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Presence of heavy metal in soil near the industrial sites in Peetal nagari Moradabad

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Abstract
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
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. Moradabad, a city in western Uttar Pradesh is situated at the banks of River Ramganga. This city is traditionally famous for bangles and brass works and is also known as "Peetal nagri" or the Brass City. 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 phytotoxicity, reduction in land usability for agricultural production causing food insecurity, and land tenure problems [7].
Moradabad have found that the level of heavy metal contamination in areas in and around the city is extremely high. Soil samples were collected from the three main locations, which are situated on the banks of River Ramganga, the water of which is used for washing by residents and for drinking in downstream.

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 HNO3, H2 SO4 and HCLO4 (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.

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

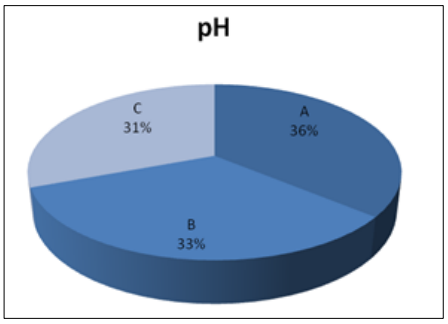

Fig 1: pH

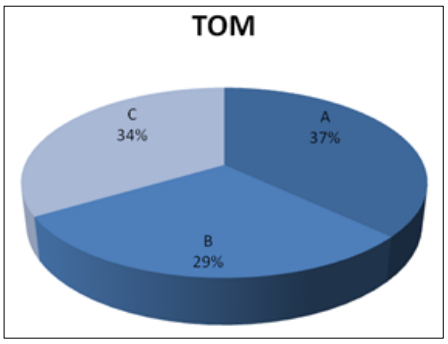

Fig 2: TOM

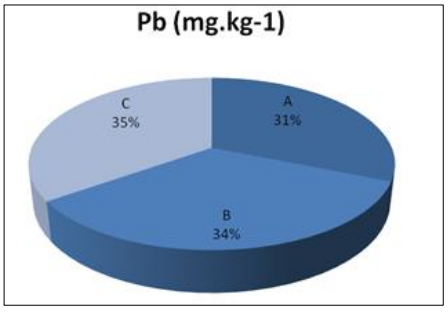

Fig 3: Pb (mg.kg-1)

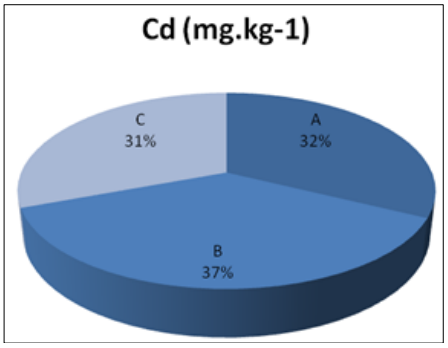

Fig 4: Cd (mg.kg-1)

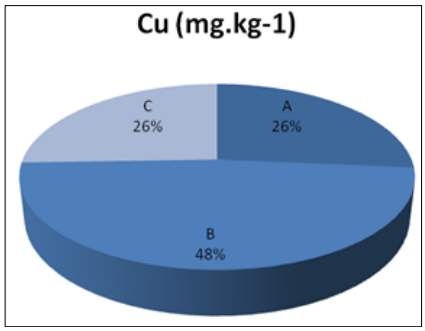

Fig 5: Cu (mg.kg-1)

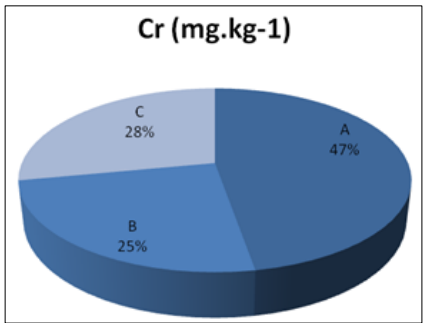

Fig 6: Cr (mg.kg-1)

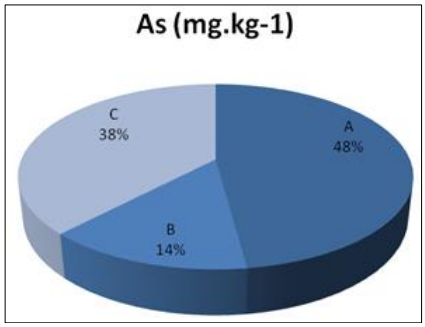

Fig 7: As (mg.kg-1)

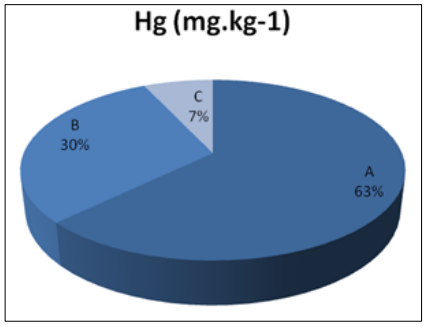

Fig 8: Hg (mg.kg-1)

Contamination factor of soil caused by different heavy metals is presented in the Fig. 9. 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. 9). 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. 9).

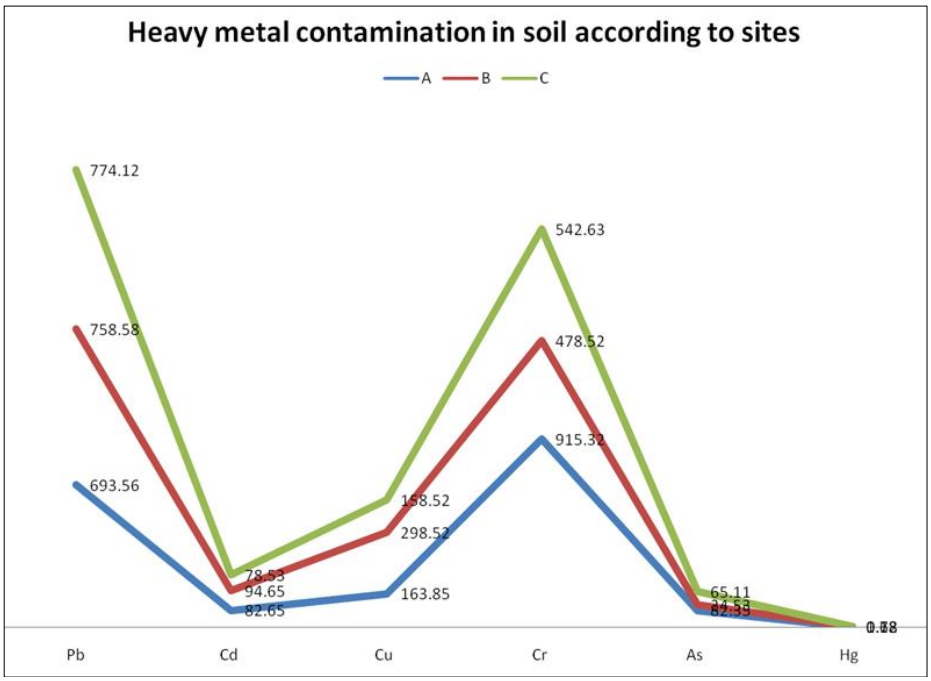

Fig 9: Heavy metal contamination in soil according to sites

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 Ramganga by rainfall, especially in the wet season (Rahman *et al*. 2012). Comparisons with previous studies and implications to minimize the illegal e-waste recycling activity, the local government in Moradabad 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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