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Correlations Between Some Hazardous Inorganic Pollutants in the Gomti River and Their Accumulation in Selected Macrophytes Under Aquatic Ecosystem

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Abstract Water quality of the Gomti River and phytoremediation potential of native macrophytes dwelling therein at six different sites were evaluated. River water showed high biochemical oxygen demand, chemical oxygen demand, nitrate, ammonium and phosphate (12.84, 77.94, 36.88, 6.04 and 2.25 mg L^{-1}, respectively). Gomti water was found to be contaminated with different metals like Fe, Cd, Cu, Cr and Pb (5.54, 1.05, 3.74, 2.57 and 0.73 mg L^{-1}, respectively). Macrophytes growing in the river accumulated considerable amounts of Fe, Cd, Cu, Cr and Pb in different parts. Among the studied plants, *Eichhornia crassipes* showed maximum remediation potential for Fe, Cd and Pb; *Jussiaea repens* for Cr; and *Pistia stratiotes* for Cd. However, in *Typha latifolia*, Cu accumulation was maximum. Except for Fe, translocation factor of *E. crassipes*, *P. stratiotes*, *Hydrilla verticellata* and *T. latifolia* was >1 for the studied metals, showing their potential to accumulate multiple metals in different plant parts.

Keywords Bioaccumulation · Metals · Phytoremediation · Translocation factor

In urban areas, deterioration of water quality of rivers like the Gomti is strongly related to the increasing developmental activities in the watershed, such as changing land use pattern, increased discharge of untreated municipal and industrial wastewater, and runoff from nearby agricultural fields (Rai et al. 2012). Discharge of untreated wastewater containing metals of variable toxicity into rivers poses a serious threat not only to the aquatic ecosystem, but also to human health (Rai 2010; Sun et al. 2014). Consumption of water contaminated with metals may lead to their chronic accumulation in the kidneys, liver and bones of humans, resulting in disruption of metabolic activities, which can also lead to cardiovascular, neurological and renal diseases (Jarup 2003; Johri et al. 2010). Other inorganic pollutants like nitrogenous ions (especially NO_2^-) present in water can combine with organic pollutants to produce cancer causing nitrosyls in human beings. Various aquatic macrophytes (floating, submerged, rooted, and emergent) growing in river courses have shown the potential to accumulate certain toxic pollutants inside their tissues and are used to monitor pollution levels (Souza et al. 2013). These plant potentials have emerged as a major area of phytotechnological studies and have been evaluated for phytoremediation potential for the removal of toxic pollutants from contaminated water and soil (Bauddh and Singh 2012; Chiranjeevi et al. 2013). Macrophyte based treatment systems can be used by developing countries for recycling of wastewater and treatment of potable water, especially those contaminated with metals (Khan et al. 2009; Rahman and Hasegawa 2011).

Some monitoring studies on the Gomti River report variable, but alarming, contamination of water with certain inorganic and organic pollutants (Agarwal et al. 2007; Lohani et al. 2008). However, in-stream macrophytes have not been investigated for their removal efficiency for Fe, Cu, Cd, Cr and Pb, the major metal contaminants of industrial, municipal and agricultural origin during different seasons. The present study is aimed at monitoring water

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