

Abstract

The Indus River is major freshwater resource for Pakistan's 160 million people for its goods (e.g. edible fishes & water for irrigation purpose) and services (recreational, hosting migratory birds of high ecological importance). Increasing heavy metals level due to industrial and urban activities in the catchment of Indus River is a serious environmental issue with regard to health of aquatic food chain. Comprehensive investigation of heavy metal contamination in the water, sediment, aquatic plants and freshwater fishes of Indus River was needed for evaluating current heavy metal level buildup along food chain, developing necessary mitigation measures against increasing metal level for reduction of impacts on its ecosystem health and conservation of goods & survives of Indus River. The present study was conducted at three sampling sites of the Indus River including two sites (Chashma barrage and Taunsa barrage) which are "RAMSAR sites" internationally important for conservation point of view. Samples of water, sediments, aquatic plants and three commercially important freshwater fish species (*Labeo rohita*, *Cyprinus carpio* and *Wallago attu*) were collected on seasonal basis. Physico-chemical water quality parameters were measured in the field and Lab. Heavy metal levels were analyzed by Atomic Absorption Spectrophotometer (AAS). Ecological risk assessment of heavy metals in Abiotic media (water & sediments), aquatic plants and human health risk of fish consumption were done respectively.

Heavy metals in different compartments of River Indus were found in the order of Sediment>Aquatic plants>Fish>Water. Concentration of Cr and Pb in many of water samples of Chashma and Taunsa Barrage and As concentration at Mithan kot was higher than recommended WHO water quality guidelines although these were lower than National environmental quality guidelines of Pakistan. Ecological risk evaluation through metal content of sediments depicts that in sediments, Fe concentration at Taunsa barrage, Cu concentration at Chashma barrage, Ni, Hg and Pb at Mithan kot were higher than recommended International Sediment Quality Guidelines that can pose serious risk of adverse ecological effects. Bioaccumulation factor [AF] of various parts of aquatic plants species (*Typha angustifolia* and *Pistia stratiotes*) in relation to the sediment metal concentration of Indus River was calculated which

shows that [AF] root ratios for *Typha aungustifolia* was high compared to the root ratios for *Pistia Stratiotes*. This difference was highest in the autumn and winter seasons. Root system of both plant species was the target part for heavy metal accumulation that concentrates highest metal concentrations in it compared to leaves and stem that accumulated comparatively lower metal content. Irrespective of inter-specific metal differences, heavy metal concentrations in the root systems of both species significantly varied on seasonal basis.

Carnivorous fish (*Wallago attu*) accumulated more heavy metal when juxtaposed with herbivorous (*Labeo rohita*) & omnivorous fish (*Cyprinus carpio*). Heavy metal levels in non-edible tissues (liver and gills) were higher than permitted level of the heavy metals by FAO. In few samples of muscle tissues, Zn concentration in all of three fish species and Cr in *Wallago attu* were higher than recommended FAO limits. Health risk assessment suggested that although current levels of heavy metal in fish tissues cannot pose health risk to native human communities, but these metal contents are continuously increasing. It is recommended that Cr, Hg, Pb and Zn levels should be monitored in fish tissues on regular basis as these metals have the potential to pose adverse health effects to human in future.

Heavy metal concentrations especially in water and sediments of Indus River were higher in low flow season of Indus River compared with international acceptable and safe limits, this may pose serious health threats through fish consumption, and can affect water use for recreational and irrigation purposes. This is utmost important for government institutions to conduct risk assessment studies or adopt intervention strategies for restoration and management of the Indus River.