A Review on Assessing the Suitability of Various Ecological Flood Mitigation Methods in Multiple Climates

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Abstract

This review assesses the suitability of ecological flood mitigation approaches across tropical, temperate, and arid/semi-arid regions. While conventional engineered grey structures effectively reduce flood peaks, they often impose ecological degradation and high maintenance demands. Ecological strategies, including wetland restoration, riparian buffers, and green infrastructure, offer sustainable alternatives that integrate natural processes to manage runoff, enhance biodiversity, and improve water quality. However, most studies are location-specific, leaving a gap in understanding how these methods perform under differing climatic and governance contexts. This review therefore evaluates the comparative effectiveness of ecological flood mitigation methods to identify context-specific strengths, limitations, and policy implications. The objectives are: (i) to synthesise recent evidence on the performance of ecological approaches across tropical, temperate, and arid/semi-arid regions; (ii) to assess their ecological, hydrological, and adaptive functions in flood reduction; and (iii) to highlight key challenges and policy implications for enhancing flood resilience. Drawing from

literature published between 2020 and 2024, findings reveal that tropical wetlands reduce runoff by ~30%, temperate levees offer up to 90% protection, and arid-region retention systems cut flood volume by ~40%. The review concludes that integrating hybrid solutions, strengthening governance, and promoting long-term comparative research are essential for advancing ecological flood resilience globally.

Author keywords

Adaptation; Climate; Ecological; Flood; Mitigation

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