

## **A Critical Evaluation of Nano- and Microplastics: Sources, Health Risks, and Mitigation Strategies**

Microplastics (1  $\mu\text{m}$ –5 mm) and nanoplastics (< 1  $\mu\text{m}$ ) have become ubiquitous contaminants across air, water, and soil systems, with growing evidence of their presence in human tissues including blood, lungs, and even the placenta. While microplastics have been extensively studied, nanoplastics remain poorly understood because of their minute size and limited standardized detection protocols. This paper explores the major sources of both micro- and nanoplastics ranging from primary origins such as microbeads and synthetic fibers to secondary degradation of larger plastics in natural environments. It further examines human exposure pathways through ingestion, inhalation, and dermal absorption and outlines associated health effects, including inflammation, microbiome disruption, and potential neurotoxicity. Remediation solutions are critically reviewed, including magnetic nanoparticle systems, enzymatic degradation via plastic-eating microbes, electrocoagulation, and emerging low-cost methods like *Moringa*-based flocculation. A central contribution of this review is its identification of research gaps: insufficient resolution in detecting particles below 100 nm, limited data on chronic human health effects, and the unknown interactions of nanoplastics with co-existing environmental toxins. By integrating technological innovation with critical analysis of existing limitations, this work offers a roadmap for advancing environmental safety and public health in the age of plastic pollution.