The Silent Intruder: A Deep Dive into Lohsar Dumpsite's Soil Heavy Metals Crisis

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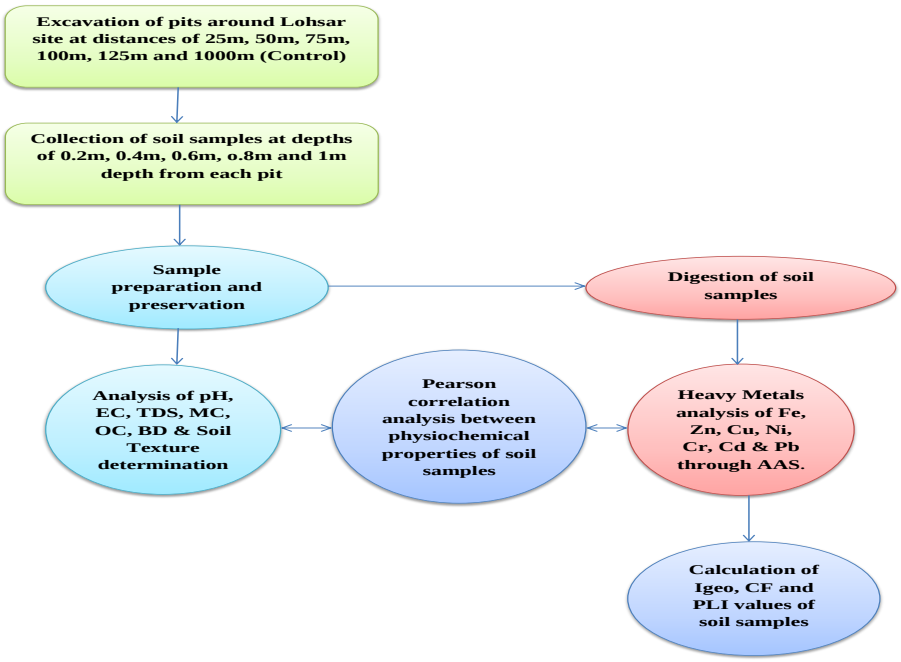
Introduction:

Municipal solid waste landfills pose an array of potential environmental issues, such as the release of greenhouse gases, the formation of leachate, and unpleasant odors. As rainwater penetrates across open dump sites, it generates leachate, a highly contaminated substance that may contain significant levels of heavy metals, organic pollutants, and other hazardous materials (Priyanka et al., 2018). Leachate can become an important component of soil degradation when it is not adequately treated before its discharge into the environment (Norouzi et al., 2022). The present research focused to access the level of heavy metals in leachate and investigate its impending to pollute soil proximity to the Lohsar dumpsite, Rawalpindi. When the agricultural soils are contaminated with the heavy metals, they are taken up by the plants and accumulate in their tissues (Beinabaj et al., 2023; Perkovic et al., 2022). These metals also accumulate in the tissues of animals that graze on these contaminated plants and enter the food chain.

Methodology:

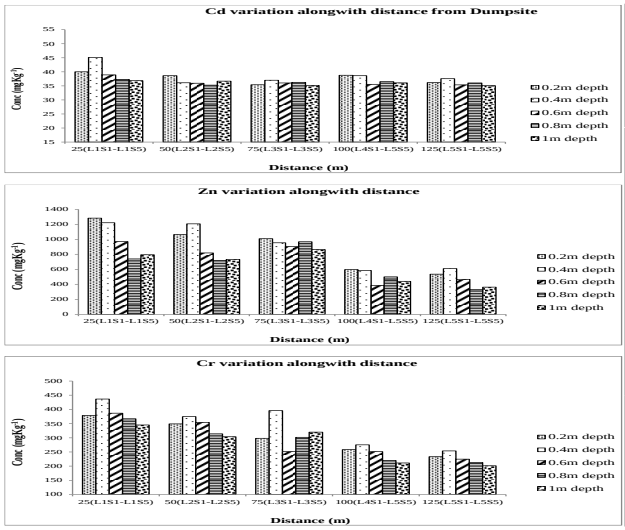
The methodology for soil contamination study is described below in the flow diagram.

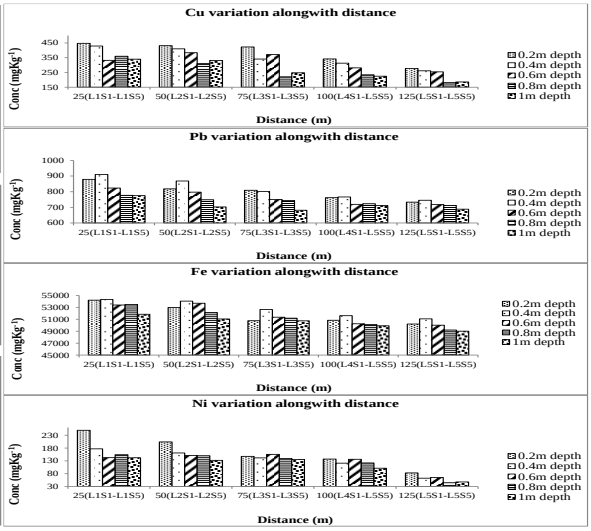


Results and Discussion:

The exploration of leachate from Lohsar dumpsites revealed higher levels of both inorganic and organic elements exceeding appreciable values. Except for Ni (nickel), Cr (chromium) and Zn (zinc), other heavy metals surpassed the acceptable values as recommended by Pakistan NEQS (National Environmental Quality Standard) for industrial and municipal sewage discharge. Soil investigation showed silty clay to silty clay loam composition, with EC (electrical conductivity), pH and organic matters declining with distance from the dump, whereas bulk density increase. Heavy metals Concentrations of Cd (cadmium): 0.22-45.12 mg kg^{-1}, Zn: 171-1283.2 mg kg^{-1}, Cr: 61-436.6 mg kg^{-1}, Ni: 31-248.9 mg kg^{-1}, Cu (copper): 93.8-447.4 mg kg^{-1}, Pb (lead): 69.39-909 mg kg^{-1} and Fe (iron): 18330-54320 mg kg^{-1}, surpassed WHO (World Health Organization) prescribed threshold for cultivated soils, with upper levels near the dumpsite.

Geoaccumulation index (Igeo) suggested moderate contamination, while contamination factor designated high levels for cadmium and lead. Based on Igeo values, soil samples generally range from uncontaminated to moderate contamination with Zn and Ni. Cd and Pb contamination levels are consistently moderate to heavy across all profiles. Fe levels in soil indicate no contamination. Heavy metal contamination ranks as Cd > Pb > Ni > Cu > Cr > Zn > Fe according to CF values. Pollution load index demonstrated overwhelming pollution, asserting human-caused pollution and a marked influence from leachate. Pearson correlation analysis reinforced leachate-associated pollution.





(a) (b)

Figure 1: (a) Variation of Cd, Zn and Cr along with distance from dump; (b) Variation of Cu, Pb, Fe, Ni along with distance from dump

Conclusion:

Open dumpsites have been conclusively identified as sources of extensive soil contamination. The analysis revealed that leachate contains very high levels of organic and inorganic contents beyond the desired limits. Except for Zn, Cr & Ni, other heavy metals Fe, Cd, Pb & Cu concentrations were found beyond Pakistan NEQ standard to discharge municipal and industrial effluents. The migration of the leachate from the dumpsite through the soil layers has a prominent impact on physiochemical properties of the soil. The soils of the Lohsar dumpsite were investigated extensively in terms of physiochemical properties and the lateral and vertical transportation of the selected heavy metals namely Fe, Pb, Cu, Ni, Cr, Zn & Cd. The study recorded alarming levels of pollutants in soil samples, surpassing established safety thresholds. This contamination raises concerns about the safety of the local soil quality. Mitigating measures are recommended, including proper waste disposal, leachate treatment, and adherence to pollution control standards. The study suggests utilization of local agricultural byproducts for leachate treatment and implements efficient landfill practices, emphasizing strict adherence to waste management policies, including segregation and continuous monitoring.

References:

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