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Assessment of Potentially Toxic Element Contamination in Soil: A Case Study of Industrial and Residential Areas in Raichur District, Karnataka, India

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The determination of potentially toxic elements (PTEs) in soil is crucial for assessing risks to biota and human health, particularly in agricultural lands. Raichur district, situated in the north-eastern part of Karnataka, India, holds significance due to its historical agricultural roots and recent industrialization trends. Soil samples were collected from industrial and residential areas of the study area and were analysed using High-Resolution Inductively Coupled Plasma-mass Spectrometry (HR-ICP-MS) to determine the concentrations of arsenic (As), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), and zinc (Zn). The study area exhibits diverse soil types, including blended-red and dark soils, medium-dark soils, profound dark soils, and red sandy soils, with depths ranging from moderately deep to very deep. Multivariate statistical analysis like Index of Geo-accumulation (Igeo), Enrichment Factor (EF), Contamination Factor (CF), and Degree of Contamination (Cd) values were determined to assess the contamination levels.

The Igeo values ranged from 0.46 to 0.83 for As, 0.33 to 0.61 for Cr, 0.07 to 0.44 for Cu, -0.96 to 0.31 for Ni, -0.03 to 0.53 for Pb, and 0.21 to 0.43 for Zn, indicating a spectrum of contamination levels from pristine to highly contaminated. The enrichment factor values ranged from 3.18 to 48.71 for As, 1.98 to 24.52 for Cr, 0.97 to 18.41 for Cu, 1.05 to 23.84 for Ni, and 0.95 to 25.13 for Zn, suggesting varying degrees of enrichment. Furthermore, the contamination factor values ranged from 1.93 to 4.53 for As, 1.42 to 2.76 for Cr, 0.79 to 1.84 for Cu, 0.07 to 1.37 for Ni, 0.61 to 2.29 for Pb, and 1.09 to 1.80 for Zn. The degree of contamination ranged from 6.34 to 13.57, with an average of 8.83, highlighting the extent of soil contamination in the study area. In conclusion, our study provides valuable insights into the distribution and levels of PTEs in soil from industrial and residential areas in Raichur district, Karnataka, underscoring the importance of monitoring and remediation efforts to safeguard environmental and human health.