Abstract

Urban areas face increasing vulnerability to climate change, manifested through flooding, water contamination, soil degradation, and the loss of green spaces. Green infrastructure has emerged as a nature-based solution to these challenges, offering multifunctional ecosystem services while promoting resilience. Within this context, biochar—a carbon-rich material produced through pyrolysis of biomass—has attracted attention due to its porous structure, adsorption properties, and potential for long-term carbon sequestration. This paper critically examines the integration of biochar across three key urban systems: bioswales for stormwater management, water filtration for contaminant removal, and urban greening for ecological restoration. The research employs a desk-based review of literature published between 2015 and 2025, synthesising findings from peer-reviewed articles, case studies, and book chapters. Results suggest that biochar significantly enhances infiltration rates and pollutant removal in bioswales, improves the efficiency of water filtration systems, and supports soil fertility and vegetation growth in green infrastructure. Unlike conventional methods that often require high energy inputs and frequent maintenance, biochar offers a cost-effective and sustainable alternative. However, challenges remain regarding scalability, standardisation, and long-term environmental trade-offs. The novelty of this paper lies in positioning biochar not as an isolated amendment, but as an integrated component of urban resilience strategies that bridge stormwater control, water quality improvement, and ecological restoration. The study concludes by recommending pilot-scale implementations and policy incentives to mainstream biochar within urban planning frameworks.