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Partitioning of microplastic from surface water and sediment in river systems

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Microplastic contamination is an emerging environmental concern posing significant implications on ecological and environmental health. Freshwater systems are highly dynamic and are influenced by a range of natural processes and anthropogenic factors that control microplastic inputs, transport pathways and their deposition. Despite increasing attention, the fate, partitioning, accumulation and ecological effects of microplastics in sediment-dominated, river systems remain poorly understood. This study investigates the partitioning of microplastic in surface water and sediments of Yamuna River, in mega city Delhi, India.

To investigate microplastic partitioning, surface water and sediment samples were collected over several locations along the densely populated Delhi stretch of the Yamuna River. After careful extraction, stereomicroscope was used to analyze structure, morphology and FTIR spectroscopy for composition of microplastic particles. Our results show that microplastics particles were detected across all sites and mediums, with concentrations ranging from 66.8 to 347.4 MPs/L in surface waters, and 250.6-665.6 MPs/kg (dry weight) in sediments, demonstrating high accumulation in downstream stretches due to high urban and industrial activities. Fibers were the dominant morphological type, while particles smaller than 120 µm constituted the most abundant size fraction, reflecting high fragmentation and prolonged environmental persistence. Further, the prevalence of smaller-sized microplastics suggests enhanced surface reactivity with greater potential for pollutant adsorption and bioavailability. FTIR analysis suggested polyethylene and polypropylene were the most abundant polymers identified in our samples, indicating diverse sources including municipal waste, industrial waste, plastic packaging materials, fishing nets and other consumer plastic products.

In summary, this study provides a comprehensive assessment of microplastic contamination in the Yamuna River and emphasizes the importance of water-sediment interactions in regulating microplastic fate and ecological risk. The findings helps in the understanding of microplastics partitioning in the water-sediment and offer valuable insights for future research, risk assessment and related river management strategies.