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Assessment of Lead and Cadmium of Hand Dug Well Around Gold Mining Areas of Rimi Sumaila Local Government Area, Kano State, Nigeria

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Abstract

Heavy metals are essential element that are very important to the soil, their accumulation beyond the permissible limit causes a health risk as it may affect the soil and plants. Mining activities can generate large quantities of heavy metals laden waste which are released in an uncontrolled manner, causing widespread contamination of the ecosystem. Heavy metals are important for normal life psychological process and also provide enormous social and economic benefit to nations, the lung time adverse effect on the environment and public health cannot be overlooked This study investigates the presence of lead and cadmium metals hand dug well around gold mining areas of Rimi Local Government, Kano State. The metals determined were lead and chromium, and the permissible limit for lead in water is 0.1mg/L according to (WHO, 2008). By consideration with the WHO (2008) acceptable limit all the ten-hand dug well water in Rimi are beyond the permissible limit. The highest lead concentrations in water lead to several disease to body organs such as brain, kidney gastrointestinal tracts and central nervous system.

Keywords: Heavy metals, Mining, Essential element, Ecosystem, Soil and plant

INTRODUCTION

Mining activities can have an impact on the environment on a local, regional, and global level through direct and indirect practices. According to Laura and Sonter (2018), impact can lead to erosion, sinkholes, and biodiversity loss. Certain mining practices can have such a negative impact on the environment and public health that they force mining corporations in some nations to abide by stringent environmental and rehabilitation regulations in order to guarantee that the mined region returns to its pre-mining condition. Another example of how mining affects the environment is the way heavy metals are transported and dissolved in water. Lead and cadmium from these mines seep into nearby ground water supplies, poisoning them (Ottawa and Okalahoma, 2008). Heavy metals in soil are metals or metalloids that can be toxic to plants, animals, andhumans in large amounts. Lead (Pb), cadmium (Cd), mercury (Hg), arsenic (As), chromium (Cr), and nickel (Ni) are some of the heavy metals present in soil. Inagricultural and urban soils, heavy metal contamination is caused by various humanactivities. Contamination from a single dominant source, such as a metal smelter, cansignificantly impact soils, plants, and potentially the health of the local population, especially in countries with lax emission controls and soil quality standards. Industrialsoils can contain a variety of heavy metal contaminants, depending on the industry, rawmaterials, and products (Abubakar M.Y *et al.*, 2024).

Mining activities can result in the production of large amounts of waste laden with heavy metals that are released uncontrollably, causing widespread contamination of the ecosystem through the use of some heavy metals, which are necessary for normal psychological processes in life and also offer significant social and economic benefits to nations. The long-term negative effects of these metals on the environment and public health cannot be ignored (Akabzaa, 2000). The primary waste product from the extraction of gold is tailing, which has a high concentration of heavy metals. When this metal comes into contact with water or passes through other materials, it releases ions into the surrounding air in an uncontrolled manner. The process of elevated concentration of heavy metals in the environment is a serious health issue worldwide due to their non degradative nature which make them persistent and thereby exert long term effect on the eco system. The non-essential heavy metals like Ag, As, Cd, Pd, and Hg of no biological importance to living organism and are very toxic when found in the eco system these heavy metal can enter the food chain as a result of their uptake by edible plant (Alirzajeva *et al.,* 2006). When heavy metals are accumulated in the human body it tends to effect the nervous system and its normal function in recent years, heavy metals such as Lead (Pb), Copper (Cu), Magnesium (Mg), Nickel (Ni), Zinc (Zn) have received significant attention due to their health problems. More also kidney related problems neurocognitive disease and cancer are related to the trace of metals such cadmium (Cd) and chromium (Cr) as reported in epidemiological studies (Dezuane, 1997).

The sub surface area where all available soil or rock is filled by water is called ground water. (Padma and Namrama, 2009). Ground water is the water found underground in the cracks and spaces in soil, sand and rocks. It is stored in and moves slowly through geological formation of soil, sand and rocks. The constant movement of this water is called the "hydrologic cycle" the cycle enumerates three type of flow which are the inflow, outflow and storages that is increase, decrease and retention to the hydraulic cycle respectively (Muthukumaravel, 2010). Ground water is one of the main sources of water used intensively for domestic and agricultural purposes. Well is among the major place where ground water can cheaply be found. It is defined as a hole or shaft usually vertically excavated in the earth for beginning out ground water to the surface, it may be shallow or deep depending on where the water can be reached (Wolf, 2004). Ground water consists 20% of water present as freshwater. However, ground water provision are sometimes on sustainable due to poor productivity of well, drying off as a result of prolonged drought and sometimes poor water quality (kortatsi,1994). Groundwater is extremely valuable due to certain characteristics that surface water does not have (Prasad and Reddy 2011, Omaloaye et al., 2010). Over half of humanity's daily sustenance comes from ground water; it is used by people all over the world as a source of drinking water. In addition to being abundant and widely distributed, ground water is valuable because of its steady high quality, which makes it a perfect drinking source. Research on ground water contamination has received more attention in the last few years. Ground water may become contaminated by this source's constituents since it comes into direct contact with soil, rocks, and plants (Nardi et al., 2009, UNESCO 2000, Hamanuman et al., 2012).

Humans depend heavily on soil, and soil contamination has an impact on crop productivity as well as indirectly on humans through the crops that are farmed. The elements known as heavy metals have a relatively high density and are toxic even in small amounts. One of the issues affecting the majority of our rivers and water bodies is industrial influence. Some heavy metals that are harmful to humans and plants are used spatially in water that is connected to cities and industries during irrigation farming. et al., Shittu (2024).

Lead is a naturally occurring toxic metal found in the earth's crust , its widespread use has resulted in environmental contamination , human exposure and significant public health problems in many parts of the world.(WHO, 2019).WHO also identified lead as 1 of 10 chemical that causes health problem. Lead is found in several minerals like PbS (lead glance) anglesites $PbSO_3$ and cerrussites $PbCO_3$. AAS and anodic stripping volumetric are the methods used for determining lead in waters (WHO, 2011). Even at low concentrations, cadmium is an exceedingly hazardous metal. Renal injury is caused by prolonged exposure to lead (Cd), which has a long biological half-life in humans of 10-33 years (Nida, 2018). A recommended guideline value for lead (Cd) is 3 mg/L according to WHO drinking quality recommendations. Normally, cadmium exists as the divalent Cd2+, which is primarily released in acidic and hazardous environments. Large concentrations of hydrous oxides, clay minerals, and organic matter also improve it, and pH has an impact on its mobility (Andreas, 2019).

MATERIALS AND METHODS

Materials/Reagent: Beaker**,** Burette**,** Conical flask, Hot plate**,** Measuring cylinder**,** Filter paper**,** Retort stand**,** Cuvette**,** Glove,Distilled water, Methyl orange indicator,Ethylenediamine tetra acetic acid (EDTA), Buffer solution, Erichrome black T, Sulphuric acid, Phenolphthalein indicator. Nitric Acid, Water sample.

Sample Collection

The water samples were collected from ten (10) different hand dug well in Rimi village, Sumaila Local Government, Kano State using polythene plastic containers prewashed with detergent. Samples for heavy metal analysis were preserved by adding few drops of 1 Molar HNO_3 (Manilla and Frank, 2009).

Heavy Metal Determination

Digestion of water sample

The determination of heavy metals in water is often regarded as the movement of total suspended and dissolved metals (soluble metals). In such cases consistent and dependable digestion procedures must be used so that data derived for total metal content is reliable. The water was immediately digested after sampling to prevent changes in composition of water samples according to standard procedures of the American Public Health Association (APHA, 1999).

Procedure for sample digestion

The water sample (50 ml) was measured and transferred into a beaker and the concentrated 5ml of HNO_3 was then added. It was warmed slowly and allowed to evaporate to about 20 ml on a hot plate. Heating with addition of concentrated HNO_3 continued until a light colored, clear solution was observed. The beaker wall was washed down with deionized water and then filtered. The filtrate was transferred to a 100-ml volumetric flask, allowed to cool and made up to the mark with deionized water (APHA, 1999). The digested sample were used to measure the individual metals concentrations in the water using an atomic absorption spectrometer (AAS).

RESULTS

SAMPLE SITE	CADMIUM (mg/L)	LEAD (mg/L)
Kofar Gabas	0.001	0.325
Kofar Yamma	0.001	0.401
Kofar Kudu	0.003	0.510
Kofar Arewa	ND	0.350
Company I	ND	0.471
Company II	ND	0.998
Company III	ND	0.530
U.Kachaka	ND	0.463
U.Dukawa	0.001	0.442
U.Kuka	0.002	0.421
WHO STANDARD	**0.003**	**0.100**

NOTE:

ND: Not detected

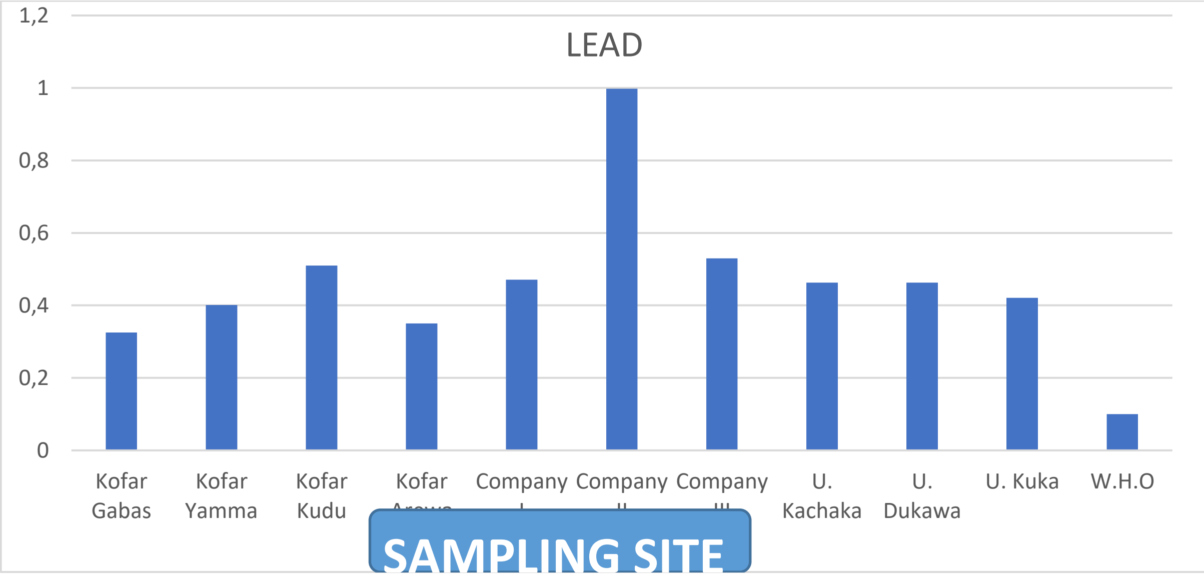

Figure 1.0: a graph concentration of lead (Pb) in mg/L

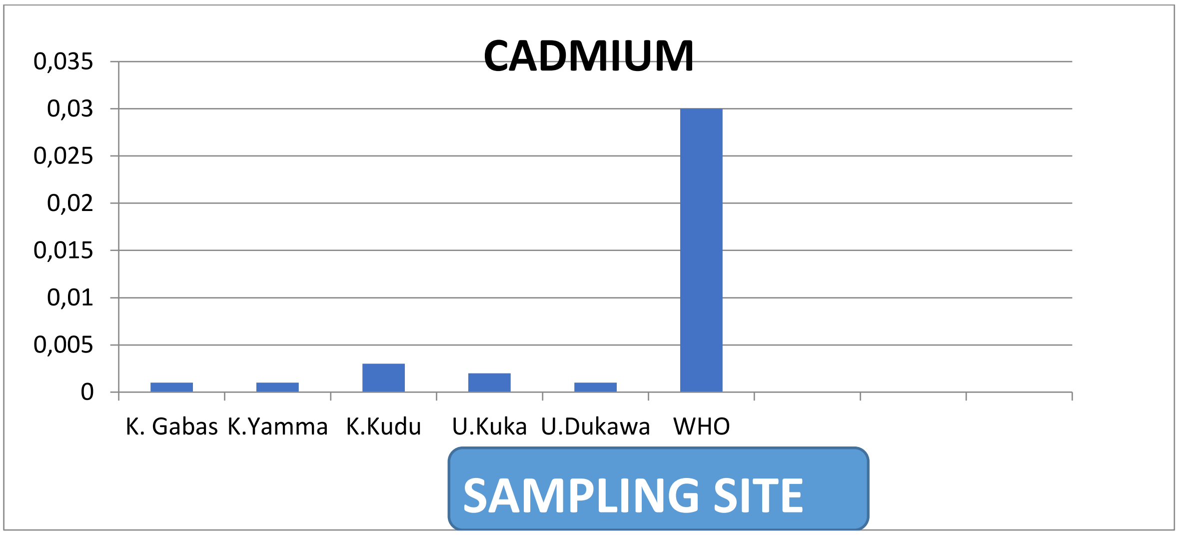

Figure 2.0: a graph concentration of Cadmium (Cd) in mg/L

DISCUSSION

The permissible limit for lead in water is 0.1mg/L according to (WHO, 2008). By consideration with the WHO (2008) acceptable limit all the 10 hand dug well water in Rimi are beyond the permissible limit. The highest lead concentrations in water lead to several disease to body organs such as brain, kidney gastrointestinal tracts, central nervous system etc. (Wuana and Okieimen 2011). The permissible limit for Cadmium in water is 0.03mg/L according to (WHO, 2008). By consideration with the WHO (2008) acceptable limit all the 6 hand dug well water in Rimi are beyond the permissible limit.

CONCLUSION

From the result obtained, revealed that heavy metals of Lead were above the maximum contaminant level as stipulated by (WHO, 2008) and for cadmium six (6) sample sites were beyond the contaminant level and was not detected in four (4) sample sites. Hence, the water should undergo treatment before consumption to avoid bioaccumulation of the heavy metals. According to the WHO (2008) acceptable limit all the ten-hand dug well water in Rimi were beyond the permissible limit. The highest lead concentrations in water lead to several diseases to internal organs such as brain, kidney gastrointestinal tracts and central nervous system.

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