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Presence of heavy metal in soil near the industrial sites in Firozabad

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Abstract
It is possible that soil near industrial sites in Firozabad may contain heavy metals, as industrial activities often involve the use and release of such materials. Heavy metals such as lead, cadmium, mercury, arsenic, and chromium can be toxic to humans and the environment in high concentrations. Studies have shown that industrial activities in Firozabad, particularly in the glass and bangle-making industries, have resulted in the release of heavy metals into the environment. The use of lead-based dyes and pigments in the production of bangles has also contributed to the presence of lead in the soil.
It is important to conduct regular monitoring of soil near industrial sites in Firozabad to assess the level of heavy metal contamination and its potential impact on human health and the environment. Proper disposal of hazardous waste and implementation of pollution control measures can also help to minimize the release of heavy metals into the environment. This study provides a clear evidence that there is an urgent need for reducing the harmful impacts on environment as well as on human health due to the industrial discharge activities. There is decrease in the pH and organic matter of soil, while increase the solubility of heavy metal concentration, which may have toxic impacts on environment. On the basis of the above study, all the sites have very high amount of Pb, Cd, Cr and Cu. This concludes that the studied sites are not suitable for the people to reside and for the cultivation of plants and crops.

Keywords: Soil moisture, nutrients, industry, profile. heavy metal, contamination

Introduction
Heavy metal pollution is a serious issue in Firozabad, particularly in areas near industrial sites. The glass and bangle-making industries in the city are known to release heavy metals such as lead, cadmium, and arsenic into the environment, which can have harmful effects on human health and the ecosystem.
Studies have shown that the levels of heavy metal contamination in soil, water, and air in Firozabad are well above the permissible limits set by regulatory bodies. The use of lead-based dyes and pigments in the production of bangles has contributed significantly to lead pollution in the city. Exposure to heavy metals can have acute and chronic health effects, including neurological disorders, respiratory problems, and cancer. Children and pregnant women are particularly vulnerable to the harmful effects of heavy metal exposure.
To address the issue of heavy metal pollution in Firozabad, it is important to implement pollution control measures in industries and promote the use of alternative, non-toxic materials. Regular monitoring of the levels of heavy metal contamination in soil, water, and air is also necessary to assess the impact on human health and the environment. Additionally, public awareness campaigns can help to educate people on the risks of heavy metal exposure and ways to reduce their exposure.
Soils may become contaminated by the accumulation of heavy metals and metalloids through emissions from the rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application of fertilizers, animal manures, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric deposition.
It has the distinction of being the biggest exporter of brassware in the country. Many households, which were engaged in brass works earlier, were left with no choice but to search other means for their livelihood. Industrial waste was one of the choices because of their metal processing knowledge. Heavy metals constitute an ill-defined group of inorganic chemical hazards, and those most commonly found at contaminated sites are lead (Pb), chromium (Cr), arsenic (As), zinc (Zn), cadmium (Cd), copper (Cu), mercury (Hg), and nickel (Ni) [3].

Soils are the major sink for heavy metals released into the environment by aforementioned anthropogenic activities and unlike organic contaminants which are oxidized to carbon (IV) oxide by microbial action, most metals do not undergo microbial or chemical degradation [4], and their total concentration in soils persists for a long time after their introduction [5]. Changes in their chemical forms (Speciation) and bioavailability are, however, possible. The presence of toxic metals in soil can severely inhibit the biodegradation of organic contaminants [6]. Heavy metal contamination of soil may pose risks and hazards to humans and the ecosystem through: direct ingestion or contact with contaminated soil, the food chain (soil-plant-human or soil-plant-animal-human), drinking of contaminated ground water, reduction in food quality (safety and marketability) via phyto toxicity, reduction in land usability for agricultural production causing food insecurity, and land tenure problems [7].

Material method

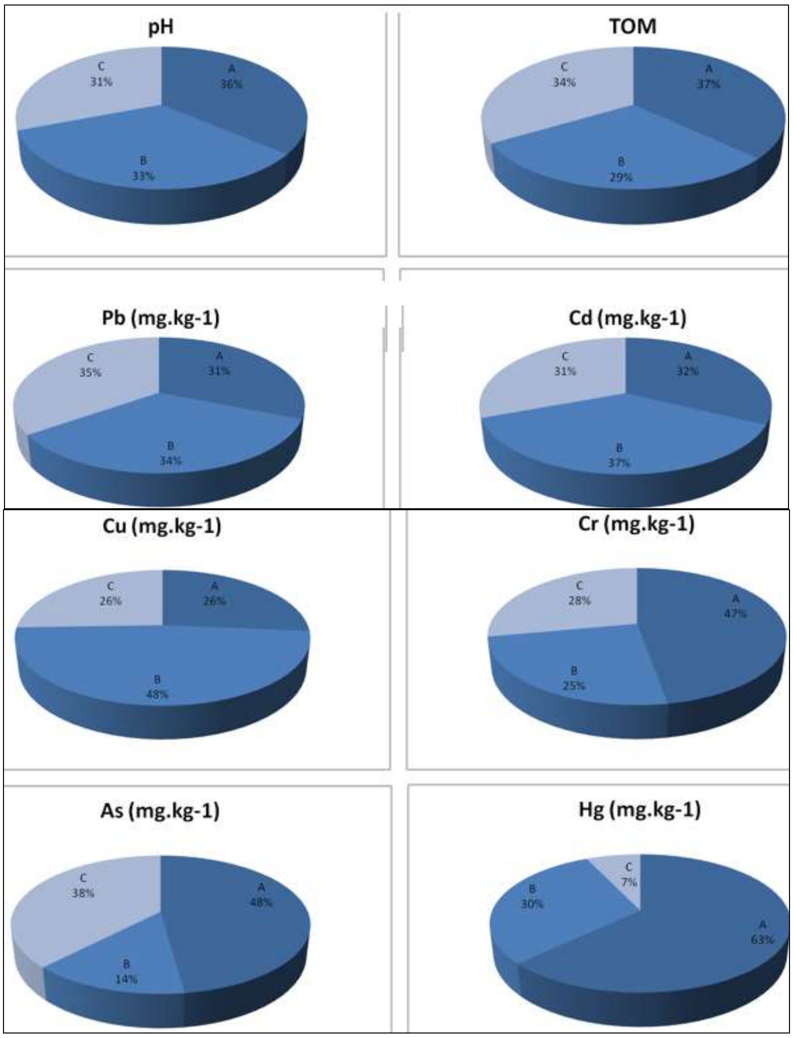
All soil samples were air dried at room temperature and sieved through a 200 µm mesh nylon sieve to remove debris. For each sample, 0.5g of dry soil was weighted and digested with mixed acids. Soil samples were digested with 15 mL of concentrated HNO_3, H_2SO_4 and $HClO_4$ (5:1:1) at 80 °C until the transparent solution was obtained. The digested solution was cooled, filtered using Whatman No. 42 filter paper and then diluted with deionised water before determination of Cu, Cr, Cd, Ni, Pb and Zn. The filtrate was kept at room temperature for further analysis of heavy metals.

Analyses of pH, Total Organic Matter and heavy metal concentrations: The soil samples were air-dried, ground and passed through a 2mm sieve. The water samples were filtered through a 0.45 µm micropore membrane and then acidified to 2% (v/v) with concentrated nitric acid, after pH measurement using a pH meter. The soil sample was mixed with distilled water (1:2.5, w/v) for 30 min and the pH of the mixture was measured using a pH meter. Total organic matter in soil was determined by mass loss upon ignition of oven-dried soil in a muffle furnace at 550°C for at least 6 h. To extract the heavy metals in soil, 0.3 g soil sample was digested by a mixture of concentrated hydrochloric acid and nitric acid (3:1, v/v) using automatic digestion block.

Observation

Table 1: Observation

Sample area	pH	ToM	Pb (mg.kg-1)	Cd (mg.kg-1)	Cu (mg.kg-1)	Cr (mg.kg-1)	As (mg.kg-1)	Hg (mg.kg-1)
A	5.65	9.52	693.56	82.65	163.85	915.32	82.35	1.62
B	5.23	7.58	758.58	94.65	298.52	478.52	24.53	0.78
C	4.82	8.63	774.12	78.53	158.52	542.63	65.11	0.18



Contamination factor of soil caused by different heavy metals is presented in the Fig. 1. Lead Pb) at all (Study sites are classified in Class 4 (represents high contamination) while Pb at SIII is classified in class I category (represents very low contamination). The contamination factor (CF) for Cd and as at all the study sites are classified in Class 4 represents a very high contamination, except at SIII which is further classified in Class 2 representing a moderate contamination (Fig. 1). The contamination factor for Hg at SI is classified in Class 4 represents a very high contamination, while SII is placed in Class 3 category representing a considerable contamination (Fig. 1).

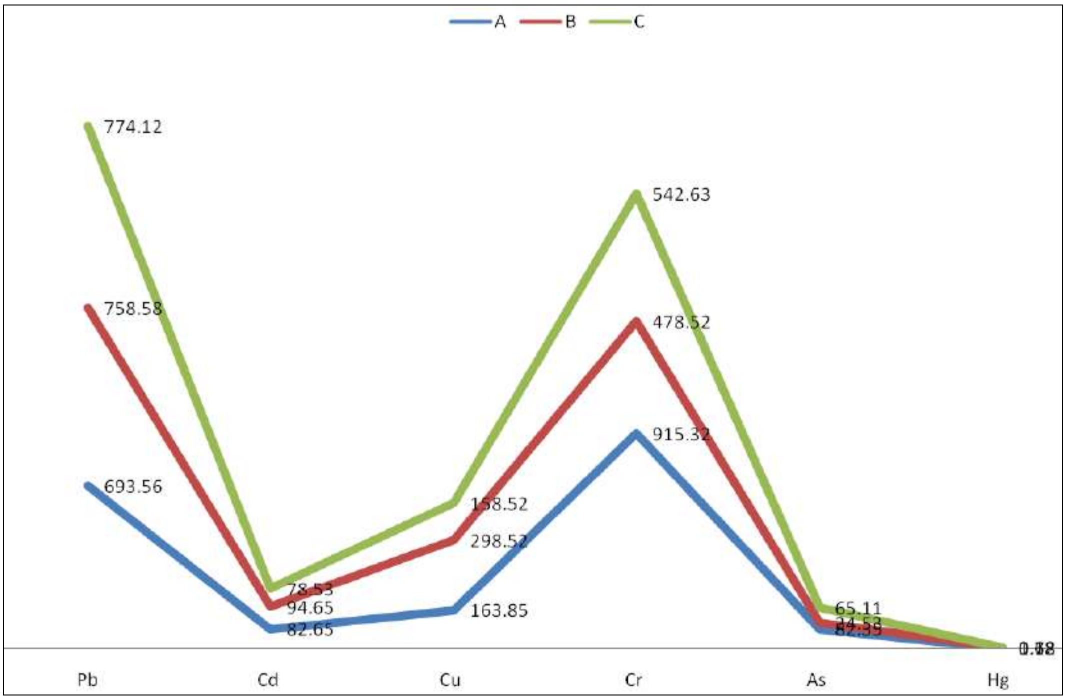


Fig 1: Heavy metal contamination in soil according to sites

Cadmium Cd at C study sites are classified in Class 4 (represents high contamination) while Cd at A is classified in class I category (represents very low contamination). Copper Cu at C study sites are classified in Class 4 (represents high contamination) while Cu at A is classified in class I category (represents very low contamination). Same as Cromium at C study sites are classified in Class 4 (represents high contamination) while Cr at A is classified in class I category (represents very low contamination) [7-12].

Conclusion

The concentrations of heavy metals, however, suggest that the heavy metals are likely transported from the surface soil to the river by rainfall, especially in the wet season (Rahman *et al*. 2012) [11]. Comparisons with previous studies and implications to minimize the illegal e-waste recycling activity, the local government in Firozabad has constructed more legal e-waste disposal centres and strengthened enforcement in recent years. Therefore, we recommend that immediate actions (e.g., soil washing, soil removal and phytoremediation) should be taken to remediate the severely contaminated areas

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