Abstract

Contamination of aquatic systems with heavy metals is an emerging issue in developing countries and recent studies revealed that heavy metal contamination poses more severe threats at ecosystems and human population than expected earlier. Consumption of fishes and benthic organisms is one of the major routes of exposure of heavy metals from aquatic ecosystems to human beings. In this context, present study has analysed the heavy metal contamination and its probable risks at ecological as well as community level at Vembanad wetland system, the largest Ramsar site in south India.

Four heavy metals (Zn, Cd, Pb and Cu) were analysed in fishes and benthic organisms collected from different locations of Vembanad Lake along with the water and sediment associated with the habitat of these organisms. Fractional distribution of heavy metals in the sediments of Vembanad Lake was also analysed in order to study the mobility and biological availability.

Sampling was done during the monsoon, pre monsoon and post monsoon seasons of 2010 and 2011. 16 different species of fishes were collected from Cochin Estuary, which includes 9 demersal and 7 benthopelagic species. Out of 18, six species of fishes were collected from the south of Thanneermukkam bund region consisting 2 demersal, 3 benthopelagic and 1 pelagic species. Apart from fishes, benthic organisms were also collected, five benthic species were collected from Cochin estuary and three species were collected from south of Thanneermukkam bund region. A fish consumption survey was also conducted among the people living on the banks of the Lake. Different pollution and risk indices were developed in order to assess the extent of pollution and ecological and community risk assessment of heavy metal pollution in the lake. Finally an exposure assessment model was also applied to study the metal intake of heavy metals by local community through different active exposure pathways.

The findings of the study revealed that water and sediment in the northern part of the Lake, represented as Cochin estuary, is highly contaminated with heavy
metals mainly due to the discharge of industrial effluents from the Udyogamandal industrial area. Cd poses high risk of toxic effects to biota in the Lake among all the metals studied. The southern portion of the Lake was less contaminated compared to northern and middle regions. Fractional distribution of metals shows that mobility and bioavailability of Cd and Zn are high in the lake, posing the possibility for bioaccumulation in aquatic biota with subsequent human health impacts, especially Cd, which comes under high risk category.

Analysis of different fishes shows that level of heavy metals in muscle tissues of many fishes exceeded the permissible limits prescribed by FAO/WHO, EU, EC and ANZFSA. *H. brachysoma, A. arius, S. orientals, E. suratensis* and *G. filamentosus* showed high accumulation of heavy metals indicating their potential as bioindicators of heavy metal pollution in the lake. Different risk assessment index values shows that Cd and Pb poses high threat to human health due to consumption of contaminated fishes from the estuary. High accumulation of Pb was noticed in the muscles of *S. serrata* and *V. cyprinoides* indicating the potential health hazards due to the consumption of these benthic organisms. Exposure assessment through various routes shows that dermal contact with sediment poses high risk of toxic effects, especially for Cd. It can be concluded that, contamination level of Cd and Pb in the water and sediments of the Vembanad Lake have reached a level that poses serious health risks to the people, who depends on the Lake for their livelihood.

*Key words: Heavy metal, Bioaccumulation, Metal Toxicity, Vembanad Lake, Benthic organisms, Fishes, Risk Assessment, Exposure assessment.*