HEAVY METAL POLLUTION FROM ARTISANAL GOLD MINES (A REVIEW)

OJIAMBO JULIUS

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Supervisor: Mr. Egor Moses

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Declaration

I, Ojiambo Julius, declare that this piece of work has been collected by myself, I confirm that the work submitted is my own. My contribution and that of the other authors to this work have been explicitly indicated below. I confirm that appropriate credit has been given within this where reference has been made to the creation of others.

Signature……date……/……/……

Ojiambo Julius

Approval

This undergraduate research project review report has been submitted for examination with my approval as research supervisor.

Signature..... Date...../...../.....

Mr. Egor Moses

Department of chemistry

Dedication

I dedicate this piece of work to my mother, Ms. Hayoko Jesca who has done great work to ensure that I reach this far. Her love, care and support cannot be measured and may the almighty God bless her abundantly.

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Abstract

Mining activities can lead to the generation of large quantities of heavy metals which are released in an uncontrolled manner causing a widespread contamination of the ecosystem. Though some heavy metals are classified as essential for normal life physiological processes, higher concentration above the stipulated levels have deleterious effect on health and biota. The unwanted release of environmental contaminants predisposed by mining activities has reached an alarming proportion that deserves attention because heavy metals have proven to be a major threat on the environment and human health. The toxic effect of these metals even though they do not have any biological role, remains present in some or the other form harmful for the human body and its proper functioning and hence the purpose of this study was to determine the degree of heavy metal contamination around gold mining site and their bio-toxic effect to people living around the gold mining sites. This review paper focuses on the certain heavy metal environment pollution and their bio-toxic effect to man.

1 Introduction

1.1 Background

1.1.1 Definitions of Key Words

The term “heavy metals” refers to any metallic element that has a relatively high density and is toxic or poisonous even at low concentration (Lenntech, 2004). Heavy metal was the popular term for one heavy metal, mercury, which was polluting the air and poisoning those who ate them. However, now heavy metal is a general collective term which applies to the group of metals and metalloids with atomic density greater than 4 g/cm^3 or 5 times greater than water (Battarbee. et al., 1988). However heavy metals have little to do with density but concerns chemical properties.

Heavy metals include lead (Pb), mercury (Hg), silver (Ag), cadmium (Cd), zinc (Zn), arsenic (As), chromium (Cr), copper (Cu), iron (Fe) and the platinum group elements. However, the main concern in this review is concentrated on Hg, Pb, and Ag (Morais. et al., 2012).

Artisanal gold mines refer to mining activities that uses rudimentary methods to extract and process minerals on a small scale. Artisanal gold mines combine mercury with gold carrying silt to form a hardened amalgam that has picked up most of the gold metal from the silt (Farlex, 2005).

Environment is the immediate surroundings of an organism or groups of organisms especially the combination of physical conditions that affect and influence the growth and development and

survival of organisms (Farlex, 2005). It consists of flora fauna and a biotic and includes the aquatic, terrestrial, and atmospheric habitants. The environment is considered in terms of the most tangible aspects of air, waters and food and less tangible though no less important the communities we live in.

A pollutant is any substance in the environment which causes objectionable effects impairing the welfare of the environment, reducing the quality of life and eventually causes death when their concentration goes beyond the acceptable limit. Hence environmental pollution is the presence of a pollutant in the environment which cause harm to the living things in the polluted environment (Farlex, 2005).

Bioaccumulation is the net accumulation of a contaminant in or on an organism from all sources including air, water and diet (Chojnacka & Mikulewicz, 2014).

Tailings are the major wastes produced from gold extraction and they contain high amount of heavy metals, these metals leach out as uncontrolled manner into surrounding environment on exposure to water or through dispersal by wind.

Figure 1: Gold wastes (tailing) from artisanal gold mining site.

1.1.2 Occurrence of Heavy Metals

Heavy metals occur as natural constitutes of the earth's crust and are non-degradable substances thus, environmental contaminants. To a small extent they enter the body system through air, food and water and bio-accumulate over a period of time (United Environmental Protection/ Global Program Of Action, 2004). Heavy metals also exist as ores in different chemical forms which they are recovered as minerals. Heavy metal ores include sulphides of lead, gold-silver, cobalt, nickel, arsenic and oxides of Al, gold, selenium and antimony. Heavy metals are basically recovered from their ores by mineral processing operations. Ores tend to occur in families whereby metals that exist naturally as sulphide would mostly occur together, likewise the oxides.

1.1.3 Heavy Metal Emission

Heavy metals can be emitted into the environment by both natural and anthropogenic causes, the major causes of the emission are the anthropogenic sources specifically mining operations (Battarbee. et al., 1988). Increased urbanization and industrialization has led to large amount of environmental pollutants worldwide and among the various pollutants heavy metals are the more serious in our natural environment (Caeiro et al., 2015). Mining activities and other geochemical processes often results in the generation of Acid Mine Drainage (AMD), a phenomenon commonly associated with mining activities (Pawan, 2012).

Several gold mining sites are registered in Eastern Cameroon located at Betare ova, Batouri, kette, etc. including small, medium, and large scale mining. In some of these areas gold is still collected from the soil surface in rivers. The levels of heavy metals resulting from industrial activities such as mining and mineral processing have not been evaluated in all sites in Cameroon.

The ten largest gold mines in the world includes; south deep gold mine in south Africa; Grasberg gold mine in Indonesia; Olimpiada gold mine in Russia; Lihir gold mine in Papua New Guinea; Norte Abierto gold mine in Chile; Carlin Trend gold mine in USA; Boddingtons gold mine in western Australia; Mponeng gold mine in south Africa; Pueblo Viejo gold mine in Dominican Republic; Cortez gold mine in Nevada.

South Africa is the largest producer of gold in Africa, in 2016, South African gold production amounted to 142.08 metric tons. Ghana was the second largest gold mining country in Africa, with production amounting to 125 metric tons.

According to the gold mining status report on February 2021 released by the ministry of energy and mineral development, one million ounces of gold are estimated in the areas of Mashonga (Bushenyi) and 500,000 ounces of gold in Ibanda District and also gold mining is found in other Districts like Kigezi, Buhweju, Mubende, Busia, Bugiri, Karamoja and finally Namayingo District at Bukana gold mining site where this project was conducted from.

Namayingo District has for more than 15 years employed close to 120000 artisanal miners in the various gold mining sites at Banda, Buyinja, and Sigulu sub counties. Bukana gold mining site is found in Buhere fishing village, on the shores of Lake Victoria in Namayingo District, Uganda. Before the discovery of gold flasks in Buhere Village, the economic activity in Bukana gold deposit was fishing; this was said by Okumu David, a 40-year-old man who started fishing at the age of 22 years after dropping out of school. With income from fishing, Okumu bought a portion of land worth UGX 1.35 m where he would grow his food. Several years later, it turned out that his land was on a gold deposit, Okumu who says he has no idea about gold and how to go about gold mining, rents pits to artisanal miners who pay him according to the size of the pit and the number of basins of ore from a prospective pit mined. Oryema who owns six acres in Buhere said the population has exceedingly increased in Buhere village with gold prospect and they haven't got an official number of people engaged in mining activities at Buhere village. Edward Wandera the chairman of the village is apparently the biggest beneficiary in the area after bagging over UGX 100 m in artisanal miners. According to Wandera there are four artisanal groups in Buhere which are supported by Non-Government Organizations, NGOs empowering them to benefit from the sector. The Aljawudah mining company says the price of gold is UGX 80000 per gram of gold in Bukana (Gabriel, 2018).

Tailing are the major wastes produced from gold extraction and they contain high amount of heavy metals. These metals leach out in uncontrolled manner into the environment on exposure to water or through dispersal by wind causing environmental pollution as well having the long run effect to humans living around Bukana gold mining site in Namayingo District. Uganda.

1.2 Problem Statement

Contamination of water and air by toxic metal is an environmental concern and hundreds of millions of people are being affected around the world. Food contamination with heavy metals is another concern for human and animal health. Concentration of heavy metals in water, air and food is assessed with this regard (Ghorani-Azam. et al., 2016; Kianoush. et al., 2013; Morais. et al., 2012). Metals among the other environmental pollutants may also remain in the environment hence human exposure to metal is inventible and some studies have reported gender difference in toxicity of metals. They may frequently react with biological system by losing one or more electron and forming metal cation which have high affinity to the nucleophilic sites of macromolecules. Several acute and chronic effects of heavy metals affect different body organs, Gastrointestinal and kidney dysfunction, nervous system disorder, skin lesions, vascular damage, immune system dysfunction birth defect, cancer are examples of complications of heavy metals toxic effects. The problem of soil pollution by heavy metals has received increasing attention in the last few decades in both developing and developed countries throughout the world.

Although mining provides enormous social and economic benefits to nations, the long-term adverse effect on the environment and public cannot be overlooked.

The presence of elevated concentration of heavy metals in the environment is a serious issue worldwide due to their non-degradable nature which makes them persistent and there by exerts

long-term effect on the ecosystem. The study of heavy metals deposition and accumulation is a universal problem because of the negative consequences that heavy metals have on environment and on human health, soils are usually regarded as the ultimate sink for heavy metals discharged into the environment(Banat et al., 2015)

This paper was therefore aimed at determining the environmental pollution of heavy metals and their bio-toxic effect to people living near gold mining sites.

1.3 Objectives

1.3.1 General Objective

- To evaluate the effect of heavy metals to people living near gold mining sites

1.3.2 Specific Objectives

- To establish the source and emission of heavy metals and their pollution on the environment;
- To evaluate the bio-toxic effect of heavy metals to people.

1.4 Justification

This study review was intended to provide more awareness about heavy metal pollution and their effect on human beings living around gold mining sites because artisanal gold mining is actually the leading causes of global mercury pollution ahead of coal-fired power plants.

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