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Quantitative assessment of metal contamination and associated pollution risk in sediments from the Mara River in Tanzania

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Abstract

For most rivers in sub-Saharan Africa, information about pollution indices related to sediments is sparse. Sedimentological research of rivers that empty into Lake Victoria is highly patchy and wide apart. The present study determined the levels and associated risk of As, Cd, Cr, Hg, and Pb in sediments collected from four different sites along the Mara River that empties into Lake Victoria in Tanzania. Samples were collected in the dry and rainy months in 2019. Pollution indices, namely geo-accumulation index (I_{geo}), enrichment factor (EF), contamination factor (CF), modified contamination degree (mCd), pollution load index (PLI), potential ecological risk factor (E_{ri}), and potential ecological risk index (RI) were used to evaluate the influence of heavy metal contamination in sediments. Dry month mean concentrations, in milligram per kilogram, of heavy metals were as follows: As (11.04 ± 0.13), Cr (1.02 ± 0.29), Cd (0.43 ± 0.05), and Hg (0.01) in the dry month. Respective sediment heavy metal concentrations for the rainy month were 22.22 ± 0.05 mg As/kg, 3.84 ± 0.34 mg Pb/kg, 1.53 ± 0.15 mg Cd/kg, 1.43 mg Cr/kg, and 0.03 mg Hg/kg. Generally, the risk indices showed high values in the rainy month and low values in the dry month, especially for As and Cd—an indication of anthropogenic influence. Correlation coefficient analysis for Pb and Cd showed a strong positive correlation ($r = 0.99$, $p < 0.01$)—this may suggest a similar source or similar transport behavior. Special attention needs to be paid with regard to rainy season As and Cd enrichment in the study area..

Keywords

Sediment pollution; Environmental risk assessment; Geochemical accumulation; Seasonal pollutant variations; Tanzanian Mara River; Lake Victoria