastes including leachates have a significant effect on the physical, chemical and biological properties of borehole water. It increases nutrient load, biochemical processes and chemical deterioration of important water parameters like dissolved oxygen, etc and increases the concentration of heavy metals. The rating of these parameters were all higher in the dumpsite borehole water samples than the control justifying that dumpsite wastes have an effect on borehole water quality in the study area. This is similar to the result obtained by Jha (2020) in Benue State, Nigeria who stated that pollution has a significant effect on water quality. This is also similar to the result obtained by Nta *et al*. (2020) who reported groundwater contamination of boreholes around the waste dumpsite in Uyo. The result also upholds the report of WHO (2015) that human activities are the major cause of pollution on surface and groundwater.

Table 2: WHO standards and unit weights for selected water quality parameters

Parameters	WHO Limit, 2015	Unit Weight
Ph	6.5 - 8.5	0.1333
Electrical conductivity (µs/cm)	1000	0.0010
Temperature (°C)	27.0–29.0	0.0400
Turbidity NTU	5.0	0.2000
Dissolved Oxygen (mg/l)	5.0–7.5	0.1818
Phosphate (mg/l)	350	0.0029
Sodium (mg/l)	175–200	0.0067
Total Dissolved Solid (mg/l)	500	0.0020
Total suspended solid (mg/l)	10.0	0.1000
Sulphate (mg/l)	250–400	0.0033
Nitrate (mg/l)	45.0–50.0	0.0222
Calcium (mg/l)	75.0–100	0.0125
Magnesium (mg/l)	30.0–150	0.0100
Lead (mg/l)	0.05	20.0000
Cadmium (mg/l)	0.003	333.3333
Nickel (mg/l)	0.05	20.0000
Copper (mg/l)	1.0	1.0000
Zinc (mg/l)	5.0	0.2000

Table 3: Water quality rating (qn) of the groundwater samples

Parameters	ARD	UVD	EUD
Ph	244.00	332.00	268.00
Electrical conductivity (µs/cm)	24.53	33.30	58.07
Temperature (°C)	112.80	114.12	113.60
Turbidity NTU	71.80	84.20	63.00
Dissolved Oxygen (mg/l)	123.85	123.41	126.70
Phosphate (mg/l)	1.21	1.39	1.07
Sodium (mg/l)	13.85	19.91	15.42
Total Dissolved Solid (mg/l)	24.80	33.87	58.27
Total suspended solid (mg/l)	0.10	0.10	0.00
Sulphate (mg/l)	0.01	0.01	0.01
Nitrate (mg/l)	4.24	6.44	4.87
Calcium (mg/l)	45.84	65.84	60.41
Magnesium (mg/l)	22.13	31.94	29.37
Lead (mg/l)	1660.00	440.00	120.00

Cadmium (mg/l)	2000.00	37666.67	36333.33
Nickel (mg/l)	120.00	180.00	120.00
Copper (mg/l)	78.00	99.00	72.00
Zinc (mg/l)	81.40	101.60	86.00

Table 4: Rating of water quality indices

Water Quality Index	Water quality status
0–25	Excellent water quality
25–50	Good water quality
51–75	Poor water quality
76–100	Very poor water quality
> 100	Unsuitable for drinking

***Source:** Asuquo and Etim (2012)*

Table 5: Water quality index (WQI)

Sampling Point	Water Quality Index
ARD	1871.919
UVD	33492.86
EUD	32288.10

Table 6: Water quality rating in the study area

Sampling point	Water Quality Index	Water Quality Status
ARD	1871.919	Unsuitable for drinking
UVD	33492.86	Unsuitable for drinking
EUD	32288.10	Unsuitable for drinking

CONCLUSION

Physicochemical properties of borehole water obtained within the dumpsite environment revealed that some borehole water samples were below the WHO standards in terms of pH, EC, temperature, turbidity, DO, phosphate, sodium, TDS, Sulphate, Nitrate and Calcium. Hence, there is higher evidence of groundwater pollution in the study areas confirming that waste dumpsites affect ground water quality. From the water quality index obtained in the study, the water quality of dumpsite boreholes is unsuitable for drinking. This implies that dumpsites have an effect on ground water quality. Water samples were mainly alkaline with pH values within the permissible limit except at UVD. Water quality parameters like Magnesium, Dissolved Oxygen, Lead (Pb), Cadmium, Nickel and Zinc were above the permissible limit of drinking water standard which reduced drinking water quality, and others were within the permissible limit of drinking water standard. The application of the water quality index revealed that the water quality index values were above the status of water for human consumption and fish culture. These boreholes require treatment before human consumption.

From the findings, the study generally showed that borehole water samples from the three dumpsites were unsuitable for drinking. Public awareness among borehole owners and users within the dumpsite environment on ground water contamination by dumpsites was recommended in the study area and the water should be treated before human consumption.

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