Mapping of Potentially Toxic Elements contamination in river sediments using combined geospatial, geochemical, and chemometric tools: A case study of the Ganga River, India

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Among the array of anthropogenic stressors that threatens freshwater biodiversity, Potentially Toxic Elements (PTEs), have addressed enormous attention owing to their toxicity, persistence, diverse sources, and bio-accumulative attributes.
Sediments act as both sinks and secondary sources of PTEs, necessitating quantification of occurrence, spatial variability, source apportionment, and ecological risk for regional management and conservation.

In this study, forty-three sediment samples were collected (March 2021), within the effluent-impacted Middle Ganga River (MGR) and geochemical indices, chemometric and geospatial tools were used to uncover PTEs contamination, possible sources, and high risk stretches.

Geovisualization and chemometric analyses revealed drain discharges as primary sources of PTEs contamination in MGR, with anthropogenic origins for Cadmium and Chromium, and mixed (geogenic and anthropogenic) sources for Lead, Copper, Arsenic, and Nickel. Spatial interpolation of potential ecological risk, using the inverse distance weighting method, highlighted severe to considerable risks in over 85% of the MGR.

The study reveals that utilizing geospatial, geochemical, and chemometric tools to generate risk maps may play a vital role in identifying pollution sources along the Ganga River, thereby enabling targeted regional pollution control efforts and safeguarding the ecological integrity of this conservation priority area.

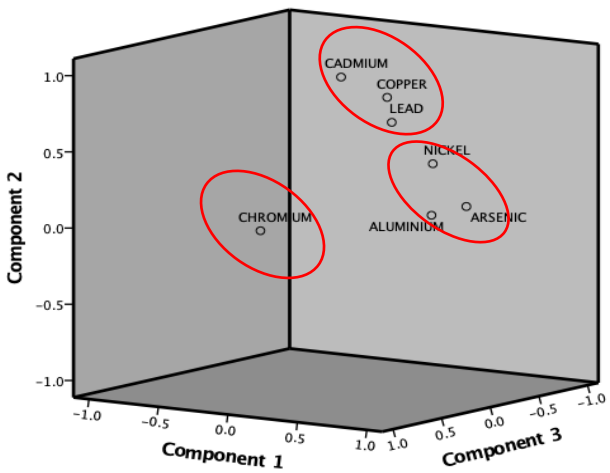

Figure 1: Plot of loading of three Principal Component Analysis results

Figure 2: Ptes hot-spots in MGR