CWAS CENTER FOR WATER AND SANITATION

CEPT UNIVERSITY | FACULTY OF PLANNING

Ideas for Urban Lakes
Theme 3 - Design For Lakes
REVITALIZING URBAN LAKES THROUGH NATURE BASED SOLUTIONS
Case study of Velachery Lake, Chennai

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Introduction

The apparent definition of urban lakes seems to those located entirely within city limits (census town) or likely urbanisable areas in the master plan and directly surrounded by urban developments, with some recreation facilities limited to the shoreline area (parks, playgrounds).

However, **modernization, urbanization, and policy neglect have led to their widespread decline, intensifying issues of water scarcity and climate vulnerability.**

Urban lakes are not just water bodies — they are **ecological, hydrological, social, and economic assets** that play a crucial role in city sustainability.

Fig . Urban lakes

Urban lakes function as natural infrastructure that regulates water, supports biodiversity, mitigates climate impacts, and enhances social and economic vitality in cities.

Benefits of Urban Lakes

Ecological / Environmental Benefits

- Improve **water quality**
- Act as **stormwater retention and detention systems**
- Enable **groundwater recharge** through slow percolation

Benefits of Urban Lakes

Social / Cultural Benefits

- Provide **public open and recreational spaces**
- Enable **recreation** (walking, boating, swimming)
- Act as **cultural and natural landscapes**

Economic Benefits

- Support **livelihoods** (fishing, tourism, informal activities)
- Boost **tourism and recreation-based economy**
- Increase **amenity value and surrounding property prices**

Water Management & Climate Resilience Role

- **Flood control and mitigation**
- **Rainwater harvesting**
- **Water storage** and regulation

Source: Jamwal, P., Carvalho, L., Bhattacharyya, S., & Muttepawar, P. (2023)*. The benefits of restoring urban lakes in the tropics.*

Relationship with SDGs

SDG 6
Clean water and Sanitation
Urban lakes improve water availability, recharge groundwater, and support urban water security.

SDG 11
Sustainable cities and Communities
Urban lakes reduce flooding, enhance liveability, and strengthen urban resilience.

SDG 12
Responsible consumption and production
Urban lakes enable wastewater reuse and promote sustainable water management.

SDG 13
Climate Action
Urban lakes support climate adaptation by buffering floods and moderating urban heat.

SDG 15
Life on Land
Urban lakes conserve biodiversity and sustain freshwater ecosystems.

Source: Sharma, A., & Ji, S. (2024). *Linkages between traditional water systems (TWS) and sustainable development goals (SDGs): A case of Govardhan, India.*

Need for Study

The 2015 Chennai floods were much worse because traditional water systems were lost. If these systems remained, **deaths could have dropped by 12%, the affected population by 25.3%, and flood heights by up to 0.8 meters** in areas like T. Nagar and Saidapet. Their absence increased flood damage in these now heavily urbanized zones.

Fig . Damage of Chennai Flood

Flood losses could have decreased by **17%**

Out of 400 cities facing acute water crisis, chennai is **1**

Groundwater resource extracted in Chennai **127.5 %**

Advantages over Modern systems

Traditional water systems **may require high investment today for restoration**, but once revived, **they deliver long-term water security with minimal maintenance cost**—unlike modern systems, which are e**xpensive to build and even more expensive to maintain.**

*Source: **Andrea Morblanc. (2023).** Reviving traditional water harvesting systems to build resilience to drought in India.*

Fig . Failure of Modern System

- Traditional systems work with natural hydrology and recharge groundwater, whereas modern systems disrupt natural flows and have a higher carbon footprint.
- Traditional systems provide local resilience against floods and droughts, while modern systems are vulnerable to failures during extreme climate events.

Decentralisation and Water Security

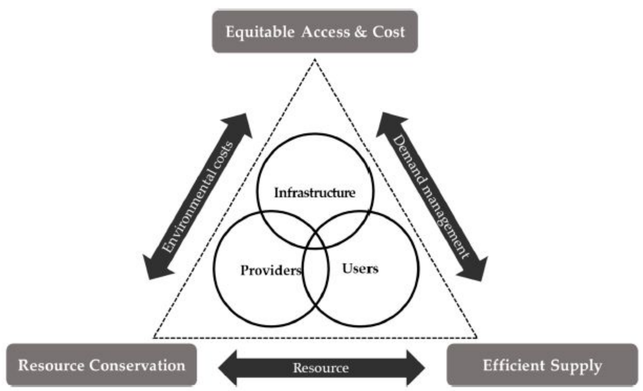
Decentralisation of water bodies ——-----→ **Thousands of small recharge points** ——-----→ **massive cumulative groundwater rise**

Localised Water Storage

- Traditional tanks harvest rainwater **where it falls**.
- Each neighbourhood becomes **self-reliant → higher reliability.**

Flood Reduction Through Distributed Storage

- Lakes act as natural "sponge zones."
- Spread-out storage reduces peak runoff & lowers flood heights.
- (Ex: In Chennai, lost water bodies increased 2015 flood heights by up to 0.8 m.)



- Infrastructure is restored and protected,
- Providers (government + communities) coordinate effectively,
- Users participate responsibly in conservation and monitoring.

*Source: **Nancey Green Leigh (2019)** Sustainable and Resilient Urban Water Systems: The Role of Decentralization and Planning*

- **Rapid population growth and urban expansion** are sharply increasing water demand, putting immense pressure on existing urban water supply systems.
- **Urban flooding and drought cycles are intensifying**, and traditional systems historically acted as buffers by capturing monsoon runoff and storing it for dry-season use.

Water Security

Water security is a multifaceted concept that encompasses the reliable availability of sufficient quantities of clean water for human well being and socio-economic development, coupled with the ability to manage water-related risks. Also considering factors like:

Quality

Accessibility

Sustainability

Institutional/Governance

Key Literature Findings and Problem statement

Decline of Traditional system

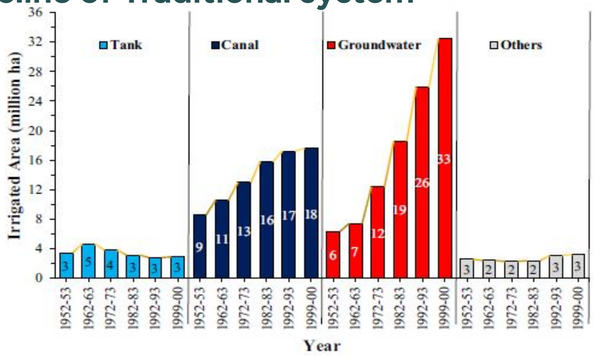


Fig 2. Decline in Tank irrigated area

- The **rise of deep tube-wells, borewells, and electrified pump sets—especially since the Green Revolution—has made individually-owned groundwater access much easier** and rendered many communal systems obsolete.

"Urban lakes are treated as drains rather than living systems."

Decline in water quality and Public health risks

Urban lakes often function as **receptacles for domestic sewage, industrial effluents, and nutrient-rich runoff**. Elevated concentrations of **nitrogen, phosphorus, heavy metals, and pathogens** have led to:

- *Eutrophication and harmful algal blooms*
- *Oxygen depletion and fish mortality*
- *Spread of water-borne diseases*
- *Groundwater contamination*

*Source: **Andrea Morblanc. (2023).** Reviving traditional water harvesting systems to build resilience to drought in India.*

Domains of Traditional Water systems

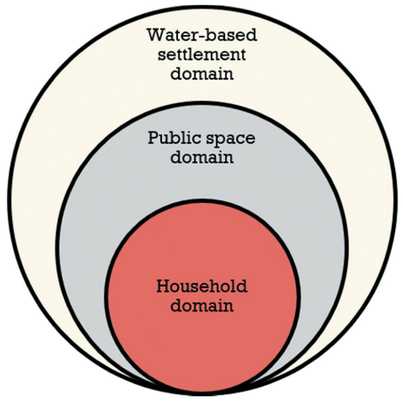


Fig 4. Domains of TWS

Traditional water systems operate across three domains:

1. **Household domain** – small-scale systems for daily domestic use (taankas, household wells).
2. **Public space domain** – community-managed shared structures (stepwells, ponds, temple tanks).
3. **Water-based settlement domain** – large hydrological systems that shape entire settlements (tanks, johads, canals, wetlands).

Together, they create a **multi-layered, resilient, and decentralized water ecosystem** in traditional Indian settlements.

Fig Public space domain

Multifaceted Benefits of Lakes

- **Groundwater Recharge:** Capture rainfall and allow continuous percolation. In Chennai's Adyar basin, tanks covering **16%** of the area significantly boosted monsoon recharge.
- **Soil Protection:** Slow runoff, reduce erosion, and stabilize land.
- **Biodiversity Support:** Maintain habitats for aquatic and terrestrial species.
- **Higher Productivity:** Steady water supply increases farm output and food security.
- **Community Resilience:** Decentralized systems reduce dependence on external water sources.

*Source: **Ali Salem, Shubham Jain, & Aman Srivastava. (2024).** Protecting ancient water harvest technologies in India: Strategies for climate adaptation and sustainable development with global lessons.*

Fig . Benefits of Lakes

Problem statement

- Urban lakes, **once integral to city water systems and community life, are increasingly shrinking, polluted, and disconnected from their natural hydrological networks due to rapid urbanization and inadequate management.**
- Their degradation has intensified **urban flooding, water scarcity, biodiversity loss, and public health risks.**
- The core problem lies in the **absence of integrated, scalable, and nature-based revitalization strategies that can restore lakes as resilient blue-green infrastructure within dense urban environments.**

Fig . Polluted urban lakes

Current Practices in Urban Lake Management

Urban lakes in Indian cities are often managed using conventional engineering and fragmented institutional approaches that focus more on ***water containment and beautification*** **rather than** ***ecological restoration.*** These practices may provide aesthetic improvements but frequently fail to restore lake function, improve water quality, or enhance ecological resilience.

Structural Engineering

Concrete embankments & revetments: Built to define lake boundaries and prevent erosion but restrict natural shoreline processes and disconnect lake from floodplains.

Deepening & desilting: Regular clearing of sediments to increase storage capacity, often without addressing the source of sediment inflows.

Stormwater diversion and straightened channels: Drains are connected directly to lakes without treatment leading to high pollutant loads entering water bodies.

Sewage treatment

Lakes in cities like Bengaluru, Pune, and Hyderabad often receive wastewater:

- **Connection of drains carrying mixed sewage**
- Installation of centralized **Sewage Treatment Plants (STPs)** around peripheries
- **Fencing & buffer fencing** to prevent direct dumping

However:

- STPs handle high loads but rely on **chemical processes** and energy-intensive operations.
- **Effluent often enters lakes without adequate tertiary treatment, leading to eutrophication.**

Beautification and Urban Amenities

To improve public perception:

- **Walking paths, lighting, seating, and parks** around lakes
- **Landscaping and lawn areas** replacing natural vegetation
- **Boundary walls and fencing** to restrict acces.

While these increase recreational appeal, they often:

- Reduce **natural vegetative buffers**
- Increase **impervious surfaces**

Ad Hoc Clean-Ups & Awareness

Municipal clean-up campaigns often include:

- Manual garbage removal
- Community clean-up events
- Occasional bio-remediation (fish stocking, limited aeration)

Positives and Limitation:

- Short-term debris removal, Temporary improvement in aesthetic quality
- Focused on surface trash, not pollutants or catchment sources

This highlights the need to shift towards Nature-Based Solutions that integrate hydrology, biodiversity, and community engagement for resilient lake restoration.

Nature Based Solutions

Nature-based Solutions are defined as **actions to protect, sustainably manage, and restore natural or modified ecosystems**, that address s**ocietal challenges effectively and adaptively, simultaneously providing human well-being** and biodiversity benefits.

The International Union for Conservation of Nature (IUCN) defines NbS as

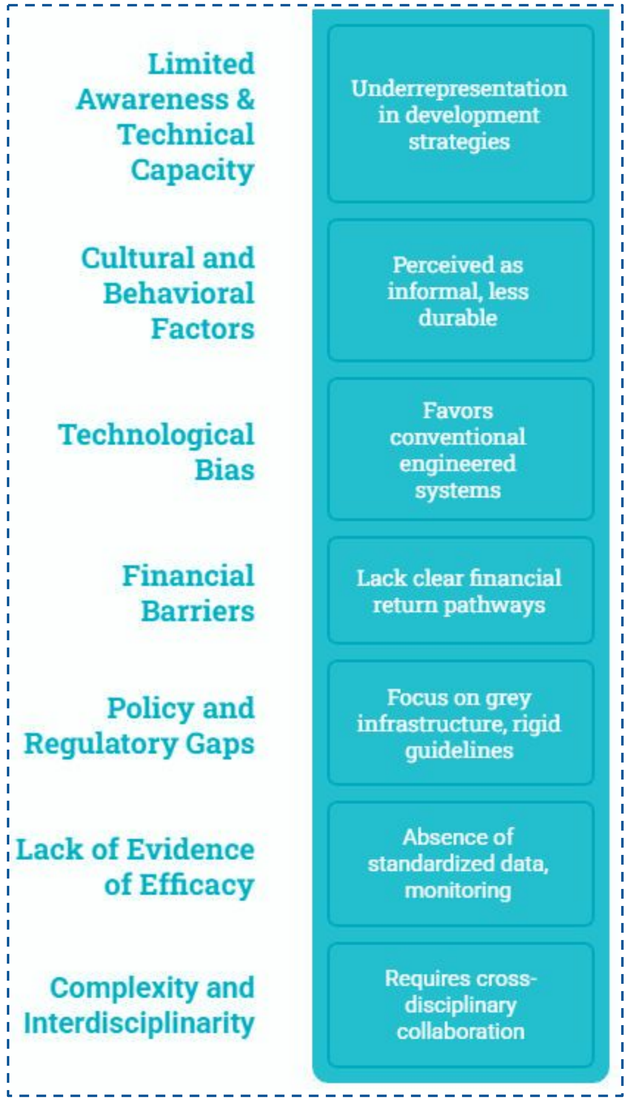
“ ***actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems****, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience, and biodiversity benefits.”*

Work *with nature*, not against it.

Benefits of Nature Based Solutions

- **Natural & Renewable Processes:** Utilize abundant natural elements, reducing carbon emissions and energy consumption through low-resource, renewable processes.
- **Financial Sustainability:** Lower lifecycle costs and minimal operation and maintenance expenses.
- **Operational Simplicity:** Passive, robust technologies requiring low supervision, adaptable to fluctuating conditions.
- **Ecosystem and Biodiversity Benefits:** Enhance biodiversity and ecosystem services such as fishing and pollination.
- **Soil Health and Food Security:** Promote closed-loop systems that improve soil quality through residue recycling.
- **Scalability:** Applicable across rural and urban settings, with high relevance in the Global South.

Barriers to NbS Adoption



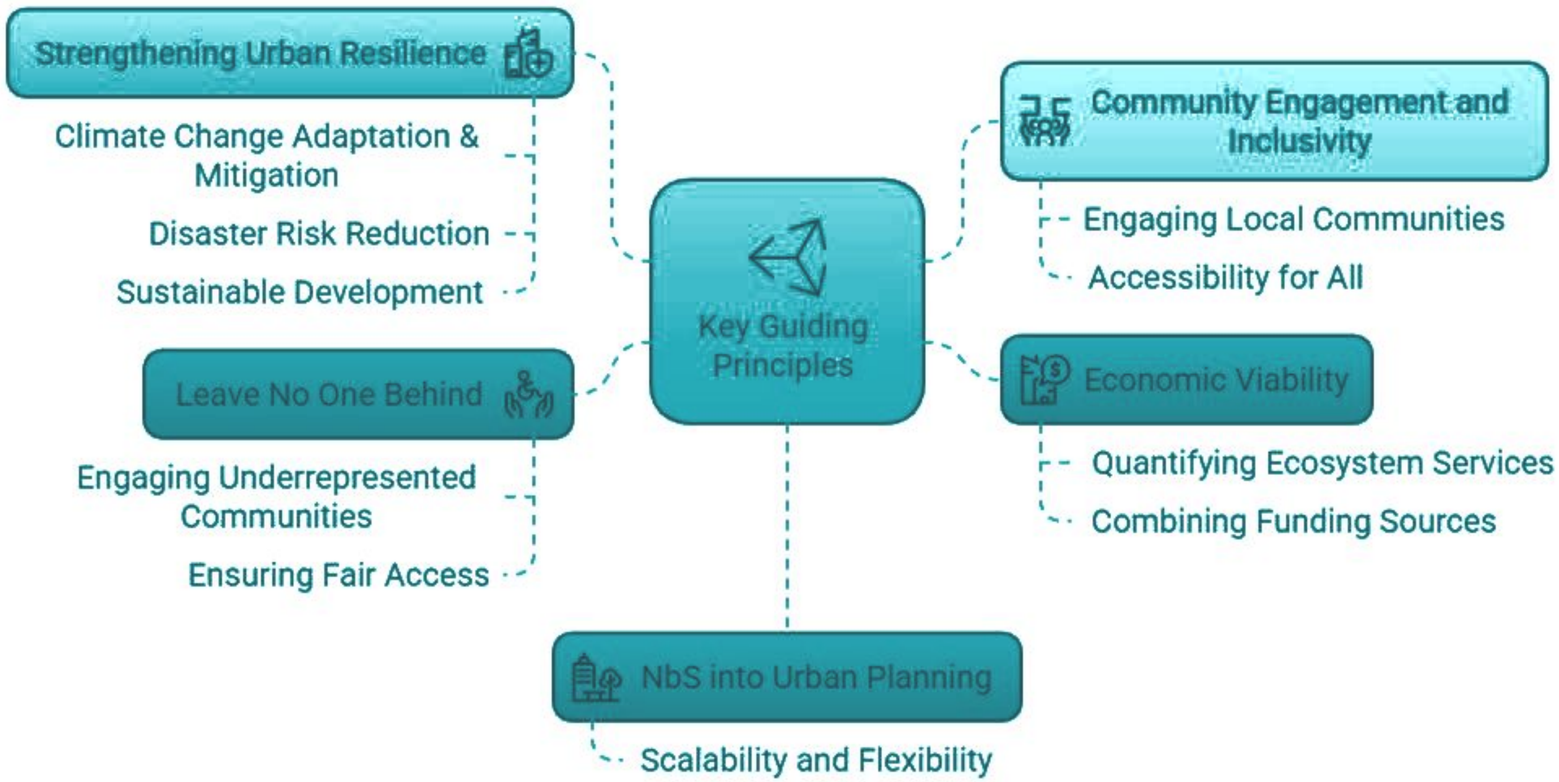
Together, these factors create institutional resistance and slow down the transition from traditional engineered systems to ecosystem-based approaches.

Source: Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu, India.

Nature based solutions for water bodies

NbS	Description	Application
Bioswales	Vegetated channels for stormwater	Water filtration, groundwater recharge
Rain Gardens	Depressions with native plants	Runoff absorption, water purification
Permeable Pavements	Surfaces allowing water infiltration	Reduce runoff, recharge aquifers
Constructed Wetlands	Artificial wetlands	Wastewater treatment, biodiversity
River Restoration	Re-naturalization of channels	Erosion control, habitat improvement

- Nature-based solutions utilize natural processes and ecosystems for effective water management.
- These strategies aim to **improve both the quantity and quality of water resources.**
- They assist communities in **adapting to climate change impacts.**
- Protecting and restoring ecosystems like wetlands, forests, and floodplains helps regulate water flow.



Source: Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu, India.

- Nature-Based Solutions strengthen urban resilience by reducing flood risks, improving climate adaptation, and supporting long-term environmental sustainability.
- By working with natural processes such as wetlands and green buffers, cities can reduce disaster risks while enhancing ecological balance.
- This ensures that urban development remains adaptive and future-ready.
- Successful NbS must actively engage local communities and ensure accessibility for all social groups.
- Special attention should be given to underrepresented and vulnerable populations who are often most affected by environmental degradation.
- This approach promotes equity, shared ownership, and long-term social sustainability.

Successful case studies : Neknampur Lake, Hyderabad

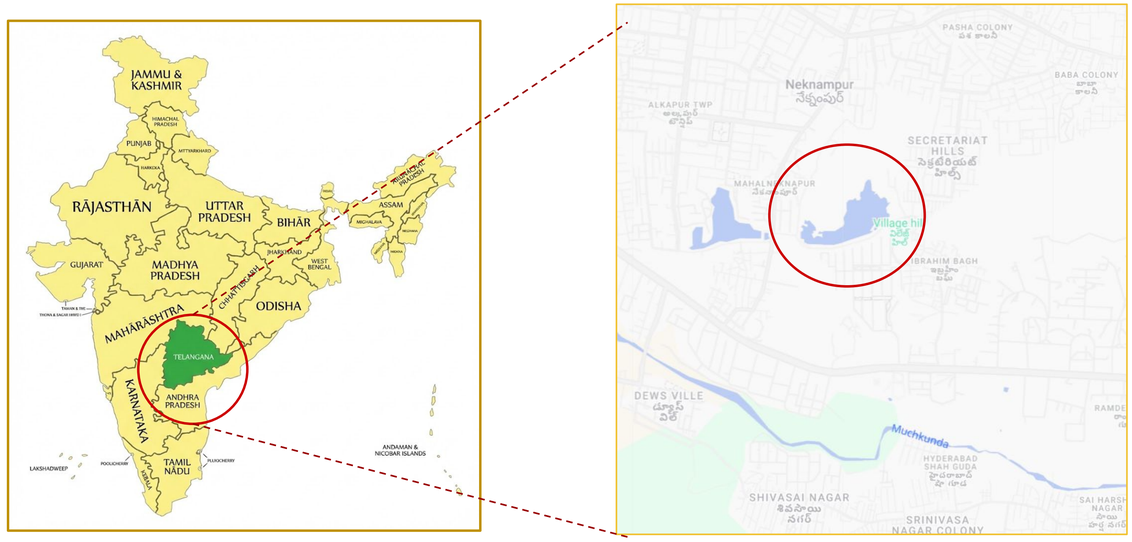
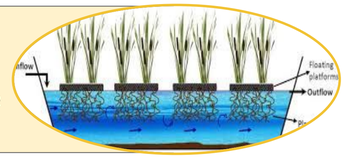


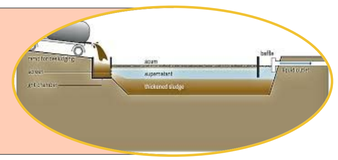
Fig . Context of Neknampur lake

NbS Techniques used

Floating Treatment Wetlands & Phytoremediation
Natural plants absorb pollutants and improve water quality.



Stormwater Treatment & Sedimentation Pond
Prevents sludge, metals, and excess nutrients from entering the lake.



Community Co-Governance
NGOs and citizens actively participate in lake maintenance and awareness.

Aeration Systems
Fountains and diffusers increase dissolved oxygen and reduce eutrophication.

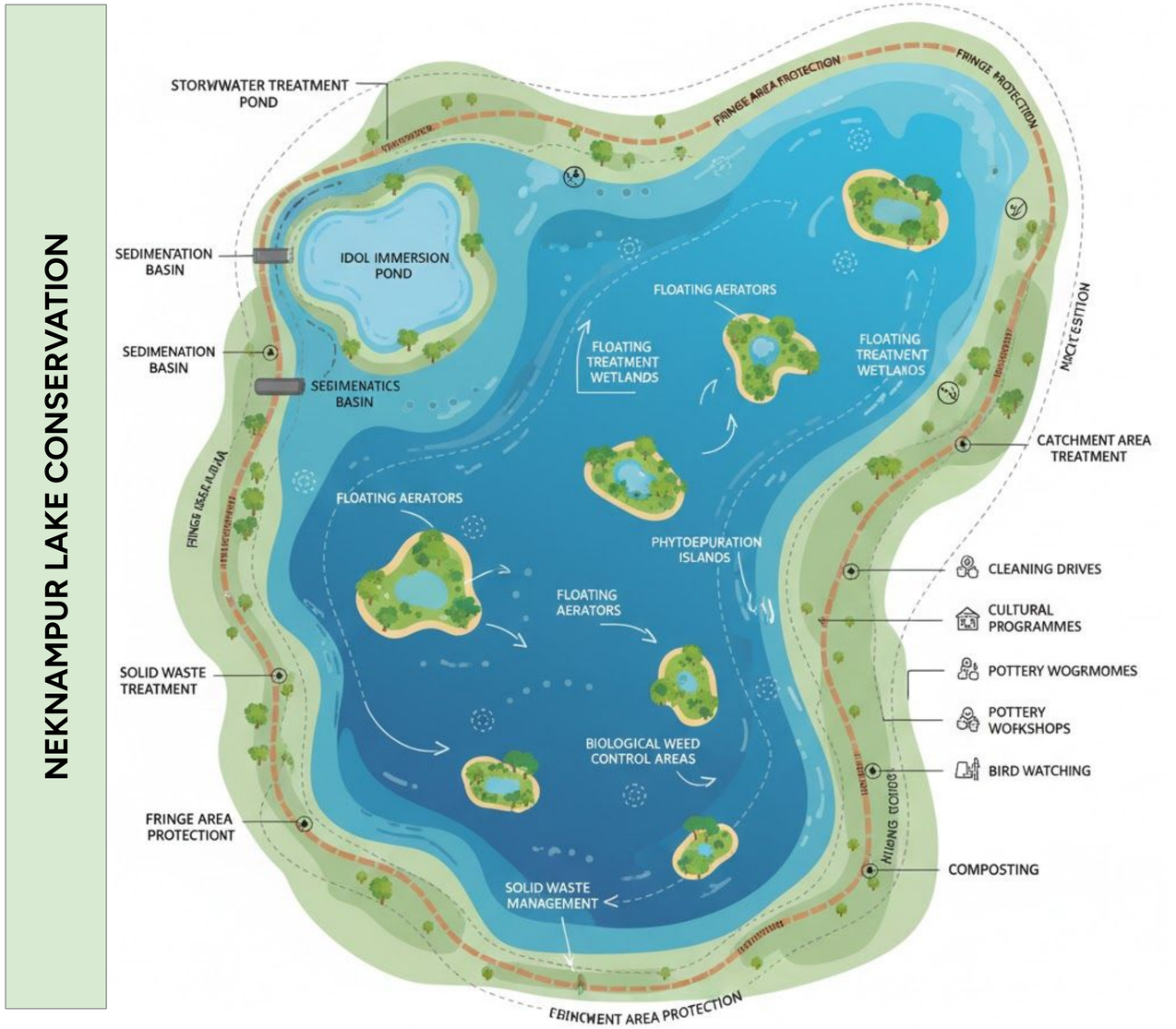
Plantation & Catchment Treatment
Restores ecology, stabilizes soil, and improves runoff management.

Focus

Creation of new green areas, Management and improved protection of rivers and other blue areas, Ecological restoration of ecosystems, Protection of natural ecosystems, Monitoring and maintenance of habitats and/or biodiversity

Project objectives

1. To develop and implement a restoration plan for Neknampur lake by integrating wetland management techniques.
2. To create a low-cost sustainable model for the restoration of the lake by using traditional and technological methods.



Research Methodology

Problem statement

" Urban lakes in Indian cities are rapidly degrading due to unplanned urbanization, pollution, and loss of natural hydrological systems, reducing their ecological, water-regulatory, and social functions. "

Preliminary research and Literature review to identify gaps and need for the study

Research Question

Formulation of Objective and Scope of work

How can Nature-Based Solutions be effectively applied to revitalize urban lakes to restore their ecological, hydrological, and social functions?

Objectives

1. To **propose an integrated NbS-based implementation strategy** for urban lake revitalization.

2. To examine the contribution of NbS-driven lake restoration to water security, flood mitigation, biodiversity, and public use.

Scope of the study

1. Assess the ecological, hydrological, and socio-spatial conditions of urban lakes and their immediate catchments.

2. Evaluate the role of NbS in enhancing water security, flood regulation, biodiversity, microclimate moderation, and public accessibility.

Steps

Literature and Policy Review

- Urban lake systems
- Nature-Based Solutions (NbS) principles
- National & international guidelines

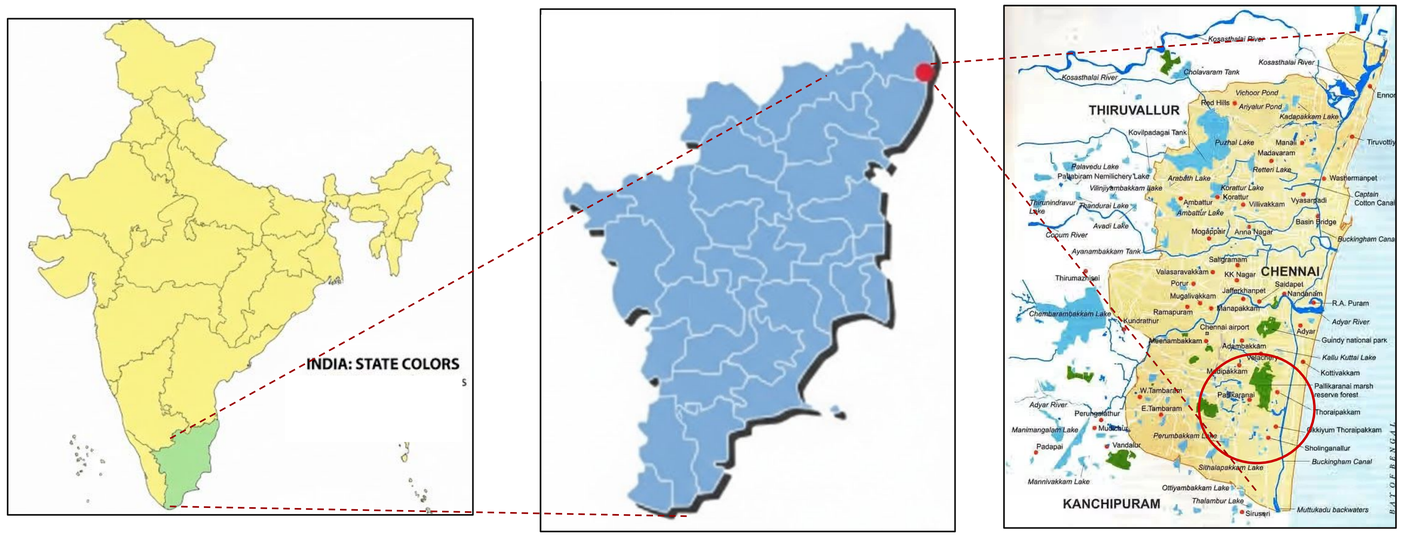
Case study analysis

- Indian urban lake restoration projects
- NbS interventions used
- Ecological, hydrological & social outcomes

Identification of Issues and challenges

Development of NbS-Based Revitalization Framework

Case study area : Velachery lake, Chennai



- **Velachery Lake** is located in the southern part of Chennai, within the rapidly urbanized neighborhood of Velachery.
- The lake lies in a low-lying basin and forms part of Chennai's historic tank system that once supported irrigation, flood control, and groundwater recharge.
- The ecological imbalance has transformed the lake from a functional hydrological asset into a stressed urban water body.
- Because of its high urban pressure and flood vulnerability, Velachery Lake serves as a strong case for implementing **integrated, nature-based revitalization strategies**.
- Due to its low elevation, Velachery experiences severe waterlogging during northeast monsoons.

Fig . Context of Velachery Lake

Existing scenario and need

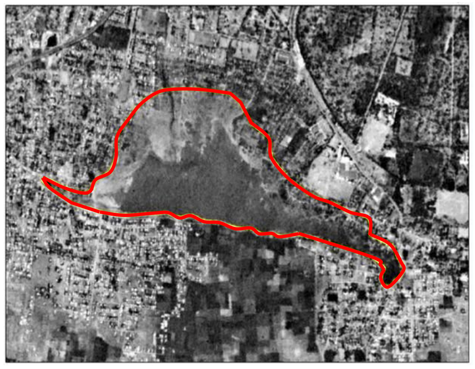


Fig. 1979 Map of Velachery Lake

Area in 1980- 108 Ha

Area in 2025- 22.25 Ha

75% Lake area is now urbanised

Fig. Existing condition of Velachery Lake

💧 Sewage and Wastewater pollution:

One of the most critical threats to Velachery Lake is the unchecked inflow of untreated sewage and wastewater from the surrounding residential and commercial areas.

Chennai, being a rapidly expanding metropolitan city, **generates enormous volumes of sewage daily, estimated to be over 800 million liters per day (MLD).**

🗑️ Solid waste dumping:

Solid waste dumping around and inside Velachery Lake is another pervasive problem exacerbating its pollution load. The lake and its banks have become **unofficial dumping grounds for household garbage,** construction debris, and plastic waste.

⚠️ Water Quality Degradation

The cumulative effects of pollution manifest starkly in Velachery Lake's declining water quality.

Measurements show dissolved oxygen (DO) levels frequently fall below the threshold required to sustain healthy fish populations, while concentrations of **heavy metals such as lead and mercury** have been detected beyond safe limits.

🌊 Groundwater Contamination

Contamination of groundwater sources in the vicinity of Velachery Lake is a growing concern. Reports indicate rising levels of **nitrates and heavy metals in groundwater samples near the lake**, suggesting seepage from polluted surface waters and improper waste disposal sites.

Velachery Lake – Nature Based Solutions Concept Map

Core Problem Areas

- Urban Flooding
- Sewage Inflow & Eutrophication
- Encroached Edges
- Loss of Biodiversity
- Poor Public Interface

Encroaching settlements

Urban Runoff

VELACHERY LAKE
வேளச்சேரி ஏரி

Inlet Wetland Treatment

Stormwater Bio-Swales

Reclaim Encroached Buffer Zone

Overflow to Downstream System

Catchment Level Interventions

Reduce Pollutant Load + Peak runoff

- Stormwater bio-swales along feeder roads
- Constructed wetlands at inlet-points
- Rain gardens in Surrounding residential pockets
- Permeable pavements in parking/public areas

Catchment Level Interventions

- Stormwater bio-swales along feeder roads

Lake Edge Restoration

Prevent Erosion + Improve

- 15-30 m vegetated buffer zone
- Native tree plantation (riparian species)
- Elevated boardwalk in parking/public areas
- Decentralized greywater treatment

Lake Edge Restoration

- Native tree plantation (riparian species)

In-Lake Ecological Solutions

Improve DO levels + reduce eutopchectation

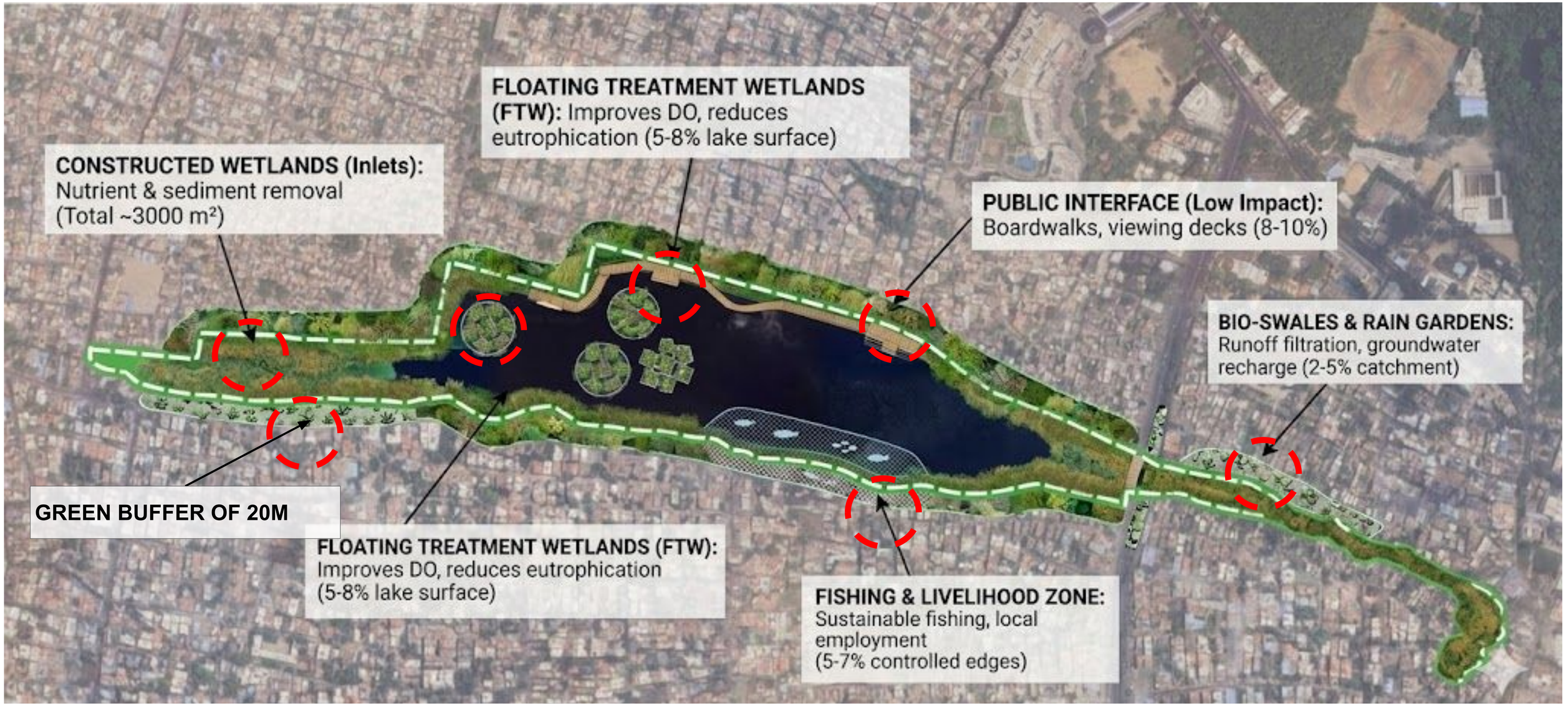
- Floating Treatment Wetlands (FTWs)
- Phytoremediation with native macrophytes
- Fish rebalancing (control invasive species)
- Desilting + sediment trap pokets
- Aeration zones (solar aerators)

In-Lake Ecological Solutions

- Floating Treatment weth native macrophytes

- ✔ **Flood reduction**
- ✔ **Improved water quality**
- ✔ **Reduced eutrophication**
- ✔ **Enhanced biodiversity**
- ✔ **Climate cooling effect**
- ✔ **Sustainable recreational space**

Zoning



S. No.	Intervention	Area / Coverage	Location	Key Functions
1	Constructed Wetlands	~0.3 ha *(3000 m² total)*	Major inflow points	Nutrient removal, sediment trapping, pre-treatment of inflow
2	Floating Treatment Wetlands (FTW)	1.1 – 1.76 ha *(5–8%)*	Within lake body	Improves dissolved oxygen (DO), reduces eutrophication
3	Buffer Zone (Green Belt)	3.3 – 4.4 ha *(15–20%)*	Surrounding lake edge	Flood absorption, pollution filtration, shoreline stabilization
4	Bio-swales & Rain Gardens	2–5% (catchment)	Roads & residential edges	Runoff filtration, groundwater recharge
5	Fishing & Livelihood Zone	1.1 – 1.54 ha *(5–7%)*	Selected lake edges	Sustainable fishing, local employment generation
6	Public Interface (Low Impact)	1.76 – 2.2 ha *(8–10%)*	Lake periphery	Boardwalks, viewing decks, recreational access

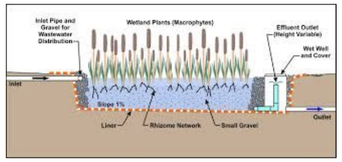
NbS solutions for Velachery lake, Chennai

Catchment Level Interventions

Stormwater Bio-Swales

Stormwater bio-swales are **vegetated channels designed to slow down and filter runoff before it enters the lake.** They trap **sediments, absorb pollutants, and increase infiltration,** thereby reducing peak discharge during heavy rainfall.

Constructed Wetlands at Inlet Points

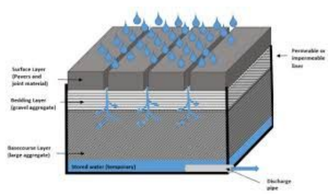


Constructed wetlands are engineered natural systems placed at lake inlets to treat **incoming stormwater and sewage-contaminated flows.** Through sedimentation and plant uptake, they remove nutrients such as nitrogen and phosphorus that cause eutrophication. **This acts as a pre-treatment layer**, improving the quality of water entering Velachery Lake.

Rain Gardens

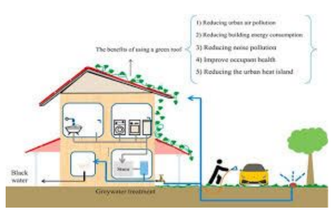
Rain gardens are **shallow landscaped depressions that collect and absorb runoff from rooftops and paved areas**. They promote groundwater recharge while reducing localized waterlogging in residential neighborhoods.

Permeable Pavements



Permeable pavements allow rainwater to pass through their surface and infiltrate into the soil below. This **reduces surface runoff, improves groundwater recharge, and decreases the load on drainage systems.** They are particularly suitable for parking areas and public spaces around the lake.

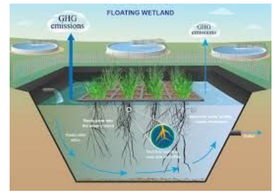
Decentralized Greywater Treatment



Decentralized greywater treatment systems **treat wastewater at the source within residential or commercial clusters.** By preventing untreated wastewater from entering storm drains, they significantly reduce nutrient and pollutant loads reaching the lake. This is crucial for addressing sewage inflow issues in Velachery.

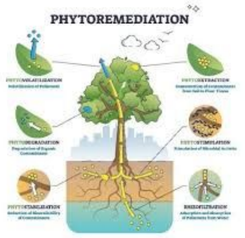
In-Lake Ecological Solutions

Floating Treatment Wetlands (FTWs)



Floating treatment wetlands consist of **buoyant platforms planted with aquatic vegetation.** Their roots hang into the water, absorbing excess nutrients and improving dissolved oxygen levels. They help control algal blooms and enhance water quality naturally.

Phytoremediation with Native Macrophytes



Phytoremediation uses aquatic plants to absorb contaminants **such as heavy metals and excess nutrients.** Native macrophytes improve water clarity and restore ecological balance within the lake. This method supports long-term, low-maintenance water purification.

Fish Rebalancing

Fish rebalancing involves controlling **invasive species and reintroducing native fish populations.** This restores the aquatic food chain and helps regulate algae growth naturally. A balanced ecosystem improves overall lake health and biodiversity..

Solar Aerators

Solar aerators **increase dissolved oxygen levels using renewable energy.** Improved oxygen levels reduce foul odors, prevent fish mortality, and enhance aquatic life. This provides an energy-efficient solution for maintaining water quality.

Costing

Component	Scope	Estimated Cost (₹ Crore)	Source of Funds	Details
A. Pre-intervention Preparations		**2.0**		Includes surveys, DPR, environmental studies
Legal & encroachment clearance	Biometric survey + rehabilitation support	0.5	State Govt (WRD) + TN Revenue Dept	Based on WRD encroachment data for Velachery
DPR & baseline studies	Hydrology, biodiversity, social	1.5	AMRUT 2.0 / GCC Budget	Essential before implementation
B. Water Quality & Hydrology		**8.0–10.0**		Primary NbS works
Inlet sedimentation basins	Silt forebays @ major inflows	2.0–3.0	AMRUT 2.0 / Urban Flood Mitigation Fund (GoTN)	Improves water clarity before entry
Constructed treatment wetlands	~500–1,000 m² scale	3.0–4.0	Climate Resilience Funds / National Adaptation Fund for Climate Change (NAFCC)	NbS alternative to STP
Floating treatment wetlands	Floating plant mats in lake body	1.0–1.5	CSR (IT & Corporate sector – OMR corridor)	Filters nutrients & supports biodiversity
Bio-swales & edge infiltration trenches	Periphery runoff management	2.0	GCC Stormwater Drain Dept + AMRUT	Reduces pollutant loads
C. Lake Morphology & Storage		**6.0–8.0**		Increases flood resilience
Desilting & dredging	Deepens lake basin	4.0–5.0	WRD (Water Resources Department, TN)	Enhances storage capacity
Soft bund grading & stabilization	Slope regrading + vegetation	1.0–1.5	State Green Fund / CAMPA (if eligible)	Replaces concrete stabilizers
Minor hydraulic works	Retrofitting sluices/outlet control	1.0	WRD Budget	Manages floods
D. Ecological & Habitat Elements		**4.0–5.0**		
Riparian planting & native species	Wetland & shoreline plants	1.5–2.0	Tamil Nadu Biodiversity Board + CSR	Stabilizes soils + habitat
Biodiversity islands & zones	Bird, butterfly, pollinator areas	1.0–1.5	CSR / Environmental NGOs	Enhances ecological value
Aquatic habitat features	Logs, riffles, littoral shelves	1.0		Supports fish, amphibians
E. Public Interface & Amenities		**3.0–4.0**		
Boardwalks & viewing platforms	Safe edge access	1.5	GCC + PPP Model	Supports recreation
Pedestrian paths & seating	Promenade + open spaces	1.0	GCC Capital Budget	Encourages social use
Interpretation signage	Education & awareness	0.5	CSR / Local Corporate Sponsorship	Explains NbS
F. O&M Provisioning & Contingency		**2.0–4.0**		
Operation & maintenance fund	5–10 yrs	2.0	Lake Management Trust + User Fee Model + CSR	Essential for wetland upkeep
Contingency reserve	~10%	2.5		For unforeseen issues

Total Estimated Cost: ₹25–30 Crore

Cost benefit Analysis

Operation and Maintenance Cost (O&M)

Component	Annual Cost (₹ Cr/year)	Details
Wetland maintenance	0.30	Plant replacement, sediment removal
Floating wetlands upkeep	0.20	Cleaning, biomass harvesting
Lake cleaning & desilting (periodic)	0.40	Once in 2–3 years (averaged annually)
Staff & management	0.50	Security, lake management authority
Public area maintenance	0.30	Pathways, lighting, waste management
Monitoring systems	0.20	Water quality sensors, audits
Total	1.90	

Revenue Generated (Direct and Indirect)

Activity	Annual Revenue (₹ Cr)	Basis
Entry fee (₹10–20 per person)	0.50–0.80	~500–1000 visitors/day
Parking fees	0.20–0.30	PPP model
Fishing permits	0.30–0.50	Controlled fishing zones
Boating / eco-activities	0.30–0.60	Low-impact recreation
Events / eco-tourism	0.20–0.40	Weekend markets, awareness programs

Source	Annual Value (₹ Cr)	Explanation
CSR funding	0.50–1.0	IT corridor (OMR companies)
Government grants	0.50	Climate/NbS funds
Carbon credits	0.20–0.30	Carbon sequestration
Total	2.7-4.4	

🌱 Environmental Benefits

Benefit	Value
Groundwater recharge	20–30% increase
Flood damage reduction	₹3–5 Cr/year saved
Water purification	Reduced treatment cost (~₹1 Cr/year)
Temperature reduction	2–3°C microclimate cooling
Biodiversity increase	Habitat restoration

👥 Social Benefits

Benefit	Impact
Public open space	10,000+ users/week
Health benefits	Reduced stress, improved air quality
Community engagement	Local stewardship
Education	Awareness, eco-learning

💰 Economic benefits

Benefit	Value
Property value increase	10–20% rise in surrounding areas
Livelihood generation	Fishing, vendors, tourism
Tourism economy	₹1–2 Cr/year
Job creation	100–200 direct + indirect jobs

"Lake restoration is not a cost, it is a high-return ecological infrastructure investment."

Total Annual Cost: ₹1.9 Cr

Total Annual Revenue: ₹2.7 – 4.4 Cr

Net Annual Benefit: ₹0.8 – 2.5 Cr

Payback Period: ~10 Years

Phasing

Phase 0 — Preparation (0–3 months)

- Site surveys, mapping & stakeholder engagement
- DPR, environmental impact & social baseline
- Legal groundwork for encroachment resolution

Cost: ₹2.0 Cr

Phase I — Water & Hydrology Setup (3–8 months)

- Inlet sedimentation basins
- Bio-swales & stormwater filtration
- Constructed wetlands start

Cost: ₹6.0–8.0 Cr

Phase II — Lake Body & Flood Storage (8–14 months)

- Dredging & desilting
- Floating wetlands deployment
- Hydraulic control works

Cost: ₹6.0–8.0 Cr

Phase III — Ecological & Public Interfaces (14–20 months)

- Riparian planting, biodiversity islands
- Boardwalks, signage, seating areas

Cost: ₹5.0–7.0 Cr

Phase IV — Testing, Handover & O&M Setup (20–24 months)

- Operations testing, monitoring systems
- Partnership with community groups
- Final cleanup & commissioning

Cost: ₹3.0–4.0 Cr

Conclusion

NbS solutions

- Revitalizing Velachery Lake through Nature-Based Solutions transforms the lake from a degraded urban water body into resilient natural infrastructure.
- By integrating catchment-level interventions, ecological edge restoration, and in-lake treatment systems, the proposal addresses flooding, pollution, biodiversity loss, and climate vulnerability in a holistic manner.
- Rather than relying solely on hard engineering, this approach works *with natural processes* to improve water quality, enhance groundwater recharge, restore habitat, and create sustainable public spaces.
- Over time, the **lake becomes not just a flood buffer, but a climate regulator, biodiversity hub, and community asset for Velachery.**
- ***Ultimately, this strategy demonstrates how urban lakes can be reimagined as multifunctional ecosystems that support environmental resilience, social well-being, and long-term urban sustainability.***

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