Vol. 5 No. 1, June, 2025

FUAM Journal of Pure and Applied Science

Available online at
www.fuamjpas.org.ng

An official Publication of
College of Science
Joseph Sarwuan Tarka University,
Makurdi.

FUAM Journal of Pure and Applied Science
© College of Science, Joseph Sarwuan Tarka University, Makurdi
https://fuamjpas.org.ng/
Vol.5 No. 1 June, 2025

Elemental Concentrations and Potential Toxic Risks in Water Sources Affected by Nearby Open Dumpsite

A.O[1]. Famuyiwa, O.D [2*]. Umoren, O.S [3]. Oladiji, M.B[4]. Abraham, K.S[5]. Sowemimo, and O.O[6]. Ajulo

[1]Department of Science Laboratory Technology, Moshood Abiola, Polytechnic, Abeokuta, Ogun State, Nigeria
[2]Department of Biological sciences, National Open University of Nigeria
[3]Department of Environmental Science and Resource Management, National Open University Abuja, Nigeria
[4]Department of Veterinary Medicine, Pan African University Life and Earth Sciences Institute, University of Ibadan, Oyo State, Nigeria
[5]Department of Chemistry, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria
[6]Department of Geosciences, Fort Hays State University, Kansas, USA
[*]Correspondence email: otohifedayo@gmail.com

Received: 15/10/2024 **Accepted**: 08/11/2024 **Published online**: 11/11/2024

Abstract
Open dumpsite is one of the most common waste disposal practices in developing nations, monitoring the location and assessing the effect it has on the surrounding water sources and the probable toxicological risk to users is essential. The study evaluated the concentration and potential toxic risk of exposure to toxic elements (TEs) in water sources around the Saje Open dumpsite in Abeokuta, Ogun State, Nigeria. Twelve (12) water samples were collected from wells, streams and boreholes for analysis. Acid digestion (20 mL Conc. Nitric (HNO_3) acid) and TE estimation using an Atomic Absorption Spectrometer (AAS). The concentration of TEs recorded (except Fe) in the samples was within the WHO guideline for water quality. There was a positively strong association between Fe and Ca; and Na and Mn, which suggests an emergence from geogenic sources. Dermal contact appears to be the major pathway of TE exposure to the human receptor in the locality. The Hazard Index (HI) value was in the descending order of Cu> Cr> Pb> Ag> Mn> Zn and Cu> Ag> Cr> Mn> Zn> Pb>Ni for adults and children respectively. The HI was less than 1, indicating no significant hazard effect of TE exposure in the water. Cancer risk due to Pb and Cr for the human receptor were within the threshold limit (1x10-6) indicating a negligible cancer risk to the users. The investigated water associated with the Saje dumpsite reveals no significant contamination and also poses no dangerous effects to the users at the time of the study.
Keywords: Toxicological Risk; Exposure; Toxic Elements; Water Sources; Open Dumpsite

Introduction

One of the greatest threats that developing nations like Nigeria faces is the amount of waste they must dispose, without the facilities and resources to meet this challenge, waste management authorities are unable to handle the volume of waste produced, and as a result, careless disposal of waste has turned many lovely Nigerian cities into enormous ghettos, causing unrelenting pollution of the land, air, and water and putting the populace at risk for health problems [1,2].

One important concern regarding waste disposal on land is the leaching of the waste into surface and groundwater resulting in contamination. Sustainable development requires access to safe drinking water, which is a fundamental human right [3]. According to the World Health Organization [4] and Umoren *et al.* [5], the supply of safe quality water is crucial to humans and the environment and these should not impose a significant risk. Additionally, although some elements are essential for human health, an excess amount can pose a negative effect [6].

Elemental contamination of water sources through leaching of the waste results in its degradation and can enter into the human food chain, posing a risk to human health [7,8]. Some elements such as Cr, Pb, Cd and as are known to be highly toxic to humans and aquatic life, causing renal and hepatic problems in addition to genotoxic carcinogens [10, 2]. Additionally, Cu, Fe, Zn, Mn and Co are essential elements which play important roles in biological metabolism at very low concentrations but can be of concern at a high concentration [8,11].

Nigeria, like many developing countries, faces significant challenges in ensuring access to safe drinking water. According to UNICEF [12], nearly 42 million Nigerians lack access to safe drinking water. This situation is further compounded by the growing threat of elemental contamination in water sources. According to Taiwo et al. [13], at least 27% of Nigerians depend solely on surface water as a major source of domestic use. Unfortunately, most of these water sources are being contaminated with various pollutants from point and non-point sources [14]. Literature has reported elemental contamination with potential risks in various water sources in different regions around the world. Additionally, there is still a large amount of investigation ongoing across Nigeria [2,8,15,16] including Abeokuta, Ogun State [5, 17]. Despite significant progress, research is needed to ensure quality water sources, especially in many low- and medium-income nations that are faced with the challenge of water scarcity [18,19].

The Saje dumpsite is an open dumpsite that is situated in Abeokuta, Ogun State, Nigeria. Characterized with an area of roughly 119,000 m^2, the dumpsite is the biggest solid waste disposal site in Abeokuta [20]. One of the main problems facing the community around this vicinity is the indiscriminate dumping of both solid and liquid wastes which could find its way into water sources. Thus, the quality of water sources around the dumpsite needs evaluation to ascertain its status. This research aims to determine the presence and the level of selected elements and exposure risks in water sources (well, stream and borehole) associated with the Saje dumpsite in Abeokuta Ogun State, South-West Nigeria.

Materials and Methods

Study Area

Abeokuta is located between latitudes 70^{0}10^r N and 70015^r N, and longitudes 30017^r E and 30026^r E. Its approximate area is 40.63 km^2. Situated in the Nigerian rainforest, Abeokuta is situated above a basement complex of volcanic rocks covered in some sedimentary strata. Because of the daily rise in the human population, solid wastes in Abeokuta are increasing. About 50% of the daily solid waste generated in Abeokuta is removed by the Ogun State Environmental Protection Agency, concerned residents, and private contractors. Solid waste is dumped along the city's streets, with an estimated generation of 0.60 kg/person/day. The remaining 50% is buried, incinerated, and thrown on any accessible land space and inside the lagoon, streams, and drainages [20]. Saje dumpsite is situated between latitudes 07011.201^r N and 07011.480^r Ni and longitudes 003021.001^r E and 003022.250^r. With an area of roughly 119,000 m2, the dumpsite is the biggest solid waste disposal site in Abeokuta. The research area's vegetation and stream discharge is regulated by the climate, which includes the wet and dry seasons of Nigeria's characteristic sub-humid and humid belts [21]. The average annual maximum temperature is 32°C, and the average annual precipitation is 1237 mm. During the dry season, when certain streams may have dried up entirely, the aquifer level is always low. In Figure 1, the map of the dumpsite is provided.

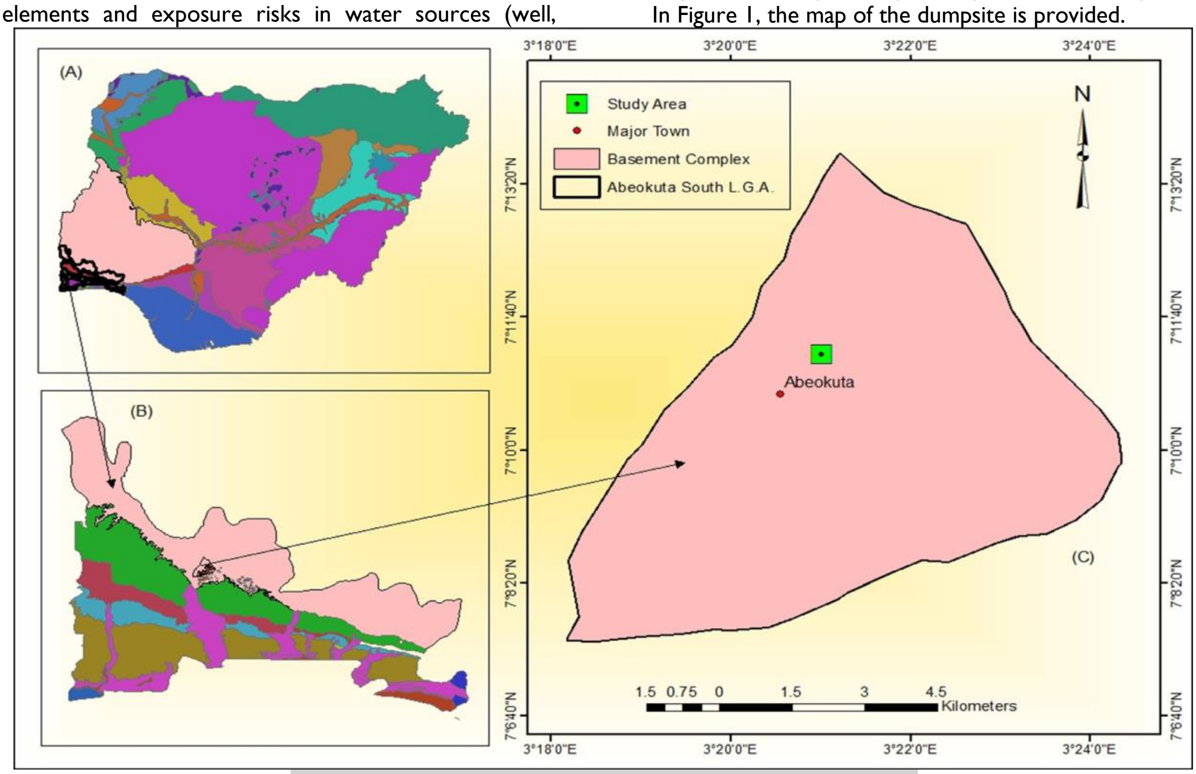


Figure 1. Map of Abeokuta showing Saje [20]

Sampling, Processing and Quality Control

All sampling collections were accurately recorded with a pen and field notebook. Sampling was done with a sterile plastic container (2L) pretreated with 5% Nitric Acid overnight, then washed thoroughly with distilled water. At the sampling site, the container was washed severally with the water sample before sampling. Twelve (12) samples were collected from wells, streams and boreholes around Saje dumpsite and then transported to the laboratory for analysis.

Digestion and Element Analysis

The digestion and elemental analysis were carried out at the laboratory of the Lagos State Environmental Protection Agency (LASEPA), Lagos State, Nigeria. Ten (10) ml of the water sample was measured using a measuring cylinder, into 250 ml of sterilized conical flask and treated with 20 ml concentration of Nitric acid. The mixture was placed on a hot plate in a fume cupboard until a clear solution was achieved. The digested sample was then filtered with Whatman No. 42 filter paper and diluted up to 50 mL with distilled water in a volumetric flask for elemental analysis using atomic absorption spectrophotometry (iCE 3000 Model).

Toxicological Risk of Exposure

The toxicological risks for the elements in water sources were estimated via ingestion and dermal contact based on the United States Environmental Protection Agency (USEPA) risk assessment method [22]. Exposure based on the average daily dose (ADD) for the elements level in water sources was calculated using Equations 1 and 2, slightly modified from the USEPA protocol [22].

$$ADI_{ing} = C \times \frac{IngR \times EF \times ED}{BW \times AT} \times 10^{-6} \qquad (1)$$

$$ADI_{derm} = (C \times SA \times PC \times EF \times ED \times CF|BW \times AT) \qquad (2)$$

Where ADD is the average daily dose through ingestion and dermal contact per kilogram of body weight [23]. C is the concentration of elements in the water sample (mg/L), IngR is the ingestion rate per unit time (L/day), ED is the exposure duration (years), which is equal to the life expectancy, EF is the exposure frequency (days/ year), BW is body weight (kg), and AT is the averaging time (ED x EF). For the conversion factor from years to days, 365 days was used. SA is the total skin surface area (cm^3), Cf is the volumetric conversion factor for water (1L/1000 cm^3), and PC is the chemical-specific dermal permeability constant (cm/h).

The hazard assessment was performed by comparing the calculated contaminant dose from ingestion and dermal exposure routes with the reference dose (RfD) to develop the hazard quotient (HQ) using Equation 3. The purpose of the hazard assessment is to evaluate whether an agent poses a non-carcinogenic hazard to humans and under what circumstances an identified hazard may be expressed [24]. $HQ = ADD/RfD$ (3)

Where HQ represents the hazard quotient via ingestion or dermal contact and RfD is the oral/ dermal reference dose (mg/L/day). Since some elements may interact synergistically [2], it is assumed that the risk of all elements is additive. Therefore, this assumption served as the basis for calculating the aggregate of non–cancer risks known as the hazard index (HI) using Equation 4.

$$HI = \Sigma HQ_i \qquad (4)$$

According to the HI's interpretation, a value of HI = or < 1 suggests that there will be no adverse health Implication, while a value of HI > 1 indicates that there is a chance that there will be such an implication. The level of concern therefore increases when HI is > 1. The cancer risks (CRs) of the elements were estimated using Equation 5 to assess the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. The slope factor (SF) is a toxicity value that quantitatively defines the relationship between dose and response. Potential carcinogenic effect probabilities that an individual will develop cancer over a lifetime of exposure are estimated from projected intakes and slope factors. The range for carcinogenic risk acceptable or tolerable stipulated by the USEPA is 1×10^{-6} to 1×10^{-4} [2,6].

$$TCRi = ADD_i \times CSF_i \qquad (5)$$

Where: CR_i - cancer risk due to exposure pathways (ingestion and dermal) and ADI - average daily dose of exposure, CSF - cancer slope factor (mg/kg/ day).

Analysis of collected data

Data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 21.0 for descriptive statistics while Microsoft Excel 2013 version was used for visualization. The relationship between elements was determined using Pearson correlation at a 95% confidence level.

Results and Discussion

Elemental Concentration in Water Sources

Elemental contamination of water is a universal environmental concern due to its direct impact on human health. The mean concentration of Fe from the study was highest in the wells (4.29 mg/L) while the lowest is found in Borehole (0.852 mg/L). The studied locations had a concentration of Fe higher than the permissible limit stated by the WHO (0.30 mg/L). Although not considered a health concern, high concentration of iron affects the water quality, leading to turbidity, unpleasant taste and colouration of cooking utensils [8]. Lead is described by the United States Environmental Protection Agency as potentially hazardous to most forms of life [6]. The mean concentrations of Pb in the water sources (0.007 mg/L for Stream, 0.001 mg/L for well and 0.004 mg/L for borehole) were within the permissible limit by WHO (0.01 mg/L). This is in contrast to the work of Aliyu *et al.* [15] who recorded a mean concentration of 1.01 mg/L of Pb in their study of surface water in Kaduna. Nickel is one of many trace elements widely distributed in the environment, being released from both natural sources and anthropogenic activity, with input from both stationary and mobile sources [2]. The concentration of Ni was recorded to be higher in both the well and borehole having an equal value (0.007 mg/L) while the stream (0.003 mg/L) has the lowest. All studied water sources had a concentration of Ni lower than the recommended limit by the WHO (0.02 mg/L), the higher concentration of Ni in the borehole water may depend on the quality of the pipes. The Streams and boreholes from the study have an equal concentration of Cd (0.0004 mg/L) while the wells (0.0005 mg/L) has a higher concentration of Cd. The sources of water possess a Cd concentration lower than the recommended permissible limit of 0.003 mg/L. This is opposite to the work of Edori *et al.* [25] who recorded the mean concentration of Cd of 0.25 mg/L in water in River State and Adebanjo and Adedeji, [16] who recorded 0.03 mg/L in a water sample in Osun stream. Chromium is a known low-movement element, most especially under moderately redox conditions and at nearly neutral pH. Sources of this element are principally from industrial steel and other amalgams, chrome coating, and colour production [8]. The concentration of Cr in this study is highest in the well (0.012 mg/L) while the lowest wast recorded in the boreholes (0.005 mg/L). The concentrations of Cr in the water sources were with the permissible limit by WHO (0.05 mg/L). Calcium is an essential component of the human diet and contributes to human physiology. The concentration of Ca has its highest value in the wells (0.346 mg/L) while the lowest was in the boreholes (0.235 mg/L). The concentration of Ca in water sources were within the WHO permissible limit (200 mg/L).

Zinc concentration in the water sources has an equal value (0.001 mg/L), the concentration was within the WHO permissible limit (3.0 mg/L). The concentration of Sodium has its highest value in the wells (0.243 mg/L) while the lowest was in the borehole (0.170 mg/L). The concentrations of Na in the water sources were within the WHO permissible limit (200 mg/L). According to WHO [4], the only known clinical picture of chronic silver intoxication is that of argyria, a condition in which silver is deposed on skin and hair, and in various organs following occupational or iatrogenic exposure to metallic silver and its compounds, or the misuse of silver preparations. The concentration of Ag in both streams and boreholes are equal (0.002 mg/L) while the wells (0.003) have a higher concentration. The higher concentration of Manganese in the both the wells and streams were equal (0.003 mg/L) while a lower concentration was recorded in the boreholes (0.001 mg/L). Concentrations of Mn in the water sources were within the WHO permissible limit (0.05 mg/L).

Table 1: Concentration of Elements in Water Sources

Elements (mg/L)	Water Sources			Overall Mean±SD	WHO [4]
	Streams	Wells	Boreholes		
Fe	0.898	4.29	0.852	2.01±1.97	0.30
Pb	0.007	0.001	0.004	0.004±0.003	0.01
Ni	0.003	0.007	0.007	0.006±0.002	0.02
Cd	0.0004	0.0005	0.0004	0.0004±0.00006	0.003
Cr	0.007	0.012	0.005	0.008±0.004	0.05
Ca	0.253	0.346	0.235	0.278±0.060	200
Zn	0.001	0.001	0.001	0.001±0.00	3.00
Na	0.175	0.243	0.170	0.196±0.041	200
Ag	0.002	0.003	0.002	0.002±0.0006	0.005
Mn	0.003	0.003	0.0007	0.003±0.000	0.05

Association between TEs

Element's correlation can suggest useful information about the source and the pathways of elements in the environmental media [2]. Pearson's correlation coefficient conducted between elements shown in Table 2, Indicates that Fe was significantly related to Ca ($r=0.933$, $p<0.01$), Na ($r= 0.969$, $p<0.01$) and Mn ($r=0.634$, $p<0.05$) while Ca was significantly related only to Na ($r=0.950$, $p<0.01$). The relationship between the elements (Fe, Ca and Na, Mn) shows the elements were purely from the geogenic sources.

Table 2: Correlation coefficients between Parameters

	Fe	Cd	Pb	Ni	Ca	Na	Cr	Ag	Mn	Zn
Fe	1									
Cd	0.209	1								
Pb	0-.478	-0.413	1							
Ni	0.238	0.349	-0.447	1						
Ca	0.933**	0.147	-0.322	0.220	1					
Na	0.969**	0.244	-0.468	0.170	0.950**	1				
Cr	0.048	0.278	-0.255	0.001	-0.147	0.024	1			
Ag	0.030	0.047	0.064	-0.483	-0.019	0.110	0.494	1		
Mn	0.634*	0.024	-0.025	-0.310	0.487	0.559	0.002	0.135	1	
Zn	0.221	-0.016	-0.341	0.562	0.044	0.132	0.481	0.127	-0.137	1

and Asterisked values are significant at $p<0.05$ and $p<0.01$.*

Toxicological Risk of Exposure

The wells, streams and boreholes assessed in this study are potential sources of drinking and domestic water for the local population, therefore water ingestion and dermal contact are assumed to be the main pathways for risk assessment. The non-carcinogenic and carcinogenic human health risks of exposure to the elements (Fe, Pb, Ni, Cd, Cr, Zn, Ca, Na, Ag and Mn) were estimated for both adults (18 -70 years) and children (1 -17 years) population through the two different possible exposure pathways (ingestion and dermal contact). The average daily dosage presented in Table 3 shows that dermal contact was the major exposure pathway of the element to the human receptors residing in the study area, appearing in descending order of Fe>Ag>Na>Mg>Zn>Cd>Pb>Cd>Cr>Ni.

Table 3: Average Daily Dose

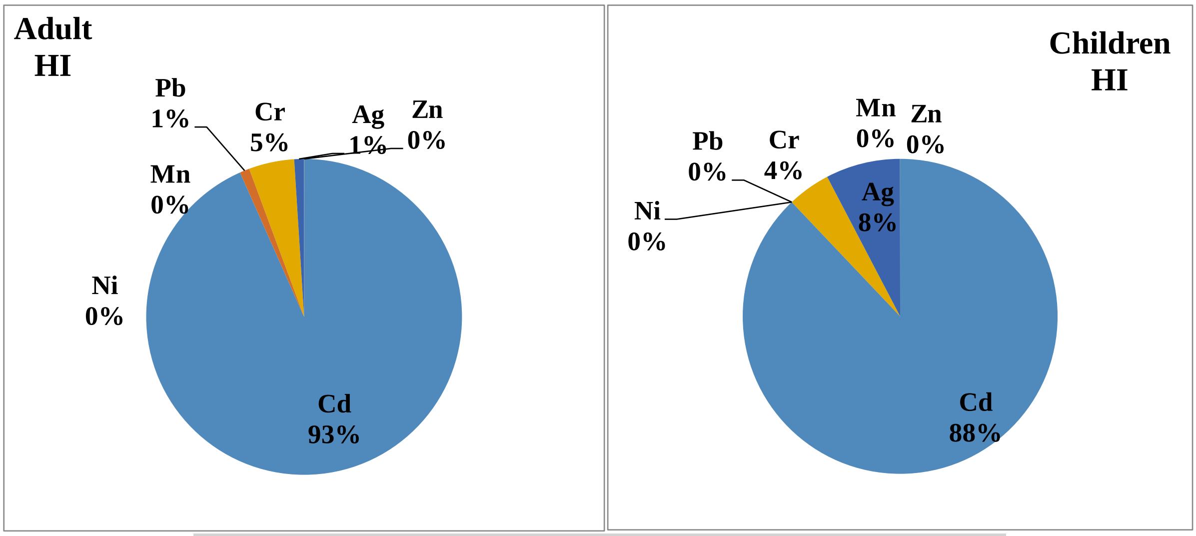
Elements	Human Receptors			
	Adult		Children	
	ADD_{ing}	ADD_{dermal}	ADD_{ing}	ADD_{dermal}
Fe	4.86E-06	1.12E-04	1.14E-05	3.18E-05
Cd	9.68E-09	2.24E-07	2.26E-08	6.32E-08
Pb	1.45E-08	3.35E-07	3.39E-08	9.49E-08
Ni	9.68E-10	2.24E-11	2.26E-09	6.32E-12
Ca	1.94E-08	4.47E-07	4.52E-08	1.26E-07
Na	6.73E-07	1.55E-05	1.57E-06	4.40E-06
Cr	1.45E-09	3.35E-08	3.39E-09	9.49E-09
Ag	4.74E-07	1.10E-05	1.11E-06	3.10E-06
Mn	4.84E-09	1.12E-07	1.13E-08	3.16E-08
Zn	7.26E-09	1.68E-07	1.69E-08	4.74E-08

Non-cancer and cancer risks

According to the US Environmental Protection Agency [6] risk assessment indices, when the value of the hazard index is greater than 1, it indicates a significant non-cancer health effect on exposure to water. The Hazard Index (HI) value for elements for adults occurs in the descending order of Cu> Cr> Pb> Ag> Mn> Zn while Cu> Ag> Cr> Mn> Zn> Pb>Ni for children. All studied elements show an HI value lower than 1 indicating a non-significant non-cancer hazard effect on the people who utilize the sources of water. The study also revealed that Cd is the major element of exposure to the people utilizing the water (Figures 2a &b). Cancer risk values are conducted to assess if the population making use of the water was at risk of developing a carcinogenic effect on prolonged exposure to the water sources. The total Cancer risk value for the elements revealed that Pb and Cr were less than $1x10^{-6}$ suggesting a negligible cancer risk to people making use of the water sources.

Table 4: Non-cancer and cancer risk

Elements	Human Receptor					
	Adult			Children		
	HQ_{ing}	HQ_{dermal}	HI	HQ_{ing}	HQ_{dermal}	HI
Cd	9.68E-06	8.96E-03	8.97E-03	2.26E-05	2.53E-03	2.55E-03
Pb	4.83E-08	9.57E-05	9.58E-05	1.02E-08	3.32E-10	1.05E-08
Ni	8.80E-09	5.09E-08	5.97E-08	2.05E-08	1.44E-08	3.49E-08
Cr	4.83E-07	4.47E-04	4.47E-04	1.13E-06	1.27E-04	1.28E-04
Ag	9.48E-05	-	9.48E-05	2.22E-04	-	2.22E-04
Mn	3.46E-08	8.00E-07	8.35E-07	8.07E-08	2.26E-07	3.06E-07
	2.42E-08	5.60E-07	5.84E-07	5.63E-08	1.58E-07	2.14E-07
Elements	Adult			Children		
	CR_{ing}	CR_{dermal}	TCR	CR_{ing}	CR_{dermal}	TCR
Pb	1.23E-10	-	1.23E-10	2.88E-10	-	2.88E-10
Cr	1.94E-08	-	1.94E-08	4.52E-08	-	4.52E-08



Figures 2a &b: Individual Elemental % contribution to human non-cancer risk

Conclusion

The study investigated the concentration of elements (Fe, Pb, Ni, Cd, Cr, Zn, Ca, Na, Ag and Mn) and potential toxic risks in water sources affected by nearby open dumpsite in Abeokuta, Ogun State Nigeria. The study showed that the level of elements (except Fe) is within the WHO water guideline. Furthermore, the detected elements are also primarily from natural sources and poses no dangerous effects to the users.

Reference

[1] Ajah, K.C. Ademiluyi, J. and Nnaji, C.C. (2015). **Spatiality, seasonality and ecological risks of heavy metals in the vicinity of a degenerate municipal central dumpsite in Enugu, Nigeria**. *Journal of Environmental Health Science and Engineering.* 13: 1-15. doi:10.1186/s40201-015-0168-0

[2] Famuyiwa, A.O. Umoren, O.D. Ande, S. Eze, R.I. Sowemimo, K.S. and Rafiu, R.B. (2023). **Physicochemical quality, potentially toxic elements characterization and toxicological risk assessment of industrial effluents in Iju River, Ogun State, Nigeria.** *Journal of Research in Forestry, Wildlife and Environment* (JRFWE), 15(3): 126 -135. https://www.ajol.info/index.php/jrfwe/article/view/258538

[3] Spijkers, O. (2020). **The sustainable human right to water as reflected in the sustainable development goals**. *Utrecht Law Review*. 16(2): 18-32.

[4] World Health Organization (WHO) (2011). ***Guidelines for Drinking–water Quality***, *4th edition.* http://whqlibdoc.who.int/publications/2011/9789241548151_eng.pdf?ua=1

[5] Umoren, O.D. Uchechukwu, D.D. Akpowu, A.G. Ayeni, L.A. Aderibigbe, B.S. and Alani, O.A. (2024a). **Physicochemical Quality of Groundwater Sources in a University Environment.** *Dutse Journal of Pure and Applied Sciences (DUJOPAS).* 10(3b): 232-239

[6] United State Environmental Protection Agency (US EPA), (2015). ***US EPA Integrated Risk Information System (IRIS) online database***. Available at: http://www.epa.gov/iris.

[7] Arimoro, F.O. Odume, N.O. Uhunoma, S.I. and Edegbene, A.O. (2015). **Anthropogenic impact on**

water chemistry and benthic macroinvertebrate associated changes in a southern Nigeria stream. *Environmental Monitoring and Assessment*. 187: 1- 14.

[8] Aluko, T.J. Ikuemonisan, F.E. Umoren, O.D. and Leramo, O.A. (2024). **Assessment of Physicochemical Properties and Heavy Metal Concentration in Hand-dug wells within the Vicinity of Lead Smelting Area in Ibadan, Oyo State, Nigeria**. *Journal of Applied Science and Environmental Management.* 28(10): 2729-2736

[9] Varol, M. and Sen, B. (2018). **Assessment of nutrient and heavy metal contamination in surface water and sediments of the upper Tigris River, Turkey**. *Catena*, 92(1):1-10. https://doi.org/10.1016/j.catena.2011.11.011

[10] Nguyen, H.L. Leermakersk, M. Osan, J. Torok, S. and Baeyens, W. (2018). **Heavy metals in Lake Balaton: water column, suspended matter, sediment and biota**. *Science of Total Environment.* 340(1-3): 213-30.

[11] Galadima, A. and Garba, Z.N. (2012). **Heavy metals pollution in Nigeria: causes and consequences**. *Elixir Journal of Pollution.* 45: 7917-7922

[12] UNICEF (2022). ***Water, Sanitation, and Hygiene (WASH)***. Available online: https://www.unicef.org/wash (accessed on July 2024).

[13] Taiwo, A.M. Olujimi, O.O. Bamgbose, O. and Arowolo, T.A. (2012). **Surface water quality monitoring in Nigeria: Situational analysis and future management strategy.** *Water quality monitoring and assessment*. 13: 301-320. https://doi.org/10.5772/33720

[14] Achi, C.G. Omoniyi, A.M. and Coker, A.O. (2021). **Distribution of Selected Toxic Elements in Water Phases of River Ogbere, Ibadan, Nigeria**. *Journal of Environmental Protection.* 12: 429-437. https://doi.org/10.4236/jep.2021.127026

[15] Aliyu, J.A. Saleh, Y. and Kabiru, S. (2015). **Heavy metals pollution on surface water sources in Kaduna metropolis, Nigeria**. *Science World Journal*. 10(2): 1-5.

[16] Adebanjo, J.A. and Adedeji, W.O. (2019). **Studies on heavy metals contents of Osun River at the pre-urban settlement and across Osogbo City, Nigeria.** *Journal of Taibah University for Science*. 13(1): 318-323

[17] Umoren, O.D. Salaudeen, G. Olowo, S.T. Mohammed, M.A. Akpowu, A.G. Ayanleke, T.A. Bamigbaye, O.P. and Afolabi, T. (2024b). **Physicochemical Parameters of Selected Ground and Surface Water Sources in Ijeun- Titun and Kuto Community, Abeokuta, Ogun State, South-western Nigeria**. *Nigerian Journal of Hydrological Sciences (NJHS).* 11(1): 87-95. https://www.ajol.info/index.php/njhydrosci/article/view/280317 .

[18] World Bank, (2016). ***The World Bank data: Country and Lending Groups***. Available at:http://data.worldbank.org/about/country-and-lending-groups#Low_income (Accessed on: Apr, 2024).

[19] Odjegba, E.E. Sadiq, A.Y. Awomeso, J.A. Laniyan, A.B. Adetula, B.A. and Ajulo, O.O. (2017). **Water Quality Index Evaluation of Self-Supply Systems in Ayetoro, Ogun State, South West Nigeria**. *International Journal of Ecology and Environmental Studies.* 4(1): 74-81

[20] Ojo, A.O. Olurin, O.T. Ganiyu, S.A. Badmus, B.S. and Idowu, O.A. (2022). **Electrical imaging characterization of a dumpsite on an abandoned quarry site in Abeokuta, South West, Nigeria**. *Scientific African*. *17*, e01330.

[21] Ganiyu, S.A. Badmus, B.S. Oladunjoye, M.A. Aizebeokhai, A.P. and Olurin, O.T. (2015). **Delineation of leachate plume migration using electrical resistivity imaging on Lapite dumpsite in Ibadan, Southwestern Nigeria.** *Geosciences.* 5(2): 70-80.

[22] Risk assessment guidance for superfund (RAGS) (2018). ***Human health evaluation manual***. Vol. 1, Washington, D.C. (Accessed Feb 2024).

[23] Hadzi, G.Y. Essumang, D.K. and Adjei. J.K. (2018). **Distribution and risk assessment of heavy metals in surface water from pristine environments and major mining areas in Ghana**. *Journal of Health and Pollution.* 5(9):86-99. https://doi. org/10.5696/2156-9614-5-9.86

[24] Naveedullah, A. Hashmi, M.Z. Yu, C. Shen, H. Duan, D. Shen, C. Lou, L. and Chen, Y. (2014). **Concentrations and human health risk assessment of selected heavy metals in surface water of sailing reservoir watershed in Zhejiang Province, *China.***, *Polish Journal of Environmental Studies*. 23(3):801-11.

[25] Edori, O.S. Iyama, W.A. and Amadi, M.C. (2019). **Status of heavy metals contamination in water from the Elelenwo River, Obio-Akpor, Rivers State, Nigeria**. *Direct Research Journal of Chemistry and Material Science*. 6(3): 25-31.

Cite this article

Famuyiwa, A.O., Umoren, O.D., Oladiji, O.S., Abraham, M.B., Sowemimo, K.S., and Ajulo, O.O. (2025). Elemental Concentrations and Potential Toxic Risks in Water Sources Affected by Nearby Open Dumpsite. FUAM Journal of Pure and Applied Science, **5**(**1**):81-88