

Economics of Wetlands and their Restoration Through Nature Based Solutions

Centre for Science and Environment Webinar on Lakes and Water Bodies 8th October 2025

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Natural Capital of Wetlands



The natural capital of wetlands refers to their inherent **Natural Assets**—such as soil, water, plants, and animals—that provide essential **Ecosystem Services** (benefits to the human population) and **Biodiversity** - variety of life within wetlands and the rich habitats they provide

Provisioning



Water provisioning services

Provide surface and groundwater for drinking, irrigation, and other uses.



Wild biomass provisioning services

Capture of fish, crustaceans, molluscs, aquatic plants from natural wetlands.



Aquaculture provisioning services

Supply of fish, shellfish, aquatic plants through rearing in wetlands.

Regulating



Global climate regulation services

Store and sequester carbon, influencing global climate.



Local climate regulation services

Evapotranspiration from wetlands influences local microclimates.



Water flow regulation services

Buffer floods, maintain flows, and recharge aquifers.

Supporting



Soil formation and fertility services

Recycle nutrients, trap sediments, and enhance soil productivity.



Lifecycle maintenance, habitat & gene pool protection

Provide critical breeding, spawning, nursery, and migratory habitats.



Pollination & seed dispersal services

Support pollinators and dispersers that benefit wetland and nearby ecosystems.

Cultural



Recreation and tourism services

Birdwatching, boating, fishing, nature-based tourism in wetlands.



Aesthetic services

Scenic and inspirational values of wetlands.



Spiritual, symbolic & heritage services

Sacred wetlands, rituals, symbolic meaning, cultural heritage.



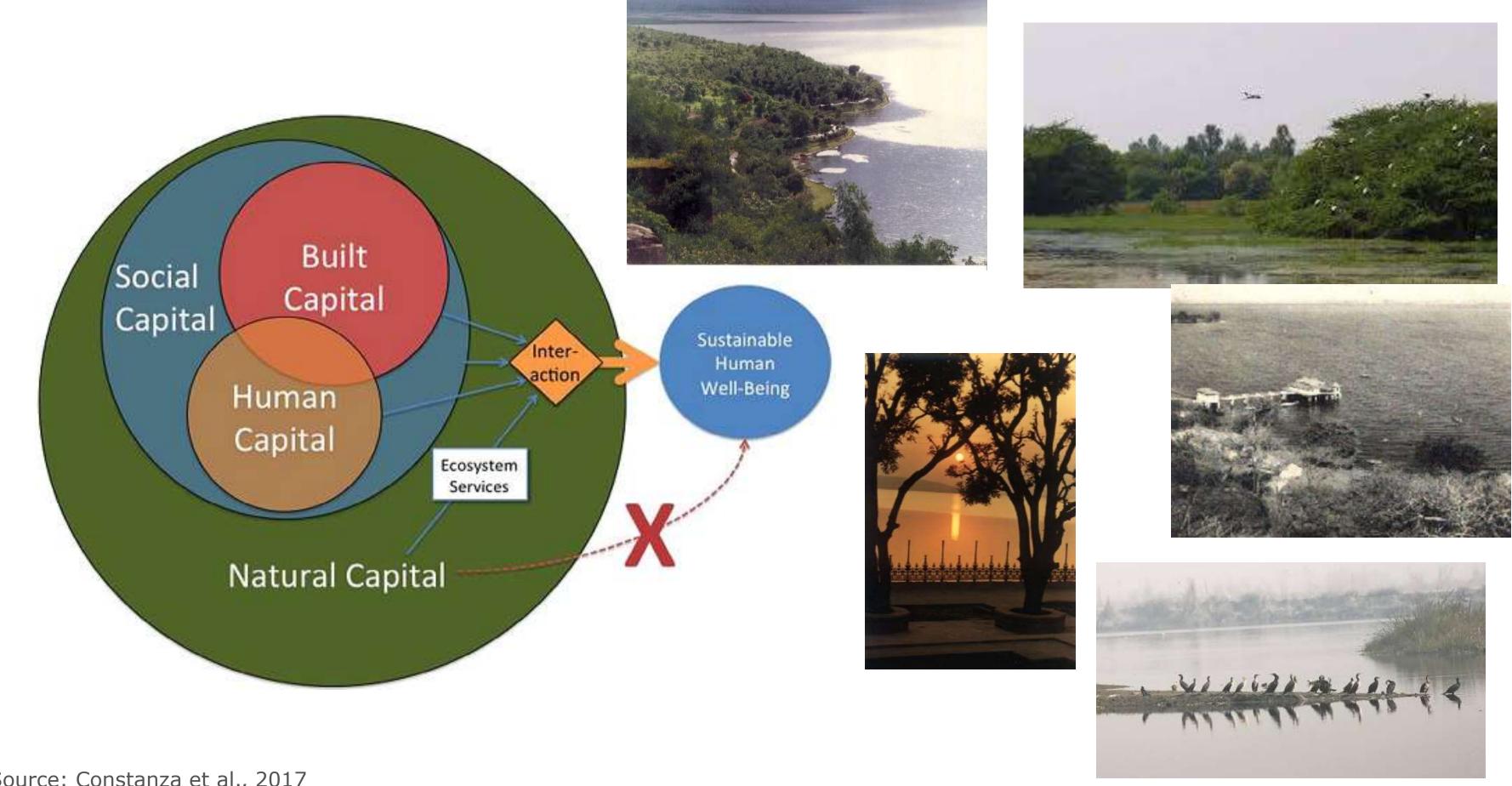
Scientific, educational & knowledge services

Sites for research, traditional knowledge, and environmental education.

Source: SEEA Framework

The interaction between built, social, human and natural capital

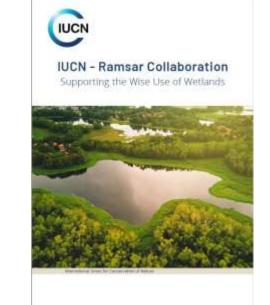




Source: Constanza et al., 2017

Ecosystem Restoration and Nature Based Solutions

- Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (IUCN)
- ➤ Help Building back Better



Nature-Based Solutions Can Deliver Big Economic Benefits

Solution: Protect and restore forests to store carbon, stabilize, soil and slow water runoffs during intense rainfall

dollar invested in restoring degraded forests would create \$7-\$30 in benefits Solution: Restore wetlands to absorb and filter flood waters, store carbon, and provide clean water

ecosystems provide services worth up to \$15 trillion, including flood protection, fisheries habitat, and water purification Solution: Restore degraded agricultural land to produce more food for more people

Restoring 160 million hectares of land would create \$84 billion in annual economic benefits globally Solution: Expand green spaces and restore forests and watersheds in and around cities to lower heat and reduce flood risks

Restoring upland forests and watersheds could save water utilities in the world's 534 largest cities an estimated \$890 million each year

Solution: Protect and restore mangroves, marshes, and reefs to buffer coasts from storms, absorb floodwaters, and capture carbon

economic Benefits: Protecting and restoring mangroves could create \$1 trillion in net benefits globally by 2030

MOUNTAINS, FORESTS & WATERSHEDS

RIVERS & WETLANDS

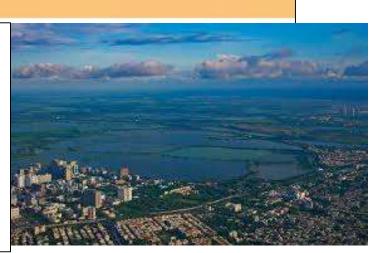
FARMLAND

CITIES



Source: Verdone and Seidl, Roots of Prosperity (Forests); Millennium Ecosystem Assessment (Rivers & Wetlands); A. Wu, How Can Restoring Degraded Landscapes Deliver Financial Returns? (Farmland); The Nature Conservancy, Beyond the Source (Cities); Global Commission on Adaptation, Adapt Now (Coasts).







Nature Based Solutions (NbS)









- Nature-centric and cost effective
- Rooted in local tradition; culturally appropriate
- Localized solutions to global problems
- Strengthening ecosystems (natural), livelihoods (economic) and social capital
- Economics of NbS-Paradigm shift to a new inclusive system
 - Moving beyond GDP figures
 - Recognition and capture of hidden values and co-benefits
 - Inclusion of a wider set of ecosystem services (eg. cultural),
 - Qualitative aspects to understand the context and traditional narrative



Nature-based solutions (NBS) utilizing wetlands

- ➤ a critical strategy for addressing climate change, water security, and biodiversity loss.
- ➤ Provide a wide array of benefits, such as water purification, flood control, carbon sequestration, and supporting biodiversity.

How Wetlands Function as NbS:

Water Management:

•Wetlands act as multifunctional systems that store excess runoff, slowly release it during dry periods, and recharge groundwater.

Flood and Drought Mitigation:

•They serve as natural buffers, absorbing floodwaters and reducing the duration and severity of droughts.

Water Quality Improvement:

•Wetlands help remove or reduce organic and inorganic pollutants from various sources.

Ecosystem Health:

•They maintain ecological integrity, support biodiversity, and provide essential services for both human well-being and the environment.





Key Initiatives in India

- •MISHTI (Mangrove Initiative for Shoreline Habitats and Tangible Income):
- •This program focuses on restoring degraded mangrove ecosystems, which are vital wetlands that provide coastal protection and support local incomes.
- Amrit Darohar Scheme:
- •This initiative promotes the optimal use of wetlands, focusing on livelihood development for local communities and the preservation of wetland ecosystems.
- Wetland Management Plans:
- •India is developing management plans, including health cards for specific wetlands, to integrate scientif

Process Flow of Putting Economic Valuation & Accounting to Practice





II. Economic Valuation:

An economic process which assigns a value (either monetary, biophysical, or other) to an ecosystem and/or its ecosystem services.



III. Environmental Accounting:

Provides data which highlights both the contribution of natural resources to economic well-being and the costs imposed by pollution or resource degradation.



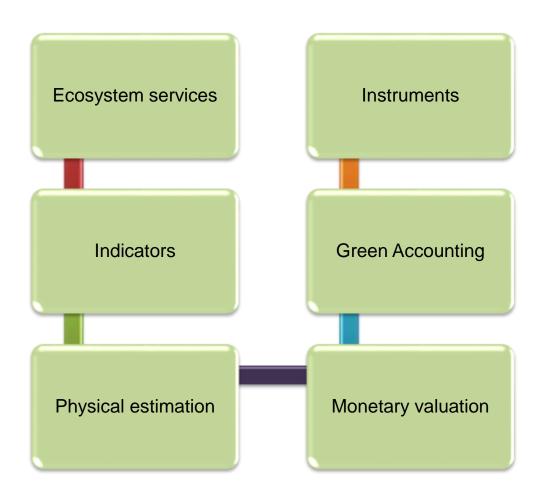
I. Ecosystem Services:

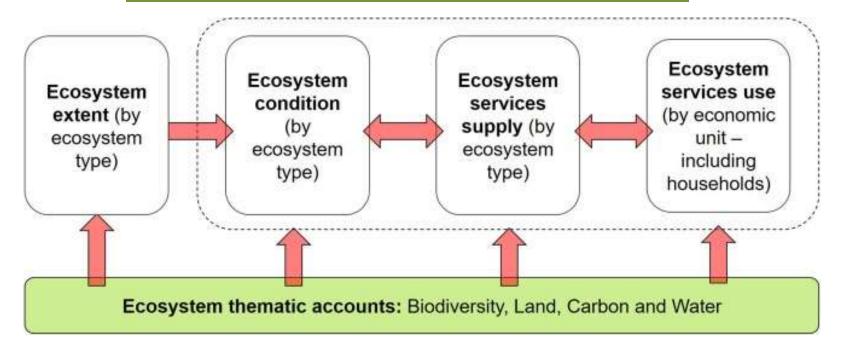
The processes and benefits provided by functioning ecosystems for people's health, jobs, and safety (MA, 2005).



IV. Payment for Ecosystem Services:

Incentives offered to farmers and landowners in exchange for managing their land to provide some sort of ecological services.





Tools for Wise Use of Wetland





Supporting Frameworks

Legal and policy support for participatory wetland management.



Local Environmental Knowledge

Integration of traditional practices for sustainable wetland use.



Economic Valuations

Quantifying ecosystem services for informed wetland policies.



Gender Inclusion

Recognizing gender roles for inclusive wetland management.



Participatory Monitoring

Involving locals in monitoring for adaptive wetland management.



Co-Management of Threats

Resolving conflicts through participatory wetland management approaches.



Source: IUCN, Ramsar, Wetland International

Wetlands for Livelihood & Climate Resilience: 5M Framework





Stakeholder mapping (fishers, farmers, washerfolk, vendors, urban residents)

Wetland catchment & land use mapping

Identify inflows: sewage, silt, nutrients



Measure

Water quality (DO, BOD, nutrients, bacteria, turbidity)

Weed/biomass extent & soil fertility

Ecosystem service valuation (water, recreation, habitat)

Socio-economic baselines (livelihoods, disease costs, income levels)

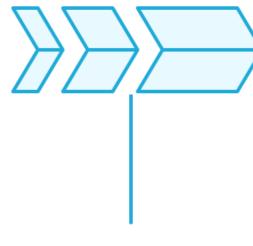


Model

Wetland dynamics model (population → sewage → water quality → livelihoods)

Scenario testing for interventions (sewage diversion, de-weeding, organic farming)

Climate resilience pathways (flood control, carbon storage, heat buffering)



Monitor

KPIs: water quality, fish yields, farm income, recreation revenue, health outcomes

> Quarterly dashboards + citizen/public reporting

Governance:
Wetland
Management
Committee with
multi-stakeholder
oversight



Voluntary contributions & recreation/tourism fees

Lakefront value capture (property levies)

PES/IBMs for upstream farmers (inputs, certification, price premiums)

Carbon credits & co-benefits financing



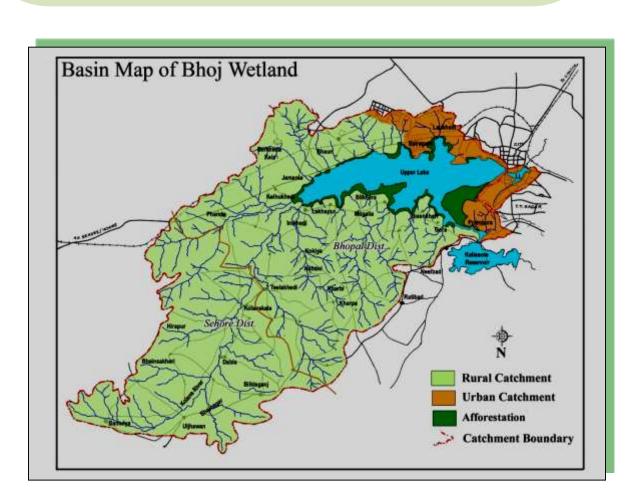
Background:

- Consists of Upper & Lower lakes, declared Ramsar Site (2002)
- Provides 40% of Bhopal's drinking water (~28 MGD)
- Supports livelihoods (fishermen, washermen, boatmen, trapa cultivators, vendors)
- Delivers ecosystem services: microclimate regulation, recreation, biodiversity support



Threats

- Siltation (1–2.58 cm/year) & sediment inflow
- Sewage inflow (7,500 m³/day) + industrial & detergent waste
- Encroachment & eutrophication (33+ km² affected by weeds)
- Religious immersions, hospital waste, motor boating impacts











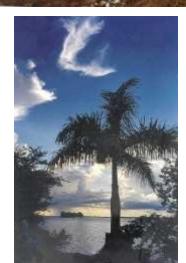


Source: Verma et. al., 2001; Verma, 2008, Verma & Negandhi, 2011

ECOSYSTEM SERVICES PROVIDED BY THE BHOJ WETLAND

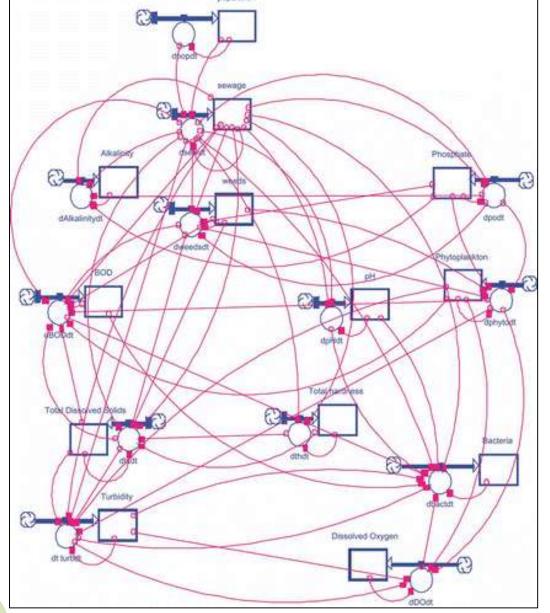
- * DRINKING WATER
- * RECREATION
- MICROCLIMATIC STABILISATION
- AESTHETIC
- SEWAGE TREATMENT
- NUTRIENT CYCLING
- CARBON SEQUESTRATION
- SOIL FORMATION
- WATER REGULATION
- WATER PURIFICATION
- SHELTER FOR ANIMALS AND BIRDS
- EMPLOYMENT







Water Resource Modelling Using STELLA









RESTORATION ACTIVITIES

•DESILTING AND DREDGING WORKS

- DESILTING AND DREDGING OF LAKESDEEPENING AND WIDENING OF THE SPILL
 - •RESTORATION OF THE TAKIA ISLAND

•CATCHMENT AREA TREATMENT

CHANNEL

- •AFFORESTATION, CREATION OF BUFFER ZONES
- •CONSTRUCTION OF CHECK DAMS, SILT TRAPS, TOE WALLS
- •CONSTRUCTION OF GARLAND DRAINS AROUND LOWER LAKE

•SHORELINE AND FRINGE AREA MANAGEMENT

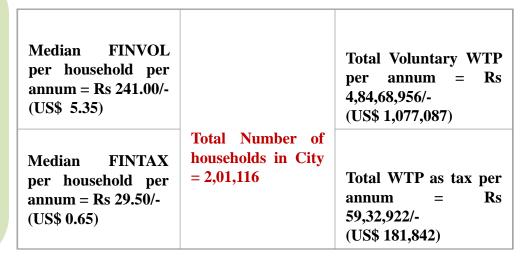
- •RETGHAT LALGHATI ROAD
- **•**SOLID WASTE MANAGEMENT
- •PREVENTIONOF POLLUTION FROM DHOBI GHATS

•WATER QUALITY MANAGEMENT

- •DEWEEDING
- **•**MONITORING OF WATER QUALITY
- •INSTALLATION OF FLOATING FOUNTAINS, OZONISERS
- •AQUACULTURE

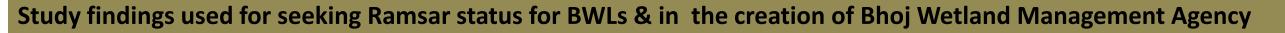
Economic Valuation Findings (IIFM Study, 2000)-at 2025 prices

- Drinking Water Supply: ₹40.04 crore/year
- Fisheries: ₹3.36 crore/year
- Trapa Cultivation: ₹2.10 crore/year
- Recreation (WTP Voluntary): ₹20.15 crore/year
- Lakefront Property Premium: 50% higher values
- Total: Multiple direct & indirect values not captured in official accounting



Implications for Natural Capital & Policy

- Wetland services are undervalued or unpriced in decision-making
- Economic valuation showed that WTP for conservation > maintenance costs
- Highlights need for **environmental accounting** to be integrated into city planning, GDP, and water management
- Supports participatory governance and beneficiary-pays model
- Demonstrates how natural capital accounting strengthens wise use strategies





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