Microplastic Contamination in Mangrove Sediments: Depth-wise Distribution and Risk Assessment in Kadolkele, Sri Lanka

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Microplastics (MPs), defined as particles smaller than 5mm, are emerging contaminants widely distributed in coastal environments. Mangrove ecosystems, with their complex root structures and waterlogged sediments, serve as important sinks for microplastics, increasing their accumulation and persistence. This study assessed the vertical distribution, characteristics, and potential ecological risks of MPs in sediments of the Kadolkele mangrove forest, Sri Lanka. Three sites were randomly selected from the study area and sediment samples were collected from each site at 0–20cm, 20–40cm, and 40–60cm depth intervals. Microplastics were extracted through density separation and filtration, followed by visual identification and FTIR analysis to characterize the MPs based on abundance, size, shape, color and polymer type. Sediment organic matter, pH, and soil texture at each depth were measured. Microplastic Diversity Integrated Index (MDII), Potential Ecological Risk Factor (PRF), Pollution Load Index (PLI), and Polymer Hazard Index (PHI) were calculated. MP abundance varied from 366.7 ± 64.2 MPs/kg to 560.0 ± 82.0 MPs/kg, with no statistically significant variation across sediment depths. Fibers and films were the dominant shapes, while particles less than 1mm were the most abundant size fraction. Silver, blue, white, and black were the most prevalent colors. Polyethylene (PE) was the dominant polymer type. The observed vertical homogenization is likely due to the tidal action, sediment resuspension, and bioturbation processes, which promote sediment mixing. A significant negative correlation was identified between sediment pH and MP abundance, while other sediment parameters showed no significant relationships. Microplastic risk assessment indicated moderate ecological risk, with moderate diversity (MDII), low pollution load (PLI < 10), and hazard level III based on PHI values. Overall, these findings emphasize the need for long-term monitoring and improved plastic waste management practices to mitigate plastic pollution and protect mangrove ecosystem health.

Keywords: *Ecological risk, Mangrove sediments, Microplastics, Sediment quality, Vertical distribution*