

# Plant-Based Approaches for Wastewater Management: A Comprehensive Review of Phytoremediation Techniques

Krishna Necti<sup>1,\*</sup>, Reena Singh<sup>2</sup> Abhishek Kumar<sup>3</sup>

<sup>1,3</sup>Research Scholar, Department of Civil Engineering, National Institute of Technology Patna, Patna, Bihar 800005, India; [krishnan.phd19.ce@nitp.ac.in](mailto:krishnan.phd19.ce@nitp.ac.in) (K.N.); [abhishekkkr.pg22.ce@nitp.ac.in](mailto:abhishekkkr.pg22.ce@nitp.ac.in) (A.K.)

<sup>2</sup>Assistant Professor, Department of Civil Engineering, National Institute of Technology Patna, Patna, Bihar 800005, India; [reena@nitp.ac.in](mailto:reena@nitp.ac.in) (R.S.)

\*Correspondence: [krishnan.phd19.ce@nitp.ac.in](mailto:krishnan.phd19.ce@nitp.ac.in); Tel.: +91-7004653743

**Abstract:** Wastewater management is a complex issue that requires attention due to the presence of harmful pollutants, toxic particles, and emerging contaminants that originate from industrial activities. These pollutants can contaminate soil, surface water, and infiltrate groundwater, posing health risks to humans and animals alike. The emerging contaminants in wastewater, such as pharmaceuticals, personal care products, pesticides, and flame retardants, are primarily synthetic organic compounds that pose serious risks to human health and biota. The demand for freshwater is increasing, which necessitates significant investments in capital and energy for water treatment plants. This review article explores the innovative use of plants in wastewater treatment, specifically through bioaccumulation. Various phytoremediation techniques, such as phytovolatilization, phytoextraction, phytofiltration, rhizofiltration, phytodegradation, phytostabilization, and phytoassimilation, are explored as sustainable alternatives. Aquatic plants, such as water hyacinth, duckweed, and water lettuce, stand out for their exceptional phytoremediation capabilities. These plants can be used to remove pollutants from wastewater, making it safe for reuse or discharge into the environment. The use of plants in wastewater treatment is a cost-effective and eco-friendly approach that can help address the growing water scarcity problem. By using phytoremediation techniques, we can reduce the need for expensive and energy-intensive treatment methods, while also promoting the growth of green spaces in urban areas. This article underscores the potential of plant-based strategies in wastewater management, emphasizing their role in mitigating environmental contaminants and safeguarding public health.

**Keywords:** Wastewater management; Bioaccumulation; Phytoremediation; Aquatic plants; Environmental contaminants