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URBAN FLOODING IN BENGALURU; A LEGAL ANALYSIS

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Abstract:

Urban wetlands constitute critical ecological infrastructure, providing flood buffering, groundwater recharge, and biodiversity conservation. In India, rapid urbanisation, coupled with inadequately enforced regulatory frameworks, has led to the progressive degradation of these wetlands, exacerbating urban flooding and waterlogging in major cities such as Bengaluru. The Wetlands (Conservation and Management) Rules, 2017, while a step toward regulatory consolidation, adopt restrictive definitions that exclude paddy fields, man-made tanks, and other human-modified water bodies, thereby limiting the scope of protection. The abolition of the Central Wetlands Regulatory Authority (CWRA) and delegation of responsibilities to State/UT Wetland Authorities (SWAs) were intended to decentralise governance; however, fragmented mandates and weak enforcement mechanisms have resulted in inconsistent implementation and ecological oversight. Empirical studies and spatial analyses, including findings from the National Wetland Atlas (ISRO, 2011), highlight that the loss of even smaller urban water bodies significantly increases runoff and flood severity during extreme rainfall events. Reports by NITI Aayog (2021) and independent research institutions underscore that anthropogenic activities such as encroachments, unplanned construction on floodplains, and the disruption of historical lake-cascade systems have compounded urban hydrological vulnerability. International experience, particularly from European Ramsar sites, demonstrates that community-based monitoring and participatory governance improve compliance and ecological stewardship, offering lessons for Indian urban wetland management. This paper synthesises legal, empirical, spatial, and policy-oriented perspectives to analyse the nexus between wetland degradation, institutional fragmentation, and urban flooding. It identifies gaps in current legislation and enforcement and proposes policy reforms that expand the scope of protected wetlands, strengthen institutional coordination, and integrate participatory governance. The study contributes to an evolving discourse on sustainable urban water management, emphasizing the urgency of preserving and rehabilitating wetlands as a central strategy for enhancing resilience against increasingly frequent and severe urban flood events.

Keywords: Wetlands (Conservation and Management) Rules, 2017; Environmental Law; Municipal Governance; Sustainable Urban Planning; Environmental Protection Act, 1986; Land Use Regulation.

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I. INTRODUCTION

Bangalore, officially known as Bengaluru, is the capital of the Indian state of Karnataka and one of the fastest-growing metropolitan cities in the country. Often referred to as the "Silicon Valley of India," it has emerged as a global hub for information technology, biotechnology, and start-up innovation over the last three decades.[3] With a population exceeding 12 million, Bangalore ranks among the top five most populous urban agglomerations in India.[4]

Historically, Bangalore was known for its temperate climate, green cover, and most notably, its unique system of interconnected lakes and tanks. These lakes over 280 at one point—were largely man-made, developed by rulers such as Kempegowda and the Wodeyars to serve agricultural and domestic water needs[5]. This decentralised water management system was well- suited for the undulating terrain of the Deccan plateau and functioned as an early form of urban flood control.

However, rapid and often unplanned urban expansion since the 1990s has severely disrupted the city's natural drainage system. Encroachments on lake beds, stormwater drains (rajakaluves), and wetlands have led to frequent urban flooding and loss of groundwater recharge zones.[6] Once a model for ecological planning, Bangalore now faces significant environmental challenges, especially in relation to its vanishing lakes and worsening flood resilience.

The lakes and water bodies played a key role in sustaining agriculture, recharging groundwater, maintaining microclimatic balance, and acting as natural flood buffers. However, with the aggressive pace of urbanisation, fuelled by the IT boom and real estate expansion, many of these lakes have either disappeared or been reduced to sewage-fed water pools surrounded by illegal construction and encroachments.

This ecological disruption has had serious consequences. In recent years, Bangalore has experienced unprecedented urban flooding, notably during the monsoons of 2017 and 2022, when even upscale neighbourhoods like Whitefield, Koramangala, and Bellandur were inundated. These flood events are no longer isolated incidents but recurring phenomena, raising critical concerns about the nexus between unregulated development, shrinking wetlands, and inadequate drainage systems. Encroachments of lake beds, stormwater drains, and natural valley systems have been directly linked to the inability of the city's infrastructure to handle heavy rainfall, thereby aggravating waterlogging and public health crises.[7]

This paper investigates the legal dimensions of this environmental challenge. While India possesses a well-defined environmental legal framework including statutes such as the

[3] NITI Aayog, *Annual Report on Indian Cities* 112 (2022).
[4] ***"****Bangalore (Bengaluru) Population, Literacy, and Religion Data,"* Census2011.co.in,
[5] T.V. Ramachandra & A. Ahalya, *Lakes of Bangalore: Conservation and Management*, 5 ENV'T & URBANISATION ASIA 83, 86 (2014).
[6] *Environment Support Group* v. *State of Karnataka*, O.A. No. 125/2017, Order dated Mar. 5, 2020 (NGT– Southern Zone).
[7] Yamini C. S., Bengaluru's Flood Paradox: Residents Report No Waterlogging While Social Media Shows Drenching Visuals, *Hindustan Times* (Oct. 23, 2024).

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Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974 its enforcement, particularly in urban spaces like Bangalore, has been inconsistent and fragmented. Moreover, state-specific legislations such as the Karnataka Lake Conservation and Development Authority Act, 2014 (now merged with other bodies under the Minor Irrigation Department) and municipal regulations remain underutilised or poorly implemented. The multiplicity of agencies, BBMP, BDA, Revenue Department, BWSSB, and the Minor Irrigation Department, has further led to administrative overlaps and weakened accountability.

II. Literature Review

The Wetlands (Conservation and Management) Rules, 2017, particularly their restrictive definitions of wetlands, form the foundational context of this research. The explicit exclusion of paddy fields, man-made tanks, and other human-modified water bodies significantly narrows the scope of wetland protection, despite their crucial roles in flood buffering, groundwater recharge, and biodiversity conservation (Wetlands (Conservation and Management) Rules, 2017). This rule-based understanding establishes the legal baseline against which subsequent analysis is developed.

Empirical and modelling studies further highlight the hydrological importance of small water bodies. For instance, Chavali and Jain (2021) demonstrate, through a detailed study of Gurugram, that the loss of even minor urban ponds transforms manageable inundation into catastrophic urban flooding. This research underscores the practical consequences of wetland degradation, linking gaps in legal protection to tangible environmental hazards and public safety risks.

The National Wetland Atlas, published by ISRO in 2011, provides spatial evidence of extensive wetland shrinkage across India. Its data and visual documentation illustrate the extent of urban wetland loss in rapidly expanding metropolitan regions, underscoring how smaller water bodies often excluded from policy frameworks play a significant role in maintaining hydrological balance. This source adds an important quantitative and longitudinal perspective to the review.

A complementary policy-oriented perspective is provided by the NITI Aayog Flood Management Report (2021). This report identifies anthropogenic drivers of urban flooding, such as encroachments on floodplains and unplanned construction over water bodies. By explicitly connecting governance shortcomings and planning failures to ecological consequences, the report strengthens the policy rationale for enhancing wetland protection as part of urban flood resilience strategies.

Further insights are offered by the Indian Institute of Human Settlements (2018), which examined Bengaluru's lake-cascade systems. The research highlights how the interruption of natural drainage channels by urban development, combined with fragmented mandates among municipal and state authorities, has exacerbated waterlogging. This institutional critique reveals that legal and ecological deficiencies operate in tandem, creating compounded risks.

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International perspectives are incorporated through the Ramsar Convention (1971) and its management handbooks, which emphasise community participation in wetland stewardship. European models of decentralised monitoring and compliance illustrate potential pathways for strengthening India's governance frameworks. These materials are particularly instructive in suggesting participatory reforms suitable for the Indian context.

Finally, media reports, such as those published in *The Hindu* and *Hindustan Times*, provide vivid accounts of Bengaluru's 2017 and 2022 floods, including in upscale neighbourhoods such as Whitefield, Koramangala, and Bellandur. These narratives connect shrinking wetlands, inadequate drainage, and unregulated construction to lived experiences of urban flooding, thereby humanising the ecological and legal issues under study.

Taken together, these seven sources provide a multi-dimensional understanding of wetlands, flooding, and governance in India. Legal frameworks, empirical studies, spatial datasets, policy analyses, institutional critiques, international conventions, and media documentation converge to demonstrate the systemic drivers of Bengaluru's recurrent urban flooding. The review also highlights a clear research gap in the need for stronger protection of smaller, human-modified wetlands and enhanced institutional coordination across governance levels.

III. Research Methodology

The present research adopts a doctrinal and analytical methodology combined with elements of applied research to examine the legal dimensions of lake encroachment and its link to urban flooding in India. The research is primarily doctrinal, as it critically analyses statutes, case laws, constitutional provisions, and rules such as the Wetlands (Conservation and Management) Rules, 2017. By interpreting legal texts and judicial pronouncements, the study investigates how environmental and municipal laws have been framed and implemented in the context of lake protection. It is also **analytical**, as it does not stop at mere description but evaluates the adequacy, effectiveness, and shortcomings of existing laws. Furthermore, the research is applied in **nature**, since it aims to propose reforms to ensure better legal and administrative mechanisms to address urban flooding.

- **Primary Sources:** Statutory provisions such as the Environmental Protection Act, 1986, Water Act, Wetlands Rules, 2017, municipal bye-laws, and constitutional provisions (especially Article 21). Judicial decisions such as *M.C. Mehta v. Union of India*, Karnataka High Court's Bellandur Lake case, and NGT orders are considered primary sources.
- **Secondary Sources:** Scholarly articles, journals, books on environmental law, policy reports by CPCB and NITI Aayog, and reliable online databases including SCC Online and Indian Kanoon.

Data will be evaluated by examining the consistency, credibility, and reliability of sources. Judicial precedents will be analysed to establish trends in environmental jurisprudence.

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Government reports will be cross-verified with independent academic sources to maintain accuracy.

IV. Research Questions

The research is guided by the following questions:

1. **What is the relationship between lake encroachment and urban flooding in Indian cities?**
2. **How effective are the existing laws and rules, particularly the Wetlands (Conservation and Management) Rules, 2017, in preventing encroachment?**
3. **What role has the judiciary played in addressing lake encroachments and urban flooding?**
4. **What are the gaps in statutory enforcement and administrative functioning that allow violations to persist?**
5. **What legal reforms or policy measures can strengthen the protection of lakes and reduce the risk of urban flooding?**

V. Research Objectives

The research is designed with the following objectives:

1. **To analyse the existing legal framework** governing wetlands and lakes in India, focusing on the Environmental Protection Act, Wetlands Rules 2017, and constitutional provisions such as Article 21 and Article 48A.
2. **To evaluate judicial interventions** in cases related to encroachment of lakes and their role in mitigating urban flooding. Special attention will be given to Supreme Court and High Court judgments that have emphasized environmental protection.
3. **To identify gaps in statutory enforcement** and administrative implementation, including issues of overlapping jurisdiction, corruption, and weak monitoring mechanisms.
4. **To propose legal and policy reforms** aimed at strengthening wetland governance. This includes suggesting stricter penalties for violators, empowering local wetland authorities, incorporating community participation, and integrating urban planning with ecological protection.
5. **To contribute to the discourse on environmental rights**, particularly by situating the issue within the constitutional guarantee of the right to life and a healthy environment under Article 21.

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By fulfilling these objectives, the research aims to provide academically rigorous yet practically useful recommendations for policymakers, urban planners, and environmental law scholars.

VI. Statement of the Problem

Wetlands are among the most productive ecosystems, playing a crucial role in maintaining biodiversity, groundwater recharge, carbon sequestration, and flood regulation. Despite their immense ecological and socio-economic value, wetlands in India continue to face unprecedented degradation due to urbanisation, industrial expansion, unregulated waste disposal, and agricultural encroachments. According to estimates, India has already lost nearly 30–40% of its wetlands in the last few decades, particularly in urban areas such as Bengaluru, Hyderabad, and Delhi, where rapid infrastructural growth has outpaced conservation efforts.

To address this crisis, the Wetlands (Conservation and Management) Rules, 2017 were notified under the Environment Protection Act, replacing the earlier 2010 Rules. The 2017 Rules sought to streamline conservation by delegating greater power to the states and creating State Wetland Authorities for site-specific management. While the Rules represent a step forward in recognising the importance of wetlands, several gaps persist. Critics argue that the Rules lack clear mechanisms for identifying wetlands, impose fewer restrictions on land-use changes, and exclude many ecologically significant but smaller wetlands from their ambit. Moreover, the heavy reliance on state authorities without adequate oversight has led to inconsistent enforcement across regions.

The problem under investigation, therefore, lies in the implementation gap between the stated objectives of the 2017 Rules and the actual protection achieved on the ground. For example, several urban wetlands have continued to shrink or disappear post-2017, indicating weak monitoring and enforcement. Questions also arise on whether the Rules sufficiently integrate local community participation, traditional ecological knowledge, and climate change adaptation needs.

This research problem specifically investigates:

1. Whether the Wetlands Rules, 2017, adequately address the ecological and socio- economic threats faced by wetlands in India.
2. The extent to which state-level authorities have been effective in implementing conservation measures.
3. The limitations and loopholes in the legal and institutional framework that hinder wetland protection.
4. The challenges of balancing urban development with ecological sustainability under the current regime.

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By situating the problem within the broader discourse of environmental governance, the study seeks to critically examine the strengths and weaknesses of the Wetlands Rules, 2017, and suggest pathways for strengthening wetland protection in India.

VII. Background of Urban Wetland Degradation in India

Wetlands and urban lakes have historically formed the backbone of India's water management systems, serving ecological, cultural, and economic purposes. Traditionally, Indian cities developed around water bodies that regulated floods, recharged groundwater, and provided livelihoods through fishing, agriculture, and other water-related activities. For example, Bengaluru once had a thriving chain of interconnected lakes, while Kolkata's wetlands sustained agriculture and fisheries for the growing population. However, the advent of rapid urbanization, industrialization, and unregulated development has triggered unprecedented degradation of these ecosystems.

Wetlands in India perform crucial ecosystem roles—regulating floods, recharging groundwater, filtering pollutants, and maintaining biodiversity. However, recent reviews confirm a rapid decline in both the extent and health of these wetlands, especially in urban areas. For instance, a study *"Status of Wetlands in India: A Review of Extent, Ecosystem Benefits and Future Challenges"* reveals wetlands have been shrinking due to urban encroachment, agricultural expansion, waste discharge, and conversion for infrastructure projects; these losses increase flood risk in cities[8]. A related paper on riverine wetlands demonstrates seasonal inundation zones are being altered or cut off by constructions and altered hydrology.[9] In floodplain wetlands, the proliferation of aquatic weeds and shrinking water-bodies reduce capacity to absorb excess rainwater and buffer against floods. These trends are clearly worsened by urban sprawl, weak protection in land-use planning, and lack of continuous mapping and monitoring. The loss is not just ecological but socio-economic: flood damage, loss of livelihoods, and stress on urban infrastructure.

Thus, the background of wetland degradation in India reveals a dual challenge—environmental governance failures and urban planning deficits. While the ecological services of wetlands are irreplaceable, their marginalization in policy frameworks has aggravated urban vulnerabilities.

VIII. Legal Framework Governing Wetlands and Lakes

[8] *Status of Wetlands in India: A Review of Extent, Ecosystem Benefits and Future Challenges*, J. Hydrol.: Reg. Studies, Vol. 2 (2014). ScienceDirect

[9] Sandeep K. Maddheshiya et al., *A Review on Riverine Wetlands in India*, Vigyan Varta: Indian Inst. Tech. (BHU) Varanasi, Vol. 11, Issue 11 (Nov. 2023). ResearchGate

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The protection of wetlands in India rests on a blend of constitutional mandates, statutory regulations, and judicial interpretations. Together, they form the foundation of environmental governance concerning these ecosystems.

Constitutional Provisions

The Constitution implicitly recognizes wetland protection. **Article 21**, guaranteeing the right to life, [10]has been expansively interpreted by the Supreme Court to include the right to a healthy environment. Directive Principles of State Policy further strengthen this mandate: **Article 48A** obliges the State to protect and improve the environment[11], while **Article 51A(g)** casts a duty on citizens to safeguard natural resources. These provisions form the constitutional backbone for environmental protection.[12]

The key legislation is the **Environment (Protection) Act, 1986 (EPA)**, enacted in response to the Bhopal Gas Tragedy. Under Section 3 of the EPA, the central government issued the **Wetlands (Conservation and Management) Rules**, first in 2010 and later revised in 2017. The 2017 Rules created State Wetland Authorities, empowered to notify wetlands, regulate prohibited activities, and develop integrated management plans. However, the Rules excluded smaller wetlands and salt pans, raising concerns about reduced coverage.

Other statutes supplement wetland governance: the **Water (Prevention and Control of Pollution) Act, 1974**, addressing water pollution; the **Wildlife Protection Act, 1972**, protecting wetlands that fall within sanctuaries; and the **Indian Forest Act, 1927**, governing forested wetlands.

Judicial Principles

Indian courts have played a transformative role. The **Public Trust Doctrine**, adopted in *M.C. Mehta v. Kamal Nath* (1997), established that the State holds natural resources in trust for public use. The **Precautionary Principle** and **Polluter Pays Principle** further guide wetland- related jurisprudence[13]. Landmark cases such as *Jagpal Singh v. State of Punjab* (2011) directed states to restore encroached village ponds, affirming wetlands as community assets.

India is also a signatory to the **Ramsar Convention, 1971**, which obligates conservation of wetlands of international importance. Presently, India has **80 Ramsar sites**, the largest in Asia, underscoring global recognition of its ecological responsibility.[14]

IX. Critical Analysis of Wetlands Rules, 2017

[10] India Const. art. 21
[11] India Const. art. 48A
[12] India Const. art. 51A(g)
[13] *M.C. Mehta v. Kamal Nath*, (1997) 1 SCC 388 (India).

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The Wetlands (Conservation and Management) Rules, 2017 (hereafter "2017 Rules") were introduced to address deficiencies in the earlier 2010 Rules and to delegate more powers to state authorities. While the Rules represent a legislative effort in environmental protection, a number of critical issues hamper their effectiveness, particularly regarding scope, institutional structure, accountability, and ecological integrity.

One major criticism of the 2017 Rules is the restrictive definition of "wetlands." The new definition explicitly excludes *river channels, paddy fields, human-made water bodies/tanks for drinking water, structures constructed for aquaculture, salt production, recreation or irrigation.* Such exclusions may result in nearly **65% of water bodies** losing legal protection, since many small wetlands fall under these categories. Critics argue this narrowing undermines ecosystem services provided by less prominent wetlands such as groundwater recharge, flood mitigation, and biodiversity corridors. [15]

Under the 2017 Rules, much of the decision-making power is delegated to **State/UT Wetland Authorities** (SWAs) and the "National Wetland Committee," which has largely advisory functions. The central institution, Central Wetlands Regulatory Authority (CWRA), existing under the 2010 Rules, is abolished. It was noted that many state authorities lack technical expertise, financial and human resources to perform tasks like identifying and notifying wetlands, preparing "brief documents," or enforcing prohibited activities. [16]This devolution without adequate oversight increases risks of inconsistent implementation across states.

While Rule 4 of the 2017 Rules prohibits activities such as encroachment, dumping of waste, discharge of untreated effluents, and industries in wetlands, there is a lack of clear binding penalties and appeal mechanisms.[17] Moreover, despite the Supreme Court mapping over **201,503 wetlands** in 2017, many remain unnotified or unprotected in practice.

X. Encroachment and the Urban Flooding Nexus

Urban wetlands and lakes historically functioned as essential hydrological infrastructure: they detained stormwater, recharged aquifers, and formed interconnected drainage networks across expanding cities. When these water bodies are physically reduced, filled, or fragmented by construction, their capacity to attenuate peak runoff collapses. Empirical and modelling studies show that the removal or loss of even smaller urban ponds significantly increases surface runoff and flood depths during extreme rainfall events, turning what would have been manageable inundation into catastrophic urban flooding.

Encroachment occurs in multiple forms: direct infill and construction on lake beds; conversion of peripheral marshes and buffers for roads and real estate; and diffuse pollution (sewage/industrial effluent) that degrades storage capacity by siltation and eutrophication. The **National Wetland Atlas** (ISRO) documented extensive wetland loss over recent decades,

[15] Ramsar Convention Secretariat, *Ramsar Sites in India* (2023), available at https://www.ramsar.org/
[16] Wetlands (Conservation and Management) Rules, 2017, Gazette of India, G.S.R. 1203(E) (Dec. 26, 2017).
[17] Wetlands (Conservation and Management) Rules, 2017, Gazette of India, G.S.R. 1203(E), r. 4

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providing spatial evidence that many urban water bodies have shrunk or vanished.[18] The NITI Aayog flood assessment highlights encroachment and unplanned construction on floodplains/waterbodies as primary anthropogenic drivers that reduce channel and basin carrying capacity.[19]

In Bengaluru, lake-cascade systems that once conveyed excess monsoon flows have been interrupted by development and pollution, contributing to rapid urban waterlogging even under conventional monsoon events. Beyond hydrology, institutional factors compound the problem: fragmented mandates among municipal, state wetland authorities, and development agencies allow encroachment to proceed unchecked; weak monitoring means many wetlands remain unnotified and thus unprotected[20]. Addressing urban flood risk therefore requires both restoration/preservation of wetlands as "green infrastructure" and legal-institutional reforms for timely identification, notification, and enforcement. Nature-based flood mitigation — through lake restoration, buffer protection, and reconnection of cascading water bodies — is cost-effective, climate-resilient, and legally enforceable when backed by robust mapping and governance.

XI. Legal Analysis Encroachment of Lakes and Urban Flooding in Bangalore

Rapid urbanisation in Bengaluru has produced a convergence of ecological degradation and regulatory deficiencies that materially increase flood risk. Encroachments on lake beds, rajakaluves (natural drains), and associated buffer zones transform hydrologic regimes by reducing storage, obstructing conveyance, and accelerating runoff. The legal architecture governing wetlands and waterbodies comprising statutory rules, administrative institutions and judicially-developed environmental principles therefore plays a determinative role in either mitigating or aggravating urban flooding.

The Wetlands (Conservation and Management) Rules, 2017 set the current regulatory baseline but adopt a narrowly circumscribed definition of "wetlands" and decentralize decision-making to State/UT Wetland Authorities[21]. That definitional retreat, combined with the abolition of a dedicated central regulator, creates lacunae in identification, notification and protective measures for many urban waterbodies that are functionally critical for flood attenuation. At the same time, environmental governance in India is layered: central legislation, state laws and municipal planning norms interact with tribunal and judicial oversight, producing a complex compliance landscape.

[18] Indian Space Research Organisation, *National Wetland Atlas* (2011).
[19] NITI Aayog, *Flood Management and Sustainable Development in India* (2021), https://www.niti.gov.in/sites/default/files/2021-03/Flood-Report.pdf.
[20] Indian Institute of Science, *Urban Wetlands and Lakes of Bengaluru: Ecology, Encroachment and Management Challenges* (2019).
[21] Wetlands (Conservation and Management) Rules, 2017

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India's Supreme Court has repeatedly furnished robust remedial principles applicable to wetland protection. Notably, the Court's endorsement of the precautionary principle and the 'polluter pays' norm in environmental cases provides doctrinal support for preventive regulation and restoration orders where encroachment or pollution impairs public goods. These principles permit courts and tribunals to direct remedial action (including demolition, restoration and monetary compensation) where encroachment and development activity have demonstrable adverse environmental impacts. The jurisprudential emphasis on substantive environmental protection thereby supplies legal basis for treating encroachments that aggravate flood risk as cognizable public injury.[22]

Recent judicial practice confirms that courts and the National Green Tribunal (NGT) may, and do, order expansive remedial measures to restore hydrological integrity. The NGT's directions creating protective buffer zones around lakes and rajakaluves, and the Supreme Court's subsequent adjudication of related appeals, illustrate both the capacity and the limits of adjudicatory remedies. Where buffer zones were imposed to prevent construction and restore conveyance, courts have balanced planning statutes against environmental imperatives signalling that retrospective measures to remove encroachments are legally tenable where ecological injury and flood-hazard are proven.

From a legal evidentiary standpoint, establishing causation between encroachment and flood damage requires: (a) mapping pre-encroachment hydrology and storage capacity; (b) demonstrating obstruction or reduction of conveyance (e.g., blocked rajakaluves, narrowed channels); and (c) linking these alterations to increased runoff volumes, faster peak flows or reduced retention during monsoon events. Spatial datasets and hydrological models — as reflected in national wetland atlases and flood-assessment reports — provide the technical substrate courts rely upon when issuing restoration or injunctive relief. The law's remedial toolkit is thus most effective when judicial fact-finding is coupled with rigorous spatial- hydrological evidence.

The principal legal gap is procedural and definitional: non-notification of many urban waterbodies and the exclusion of human-modified wetlands from statutory protection permit incremental encroachments that culminate in systemic flood risk. Doctrinal remedies exist the precautionary principle, expanded judicial standing for public interest petitioners, and the NGT's restorative jurisdiction but their efficacy depends on institutional capacity to implement orders and on harmonizing municipal land-use norms with environmental safeguards.

Legally sustainable flood resilience demands (i) broadening statutory definitions to encompass small and human-modified wetlands; (ii) institutional mechanisms for coordinated identification, notification and enforcement across municipal, state and central agencies; (iii) use of spatial-empirical evidence as standard admissible proof of hydrological harm; and (iv) deployment of judicially-enforced restoration where encroachments demonstrably increase flood risk. Only through aligning legal rules, scientific evidence and administrative oversight the encroachment–flooding nexus in Bengaluru be meaningfully disrupted.

[22] M.C. Mehta v. Union of India (Oleum Gas Leak Case), A.I.R. 1987 1086 (S.C. India).

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XII. Role of Greater Bangalore Authority, and Local Bodies in Wetland Protection and Flood Management

Urban flooding in Bengaluru is intrinsically linked to the governance and regulatory oversight exercised by municipal and metropolitan authorities. The newly proposed Greater Bangalore Authority and related local bodies, occupy a pivotal position in enforcing urban planning norms, preventing encroachment, and maintaining hydrological infrastructure. Legal responsibility in this domain arises from municipal statutes, environmental laws, and delegated powers under central and state regulations, particularly the Wetlands (Conservation and Management) Rules, 2017.

The BBMP was mandated under the Karnataka Municipal Corporations Act, 1976, to regulate land use, control unauthorized constructions, and preserve public amenities. It exercises critical supervisory authority over urban lakes, stormwater drains, and rajakaluves. The Greater Bangalore Authority, envisaged to coordinate planning across multiple municipal limits, is designed to bridge institutional fragmentation, ensuring unified enforcement of development controls, wetland protection, and flood mitigation measures. Both bodies are empowered to issue building permissions, enforce zoning regulations, and execute restoration orders — responsibilities that acquire heightened importance when urbanization encroaches upon ecologically sensitive waterbodies.

Despite statutory mandates, municipal and metropolitan bodies often encounter enforcement deficits, arising from bureaucratic inertia, overlapping jurisdictions, and political pressures. The NGT and Supreme Court have repeatedly emphasized that local authorities must proactively identify encroachments, monitor compliance, and implement remedial measures, including demolition or restoration of illegally occupied wetlands. Judicial precedents, such as

M.C. Mehta v. Kamal Nath, and subsequent NGT directives illustrate that courts can compel BBMP and local authorities to act decisively in protecting hydrological infrastructure, reinforcing their legal accountability.

Effective flood management depends on integrated planning between the BBMP, Greater Bangalore Authority, and other local bodies, including water supply and drainage agencies. These authorities are responsible for maintaining lake peripheries, preserving buffer zones, and ensuring unobstructed rajakaluves. Local Bodies must emphasize that coordinated institutional action is crucial for applying the precautionary principle and preventing cumulative hydrological harm. Failure to harmonize planning and enforcement not only violates environmental statutes but also directly contributes to urban flooding, as evidenced during the monsoon inundations of 2017 and 2022.

Strengthening municipal accountability requires explicit statutory mandates to expand wetland coverage, integrate land-use planning with flood risk assessment, and establish inter-agency coordination mechanisms. Judicial oversight and the precautionary principle remain critical tools, but institutional efficiency at the BBMP and metropolitan level is essential to

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operationalise these principles. Policies that empower local authorities to monitor, prevent, and remediate encroachments, coupled with robust public reporting and participatory governance, can transform Bengaluru's urban hydrology from a reactive to a proactive management regime.

XIII. Gaps and Challenges in Implementation

Despite the promise of the Wetlands (Conservation and Management) Rules, 2017, implementation at the ground level remains deeply problematic. Several gaps legal, institutional, and socio-political undermine their efficacy.

The Rules require states to prepare a list of wetlands and notify them for protection. However, data from the Ministry of Environment, Forest and Climate Change reveal that many states have failed to notify even a fraction of their wetlands. Small wetlands, critical for local flood control, remain excluded due to narrow definitions. This undermines the rule's preventive framework by leaving ecologically significant water bodies unprotected. The abolition of the Central Wetlands Regulatory Authority (CWRA) and delegation of powers to State Wetland Authorities (SWAs) was intended to decentralize governance[23]. Yet, most SWAs lack technical expertise, mapping capacity, and financial resources. In many cases, they exist only on paper. Without institutional strength, rules are merely declaratory and cannot prevent encroachment or pollution. Although the Rules prohibit dumping, discharge of effluents, and construction, enforcement mechanisms are unclear. Unlike the 2010 Rules, the 2017 framework does not explicitly provide for appeal to the National Green Tribunal (NGT). This dilutes accountability, as affected citizens lack a clear remedial forum. Urban wetlands are highly vulnerable to political and commercial interests. Real estate projects, infrastructure development, and even government-sanctioned projects often bypass wetland protection norms. Weak monitoring, coupled with lack of punitive sanctions, allows encroachments to continue with impunity.

XIV. Proposed Legal and Policy Reforms

Addressing the deficiencies of the Wetlands Rules, 2017, requires a multipronged approach that combines legal strengthening with institutional and community reforms.

1. Expanding the Scope of Protection

The restrictive exclusions in the Rules (such as paddy fields and man-made tanks) should be revisited.[24] Smaller and human-altered wetlands play vital roles in flood buffering, groundwater recharge, and biodiversity.

2. Restoring Strong Oversight and Remedies

The abolition of the Central Wetlands Regulatory Authority has created fragmentation. A hybrid model—strong central guidelines coupled with empowered state authorities—could

[23] Wetlands (Conservation and Management) Rules, 2017
[24] Wetlands (Conservation and Management) Rules, 2017

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balance decentralization with accountability. Explicit restoration of appeal mechanisms to the National Green Tribunal would provide judicial recourse for citizens.

3. Enhancing Community Participation

International experience, particularly Ramsar site management in Europe, shows that community monitoring fosters compliance and ecological stewardship. [25]Local fisherfolk, farmers, and resident groups must be institutionalized within wetland authorities.

4. Integrating Wetlands into Urban Planning

Wetlands must be recognized as "green infrastructure" in master plans, zoning laws, and smart city policies. Protecting natural drainage and lake cascades reduces urban flood risk and saves economic costs compared to hard infrastructure.

XV. Conclusion

This study demonstrates that the encroachment of lakes, rajakaluves and ancillary waterbodies in Bengaluru is not an incidental by-product of urban growth but a legally remediable driver of heightened flood risk. Empirical and spatial evidence coherently link the systematic loss and functional impairment of wetlands to increased surface runoff, diminished retention capacity and accelerated peak flows during extreme precipitation. These hydrological outcomes, in turn, manifest in recurring and spatially dispersed urban inundation that undermines public safety, infrastructure resilience and ecological integrity.

From a legal standpoint, the present regulatory architecture exhibits two interrelated deficits. First, definitional and procedural lacunae in the Wetlands (Conservation and Management) Rules, 2017 — notably the exclusion of many human-modified and small urban waterbodies — materially narrow the ambit of statutory protection and thereby enable incremental encroachment. Second, institutional fragmentation following the abolition of a central regulatory authority has attenuated consistent identification, notification and enforcement, producing divergent outcomes across municipal and state jurisdictions. These deficits are compounded by municipal planning and land-use regimes that insufficiently internalize hydrological externalities arising from development decisions.

To redress the encroachment–flood nexus, a calibrated legal and policy response is required. Statutory reform should broaden the definition of protected wetlands to include small, seasonal and anthropogenically altered waterbodies, and streamline mandatory notification procedures. Institutional reform must prioritize integrated metropolitan governance anchoring inter-agency coordination among BBMP, the envisaged Greater Bangalore Authority, state departments and watershed agencies supported by a centralized data platform for wetland inventories and flood-risk modelling.

[25] Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar Org