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Determination of Heavy Metal Levels in Soils Affected by Boko Haram and Military Activities in Konduga, Borno State, Nigeria

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Abstract: *This study investigated the levels of heavy metals (Pb, Cu, Zn, Cd, and Mn) in soil samples collected from areas affected by Boko Haram and military activities in Konduga, Borno State, Nigeria. 5 g of Soil samples were collected from different points with fifty (50) meters between each sampling point and was collected at 25 cm deep for the determination of level of some heavy metals like Pb, Cu, Zn, Cd and Mn using digestion and cleanup procedures and was determined using AAS machine. Among the heavy metals studied, lead and zinc were the predominant metals detected in both samples. The value of Pb was 3.1300±1.4445 mg/kg in sample KDEHMS to 2.1120±1.1866 mg/kg in sample KDSHMS and was found to be the highest in sample KDEHMS and Mn was recorded as least concentration in sample KDSHMS with a value of 0.0040±1.7688 mg/kg in sample KDEHMS. This is not unexpected because Pb is one of the major components of the bullets. The result reveals that, the order of heavy metal concentrations was Pb > Zn > Cu > Cd > Mn.*

Keywords: *Heavy Metals, Bullet, Soil, Carcinogenic, Boko Haram, pollution*

INTRODUCTION

Soil is a unique part of the ecosystem, however, pollution with heavy metals is the problem of increasing concern. Natural occurring heavy metals are often not available for biota, while metals from anthropogenic sources have high bioavailability. Soil organisms are directly exposed to soil and heavy metals. Therefore, heavy metals can lead to changes in soil microorganism for example their size, composition and activity. From the soil matters can be washed into lakes, rivers, bays and consequently can easily enter the food chain and pose a serious threat.

Over the last century global industrialization, war and natural processes have resulted in the release of large amounts of toxic compounds into the biosphere. These have led to the problem of environmental pollution and ecological concern. A pollutant is any material that is introduce into the environment as a result of man's activities and causes

injury to the health of the environment, including life forms present in it, appliance installed in it and reduces the aesthetic quality of the environment. Pollution thus is the occurrence in the environment of any substance or condition that is liable to cause harm or has deleterious effect on human health, plant and animal life or the aesthetic quality of land, water air and socio-economic components of the environment. (Nwaedozie *et a*l.,2013).

Zellmer, (2019) heavy metals are metallic element with a specific gravity of 5.0gcm^{-3} or more that is generally toxic in relatively low concentrations to plants and/or humans and animals. These heavy metals were inventoried because they are present in various components of small-arms ammunition. Bockins, (2019). The major components of small-arms ammunition are arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), tin (Sn), and zinc (Zn).

Mahmood, (2011) it is well known that excess of the heavy metals can disrupt body functions and have pathogenic effects on human respiratory organs, kidney, and skin and affect sexual and neurological development and functions.

Potential sources of heavy-metal contamination in the soils at small-arms ranges consist of the heavy metals contained in the bullet, bullet jacket, tracer materials, and primer (Anke *et a1,* 2018). The intensity of the shooting activity is a key factor determining the extent of pollution in the shooting range. Lead (Pb) is the main component of the bullet (> 90%), but various amounts of other heavy metals are also found in the bullet mass (antimony, arsenic, silver, cadmium, copper, zinc, nickel etc.) Bockins, (2019).

Dauda, (2008) Cadmium and nickel are known to be human toxic, carcinogenic and teratogenic Lead, copper and zinc are well known human multisystem tic toxic and phototoxic. Site investigations in USA and elsewhere have shown that, 2,4,6-trinitrotoluene (TNT) is the least mobile and the frequent occurring contaminating compound in the soil, water, vegetation's and sediments. High levels of TNT contamination and major concern since TNT and most of its biodegradation and photolytic by products are mutagenic and carcinogenic or otherwise toxic to aquatic and terrestrial life (Jenkins, 2012).

Zellmer, (2013) the bullet is usually made of a lead alloy consisting of copper, sometimes tin, and up to 15% antimony, which is added for hardness. Unjacketed or bare balls are used in several types of revolver cartridges. Jacketed bullets are used in high-velocity and automatic weapons. The metal jacket consists of either copper-plate or a thin layer of gilding metal having copper and zinc and cadmium as the major components. Bullets at high-velocity may shatter upon impact, exposing the lead, copper, zinc, and antimony of the bullet core and jacket. Tracer munitions are used to determine the direction of rapid fire (Nwaedozie et al.,2013). Tracer materials are made from compounds containing strontium, magnesium, barium, zinc, and potassium. The ignition cap or primer for small-arms ammunition generally contains compounds of lead, barium, antimony, and potassium. Potential sources of heavy-metal contamination in the soils at small-arms ranges consist of the heavy metals contained in the bullet, bullet jacket, tracer materials, and primer (Anke *et a1.,* 2018).

Copper can be found in many kinds of food, in drinking water and in air. When copper ends up in soil it strongly attaches to organic matter and minerals. As a result, it does not travel very far after release and it hardly ever enters groundwater. Copper does not break

down in the
environment and because of that it can accumulate in plants and in animals. Copper causes metal fever in man and in animal. Inhalation of dust and vapours of copper can irritate the nose, mouth and eyes and cause headaches, dizziness, and diarrhea (ATSDR, 1997). Copper is widely employed in munitions, corrosive- resistant and decorative plating (Nwadike et al.,2013).

The aim of this research was to investigate the level of heavy metals in soil samples of Boko haram military activities of Konduga local government, Borno state, that may be a threat to people in that environment.

MATERIALS AND METHODS

Sampling Location

The sampling sites of this work are the three soil samples located within Konduga Borno state namely; Konduga south heavy metal soil(KDSHMS), Konduga east soil (KDEHMS). The two soil samples were collected within the vicinity where they have been heavy battles between military and book haram using hand guns and bullet shells disposal sites. The soil samples were collected and harmonized at various locations of the sites.

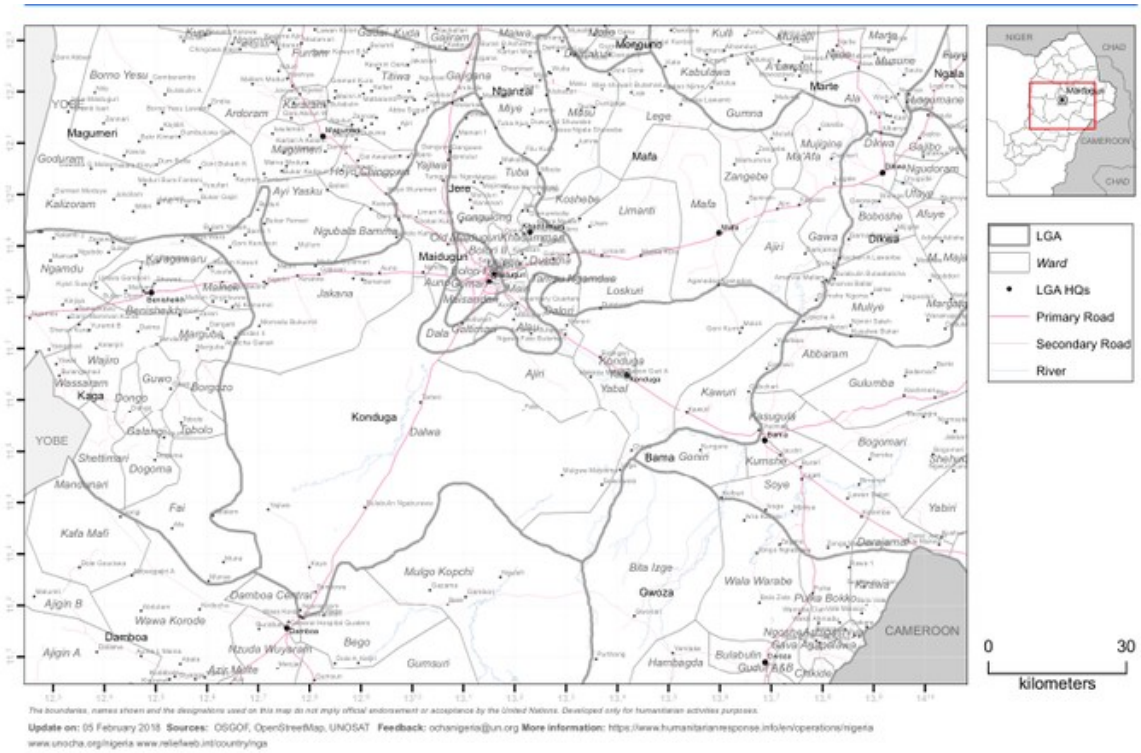

Fig. 1: Map of Konduga showing sample areas

Sample Collection

Zellmer, (2019) 5 g of soil samples was taken by means of a stainless- steel spoon at different locations and stored in polyethylene bags. The soil samples were collected from Konduga from different points with fifty (50) meters between each sampling point and was collected at 25 cm deep.

Extraction and Cleanup of Soil Samples for Heavy Metals

Dry soil samples were digested according to UNEPA, (2007). 1g of sieved sample $HClO_4$ and 2ml was placed into a beaker (100ml). This was extracted with a mixture of 4ml of 70% of HNO_3 acid and the content was left in the oven at 100^0c over night to obtain white ash which was dissolved in 1 mol per dm^3 HCl. The digest was filtered into 50ml standard flask. The beaker was then rinsed with small portions of double distilled water and filtered into the flask. The mixture was made to mark with double distilled water and used for heavy metal determinations.

Results and Discussion

Results of some Heavy Metals concentrations of Pb, Cu, Zn, Mn and Cd have been assessed in Soil Samples using atomic absorption spectrophotometer at various sampling points namely; Konduga east heavy metal soil (KDEHMS) and Konduga south heavy metal soil (KDSHMS) of Konduga local government area**.**

Fig 1 shows the mean concentration of some heavy metals detected in soil samples obtained from impact areas where heavy battles have occurred between military and Boko haram using hand guns that release bullet in Konduga local government area Borno state. Among the heavy metals studied, lead and zinc were the predominant metals detected in both samples. The value of Pb was 3.1300±1.4445 mg/kg in sample KDEHMS to 2.1120±1.1866 mg/kg in sample KDSHMS. The value of Zn ranges between 2.2540±1.2258 mg/kg in sample KDEHMS to 2.0130±1.1507 mg/kg in sample KDSHMS. While Cu ranges between 1.2110±1.0866 mg/kg in sample KDEHMS to 1.1310±0.8683 mg/kg in KDSHMS. Cd and Mn were having concentrations of 1.0130±0.8212 and 0.0040±1.7688 mg/kg respectively both in sample KDEHMS and both metals were not detected (ND) in sample KDSHMS. The value of Pb was found to be the highest in sample KDEHMS and Mn was recorded as least concentration in sample KDSHMS. This is not unexpected because KDEHMS was obtained from unexploded ordinances (UXO) disposal sites and because Pb is among the major components of the bullets. Bullets at high velocity may shatter upon impact exposing the Pb, Cu, Zn and antimony of the bullet core and jacket (Zellmer, 2013). Potential sources of heavy metals contamination in the soils at small arms ranges consist of the heavy metals contained in the bullet, jacket tracer materials and primers Nwaedozie *et al.,* 2013) . This study is comparable with the research carried out by Nwaedozie *et al*., 2013) that showed soil samples from Nigerian army depot Zaria, Jaji military training and air force base training ranges with high values of heavy metals like Pb, Cu, Cd and Zn. And was also supported by Zellmer (2019) heavy metals contamination from training ranges at Grafenwöhr training area, Germany.

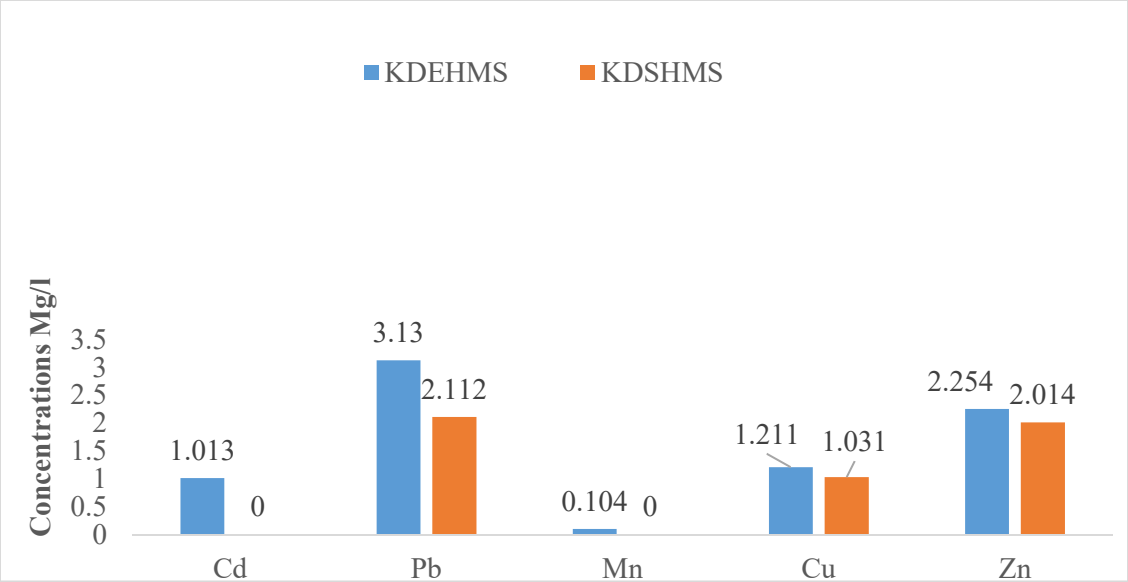

Fig .2: Mean Concentrations of some of Heavy Metals detected inn soil Samples of Konduga LGA

CONCLUSION

Base on the results of this study, it was observed that the concentrations of Pb was considered as the highest while Mn was recorded as the least value. The study revealed that, most of the values were within the permissible limit of WHO (2014). The results of this study implies that continuous monitoring has to be carried out to ascertain whether or not the presence of these heavy metals. The USEPA (2014) has classified heavy metals as potential human carcinogens. The order of heavy metal concentrations was Pb > Zn > Cu > Cd > Mn.

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