



Constructed Wetlands

For Prelims: Benefits of constructed [wetlands](#), Types of constructed wetlands, Wetlands, [Central Pollution Control Board \(CPCB\)](#)

For Mains: How constructed wetlands can help India's water crisis, Using constructed wetlands for sustainable development India

[Source: DTE](#)

Why in News?

- Recently, there has been a **shift towards constructed wetlands**, which are a more comprehensive and nature-based solution for [industrial wastewater treatment](#), as compared to traditional methods that have **proven inadequate in addressing the array of pollutants present**.

What are Constructed Wetlands?

- **About:**
 - Constructed wetlands are **engineered systems** designed to replicate the natural processes of wetlands **for wastewater treatment**.
 - They consist of carefully selected vegetation, soil, and water that work together to purify wastewater.
 - These wetlands are specifically designed to **promote the growth of beneficial microorganisms** and plants that can break down pollutants and improve water quality.
- **Types of Constructed Wetlands**
 - **Subsurface Flow (SSF):** SSF wetlands involve passing wastewater through **gravel beds or porous media**, where microbial activity degrades organic matter.
 - **Surface Flow (SF):** SF wetlands have **water flowing above the surface**, often creating aesthetically pleasing landscapes with diverse vegetation.
- **Benefits of Constructed Wetlands:**
 - **Need:** Traditional treatment methods, such as **physical and chemical treatments**, often struggle to effectively treat the complex mix of pollutants found in industrial wastewater.
 - These methods can be **costly, energy-intensive**, and may not completely remove all contaminants. There comes the role of more comprehensive and sustainable solutions like constructed wetlands.
 - **Environmental Benefits:** They can serve as **habitats for a variety of plant and animal species**, contributing to [biodiversity conservation](#).
 - Moreover, they can provide ecosystem services such as flood control and carbon sequestration, enhancing their ecological significance and value.
 - Constructed wetlands are also a **sustainable solution** for water treatment. They require minimal energy and utilize natural processes for purification.
 - **Cost-Effective:** Compared to traditional wastewater treatment plants, constructed wetlands are **less expensive** to build, operate, and maintain.

- **Nutrient Removal:** They are **efficient in removing pollutants** like nitrogen, phosphorus, and organic matter.
- **Land Reclamation:** These systems can be used to **reclaim land degraded** by mining activities by **restoring natural wetland** functions.
- **Applications of Constructed Wetlands:**
 - **Municipal Wastewater Treatment:** Constructed wetlands can be a secondary or tertiary treatment stage **for municipal wastewater**, improving water quality before discharge or reuse.
 - **Stormwater Management:** These systems can effectively **filter stormwater runoff**, removing pollutants and sediments before they enter natural waterways.
 - **Industrial Wastewater Treatment:** Constructed wetlands can be adapted to treat specific types of industrial wastewater, depending on the contaminants present.
 - **Agriculture:** They can be used to **treat agricultural runoff**, reduce pollution and improve water quality for irrigation.

Example of Constructed Wetlands in India

- The [Asola Bhatti Wildlife Sanctuary in Delhi](#) uses constructed wetlands to purify sewage from nearby settlements while also providing a sanctuary for flora and fauna.
- Similarly, the [Kolkata East Wetlands in West Bengal](#) treat wastewater from Kolkata while supporting local fishing and agriculture.
- In Rajasthan, the [Sariska Tiger Reserve](#) has embarked on an innovative initiative, utilising constructed wetlands for treating wastewater from nearby villages.

What is the Difference Between Wetlands and Constructed Wetlands?

Feature	Wetlands	Constructed Wetlands
Origin	Naturally occurring ecosystems	Engineered systems designed by humans
Formation	Develop over time through geological processes, flooding, or changes in water flow.	Deliberately constructed in a specific location.
Water Source	Varied - precipitation, groundwater, surface water runoff.	Controlled source - wastewater, stormwater runoff, or specific water bodies.
Purpose	Provide a variety of ecological functions like flood control, water purification, habitat for diverse species.	Primarily designed for water treatment (wastewater, stormwater) or specific purposes like habitat creation.
Biodiversity	Established communities of plants, animals, and microbes adapted to the specific wetland type.	Plant species are chosen and introduced, while microbial communities develop over time.
Land Area	Can range from small ponds to vast marshes, typically covering large areas.	Designed with a specific footprint based on treatment needs, can be smaller than natural wetlands.
Regulation	Often protected under environmental regulations due to their ecological	May require permits for construction and operation depending on local

	importance.	regulations.
Maintenance	Minimal human intervention required after establishment.	Regular maintenance needed to ensure proper functioning (water flow, plant health, sediment removal).

RAMSAR CONVENTION

About

- Also known as the Convention on Wetlands.
- An intergovernmental treaty, adopted in 1971, in Ramsar, Iran.
- Entered into force in 1975.
- Wetlands that are of international importance are declared as Ramsar sites.
- **Largest Ramsar Site in World:** Pantanal: South America

Montreux Record

- Adopted in Montreux (Switzerland) in 1990.
- Identifies Ramsar sites that need priority conservation attention at national or international level.

Wetlands

- A place in which the land is covered by water – salt, fresh, or somewhere in between – either seasonally or permanently.
- Take many forms including rivers, marshes, bogs, mangroves, mudflats, ponds, swamps, billabongs, lagoons, lakes, and floodplains.
- **World Wetlands Day: 2nd February**

India & Ramsar Convention

- Came into force in India: **1982**
- **Total Number of Ramsar Sites: 75**
- Chilika Lake (Odisha), Keoladeo National Park (Rajasthan), Harike Lake (Punjab), Loktak Lake (Manipur), Wular Lake (Jammu and Kashmir), etc.
- **Related Framework in India**
- The Ministry of Environment, Forest and Climate Change (MoEF&CC) has notified Wetlands (Conservation and Management) Rules, 2017 under the provisions of the Environment (Protection) Act, 1986 as regulatory framework for conservation and management of wetlands.
- The 2017 Rules decentralise wetlands management and provide for the constitution of the State Wetlands Authority or Union Territory Wetlands Authority.

Key Facts

- **Largest Ramsar Site:** Sunderbans, West Bengal
- **Smallest Ramsar Site:** Vembannur Wetland Complex, Tamil Nadu
- **State with the maximum number of Ramsar Sites:** Tamil Nadu (14)
- **Wetlands in Montreux Record:**
- Keoladeo National Park: Rajasthan
- Loktak Lake: Manipur



What are the Challenges associated with the Constructed Wetlands?

- **Plant Selection: Effective plant selection** in constructed wetlands is critical for nutrient absorption and pollutant removal, with species like cattails, bulrushes, and sedges proving particularly adept at absorbing nitrogen and phosphorus while providing habitat for beneficial bacteria to degrade pollutants.
- **Land Requirement:** Constructing wetlands requires a **significant amount of land**, which might be a limitation in urban areas.
- **Treatment Efficiency:** While effective, constructed wetlands might **not achieve the same level of purification** as conventional treatment plants for heavily polluted water.
- **Maintenance Needs:** Regular maintenance is required to ensure proper functioning and prevent clogging or mosquito breeding.
- **Other Challenges:** There is a need for **clear policies and regulations** to promote their adoption, raising **awareness and technical expertise** among stakeholders, and continuous monitoring and research to optimize their performance.

Way Forward

- **Leveraging Global Best Practices:**
 - **Design Optimisation:** India can learn from countries like **Germany and the Netherlands**, pioneers in constructed wetland design.
 - These nations utilize **multi-stage systems** with free water surfaces (surface flow) and subsurface flow for optimal treatment depending on the influent characteristics.

- **Performance Monitoring:** The **US Environmental Protection Agency (US EPA)** recommends establishing clear performance monitoring protocols.
 - Regular monitoring of water quality parameters and wetland health is crucial for optimizing treatment efficiency and identifying potential issues.
- **Implementing Constructed Wetlands in India:**
 - **Policy and Regulation:** The **Central Pollution Control Board (CPCB)** has already recognised constructed wetlands as a viable wastewater treatment option.
 - Further policy frameworks could **incentivize their adoption** by municipalities and industries, along with clear guidelines for design, operation, and maintenance.
 - **Financial Instruments:** Exploring innovative financing mechanisms like Public-Private Partnerships (PPPs) and subsidies for constructing and maintaining these systems can attract investment and make them more accessible, particularly for smaller communities.
 - **Demonstration Projects:** Establishing successful demonstration projects across diverse geographical and climatic zones in India is crucial.
 - This would showcase the effectiveness of constructed wetlands in real-world scenarios and provide valuable data for future applications.
 - **Community Engagement:** Local communities should be involved in the **planning, construction, and operation** of constructed wetlands.
 - Raising awareness about the benefits of these systems and fostering a **sense of ownership** will ensure their long-term success.

Drishti Mains Question:

Q. Discuss the concept of constructed wetlands as a sustainable solution for industrial wastewater treatment in India. Evaluate the challenges and opportunities associated with the widespread adoption of constructed wetlands in the country.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q. If a wetland of international importance is brought under the 'Montreux Record', what does it imply? (2014)

- (a) Changes in ecological character have occurred, are occurring or are likely to occur in the wetland as a result of human interference.
- (b) The country in which the wetland is located should enact a law to prohibit any human activity within five kilometers from the edge of the wetland.
- (c) The survival of the wetland depends on the cultural practices and traditions of certain communities living in its vicinity and therefore the cultural diversity therein should not be destroyed.
- (d) It is given the status of 'World Heritage Site.'

Ans: (a)

Mains

Q. What is wetland? Explain the Ramsar concept of 'wise use' in the context of wetland conservation. Cite two examples of Ramsar sites from India. (2018)