INDIA Water FOUNDATION

REVITALIZING
THE WETLANDS OF INDIA

PROGRESS REPORT
2025

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Foreword

Dr. Arvind Kumar
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Reflecting on a decade of wetland conservation in India, I offer a critical assessment and measured hope for Guidelines for implementing Wetlands (Conservation and Management) Rules, 2017, which I had the privilege to help draft as a member (Hydrology) of MoEF&CC, GoI. When we proposed an "integrated approach" and advocated for enumerating wetlands in land records to prevent encroachment, we envisioned a transformative framework that would halt the alarming degradation of these critical ecosystems. Similarly, through my role in the Technical Advisory Committee for India's Second and Third National Communication and Biennial Update Reports to UNFCCC, we laid foundational strategies for sustainable climate adaptation and mitigation, recognizing wetlands as nature's frontline defence against climate change impacts.

The reality check presented in this comprehensive report "Status of Wetlands 2025" is both sobering and necessary. While India's designation of 91 Ramsar Sites making us Asia's leader and the world's third-largest wetland network represents commendable progress, the underlying statistics reveal a devastating truth: nearly 40% of our wetlands have vanished over three decades, with 50% of remaining wetlands showing signs of ecological degradation. The proliferation of man-made wetlands now constituting 71% of our wetland area signals not innovation but desperation, a hydrological regime fundamentally altered by human intervention. Cities like Chennai have lost 85% of their wetlands, Mumbai 71%, and Kolkata 36%, directly contributing to the climate disasters these urban centres now regularly face.

The implementation challenges we anticipated have materialized with concerning regularity. Despite clear mandates for the enumeration of wetlands in land records, encroachment continues unabated reports indicate that nearly 10% of water bodies in regions like Noida face illegal occupation, sometimes even by government agencies themselves. The decentralization approach through State Wetland Authorities, while theoretically sound, has faltered due to inadequate institutional capacity, insufficient funding, and weak enforcement mechanisms. Most critically, the exclusion of wetlands smaller than 2.25 hectares from legal protection has created gaping loopholes that developers and encroachers exploit with ease. This oversight is particularly troubling in urban contexts, where small wetlands play a vital role in regulating surface runoff and mitigating urban flooding. For instance, in Seoul, South Korea, the Cheonggyecheon Stream restoration transformed a concretized urban channel back into a functioning wetland system, significantly reducing flood risk while enhancing biodiversity and livability. Similar decentralized wetland systems across Indian cities could serve not only as ecological buffers but also as critical infrastructure for climate resilience. Ignoring the conservation of smaller wetlands, therefore, undermines both environmental security and urban sustainability.

Yet, this report also illuminates pathways forward that align with our original integrated vision. The emergence of community-based conservation initiatives, technological

innovations in monitoring through satellite imagery and drone surveillance, and the growing recognition of wetlands' economic value in climate adaptation present genuine opportunities. The integration of wetland conservation with urban planning, the development of nature-based solutions, and the increasing awareness of wetlands' role in disaster risk reduction offer hope for course correction.

As we stand at this crossroads, the choice is clear: we can continue with fragmented, reactive approaches that have yielded mixed results, or we can embrace the transformative, systemic change that wetlands and our climate-vulnerable nation desperately need. The guidelines we crafted in 2017 remain sound; what we require now is the political will, institutional capacity, and societal commitment to implement them with the urgency that our vanishing wetlands demand.

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Executive Summary

Wetlands are among the most productive and valuable ecosystems on the planet, vital to biodiversity, water security, climate regulation, and the livelihoods of millions. The report ***"Revitalizing the Wetlands of India- Progress report 2025"*** presents a comprehensive and data-rich assessment of the current state of wetlands across India, underscoring both progress and persisting challenges. India's wetlands ranging from high-altitude Himalayan lakes and riverine floodplains to mangroves, coastal lagoons, and man-made reservoirs cover approximately 16.89 million hectares, or 5.12% of the country's landmass. India now boasts 91 Ramsar Sites, the largest number in Asia and third globally, reflecting its growing international leadership in wetland conservation. These ecosystems provide critical services including water purification, groundwater recharge, carbon sequestration, biodiversity conservation, disaster risk reduction, and cultural value. However, the report highlights alarming trends: nearly 40% of wetlands have been lost over the past three decades, and 50% of those remaining are ecologically degraded due to encroachment, pollution, unsustainable land use, and climate change.

Drawing upon extensive national datasets such as the Wetlands Atlas 2024, the National Wetland Inventory and Assessment (2nd Cycle), and satellite-based analyses by ISRO combined with field surveys and citizen science contributions, the report offers a granular overview of wetland distribution, typology, and condition. It identifies that man-made wetlands now constitute over 71% of India's wetland area, a sign of shifting hydrological regimes and increasing human intervention. While inland wetlands dominate the landscape, coastal wetlands remain under significant threat despite their critical role in climate adaptation. The Indo-Gangetic Plains, North-East, and deltaic regions are home to the highest concentrations of wetlands, but even Ramsar Sites such as Kolleru Lake and Deepor Beel show signs of rapid decline due to poor management, nutrient loading, and encroachments.

The report outlines the major drivers of wetland loss, categorizing them into four primary forces: land-use change through urbanization and agriculture; hydrological modifications and pollution from sewage and industrial effluents; climate change impacts such as erratic rainfall and rising sea levels; and biological threats including invasive species and resource over-extraction. The combined effects of these pressures have reduced wetland health, impacted aquatic biodiversity, and diminished their ability to buffer against natural disasters. Wetland health cards assessed under the Wetlands Rejuvenation Programme show only 19% of wetlands rated as "Very High" in ecological integrity, while a majority fall in moderate or poor categories, particularly in urban and industrial corridors.

Despite the challenges, the report also celebrates milestones achieved under flagship national initiatives. The National Plan for Conservation of Aquatic Eco-systems (NPCA), Mission Sahbhagita, the Save Wetlands Campaign, and the Amrit Dharohar initiative have collectively led to improved wetland mapping, community engagement, integrated management planning, and mainstreaming of wetland values into developmental agendas. Over two million citizens have participated in wetland conservation efforts, and over 680 wetlands now have health cards uploaded, reflecting a growing culture of citizen science and environmental stewardship. Additionally, innovative approaches like Payments for Ecosystem Services, green bonds, and wetland carbon assessments are gaining traction as India explores new financing models for ecosystem restoration.

Importantly, the report frames wetlands as not merely environmental assets but as socio-economic lifelines especially for Indigenous and rural communities. Wetlands support traditional fisheries, floodplain agriculture, pastoralism, and cultural practices, sustaining over 90 million people. Case studies from Loktak, Chilika, Kuttanad, and Sambhar Lake illustrate how traditional ecological knowledge and community-based governance can enhance wetland resilience. The economic valuation of wetlands reveals that inland and coastal wetlands contribute ecosystem services worth tens of billions of dollars annually. This underscores the urgent need to incorporate wetlands into national accounts and decision-making frameworks.

Looking forward, the report calls for a paradigm shift in wetland management towards basin-scale planning, cross-sectoral integration, legal enforcement, and inclusive governance. It recommends accelerating national inventories, protecting small and seasonal wetlands, leveraging space-based monitoring technologies, and adopting adaptive management approaches. The *WISER 2025* framework **Wetland Inventory, Science, Economics, Restoration** provides a roadmap that links data, policy, and practice. India's wetland future depends on timely and transformative action: reclaiming wetlands is no longer a conservation choice but an ecological necessity to build a water-secure, climate-resilient, and inclusive future.

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INTRODUCTION

Importance of Wetlands

Healthy, natural wetlands are vital for human survival, providing water, food, biodiversity, climate regulation, and flood control, yet they face mounting threats from urbanization, pollution, and climate change. They also include some of the world's most productive ecosystems and provide ecosystem services leading to countless benefits (MEA 2005; Russi et al. 2013). Wetlands encompass a wide variety of habitats, from lakes, rivers, and marshes that are permanently or seasonally filled with freshwater, to coastal and marine environments like estuaries, lagoons, mangroves, and coral reefs. These ecosystems are fundamental to the global water cycle, supporting primary production, nutrient recycling, and providing essential resources such as freshwater and food for people. Wetlands also serve as vital corridors for transportation and sources for hydropower, while supplying raw materials, genetic resources, and medicinal compounds. Additionally, they play a crucial role in flood mitigation, coastline protection, and carbon storage and sequestration. Beyond their ecological and economic importance, many wetlands hold significant cultural, spiritual, recreational, and inspirational value. Some of these diverse benefits are illustrated in Figure 1.1 below.

However, the contributions that wetlands make to human well-being have often been overlooked or underappreciated. As a result, wetland management has been given little emphasis in development planning. Stakeholders in one sector tend to make decisions based on narrow and short-term interests, which leads to missed opportunities for achieving multiple benefits and causes further wetland loss and degradation. It is essential to encourage policy makers across all sectors to recognize and consider the multiple values of wetlands along with their interdependencies in order to achieve wise use of wetlands and sustainable development. Effective management of wetlands requires collaboration from many sectors of society, particularly those who use the many benefits provided by wetlands or who have the power to influence their management and conservation.

At present, the Ramsar Convention remains the only international treaty dedicated to wetland conservation, guiding countries including India in protecting these ecosystems and supporting global commitments like the SDGs and Paris Agreement. India has made significant strides, increasing its Ramsar Sites to 91 by 2025 and launching initiatives such as Amrit Dharohar and the Wetlands (Conservation and Management) Rules, 2017, but challenges persist in the form of inadequate protection, poor enforcement, and ongoing habitat loss. The "Revitalizing the Wetlands of India Progress Report 2025" highlights both progress and ongoing threats, emphasizing the urgent need for strengthened policies, restoration efforts, and community engagement to ensure wetlands continue to underpin ecological security and resilience for future generations in India. This report outlines the state of the India's wetlands and their associated benefits. It will set a baseline to assess progress on the National Plan for Conservation of Aquatic Eco-systems (NPCA), and strengthen the attention given to wetlands in the Ramsar Convention, Wetlands Rejuvenation Programme, Amrit Dharohar scheme and the regulatory framework under various laws in India. It examines the state and trends of wetlands, identifies knowledge gaps and looks to potential changes in the future. The report identifies many negative trends, but also highlights successes and best practices. It reviews the drivers of wetland loss and degradation and outlines responses for the wetland community and other sector

Scope and objectives of this report

Wetlands in India are critical to the nation's ecological security, water balance, and resilience against climate change. Despite hosting the largest network of

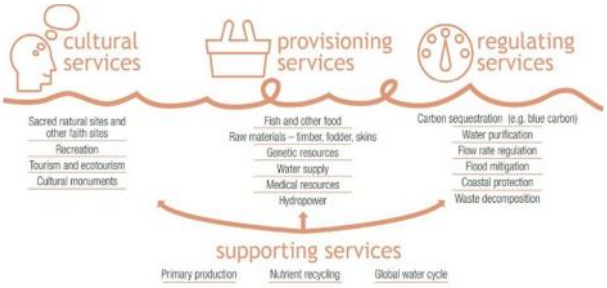


Figure 1.1 Ecosystem Services from Wetlands

Ramsar Sites in Asia and third-largest worldwide; India continues to face significant wetland loss and degradation due to urban expansion, agricultural conversion, unsustainable resource use, and pollution. While protected areas have expanded, many wetlands outside these zones remain vulnerable, often hindered by incomplete inventories and limited monitoring. These ecosystems provide essential services including water purification, flood control, groundwater recharge, climate regulation, biodiversity support, fisheries, and livelihoods for millions of people.

The economic value of these services far outweighs alternative land uses, yet remains insufficiently integrated into national accounting, and the degradation of wetlands has led to increased flooding, water scarcity, biodiversity loss, and greater vulnerability to climate impacts. Meeting international commitments to wetland conservation demands restoration at landscape scales, which in turn requires investment far beyond current funding levels. Innovative financial approaches such as *Payments for Ecosystem Services* and green bonds offer promising avenues to bridge this gap. To effectively reclaim and sustain India's wetlands, it is vital to mainstream wetland conservation into sectoral planning, scale up restoration efforts, strengthen science-policy linkages, and actively involve local communities alongside private sector participation. Urgent actions include completing

comprehensive national wetland inventories, increasing restoration funding, enforcing existing protection laws, and leveraging modern technology like remote sensing and citizen science for robust monitoring and adaptive management. Illustrative success stories from diverse Indian wetlands demonstrate the potential of integrated approaches, underscoring the need to act decisively despite data uncertainties, in order to secure ecological resilience and sustainable livelihoods through wise use and restoration of these indispensable ecosystems.

Water is the new Oil

Water is increasingly being hailed as “the new oil,” underscoring its mounting geopolitical, economic, and humanitarian significance. While oil powered the conflicts and economies of the 20th century, water, utterly irreplaceable and unequally distributed, is fast emerging as the defining resource of the 21st. By 2025, 1.8 billion people are projected to suffer “absolute water scarcity,” and two-thirds of humanity will confront severe water stress as populations swell, demand soars, and climate change disrupts hydrological cycles. The number of countries ranking water supply shortages among their top five risks has leapt from seven in 2024 to 27 in 2025, underscoring its emergence as a leading global threat. Unlike oil where scarcity can spur exploration and substitution freshwater has no substitute, and over 97% of Earth’s water is saline, leaving less than 3% as freshwater, much of which is locked in glaciers or polar ice caps.

In this high-stakes context, wetlands function as indispensable natural infrastructure. By storing and slowly releasing water, they recharge aquifers, moderate floods and droughts, and filter pollutants, ensuring sustained supply of high-quality freshwater for communities, agriculture, and industry. The degradation or loss of wetlands occurring at a global rate of 1–2% per year not only accelerates water scarcity but also undermines resilience to climate extremes, making wetland conservation a linchpin of water-security strategies in an era when every drop is as precious as oil.

Box 1.1 Water is the New Oil

ecosystem services such as carbon sequestration, water purification, flood regulation, and habitat provision for biodiversity.

2030 Sustainable Development Agenda and Sustainable Development Goals (SDGs)

Wetlands are intrinsically linked to achieving the United Nations' 2030 Agenda for Sustainable Development, anchored in 17 Sustainable Development Goals (SDGs) and 169 associated targets. They directly or indirectly contribute to goals related to poverty alleviation, hunger eradication, health, clean water and sanitation, energy, responsible consumption, climate action, and life below water and on land. SDG 6 (Clean Water and Sanitation) emphasizes the protection and restoration of water-related ecosystems, including wetlands, rivers, and lakes, with specific targets to halt their degradation. The Ramsar Convention provides significant data that informs monitoring progress under this goal.

SDG 14 (Life Below Water) drives the protection and sustainable use of coastal and marine ecosystems, which includes coastal wetlands, mangroves, and estuaries, crucial for resilience against climate impacts and sustaining fisheries. SDG 15 (Life on Land) explicitly calls for the conservation, restoration, and sustainable use of
inland freshwater ecosystems, prioritizing wetlands and their critical role in terrestrial ecosystem health. Many SDGs build upon and adapt targets from the earlier Aichi Biodiversity Targets, indicating the fluid nature of international conservation benchmarks, with revisions and updates anticipated beyond 2020 to reflect emerging data and priorities.

Land Degradation Neutrality (LDN)

Under the United Nations Convention to Combat Desertification (UNCCD), the global target of achieving Land Degradation Neutrality aims to halt and reverse the degradation of land across ecosystems, many of which interconnect with water systems supporting wetlands such as peatlands, floodplains, estuaries, and river basins. Wetlands are among the most vulnerable ecosystems to land degradation hotspots worldwide, directly affected by soil erosion, sedimentation, salinization, and altered hydrological regimes driven by unsustainable land use and climate pressures. Achieving LDN requires integrated water-land management approaches that prioritize wetland conservation and restoration to maintain resilience.

Climate hange and Disaster Risk Reduction

Wetlands are recognized in several climate policy frameworks, such as the Paris Agreement under the UNFCCC, for their critical role in carbon storage often termed "blue carbon" in coastal wetlands and in providing natural buffers to extreme weather events. Restoring and conserving wetlands contributes to nature-based solutions that align with Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs), thereby reinforcing global climate action goals.

Moreover, wetlands reduce disaster risk by absorbing floodwaters, reducing storm surges, and maintaining groundwater recharge. As such, they are key to implementing Sendai Framework for Disaster Risk Reduction targets, making

their preservation central to resilience planning.

The Paris Agreememt

The Paris Agreement, adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC), underscores the importance of ecosystem-based approaches including wetland conservation and restoration as effective strategies for both climate mitigation and adaptation. Wetlands play a crucial role in carbon sequestration, especially in peatlands and mangroves, helping countries meet their nationally determined contributions (NDCs) towards greenhouse gas reduction. Many signatory states now explicitly incorporate wetlands management in their climate action plans, recognizing the significant potential of restored and protected wetlands in achieving the objectives of the Paris Agreement.

Biodiversity related multilateral agreements

The Convention on Biological Diversity (CBD), through the Kunming-Montreal Global Biodiversity Framework, has emphasized the conservation, restoration, and sustainable use of wetlands as essential measures to halt biodiversity loss

and promote the resilience of ecosystems. Other biodiversity treaties and frameworks, such as the Convention on Migratory Species (CMS) and the Convention on International Trade in Endangered Species (CITES), highlight wetlands as critical habitats for migratory birds and numerous threatened species. Coordination between these agreements and the Ramsar Convention has intensified collaborative action, setting clear targets for safeguarding wetland-rich habitats and addressing cross-border conservation challenges.

The Ramsar Convention

The Convention on Wetlands is the only international legal treaty with a primary focus on wetlands, signed in 1971 in the Iranian city of Ramsar and known as the Ramsar Convention. It came into force in 1975 and to date 170 countries have joined as Contracting Parties. The wise use framework developed by the Convention provides a mechanism for ensuring that wetlands are incorporated into the global agenda for sustainable development, supporting initiatives relating to biodiversity, climate change, disaster risk reduction and land degradation.

The Convention defines wetlands rather broadly as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Ramsar recognizes 42 wetland types in three categories: marine and coastal wetlands, inland wetlands and human-made wetlands (Ramsar Convention Secretariat 2010a).

Contracting Parties have three primary obligations, the "pillars" of Ramsar:

1. Conserving and using wisely all wetlands;

2. Designating and conserving at least one Wetland of International Importance, or Ramsar Site; and

3. Cooperating across national boundaries on transboundary wetlands, shared wetland systems and shared species (Gardner & Davidson 2011).

Another key Ramsar concept is the ecological character of wetlands: "the combination of the ecosystem components, processes and benefits/ services that characterize a wetland at a given point in time" (Ramsar Convention 2005). Countries are encouraged to maintain the ecological character of all wetlands, and are required to report any adverse human-induced changes in a Ramsar Site to the Secretariat and take necessary actions to restore these sites to their former state.

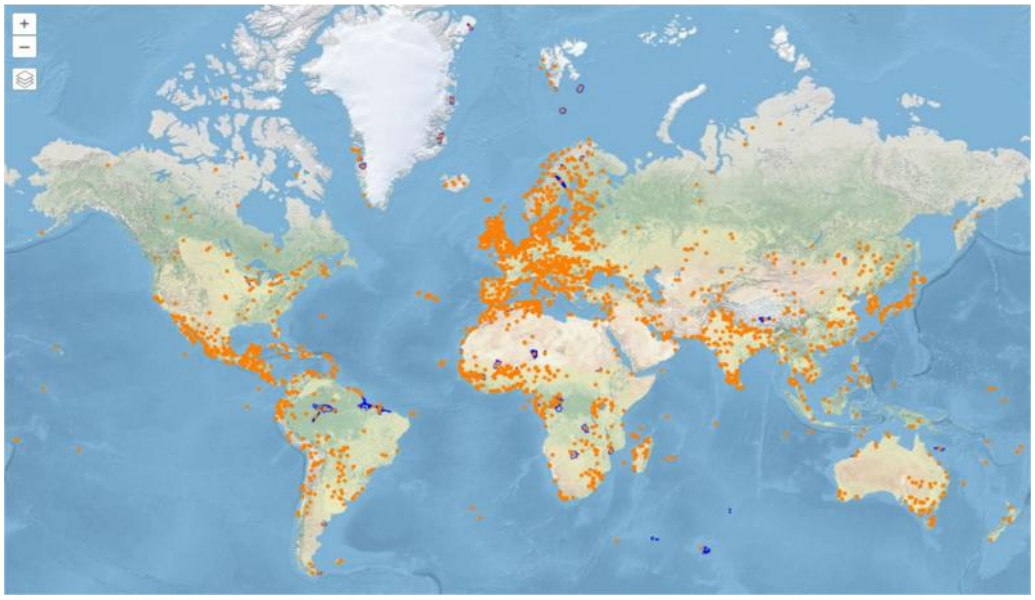


Figure 1.2: Wetlands of International Importance throughout the world. Source: RSIS

National Policy and Guidelines

India's national policy and targets relating to wetlands have evolved in a structured manner through a sequence of policy formulations, action plans, and government schemes, reflecting a deepening commitment to conserving and sustaining its vital wetland ecosystems. The primary policy foundation for wetland management was laid through the **Environment (Protection) Act, 1986,** under which the **Wetlands (Conservation and Management) Rules** were first notified in 2010 and comprehensively revised in 2017. These rules mark a pivotal shift by empowering states to identify, notify, and manage wetlands through **State Wetland Authorities**, mandating inventories, and specifying prohibited activities. The 2017 rules aim for the wise use of wetlands, integrating conservation objectives into developmental planning at all governance levels and granting legal protection, especially for wetlands of international importance designated under the Ramsar Convention.

Complementing this policy, the **National Wildlife Action Plan (2017–2031)** identifies the conservation of inland aquatic ecosystems as a priority area, calling for a national wetlands mission and a biodiversity register as key interventions. The plan emphasizes sustainable management, stakeholder engagement, and the establishment of scientifically informed management frameworks.

In terms of action plans and central-level schemes, the government began with the National Wetland Conservation Programme (NWCP) in 1987, focusing on inventorization, research, awareness, and on-ground conservation of ecologically significant wetlands. This was followed by the National Lake Conservation Plan (NLCP). In 2013, these initiatives were merged for better synergy into the **National Plan for Conservation of Aquatic Ecosystems (NPCA),** a centrally sponsored scheme aimed at holistic conservation of both wetlands and lakes. NPCA supports activities such as pollution abatement, catchment area treatment, biodiversity conservation, and community awareness. This integrated approach factors in comprehensive management, regulatory support, a single-point data portal, and the inclusion of local communities through initiatives like ecosystem health cards and 'Wetland Mitras'.

Recent schemes further underscore the policy's evolution towards community-driven and climate-resilient conservation. Notably, the **Amrit Dharohar scheme**, announced as part of the Green Growth strategy in the 2023 Union Budget, is designed to promote the conservation of Ramsar sites through "sustainable ecosystem development with the help of local communities." Alongside, the newly launched MISHTI (Mangrove Initiative for Shoreline Habitats and Tangible Incomes) scheme focuses on restoring and expanding mangrove cover along India's coasts, comprising financial support and

knowledge sharing for participating states. These schemes ensure central and state cost-sharing, promote eco-tourism, mobilize public-private partnerships, and place local participation at the core.

Collectively, these policies, plans, and schemes are helping India by safeguarding crucial wetland habitats that provide ecosystem services such as water purification, climate regulation, flood mitigation, biodiversity support, and sustainable livelihoods. They have enabled India to expand its Ramsar site network now among the world's largest as well as build a robust legal and institutional framework for wetland management. Importantly, these efforts foster collaboration across sectors and levels of government, mainstream wetland values into decision-making, raise public awareness, and offer models of community stewardship essential for resilience against climate change and ecological degradation

India's Vanishing Urban Wetlands

Chennai has witnessed a catastrophic decline in its network of ponds, marshes and lakes, losing approximately 85 percent of its wetland area over the past three decades. Once home to over 474 distinct wetland complexes, including the Pallikaranai marsh and scores of traditional tanks, the city now retains barely 15 percent of its original blue spaces. This degradation from illegal encroachments and land reclamation to untreated sewage inlets and solid-waste dumping has severely compromised Chennai's natural drainage system, contributing to both devastating floods (2015) and acute water shortages during drought years (2019), and leaving the metropolis more vulnerable to extreme weather.

Hyderabad's storied tank-and-lake system has also collapsed under rapid urban expansion. Satellite imagery from the National Remote Sensing Centre reveals that between 1979 and 2024, the Greater Hyderabad area lost 61 percent of its notified lake surface. Nearly 40 of the city's 185 officially recognised lakes, such as Ibrahim Cheruvu and RK Puram, have dried up completely, while unchecked real estate growth, untreated effluent discharge and poor storm water management continue to drive further losses. As a result, groundwater recharge has plummeted, exacerbating perennial water stress and threatening both biodiversity and urban livelihoods.

Gurugram once dotted with hundreds of water bodies nestled against the Aravalli foothills has seen its wetland cover shrink precipitously. A 2017 assessment by the Gurugram Metropolitan Development Authority documented a fall in total water-body area from 55.25 km² in 2007 to 12.43 km² in 2017, a 77.5 percent reduction. If current trends persist, projections estimate that by 2025, the city's natural water bodies will dwindle to 0.42 km², effectively erasing nearly 100 percent of its remaining blue spaces. Basai village's famed 260 hectare marsh once a haven for 20,000 migratory birds has been largely lost to waste-processing plants and housing plots,

Box 1.2 India's Vanishing Urban Wetlands

EXTENT AND TYPES OF WETLANDS

Classification and Mapping of Wetlands

Wetlands are central to meeting many of the United Nation's 17 Sustainable Development Goals (SDGs) and 169 associated targets, focusing on poverty, hunger, health, energy, consumption and climate change. One of the difficulties most frequently faced for decision-making is lack of scientific data of our natural resources. Often the data are sparse or unconvincing, rarely in the form of geospatial database (map), thus open to challenges. Thus, the current thrust of every country is to have an appropriate geospatial database of natural resources that is based on unambiguous scientific methods2. Regular updation of the status of the wetlands is more significant in view of accelerating pressure on the very existence of these resources due to developmental activities and population pressure being witnessed currently. Over a period of time, the database of wetlands has been widely used in developmental activities that require environmental clearances etc.

Aquatic biodiversity is dependent on hydrologic regime; geological conditions and efforts are being made to conserve the biodiversity found in wetlands, streams and rivers. The goal of this irreplaceable biodiversity is to minimize its loss through sustainable management and conservation practices (Groombridge & Jenkins 1998). In India, lakes, rivers and other freshwaters support a large diversity of biota representing almost all taxonomic groups. Algae in open waters represent the floristic diversity and macrophytes dominate the wetlands. Wetlands are also important as resting sites for migratory birds. Aquatic vegetation is a valuable source of food, especially for waterfowl. In the winter, migratory waterfowl search the sediment of wetlands for nutritious seeds, roots and tubers (Tiner, 1999).

Indian land mass is characterised by highly diversified climate, landforms and landscapes spreading over high altitude mountain system, long coastline, surface and subsurface geological formations, forests types and various land cover systems. The interactive processes among these natural regions lead to formation of wetland ecosystems. Natural wetlands in India consists of the high-altitude Himalayan lakes, followed by wetlands situated in the flood plains of the major river systems, saline and temporary wetlands of the arid and semi-arid regions, coastal wetlands such as lagoons, backwaters and estuaries; mangrove swamps; coral reefs and marine wetlands etc.

The first National Wetland Inventory and Assessment (NWIA) of India was conducted in 2006-07, providing a baseline national inventory of wetlands (≥2.25ha) based on remote sensing data. Recognizing the need for updated, more accurate information due to rapid land use changes and increased pressures, the Space Applications Centre (SAC) of ISRO launched the "National Wetland Inventory and Assessment - 2nd Cycle," using Resourcesat-2/2A LISS-III satellite data for 2017-18 and following refined technical guidelines.

This second cycle employed consistent methodology with the previous inventory but leveraged advances in remote sensing, GIS, and multi-temporal satellite imagery. Wetlands were classified according to a hierarchical system: Level-I differentiated between inland and coastal wetlands; Level-II split each into natural and man-

made wetlands; Level-III provided 20 specific wetland types (excluding rice paddies for standardized reporting). This structure is harmonized with IUCN/Ramsar definitions and designed for compatibility with international reporting needs.

The updated inventory shows that, as of 2017-18, India's mapped wetlands (excluding rivers and rice fields, and counting only areas ≥2.25ha) cover approximately 15.98 million hectares, representing about 4.86% of India's geographic area. This reflects a more refined and comprehensive mapping approach, using both state-level validation and time-series analysis (including Google Earth and extensive ground surveys) for higher accuracy. Significant advances include better delineation of smaller wetlands, seasonal and temporary water bodies, and systematic updating of boundaries and wetland attributes.

The new NWIA geo-database now provides a foundation for national wetland management and policy, offering state and district-wise details on wetland area, type, and ecological context. Despite these advances, the inventory underscores ongoing data challenges: persistent gaps for wetlands <2.25ha, classification inconsistencies at sub-state levels, and a need for more frequent real-time updates to reflect changes from urbanization, climate variability, and anthropogenic pressures.

This reassessed database publicly accessible via VEDAS (SAC-ISRO) and government portals enables more informed conservation planning, prioritization of restoration efforts, and reporting for national schemes and international conventions. The 2nd Cycle of NWIA represents a significant step forward in India's ability to monitor, assess, and manage its invaluable wetland resources for ecological security and resilience.

The details of National Wetlands Classification System are given in the Table 2.1.

Table 2.1: Classification of India's Wetlands System
Source: Wetland Classification System (Ref: Garg J.K. and Patel J. G., 2007)

Level-I	Level-II Code	Level-III Code
Inland Wetlands	Natural (1100)	1101: Lakes
		1102: Ox-Bow Lakes/Cut-off Meanders
		1103: High altitude Wetlands
		1104: Riverine Wetlands
		1105: Waterlogged (natural)
		1106: River/Stream
	Man-made (1200)	1201: Reservoirs/Barrages
		1202: Tanks/Ponds
		1203: Waterlogged (man-made)
		1204: Salt Pans (inland)
		1205: Aquaculture ponds (inland)
Coastal Wetlands	Natural (2100)	2101: Lagoons/Backwaters
		2102: Creek
		2103: Sand/Beach
		2104: Intertidal mud flats
		2105: Salt marsh
		2106: Mangroves
		2107: Coral Reefs
	Man-made (2200)	2201: Salt Pans (Coastal)
		2202: Aquaculture ponds (coastal)

Geographic Extent

India has a large variety of freshwater, saline and marine wetlands. A vast majority of the inland wetlands are temporary and/or man-made. During the past two decades, wetlands have received increasingly greater attention, from the viewpoint of their hydrology, ecology as well as conservation. Large seasonal and year to year variations occur in the water level of rivers, lakes and reservoirs. In terms of wetland habitats, a large majority of wetlands in the region is therefore not only seasonally temporary but many of them often appear and disappear in successive years. However, wetlands of the Indian subcontinent are unique due to their interaction with human populations for several millennia. The diverse eco-climatic regimes extent in the country resulted in a variety of wetland systems ranging from high altitude cold desert wetlands to hot and humid wetlands in coastal zones with its diverse flora and fauna. India, with its annual rainfall of over 115 cm, varied topography and climatic regimes support and sustain diverse and unique wetland habitats. Natural wetlands in India consists of the high altitude Himalayan lakes, followed by wetlands situated in the flood plains of the major river systems, saline and temporary wetlands of the arid and semi-arid regions, coastal wetlands such as lagoons, backwaters and estuaries; mangrove swamps; coral reefs and marine wetlands, and so on. In fact with the exception of bogs, fens and typical salt marshes, Indian wetlands cover the whole range of the ecosystem types found. In addition to the various types of natural wetlands, a large number of man-made wetlands also contribute to the faunal and floral diversity. These man-made wetlands, which have resulted from the needs of

majority of the inland wetlands are directly or indirectly dependent on the major rivers like, Ganga, Brahmaputra, Narmada, Godavari, Krishna, Kaveri, Tapti. They occur in the hot arid regions of Gujarat and Rajasthan, the deltaic regions of the east and west coasts, highlands of central India, wet the Andaman and Nicobar & Lakshadweep islands. India has a wealth of wetland ecosystems that support diverse and unique habitats. These wetlands provide numerous ecological goods and services but are under tremendous stress due to rapid urbanization, industrialization and agricultural intensification, manifested by the decline in the hydrological, economic and ecological functions they perform.

The extent of an ecosystem is the starting point for the compilation of the accounts. It records the total area of each ecosystem classified by type within the ecosystem accounting area. Ecosystem extent accounts are measured over time by ecosystem type, thus illustrating the changes in extent from one ecosystem type to another over the accounting period. During the past two decades, wetlands have received increasingly greater attention, from the view point of their hydrology, ecology as well as conservation. Large seasonal and year to year variations occur in the water level of rivers, lakes and reservoirs. In terms of wetland habitats, a large majority of wetlands in the region is therefore not only seasonally temporary but many of them often appear and disappear in successive years.

According to the most recent and comprehensive assessment conducted by the Space Applications Centre (SAC) of ISRO, as reflected in the 2024 Wetlands Atlas, India's wetland resources span an estimated 16.89 million hectares. This accounts for roughly 5.12% of the nation's total geographic area and marks a significant advancement in precision mapping, thanks to the use of high-resolution Resourcesat-2/2A LISS-IV satellite imagery and ground truthing. The updated inventory considers both inland and coastal wetlands, and classifies them into 20 distinct types based on an internationally harmonized system aligned with IUCN/Ramsar definitions, ensuring compatibility with global reporting standards. Notably, the database captures over 3.58 million individual wetlands, including both larger bodies (2.49 million wetlands ≥0.1ha) and smaller or temporary water bodies (1.09 million <0.1ha), offering a granular view that surpasses earlier national inventories. According to the Directory of Asian Wetlands (1989), wetlands occupy 18.4% of the country's area (excluding rivers), of which 70% are under paddy cultivation. The coastal wetlands occupy an estimated 6,750 sq. km and are largely dominated by mangrove vegetation. About 80% of the mangroves are distributed in the Sundarbans of West Bengal and the Andaman and Nicobar Islands, with the rest in the coastal states of Odisha, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Goa, Maharashtra, and Gujarat.

The latest mapping and incorporation of more nuanced data layers have provided critical insights into the distribution, typology, ecological significance, and vulnerability of India's wetland ecosystems. Such progress directly supports evidence-based conservation planning, restoration initiatives, and policy interventions at both national and sub-national scales. The Wetlands Atlas and associated datasets are publicly accessible via portals such as VEDAS (SAC-ISRO), reflecting a commitment to transparency and ongoing scientific progress. These

efforts underscore the importance of wetlands in shaping India's ecological security, climate resilience, and socio-economic well-being, while providing a robust foundation for monitoring changes and guiding future management strategies.

Sr. No.	Wetcode	Wetland Category	Number of wetlands	Total wetland area	% of wetland area	Open Water	
						Post-monsoon area	Pre-monsoon area
	1100	**Inland Wetlands – Natural**					
1.	1101	Lake/Pond	11740	729532	4.78	454416	198054
2.	1102	Ox-bow lake/Cut-off meander	4673	104124	0.68	57576	37818
3.	1103	High altitude	2707	124253	0.81	116615	109277
4.	1104	Riverine wetland	2834	91682	0.60	48918	29739
5.	1105	Waterlogged	11957	315091	2.06	197003	112631
6.	1106	River/Stream	11747	5258385	34.46	3226238	2628182
	1200	**Inland Wetlands -Man-made**					
7.	1201	Reservoir/Barrage	14894	2481987	16.26	2260574	1268237
8.	1202	Tank/Pond	122370	1310443	8.59	916020	349512
9.	1203	Waterlogged	5488	135704	0.89	85715	33822
10.	1204	Salt pan	60	13698	0.09	5293	2599
		Total - Inland	188470	10564899	69.23	7368368	4769871
	2100	**Coastal Wetlands – Natural**					
11.	2101	Lagoon	178	246044	1.61	208915	191301
12.	2102	Creek	586	206698	1.35	199743	189489
13.	2103	Sand/Beach	1353	63033	0.41		
14.	2104	Intertidal mud flat	2931	2413642	15.82	516636	366953
15.	2105	Salt Marsh	744	161144	1.06	5369	2596
16.	2106	Mangrove	3806	471407	3.09	–	–
17.	2107	Coral Reef	606	142003	0.93	–	–
	2200	**Coastal Wetlands – Man-made**					
18.	2201	Salt pan	609	148913	0.98	105253	94047
19.	2202	Aquaculture pond	2220	287232	1.88	196514	186963
		Total – Coastal	13033	4140116	27.13	1232430	1031349
		Sub-Total	201503	14705015	96.36	8600798	5801220
		Wetlands (2.25 ha)	555557	555557	3.64	–	–
		Total	**757060**	**15260572**	**100.00**	**8600798**	**5801220**

Table 2.2: National Wetlands Statistics Source: Wetlands of India Portal

The pie chart from the Wetlands of India Portal provides a clear overview of the type-wise distribution of wetlands across the country. The data reveals a pronounced predominance of man-made inland wetlands, which account for a remarkable 71% of the total wetland area. This underscores the substantial influence of human interventions such as reservoirs, ponds, and tanks in shaping India's present wetland landscape a reflection of both historical water management traditions and contemporary responses to water scarcity in many regions.

Natural inland wetlands, comprising lakes, marshes, and river floodplains, represent 23% of the total. Although they form the bedrock of India's freshwater biodiversity and ecosystem services, their relatively smaller proportion highlights the widespread conversion, fragmentation, and degradation these systems have faced over time. Coastal wetlands, both natural (mainly mangroves, lagoons, and tidal flats) and man-made (such as salt pans and aquaculture ponds), collectively make up only 6% (with 5% natural and 1% man-made). This lower share, despite India's long coastline and vast deltaic regions, suggests substantial loss of coastal wetland extent and the ongoing threats posed by urbanization, industrial development, and changing land use at the land-sea interface.

The distribution presented indicates a transition in India's wetland character, with artificial systems now dominating the national inventory. This has important implications for biodiversity conservation, hydrological regulation, and climate resilience, as man-made wetlands often provide different ecosystem services and are more vulnerable to intensive exploitation and rapid change. The data highlights the need for balanced conservation and wise use policies that address both the restoration of natural wetlands and the sustainable management of expanding artificial wetland systems.

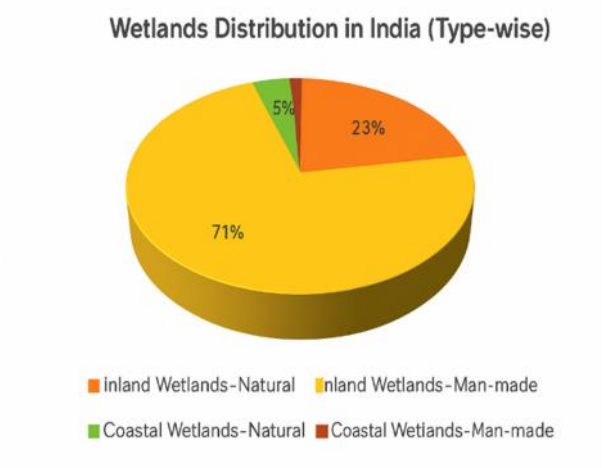


Chart 2.1: Wetland Distribution in India
Source: Wetlands of India Portal

A global study published in Nature in 2023 with a longer-term reconstruction of natural wetland change suggests that India may have had 61.3 million hectares of natural wetlands in 1700, which nearly halved to 37.2 million hectares by 2020. India has been indicated as the top three countries (after the United States and China) in terms of wetlands loss during 1700- 2020. India is a land of small wetlands. As per 2024 Atlas, wetlands less than 0.1 ha comprise 90 per cent of the total wetlands. However, none of the change studies capture the dynamics in the extent of these ecosystems.

The 2024 Atlas and 2022 Atlas are based on remote sensing images of only a years' difference, with the former using higher resolution data as compared with the latter. However, surprisingly and counter-intuitively, in the 2024 atlas, a reduced wetland area has been reported for several categories. In the inland wetlands category, a reduced area has been reported for lakes (37 per cent), riverine wetlands (34 per cent), nature waterlogged (21 per cent), human-made waterlogged (44 per

cent), salt pans (33 per cent), oxbows (four per cent) and high-altitude wetlands (two per cent).

Similarly, in the coastal wetlands category, a reduced area has been reported for sand/beach (25 per cent), lagoon (six per cent), intertidal wetlands (35), saltpans (13 per cent) and coral reefs (two per cent). The 2024 Wetlands Atlas has reported a significant increase in the number of wetlands due to enhanced resolution and revised classification methods. However, inconsistencies persist between the 2022 and 2024 atlases due to varying classification systems. The current 20-fold typology, though adapted from Ramsar's framework, lacks standardisation and omits crucial wetland types like peatlands and seagrasses.

Remote sensing, the primary tool for mapping, faces limitations due to the dynamic nature and diversity of wetlands. Optical imagery, while useful, needs to be augmented with radar, LiDAR, and InSAR technologies to capture seasonal variations, sub-surface water, vegetation types, and elevation data more accurately. Ground truthing remains essential to improve accuracy and usability.

Existing atlases mostly capture extent and basic characteristics, falling short in assessing wetland conditions or ecosystem functions vital for informed policy and planning. A robust national inventory must integrate ecological, hydrological, and spatial data and adopt a function-based classification. It should also be tailored to meet the practical needs of state wetland authorities and managers.

India has an opportunity to lead wetland inventory development in South Asia by sharing its experiences in mapping, classification, and management.

TRENDS IN WETLAND LOSS AND DEGRADATION

A focused examination of wetland trends since 2014 reveals a continuation of persistent, substantial declines in both the area and quality of India's wetlands. Over the past decade, wetlands have continued to shrink and degrade under sustained pressures. Data from recent satellite-based inventories show a discernible reduction in wetland extent, particularly around rapidly urbanizing regions, expanding agricultural lands, and infrastructural corridors. Notable metropolitan areas have witnessed further drastic shrinkage; for instance, between 2014 and 2024, reports indicate additional wetland losses in cities like Mumbai, Chennai, and Hyderabad, compounding already severe historical declines.

Nationally, comprehensive wetland monitoring efforts, such as the updated National Wetlands Inventory and Assessment (NWIA), have documented ongoing contraction and fragmentation of major wetland systems, with small and seasonal wetlands at heightened risk of disappearance due to insufficient legal protection and encroachment. The degradation is not confined solely to areal loss ecological functions such as water purification, flood buffering, biodiversity support, and groundwater recharge are reported to have suffered, as evidenced by declining water quality, reduced aquatic biodiversity, and impaired hydrological regimes in affected basins.

Although there has been an increase in Ramsar site designations and a scaling up of restoration projects since 2014, these efforts have been unable to match the scale of ongoing losses outside protected areas. Overall, the period since 2014 is marked by a sustained and measurable negative trend in India's wetlands, further reinforcing the urgency for comprehensive restoration and stronger wetland management interventions.

Current rates of wetland loss and degradation

According to the Global Wetland Outlook 2025 and corroborated by recent national assessments and environmental journalism, the current rates of wetland loss and degradation in India are both substantial and alarming. Over the last 30 years, it is estimated that nearly 40% of India's wetlands have disappeared entirely, with much of this decline occurring outside the boundaries of protected areas such as Ramsar sites. Additionally, of the remaining wetlands, close to 50% exhibit signs of ecological degradation manifested in declining water quality, reduced biodiversity, and impaired ecosystem services like groundwater recharge and flood buffering.

Quantitatively, the annual rate of wetland loss in India aligns closely with the global trend, which is approximately -0.52% per year since 1970 as reported in the Global Wetland Outlook 2025. This means that every year, India is losing more than half a percent of its total wetland area, a rate that, while average in global terms, is particularly acute given the population pressures and land use changes in the country. The ongoing loss is most pronounced in urban and peri-urban landscapes, and in agriculturally dominant regions. As smaller, seasonal, and unprotected wetlands vanish, their capacity to deliver essential ecosystem services, support livelihoods, and buffer against climate extremes diminishes further.

While there have been positive developments but these policy

interventions and isolated restoration projects have not been able to sufficiently offset the scale and speed of the ongoing decline. The fact that nearly half of the remaining wetlands are degraded indicates that current conservation efforts are proving inadequate in the face of rising anthropogenic and climate pressures. The scientific consensus, drawn from synthesized global and Indian sources, is that unless urgent and comprehensive measures are adopted, the downward trajectory in wetland extent and health is set to continue, undermining India's ecological security and resilience.

Regional and ecosystem-specific analyses

A comprehensive analysis of India's wetlands, drawing upon the most recent government data such as the 2024 Wetlands Atlas by ISRO's Space Applications Centre and other national inventories, reveals significant regional and ecosystem-specific variations in wetland extent, condition, and trends. With a total of approximately 2.49 million wetlands covering about 16.84 million hectares equivalent to 5.12% of the country's geographic area this inventory highlights the critical role of wetlands within major river basins. The Indo-Gangetic Plains and north-eastern river basins like the Ganga and Brahmaputra harbour the greatest concentration of inland freshwater wetlands. The Ganga Basin leads in both the number and area of wetlands, encompassing nearly 4.09 million hectares or 23.8% of India's total wetland extent, emphasizing the basin's ecological importance in sustaining biodiversity and hydrological functions. Other prominent basins include the Godavari, Brahmaputra, Krishna, and Mahanadi, collectively hosting large wetland areas vital for maintaining regional ecological balance, water regulation, and livelihoods.

In contrast, peninsular India is characterized by numerous artificial wetlands such as tanks, reservoirs, and irrigation ponds mainly in water-scarce states like Andhra Pradesh, Karnataka, and Tamil Nadu which, while numerous, often face challenges related to water quality degradation and siltation. The western dry zones, including Rajasthan and Gujarat, feature important seasonal saline wetlands like the Rann of Kutch and Sambhar Lake; these are ecologically sensitive and vulnerable to climatic fluctuations. Coastal regions, particularly in West Bengal, Odisha, Tamil Nadu, and Andhra Pradesh, encompass extensive mangroves, lagoons, tidal flats, and salt marshes. These coastal wetlands are critical habitats for migratory birds and marine life and provide natural buffers against cyclones and sea-level rise.

The Andaman and Nicobar Islands stand out with wetlands covering more than 95% of the basin's area, predominantly mangrove forests and coral reef ecosystems, reflecting the unique status of island and coastal wetland ecosystems that are especially important for habitat diversity and climate resilience. This wide variation in wetland coverage relative to basin or state size underscores the need for regionally tailored conservation and management strategies that recognize distinct ecological contexts and the pressures faced by different basins. Such a basin-wise perspective serves as a crucial guide for prioritizing restoration efforts, safeguarding ecosystem services, and enhancing India's overall ecological security through the wise use of its wetlands.

Ecosystem-specific assessments indicate that natural inland wetlands are experiencing fragmentation and significant

declines, especially smaller wetlands under two hectares, which are critical for local water security but often overlooked in protection efforts. While mangrove ecosystems have seen marginal gains in certain regions due to restoration efforts, salt marshes and intertidal mudflats continue to diminish substantially because of upstream water diversion and coastal development. Artificial wetlands, although increasing in number, frequently face degradation caused by pollution and inadequate management.

State-wise, the distribution of Ramsar sites numbering 91 concentrates heavily in coastal and Indo-Gangetic regions, with Tamil Nadu hosting the largest number. However, many Ramsar sites such as Deepor Beel and Kolleru Lake continue to suffer from urban encroachment and pollution, underscoring that designation alone is insufficient without robust, ongoing site management and protection measures.

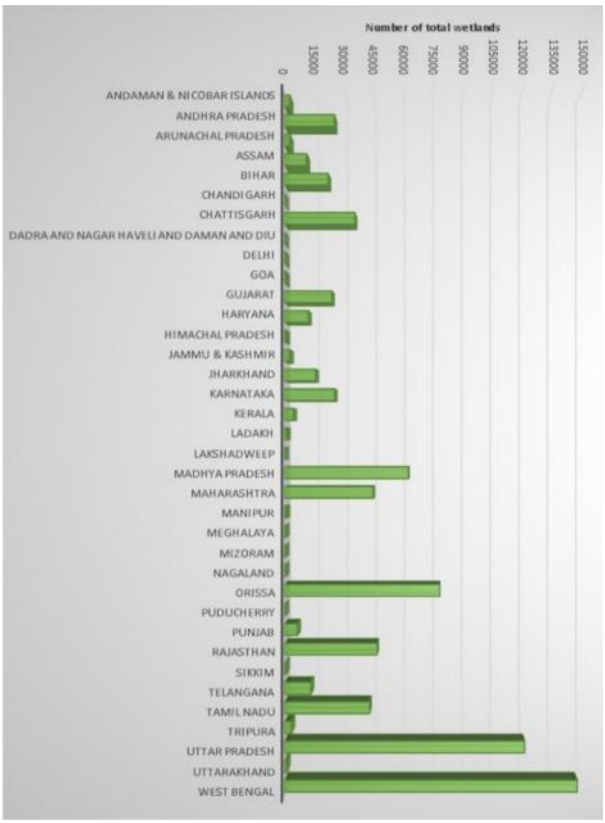
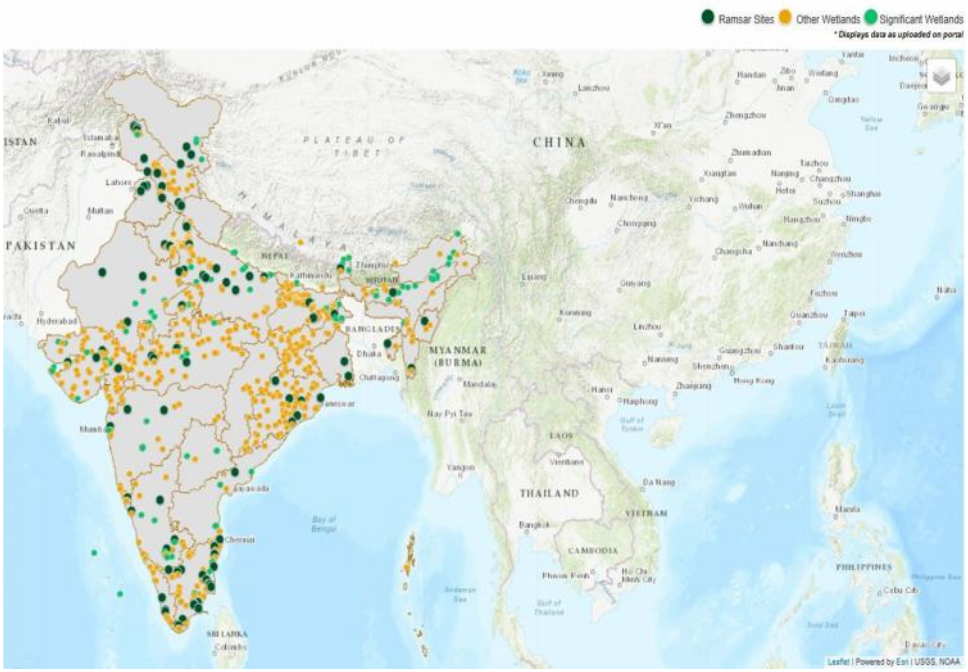


Chart 3.1:
State-wise distribution of Wetlands
Source: Wetlands of India Portal



Map 3.1:
Interactive Wetland Map
Source: Wetlands of India Portal

DRIVERS OF LOSS & DEGRADATION

The loss and degradation of wetlands in India is driven by a complex array of interconnected factors that have accelerated in recent years. Based on the latest government data and scientific assessments, these drivers can be categorized into four primary areas that collectively threaten India's wetland ecosystems.

Land-Use Change (Agriculture and Urbanization)

Land-use change remains the most significant driver of wetland loss in India, with urban expansion and agricultural conversion fundamentally altering the landscape. Recent data reveals that rapid urbanization has led to catastrophic wetland losses in major cities: Chennai lost 85% of its wetlands due to unplanned urban development, Mumbai experienced a 71% reduction, Hyderabad lost 55%, and Delhi-NCR witnessed a 38% decline. The National Land Use and Land Cover Atlas indicates that built-up areas have increased by 30.77% between 2005-2023, with much of this expansion occurring at the expense of wetlands and agricultural lands. Urban development pressures are particularly intense around metropolitan areas, where wetlands are routinely filled, drained, or converted for housing, commercial infrastructure, roads, and waste disposal. Agricultural expansion continues to drive wetland conversion, especially in fertile floodplains and marshes that are drained for crop cultivation and aquaculture. The construction of field bunds, canals, and irrigation infrastructure further disrupts natural wetland hydrology, reducing their ecological functionality. Recent case studies, such as the Najafgarh wetland area, demonstrate how agricultural lands surrounding wetlands are being converted to urban infrastructure, with over 2.90 km² of agricultural land converted to built-up areas and significant portions transformed into open spaces for future development.

Water Resource Development and Pollution

Large-scale water resource projects and pollution constitute the second major driver of wetland degradation. The construction of dams, barrages, embankments, and diversion channels has fundamentally altered hydrological regimes of both inland and coastal wetlands, disrupting natural water flows and causing either waterlogging or desiccation in different regions. Parliamentary data from February 2024 reveals that over 402.67 million litres per day of industrial effluents from 3,186 grossly polluting industries are discharged into major rivers like the Ganga and Yamuna, with significant biochemical oxygen demand loads of 19.74 tonnes per day. Sewage pollution presents an even more severe challenge; India generates approximately 72,368 million litres of sewage daily but has operational capacity to treat only 37% of it, actually treating merely 28%. This massive volume of untreated wastewater, containing high nutrient loads, heavy metals, pharmaceuticals, and industrial chemicals, flows directly into wetland systems, causing eutrophication, oxygen depletion, algal blooms, and severe degradation of water quality. Coastal wetlands face additional pressures from port development, seawalls, and aquaculture expansion, while industrial effluents containing chemicals and heavy metals continue to contaminate both freshwater and coastal wetland systems.

Climate Change Impacts

Climate change is increasingly exacerbating existing pressures on Indian wetlands while introducing new risks. The Global Wetland Outlook 2025 confirms that climate change impacts are becoming more pronounced, with erratic precipitation patterns, prolonged droughts, and altered monsoon timing leading to irregular wetting and drying cycles in wetland systems. In high-altitude Himalayan and north-eastern wetlands, changing glacial melt patterns and altered snowfall regimes disrupt natural inflow and hydro-periods. Coastal wetlands face particular vulnerability from rising sea levels, which cause salinization and submergence of tidal wetlands, salt marshes, and mangroves. The increased frequency and intensity of extreme weather events, including cyclones and floods, accelerate physical and ecological disturbance in wetland ecosystems. Temperature increases and changing precipitation patterns also alter habitat suitability for wetland-dependent species, disrupt migratory routes, and undermine the ecosystem services that wetland-dependent communities rely upon for their livelihoods.

Invasive Species and Resource Extraction

The proliferation of invasive species and unsustainable resource extraction represent significant threats to wetland ecosystem integrity. Water hyacinth (Eichhornia crassipes) has emerged as a particularly aggressive invader, with recent studies showing it can reproduce from 10 plants to 655,360 plants covering approximately half a hectare in just 8 months. In India, control measures for water hyacinth cost over ₹2.3 billion annually, with approximately two million hectares of water bodies affected. The invasive species forms dense mats covering 75-94% of surface waters in severely affected areas like Kerala's Kuttanad region, blocking sunlight, depleting oxygen, altering water chemistry, and creating ideal breeding grounds for disease vectors. Other invasive species include alligator weed, common reed, salvinia, and various invasive fish species like common carp and African catfish, which displace native species and disrupt aquatic food webs. Resource over-extraction compounds these problems through excessive water abstraction for irrigation and urban use, unsustainable fishing practices, peat and clay mining, sand extraction, and overharvesting of wetland vegetation for fuel, fodder, and construction materials. The combination of invasive species proliferation and resource depletion pushes wetland ecosystems beyond their ecological tipping points, resulting in irreversible habitat degradation and biodiversity loss.

These four primary drivers work synergistically to accelerate wetland loss and degradation across India. The persistence and interaction of land-use change, hydrological alteration, pollution loads, climate stressors, biological invasions, and unsustainable resource use have resulted in the documented loss of nearly 40% of India's wetlands over the past 30 years, with approximately half of the remaining wetlands considered ecologically degraded. This situation underscores the urgent need for coordinated, cross-sectoral action to address these multiple, interconnected threats to secure the future of India's vital wetland ecosystems.

HEALTH OF WETLAND ECOSYSTEMS

Where do we stand?

The Ministry of Environment, Forest and Climate Change (MoEFCC) aims to conserve a network of healthy wetlands which sustain rich biodiversity and provide wide ranging ecosystem services for societal well-being. 'Wetlands rejuvenation' is a transformative idea of the Government of India, under which systematic rejuvenation is being initiated of selected wetlands on the basis of well-defined and targeted management plans and with active stakeholder collaboration. The State Wetlands Authorities and wetlands managers are at the forefront of implementation of this programme, with the Ministry providing an enabling environment in the form of programmatic framework, capacity development, and financing (on convergence basis).

The programme is structured around a four pronged approach:

i. Developing baseline information

ii. Rapid assessment of wetlands condition

iii. Enabling stakeholder platforms

iv. Management planning

A total of 21,12,832.96 hectares of wetlands now have Health Cards uploaded to the portal, covering 684 distinct wetlands nationwide. These Health Cards are distributed by wetland size as follows:

- ≤ 10 ha: 157 wetlands
- 11–100 ha: 162 wetlands
- 101–1,000 ha: 251 wetlands
- 1,001–5,000 ha: 63 wetlands
- 5,001–10,000 ha: 19 wetlands
- 10,001–50,000 ha: 17 wetlands
- 50,001–100,000 ha: 8 wetlands
- 100,000 ha: 3 wetlands.

Health Cards have been uploaded by all States and UTs; the highest counts are from Madhya Pradesh (94), Gujarat (77), Odisha (77), Bihar (71), and Tamil Nadu (71), while the National Capital Territory of Delhi contributes 56 Health Cards.

This framework evaluates each wetland against nine key indicators across four categories landscape change, hydrology, water quality & biodiversity, and governance each scored against a "desired value" and aggregated into an overall health rank. Under landscape change, the percentage of wetland area converted to non-wetland use since 2000 is measured (with a target of zero conversion). Hydrological integrity is gauged by the proportions of natural inlets and outlets that are choked or diverted (each desired to be under 20 percent). Water quality is monitored via Biological Oxygen Demand and Dissolved Oxygen (and, for urban wetlands, Chemical Oxygen Demand) samples, seeking ≥ 6 mg/L DO and COD < 50 mg/L to ensure aquatic ecosystem viability. Biodiversity health is captured by the extent of invasive macrophyte coverage (target < 10 percent of wetland area) and, in high-ornithological-value sites, the ratio of current to maximum waterbird counts over the past decade

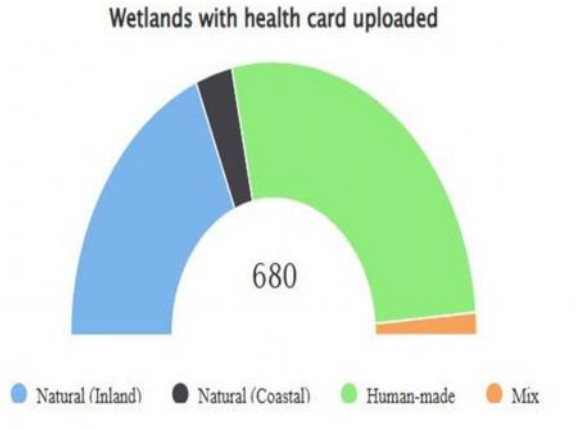


Chart 5.1: Wetlands with health card uploaded. Source: Wetlands of India Portal

(with a benchmark of ≥ 0.7). Finally, governance is evaluated through the existence and formal approval of wetland maps

and Integrated Management Action Plans

by State Wetland Authorities, along with legal notification under national regulations. Each indicator is graded (A to E), weighted, and synthesized into a composite health score that is classified from "Very Good" (A+) to "Very Low" (E). This detailed, rapid assessment protocol applied to over 680 wetlands provides a transparent, comparable, and actionable snapshot of ecological character, guiding prioritization of restoration and management interventions and enabling adaptive governance across India's diverse wetland landscapes.

Category	Indicator	Desired Value
Conversion to non-wetlands use	% wetland area converted to non-wetland use since the year 2000	No conversion to non-wetland use
Hydrological regimes	Ratio of natural inlets choked and diverted to total number of natural inlets	<0.2
	Ratio of natural outlets choked & diverted to total number of natural outlets	<0.2
	% of water quality samples conforming to desired Biological Oxygen Demand / Dissolved Oxygen levels*	Dissolved Oxygen >= 6 mg/l Biological Oxygen Demand: Between 3 – 6 mg/l *For urban wetlands: Chemical Oxygen Demand: < 50 mg/l
Biodiversity	% wetland area covered by invasive macrophytes	< 10%
	Annual January water bird count as a proportion to maximum count observed count in last 10 years (only for protected areas of high ornithological value)	0.7 and above
Governance	Status of wetland mapping	Wetlands map prepared and approved by State Wetlands Authority
	Status of wetland management action plan	Management Action Plan prepared and approved by State Wetlands Authority
	Status of notification	Wetland notified under extant regulation

Table 5.1: Ecosystem Health Indicators

There is pronounced interstate variation in ecological condition. Gujarat leads the nation with nine wetlands rated "Very High" (A+ / A–), reflecting exceptional integrity and management practices. Himachal Pradesh follows with five and Andhra Pradesh with two in this top tier. Karnataka and Uttar Pradesh each have multiple wetlands scoring "High" (B+ / B–), indicating generally good ecological health. In contrast, Bihar, Kerala, Maharashtra, Odisha, Rajasthan, Sikkim, and Tamil Nadu report no "Very High" or "High" wetlands; most of their assessed sites fall into the "Moderate" (C+ / C–) bracket, signalling only fair condition. The National Capital Territory of Delhi and Jharkhand each assessed five water bodies, yet none exceed a "Low" (D) rating, underscoring urgent restoration needs. Smaller States and Union Territories such as Arunachal Pradesh, Mizoram, Nagaland, and Tripura have completed only one or two assessments apiece, with both falling in the "Moderate" category, pointing to nascent monitoring efforts and room for improvement. Overall, 19% of assessed wetlands achieved "Very High," 31% "High," 24% "Moderate," 20% "Low," and 7% "Very Low" (E) health ranks, highlighting clear success stories in some regions and critical priorities for renewed conservation and governance in underperforming states.

Results of field surveys, citizen science, and satellite monitoring

The 2024 Wetlands Atlas, produced by the Space Applications Centre (SAC), ISRO, in collaboration with 30 state remote sensing agencies, represents the most comprehensive geo-spatial database ever for Indian wetlands. Using high-resolution LISS-IV satellite imagery and field ground-truthing, the Atlas mapped wetlands at a 1:12,500 scale and captured over 3.58 million distinct wetlands—2.49 million of these with an area ≥0.1ha, and 1.09 million <0.1ha—which provides coverage of 16.89 million hectares, or approximately 5.12% of the nation's landmass. These findings significantly surpass the granularity of previous inventories by incorporating smaller, often-overlooked wetlands, and the simultaneous use of pre- and post-monsoon imagery has improved both seasonal accuracy and the ability to detect changes in wetland extent and health.

Field validation remains central to the national approach: an extensive ground-truthing campaign, mandated by the Supreme Court in December 2024, required all Indian states and union territories to visit, verify, and demarcate wetlands noted in the National Wetlands Atlas within just three months. These field surveys, paired with citizen-led mapping efforts under Mission Sahbhagita and the Save Wetlands Campaign, resulted in over two million citizens directly engaging in wetland conservation, with more than 170,000 wetlands ground-truthed and nearly 100,000 having their physical boundaries formally demarcated as of 2025. Citizen science now plays a pivotal role, especially in biodiversity monitoring and the reporting of wetland conditions, bird censuses, aquatic biodiversity surveys, and invasive species identification are regularly augmented by local community and volunteer participation.

Table 5.2: Ecosystem Health Scores and Ranks

Ecosystem Health Score	Ecosystem Health Rank	Health Category
Between 0.96 - 1	A+	Very good
Between 0.91 - 0.95	A-	Very good
Between 0.86 - 0.90	B+	Good
Between 0.81 - 0.85	B-	Good
Between 0.76 - 0.80	C+	Moderate
Between 0.71 - 0.75	C-	Moderate
Between 0.61 - 0.70	D	Low
0.60 and below	E	Very Low

The use of advanced satellite and AI-powered remote sensing further enables continuous and large-scale wetland monitoring. The integration of multi-temporal data, multi-sensor imagery, and machine learning algorithms allows for real-time tracking of wetland change, vegetation cover, hydrological patterns, and incident threats such as pollution or encroachment. India's various monitoring platforms (such as the Bhuvan portal and VEDAS SAC) support decision-making by providing high-frequency, up-to-date data accessible to both authorities and the public.

However, even with these improvements, challenges remain including the continued decline of smaller, unprotected wetlands, and the need for regular, consistent data updates to better guide policy and restoration priorities. Nonetheless, the synergy of field surveys, citizen science, and space-based technology is substantially advancing the precision and responsiveness of wetland health assessment and conservation in India.

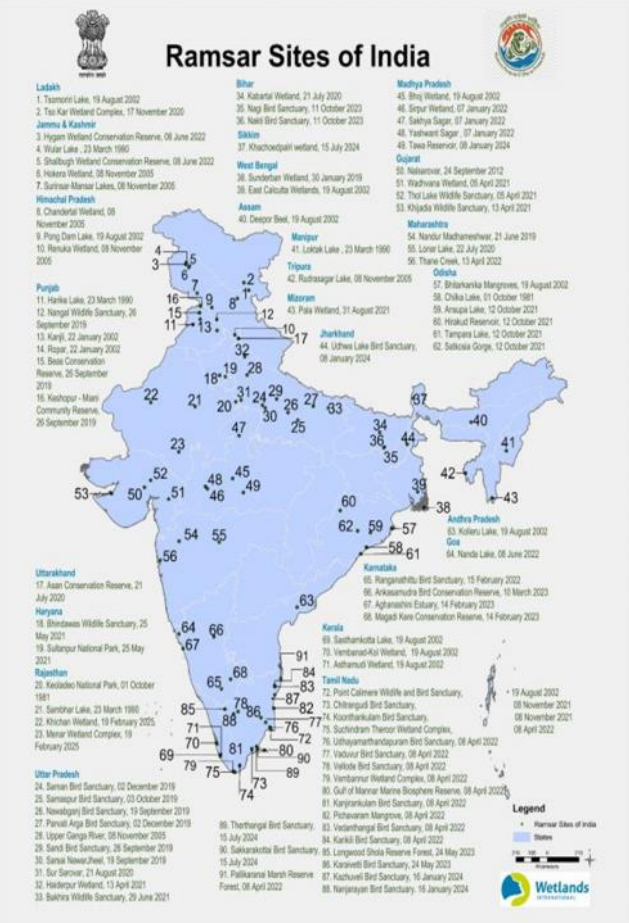
Condition of Ramsar and other significant sites

On average, India's Ramsar Sites demonstrate good to moderate health, reflecting substantial conservation efforts alongside persistent pressures. Approximately 47 percent of Ramsar Sites score in the "Very High" (A+/A–) or "High" (B+/B–) categories, showcasing robust ecological integrity and effective management frameworks. Prominent examples include Chilika Lake (Odisha) and Loktak Lake (Manipur), both of which exhibit excellent water quality metrics (Dissolved Oxygen consistently above 6 mg/L) and minimal invasive species cover (< 5 percent), buoyed by strong community governance and adaptive hydrological management plans .

However, nearly 40 percent of Ramsar Sites fall into the "Moderate" (C+/C–) bracket, indicating areas where targeted restoration and stricter enforcement are needed. Notable among these are Sundarban Wetland (West Bengal) and Chilika's satellite site, Bhitarkanika Mangroves (Odisha), where upstream hydrological alterations and episodic pollution events have led to periodic deviations from desired hydrological inlets/outlets thresholds of 20 percent .

Critically, around 13 percent of Ramsar Sites are rated "Low" (D) or "Very Low" (E), reflecting severe ecological degradation. Kolleru Lake (Andhra Pradesh) remains in the "Poor" category due to over 40 percent of its area converted to aquaculture ponds and chronic nutrient pollution driving eutrophication, while East Kolkata Wetlands (West Bengal) is classified as "Very Low" health, with more than 50 percent loss of wetland area to urban and industrial encroachment since 2000 and high Biological Oxygen Demand readings exceeding 50 mg/L .

These health assessments underscore that, although India's network of internationally important wetlands is expanding, the condition of many sites varies widely. The best-performing Ramsar Sites combine sound legal protection, community participation, and adaptive management informed by real-time monitoring, whereas underperforming sites reveal the need for integrated land-use planning, pollution control, and capacity building at state and local levels.



Map 5.1: Ramsar Sites of India. 2025

Health of Wetland Ecosystems in Coastal Regions of India

India's coastal wetlands span approximately 3,880,569 hectares across 3,497 wetland systems, representing 24.27% of the country's total wetlands.

These ecosystems include mangroves, estuaries, lagoons, coral reefs, salt marshes, and mudflats distributed along 7,516 kilometers of coastline. The assessment reveals a concerning pattern of degradation across multiple indicators.

Mangroves constitute the predominant coastal wetland type, covering 4,992 square kilometers as of 2023. However, recent data shows a decline of 7.43 square kilometers compared to 2021 levels, indicating ongoing pressure on these critical ecosystems. The Forest Survey of India's 2023 report highlights that while some states like Odisha, Maharashtra, and Karnataka have shown increases, significant losses continue in Gujarat and Andaman & Nicobar Islands.

The Sundarbans, representing 40% of India's mangrove cover, faces particular challenges. Research indicates that mangrove species distribution has altered due to rising salinity, with salt-sensitive species like Heritiera fomes and Xylocarpus disappearing from many forests. This degradation affects the region's capacity for carbon sequestration, with polluted coastal wetlands showing considerably increased emissions of methane and nitrous oxide compared to unpolluted systems.

Coastal Regulation Zone (CRZ) Notification, 2019

The CRZ framework classifies coastal areas into four zones with varying development restrictions. CRZ-IA areas include ecologically sensitive mangroves, coral reefs, salt marshes, and turtle nesting grounds, receiving the highest protection. The notification mandates 50-meter No Development Zones for most coastal areas and establishes Critically Vulnerable Coastal Areas including the Sundarbans, Gulf of Khambat, and Gulf of Mannar.

A survey of the Vembanad wetland system found that 185 out of 200 buildings constructed between 2012-2018 violated CRZ regulations, highlighting implementation gaps. The Coastal Zone Management Authorities report numerous violations, with Odisha alone recording 63 violations between 2000-2012.

Specialized Conservation Initiatives

The MISHTI (Mangrove Initiative for Shoreline Habitats & Tangible Incomes) scheme, launched in 2023, targets restoration of 540 square kilometers of mangroves across nine states and four union territories over five years. Gujarat has emerged as a leader, covering 19,020 hectares in two years. The initiative emphasizes community participation and livelihood generation alongside ecological restoration.

The Amrit Sarovar Mission, while primarily focused on rural water bodies, has achieved remarkable success with 68,000+ small wetlands completed against a target of 50,000. The mission's cost-effectiveness at Rs 1.8 lakh per wetland demonstrates the potential for large-scale restoration when community participation is prioritized.

Budgetary Allocation and Utilization

The Ministry of Environment, Forest and Climate Change received Rs 3,413 crore in FY 2025-26, representing a 9% increase over the previous year. However, this allocation falls short of projected demand, with a historical shortfall of Rs 1,204 crore (27%) between ministry requirements and actual allocations in FY 2023-24.

Conservation of Natural Resources and Ecosystems, which includes wetland conservation, received Rs 50 crore in FY 2025-26, a 67% increase from the previous year. While this represents positive

momentum, the allocation remains modest compared to the scale of wetland degradation across the country.

The National Coastal Mission's budget allocation has been inconsistent, declining from Rs 101 crore in 2021-22 to Rs 32 crore in 2025-26. This reduction, attributed to withdrawal of World Bank funding support, hampers integrated coastal zone management efforts.

Therefore, wetlands in India represent irreplaceable components of the nation's natural heritage, harboring exceptional biodiversity, providing critical ecosystem services, and supporting millions of people's livelihoods. However, current degradation trends, inadequate protection coverage, and mounting climate change pressures threaten these systems' long-term viability. Urgent, coordinated conservation action incorporating scientific research, policy reform, community engagement, and innovative management approaches is essential to preserve these unique ecosystems for future generations while maintaining their vital ecological and socioeconomic functions.

VALUES AND ECOSYSTEM SERVICES OF WETLANDS

Food, water, biodiversity, and cultural services

Wetlands in India deliver a multitude of provisioning, regulating, supporting and cultural services that are indispensable to ecological integrity and human well-being. Provisioning services encompass the direct supply of food; most notably fish from floodplain lakes and reservoirs, freshwater for drinking, irrigation and livestock, edible plants and fuelwood, medicinal herbs, and materials such as reeds and salt. As natural buffers and regulators of the hydrological cycle, wetlands purify water by trapping sediments and assimilating nutrients and pollutants, recharge groundwater aquifers critical for rural and urban supply, and attenuate floods and storm surges by absorbing and slowly releasing excess flows. Their rich mosaic of habitats supports remarkable biodiversity, offering breeding, feeding and resting sites for innumerable aquatic species and serving as vital staging grounds for migratory waterbirds at sites like Chilika and Keoladeo. Culturally, wetlands underpin traditional livelihoods and heritage: they host religious festivals on their shores, foster eco-tourism and recreation, and sustain centuries-old practices of wetland rice farming and artisanal fisheries.

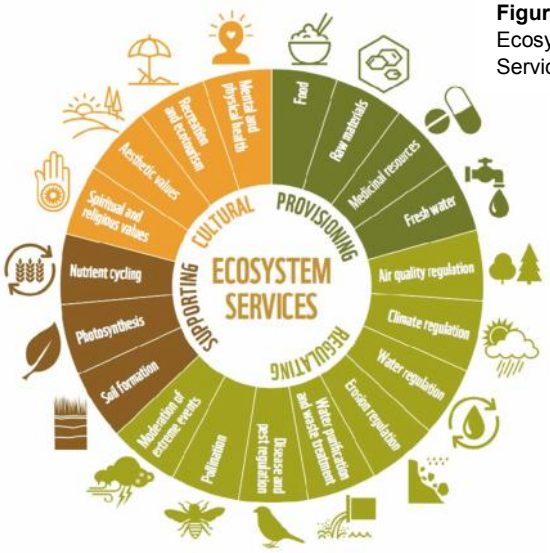


Figure 6.1: Ecosystem Services

Economic valuation (national estimates, case studies)

Recent economic valuation studies reveal that Indian wetlands deliver ecosystem services of exceptional monetary value at both the national and local scale. According to the Global Wetland Outlook 2025 and research synthesized from national policy documents, the average annual benefit provided by India's inland wetlands is estimated at about 25,682 international US dollars per hectare per year, while coastal wetlands (which include mangroves, lagoons, and mudflats) yield ecosystem services worth up to 193,845 international US dollars per hectare each year. These figures account for direct provisioning benefits such as fish, water, forage, fuelwood, and wetlands-based agriculture as well as essential regulating functions, including water purification, flood attenuation, groundwater recharge, and climate regulation.

Nationally, wetlands underpin the livelihoods of tens of millions of people, particularly in states with extensive floodplain and delta systems. For example, the fisheries of Chilika Lake in Odisha contribute upwards of ₹250 crore (over US$30 million) annually to the local economy, supporting more than 200,000 fishers and their families. A large-scale valuation exercise for Karnataka put the net present value of ecosystem services from the state's inland wetlands including drinking and irrigation water supply, fisheries, nutrient cycling, and recreational benefits at approximately ₹7,32,060 crore (US$88 billion) over a 50-year period, as detailed in recent reports to the Karnataka High Court.

At a site-specific level, restored wetlands demonstrate particularly high economic returns. The integrated management of

Loktak Lake in Manipur and ecosystem recovery efforts at Chilika Lake have resulted in rapid increases in fish landings, increased resilience to floods and droughts, and substantial growth in eco-tourism. Conversely, studies from degraded sites such as Kolleru Lake in Andhra Pradesh show that loss of wetland area and ecological functions translates into sharp declines in fisheries, water quality, and traditional livelihoods imposing significant social costs and necessitating greater expenditure on water treatment and disaster management.

Ecosystem-Based Adaptation, Climate Regulation, and Disaster Risk Reduction in India

Wetlands perform a vital role in climate regulation by sequestering carbon in their biomass and sediments. Indian mangroves alone store approximately 26.1 million t of carbon in their living biomass and soils, equating to about 43 t C ha^{-1} far higher than most terrestrial forests. Peatlands in the Himalayan foothills and the terai region, though limited in extent, are potent carbon sinks, accumulating carbon at rates up to 0.9 t C ha^{-1} yr^{-1}. By maintaining waterlogged, anoxic soils, wetlands slow organic decomposition, thereby mitigating greenhouse gas emissions.

As natural infrastructure for disaster risk reduction, wetlands attenuate floods, buffer storm surges, and reduce drought impacts. In coastal Odisha, mangrove restoration between 2000 and 2020 increased coastal setback by up to 0.5 km, reducing cyclone wave height by 20 percent at Sundarban fringe villages. Inland floodplains such as those of the Mahanadi and Kosi rivers store monsoon runoff, lowering peak flood levels by up to 30 percent locally and averting damage to agriculture and settlements. Seasonal and permanent wetlands also recharge aquifers, sustaining dry-season base flows that diminish water-scarcity crises in central India.

Ecosystem-Based Adaptation (EbA) harnesses these wetland services to increase resilience to climate change. Dr. Arvind Kumar's seminal volume, Ecosystem-Based Adaptation: Approaches to Sustainable Management of Aquatic Resources (Elsevier, 2022), offers comprehensive frameworks for applying EbA in river basins, flood plains, and aquifers across India. He proposed an "integrated approach" and also advised enumerating the wetlands in land records and preventing encroachment of the wetlands in drafting the guidelines to Wetlands (Conservation and Management) Rules, 2017 towards wetland management, biodiversity conservation and ecosystem services protection. Similarly, in the capacity of member Technical Advisory Committee for India's Third National Communication and Biennial Update Reports to UNFCCC, MoEF&CC, GoI foundational strategies towards sustainable climate adaptation & mitigation strategies was shared.

Policy integration of wetlands into EbA strategies is advancing under India's National Plan for Conservation of Aquatic Eco-systems (NPCA) and the National Disaster Management Plan, which now explicitly recognize eco-DRR measures that combine natural wetland buffers with early-warning systems and community preparedness. Therefore, India's wetlands are indispensable for harnessing sustainable and resilient development.

SOCIO-ECONOMIC AND CULTURAL DIMENSIONS

Wetlands underpin the livelihoods of millions of rural and Indigenous peoples across India, serving as both workplace and cultural heartland. An estimated 6 percent of India's population over 90 million people depend directly on wetlands for their daily subsistence and income (Wetlands For LiFE report, MoEFCC). In floodplain states such as Assam and West Bengal, artisanal fisheries in oxbow lakes ("beels") support some of the country's poorest communities: in Deepor Beel alone, no fisher household relies less than 40 percent on fisheries, and 90 percent of fishers derive at least 60 percent of their total income from the wetland's bounty; similarly, 42 percent of fishers in Kholsi and Akaipur beels earn over 60 percent of their household income from fishing, with average monthly earnings from fisheries of ₹13 652 and ₹4 945 respectively. Moreover, these fishers meet most of their protein needs from wetland catches over 71 percent of households around Deepor Beel and 68 percent in West Bengal beels obtain all their animal protein from fish harvested in their local wetland.

Beyond fisheries, wetlands sustain a suite of complementary livelihoods rice cultivation on adjacent floodplain soils, seasonal harvesting of reeds and medicinal plants, and livestock grazing on reclaimed beds. In peninsular India, traditional tank-irrigation systems underpin livelihoods in Rajasthan and Tamil Nadu, where village tank chains replenish groundwater and support dry-season cropping and grazing. In the Andaman and Nicobar Islands, mangrove-dependent communities harvest crabs, honey and thatch, exchanging these goods in coastal markets and preserving ancestral practices of canoe-building and salt extraction.

For many Indigenous groups such as the Dhiwar fishers of Vidarbha and the villagers of Loktak Lake's floating islands in Manipur wetlands are inseparable from cultural identity. Loktak's "phumdi" dwellers, for example, have maintained communal fishing cooperatives for generations, managing seasonal closures and spawning sanctuaries through customary rules that echo modern resource governance. Their adaptive knowledge of monsoon-driven hydrology, combined with spiritual traditions that revere lake deities, has preserved wetland habitats even as external pressures mount.

The intimate link between wetlands and livelihoods underscores an urgent need to strengthen community-based management, secure land- and water-use rights, and integrate traditional knowledge into formal conservation frameworks so that India's wetland-dependent cultures and economies can endure.

Woman collects lotus fruit leaves and flowers in Loktak wetlands

Cultural significance and traditional knowledge

Wetlands in India are deeply interwoven with the country's cultural heritage and traditional ecological knowledge, serving as both sacred landscapes and repositories of ancestral practices that sustain biodiversity and human communities alike.

Across India's varied regions from the floodplains of the Ganga and Brahmaputra to the coral reefs and mangroves of the Andaman Islands, wetlands are celebrated in folklore, rituals, and art, while indigenous and local communities have developed specialized knowledge systems for their sustainable use and conservation.

At the heart of many tribal and rural cultures, wetlands function as focal points for festivals and rites that honour water deities and seasonal cycles. For example, in Manipur's Loktak Lake region, the Meitei community celebrates the "Lai Haraoba" festival on its phumdi (floating islands), offering prayers to lake spirits and practicing age-old communal fishing methods timed to fish breeding seasons. Similarly, the Sundarbans' mangrove forests are sacred to coastal fisherfolk, who observe the "Banabibi" rites to seek divine protection before entering the creeks for crab and honey collection (Wetlands of India Portal).

Lai Haraoba" festival

Traditional ecological knowledge (TEK) in wetland management encompasses a broad array of practices. In Kerala's Kuttanad backwaters, rice–fish–duck polyculture systems combine paddy cultivation with integrated fish and duck rearing, leveraging tidal inundation cycles to maintain soil fertility and control pests without chemical inputs. In Rajasthan's Sambhar Lake region, herder communities employ centuries-old rotational grazing on seasonal salt marshes to regulate vegetation growth and replenish soil moisture. Across north-eastern India, the Apatani tribes practice "zabo" wetland rice cultivation in Arunachal Pradesh, constructing elaborate embankments and channels that both irrigate fields and create wildlife habitat, underpinning food security and biodiversity (Barman et al. 2025).

Sacred groves and temple tanks further embody cultural ties to wetlands. In Tamil Nadu and Karnataka, village temple tanks (kalyani or pushkarni) serve as both ritual bathing sites and groundwater recharge structures, managed collectively under customary rules that dictate harvest seasons and water use, reflecting a fusion of spiritual and practical wetland stewardship (Silene 2023). Likewise, Chola-era stepwells in central India exemplify historic engineering knowledge for harvesting monsoon rains and sustaining communities in semi-arid landscapes, combining inscriptions and iconography that record water-related lore.

Beyond agricultural and ritual practices, ethnobotanical traditions preserve knowledge of wetland flora for medicine, crafts, and water purification. In Odisha and West Bengal, villagers harvest Nipa palm (Nypa fruticans) leaves for thatch, using selective cutting methods that allow rapid regeneration and maintain mangrove integrity; they also collect lotus rhizomes and water chestnut for food and trade, guided by lunar-tide calendars passed down through generations (Barman et al. 2025).

This living body of TEK is now being documented and enhanced through the Wetlands of India Portal, which in 2025

has engaged over 150,000 registered "Wetland Mitras" (citizen volunteers) who upload photographs, oral histories, and site-specific management plans, strengthening participatory conservation (Wetlands of India Portal). Such community contributions complement formal assessments and underscore the indispensable role of cultural values and traditional knowledge in achieving resilient, equitable wetland management for India's ecological and social well-being.

SAVE WETLANDS CAMPAIGN

A People's Movement to Celebrate, Revive, Rejuvenate Wetlands

Approach

WETLAND MITRA

Build on the vision outlined by Mission *Sahbhagita* and will advance the 'whole of society' approach for conserving and sustainably managing *Amrit Dharohars*, with primary stakeholders and local communities at the forefront;

Implement Mission LiFE (Lifestyle for Environment) envisioned by the Hon'ble Prime Minister of India Shri Narendra Modi. The campaign will inspire, nudge and build capacity to bring individual behaviour change and action at the forefront of the conservation of wetlands helping India strengthen its leadership in the global biodiversity and climate action front.

Implement as a people's campaign in collaboration with various ministries of the Government of India, State Governments, Panchayati Raj Institutions, Technical Institutions, Educational Institutions, CSOs, Private Sector, Knowledge Partners and communities.

RESTORATION CONSERVATION & PRESERVATION INITIATIVES

The National Plan for Conservation of Aquatic Eco-systems (NPCA) (formerly NLCP & NWCP, merged 2015) remains the flagship scheme under MoEFCC, operating on a 70:30 (90:10 NE states) cost-sharing model with state governments. As of mid-2025, NPCA has sanctioned integrated management plans for 164 wetlands, releasing ₹10.6643 billion in central assistance for activities including wastewater interception/ diversion, shoreline protection, desilting and de-weeding, bioremediation, catchment treatment, bio-fencing, fisheries development, and community awareness.

Building on NPCA, the **"Wetlands Rejuvenation" initiative** (launched 2020) adopted a four-stage approach baseline data collation, rapid health assessment via Health Cards, formation of local "Wetland Mitras," and Integrated Management Plans to revitalize 130 priority wetlands in its first 100-day cycle, and is now scaling up to 1,000 wetlands nationwide under the Government's 169 transformative ideas agenda.

Under Mission Sahbhagita (2022), an essential step towards participatory conservation and wise use of wetlands. The mission is structured on the whole of society and whole of government approach, bringing communities and primary stakeholders to the forefront. People's participation is ensured at all levels of the execution of the mission through engaging the network of Wetland Mitra (an informal, voluntary and non-statutory network of concerned citizens to foster and promote community engagement in wetlands conservation and management efforts) and local communities in wetland management planning, implementation, monitoring, communication, education and awareness activities. The Mission also aims to strengthen the mechanisms for inter-agency cooperation at the district and local levels through Urban Local Bodies and Panchayats to ensure the integration of wetlands within the district-level plans and programmes for different sectors such as tourism, disaster management, environment, and others.

Under the aegis of Mission Sahbhagita, seven regional workshops were organised to provide a platform for wetland managers to share best wetland management practices and discuss key challenges and issues. Launch of 'Save Wetlands Campaign' - Under the aegis of Mission Sahbhagita, the MoEFCC launched the Save Wetland Campaign, a people's movement to celebrate, revive and rejuvenate wetlands. The campaign is structured on the 'whole of society' approach for wetland conservation at all societal levels and involves all social strata. Through the Save Wetlands campaign, the Ministry envisages making wetland conservation a people's movement and inspire, infuse pride and ownership amongst stakeholders to adopt sustainable lifestyles for healthy wetlands and promote wise use of wetlands, aligning with Mission Lifestyle for Environment (LiFE) for wetlands. Significant milestones were achieved during the first year of the campaign that included, ground-truthing of more than 75,000 wetlands, sensitisation of more than 2,000,000 people and registration of more than 18000 people as Wetland Mitras (friends of wetlands).

Similarly, **Launch of Amrit Dharohar Initiative** - For the first time in India, wetlands were included in the national budget, introducing a targeted initiative titled Amrit Dharohar. Aligning with Mission Lifestyle for Environment (LiFE) this three-year initiative was launched in 2023 with the aim of promoting the unique

conservation values of the Ramsar Sites of the country. Amrit Dharohar aims to create demonstration, replication and upscaling effect on other wetlands of national and international importance with the purpose of maintaining a healthy and effectively managed network of Ramsar Sites, buffering the landscape from the fury of nature, generating local employment and supporting livelihood; and conserve and celebrate rich cultural heritage.

The initiative has four components: Species and habitat conservation, Nature tourism, Wetlands livelihoods and Wetlands carbon assessment. Under the ambit of this initiative, collaborations have been established between the MoEFCC and other relevant ministries, such as the Ministry of Tourism, to build capacities of local communities to enhance livelihood opportunities through nature tourism. Around 200 local community members across five Ramsar Sites, Sultanpur National Park in Haryana, Sirpur Lake and Yashwant Sagar in Madhya Pradesh, and Bhitarkanika Mangroves and Chilika Lake in Odisha have been trained on Alternative Livelihood Programmes subsequently certified as nature guides. In collaboration with the Central Institute of Educational Technology of the National Council of Educational Research and Training, a series of educational videos have been developed to sensitize primary, middle and senior-level students on the importance of wetland conservation and management. In collaboration with Botanical Survey of India (BSI) and Zoological Survey of India (ZSI), MoEFCC has developed floral and faunal inventory of the Ramsar Sites.

Furthermore, under Amrit Dharohar, MoEFCC has engaged the Biodiversity Management Committees at the village level to develop and update Peoples' Biodiversity Registers for the Ramsar Sites. A 'Standard Operating Procedure for Assessment of Carbon Stock in Wetlands' was released in collaboration with National Centre for Sustainable Coastal Management (NCSCM), which has been utilized to assess the Carbon-stock of around Ramsar Sites. Incollaboration with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, and otherknowledge partners, MoEFCC is developing a climate co-benefit (adaptation and mitigation benefis) assessment methodolgy for Indian wetlands. In 2023, MoEFCC with support from GIZ, launched a publication titled the 'Cultural Significance of Indian Wetlands' which is a compilation research data and lived experiences of the cultural linkages to wetlands in India.

Complementing these, the Centre for Wetland Conservation and Management (CWCM) an MoEFCC entity within NCSCM, Chennai serves as a national knowledge hub, providing technical guidance, research support, and capacity building for wetland managers, researchers, and policy-makers. Its work underpins evidence-based restoration, from piloting remote-sensing tools to disseminating best practices for ecological engineering and community engagement.

Revised National Plan for Conservation of Aquatic Resources (NPCA) guidelines

To expedite the process of integrated management planning of the Indian wetlands, the MoEFCC revised the NPCA guidelines. The revised guidelines introduced a graded two-stage approach for integrated management plan preparation with the Introduction of a Framework Management Plan (FMP). This enables acting on the available information and, at the same time, builds an evidence base through assessments and stakeholder consultations for developing a

comprehensive Integrated Management Plan for the site. The MoEFCC is actively fostering partnerships with the private sector for wetlands conservation. A Memorandum of Cooperation has been signed between the Indian Business and Biodiversity Initiative (established by the MoEFCC and the Confederation of Indian Industries to enable Indian Businesses to make commitments for biodiversity conservation and sustainable use) and the MoEFCC to foster the participation of the private sector in wetlands management and conservation efforts. The India Wetland Coalition (IWC) was launched to enable business partnerships for Wetlands Conservation, addressing the risk of nature loss and building resilience to climate change.

The MoEFCC also released the **'National Decadal Wetlands Change Atlas'** in collaboration with Space Application Centre under Indian Space Research Organisation. Produced as an outcome of the 'National Wetland Inventory and Assessment – 2nd Cycle' project of the Space Application Center, the report provides data on wetland numbers and extent in 2017-18 and an assessment of change by comparison with the National Wetlands Atlas 2011 which used 2006-7 remote sensing data. This is the first time that a decadal change analysis on wetlands at a national scale has been published by the MoEFCC. In a marked improvement from the previous iteration, the report provides information on the extent of wetlands within various river basins and bio-geographic zones of India.

Legal Frameworks

India's wetlands are protected and managed under a robust legislative framework centering on the **Wetlands (Conservation and Management) Rules, 2017**, backed by complementary national committees, digital platforms, and institutional arrangements.

Under the **Environment (Protection) Act, 1986,** MoEFCC notified the 2017 Rules (G.S.R 1203[E], 26 Sep 2017), replacing the 2010 Rules. These establish:

A **National Wetland Committee (NWC)** chaired by the MoEFCC Secretary to advise on policy, Ramsar site designation, and inter-ministerial coordination.

Mandatory constitution of **State/UT Wetland Authorities (SWAs)**, chaired by state Environment Ministers, to prepare digital inventories within one year, notify wetlands and their zones of influence, regulate prohibited and permitted activities, and formulate Integrated Management Plans. As of 2025, 33 SWAs cover all 28 states and 5 UTs.

A **"wise-use principle"** guiding judicious wetland utilization, balancing ecological character maintenance with sustainable community benefits.

Prohibitions on solid waste dumping, untreated effluent discharge, non-wetland conversion, and permanent structures within 50 m of mean high flood levels.

To operationalize the Rules, MoEFCC developed detailed Implementation Guidelines (published 2020), specifying formats for Brief Documents, Health Cards, Wetland Mitra engagement, and Integrated Management Plans.

Legislative backing is reinforced through site-specific notifications under the Wildlife Protection Act (1972), Forest Conservation Act (1980), and state acts for temple tanks and protected wetlands. World Wetlands Day drives annual awareness and workshop series at national/regional levels.

State and Union Territory Wetland Authorities (SWAs)

As of 2025, 33 State and Union Territory Wetland Authorities (SWAs) have been constituted under the Wetlands (Conservation & Management) Rules, 2017, encompassing all 28 States and five Union Territories. Their recent activities, drawn exclusively from the Wetlands of India Portal and official State SWA web-portals, include:

In the Northeast, Arunachal Pradesh completed a digital inventory of all wetlands ≥2.25 ha and launched the "Zabo" pilot to integrate indigenous rice–fish systems, while Assam validated Deepor Beel's Health Card and installed real-time water-level gauges alongside training 200 local "Wetland Mitras" in invasive-species monitoring. In the Gangetic plains, Bihar launched a geo-portal for state-wide wetland mapping and prepared Health Cards for 35 priority sites, then undertook desilting and embankment stabilization at Kanwar Jheel and Kawar; nearby Uttar Pradesh finalized Health Cards for 60 wetlands and carried out desilting and bank protection at Nawabganj Bird Sanctuary and Sur Sarovar. In the hills and islands, Ladakh inaugurated a Changthang high-altitude pilot with electrode-based salinity monitoring and herder training, while Lakshadweep completed coral-reef and lagoon health assessments and installed wave-attenuation mangrove plots on Agatti Island.

In the west and central regions, Madhya Pradesh, the SWA, in collaboration with the Environmental Planning & Coordination Organisation (EPCO) and MAP-IT Bhopal, has completed a digital inventory of all wetlands ≥2.25 ha and launched an interactive GIS web-portal (https://geoportal.mp.gov.in/epco/) that provides district- and village-level wetland boundaries, area, coordinates, drainage information, highways, railways, and administrative units. Under the MoEFCC's Wetland Rejuvenation Programme (Phases I & II), MP SWA identified 120 district wetlands for health-card preparation and has already submitted over 110 Health Cards to the Centre. The Authority has sanctioned and begun implementing Urban Wetland Conservation plans for key water bodies such as the Bhoj Wetland (Bhopal), Amrit Sagar (Ratlam), Sirpur (Indore), and Shivpuri Lakes with combined central assistance exceeding ₹100 crore. On World Wetlands Day 2025, MP SWA organized statewide "Wetland Mitra" workshops, guided a Chief Secretary-chaired inter-departmental review, and inaugurated the Amrit Sagar restoration project in Ratlam with a ₹4 crore first instalment.

In Gujarat, the SWA has updated its state wetland atlas using high-resolution satellite imagery, demarcating over 1,200 wetlands, and launched community "Wetland Mitra" training in coastal districts to monitor mangrove and mudflat health. The Authority has also approved Integrated Management Plans for eight priority sites, including Nalsarovar and Thol Lake, deploying bioremediation trials and innovative floating treatment wetlands to improve water quality.

Rajasthan restored the Sambhar Lake catchment through afforestation and saline wetland demarcation and submitted Health Cards for 45 wetlands, while Chhattisgarh's community-led Achanakmar restoration saw 25,000 native saplings planted and floating treatment wetlands installed. Maharashtra completed Health-Card assessments for 55 wetlands and initiated sewage interception at Thane Creek and debris clearance at Pune's

Pashan Lake; Goa restored mangroves and tidal flats along the Mandovi estuary with drone-based sediment monitoring.

In the South, Karnataka ran a statewide campaign registering 150 Wetland Mitras, executed desilting and aeration at Kajjikere and Tannirbhavi wetlands, and launched a GIS portal for live water-level and quality data. Kerala removed invasive water hyacinth to restore its Kuttanad rice–fish–duck systems and completed Health Cards for 40 tanks and backwaters. Andhra Pradesh's SWA has fast-tracked hydrological restoration at Kolleru Lake through "Operation Kolleru" Phase II, removing illicit aquaculture ponds from 350 ha and re-establishing native macrophyte cover. Concurrently, the SWA rolled out a smartphone-app-based citizen-science program "My Wetland My Responsibility" which has logged over 5,000 geo-tagged observations of water quality and biodiversity across 50 wetlands.

Tamil Nadu's Wetlands Mission, under its SWA, sanctioned ₹ 1.1515 billion for ecological restoration of 100 urban and rural wetlands through the Tamil Nadu Municipal Administration Department. Key actions include sewage-interception networks around Pallikaranai Marsh Reserve Forest, desilting of Pichavaram Mangrove channels, and eco-tourism infrastructure at Vedanthangal Bird Sanctuary. It has also formalized nine public-private partnerships to develop floating education platforms and live-data water quality dashboards.

In the Himalayan and foothill states, Himachal Pradesh organized a January 2025 workshop on wetland climate resilience and installed checkpoint silt traps at Pong Dam wetlands; Uttarakhand prepared Integrated Management Plans for 12 Himalayan wetlands and launched a cross-state forum for knowledge exchange; and Jammu & Kashmir rehabilitated the Dal Lake catchment by removing encroachments, re-establishing its chinar-belt buffer, and initiating water-quality citizen monitoring. The remaining States and UTs have similarly completed digital inventories, Health-Card uploads, and restoration pilots: The Delhi SWA, acting on an NGT order, conducted a joint field inspection on June 11, 2024, with CPCB, DPCC, and Forest Department officials to assess ten key wetlands within the Asola Wildlife Sanctuary. Following the December 4, 2024 report, Phase I works including dredging, bund construction, plantation of Doob grass and native shrubs along wetland margins have been completed in Maidan Garhi, Sahoopur, and Satbari, aimed at arresting groundwater decline and enhancing monsoon water retention.

Chandigarh notified 12 urban wetlands under Rule 10 and finalized management plans for Sukhna Lake and its feeder ponds; Jharkhand prepared Health Cards for 18 sites and began desilting works at Ranchi-Patna Road wetlands; Meghalaya restored Umiam Lake's riparian buffer and launched invasive-species rapid-response teams; Mizoram and Tripura each completed Health Cards for two wetlands alongside targeted water-quality monitoring and seasonal channel restoration; Nagaland drafted an Integrated Management Plan for Doyang Lake with fishery co-management workshops; Odisha deployed drone-based mangrove monitoring at Bhitarkanika, formed an oil-spill response team, and desilted and bio-remediated Chilika's satellite lagoons; Punjab prepared Health Cards for 30 wetlands and launched fishery enhancement at Harike and Ropar; and West Bengal conducted an East Kolkata Wetlands rapid-impact pilot featuring

drainage channel demolition, aerator installations, and wetland-edge plantation while launching the "MyBeelMyLife" citizen-science mapping program for rural beels. Collectively, these initiatives reflect India's nationwide shift toward data-driven wetland management, robust stakeholder engagement, and multi-sectoral restoration financing.

The Government has undeniably ramped up wetland governance yet beneath this veneer of progress lie several critical shortcomings:

Fragmented Data Ecosystem

Although every SWA now boasts GIS maps and smartphone apps, there is no mandatory national standard for data formats, metadata quality, or update frequency. As a result, Madhya Pradesh's finely detailed portal and Gujarat's atlas cannot seamlessly feed into a consolidated national dashboard, forcing the Centre to expend additional resources reconciling divergent datasets.

Health-Card "Completion" vs. Remediation

The rush to tick boxes on health-card submissions like 110 from MP, 60 from UP, 45 from Rajasthan often overshadows true ecological outcomes. Many SWAs lack earmarked budgets and clear timelines for implementing health-card recommendations, turning detailed diagnostics into mere bureaucratic exercises.

Upfront Funding, Deferred Maintenance

Central assistance topping ₹1 billion in MP or ₹1,151.5 million in Tamil Nadu has catalyzed impressive capital works. Yet by neglecting operations and maintenance planning no dedicated O&M funds or user-fee mechanisms the Government risks seeing these restored wetlands degrade within a few years once contractors leave.

Ad hoc Community Engagement

Citizen-science programs have mobilized thousands of volunteers, but without standardized training, data-validation protocols, or integration pathways into SWA decision-making, much of this grassroots energy remains underutilized and vulnerable to quality lapses.

Bureaucratic Overlap and Delays

Inter-departmental coordination forums exist on paper Chief Secretary-chaired reviews in MP, CPCB-DPCC collaborations in Delhi but ambiguous roles and cumbersome MoUs continue to stall critical actions such as fund transfers, joint inspections, and policy enforcement.

Absence of Sustainable Financing Instruments

The Government has yet to establish a National Wetland Fund, green bond mechanisms, or tax incentives for private-sector participation. Without innovative revenue streams eco-tourism levies, payments for ecosystem services the restoration impulse may falter once central grants dry up.

Judicial Oversight

The Indian government has established an extensive policy framework for wetland conservation, additionally, significant budgetary allocations have been made under various schemes, including provisions for sewage treatment infrastructure and wetland restoration projects. However, the persistent failure of government authorities to translate these policy commitments into meaningful action has compelled India's judiciary to assume an increasingly activist role in environmental protection. The Supreme

Court's landmark intervention in December 2024, arising from a petition by environmentalist Anand Arya and NGO Vanashakti, starkly exposed the government's systematic neglect of its own wetland conservation mandates. The Court's observation that "almost all states" had failed to conduct the required ground-truthing and boundary demarcation, with only Punjab showing limited compliance, represents a damning indictment of governmental inaction spanning nearly seven years since the 2017 rules were enacted. This judicial rebuke was compounded by the Court's finding that despite the clear statutory requirements, boundary demarcation had been completed for merely 784 wetlands out of over 231,000 identified, exposing the vast chasm between policy pronouncements and actual implementation.

The inadequacy of government enforcement mechanisms becomes further evident through the Supreme Court's December 2024 order directing states and union territories to complete ground-truthing and demarcation within three months, effectively imposing external judicial deadlines where internal administrative systems had failed. The Court's parallel directive for suo motu monitoring of 85 Ramsar sites by various High Courts underscores the judiciary's recognition that government agencies cannot be trusted to protect even internationally recognized wetlands without continuous judicial oversight. This judicial intervention was necessitated by the government's own admission through an affidavit revealing that only 92 out of 231,195 identified wetlands had been formally notified for protection, while brief documents existed for merely 1,965 wetlands, demonstrating the profound disconnect between the scale of wetland resources and the government's protection efforts.

The National Green Tribunal has been compelled to intervene repeatedly in cases where state and local authorities have abdicated their statutory responsibilities for wetland protection and restoration. In Delhi alone, the Tribunal's May 2024 order regarding the construction of sewage treatment plants and refurbishment of ten waterbodies in Asola Wildlife Sanctuary came only after authorities failed to produce any status updates despite earlier commitments. The NGT's criticism of the Delhi Development Authority and other agencies for filing no compliance affidavits regarding six historic ponds in Mundka village, while permitting continued encroachment, exemplifies the government's pattern of making promises without follow-through. The Tribunal's February 2025 directive to the Delhi State Wetland Authority to trace and restore waterbodies that had vanished from revenue records reflects the administrative failure to maintain basic documentation of wetland resources.

The government's inadequate sewage treatment infrastructure has drawn particularly sharp judicial criticism, as evidenced by the NGT's April 2025 order concerning the Macchali Talab in Vasant Kunj. The Tribunal's finding that a decentralised sewage treatment plant had been commissioned without proper environmental clearances and was operating without valid consent highlights the systematic regulatory failures that characterize government environmental management. The NGT's direction to the Delhi Jal Board to levy environmental compensation for these violations demonstrates the judiciary's recognition that financial penalties may be necessary to compel compliance where

administrative oversight has failed. The Tribunal's July 2025 intervention regarding the Jharoda pond, which had been completely buried under waste from the Bhalswa landfill, illustrates how government agencies have permitted the destruction of wetland ecosystems through unauthorized dumping while failing to prevent or remediate such environmental crimes.

State High Courts have similarly been forced to step in where regional authorities have failed to implement central policies and protect critical wetland ecosystems. The Bombay High Court's January 2025 suo motu PIL regarding Maharashtra's wetlands, triggered by the Supreme Court's December directive, reflects the institutionalized failure of state-level wetland authorities to proactively address conservation requirements. The Court's appointment of an amicus curiae to oversee state compliance and its issuance of notices to multiple government agencies demonstrates the judicial system's recognition that external oversight is essential for ensuring governmental accountability. The Calcutta High Court's intervention in the East Kolkata Wetlands case, where it stayed developmental activities and criticized the slow pace of demolishing illegal structures, highlights how government agencies have consistently failed to prevent encroachment and restore degraded wetland areas.

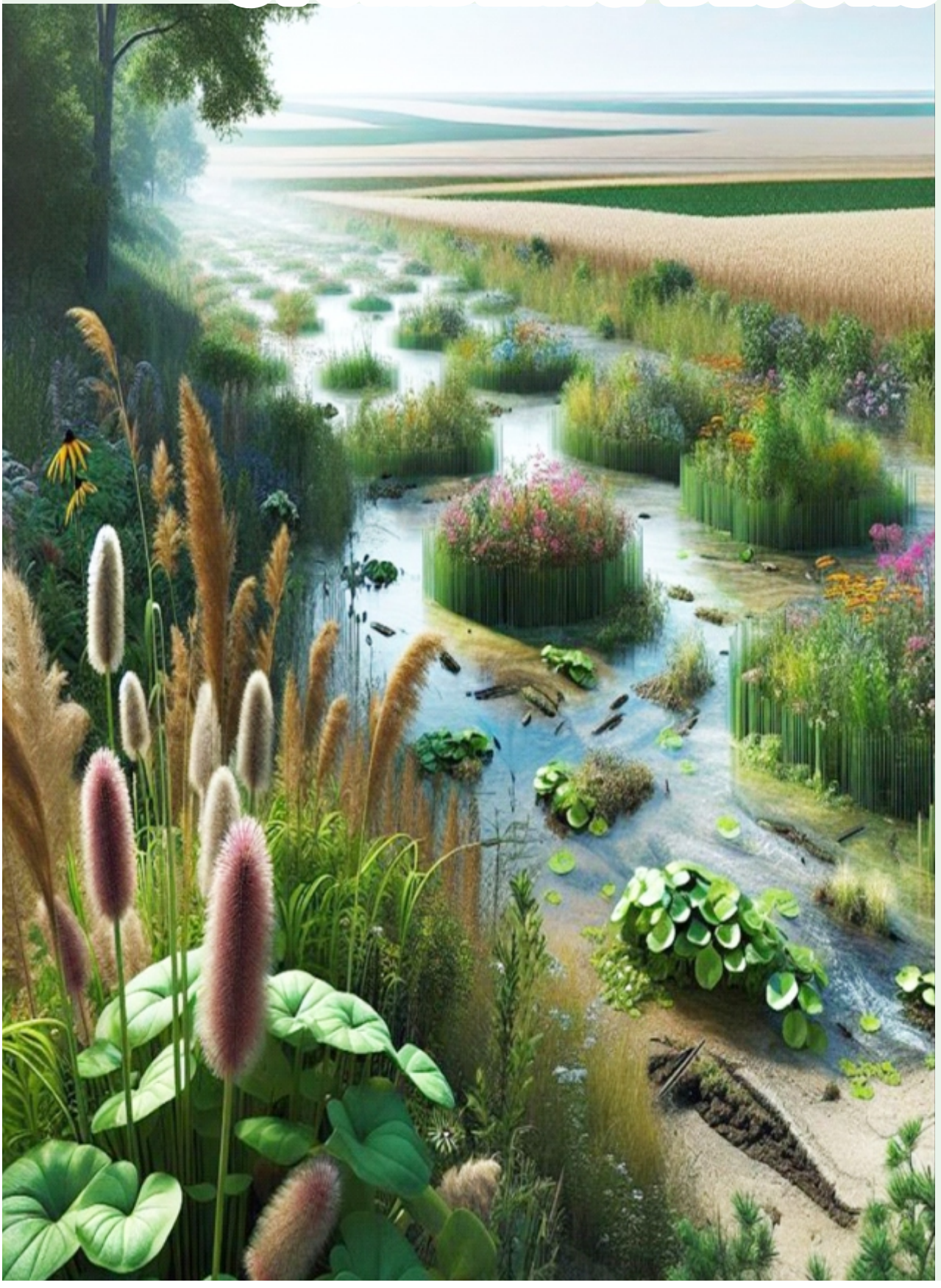
The Kerala High Court's July 2025 directive to establish an Ashtamudi Wetland Management Unit emerged only after the Court observed that despite the 2017 rules and Ramsar guidelines, no integrated management plan had been implemented for this internationally important wetland. The Court's criticism that various government departments were "functioning in isolation, resulting in fragmented and ineffective conservation measures" exposes the fundamental coordination failures that plague government environmental management. Similarly, the Madras High Court's intervention in the Pallikaranai Marshland case, leading to the re-notification of 317 hectares under reserved forest status, demonstrates how judicial pressure remains necessary to compel government agencies to properly classify and protect critical wetland habitats.

Conversely, the Meghalaya High Court's closure of its suo motu PIL after finding that none of the state's wetlands qualified as Ramsar sites illustrates the importance of judicial verification of government claims and scientific standards. This decision, based on a comprehensive ground-truthing exercise covering 225 different waterbodies, demonstrates the judiciary's commitment to evidence-based decision-making that often contrasts with government agencies' tendency toward bureaucratic formalism rather than substantive environmental protection.

The pattern of judicial intervention across these cases reveals a systemic failure of government institutions to implement their own environmental policies, protect constitutionally mandated ecological resources, and fulfill international commitments under treaties like the Ramsar Convention. The judiciary's repeated observations about government inaction, missed deadlines, lack of compliance reports, and continued environmental degradation paint a consistent picture of administrative negligence that has necessitated external judicial supervision to ensure basic environmental protection. Through these successive interventions from extending legal protection to smaller wetlands, to

enforcing pollution controls, to mandating restoration of destroyed ecosystems the Indian judiciary has effectively become the primary guardian of the nation's wetland resources, filling the accountability vacuum left by ineffective government implementation. This judicial activism, while necessary for environmental protection, represents a troubling indication of the government's failure to fulfill its own statutory mandates and constitutional obligations to protect the environment for present and future generations.

STUMBLING BLOCKS



Wetland conservation in India is impeded by a convergence of institutional, technical, socio-economic and environmental challenges that undermine protection, restoration and wise use of these critical ecosystems. **Fragmented governance** and regulatory overlap among multiple agencies environment, irrigation, fisheries, urban development and local bodies have created confusion over roles and delayed notification of thousands of wetlands, leaving many smaller and seasonal water bodies unprotected despite the Wetlands (Conservation and Management) Rules, 2017. **Data gaps and inconsistent inventories** further exacerbate planning shortfalls: although ISRO's 2024 Wetlands Atlas mapped over 3.58 million wetlands, dozens of States still lack up-to-date digital inventories, and many wetlands under 2.25 ha remain undocumented in official records, enabling their ad hoc conversion.

Chronic underfunding and limited technical capacity at State Wetland Authorities restrict effective monitoring, ground truthing and long-term restoration; most authorities depend on short-term project cycles, which prevents sustained follow-through on treatments such as desilting, bio remediation and invasive-species control. **Weak enforcement** compounds these issues: prohibitions on waste dumping, untreated effluent discharge and encroachment within wetland boundaries are frequently flouted, and judicial directives while robust often struggle to translate into timely on-ground action across diverse jurisdictions.

Rapid land-use change driven by unplanned urbanization and agricultural expansion continues unabated, with wetlands near major cities routinely reclaimed for infrastructure and real estate. For example, Mumbai and Chennai lost over 70 percent and 85 percent of their wetlands, respectively, between 1970 and 2014; similar trends persist in peri-urban areas, where wetlands are viewed as "wastelands" for development rather than ecological assets. **Pollution** from untreated municipal sewage, industrial effluents and agricultural runoff laden with nutrients and pesticides has degraded water quality in both inland and coastal systems, leading to eutrophication, loss of aquatic biodiversity and impaired ecosystem services.

Climate change compounds these pressures through altered monsoon patterns, more intense floods and droughts, and sea level rise that accelerates salinization and submergence of coastal wetlands. Yet adaptation measures such as integrating wetlands into flood management and drought resilience plans remain poorly mainstreamed into national and state policy frameworks. Finally, **biological invasions and unsustainable resource extraction** exemplified by rampant spread of water hyacinth covering up to 94 percent of surface waters in severely affected lakes, and excessive sand mining, peat removal and overfishing push wetland ecosystems beyond ecological tipping points, reducing their resilience and ability to recover without intensive intervention.

Equity, Access, Benefit-and Credit Sharing

On the front of equity and access, large-scale citizen engagement initiatives, the inclusion of marginalized communities in project design and benefit allocation remains inconsistent. Women, indigenous groups, and landless households often continue to face systemic exclusion. Furthermore, weak coordination among various stakeholders including water boards, local governance bodies, and user associations creates institutional barriers

that hinder equitable access to restoration resources. Regional disparities also persist, with vulnerable communities in certain geographies receiving limited attention in terms of both financial investment and capacity-building initiatives.

In terms of benefit-sharing, India has strengthened its alignment with international Access and Benefit Sharing (ABS) protocols. The revised ABS Rules of 2025, framed under the Biological Diversity Act, stipulate that users of biological resources ranging from traditional medicine practitioners to biotech enterprises must share benefits with local communities. These benefits may be monetary or non-monetary and are intended to support biodiversity conservation and sustainable livelihoods. The revised framework introduces a turnover-based contribution model that eases the burden on small enterprises while mandating greater responsibility from larger companies. Nevertheless, implementation challenges remain. Questions about transparency, consent procedures, and the adequacy of community compensation continue to surface, raising concerns about the fairness and effectiveness of the benefit-sharing process.

Credit sharing has also gained prominence, with increasing acknowledgment of diverse stakeholder contributions to restoration efforts. The evolving credit culture now seeks to highlight the roles of grassroots volunteers, citizen scientists, NGOs, and private sector collaborators. For instance, initiatives under the India Wetland Coalition have promoted inclusive public-private partnerships that recognize both technical input and community-based knowledge. However, despite these developments, credit for restoration achievements is still disproportionately awarded to government agencies and prominent NGOs.

Altogether, while India's wetland restoration journey has made significant strides in institutionalizing equity, access, benefit-sharing, and credit acknowledgment, ongoing structural challenges and gaps in implementation highlight the need for deeper reforms and inclusive strategies moving forward.

Citizen Science in Wetland Monitoring

A globally recognized and active success story of citizen science in wetland monitoring is the ***iWetland project*** developed by the McMaster Ecohydrology Lab in Canada. Launched in 2016, iWetland was designed to engage community members in monitoring water levels across various wetland types, including peatlands, swamps, and coastal wetlands.

From 2016 to 2019, nearly 2,000 community participants recorded over 2,600 water level observations at 24 different wetland stations. Anyone with a mobile phone could take part no special training or downloads were required making it exceptionally accessible. The data residents gathered proved to be of high quality and valuable for scientific modelling and conservation decisions. Regular outreach, interactive events, and social media contests kept public engagement high. The program has been lauded for its adaptability, scientific rigor, and genuine empowerment of citizens to contribute to wetland conservation while deepening their understanding of wetland ecology. Its simple, replicable design makes it a leading model for other countries and organizations looking to implement citizen science in environmental monitoring.

This project shows the power of community involvement not only in data

CASE STUDIES

1. Sirpur Lake, Indore

Sirpur Lake in Indore, Madhya Pradesh, stands as one of India's most successful examples of community-driven urban wetland restoration. This 130-year-old lake transformed from a severely degraded water body in the 1990s to a thriving Ramsar site supporting 189 bird species by 2025, demonstrating how coordinated government policies and grassroots conservation efforts can revive dying ecosystems.

The Crisis Years: Sirpur Lake in Decline (1970s-1990s)

- Severe Environmental Degradation: By the 1990s, Sirpur Lake faced near-complete ecological collapse due to decades of neglect and anthropogenic pressures. Human encroachment had severely reduced the lake's catchment area, with illegal settlements and agricultural conversion destroying critical buffer zones. Sewage pollution from overflowing drains and direct discharge transformed the once-pristine water body into a contaminated cesspool.
- Illegal dumping of solid waste and industrial effluents had degraded water quality to dangerous levels. The lake's natural flow channels were blocked by unauthorized construction, disrupting the hydrological cycle essential for ecosystem health. Uncontrolled fishing, cattle grazing, and poaching had devastated aquatic biodiversity.
- The bird population had plummeted to just 50 species from its historical highs, with many migratory species abandoning the site entirely. Water quality parameters were far below acceptable standards, with high levels of pollutants making the water unsuitable for wildlife or human use.

Government Policies and Conservation Intervention

- The Nature Volunteers Initiative: The transformation began when renowned photographer and environmentalist Bhalu Mondhe (Padma Shri awardee) co-founded The Nature Volunteers (TNV) NGO in 1992. This grassroots organization, working in partnership with journalist Abhilash Khandekar, initiated a comprehensive 15-year restoration campaign that would become a model for urban wetland conservation across India.
- Multi-Stakeholder Collaboration: The restoration success resulted from unprecedented collaboration between TNV, Indore Municipal Corporation (IMC), Madhya Pradesh government, and local communities. The Environmental Planning & Coordination Organization (EPCO) provided technical expertise and policy support, while the Lake Conservation Authority included Sirpur in the state's master conservation plan.

Key Policy Interventions

- Water withdrawal restrictions prevented municipal authorities

from extracting water for public supply, allowing the lake to maintain adequate levels for ecosystem functioning. Fishing and boating bans eliminated disturbance to wildlife, while sewage diversion projects redirected polluted inflows away from the lake.

- Encroachment removal drives cleared illegal structures from catchment areas, with the most recent action in 2024 removing 30 unauthorized stalls under National Green Tribunal orders. Buffer zone establishment with barbed-wire fencing protected the lake from further encroachment.

Remarkable Recovery: Latest Data and Achievements

- Biodiversity Renaissance: The restoration has achieved spectacular results, with bird species increasing from 50 to 189 species belonging to 55 families as of 2025. The lake now hosts both resident and migratory species, including rare visitors like Greater Flamingo, Sarus Crane, and Peregrine Falcon.
- Water quality improvements have raised the lake from severely polluted to acceptable standards, with dissolved oxygen levels supporting diverse aquatic life. The ecosystem now supports 30 fish species, multiple reptile and amphibian species, and various insects and butterflies.

International Recognition and Status

- Ramsar Site designation on January 7, 2022 provided international recognition as a "wetland of international importance". This achievement made Sirpur the third Ramsar site in Madhya Pradesh and demonstrated the effectiveness of community-led conservation efforts.
- Important Bird and Biodiversity Area (IBA) status from BirdLife International in 2015 acknowledged the lake's significance for avian conservation. The site now attracts over 20,000 waterbirds during winter months, meeting international criteria for protected area designation.

Economic and Social Benefits

- Eco-tourism has grown dramatically, with annual visitor numbers increasing from approximately 5,000 in the 1990s to over 150,000 in 2025. The lake provides ecosystem services valued at millions of dollars annually, including flood control, carbon sequestration, and water purification.
- Community engagement has reached unprecedented levels, with 59 local "WetlandMitras" taking pledges to protect Indore's

wetlands in 2024. Educational programs and research activities now involve multiple universities and conservation organizations.

Replication and Scaling Potential

- The Sirpur Lake model demonstrates how community leadership, government support, and scientific management can restore even severely degraded urban wetlands. The success has inspired similar initiatives at Yashwant Sagar and other regional water bodies.
- Training programs and knowledge sharing through TNV and partner organizations are spreading Sirpur's restoration methodologies to other cities across India. The integration of traditional ecological knowledge with modern conservation science provides a sustainable framework for wetland management.

Conclusion

Sirpur Lake's transformation from environmental degradation to Ramsar site status represents a landmark achievement in urban wetland conservation. The 278% increase in bird species diversity, water quality restoration, and community engagement success demonstrate that coordinated policy intervention and grassroots action can reverse decades of environmental damage. This case study provides a replicable model for sustainable wetland management in rapidly urbanizing India, proving that ecological restoration and urban development can coexist when supported by effective governance and community stewardship.

2. Tamulidoba Wetland, Pobitora Wildlife Sanctuary, Assam

Site Overview: Tamulidoba, the largest wetland within Assam's Pobitora Wildlife Sanctuary, known for its dense population of one-horned rhinos and diverse water birds, is facing severe ecological degradation as of 2025.

Degradation Issues:

- Drying Wetland: Heavy siltation has raised the wetland bed substantially, resulting in widespread drying. The wetland now resembles a dry field rather than a waterbody, with very little surface water remaining.
- Wildlife Impact: The drying forces rhinos and buffaloes, which depend on the wet conditions for wallowing and habitat, to shift areas within the sanctuary. For the first time, rhinos have been observed drinking from alternative water sources, signalling distress due to habitat loss.
- Human- Induced Changes: Alterations to the wetland's water inlets and outlets caused by human activities have disrupted natural flooding patterns critical for replenishing wetland water levels.
- Threats to Biodiversity and Tourism: The loss of water and habitat quality diminishes biodiversity and undermines the sanctuary's appeal as a wildlife tourism destination.

Underlying Causes:

- Extensive siltation mainly from watershed erosion upstream.
- Disruption of natural flood cycles by changes in hydrological connectivity with Brahmaputra River.
- Lack of effective wetland management and restoration initiatives.

Key Takeaway:

Tamulidoba's plight exemplifies the worst-performing wetland scenario where natural processes combined with human interference cause irreversible ecological damage, threatening biodiversity and local livelihoods. It underscores the urgent need for targeted restoration, sustainable watershed management, and protection policies to prevent loss of critical wetland habitats in India.

This case stands in sharp contrast to success stories like Sirpur Lake, showing how neglect and mismanagement lead to steep ecological decline despite the wetland's recognized ecological importance.

3. Bhitarkanika Mangroves

Before its designation as a wildlife sanctuary in 1975, Bhitarkanika faced unprecedented environmental degradation that threatened its very existence. The mangrove ecosystem, located in the confluence of the Brahmani, Baitarani, Dhamra, and Pathsala rivers in Kendrapara district, Odisha, was experiencing rapid destruction due to multiple anthropogenic pressures.

The primary threats included massive human encroachment for agricultural expansion, with local communities converting mangrove areas to paddy fields and shrimp farming operations. Illegal logging was rampant, as communities harvested mangrove timber for construction and fuel wood without any regulatory oversight. The saltwater crocodile population had plummeted to just 96 individuals by 1975, pushing this apex predator toward local extinction.

Habitat destruction occurred through systematic clearing of mangroves for human settlements, with over 240,000 inhabitants in nearly 400 villages living within the sanctuary area. Pollution from agricultural runoff and domestic waste severely compromised water quality, while unregulated fishing practices disrupted the delicate aquatic ecosystem balance. The combination of these factors created a cascading effect of environmental degradation that threatened the entire mangrove ecosystem's survival.

Government Intervention:

- The Government of Odisha's decision to declare Bhitarkanika as a wildlife sanctuary in 1975 under the Wildlife Protection Act marked the beginning of a comprehensive conservation transformation. This legislative action provided the legal framework necessary to halt further degradation and initiate systematic restoration efforts. The Crocodile Conservation Project, launched simultaneously with support from the United Nations Development Programme (UNDP) and Food and Agriculture Organization (FAO), established India's most successful reptile conservation program.
- The conservation journey followed a carefully planned trajectory of escalating protection measures. In 1998, the core area of 145 square kilometers was upgraded to National Park status, providing the highest level of legal protection available under Indian wildlife law. This designation prohibited all extractive activities and human habitation within the core zone, creating a pristine refuge for endangered species.
- Ramsar Site designation in 2002 brought international recognition and funding opportunities, acknowledging Bhitarkanika as a "wetland of international importance". This status attracted global scientific attention and

established partnerships with international conservation organizations, significantly enhancing technical expertise and financial resources available for management.

- The Gahirmatha Marine Sanctuary establishment in 1998 created an integrated conservation landscape connecting terrestrial mangroves with marine ecosystems. This holistic approach recognized the interconnected nature of coastal environments and provided protection for marine species, including the world's largest congregation of Olive Ridley sea turtles.

Community Engagement and Eco-Development Programs

- Recognizing that conservation success required local community support, the forest department initiated Eco-Development Committees (EDCs) in 2001. These committees, established in 31 peripheral villages, created structured partnerships between conservation authorities and local communities. The program provided alternative livelihoods through cattle vaccination, health camps, vocational training for women, bee-keeping, inland fishing, and sustainable grass plantation.
- The reduction of dependency on forest resources was achieved through innovative programs including biogas plant establishment, firewood depots, and promotion of alternative fuel sources. Communities voluntarily shifted from firewood to dry coconut twigs, branches, and cow dung cakes, significantly reducing pressure on mangrove forests.

Scientific Management and Technological Innovation

- Advanced Monitoring Systems: The implementation of cutting-edge technology revolutionized conservation management at Bhitarkanika. The Timestamp Camera App, introduced for the 2025 crocodile census, provides video evidence with precise time and GPS watermarks, minimizing human error and improving data accuracy. This technological advancement allows for real-time monitoring of crocodile populations and habitat conditions.
- Satellite remote sensing and GIS mapping enable continuous monitoring of mangrove cover changes, helping identify restoration priorities and assess conservation effectiveness. The integration of drone technology and artificial intelligence supports comprehensive ecosystem health assessments and early warning systems for environmental threats.

Remarkable Recovery:

- Population Recovery Success: The saltwater crocodile population recovery represents one of conservation biology's most remarkable success stories. From a critically low population of 96 individuals in 1975, the population has grown steadily to 1,826 crocodiles in 2025, representing a 1,802% increase over five decades. The 2025 census documented 585 hatchlings, 403 yearlings, 328 juveniles, 164 sub-adults, and 346 adult reptiles, indicating a healthy age structure and sustainable reproduction.

- The presence of 18 albino crocodiles in 2025 highlights the genetic diversity and exceptional conservation conditions. The 117 crocodile nests recorded in 2025 demonstrate stable breeding success, with each female producing 50-60 eggs per nest. These metrics indicate that Bhitarkanika now hosts approximately 70% of India's saltwater crocodile population.

Ecosystem Restoration Achievements

- Mangrove cover has stabilized at approximately 209 square kilometers, with 145 square kilometers within the strictly protected National Park core area. The ecosystem now supports over 60 species of mangroves, including prominent Avicennia, Rhizophora, and Bruguiera species. Dense forest coverage remained constant at 82 square kilometers between 2009-2015, indicating successful habitat protection.
- The restoration has created a complex network of 672 square kilometers of wildlife sanctuary, supporting diverse fauna including over 200 bird species, Indian pythons, king cobras, black ibis, and countless marine species. The integration of terrestrial and marine habitats provides comprehensive ecosystem services that benefit both wildlife and human communities.

Economic and Social Benefits

- Ecosystem services valuation reveals that Bhitarkanika provides approximately $174.3 million USD in annual economic benefits. Storm protection services alone contribute $42.8 million annually, protecting 150,000 coastal residents from cyclones and tsunamis. Carbon sequestration services valued at $25.5 million contribute significantly to global climate change mitigation efforts.
- Eco-tourism revenue has grown substantially, with the park reopening in 2025 attracting increased international visitors

seeking authentic wildlife experiences. Fisheries support services worth $18.3 million benefit 80,000 fishing community members, while biodiversity conservation values of $15.7 million support global scientific research and pharmaceutical discoveries.

- Community livelihood improvements are evident through reduced dependency on forest resources and increased alternative income opportunities. The employment generation through conservation activities includes park management, eco-tourism,

Global Recognition and Replication Potential

- International Conservation Model: Bhitarkanika's success has earned recognition as a global model for coastal wetland conservation. The Ramsar Convention designation and UNESCO World Heritage Site consideration acknowledge its international significance. Scientific publications documenting restoration methodologies provide blueprints for similar ecosystems worldwide.
- The integration of community participation, scientific management, and government policy demonstrates how multi-stakeholder approaches can achieve conservation success while supporting local livelihoods. Training programs for international conservation practitioners share Bhitarkanika's methodologies with restoration projects across South Asia and beyond.

Scaling Conservation Success

- The Mangrove Initiative for Shoreline Habitats and Tangible Incomes (MISHTI) scheme launched in 2023 aims to replicate Bhitarkanika's success across India's coastline. Odisha's ambitious restoration targets of 8,400 hectares by 2030 build upon proven methodologies developed at Bhitarkanika. Community-led mangrove nurseries trained by Bhitarkanika experts are establishing restoration capacity in other coastal states.
- Corporate partnerships and carbon credit mechanisms provide sustainable financing for restoration projects, ensuring long-term conservation success. Educational programs and research collaborations with international institutions continue expanding Bhitarkanika's influence on global conservation practices.

Conclusion:

Bhitarkanika National Park's transformation from a degraded wetland to a thriving conservation success story demonstrates the power of integrated policy approaches, scientific management, and community engagement. The 50-year conservation journey illustrates how sustained government commitment, adaptive management strategies, and stakeholder collaboration can reverse environmental degradation and create resilient ecosystems. Bhitarkanika's model of balancing conservation with community development provides a blueprint for

sustainable wetland management in the face of increasing global environmental challenges.

4. Sembakkam Lake in Chennai, Tamil Nadu

Spanning approximately 100 acres within the Pallikaranai watershed of Chennai, Tamil Nadu, Sembakkam Lake had suffered decades of severe degradation by the late 2010s. Issues such as heavy siltation, direct inflow of untreated sewage, extensive solid waste dumping, and unchecked encroachments drastically reduced the lake's ability to mitigate flooding, recharge groundwater, and support rich biodiversity.

Restoration Initiatives

Recognizing the lake's critical role for both ecology and local communities, a comprehensive restoration project was launched in 2018. Led collaboratively by The Nature Conservancy (TNC), IIT Madras, Care Earth Trust, alongside government bodies and local stakeholders, the project adopted a participatory, ecosystem-based management approach.

Major interventions included:

- Desilting and Capacity Enhancement: Removal of over 100,000 cubic meters of accumulated silt restored the lake's depth and boosted its water holding capacity by about 36%, significantly increasing groundwater recharge by an estimated 50,000 cubic meters annually.
- Embankment Strengthening and Flood Control: Reinforcement of 1.5 kilometers of embankments and installation of two flood regulators improved resilience to intense rainfall events, reducing the risk of flooding in surrounding urban settlements and enhancing stormwater management.
- Innovative Hybrid Wastewater Treatment: A pioneering nature-based solution was implemented via constructed wetlands combined with phytoremediation leveraging plant roots and microbial action to naturally treat wastewater. This system treats up to 7 million liters of wastewater daily, achieving Central Pollution Control Board (CPCB) standards for aquatic life propagation while reducing construction and operational costs by 30% and 70%, respectively, compared to conventional treatment plants.
- Biodiversity and Community Space Creation: Restoration efforts fostered revitalization of native aquatic and terrestrial flora and fauna, with updated surveys (2025) recording over 200 plant species and 75 bird species, including migratory and resident birds. Development of eco-friendly green spaces and walking paths also enhanced community recreation and environmental education.

- Stakeholder Engagement and Sustainability: The project actively involved 10,000+ local households, resident welfare associations, NGOs, and corporate partners in participatory planning, monitoring, and governance. This approach ensured strong community ownership and commitment toward long-term upkeep and protection.

Outcomes and Impact:

- Hydrological Benefits: The lake now plays a vital role in flood attenuation, especially during intense monsoon events, protecting nearby urban neighborhoods from waterlogging. Groundwater table levels around Sembakkam have improved by approximately 1 to 2 meters, enhancing water security in a region facing growing extraction pressures.
- Water Quality Improvement: Continuous monitoring indicates a 70% decline in key pollution parameters such as Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and nutrient loading, enabling flourishing aquatic ecosystems.
- Biodiversity Gains: Species richness has increased markedly, including the return of several butterfly species, amphibians, and fish stocks that contribute to ecological balance and livelihoods. Bird populations, monitored via citizen science programs, show steady growth across migratory seasons.
- Social and Economic Benefits: The restored lake has become a focal point for eco-tourism, environmental awareness programs in schools, and sustainable livelihood opportunities such as managed fishing and nursery plant sales. Local property values have seen appreciable appreciation due to improved environmental quality.

Conclusion

The Sembakkam Lake restoration stands as a transformative example of how science-driven, participatory, nature-based solutions can successfully rehabilitate critical urban wetlands under pressure from rapid urbanization and pollution. By harmonizing ecological restoration, technological innovation, and community empowerment, the project has enhanced urban resilience against floods and climate variability, improved groundwater recharge and water quality, revitalized biodiversity in an increasingly fragmented landscape, strengthened local stewardship and socio-economic well-being.

As cities worldwide grapple with the twin challenges of environmental degradation and climate change, Sembakkam Lake offers a scalable, cost-effective model demonstrating that degraded urban wetlands can be restored to deliver multiple ecosystem services and enrich human lives sustainably.

5. Ansupa Lake

Ansupa Lake in Cuttack, Odisha, is India's largest oxbow lake, embedded within a forested landscape. Once facing ecological collapse, it now stands as a vivid example of science-based restoration and community-centered management:

Core Challenges

For decades, Ansupa Lake was severely impacted by:

- Siltation from runoff and erosion, reducing depth and water spread from 3.17sq.km (1973) to 1.76sq.km (2004).
- Weed and Algae Infestation: Over 20 invasive/floating weed and algae species choked 80% of the open water by the late 2010s.
- Blockage of Natural Inflows and Outflows (Kabula Nallah), distorting natural flood cycles and making the lake dynamic but vulnerable.
- Nutrient Pollution (Eutrophication): Agricultural runoff and detergent-laden wastewater triggered rampant weed growth, catastrophic fish stock declines, and rapid loss of migratory birds.
- Catchment Encroachment: Conversion of buffer forest and wetland to agriculture and settlements accelerated erosion and siltation.

Recent Interventions

- Use of advanced weed harvesters (including Truxor amphibious machines) systematically cleared over 295 acres of weeds, increasing

clear water from just 20 to nearly 300 acres.

- Desilting and deepening operations restored the lake's depth and holding capacity, increasing water spread from 400 acres (2017) to 490 acres (2019), sustaining 490 acres of healthy wetland as of 2025.
- Partial restoration of Kabula Nallah revives natural inflows/outflows, supports the annual ecosystem cycle, and reduces flash flood and sedimentation risks.
- Staggered trenches and embankments minimize soil and nutrient influx, encourage groundwater recharge, and maintain water levels in the dry season.
- Regular release of native fish fingerlings (esp. local carps) restores lake fisheries, with daily catch rising to 5kg/fisher (up from less than 1kg in 2017).
- Selective weed retention creates habitat for diverse birdlife, especially in strategic zones for nesting and feeding.

Community Engagement & Sustainable Livelihoods

- Formation of Ansupa Integrated Self Help Groups (SHGs), managed by local women and fisherfolk, leads to co-management of fisheries, boating, eco-tourism services, and lake monitoring.
- Eco-garden development and improved tourism infrastructure increase visitor numbers, generating local income and incentivizing lake stewardship.

Water Quality Monitoring & Trends

- Water quality (WQI) improved significantly. As of 2021, three out of four lake stations (Bishnupur, Kadalibari, Sarandagarh) rated "excellent" (safe for drinking, irrigation, industrial use); Subarnapur "good" (safe for irrigation/domestic use).
- Marked declines in turbidity and nutrient loads, reduction in algal blooms, and improved dissolved oxygen support healthy aquatic life and better fish catches.

Outcomes

- Open, clear water area: Up to 300 acres weed-free, supporting robust fisheries.
- Fisheries and livelihoods: Fish catch and income continue to rise; local communities gain new jobs in eco-tourism and lake management.
- Biodiversity: Dramatic recovery of aquatic, avian, and forest species; regionally important for migratory birds and ecological connectivity. Biodiversity surveys record 194 bird species (including 60 migratory birds), 61 fish species, 244 macrophyte species, 88 butterflies, and 26 mammals.
- Water quality: Now meets standards for habitat, fisheries, and even irrigation/drinking at most stations.
- Community empowerment: Over 100 SHG members (majority women) actively involved in revenue sharing, patrol, weed-clearing, and visitor services.
- Return of resident and migratory birds is visible, with up to 10,000 birds seen during winter seasons.

Conclusion

Ansupa Lake exemplifies how targeted government action, scientific intervention (de-weeding, desilting, fish stocking), hydrological restoration, and community empowerment can revive a forest wetland, safeguard biodiversity, and generate inclusive livelihoods. Ongoing vigilance, ecological monitoring, and adaptive management remain vital to sustaining these gains as climate and land use pressures continue to evolve.

Curtain Falls on Ramsar COP15 with Strong Global Commitments for Wetland Restoration and Protection

The 15th Meeting of the Conference of the Contracting Parties (COP15) to the Ramsar Convention on Wetlands concluded on July 31 in Victoria Falls, Zimbabwe. The landmark event drew participation from over 3,000 delegates, including government representatives, UN agencies, scientists, conservation organisations, and local communities. It marked only the second time Africa has hosted a Ramsar COP, following Uganda's hosting of COP9 in 2005. The next COP (COP16) will be held in Panama in 2028.

Held under the theme "Protecting Wetlands for Our Common Future," COP15 provided a timely platform to address the growing threats facing freshwater ecosystems and to forge a global pathway towards more sustainable wetland management.

Key Outcomes and Resolutions

A major highlight of COP15 was the adoption of the Victoria Falls Declaration, which emphasises the urgent need for political will, enhanced resource mobilisation, and increased investment in wetland conservation and restoration efforts.

All 13 proposed resolutions were successfully adopted, signalling renewed international commitment. These resolutions focus on:

- Accelerating national and regional action on wetland conservation
- Enhancing monitoring, reporting, and capacity-building
- Mobilising financial resources
- Mainstreaming wetlands in climate adaptation, disaster risk reduction, and development planning

A ground-breaking resolution on wetland restoration calls on contracting parties to develop or strengthen national legislation, policies, and programmes for restoring degraded freshwater ecosystems. Parties were encouraged to align efforts with the Freshwater Challenge to bolster national implementation of the Convention.

Another significant resolution refined the criteria for designating Wetlands of International Importance, drawing on data from the IUCN Red List and IUCN Specialist Groups.

Furthermore, COP15 endorsed the creation of the Global Waterbird Estimates Partnership, reaffirming commitments to protect migratory birds and wetland-dependent species such as river dolphins, which serve as key indicators of inland wetland health.

Strategic Planning and Financial Agreements

After intensive deliberations, parties adopted the 5th Strategic Plan of the Ramsar Convention, structured around four overarching goals and 18 specific targets. The Scientific and Technical Review Panel (STRP) was tasked with developing indicators to monitor implementation and assess progress.

While consensus on long-term financing mechanisms remained elusive, the core budget for the 2025–2027 triennium was approved with a 4.1% increase raising the Convention's total budget to CHF 15.5 million (approximately USD 19.4 million). This represents a modest yet essential step toward strengthening institutional capacities.

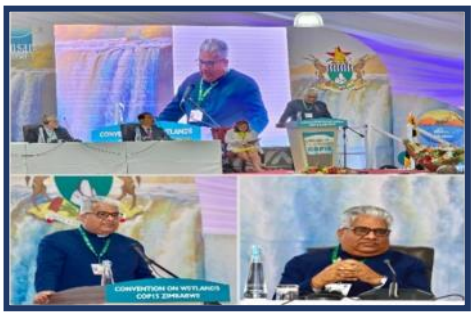
Governance, Inclusion, and Urban Wetlands

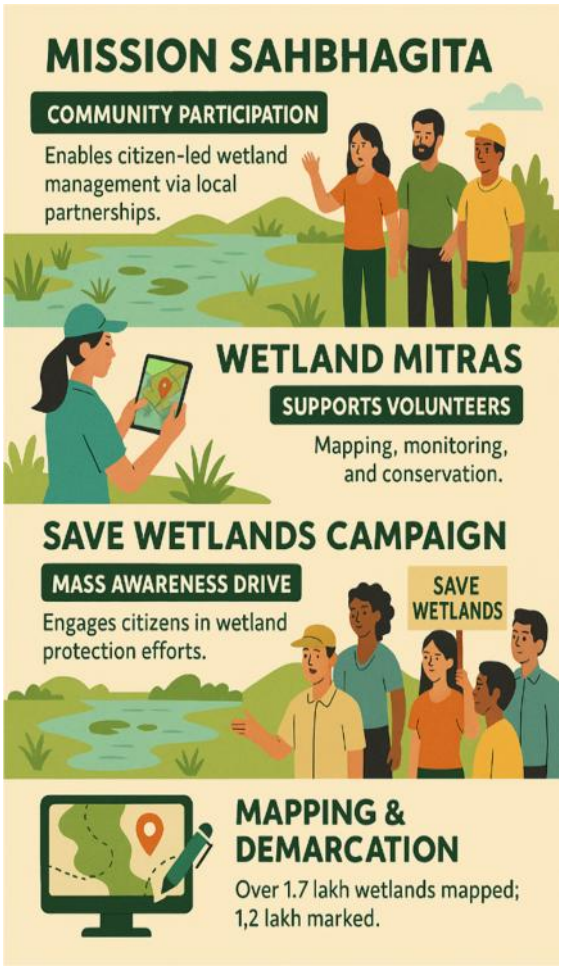
The conference also saw adoption of a resolution promoting equitable wetland governance, advocating rights-based conservation approaches within protected areas and Other Effective Area-Based Conservation Measures (OECMs). Complementary resolutions focused on traditional knowledge, youth engagement, and urban wetlands, highlighting the critical role of inclusive knowledge systems, intergenerational participation, and wetlands in supporting urban resilience and sustainability.

A Call for Synergy and Global Cooperation

In her closing remarks, COP15 President and Zimbabwe's Minister of Environment, Climate and Wildlife, Hon. Evelyn Ndlovu, urged all contracting parties to integrate COP15 commitments into national strategies and action plans. She called for enhanced international cooperation and financial mechanisms to bridge the resource gap in wetland protection and restoration.

Ndlovu also underscored the importance of synergy with other multilateral environmental agreements to tackle interconnected global challenges such as climate change, plastic pollution, and mercury contamination. Strengthening these linkages, she said, will not only improve outcomes for ecosystems and public health but also foster shared learning and innovation for a more sustainable future.





INDIA AT COP-15

The 15th Meeting of the Conference of the Contracting Parties (COP 15) to the Ramsar Convention on Wetlands, held from 23 to 31 July 2025 in Victoria Falls, Zimbabwe, marked a major advance in global wetland conservation. Delegates from 172 countries convened to address the accelerating loss of wetlands, which have already declined by about 35% since 1970. The conference adopted the historic Victoria Falls Declaration, which commits nations to enhancing wetland restoration efforts and integrating wetlands more deeply into climate and development agendas. A significant proposal discussed was the establishment of a Global Wetland Restoration Fund to finance conservation efforts globally. Emphasis was also placed on technological innovation, improved wetland inventories, and partnerships across governments, civil society, and the private sector to combat wetland degradation.

India played a prominent and proactive role at COP 15, presenting a robust model of participatory wetland conservation. The Indian delegation highlighted several achievements and initiatives. Over the last decade, Ramsar network has expanded by 250%. Notably, two Indian cities, Udaipur and Indore, received international Wetland City accreditation for their exemplary urban wetland management, a first for India.

India's actions included the rejuvenation of over 68,800 small wetlands within a single year, achieved through schemes such as Mission Sahbhagita and the Amrit Sarovar scheme, both of which emphasize community engagement and technological interventions like GIS-based mapping. Over 2 million citizens participated in these efforts, resulting in detailed mapping and boundary demarcation of over 170,000 wetlands across the country. India also showcased how constitutional mandates and policy frameworks, including the National Biodiversity Strategy and the National Wildlife Action Plan, embed wetland conservation in national priorities. Indian representatives called on other countries to mainstream sustainable lifestyles into their policies and to integrate wetland conservation more deeply into climate action agendas. Through platforms like Mission LiFE and global initiatives for biodiversity and resilience, India has championed the message of "Oneness with Nature," striving to link environmental stewardship with community-led action and intergenerational equity.

Overall, COP 15 reinforced the global urgency of protecting wetlands for ecological health, climate resilience, and economic value. India emerged as a leader by demonstrating large-scale citizen participation, innovative technology use, and mainstream policymaking for wetland conservation.

RECOMMENDATIONS & SUGGESTIONS

To secure the future of India's wetlands and align with global best practices, a suite of interlinked strategies spanning policy, planning, science, community, and adaptive management must be adopted. The following descriptive recommendations incorporate the latest domestic data and illustrative international examples.

1. Policy Reforms and Integrated Planning

India's Wetlands (Conservation and Management) Rules, 2017, provide a sound legal basis yet suffer from fragmented mandates across environment, water resources, urban development, and agriculture departments. Strengthening a National Wetland Committee (NWC), chaired by a Secretary level official, would unify policy direction, harmonize guidelines for wetland demarcation and buffer zone regulation, and oversee implementation by State Wetland Authorities. The NWC should develop a National Wetland Action Plan with clear targets, performance metrics, and timelines for inventory completion, notification, and restoration. For example: The European Union's Water Framework Directive integrates wetland objectives into basin wide river management plans, requiring Member States to achieve "good ecological status" for all water bodies, including wetlands, by 2027.

2. Mainstreaming Wetlands into Sectoral Policies

Wetlands must be treated as critical infrastructure in agriculture, urban planning, and water management.

Agriculture: Incorporate wetland buffer zones into irrigation projects to enhance groundwater recharge and trap agrochemicals.

Urban Planning: Mandate "green blue" zoning in municipal master plans cities such as Rotterdam now require wetland retention as part of flood resilient development.

Water Resources: Embed wetland restoration in basin level Integrated Water Resource Management (IWRM) frameworks, mirroring the Netherlands' Room for the River programme, which devoted €2.3 billion to re-establish 34 floodplains along the Rhine, achieving biodiversity increases in 76–93% of targeted floodplains.

3. Strengthening Science–Policy Interfaces

Bridging research and decision making is essential for evidence based policy.

- Create a Wetland Science–Policy Cell within MoEFCC to translate satellite monitoring, Health Card data, and field studies into concise policy briefs.
- Constitute multidisciplinary advisory panels ecologists, hydrologists, social scientists to review major interventions.
- Fund national research networks (e.g., via CWCM and ICAR) to advance real-time monitoring tools and ecosystem service valuation methods.

Example: The EU's MAES (Mapping and Assessment of Ecosystems and their Services) process standardizes wetland mapping and ecosystem service accounting across all Member States.

4. Community Engagement and Traditional Knowledge

Local communities are frontline stewards of wetlands; their knowledge and participation are pivotal.

- Scale up the Wetland Mitras volunteer network nationwide, training participants in biodiversity monitoring, invasive species detection, and boundary demarcation building on the 150,000 registered volunteers contributing via the Wetlands of India Portal in 2025.
- Integrate Traditional Ecological Knowledge (TEK) such as Loktak Lake's phumdi management and Kerala's rice–fish–duck polyculture into Integrated Management Plans, ensuring Free, Prior, and Informed Consent of Indigenous groups.
- Support community enterprises (eco-tourism, artisanal fisheries) through micro-grants and technical training, linking livelihoods to conservation outcomes.

5. Monitoring, Reporting, and Adaptive Management

Dynamic information systems enable responsive governance.

- Enhance the Wetlands of India Portal to include near-real-time feeds from SAC's VEDAS platform and citizen-science inputs, producing interactive dashboards of wetland extent, hydrology, and health metrics.
- Mandate annual reporting by each State Wetland Authority to the NWA, summarizing Health Card updates, restoration milestones, and compliance with management plans.
- Adopt an adaptive management cycle: establish baselines, implement actions, monitor ecological outcomes, and iteratively refine strategies.

For example: Under the EU's Common Implementation Strategy for the Water Framework Directive, Member States submit river basin management plans every six years, incorporating progress on wetland restoration and adjusting measures based on monitoring data.

6. Innovative Financing Mechanisms

Payments for Ecosystem Services (PES) schemes have demonstrated success in rewarding land stewards for maintaining wetland functions. In Costa Rica's national PES programme one of the world's oldest and largest over 1.5 million ha of forests and wetlands have been conserved through direct contracts with private landowners, disbursing more than US $600 million by 2022 and reducing downstream dry-season water deficits by 24 percent.

Green and blue bonds are rapidly scaling up nature-based infrastructure financing. In Mexico City, a MXN 2.1 billion (US $100 million) sustainability bond issued in 2017 funded constructed-wetland parks that have cut intake turbidity by 20 percent. Reykjavík's €60 million green bond (2023) financed storm-water wetlands and shoreline restoration, reducing peak urban runoff by 15 percent during extreme rain events and enhancing coastal resilience.

7. Opportunities for Public–Private Partnerships

Large-scale PPPs leverage private capital and expertise for wetland restoration. The Netherlands' Room for the River programme (€2.3 billion, 2007–2022) united government agencies, regional

water boards, and engineering firms to reconnect 4 400 ha of Rhine floodplain wetlands, lowering 1-in-1 250-year flood levels by 0.3 m on average, reducing flood risk for 60 000 people, and generating €150 million in eco-tourism revenues.

In Perth, Australia, a PPP between the City Council and the water utility created constructed wetlands treating 6 ML/day of urban runoff, achieving 90 percent removal of suspended solids and establishing habitat for 25 waterbird species.

8. Multi-stakeholder Involvement

Inclusive governance platforms ensure coordinated action. Under the EU Water Framework Directive, basin-level River Basin Management Plans integrate wetland objectives into all water-sector policies; by 2021, 58 percent of Member States met interim wetland area and status targets, submitting six-yearly progress reports that adjust measures based on monitoring data.

In Thailand's Bang Pakong River basin, a multi-stakeholder forum of government agencies, local communities, NGOs, and academia co-designed an Integrated Management Plan, resulting in a 50 percent increase in native fish populations within three years of implementation.

9. Ecosystem-Based Adaptation (EbA)

Wetlands serve as living infrastructure, buffering climate extremes and supporting livelihoods. The Netherlands' Room for the River exemplifies EbA: by restoring historic floodplains, peak discharges during the Rhine's 1995 and 1998 floods were reduced by 10–20 percent, averting €400 million in damages.

In the Lake Victoria Basin across Kenya, Tanzania, and Uganda, collaborative EbA interventions re-establishing papyrus wetlands and protecting springs have increased dry-season flows by 20 percent, improved water quality, and bolstered climate resilience for smallholder farmers through integrated watershed-to-wetland management.

10. "Wetland-Wise" Approach

Implementing Ramsar's Wise-Use principle balances ecological integrity with sustainable benefits. The TEEB Water and Wetlands report highlights "wise-use audits" that quantify trade-offs between service provisioning and conservation; for example, evaluations of rice-fish systems in Southeast Asia informed cropping calendars that maintained base flows while increasing yields by 12 percent.

Eco-certification schemes for sustainable wetland products such as "Blue Models" for fisheries link premium market prices to certified catch limits, aligning community incomes with habitat restoration and achieving shoreline stabilization increases of up to 15 percent over five years.

Collectively, these interconnected strategies reinforce each other, creating a resilient, adaptive, and well-funded wetland management framework. This will not only halt the ongoing degradation of India's wetlands but will also enhance their ecological functions, safeguard dependent communities, and strengthen overall climate resilience amid mounting development pressures.

Conclusion

India's wetlands stand at a pivotal crossroads. This report makes it abundantly clear that while significant progress has been made through landmark policies, increased Ramsar site designations, citizen participation, and technological advancements in monitoring, the ecological and hydrological health of many wetlands remains precarious. With

nearly 40% lost and over half of the remaining wetlands showing signs of degradation, our current trajectory cannot sustain the critical ecosystem services that wetlands provide for biodiversity, climate resilience, and human well-being.

The emergence of initiatives like the Amrit Dharohar scheme, Mission Sahbhagita, and Wetland Health Cards reflect growing awareness and commitment. Yet, these strides, though commendable, are far from sufficient. The challenges ranging from urban encroachment and weak enforcement to underfunded state mechanisms and the exclusion of smaller wetlands from legal protection underscore the scale of transformation still required.

If India is to reclaim its wetlands as pillars of ecological security and climate adaptation, a stronger alignment of science, policy, and community action is essential. The vision laid out in the Wetlands (Conservation and Management) Rules, 2017 remains a robust foundation. What is now required is unwavering political will,

intersectoral coherence, and scaled-up financing mechanisms that prioritize wetland values in national development.

In sum, while we have come a long way in recognizing the worth of our wetlands, there are still miles to go. The future of India's wetlands will depend on sustained, bold, and inclusive action—because reclaiming wetlands is not just an environmental imperative, but a developmental necessity.

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