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Investigating the Effects of Solid Waste Dumps on Surrounding Soil and Ground Water Quality Around Umuwaya Road (Isi-Gate) Umuahia, Abia State, Nigeria

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ABSTRACT: An increase in industrialization, urbanization, and the rising demand for food and other essentials for human sustainability leads to a rise in the amount of waste being generated daily by individuals, communities, and nations if not properly managed. In Abia State, particularly at the central entrance into the city of Umuahia, generated waste is eventually thrown into open dumps, causing a severe impact on soil, surface and ground water quality. As a result, it has become a probable source of human health risk. Therefore, this study was aimed at investigating the effect of solid waste dumps on surrounding soil and groundwater quality in Umuwaya Road, Nigeria. Three soil samples and three groundwater samples were collected and analyzed. Heavy metals from soil and groundwater were measured by using flame atomic absorption spectroscopy. The physicochemical properties of the soil and water samples were also determined following standards. The data was analyzed using the descriptive SPSS statistical package. The concentration of heavy metals in soil samples revealed copper (0.01±0.00–0.26±0.07), cadmium (0.00±0.00–0.18±0.01), lead (0.03±0.01–0.40±0.03), iron (0.06±0.01–0.58± 0.02) and zinc (0.02±0.01–0.20± 0.04). All the water parameters and heavy metals screened in the samples were within the World Health Organization (WHO) and Nigeria Standard for Drinking Water Quality (NSDWQ) permissible limits, respectively. It is recommended that indiscriminate waste disposal should be prohibited completely in the capital city. Waste reduction, recycling, and reuse must be promoted by the citizens of the state for a sustainable future.

KEYWORDS: Open dumps; solid waste; Umuahia; health-risk; soil quality; water quality

1. Introduction

The disposal of domestic, commercial and industrial garbage in the world is a problem that continues to grow with human civilization [1,2]. Perhaps of greater and longer-term impact are the substances deposited on the soil that adversely impact the flora and fauna. Municipal solid waste usually contains paper, food waste, metal scraps, glass, ceramics, and ashes. Decomposition or oxidation process releases the heavy metal contained in these wastes to the soil thereby contaminating the soil [3]. Exposure to heavy metals may cause blood, bone disorders, kidney damage, decreased mental capacity and neurological damage [4,5]. Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs [6]. Open dumping of solid waste remains the prevailing form of waste disposal in developing countries like Nigeria. Contamination of water bodies has become an issue of serious environmental concern [7,8]. The rapid growing waste generation rates and high cost of waste disposal, depletion of landfill space and the problem of obtaining new disposal sites resulting in open dumping are unresolved issues [9,10]. Improper waste handling and management pose great threats to the environment and public health [9,11]. Indiscriminate dumping of solid waste and poor solid waste management within Umuahia municipal has been one of the issues that hinders development of the town. Umuwaya road waste dump site contain varieties of municipal solid wastes in addition to the associated heavy metals, and thus serve as a breeding site for most insects and rodents. Soil from dumpsites have been found to contains high concentrations of organic matter, heavy metals, nutrients and pathogens, which if not properly collected and treated can cause serious pollution of surface and groundwater sources [12-14]. Monitoring of ecosystem activities and waste generated are keys to a sustainable city. Based on these background that this study is aimed at investigating the concentration level of heavy metals and the physicochemical properties of soil and groundwater around solid waste open dump site in Umuwaya road (Isi-Gate) in Umuahia Capital city of Abia State, Nigeria.

2. Materials and Methods

2.1. Study area and design

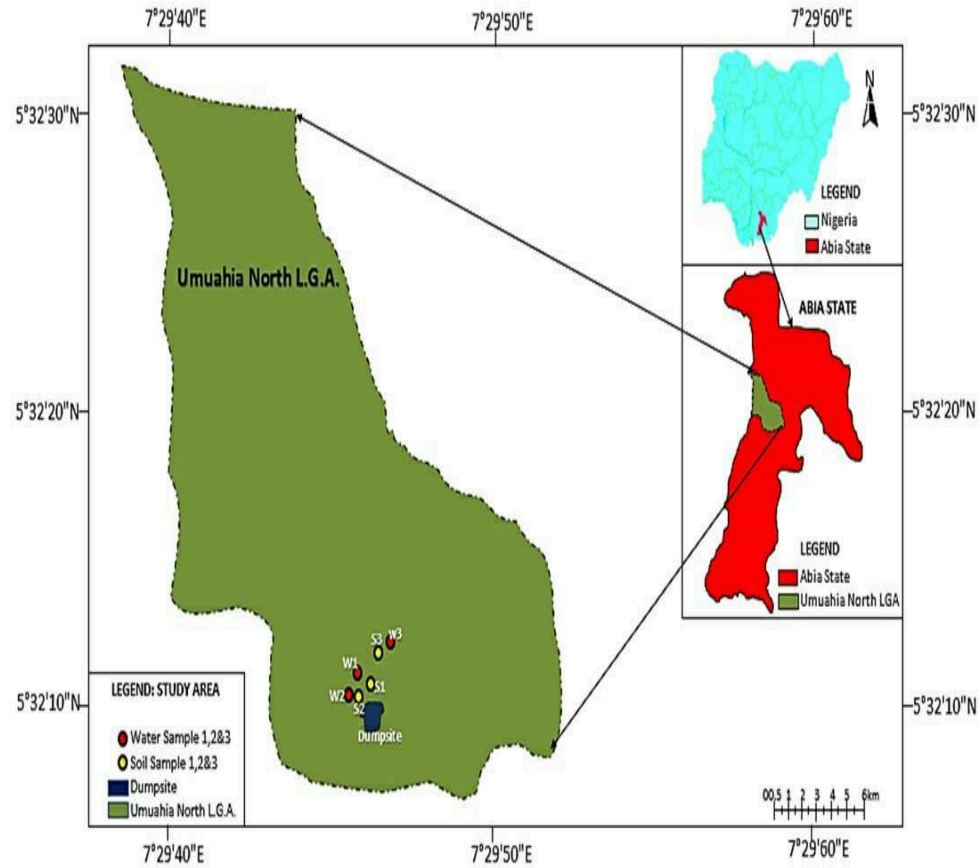

Fig. 1. Map of the study area.

The study was carried out at the solid waste dump sites located in Umuwaya Road, Isi-gate, and Umuahia North Local Government Area in Abia State, Nigeria. Umuahia is the capital of Abia State. The area is surrounded by residential houses, mini-markets, petrol stations, various motor parks, automobile repair shops, shopping malls, and other urban facilities that generate substantial quantities of waste within the urban center (Figure 1). A reconnaissance survey was carried out within the study area to access the solid waste dumpsite, identifying existing boreholes within the study location using both primary and secondary data. Primary data was collected through a direct field survey.

2.2. Soil sample collection and treatment.

Soil samples were collected from three sample positions. The sample points were labelled A, B, and C and were carefully mapped out within the solid waste dump site at 100 m apart from each other, while point D was collected 1000 m away from the waste dump site, which served as the control point. Soil samples were collected from three (3) different soil depths in each of the stations; 0–15 cm, 15–30 cm, and 30-45 cm, respectively, using a soil hand auger. The soil hand auger was washed with clean water, rinsed with distilled water, and dried after sampling at each sample point in order to prevent cross contamination. The soil samples collected were replicated into two in each case, labelled clearly in a polyethylene bag and transported to the laboratory for pre-treatment and analysis of various physico-chemical properties. The soil pH, electrical conductivity, heavy metals, and organic matter were determined.

2.3. Groundwater (borehole) sample collection and treatment.

Groundwater samples were collected from three borehole locations with the aid of clean bottle containers, carefully labelled in each case, and transported to the laboratory for pre-treatment and analysis of the water quality parameters. Two of the three water samples were collected from boreholes situated 100m apart from the solid waste dump site, while the third sample was collected 1000m away from the solid waste dump site, which served as the control for the experimental study. Sample collection points as well as their coordinates are summarized in Table 1.

Table 1. Various sample locations and their coordinates.

Code	East (X)	North (Y)
Soil Sample 1	$7^{o} 29^{I} 43.6920^{II}$	$5^{o}32^{I} 14.9928^{II}$
Soil Sample 2	$7^{o} 29^{I} 41.6148^{II}$	$5^{o} 32^{I} 12.1380^{II}$
Soil Sample 3	$7^{o} 29^{I} 47.3388^{II}$	$5^{o} 32^{I} 22.1028^{II}$
Water Sample 1	$7^{o} 29^{I} 41.5248^{II}$	$5^{o} 32^{I} 15.8280^{II}$
Water Sample 2	$7^{o} 29^{I} 41.5248^{II}$	$5^{o} 32^{I} 12.0300^{II}$
Water Sample 3	$7^{o} 29^{I} 51.2952^{II}$	$5^{o} 32^{I} 22.3908^{II}$

2.4. Analytical methods used.

Soil parameters determined from the study locations include the following: soil pH by pH meter (Hanna 909); soil electrical conductivity (EC) by electrical conductivity meter (PHWE); organic carbon using the wet combustion method; total nitrogen using the micro-kjeldahl method; available phosphorus by Bray's method; exchangeable bases (Na, K, Mg, and Ca) and heavy metals (copper-Cu, cadmium-Cd, Lead–Pb, iron–Fe, and zinc-Zn) were determined using a flame atomic absorption spectrophotometer (AA240). Groundwater parameters from selected boreholes around the vicinity of the study location include pH by SUNTEX HACH

2010, EC by conductivity meter, turbidity by HACH Lang 2100Q turbidity meter, total solids by gravimetric method, dissolved oxygen (DO) by Winkler's titration method, phosphate using UV-Spectrophotometer, and heavy metals were determined using a flame atomic absorption spectrophotometer [15].

2.5. Data analysis.

SPSS statistical software was used to analyze the data. Analysis of variance (ANOVA) was used to assess the significance difference between the mean values of heavy metals and physicochemical parameters in soil and water samples. Possibilities with a p value less than 0.05 ($p>0.05$) were considered statistically significant. The analyzed data was presented by using tables. The mean values were compared with the limits in soil and water prescribed by the World Health Organization standards.

3. Results and Discussion

The physicochemical properties of soil sample and groundwater samples and heavy metal result at waste dump site around sample location are presented in Table 2 – 6.

Table 2. Soil chemical properties from waste dump sites around Umuwaya road in Umuahia.

SITE	Depth (cm)	pH	Av. P (mg/kg)	OC (%)	OM (%)	TN (%)	C/N (%)
A	0 -15	6.73±0.08	80.67±0.03	2.57±0.05	5.38±0.08	0.23±0.01	11.41±0.03
	15 -30	7.10±0.03	67.42±0.01	1.07±0.03	3.60±0.07	0.12±0.03	10.32±0.00
	30 – 45	7.25±0.04	47.37±0.08	0.57±0.69	3.60±0.07	0.06±0.03	8.37±0.07
	Mean	**7.03±0.25^{b}**	**65.15±15.00^{d}**	**1.40±0.98^{b}**	**4.19±0.92^{d}**	**0.14±0.08^{b}**	**10.03±1.38^{a}**
B	0 -15	6.60±0.06	81.16±0.07	3.19±0.02	5.71±0.06	0.19±0.01	10.94±0.06
	15 -30	7.19±0.04	67.05±0.10	0.98±0.03	3.32±0.01	0.13±0.01	10.27±0.05
	30 – 45	7.29±0.04	46.55±0.04	0.91±0.07	2.82±0.01	0.10±0.00	9.27±0.05
	Mean	**7.02±0.34^{b}**	**64.92±15.57^{c}**	**1.69±1.16^{c}**	**3.95±1.38^{c}**	**0.14±0.04^{b}**	**10.16±0.75^{b}**
C	0 -15	6.91±0.06	80.18±0.08	1.82±0.08	5.97±0.01	0.27±0.01	11.19±0.03
	15 -30	7.17±0.04	67.83±0.07	0.96±0.04	3.56±0.16	0.18±0.02	10.15±0.04
	30 – 45	7.32±0.03	45.81±0.04	0.66±0.04	1.46±0.01	0.12±0.01	8.85±0.10
	Mean	**7.13±0.19^{c}**	**64.61±15.57^{b}**	**1.15±0.54^{b}**	**3.66±2.02^{b}**	**0.19±0.07^{c}**	**10.06±1.05^{a}**
D	0 -15	5.26±0.04	45.81±0.04	0.98±0.02	3.41±0.04	0.10±0.01	13.22±0.03
	15 -30	4.66±0.01	38.82±0.06	0.86±0.01	3.25±0.02	0.12±0.01	13.29±0.01
	30 – 45	4.41±0.06	31.72±0.06	0.76±0.01	3.05±0.02	0.09±0.01	13.29±0.01
	Mean	**4.78±0.39^{a}**	**38.78±6.30^{a}**	**0.87±0.10^{a}**	**3.23±0.17^{a}**	**0.10±0.01^{a}**	**13.27±0.04^{c}**

Means with different superscript are significantly different from each other at $P \leq 0.05$. A = 0 m, B = 100 m, C = 200 m , D = control ; Where Av. P = Available phosphorus, OC = Organic carbon, OM = Organic matter, TN = Total Nitrogen and C/N = Carbon-Nitrogen ratio

From the results, values ranged from pH (7.13 ± 0.19 to 4.78 ± 0.39), available phosphorus (65.15 ± 15.00 to 38.78 ± 6.30 mg/kg), organic carbon (OC) (1.69 ± 1.16 to 0.87 ± 0.10 %), Organic Matter (OM) (4.19 ± 0.92 to 3.23 ± 0.17 %), Total Nitrogen (0.19 ± 0.07 to 0.10 ± 0.01%), Carbon ratio to Nitrogen (13.27 ± 0.04 % to 10.03 ± 1.38 %). The soil pH was observed to be neutral at lower depths around the areas close to the dump sites, while the control sites were largely acidic at all soil depths. Also, soil pH at sites closer to the dumpsite was observed to be neutral, while at the control site it was acidic. Phosphorus was low in the control site and largely higher in sites close to the waste dump site. Similarly, organic carbon, organic carbon, and total nitrogen were observed to be available in a similar pattern. The % organic matter value in this study was within the range of 2.39 to 9.14 % with a mean value of 5.71, which is higher than the control value (5.14) [16]. The higher value in the areas closer to the dump site may have resulted from the decomposition and composting processes of the animal wastes such as animal dung, blood, food wastes, smoke, etc.

Table 3. Soil nutrient properties from waste dumps around Umuwaya road in Umuahia.

SITE	Depth (cm)	Ca (cmol/kg)	Mg (cmol/kg)	K (cmol/kg)	Na (cmol/kg)	CEC (cmol/kg)	EA (cmol/kg)
A	0 -15	61.53±0.01	14.03±0.04	2.09±0.04	1.92±0.03	79.85±0.02	0.59±0.01
	15 -30	43.72±0.08	11.23±0.04	1.14±0.03	1.98±0.01	45.85±0.02	0.89±0.01
	30 – 45	33.77±0.01	7.98±0.03	0.84±0.03	2.03±0.06	25.40±0.05	1.09±0.01
	Mean	**46.34 ± 12.58^{b}**	**11.08 ± 2.71^{b}**	**1.36 ± 0.58^{b}**	**1.98 ± 0.06^{b}**	**50.36 ± 24.60^{c}**	**0.86 ± 0.23^{a}**
B	0 -15	60.85±0.04	14.02±0.06	2.19±0.01	1.88±0.03	76.82±0.07	0.70±0.03
	15 -30	44.13±0.02	11.82±0.08	1.24±0.06	1.93±0.04	46.72±0.07	0.80±0.03
	30 – 45	34.03±0.02	8.82±0.08	0.81±0.01	1.98±0.03	26.62±0.07	1.00±0.03
	Mean	**46.33 ± 12.12^{b}**	**11.55 ± 2.34^{d}**	**1.41 ± 0.63^{c}**	**1.93 ± 0.05^{b}**	**50.05 ± 22.60^{b}**	**0.83 ± 0.14^{a}**
C	0 -15	61.94±0.06	13.94±0.06	2.17±0.07	1.86±0.03	78.94±0.06	0.67±0.01
	15 -30	44.06±0.04	11.84±0.08	1.18±0.06	1.93±0.07	46.94±0.06	0.87±0.01
	30 – 45	34.11±0.04	8.54±0.06	0.83±0.01	2.08±0.00	26.94±0.06	0.97±0.01
	Mean	**46.70 ± 12.62^{c}**	**11.44 ± 2.44^{c}**	**1.39 ± 0.63^{bc}**	**1.96 ± 0.11^{b}**	**50.94 ± 23.46^{d}**	**0.83 ± 0.14^{a}**
D	0 -15	12.76±0.16	6.77±0.01	0.36±0.03	0.51±0.04	17.63±0.04	1.63±0.04
	15 -30	9.87±0.01	4.77±0.01	0.21±0.04	0.43±0.02	12.73±0.18	1.13±0.04
	30 – 45	6.82±0.08	3.92±0.08	0.16±0.03	0.33±0.02	10.23±0.53	1.03±0.04
	Mean	**9.81 ± 2.66^{a}**	**5.15 ± 1.31^{a}**	**0.24 ± 0.10^{a}**	**0.42 ± 0.09^{a}**	**13.53 ± 3.38^{a}**	**1.26 ± 0.29^{b}**

Means with different superscript are significantly different from each other at P≤0.05. A = 0 m, B = 100 m, C = 200 m , D = control ; Where Ca = Calcium, Mg = Magnesium, K = Potassium, Na = Sodium, CEC= Cation Exchange Capacity and EA = Exchangeable Acidity

Table 4. Mean ± SD of heavy metal properties in soil from waste dumps around Umuwaya road in Umuahia.

SAMPLE SITE	Depth (cm)	Cu (ppm)	Cd (ppm)	Pb (ppm)	Fe (ppm)	Zn (ppm)
A	0 -15	0.21±0.01	0.17±0.01	0.25±0.04	0.58±0.02	0.10±0.01
	15 -30	0.16±0.03	0.13±0.05	0.20±0.02	0.38±0.12	0.15±0.06
	30 – 45	0.17±0.04	0.12±0.01	0.15±0.05	0.23±0.05	0.11±0.00
	Mean	**0.18 ± 0.03^{b}**	**0.14 ± 0.03^{b}**	**0.20 ± 0.06^{b}**	**0.39 ± 0.17^{c}**	**0.12 ± 0.04^{b}**
B	0 -15	0.26±0.07	0.15±0.01	0.40±0.03	0.25±0.01	0.15±0.03
	15 -30	0.10±0.01	0.15±0.01	0.16±0.07	0.35±0.01	0.20±0.04
	30 – 45	0.14±0.03	0.09±0.01	0.10±0.01	0.20±0.08	0.12±0.02
	Mean	**0.17 ± 0.08^{b}**	**0.13 ± 0.03^{b}**	**0.22 ± 0.15^{b}**	**0.26 ± 0.08^{b}**	**0.16 ± 0.05^{c}**
C	0 -15	0.22±0.04	0.18±0.01	0.25±0.03	0.28±0.00	0.14±0.03
	15 -30	0.11±0.01	0.13±0.07	0.17±0.04	0.43±0.07	0.08±0.02
	30 – 45	0.11±0.01	0.11±0.01	0.16±0.03	0.33±0.07	0.08±0.01
	Mean	**0.14 ± 0.06^{b}**	**0.14 ± 0.05^{b}**	**0.19 ± 0.05^{b}**	**0.35 ± 0.08^{c}**	**0.10 ± 0.04^{b}**
D	0 -15	0.04±0.02	0.00±0.00	0.03±0.01	0.34±0.01	0.02±0.01
	15 -30	0.01±0.00	0.00±0.00	0.07±0.03	0.14±0.01	0.07±0.01
	30 – 45	0.02±0.01	0.00±0.00	0.04±0.02	0.06±0.01	0.03±0.01
	Mean	**0.02 ± 0.02^{a}**	**0.00 ± 0.00^{a}**	**0.05 ± 0.03^{a}**	**0.18 ± 0.13^{a}**	**0.04 ± 0.03^{a}**
P≤0.05		***	***	***	***	***
	P≤0.05	***	*	***	***	*
P≤0.05	**P≤0.05**	NS	NS	***	***	*

NS = not significant,* = significant at P≤0.05, ** = significant at P ≤ 0.01, *** = significant at P≤0.001. Means with different superscript are significantly different from each other at P≤0.05. A = 0m, B = 100 m, C = 200 m, D = control. Where Cu =Copper, Cd = Cadmium, Pb = Lead, Fe = Iron and Zn = Zinc

Calcium levels in the soil were observed to be very high in sample sites A, B, and C, which were sites close to the dumpsite, but were found to be low in the control site. This is an indication that waste dumps may increase the calcium available in soil. However, this poses a threat to water bodies. According to Aurangabadkar et al. [17], solid waste dumps were responsible for the higher concentration of the physicochemical properties in the solid waste soil". The decomposition and mineralization of the biodegradable solid waste in the solid waste dumpsites into the soil remains a great concern. Similar, magnesium, potassium, and sodium CEC were observed to be higher in sites near the dump sites. Also, it was observed in this present study that levels of magnesium, potassium, sodium, and CEC decreased as the depth level increased. The trace elements and macro (Ca, Mg, K) nutrients were quantitatively recorded in the soil from the dumpsites. The values of organic matter, available phosphorous, total nitrogen and cation exchange capacity were within the normal range in soil for agricultural purposes [18].

The result of the heavy metal test showed that copper, cadmium, iron, zinc, and lead were all available in the soil. This is confirmation that soils in their natural state contain trace levels of these heavy metals. This was similar to observations made during studies done on soil in a waste dump site at Ubakala [19]. The higher status of lead than zinc and copper might have been attributed to refuse from the dumpsites, which was mainly the alloys, plastic cables, used batteries, demolishing structures, electric cables, etc. The trend in contamination status of this study was in contrast with the trend observed (Cd > Cr > Pb > Mn > N) [20].

Table 5. Physiochemical properties in borehole water around Umuwaya road in Umuahia.

Sites	Temp (^{o}C)	Turbidity (NTU)	DO (mg/l)	Alkalinity (Mg/l)	pH	TDS (mg/l)	TSS (mg/l)
A	27.30±0.01^{b}	0.19±0.02^{b}	7.57±0.07^{b}	17.74±0.12^{a}	7.03±0.04^{b}	9.11±0.01^{c}	31.79±0.04c^{b}
B	27.20±0.00^{a}	0.05±0.06^{a}	6.83±0.04^{a}	15.90±0.01^{a}	7.18±0.04^{b}	7.13±0.07^{b}	37.22±0.05^{c}
C	27.31±0.01^{ab}	0.53±0.02^{d}	7.45±0.04^{b}	17.62±0.13^{a}	6.67±0.13^{a}	11.20±0.06^{d}	35.85±0.56^{c}
D	27.25±0.07^{ab}	0.36±0.06^{c}	9.55±0.07^{c}	21.00±1.70^{b}	6.60±0.07^{a}	6.29±0.01^{a}	28.75±1.06^{a}
Total	27.26±0.05	0.28±0.20	7.85±1.09	18.06±2.08	6.87±0.26	8.43±2.03	33.40±3.60
P≤0.05	NS	**	***	*	**	***	***
NSDWQ$_{PML}$	Ambient	5.00	14.00	-	6.5 – 9.0	1000	25
WHO$_{PML}$		5.00	-	-	6.5 – 8.5	1000	≤ 30

Sites	EC µS/cm	BOD mg/l	COD mg/l	TH mg/l	NO_3 mg/l	PO_4 mg/l
A	65.14±0.05^{c}	4.30±0.04^{b}	5.45±0.14^{d}	12.05±0.08^{a}	16.90±0.01^{c}	7.62±0.08^{c}
B	61.36±0.13^{a}	3.33±0.15^{a}	3.66±0.04^{b}	14.13±0.04^{a}	14.34±0.10^{a}	7.84±0.06^{c}
C	65.05±0.10^{c}	4.71±0.08^{c}	4.27±0.08^{c}	260.27±353.57^{a}	15.14±0.05^{b}	6.72±0.22^{b}
D	62.88±0.53^{b}	3.26±0.01^{a}	3.13±0.01^{a}	8.50±0.35^{a}	18.58±0.11^{d}	5.08±0.11^{a}
Total	63.60±1.71	3.90±0.67	4.13±0.93	73.74±176.40	16.24±1.75	6.81±1.17
P≤0.05	***	***	***	NS	***	***
NSDWQ$_{PML}$	**1000**	-	-	100.00	10.00	100.00
WHO$_{PML}$	-	**6.00**	10.00	**200.00**	-	-

NS = not significant,* = significant at P≤0.05, ** = significant at P ≤ 0.01, *** = significant at P≤0.001. Means with different superscript are significantly different from each other at P≤0.05. A = 0m, B = 100 m, C = 200 m, D = control. Where; Temp = Temperature, DO = Dissolved oxygen, TDS = Total dissolved solids and TSS = Total suspended solids, EC = Electrical conductivity, BOD = Biochemical oxygen demand, COD = Chemical oxygen demand, TH = total hardness, NO_3 = Nitrate, PO_4 = Phosphate, Mg = Magnesium and Ca = Calcium

Table 6. Heavy metal properties in borehole water around Umuwaya road in Umuahia.

SITES	Zn (ppm)	Pb (ppm)	Fe (ppm)	Cu (ppm)	Cd (ppm)	Mg (mg/l)	Ca (mg/l)
A	1.20±0.03^{b}	0.21±0.04^{b}	0.06±0.00^{b}	0.02±0.01^{a}	**ND**	26.21±0.11^{a}	22.72±0.07^{a}
B	1.44±0.01^{d}	0.16±0.03^{ab}	0.04±0.02^{ab}	0.03±0.01^{a}	**ND**	31.20±0.12^{d}	26.69±0.03^{c}
C	1.30±0.02^{c}	0.15±0.04^{ab}	0.04±0.01^{ab}	0.03±0.01^{a}	**ND**	28.46±0.27^{b}	24.55±0.06^{b}
D	1.13±0.04^{a}	0.12±0.01^{a}	0.02±0.00^{a}	0.02±0.01^{a}	**ND**	30.00±0.28^{c}	24.65±0.72^{b}
Total	1.26±0.13	0.16±0.04	0.04±0.02	0.02±0.01^{a}	**ND**	28.97±2.00	24.65±1.53
P≤0.05	***	NS	NS	NS	0	***	
NSDWQ$_{PML}$	-	0.01	0.3	1	0.003	0	20.00
WHO$_{PML}$	3.0	0.01	0.3	2	0.003	0	-

NS = not significant, * = significant at P≤0.05, ** = significant at P ≤ 0.01, *** = significant at P≤0.001. Means with different superscript are significantly different from each other at P≤0.05. A = 0m, B = 100 m, C = 200 m, D = control. Where, Zn = Zinc, Pb = Lead, Fe = Iron, Cu = Copper and Cd = Cadmium

The water parameters and heavy metal screening in the sampled borehole sources were within the WHO and NSDWQ permissible limits, respectively [21,22]. The non-detection of Cd as reported in this study is not strange [23]. They indicated that chromium and copper were not observed in the wet season samples or in the dry season samples.

4. Conclusion

In conclusion, given the observed decrease in physicochemical and heavy metal properties of the soil around areas closer to the dumpsite, it is therefore imperative to say that the solid waste dumped in the study area did not adversely affect the soil properties and water quality. However, it is important to suggest that the government should implement a policy of waste disposal that sorts types of waste from homes rather than allow people to dump diverse waste types indiscriminately into the environment. Waste reduction, segregation, recycling, and reuse must be promoted by citizens of the state, and it is imperative that the government should strategize its waste management structure to make the state better for the future generation.

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