African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 7, Issue 2, 2024 (pp. 148-164)
www.abjournals.org

HEAVY METAL CONCENTRATION ASSESSMENT OF SURFACE AND GROUNDWATER IN THE VICINITY OF AJAKANGA DUMPSITE, OLUYOLE, IBADAN, SOUTHWESTERN NIGERIA

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Cite this article:

Adejumo S. A., Oyerinde A. O. (2024), Heavy Metal Concentration Assessment of Surface and Groundwater in the Vicinity of Ajakanga Dumpsite, Oluyole, Ibadan, Southwestern Nigeria.. African Journal of Environment and Natural Science Research 7(2), 148-164. DOI: 10.52589/AJENSR-ZMHIZVSR

Manuscript History

Received: 3 Mar 2024

Accepted: 12 May 2024

Published: 7 June 2024

ABSTRACT: *Heavy metal levels in the surface and groundwater sources in the vicinity of Ajakanga dumpsite, Ibadan Nigeria were assessed for quality status evaluation of the water sources within the dumpsite environment for their domestic and industrial suitabilities. Thirty-eight (38) water samples consisting of Twenty-three (23) from hand-dug wells, ten (10) from boreholes and five (5) from streams were collected around the dumpsites with strict adherence to the prescribed standard. The water samples collected were tested for the following Heavy metal contents; Lead (Pb), Iron (Fe), Cadmium (Cd), Cobalt (Co), Copper(Cu), Manganese(Mn), Zinc(Zn), Nickel (Ni), and Chromium(Cr) in the laboratory using computerised Atomic Absorption Spectrophotometer (AAS)model 210. The results were evaluated and compared with WHO, EU and NSDWQ water quality standards. The comparison reveals that 93%, 75%, 63%, 37% and 19% of water sampled are characterised respectively by Fe, Pb, Ni, Cd and Mn concentrations higher than the WHO, EU and NSDWQ recommended standard permissible limits, indicating the possible impact of dumpsite on the groundwater quality. The Zn concentration in about 42% of total samples is above the EU health-based value but is well within the WHO and NSDWQ permissible limits for all samples as with those of Cu, Cr and Co. The alarming and unacceptable higher concentration recorded for Pb, Fe and Ni in the samples renders the water sources unfit in their present form for human consumption and some industrial usabilities. Hence, an urgent need for standard treatment and well-organised precautionary measures for the use of the water sources in the environment of the dumpsite.*

KEYWORDS: Heavy metals, Dumpsite, surface water, groundwater, concentration.

Article DOI: 10.52589/AJENSR-ZMHIZVSR
DOI URL: https://doi.org/10.52589/AJENSR-ZMHIZVSR

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INTRODUCTION

Water is a colorless, transparent, tasteless, scentless compound of oxygen and hydrogen with the formula H2O in its intermediate state between ice and vapour (Linton, 2010). Water covers 70.9% of the Earth's surface and is vital for all known forms of life. On Earth, it is found mostly in Oceans and other large water bodies (CIA, 2008). Contaminated water is a global public health threat placing people at risk of a host of diarrheal and other illnesses as well as chemical intoxication (Okonko et al., 2009). Main sources of groundwater contamination are mine dumps, leach residue, landfills, leaking septic tanks, oil spillage, acid rain and host rock in which it is dug. Hence, the location of a borehole yet to be drilled should be well assessed in other to avoid water pollution that can pose a threat to human lives. Dumps and landfills are a threat to water quality when rainfall percolates through waste, leaching out a variety of substances. The leachate produced can eventually contaminate groundwater (Pedersen, 1997).

Nowadays, excessive exposure to high concentrations of heavy metals in natural environments such as water, sediments and soil has proved to be harmful to the organisms. Most hand-dug wells in the town are neither cased nor are they properly capped after completion. Also, the immediate surroundings of the wells are inadequately sequestered from unsanitary conditions. A more worrisome fact is that some of these wells are located near solid waste dumpsites which lack any form of management, coupled with the nearness of household pit latrines used as permanent stores for human faeces and/or poorly engineered septic tanks.

A possibility is that the water may be contaminated by substances like toxic chemicals, heavy metals and organic materials among others which are leached out of the waste. Once contaminated, a groundwater system takes a long time to purify. There has been a report of borehole water contamination through many domestic wastewater and livestock manure especially if there is a puncture in a layer of soil (Obi and Okacha, 2007). These wastes and sewage when deposited near the boreholes may travel with percolating rainwater directly into the boreholes or may travel along the well wall or surrounding material of the drill holes (Obi and Okacha, 2007).

LITERATURE/THEORETICAL UNDERPINNING

Contaminants such as heavy metals, lead, arsenic, chromium, cadmium and mercury are dangerous for human health when consumed at high concentrations because they are toxic and can be carcinogenic (Doan et al., 2018; Malaysia et al., 2015). Heavy metals are stable and persistent environmental contaminants since they cannot be degraded nor destroyed (Sevgi et al; 2009). They are known to be associated with numerous serious health disorders as they usually accumulate in the vital organs of the human body such as kidneys, bones, liver due to their non-biodegradable and persistent nature. Research claims that Ocean holds 97% of surface water such as rivers lakes, ponds (Gleick, 1996). A very small percent of Earth's water is contained within biological bodies and manufactured products (Gleick, 1993). Water present on earth moves through a cycle of evaporation, precipitation and runoff, usually reaching the sea (Gedney et al., 2006) described as evapotranspiration.

To determine the quality of water, several parameters must be examined. Among the key parameters listed by World Health Organization (WHO) for the determination of water quality are conductivity, dissolved oxygen (DO), pH, color of water, taste and odour, turbidity, total

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suspended solids (TSS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), micro-organisms such as faecal coliform bacteria (Escherichia coli), Cryptosporidium and Giardia lamblia; nutrients (fertilizers), dissolved metals and metalloids (lead, mercury, arsenic and so on) and dissolved organics (WHO, 2011). Studies have shown the adverse impacts of solid waste in dumpsites on groundwater. Akoteyin (2011) investigated groundwater contamination around landfill sites in a typical sub-urban settlement in Lagos, Nigeria and found that that leachate from the landfill have impacted adversely on the groundwater of the sampled area. The study showed that the concentration of lead and zinc exceeded the mean concentration of all the measured heavy metal parameters in about90% of sampled waters based on the maximum permissible limit of WHO drinking water quality. Iron and copper were also found to exceed the mean concentration of all measured parameters in about 50% and 40% based on maximum permissible limits of WHO standards for drinking water quality.

Rao and Shanataram (2003) investigated three landfill sites in Hyderebad, a major Indian city with a population of more than six million generating solid waste of about 2500 tons per day, found the groundwater at all sites were polluted and unfit for human consumption and domestic use, but could be used for irrigation only. The purpose of this study is to assess the heavy metal concentration level of groundwater from hand-dug wells, boreholes and stream especially those near solid waste dump sites at Ajakanga Ibadan, south western Nigeria. This study will help to evaluate the quality of the water against the current use among the inhabitants of the area.

METHODOLOGY

Site Description and Geological Setting

The study area, Ajakanga Asunle dumpsite environment lies between the latitude 7°18’47” to 7°18’57” North and longitude 3°50’31” to 3°50’26” East. It is located at Oluyole part of Oluyole local government, Oyo state, South-western Nigeria (Figure 1) with Oke Ado major road linking the whole settlement together. The study area is easily accessible by foot or trekking but partially accessible by vehicle or motorcycle due to the severe damage it has gone through overtime. The study area is understood to be a scattered settlement thus having scanty population and as a result of this, traversing and collection of sample were carried out by foot. Topographically, the study area can be said to be characterized by medium to high topography. Topography is gentle with surface elevation of about 160.1m to 255.3m above the sea level.

The drainage pattern is dendritic as they are characterized by irregular branching of tributary stream in many directions. The study area falls in the tropical climate and the tropical wet and dry (also known as tropical Savanna climate). The zone is a transitional zone between tropical and semi-arid dry season. It is characterized by two seasons the wet and dry season. Rainfall spans for about eight months (April- October) and the dry season spans for about four months (November- March). The wet season is characterized by heavy rainfall with corresponding low temperature while the dry season comes with high temperature and little or no rainfall. At the peak of the rainy season, it is not uncommon to have flash floods occurring but during the dry season, hot and dusty, cold and hazy condition one prevalent especially toward the end the end of the year.

Geologically, Ibadan contain the basement complex rock types which are mainly metamorphic rocks of Precambrian age with few intrusions of granites and porphyries of Jurassic age

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Volume 7, Issue 2, 2024 (pp. 148-164)

(Badmus et al., 2014). In the study area, the dominant rock formation types are quartzites of the meta-sedimentary rock (Quartzite quartz Schist).

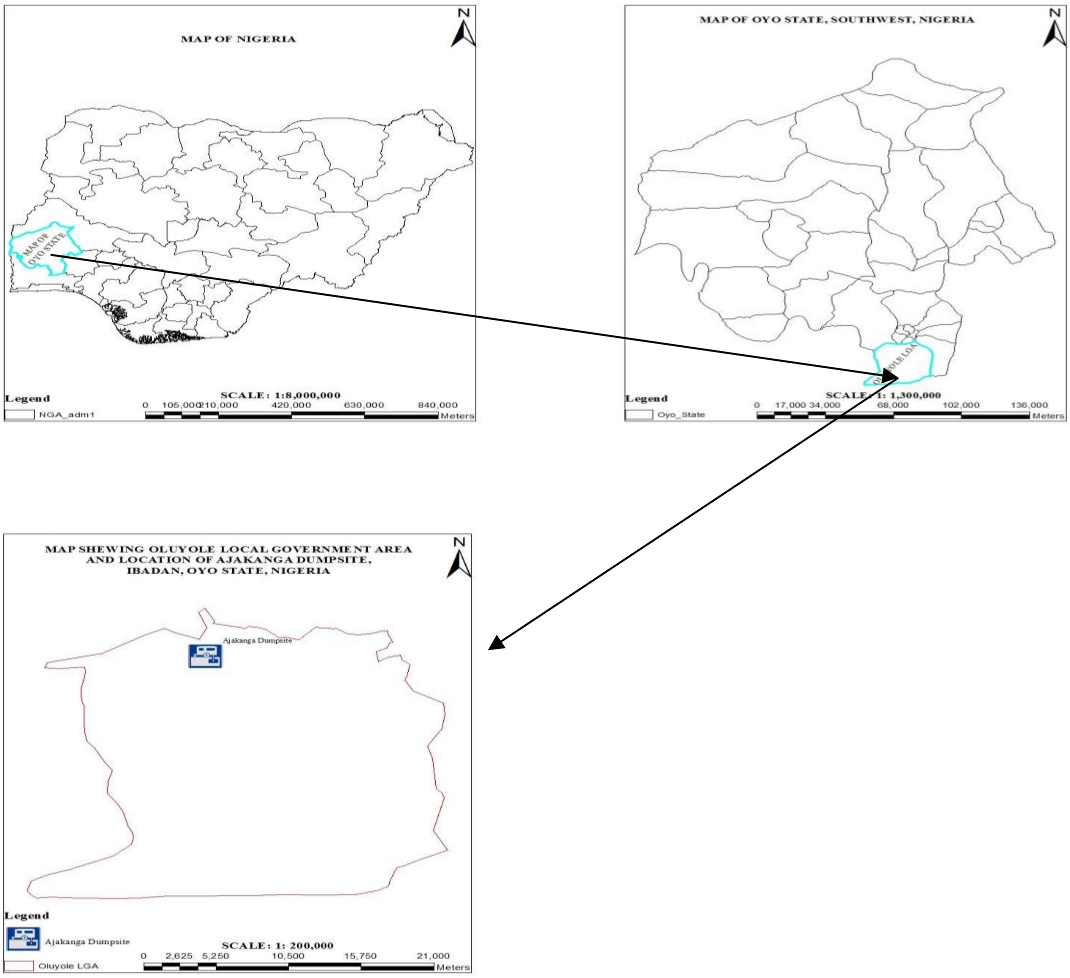

Figure 1: Map of the study area

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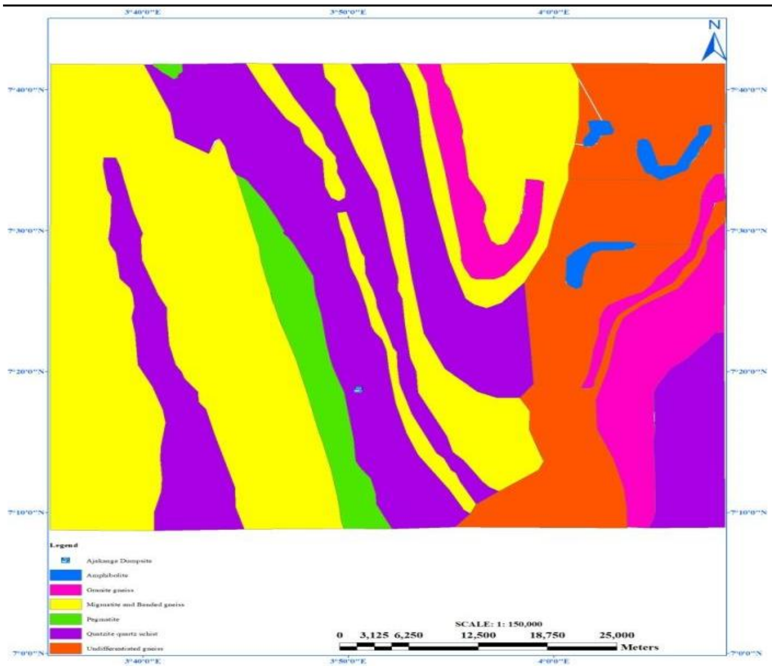

Fig. 2 Geological map of Ibadan showing the study area

Sampling and sampling techniques

A total of thirty eight (38) water samples were collected around the dumpsites following a reconnaissance survey which facilitated a better understanding of the local geology and spatial distribution of hand dug wells, boreholes and stream within the study area. During the reconnaissance stage, sampling site selection was carried out considering the proximity to the residential areas, topography, accessibility and locations. This is often used to gather initial information regarding the presence or the absence of historic properties within area. Twenty-three (23) samples were from hand-dug wells, ten (10) from boreholes and five (5) from streams totalling 38 samples. Water samples were collected mostly by considering nearness to the dumpsite and especially the suspected most affected wells (Figure.3). The water sampling was carried out with strict adherence to the standard prescribes by the Nigerian standard for drinking water quality (NSDWQ, 2007). All representatives' water samples from the three water source were collected into clean and well rinsed 0.75lt plastic sample container. The bottles used in sample collection were washed with deionised water, and then several times with the sample water before collection in order to avoid any contamination and were also sterilized and capped. After sampling, the lids of the bottles were immediately replaced to minimize contamination and escape of gases. All the samples collected were then stored in an ice-packed cooler for analysis within 24 hours. The entire samples were then transferred to soil science laboratory of the International Institute of Tropical Agriculture (IITA) for heavy metal analysis. The heavy metal tests conducted were; iron (Fe), lead (Pb), copper (Cu), and cobalt (Cb) using a computerized Atomic Absorption Spectrophotometer (AAS) model210.

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RESULTS/FINDINGS

Data used in this study were processed using ArcGIS 10.4 (ArcMap 10.4 version) for GIS analysis, Surfer 13 for height at different points and at equal elevation above the mean sea level, and as well as the terrain slope. Microsoft Excel 2013 was used for data sorting, analysis and chart drawing. Table 2 presents the result of the heavy metal contents test.

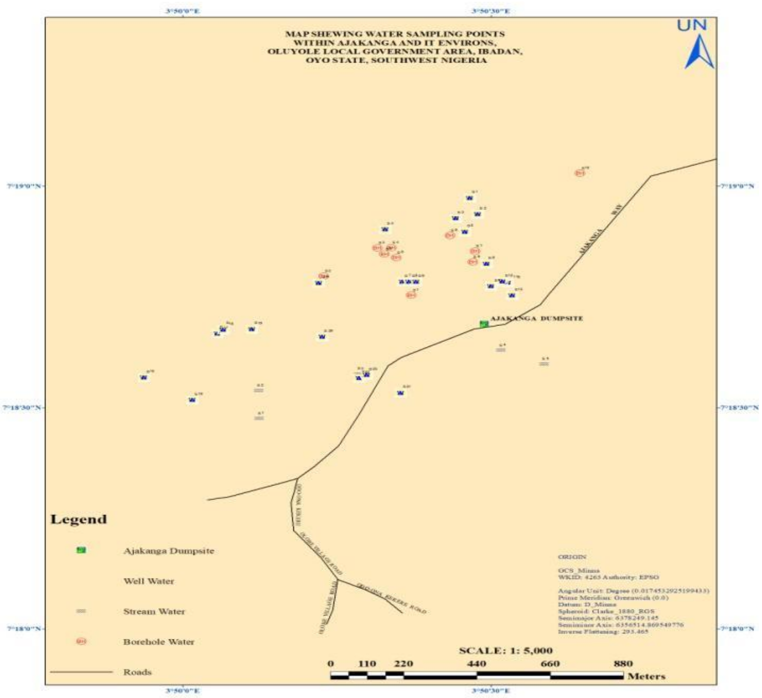

Figure 3: Map showing sampling points

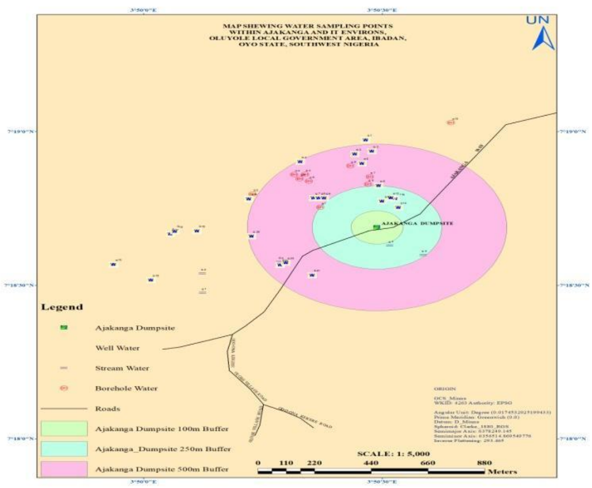

Figure 4a: Map showing 100m, 250m and 500m buffer

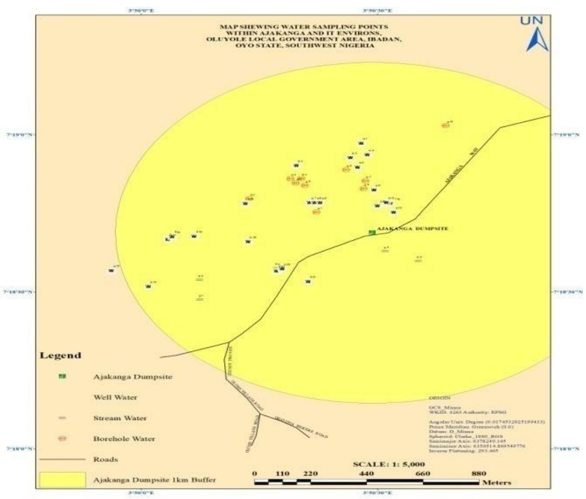

Figure 4b: Map showing 1km buffer

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Queries 1: 1km radius of well water, borehole water and stream water to Ajakanga dumpsite

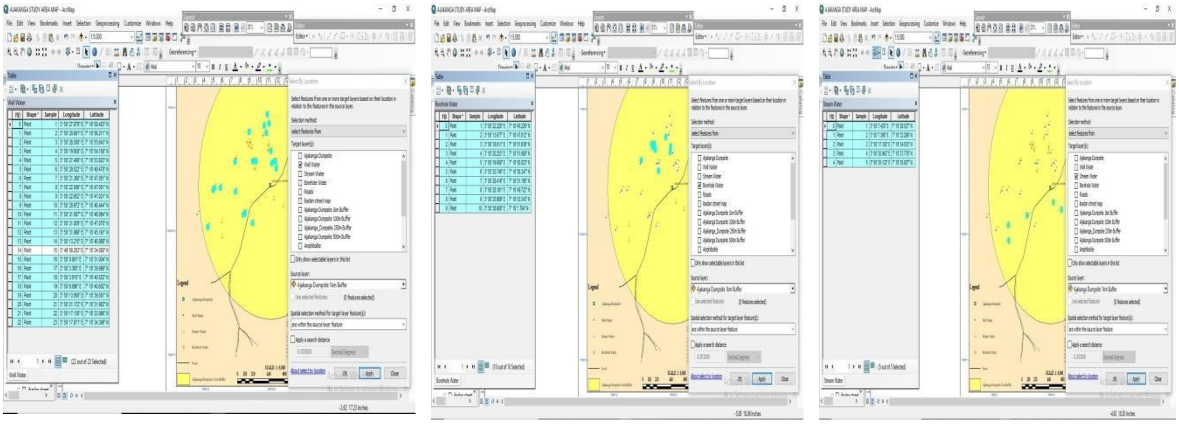

Figure 5: 1km Selection by location of well water, borehole water and stream to Ajakanga dumpsite

Queries 2: 500m radius of well water, borehole water and stream water to Ajakanga dumpsite

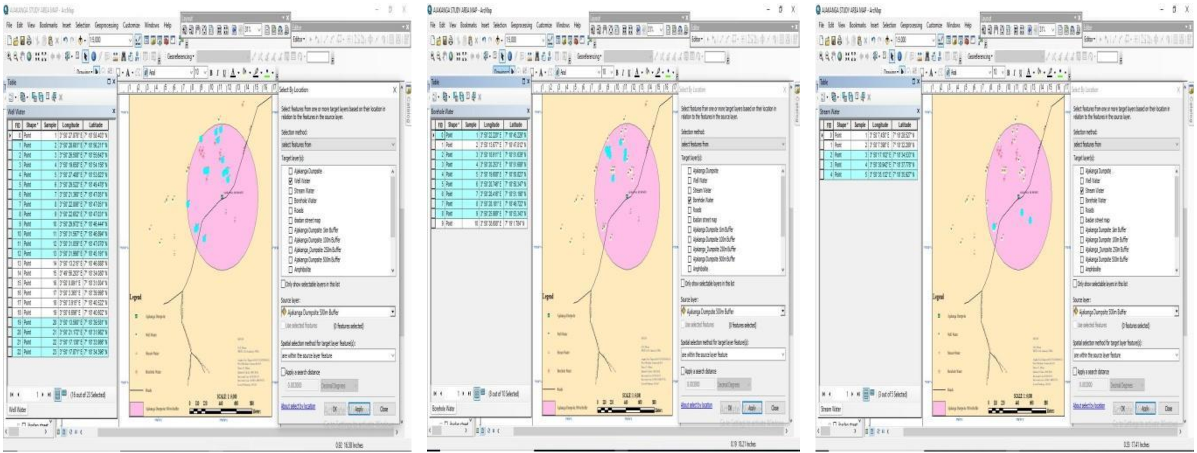

Figure 6: 500m Selection by location of well water, borehole water and stream to Ajakanga dumpsite

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Queries 3: 250m radius of well water, borehole water and stream water to Ajakanga dumpsite

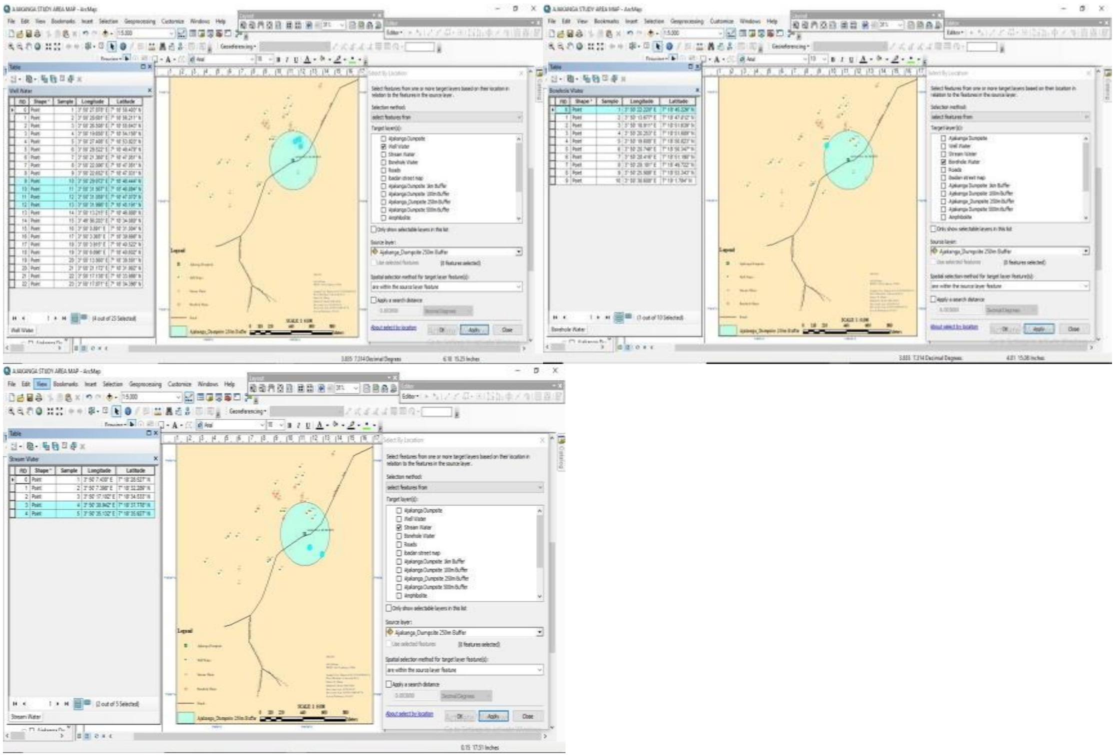

Figure 7: 250m Selection by location of well water, borehole water and stream to Ajakanga dumpsite

Queries 4: 100m radius of well water, borehole water and stream water to Ajakanga dumpsite

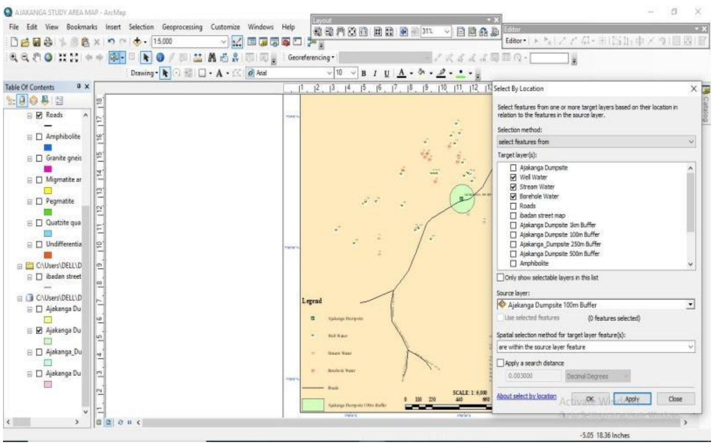

Figure 8: 100m Selection by location showing well water, borehole water and stream not within Ajakanga dumpsite

The above figure 3 showed that water sample taken within the vicinity of Ajakanga was concentrated on the North Western part of the dumpsite. It also revealed that people are not citing boreholes within the South Eastern and Western parts of the dumpsite. Figure 4a revealed 100m, 250m and 500m buffer zone radius of water sampling points to Ajakanga dumpsite and

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Figure 4b showed 1km buffer zone radius of water sampling points to Ajakanga dumpsites. Figure 5 above showed that 22 out of 23 well water sources, all boreholes (10) and stream (5) water source are within 1km distance to Ajakanga. Moreover from figure 6, it showed that, 16 out of 23 well water source, 8 out of 10 boreholes water source and 3 out of 5 stream water source are within 500m distance to Ajakanga. Figure 7 revealed 4 out of 23 well water sources, 1 borehole out of 10 and 2 streams out of 5 are within 250m distance to Ajakanga. Moreso, figure 8 showed none of the water source is within 100m distance to the dumpsite. Those that have distance less than 250m may be prone to leachate percolation into the soil.

Table 1: showing the coordinates of sources of analyzed water samples

Sample Code	Water source Types	Longitude (dms)	Latitude (dms)	Elevation (m)
Well Samples				
S1	Well	3.84107722	7.31622306	172.85m
S2	Well	3.84130028	7.31561417	166.96m
S3	Well	3.84069667	7.31545639	115m
S4	Well	3.83879389	7.31504333	132.05m
S5	Well	3.84094667	7.31495083	193.1m
S6	Well	3.84153389	7.31374389	165.98m
S7	Well	3.83926667	7.31306972	181m
S8	Well	3.83944611	7.31306972	180m
S9	Well	3.83962556	7.31306417	145m
S10	Well	3.84165889	7.31290111	176m
S11	Well	3.84210194	7.31302611	160.05m
S12	Well	3.84196083	7.313075	181.5m
S13	Well	3.84222167	7.31255306	181.3m
S14	Well	3.83700417	7.31302444	181.94m
S15	Well	3.83227861	7.30946667	254.89m
S16	Well	3.83358083	7.30861222	255.28m
S17	Well	3.83426806	7.31111056	161.72m
S18	Well	3.83442083	7.31125611	166.95m
S19	Well	3.83519333	7.31127833	257.21m
S20	Well	3.8371	7.31099472	175.42m
S21	Well	3.83921444	7.30888389	132.88m
S22	Well	3.83809389	7.30944056	102.02m
S23	Well	3.8382975	7.30955444	113.96m
Borehole Samples				
S1	Borehole	3.83950556	7.31256278	181.01m
S2	Borehole	3.8371325	7.31328111	197.89m
S3	Borehole	3.83858639	7.31434417	168.32m
S4	Borehole	3.83895917	7.31435806	167.52m
S5	Borehole	3.83878	7.3141175	191.74m
S6	Borehole	3.83909611	7.31398528	193.01m
S7	Borehole	3.84122667	7.31421944	176.02m

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S8	Borehole	3.84116139	7.31381167	133.41m
S9	Borehole	3.8405525	7.3148175	204.95m
S10	Borehole	3.84405778	7.31716222	116.03m
Stream Samples				
S1	Stream	3.83539722	7.30792417	135.01m
S2	Stream	3.83538833	7.30896717	154.78m
S3	Stream	3.83808389	7.3095925	161.02m
S4	Stream	3.84192833	7.31049389	174.21m
S5	Stream	3.84309222	7.30997972	173.01m

Note: WS = Water sample; BS = Borehole sample and SS = Stream sample

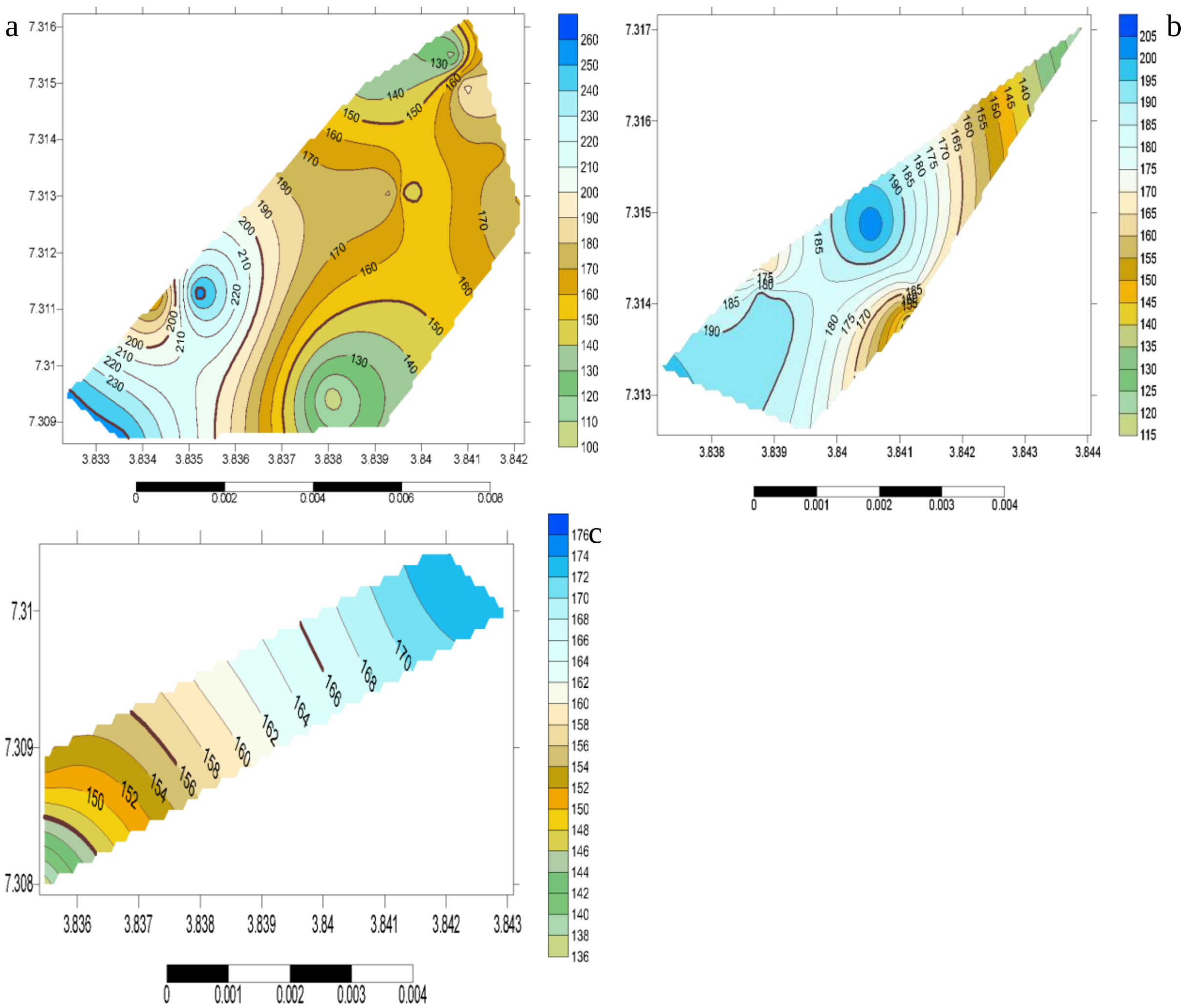

Figure 9: contour of well (a), borehole (b) and stream (c)

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Volume 7, Issue 2, 2024 (pp. 148-164)

a b

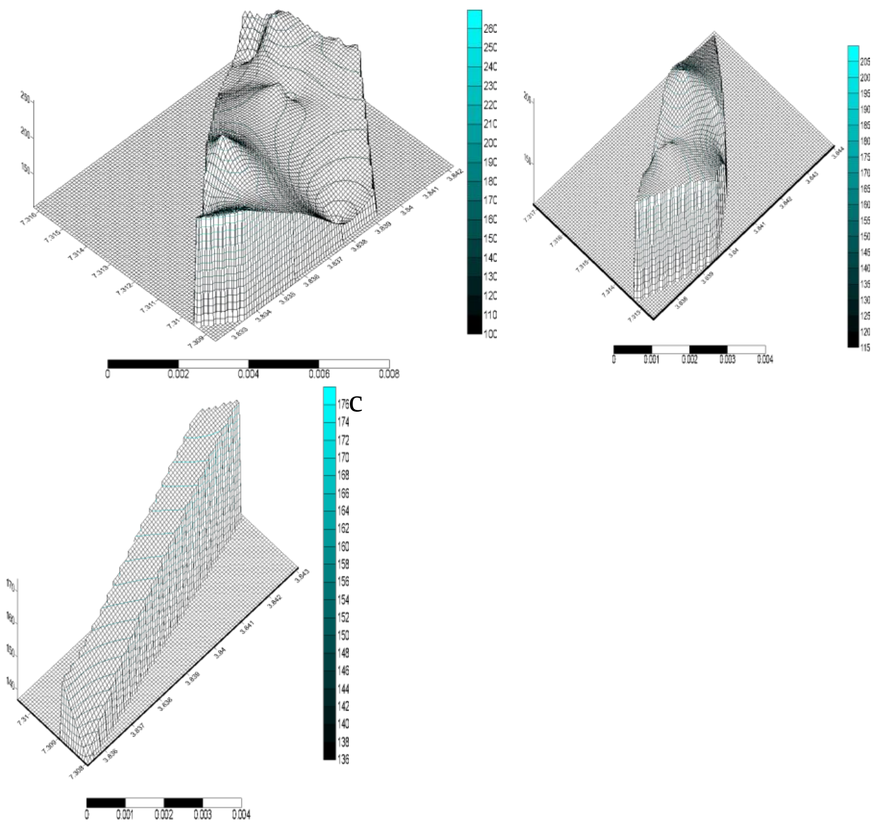

Figure 10: 3D wireframe of well (a), borehole (b) and stream (c)

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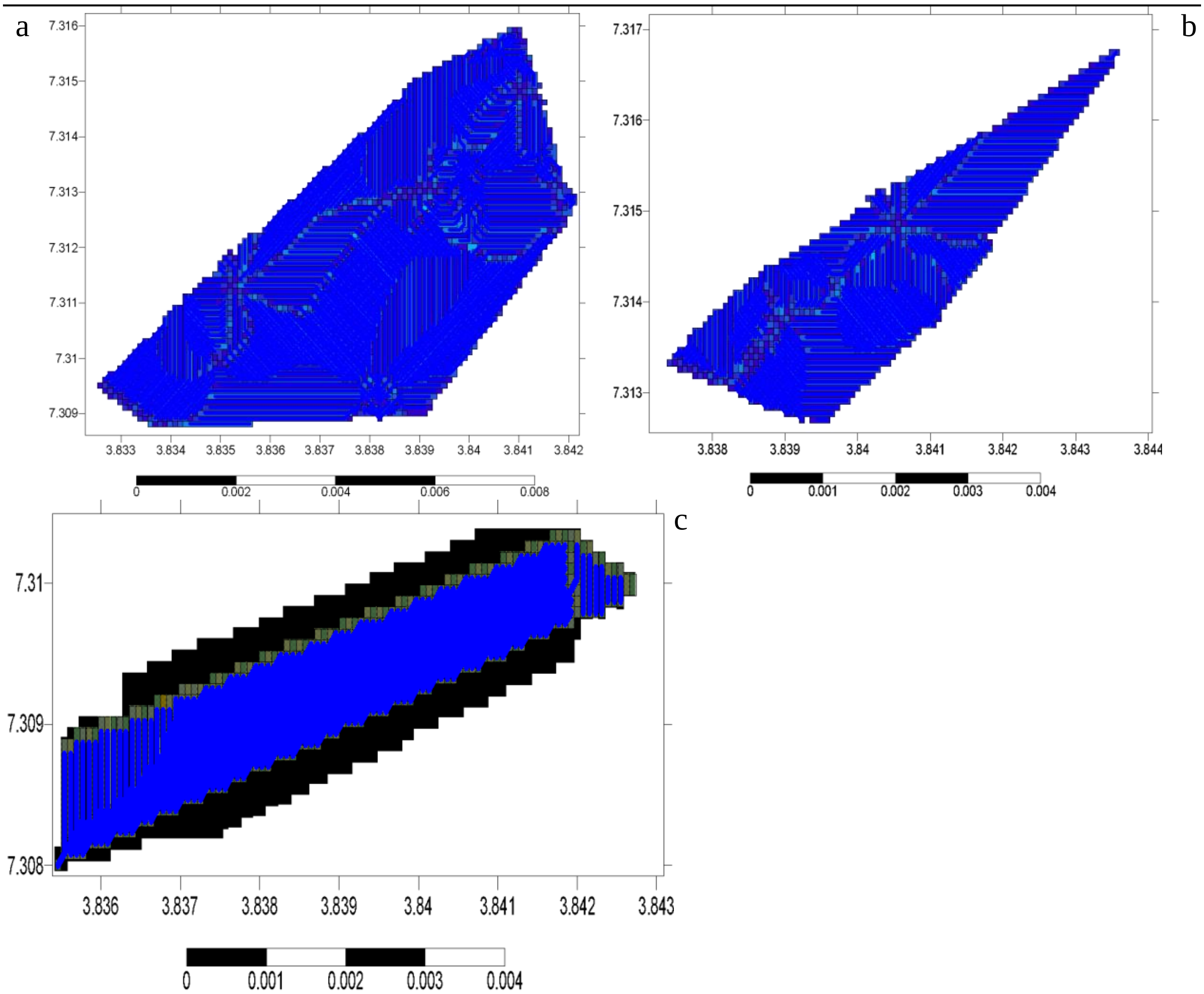

Figure 11: watershed of well (a), borehole (b) and stream (c)

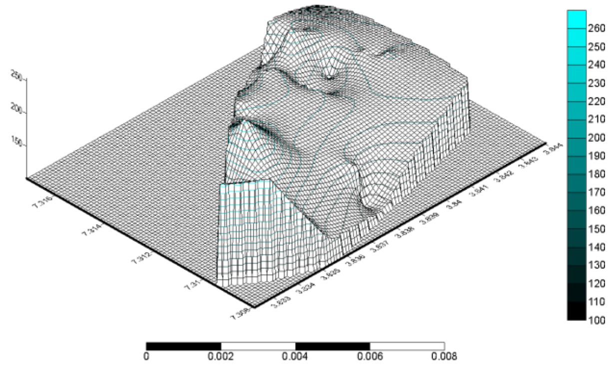

Figure 12: contour, watershed and 3D wireframe of all sample points.

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From figure 9a, minimum and maximum contour is 100m to 260m at 10m contour interval and figure 10a with minimum and maximum contour 115m to 205m respectively at 5m contour interval. Moreover, figure 11a has minimum and maximum contour 136m to 176m at 2m contour interval. The elevations within the study area range from 100m to 260m. The lower the elevations above mean sea level as the rain fall, the faster the percolation of the chemical elements/leachate to the soil and the higher the elevations, the safer the water present underneath the ground for human consumption.

Heavy Metals Parameter

Table 2: showing the results of heavy metal parameters of analyzed water samples

S/code	Fe Ppm	Pb Ppm	Cu Ppm	Cr Ppm	Mn Ppm	Zn Ppm	Ni ppm	Co Ppm	Cd Ppm
Samples for Well									
S1	11.998	0.082	0.053	0.021	0.073	0.051	0.003	0.003	0.004
S2	0.115	0.003	0.011	0.005	0.029	0.004	0.005	0.002	0.003
S3	0.223	0	0.013	0.007	0.016	0.006	0.004	0.004	0.004
S4	7.383	0.041	0.028	0.002	0.026	0.021	0.008	0.005	0.002
S5	0.788	0.016	0.015	0.008	0.012	0.005	0.005	0.006	0.003
S6	0.821	0	0.012	0.007	0.013	0.013	0.002	0.0002	0.0003
S7	0.561	0.002	0.010	0.005	0.018	0.012	0.006	0.0004	0.0004
S8	0.437	0	0.021	0.010	0.011	0.005	0.001	0.0003	0.0003
S9	0.799	0.001	0.001	0.011	0.015	0.011	0.004	0.006	0.004
S10	0.672	0.011	0.014	0.012	0.016	0.013	0.006	0.002	0.0004
S11	0.698	0.008	0.019	0.013	0.022	0.011	0.002	0.004	0.0002
S12	0.682	0.013	0.024	0.007	0.028	0.005	0.004	0.004	0.0003
S13	0.728	0.007	0.026	0.009	0.025	0.008	0.007	0.005	0.0005
S14	0.617	0.008	0.019	0.001	0.027	0.011	0.002	0.004	0.004
S15	0.730	0.011	0.023	0.013	0.026	0.014	0.0004	0.004	0.0005
S16	0.526	0.009	0.011	0.011	0.023	0.009	0.005	0.005	0.0003
S17	0.811	0.010	0.024	0.009	0.017	0.012	0.004	0.004	0.003
S18	8.792	0.035	0.033	0.024	0.044	0.010	0.005	0.002	0.005
S19	1.833	0.017	0.026	0.012	0.023	0.001	0.002	0.003	0.004
S20	2.566	0.016	0.059	0.013	0.034	0.012	0.008	0.002	0.0003
S21	0.838	0.014	0.031	0.009	0.022	0.009	0.005	0.005	0.004
S22	2.700	0.017	0.039	0.015	0.032	0.008	0.004	0.002	0.0004
S23	3.614	0.019	0.035	0.016	0.026	0.002	0.006	0.004	0.003
Samples for Borehole									
S1	0.117	0.004	0.013	0.006	0.018	0.005	0.0005	0.0003	0.0002
S2	0.514	0.009	0.017	0.015	0.015	0.009	0.005	0.0004	0.0002
S3	0.624	0.012	0.025	0.007	0.018	0.008	0.003	0.003	0.0004
S4	0.690	0.006	0.022	0.001	0.023	0.006	0.006	0.002	0.0005

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S5	0.789	0.016	0.029	0.013	0.002	0.001	0.008	0.001	0.002
S6	0.738	0.017	0.041	0.010	0.031	0.009	0.004	0.002	0.0005
S7	0.621	0.013	0.023	0.013	0.036	0.003	0.008	0.003	0.004
S8	0.702	0.012	0.021	0.011	0.033	0.001	0.002	0.004	0.001
S9	0.787	0.015	0.024	0.017	0.041	0.011	0.004	0.002	0.0003
S10	0.671	0.013	0.028	0.011	0.036	0.013	0.003	0.001	0.004
Samples for Stream									
S1	5.732	0.071	0.051	0.016	0.035	0.051	0.003	0.002	0.004
S2	0.527	0.015	0.019	0.012	0.049	0.013	0.002	0.002	0.0003
S3	7.532	0.096	0.051	0.013	0.056	0.053	0.007	0.004	0.005
S4	3.729	0.052	0.041	0.019	0.026	0.018	0.005	0.003	0.004
S5	2.781	0.011	0.011	0.005	0.019	0.011	0.004	0.002	0.003
WHO	**0.3**	**0.01**	**2.0**	**0.05**	**0.05**	**3.0**	**0.003**	**0.05**	**0.003**
NSDWQ	**0.2**	**0.01**	**2.0**	**0.05**	**0.05**	**3.0**	**0.003**	**0.05**	**0.003**
EU Std	**0.2**	**0.01**	**2.0**	**0.05**	**0.05**	**0.1**	**0.2-0.5**	**0.05**	**0.005**

Note: S = Sample point

DISCUSSION

Heavy metals are elements having atomic weight between 63.564 and 200.590 (Kennish, 1992) and a specific gravity greater than 4.0 (Connell et al., 1984). They exist in water in colloidal particulate and dissolve phase with their occurrence in water bodies being either of natural or anthropogenic origin (Adepoju et al., 2009). They include iron, copper, cadmium, cobalt and chloride. From Table 3, concentration of iron in well water samples 2 - 3 are within the permissible limits of 0.3ppm,0.2 ppm and 0.2 ppm stipulated by WHO, NSDWQ and EU respectively while other samples exceeded the WHO, NSDWQ and EU water quality standard as they range from 0.437ppm to 11.998ppm.

However, sample 1 in borehole water is within the permissible limits of 0.3ppm by WHO and 0.2ppm by NAFDAC and EU with 0.117ppm while others are above the permissible limits and ranges from 0.514ppm to 0.789ppm. No stream samples are within the permissible limits by of 0.3ppm by WHO, and 0.2ppm by NSDWQ and EU as they ranges from 0.527ppm to 7.532ppm. As none of the samples is within the permissible limits, consumption of such water due to high iron in the human body can lead to diabetes, hemochromatosis, Stomach Problems, Nausea, and Vomiting. Liver damage, Pancreas and hearts etc. 92% of well water, 90% of borehole water sampled and 100% of stream water sampled has high concentration of iron.

Concentration of lead in well water samples 2-3, 6-9, 11, 13-17 and 24 are within the permissible limits of 0.01ppm by WHO, NSDWQ and EU while others are above the limits and ranges from 0.012ppm to 0.0385ppm. Moreover, borehole water samples 1-2, 4 are within the permissible limits of 0.01ppm by WHO, NSDWQ and EU while others are above the limits and ranges from 0.012ppm to 0.017ppm. No stream samples are within the permissible limits of 0.01ppm by WHO, NSDWQ and EU and they ranges from 0.011ppm to 0.096ppm. However, consumption of high content of lead from the stream water may cause anemia, weakness, and kidney and brain damage and very high lead exposure can caused death, and

Article DOI: 10.52589/AJENSR-ZMHIZVSR
DOI URL: https://doi.org/10.52589/AJENSR-ZMHIZVSR

can damage a developing baby's nervous system and affect their behavior and intelligence. 52% from well water, 30% from borehole water sampled were not contaminated by lead.

Concentration of copper in all water samples from wells, boreholes and streams are within the WHO, NSDWQ and EU standard limit for drinking water as they ranges from 0.010ppm to 0.059ppm, 0.013ppm to 0.041ppm and 0.011ppm to 0.051ppm respectively.

Concentration of chromium in all the water samples from wells, boreholes and streams are within the permissible limits of 0.05ppm by WHO, NSDWQ and EU for drinking water as they respectively ranges from 0.005ppm to 0.019ppm, 0.001ppm to 0.017ppm and 0.001ppm to 0.024ppm.

Concentration of Manganese in well water samples 1 (0.073ppm) exceeded the permissible limits of 0.05ppm by WHO, NSDWQ and EU while other samples (2-23) are below the permissible limits as they ranges from 0.011ppm to 0.044ppm. All water samples from boreholes are below the permissible limits of 0.05ppm as they range from 0.002ppm to 0.041ppm for standard drinking water. However, sample 3 from stream water exceeded the permissible limit of 0.05ppm by WHO, NSDWQ and EU with 0.56ppm while other samples 1, 2, 4-5 are below the limits as they ranges from 0.019ppm to 0.035ppm. 96% from hand dug well water sampled, 100% borehole water sampled and 20% stream water sampled are free of contamination from Manganese.

Concentration of Zinc in water samples from wells, boreholes and streams are below the permissible limits of 3.0ppm by WHO, NSDWQ as they ranges from 0.001ppm to 0.051ppm, 0.001ppm to 0.013ppm, 0.011ppm to 0.053 and permissible limits of 0.1ppm by EU as they range from 0.001ppm to 0.053ppm. All samples from the three sources are free of contamination from Zinc.

Concentration of Nickel in well water samples 1, 6, 8, 11, 14-15 and 19, borehole water samples 1, 3, 8 and 10 and stream water sample 1-2 are within the permissible limit of 0.003ppm by WHO and NSDWQ. Other samples from wells, boreholes and streams exceeded the permissible limits as they ranges from 0.004ppm to 0.008ppm. For the EU permissible limits of 0.2ppm-0.5ppm, all water samples are within the limits as they range from 0.0004ppm to 0.008ppm from well and borehole water samples and 0.004ppm-0.007ppm from stream samples. 60% from well water sampled, 40% from borehole water sampled and 40% from stream samples are free of contamination from Nickel.

Concentration of cobalt in water samples in wells, boreholes and streams are below the permissible limit of 0.05ppm by WHO, NSDWQ and EU as they ranges from 0.0002ppm to 0.006ppm, 0.0003ppm to 0.002ppm and 0.004ppm respectively and this may occur as a result of effect of dumpsite over surface and groundwater of that particular area. Cobalt is beneficial for human as part of vitamin B12, which is essential to maintain health and also increases red blood cell production. All samples from the three sources are free of contamination from cobalt.

Concentration of Cadium in water samples 2, 4-6, 8, 10-13, 15-17, 20, 22-23 from wells, sample 1-6, 8-9 from boreholes and sample 2 and 5 from streams are within the permissible limit of 0.003ppm stipulated by WHO and NSDWQ as they ranges from 0.0002ppm to 0.003ppm, and sample 18 in well water source and sample 4 in stream samples that are within 0.005ppm stipulated by EU. High concentration of cadium can result in flu-like symptom (chill, fever, muscle pain) and can damage the lungs. Chronic exposure (low level over an extended

Article DOI: 10.52589/AJENSR-ZMHIZVSR
DOI URL: https://doi.org/10.52589/AJENSR-ZMHIZVSR

African Journal of Environment and Natural Science Research

ISSN: 2689-9434

Volume 7, Issue 2, 2024 (pp. 148-164)

www.abjournals.org

period of time) can result in kidney, bone and lung diseases. 100% of the samples have low concentration of cadium. All samples from the three sources are free of contamination from Cadium

Concentration of Cadium in water samples 2, 4-6, 8, 10-13, 15-17, 20, 22-23 from wells, sample 1-6, 8-9 from boreholes and sample 2 and 5 from streams are within the permissible limit of 0.003ppm stipulated by WHO and NSDWQ as they ranges from 0.0002ppm to 0.003ppm. This indicate that 69.6% of hand dug well water , 80% of borehole water and 40% of stream water samples are Cadium contaminated-free according to WHO and NSDWQ standard. All water sampled from the three sources is within the 0.005ppm stipulated by EU standard. High concentration of cadium can result in flu-like symptom (chill, fever, muscle pain) and can damage the lungs. Chronic exposure (low level over an extended period of time) can result in kidney, bone and lung diseases. By EU standard, 100% of the samples from the three sources in the area studied are free of contamination from Cadium.

CONCLUSION

This study has assessed the heavy metal contents of the surface and groundwater within Ajakanga dumpsite, Oluyole, Ibadan, Nigeria. The finding from this study although, indicated moderate levels of some heavy metals such as Copper, Cobalt, Chromium, Manganese, Zinc and Cadmium, the elevated presence of toxic metals such as iron, lead and Nickel from hand-dug wells, boreholes and streams assessed for most locations has grossly put interactions between the groundwater and dumpsites at high risks in the study area at the time of the assessment. This requires urgent attention to avoid health issues and this could be done through proper assessment by the concerned authority and as well through further research of the study area.

FUTURE RESEARCH

Future research will be on physicochemical and microbiological parameters assessment of the study area.

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