



Heavy Metals Accumulation in Soils from Mechanic Workshops Within Gusau Town

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ABSTRACT

Heavy metal pollution is a problem inherent in industrial areas. However, automobiles and activities associated with automobiles are now considered to be among the largest sources of heavy metals with the soil serving as a sink for these metals. It is against this backdrop that the study "Heavy metals accumulation in soils from mechanic workshops within Gusau town" is centred. The concentration of heavy metals; lead, cadmium, nickel, copper, chromium and zinc were determined using Atomic Absorption Spectrophotometer. The mean concentrations ranges from 0.039-0.046ppm for Ni, 0.360-0.397 ppm for Pb, 0.089-0.147 ppm for Cu, 0.018-0.061ppm for Cr and 2.855-3.509ppm for Zn. The result was analysed using descriptive statistics. The results showed the presence of heavy metals in most of the workshops. Their concentrations however, are within the WHO permissible limit.

Keywords: Mechanic workshop; Pollution; Heavy metals; Automobiles; Gusau

1.0 INTRODUCTION

Gusau, the capital city of Zamfara state Nigeria is situated at 12.16° North latitude, 6.66° East longitude and 450 meters elevation above the sea level and having about 226,857 inhabitants (www.maps-streetview.com).

Following the creation of the state twenty-two years ago, commercial activities have been on the increase due to influx of settlers. This gave rise to increase in the number of automobiles and consequently increased number of auto mechanic workshops established in the town.

Auto mechanic workshops are found all over Gusau metropolis with a range of artisans working within their vicinity. They include; auto electricians, battery chargers, auto body repairers, painters, automobile furniture repairers among others all of which produce different kinds of waste from their activities. These wastes are littered indiscriminately or half buried around their workshop thus tilting towards polluting the environment.

Environmental pollution is said to occur when there is an introduction of any material into the environment in more than its natural concentration and which has net detrimental effect on the environment or something of value in the environment (Okonkwo, 1999).

Activities of mechanics in mechanic workshops may most likely lead to the introduction of pollutants into the soil. Metals such as Copper, Lead, Cadmium, Zinc, Chromium, Aluminium, Nickel etc are capable of causing pollution (Ezeigbo, 2011). Zinc, Copper and Lead are three of the most common heavy metals associated with automobiles.

Motor oil tends to accumulate metals as it comes into contact with the adjoining parts of the engine as it runs. These oils are discharged into the soil in most auto workshops during servicing of vehicles thus creating a part way through which metals go into the surroundings (Shinggu *et al.*, 2010). Heavy metals are amongst the most widespread environmental pollutants and their

occurrence in the soil indicates the existence anthropogenic sources (Pravin *et al.*, 2012). Anthropogenic sources are associated mainly with built-up activities such as metal finishing, painting, mining activities, smelters and diffuse activities like combustion by products, traffic emission, constituent products pesticides etc (Omar and Al-khashman, 2004., Bourlarba *et al.*, 2006). Carbody parts, brake linings, hydraulic fluids, grease, automotive plastics,

fuels, spent car batteries, air condition components, galvanized pipes in cars are all sources of heavy metals as shown in Table 1. These are discarded carelessly into the soil in most mechanic workshops. The aim of this paper is therefore to provide information on the contribution of mechanic workshops to the heavy metal contamination load of Gusau metropolis.

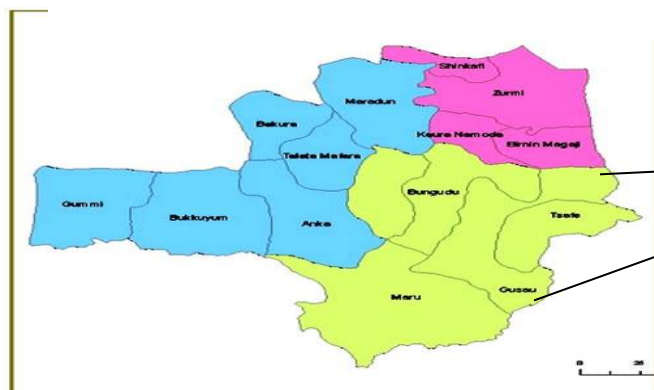


Fig 1(a): Map of Zamfara
Source: <http://www.nigerianmuse.com>



(b) Street map of Gusau showing the study area
Source: www.maps-streetview.com

1.2 ECOTOXICITY

Heavy metals not metabolized by the body, build up in soft tissues thus become toxic (Galadima *et al.*, 2012). Heavy metals have been found to reduce the size of the microbial populations, destruct their community structure and trim down their action when present in amply high concentration, (Kandel *et al.*, 2000, Chander *et al.*, 2001, Wang *et al.*, 2004). Pollution by heavy metal may hence result in stern environment interruption as most heavy metals have no known organic function and can cause serious health issues if they enter the human food chain. However, zinc and copper are trace elements vital to the performance of organic systems although at elevated concentrations they become toxic.

Cadmium is associated with a range of chronic health problems and as a result has become one among a small group of metals for which the Food and Agricultural Organisation and the World Health Organisation have set a limit for their daily intake by humans. (EC, 2001).

Lead poisoning is a universal environment and public health hazard predominantly in adolescent (Adriano, 2001), which has led to the proscription of lead as additives in petrol and paint in many countries.

According to Toxic Release Inventory, in 1997 the approximate releases of chromium was 30,862,235 pounds of soil from 3,391 large processing facilities accounted for about 94.1% of total environmental releases (ATSDR, 2000). Naturally occurring chromium is usually present in trivalent Cr (III). Hexavalent Cr (VI) in the environment is almost entirely generated from human activities (WHO, 1990). The environment can be exposed to chromium during wind erosion of soils which makes the particles airborne thus increasing the probability of chromium inhalation.

The purpose of the current study was to quantify heavy metals concentration in soils within some mechanic workshops in Gusau with a view to making known their impact on public health. The undertaken study will facilitate the adequate

monitoring of the environment by planners, auto-technicians, and general public.

2.0 MATERIALS AND METHODS

2.1 Description of the Study Area

The study focuses on four mechanic workshops randomly selected within Gusau metropolis. The workshops include; Gadabiyu mechanic village, Mechanic workshop next to former FUGUS operational office, Workshop behind Fatima Catholic Church, and Alakatangura old mechanic village Tudun wada.

2.2 Sampling and Sample Pre – Treatment

A total of eight samples were collected from the four mechanic workshops using stainless steel hand trowel. The soils were taken from two depths of 0 – 5cm and 5 – 10cm. The samples were stored in a clean polythene bag and transported to the laboratory. About 10g of each sample was weighed and labelled accordingly.

The samples were dried at room temperature for one week after which the lumps were kneaded using a clean glass bottle to loosen the soil particles. They were sieved using a 20mm sieve to give 2mm soil. Each sieved sample was stored in a polythene bag and labelled accordingly.

2.3 Analysis

1.0g of each of the sieved soil samples were weighed and transferred into a beaker and 12ml of freshly prepared aqua regia (3ml HNO₃ + 9ml HCl) was added. The beaker was covered and the contents heated with a medium heat on the hot plate. Heating continued until sample was reduced to 1/3 of its original volume. The mixture was allowed to cool and then filtered through a whatman no.42 filter paper into 50ml standard volumetric flask. This was made up to 50ml with distilled water and then used for elemental analysis.

The atomic absorption spectrophotometric measurement was taken using Varian spectra AA55B air acetylene flame. The instrument searches for a particular metal by focusing a beam of UV light at a specific wavelength through a flame and into a detector. The sample of interest is aspirated into the flame. If that metal is present in the sample, it will absorb some of the light, thus reducing its intensity, the instrument measures the change in intensity which is then converted into absorbance by the computer data system. Each of the samples was analyzed using the same method.

3.0 Results and Discussion

The Atomic Absorption Spectrophotometric Analysis of the samples showed the presence of various heavy metals such as Nickel, Lead, Chromium, Copper and Zinc. The mean concentrations and standard deviation of the heavy metals for the samples in parts per million at different depths are as shown in Table 2.

The concentration of Nickel ranges from 0.047 – 0.092ppm in site D at a depth of 0 -5cm while at a depth of 5 – 10cm the range is from 0.054 – 0.030ppm. The concentration of Ni more at a depth of 0-5cm except for site B were the concentration is 0.060ppm at 5 -10cm depth.

Cadmium was not detected at any depth within all the sites studied. This may be due to absence of auto battery repairers around the study area hence spent car batteries which are the major source of Cadmium are not discharged into the environment.

Concentration of Lead ranges between 0.010 – 1.160ppm with site D having the highest concentration at 0-5cm depth while at 5-10cm depth, the concentration ranges between 0.010-0.760ppm with site B having the highest concentration.

Table 1: Heavy metals and their sources in car components

Heavy metals	Sources
Ni	Lubricating oil, diesel fuel and gasoline.
Pb	Leaded gasoline, worn-out tire, lubricating oil, grease
Zn	Grease, motor oil, corroded galvanised car pipes, brake emissions
Cr	Air condition coolants, engine parts
Cd	Burning fuel, batteries
Pb	Automobile plastics
Al	Auto body corrosion
Fe	Auto body rust, engine parts

Cu

Engine parts

Source: <https://www.fairfaxcounty.gov>**Table 2: Mean concentration of heavy metals at two different depths**

Samples	Depths			0 -5cm			5 – 10cm					
	Ni	Cd	Pb	Cu	Cr	Zn	Ni	Cd	Pb	Cu	Cr	Zn
A	0.047	ND	0.010	0.071	0.032	1.161	0.054	0.000	0.010	0.007	ND	0.566
B	0.030	ND	0.020	0.060	ND	0.414	0.060	ND	0.760	0.065	0.061	0.813
C	0.014	ND	ND	0.000	ND	0.491	0.012	ND	0.000	ND	ND	0.397
D	0.092	ND	1.160	0.457	0.003	11.94	0.030	ND	0.670	0.195	ND	9.644
X	0.046	ND	0.397	0.147	0.018	3.509	0.039	0.000	0.360	0.089	0.061	2.855
S	0.033	-	0.661	0.181	0.024	5.636	0.022	0.000	0.412	0.078	0.000	4.529

Key:

A = Gadabiu mechanic village

B = Mechanic workshop next to FUGUS operational office

C = Mechanic workshop behind Fatima Cath. Church

D = Alakatangura mechanic workshop

ND = Not detected

X = mean

S = Standard deviation

Copper has a concentration ranging 0.000 – 0.071ppm with the highest concentration in site A and the depth of 0-5cm while at the depth of 5-10cm depth, the concentration ranges from 0.007-0.195ppm. The highest concentration was found at site D while at site C copper was not detected.

The concentration of Chromium ranges from 0.003-0.032 at 0-5cm depth. At site B and C, chromium was not detected while at the depth of 5-10cm Chromium was only detected at site B with a concentration of 0.061ppm.

Concentration of zinc ranges from 0.414 – 11.94 at 0-5cm depth while at 5-10cm depth, the concentration ranges from 0.397 – 9.644ppm.

The concentration of the metals in all the sites studied are within the permissible limit set by World Health Organization (WHO). This implies that there is no pollution resulting from heavy metals in the immediate environment of the workshops.

4.0 CONCLUSION AND RECOMMENDATIONS

Although the concentration of heavy metals in the workshops are within WHO permissible limits, it is pertinent to regulate the establishment of mechanic workshops in the state to make the environment safe for man.

This can be achieved by establishing within the city a single mechanic village that will accommodate every mechanic as against the current trend of allowing them establish anywhere of their choice. Mechanics should be encouraged to observe good workshop practices in the area of waste and sludge disposal in other to safeguard their environment. Periodic assessment should be carried out to determine the concentration of these metals with a view to ensuring that these metals are not accumulating in the environment.

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