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Distribution, Source Apportionment and Assessment of Pollution Level of Trace Metals in Water and Sediment of a Riverine Wetland of the Brahmaputra Valley

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Abstract : Deepor Beel (DB), the lone Ramsar site and an important wetland of the Brahmaputra valley in the state of Assam. The local people from fourteen peripheral villages traditionally utilize the wetland for harvesting vegetables, flowers, aquatic seeds, medicinal plants, fish, molluscs, fodder for domestic cattle etc. Therefore, it is of great importance to understand the concentration and distribution of trace metals in water-sediment system of the beel in order to protect its ecological environment. DB lies between26°05′26″N to 26°09′26″N latitudes and 90°36′39″E to 91°41′25″E longitudes. Water samples from the surface layer of water up to 40cm deep and sediment samples from the top 5cm layer of surface sediments were collected. The trace metals in waters and sediments were analysed using ICP-OES. The organic Carbon was analysed using the TOC analyser. The different mineral present in the sediments were confirmed by X-ray diffraction method (XRD). SEM images were recorded for the samples using SEM, attached with energy dispersive X-ray unit, with an accelerating voltage of 20 kv. All the statistical analyses were performed using SPSS20.0 for windows. In the present research, distribution, source apportionment, temporal and spatial variability, extent of pollution and the ecological risk of eight toxic trace metals in sediments and water of DB were investigated. The average concentrations of chromium(Cr) (both the seasons), copper(Cu) and lead(Pb) (pre-monsoon) and zinc(Zn) and cadmium(Cd) (post-monsoon) in sediments were higher than the consensus based threshold concentration(TEC). The persistent exposure of toxic trace metals in sediments pose a potential threat, especially to sediment dwelling organisms. The degree of pollution in DB sediments for Pb, Cobalt (Co) Zn, Cd, Cr, Cu and arsenic (As) was assessed using Enrichment Factor (EF), Geo-accumulation index (Igeo) and Pollution Load Index (PLI). The results indicated that contamination of surface sediments in DB is dominated by Pb and Cd and to a lesser extent by Co, Fe, Cu, Cr, As and Zn. A significant positive correlation among the pairs of element Co/Fe, Zn/As in water, and Cr/Zn, Fe/As in sediments indicates similar source of origin of these metals. The effects of interaction among trace metals between water and sediments shows significant variations ($F = 94.02$, $P < 0.001$), suggesting maximum mobility of trace metals in DB sediments and water. The source apportionment of the heavy metals was carried out using Principal Component Analysis (PCA). SEM-EDS detects the presence of Cd, Cu, Cr, Zn, Pb, As and Fe in the sediment sample. The average concentration of Cd, Zn, Pb and As in the bed sediments of DB are found to be higher than the crustal abundance. The EF values indicate that Cd and Pb are significantly enriched. From source apportionment studies of the eight metals using PCA revealed that Cd was anthropogenic in origin; Pb, As, Cr, and Zn had mixed sources; whereas Co, Cu and Fe were natural in origin.

Keywords : Deepor Beel, enrichment factor, principal component analysis, trace metals
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