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Ecological restoration of Ganga River Wetlands: A review of Challenges and Opportunities

Dr. R. Sreelatha

Assistant Professor, Department of Botany, GDC Medak, Telangana, India

drsreelatharallabandi@gmail.com

ABSTRACT: The Ganga River wetlands, a vital component of the Ganga River Basin ecosystem, are facing unprecedented threats due to human activities, climate change, and institutional barriers. The degradation of these wetlands has severe implications for biodiversity conservation, ecosystem services, and human well-being. Ecological restoration of these wetlands is critical to revitalize their ecological integrity and ecosystem services.

This review paper provides a comprehensive synthesis of the current state of knowledge on the ecological restoration of Ganga River wetlands. We examine the challenges and opportunities for restoration, including the role of community-based restoration approaches, eco-tourism, and sustainable livelihoods in supporting ecological restoration. We also discuss the need for policy and legislative support, enforcement of environmental regulations, and provision of funding and technical assistance to facilitate restoration efforts.

Our review highlights the importance of adopting a holistic and interdisciplinary approach to ecological restoration, incorporating insights from ecology, sociology, economics, and policy studies. We identify key research gaps and priorities for future research, including the need for longitudinal studies on restoration outcomes, assessment of community engagement and participation, and evaluation of policy effectiveness.

The findings of this review have significant implications for policymakers, practitioners, and researchers working towards the conservation and restoration of Ganga River wetlands. Our recommendations provide a roadmap for future research and action to support ecological restoration of these vital ecosystems, ultimately contributing to the conservation of biodiversity, ecosystem services, and human well-being.

KEYWORDS: Ganga River wetlands, ecological restoration, community-based restoration, eco-tourism, sustainable livelihoods, policy support, biodiversity conservation, ecosystem services.

I. INTRODUCTION

The Ganga River system is a vast and complex network of rivers, streams, and wetlands spanning India, Tibet (China), Nepal, and Bangladesh. It covers an area of over 861,000 square kilometres, making it the largest river basin in India. The system supports a rich biodiversity and provides a range of ecosystem services. The Gangetic wetlands are the largest riverine wetland system in India. They are among the most significant ecological zones in India, supporting diverse flora and fauna while also providing crucial ecosystem services. However, these wetlands are increasingly under threat due to anthropogenic activities such as urbanization, industrialization, and pollution. Degradation of these wetlands has led to biodiversity loss, declining water quality, and reduced ecosystem functionality.

This paper aims to review the challenges faced in the ecological restoration of Ganga River wetlands and explore the opportunities available for effective conservation and restoration strategies. The study examines both environmental and socio-economic aspects to provide a holistic perspective on restoration efforts.

The review focuses on the wetlands associated with the Ganga River basin, spanning across multiple states in India. Various types of wetlands, including floodplain wetlands, oxbow lakes, and marshes, are considered within this study.

The paper also highlights the intersection of ecological restoration with policy frameworks and community participation.



<https://www.indiawaterportal.org/articles/basin-maps-ganga-river-showing-basin-indicators-landcover-classes-and-biodiversity>

II. IMPORTANCE OF GANGA RIVER WETLANDS

Biodiversity Hotspots

Ganga River wetlands harbour a wide range of species, including several threatened and endangered species such as the Ganges River dolphin (*Platanista gangetica*), Indian skimmer (*Rynchops albicollis*), and various species of migratory birds (Singh et al., 2023). These wetlands serve as critical breeding and feeding grounds, making their conservation vital for maintaining regional biodiversity.

Ecosystem Services

The wetlands provide essential ecosystem services such as:

- **Water Filtration:** Wetlands help filter pollutants, improving water quality (Trivedi, 2015).
- **Flood Control:** They act as natural buffers, absorbing excess water during monsoons and mitigating flood risks (National Mission for Clean Ganga & WWF India, 2022).
- **Carbon Sequestration:** Wetlands serve as carbon sinks, helping to regulate atmospheric carbon levels and mitigate climate change (UNEP, 2023).

Cultural Significance

Ganga River wetlands hold immense cultural and religious significance for local communities. The river is revered in Hinduism, and its wetlands are often associated with religious rituals, festivals, and livelihoods (Namami Gange Programme, 2024). Sustainable restoration of these wetlands can help maintain their cultural importance while enhancing ecological balance.

III. CHALLENGES TO ECOLOGICAL RESTORATION

Habitat Degradation

The rapid expansion of agriculture, urban settlements, and infrastructure projects has led to extensive habitat loss and fragmentation. Wetland drainage for land reclamation and altered hydrological regimes due to dam construction have further exacerbated habitat degradation (Pollution of the Ganges, 2025). Additionally, encroachment of wetland areas by commercial and residential developments leads to permanent alterations in wetland ecology, resulting in loss of native vegetation and disruption of food webs (Singh et al., 2023). The lack of proper wetland mapping and monitoring programs has further contributed to mismanagement, making restoration efforts challenging (UNEP, 2023).



Water Pollution

The discharge of industrial effluents, agricultural runoff, and domestic sewage has significantly degraded water quality in the Ganga River wetlands. High levels of heavy metals, pesticides, and organic waste threaten aquatic life and disrupt the wetland ecosystem (Trivedi, 2015; Singh et al., 2023). Eutrophication caused by excessive nutrient inflow leads to algal blooms, which deplete oxygen levels and cause fish mortality (Wetlands International South Asia, 2024). Furthermore, unregulated sand mining and construction activities contribute to increased turbidity and sedimentation, affecting water clarity and wetland health (National Mission for Clean Ganga & WWF India, 2022).

Climate Change

Climate change poses an additional challenge, impacting wetland hydrology through shifts in precipitation patterns, rising temperatures, and increasing frequency of extreme weather events (Wetlands International South Asia, 2024). Changes in monsoon intensity and unpredictability affect the seasonal water balance of wetlands, leading to prolonged droughts or excessive flooding (Singh et al., 2023). Increased evaporation rates and reduced groundwater recharge due to climate variability exacerbate the degradation of wetland ecosystems, making their restoration even more complex (UNEP, 2023).

Institutional and Social Barriers

The restoration of Ganga River wetlands is hindered by:

- **Lack of Coordination:** Multiple agencies and stakeholders operate with fragmented mandates, leading to ineffective management (National Mission for Clean Ganga & WWF India, 2022).
- **Inadequate Funding:** Limited financial resources restrict the implementation of large-scale restoration projects (Singh et al., 2023). Government allocations for wetland conservation often get diverted to competing priorities, leaving restoration initiatives underfunded (UNEP, 2023).
- **Conflicting Land-Use Priorities:** Developmental projects often take precedence over conservation efforts, leading to further degradation (UNEP, 2023). In addition, socio-economic pressures such as population growth and agricultural dependency have increased encroachment on wetland areas (Trivedi, 2015).

IV. OPPORTUNITIES FOR ECOLOGICAL RESTORATION

Restoration Techniques

Several ecological restoration techniques can be employed, including:

- **Wetland Creation and Enhancement:** Restoring degraded wetlands and creating new wetland areas (Wetlands International South Asia, 2024). This can be achieved through reforestation, controlled flooding, and hydrological interventions that mimic natural processes.
- **Habitat Reconstruction:** Reintroducing native vegetation and improving hydrological connectivity (Singh et al., 2023). Projects like buffer zone plantations and artificial wetland creation can help support biodiversity recovery.
- **Invasive Species Management:** Removing non-native species that threaten wetland biodiversity (UNEP, 2023). Active monitoring and biological control measures can prevent invasive species from outcompeting native flora and fauna.



Ganga River Wetlands

<https://indianexpress.com/article/lifestyle/destination-of-the-week/five-new-indian-wetlands-ramsar-recognition-8053168/>

Community-Based Restoration

Active participation of local communities is essential for sustainable restoration efforts. Community-led conservation initiatives, educational programs, and participatory governance can enhance the effectiveness of restoration projects (Trivedi, 2015). Engaging local stakeholders in decision-making processes ensures the long-term success of restoration efforts by aligning conservation goals with community interests. Incentive programs such as wetland-friendly agriculture and sustainable fishing practices can further encourage community participation (Singh et al., 2023).



Community Based Cleaning

<https://indianexpress.com/article/india/overseas-indians-contributed-less-than-2-percent-to-clean-ganga-fund-86-percent-from-govt-entities-5413556/>

Eco-Tourism and Sustainable Livelihoods

Promoting eco-tourism and sustainable fishing practices can provide economic incentives for local communities to engage in wetland conservation. Developing eco-tourism infrastructure while maintaining ecological balance can support both conservation goals and economic development (Singh et al., 2023). Wetland-based ecotourism can be designed to include bird-watching tours, cultural heritage sites, and community-led homestay programs, creating alternative livelihoods for those dependent on wetland resources (UNEP, 2023).

Policy and Legislative Support

Stronger environmental regulations, improved enforcement mechanisms, and adequate funding are essential for successful restoration. Policies such as the National Wetland Conservation Programme (NWCP) and the Namami Gange initiative offer frameworks that can be leveraged for restoration projects (Namami Gange Programme, 2024).



Strengthening inter-agency coordination, enforcing stricter pollution controls, and incorporating traditional ecological knowledge into policy-making can enhance wetland conservation efforts (National Mission for Clean Ganga & WWF India, 2022).

V. CONCLUSION

Summary of Key Findings

The ecological restoration of Ganga River wetlands faces significant challenges, including habitat degradation, pollution, climate change, and institutional barriers. However, opportunities exist through restoration techniques, community participation, eco-tourism, and policy support.

Recommendations for Future Research and Action

- **Scientific Research:** More research is needed to understand wetland dynamics and develop effective restoration models (Singh et al., 2023).
- **Integrated Management Approaches:** Collaborative efforts among government agencies, NGOs, and local communities can enhance restoration outcomes (National Mission for Clean Ganga & WWF India, 2022).
- **Sustainable Development Policies:** Striking a balance between economic development and ecological conservation is crucial for the long-term health of Ganga River wetlands (UNEP, 2023).

REFERENCES

1. National Mission for Clean Ganga (NMCG) & WWF India. (2022). *Connecting Wetlands, Rivers and People: Challenges, Experiences & Opportunities*.
2. Wetlands International South Asia. (2024). *Ecological Restoration of Wetlands*.
3. United Nations Environment Programme (UNEP). (2023). *Restoring India's Holiest River*.
4. Trivedi, R. C. (2015). *Ecology of the River Ganga - Issues and Challenges*. *International Journal of Environmental Sciences*, 5(6), 1426-1438.
5. Singh, O., Dhyani, S., Peerzada, I., & Reddy, N. (2023). *Riverscape Approach and Forestry Interventions for Ganga River Rejuvenation*.
6. Namami Gange Programme. (2024).
7. Pollution of the Ganges. (2025).



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