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Land use patterns influence the distribution of potentially toxic elements in soils of the Usangu Basin, Tanzania

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Abstract

Spatial distribution of Potentially Toxic Elements (PTEs) in agricultural soils in Usangu Basin (Mbeya Region)-Tanzania were conducted. The study included three land-use types (paddy farming, maize farming, and conserved community forest areas). About 198 soil samples were collected from November to December 2019 across contrasting land management schemes (Group I dominated by agricultural areas versus Group II dominated by residential and agricultural areas). Total (aqua regia extracts) and bioavailable (Mehlich 3 extracts) PTEs concentrations were analyzed. For Group I and II areas, total and bioavailable concentrations (mg/kg dry weight, mean values) of some PTEs were: chromium 1662 ± 5.2 $\mu\text{g/kg}$ for Group I and 1307 ± 3.9 $\mu\text{g/kg}$ for Group II (Total), 55.1 ± 37.1 $\mu\text{g/kg}$ for Group I and 19.2 ± 21.6 $\mu\text{g/kg}$ for Group II (bioavailable); and lead 5272 ± 1650 $\mu\text{g/kg}$ for Group I and 6656 ± 1994 $\mu\text{g/kg}$ for Group II (Total), 1870 ± 800 $\mu\text{g/kg}$ for Group I and 1730 ± 530 $\mu\text{g/kg}$ for Group II (bioavailable). Soil total PTEs such as cadmium and lead were generally lower in Group I areas than in Group II areas. The reverse scenario was observed for copper. Farming areas had high PTEs concentration than non-farming areas because of anthropogenic activities. Overall, soil total concentrations of Fe (99.5%), As (87%), Se (66%), and Hg (12%) were above Tanzanian Maximum Allowable Limits. This study provides essential baseline information to support environmental risk assessment of PTEs in Tanzanian agro-ecosystem.

Keywords

Agriculture; Toxic elements; Risk management; Hazard assessment; Paddy farming; Irrigation