

## Heavy metals bioavailability and pollution indices evaluation in the mangrove surface sediment of Sungai Puloh, Malaysia

### ABSTRACT

Heavy metals bioavailability, organic matter and grain size were investigated in the surface sediment of Sungai Puloh mangrove area using modified sequential extraction technique, loss on ignition and pipette method, respectively. There was elevated level of heavy metals concentration for Cd, Cu, Pb, Zn and Ni as high as 1.46, 202.34, 225.47, 650.83 and 226.90  $\mu\text{g/g}$ , respectively. High organic matter content was also recorded in the range 38.45–46.90%. Particle size analysis revealed that the sediment is sufficiently of clay texture (over 50%). Geoaccumulation index ( $I_{\text{geo}}$ ), contamination factor (CF), pollution loads index (PLI) and risk assessment code were determined. RAC was as high as 50%. Very strong pollution ( $I_{\text{geo}} < 3$ ) and high CF ( $\text{CF} > 6$ ) were observed. All sites therefore may be considered polluted ( $\text{PLI} > 1$ ). Discriminant analysis, nonparametric Kruskal–Wallis test as well as principal component analysis (PCA) were conducted. Significant difference for concentration of heavy metals in sediment was obtained ( $P < 0.05$ ) for Kruskal–Wallis tests. PCA resulted in the extraction of three components (F1, F2 and F3) accounts for 80.04% of the total variation. Anthropogenic as well as natural activities are the sources of pollution in Sungai Puloh.

**Keyword:** Heavy metals; Bioavailability; Risk assessment code; Geoaccumulation index; Contamination factor; Multivariate analysis