ECOLOGICAL RISK ASSESSMENT OF TRACE METAL IN THE SEDIMENTS OF HOOGHLY-MATLA ESTUARINE SYSTEM

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Introduction : Rapid and unplanned industrial development alongside urbanization has lead to serious environmental degradation due to the accumulation of trace metal in the coastal – estuarine habitats. Estuarine sediments are the repository of trace metals generated from different sources like agricultural/surface run-off, industrial effluent and atmospheric deposition (Pan et al., 2014). Accumulation of trace metals in sediments depends upon several factors like Fe and/or Mn oxy-hydroxides, organic content, grain size, redox potential (Banerjee et al., 2012). Gradual accumulation of trace metals in the estuarine habitats as a result of anthropogenic interference poses a threat for estuarine habitats (Lichtfouse et al., 2005). This study represents the degree of trace metal contamination by using sediment quality indices and their related ecological risks in the sediments of six locations of Hooghly-Matla estuarine system namely Kumirmari (S1 & S2), Samshernagar (S3), Petuaghat (S4), Tapoban (S5) and Chemaguri (S6).

Methods : The trace metal and particle size analysis was carried out using Atomic Absorption Spectrophotometer and Particle Size Analyzer respectively.

Results : Texture analysis reveals the deposition of sediment fractions in the following order: silt (56.7 - 65.7)%> clay (18.8 - 26.3)%> sand (10.7 - 24.5)% in Hooghly estuary and silt (66.9 - 68.1)%> clay (29.7 - 31.4)%> sand (1.7 - 2.2)% in Matla estuarine system ; which may occur due to the high energy hydrodynamic conditions. It was found that the element such as Cu, Zn, Co, Cr and Fe shows a wide range of variation in their distribution. The results obtained for different trace metals in the sediments ranges between Cu (150.1 - 195.1) mg/kg, Fe (1.84 - 2.06) %, Zn (36.4 - 153.4) mg/kg, Co (60.7 - 95.7) mg/kg and Cr (97.1 - 166.7) mg/kg in Hooghly estuary and Cu (79.0 - 128.7) mg/Kg, Fe (1.70 - 1.79)%, Zn (138.6 - 171.4) mg/kg, Co (89.5 -148.6) mg/kg and Cr (20.2 - 52.4) mg/kg in matla estuarine system respectively. This variation in trace metal accumulation is may be due to different types of source of rock and different type and magnitude of industrial effluent and domestic sewage. Different sediment quality indices such as Enrichment Factor (EF), Geo-accumulation index (I_{geo}), Pollution Load Index (PLI) were used to assess the sediment contamination. The EF values of trace elements varies between Cu (13.2 - 17.3), Zn (1.1 - 4.7), Co (7.4 - 12.3), Cr (2.5 - 4.3) and Cu (7.6 - 11.7), Zn (4.4 - 5.8), Co (12.0 - 21.0), Cr (0.56 - 1.4 (Figure 1a) whereas I_{geo} values ranges between Cu (2.0 - 2.38), Zn (-1.55 - 0.53), Co (1.25 - 1.91), Cr (-0.39 - 0.39) and Cu (1.08 - 1.78), Zn (0.38 - 0.69), Co (1.81 - 2.54) in Hooghly and Matla estuary (Figure 1b) respectively. The PLI value varied between 1.55 – 2.21 and 1.43 – 1.70 and overall trend follows the following order S3 <S1 <S2 and S4<S6<S5 in Hooghly and Matla estuarine region (Figure 2) respectively. The ecological risk of trace metals (Cu, Zn and Cr) were assessed using effect range-low (ERL)/ effect range median (ERM) values and threshold effect level (TEL)/ probable effect level (PEL) values. It was observed that the mean values of Cu is between ERL – ERM and >PEL (except S3) in all the locations whereas mean value of Zn is between ERL – ERM (S1, S3 and S5), < ERL (S2, S4 and S6), between TEL – PEL (S1, S2, S3 and S5) and <TEL (S4 andS6). The mean value of Cr is <ERL (S1, S2 and S3), between ERL – ERM (S4, S5 and S6), <PEL (S1 and S3), between TEL – PEL (S2, S4 and S6) and >PEL (S5).

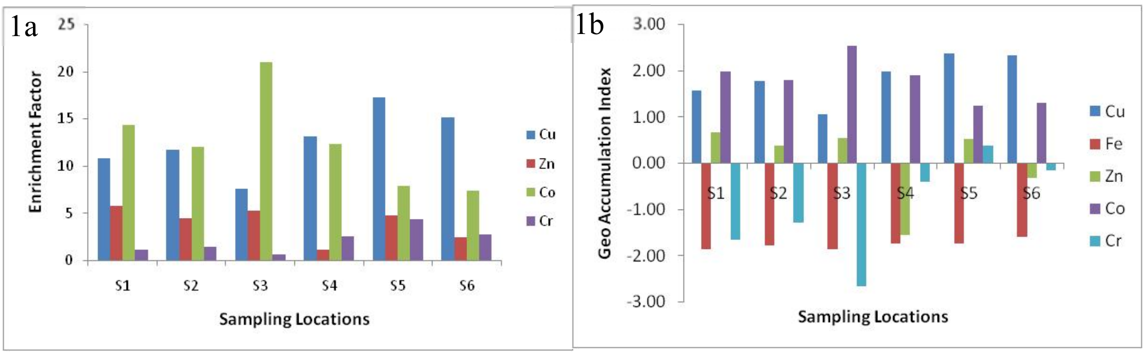

Figure 1 : Sediment Quality Indices; 1a) Enrichment Factor 1b) Geo Accumulation Index

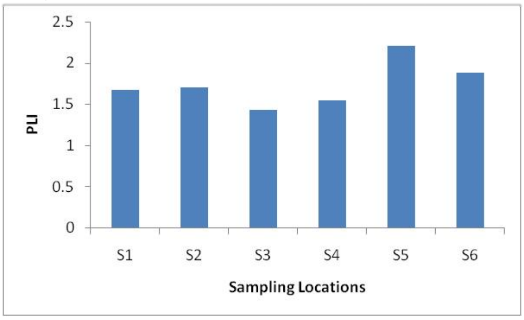

Figure 2 : Pollution Load Index

Conclusion : The work has potentially assessed the status of trace element accumulation in the reclaimed area of Indian Sundarban and mangrove ecosystems of Hooghly Estuary. The study has also focused on the need for proper management of coastal ecosystem by implementation of stringent pollution control measures along with regular monitoring program. Domestic sewage, industrial effluents, surface and agricultural run-off are all potential sources of trace element contamination, although more detailed study is required to identify other possible sources of contaminations.

Reference

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