



Water Circularity

For Prelims: [Composite Water Management Index](#), Water circularity, [Industry 4.0](#), [3G Ethanol Production](#), [AMRUT 2.0](#), [Central Pollution Control Board](#)

For Mains: Water crisis and management in India, Wastewater treatment and reuse in India, Circular economy.

[Source: DTE](#)

Why in News?

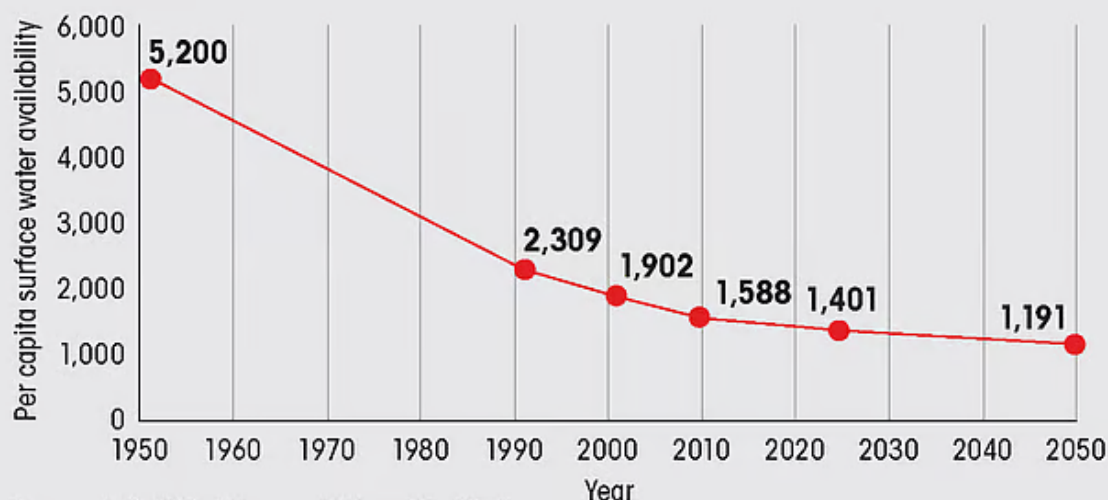
A study, "**Waste to Worth: Managing India's Urban Water Crisis Through Wastewater Reuse**," published by the **Centre for Science and Environment (CSE)**, highlights the need for **water circularity** by reusing [treated wastewater](#) as a solution to both [water scarcity](#) and **environmental degradation**.

What are the Key Findings of the Study on Wastewater Reuse?

- **India's Growing Water Scarcity:** India ranks **132nd globally in per capita water availability** (India-WRIS), with freshwater resources declining by **73% from 5,200 cubic meters (m³) in 1951**.
 - The [Central Water Commission](#) estimates per capita availability at **1,486 m³ in 2021, projected to drop to 1,367 m³ by 2031**.
 - India is already a **water-stressed nation (below 1,700 m³ per capita)** and risks becoming **water-scarce (below 1,000 m³ per capita)** without urgent action.
 - India occupies **2% of the Earth's landmass** but has only **4% of global freshwater resources**, while supporting **18% of the world's population** and **15% of its livestock**, putting immense pressure on its water supply.

Surface water scarcity

Between 1950 and 2024, India has seen a decline of 73 per cent in per capita surface water availability

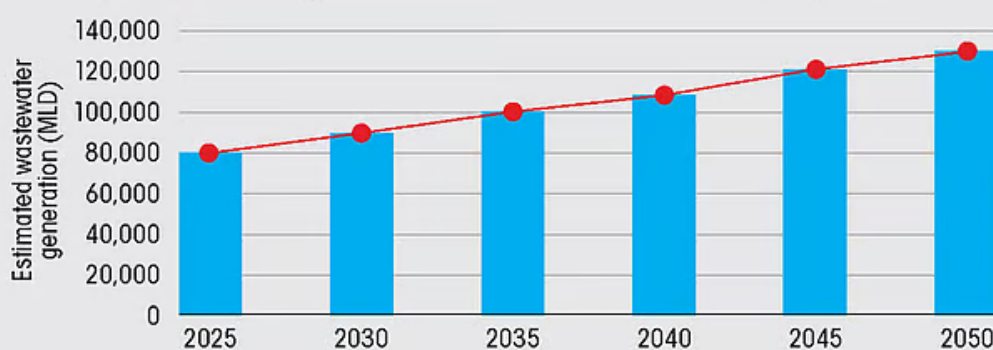


Source: India Water Resource Information System

- **Wastewater Generation Crisis:** In 2020-21, Urban India generated **72,368 million litres per day (MLD)** of sewage, but only **44% (31,841 MLD)** had treatment capacity, with an operational capacity of **26,869 MLD**.
 - As a result, only **28% (20,236 MLD)** was treated, while **72% remained untreated**, polluting water bodies and land.
 - Wastewater generation is expected to increase by **75-80%** over the next **25 years**, reaching **48 BCM annually by 2050**, which is **3.5 times** the current treatment capacity.
 - **Wastewater is an untapped resource** that can supplement fresh water supply while reducing environmental pollution.

Wastewater projections

The total wastewater generation in India will rise by 75-80 per cent in 25 years, reaching an estimated 0.13 million MLD by 2050



MLD: Million litres a day; Source: NITI Aayog

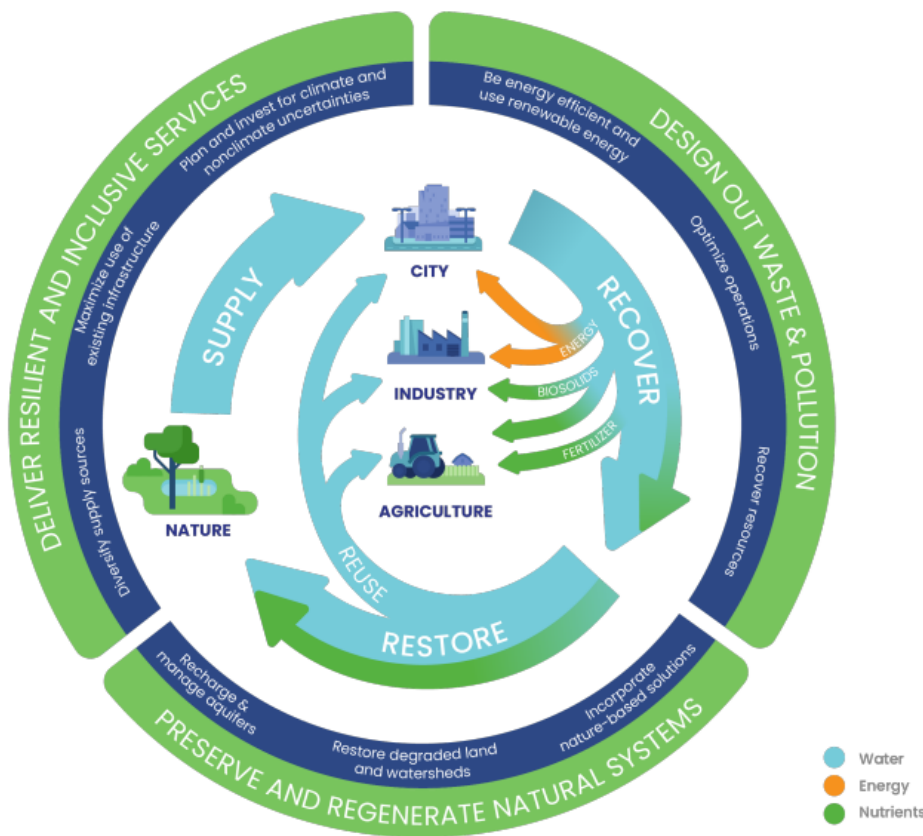
- **Water Governance Challenges:** Indian cities heavily rely on **distant rivers for water** (Bengaluru (Cauvery), and Hyderabad (Krishna, Godavari)). This dependence increases costs, and leads to shortages and unequal access, especially in urban peripheries and informal settlements.

- The [NITI Aayog Composite Water Management Index](#) shows **16 states score below 50 out of 100, indicating poor water management**. Most cities dispose of untreated or partially treated sewage into water bodies.
- The **Union Ministry of Jal Shakti** mandates that cities **reuse at least 20% of their treated water**, but compliance is low.
- Wastewater is informally reused in **agriculture and industry**, but without structured policies. Farmers use **untreated sewage**, risking health.
- Large irrigation projects have **been repurposed** to supply water to urban areas (Narmada Project (Gujarat), Bisalpur Project (Rajasthan)), **reducing water availability for agriculture**.

What is Water Circularity?

- **About:** Water circularity is the practice of **recycling, reusing, and recovering resources** within the water treatment cycle to maximize value for people, nature, and businesses. It minimizes waste, reduces pollution, and regenerates natural systems.

WATER IN CIRCULAR ECONOMY AND RESILIENCE



- **Benefits of Water circularity:** Recycling treated wastewater lowers industrial water costs, especially in **power plants and data centers running Artificial Intelligence (AI) models**, by replacing freshwater for cooling and supporting **Industry 4.0**.
 - In India, around 317 km³ of municipal wastewater generated every year could potentially irrigate 40 million hectares, covering **10% of all irrigated land**.
 - A study found that **wastewater recycling in thermal power plants** can save **10 million cubic meters of water** annually and generate **USD 300 million per year in benefits**.
 - India's class I and II cities generate 2,500 tonnes of nutrients daily (from 6,400 MLD sewage water), valued at Rs 19.5 million. Recovering nutrients (nitrogen, phosphorus) from treated sewage can produce **organic fertilizers**, **reducing reliance on synthetic**

alternatives, enhancing soil health, and boosting crop productivity.

- Using treated sewage for **artificial groundwater recharge**, helping replenish **depleted aquifers** and improving water security.
- Extracting **biogas from wastewater** can power water utilities, while **algal biofuel production (known as 3G ethanol production)** can reduce environmental impact and support **India's climate policies**.

What Measures Can Strengthen Wastewater Reuse in India?

- **Water Credit: Water reuse credits** can incentivize industries to adopt water-efficient practices, similar to **carbon trading systems**.
- **Decentralized Wastewater Treatment:** Decentralized wastewater treatment systems (households, communities, institutions) can reduce pressure on centralized **large sewage treatment plants (STPs)** and enhance local reuse.
 - Integrate **localized wastewater treatment and reuse systems** in **Smart Cities** under **AMRUT 2.0**.
- **Industries & Power Plants:** Enforce **100% treated wastewater use in thermal power plants within 50 km of STPs** (as per **Power Tariff Policy 2016**).
 - Impose **water abstraction charges** for industries still using freshwater despite available treated wastewater.
- **Wastewater Distribution Networks:** Convert **unused canal networks into wastewater supply channels** (e.g., similar to Uttar Pradesh's initiative to channel treated wastewater for irrigation).
- **Tax & Financial Incentives:** Offer low-interest loans for private investments in wastewater recycling and incentives for adopting **zero liquid discharge (ZLD) systems** (which eliminate liquid waste discharge).
- **Monitoring & Regulation:** Enforce **Central Pollution Control Board (CPCB)** discharge standards with regular audits and develop **Internet of Things (IoT)** based sensors in all STPs for real-time water quality monitoring.

2008	National Urban Sanitation Policy: Promotes the recycle and reuse of wastewater. The policy mandates that treated wastewater should comprise a minimum of 20 per cent of the water used in a city.	2021	Swachh Bharat Mission (SBM) 2.0: This mission aims to ensure that no untreated wastewater is discharged into the environment, all used water is safely contained, transported and treated, along with maximum reuse of treated used water in all cities that have a population of less than 0.01 million. The mission also aims to work on reuse policies with the states and organize trainings and capacity building programmes for ULBs on solid and liquid waste management. The mission recommends the utilization of used water as much as is feasible, but not less than 20 per cent .
2010	Service-Level Benchmark Framework: Encourages the reuse of wastewater in cities.		
2012	National Water Policy (NWP), 2012: NWP 2012 focuses on reducing water pollution; the draft of the revised NWP 2020 embraces the imperative of recycling and reuse.		
2012	Jawahar Lal Nehru National Urban Renewal Mission (JNNURM): This mission mandates the treatment of 100 per cent of the wastewater in 63 cities and promotes the reuse of treated wastewater. This mission also focuses on the development of bye-laws for reuse of recycled water.		
2014	National Mission for Clean Ganga (Namami Gange): This programme focuses on the rejuvenation and conservation of the Ganga. It includes initiatives for the treatment of sewage and industrial effluents, with an emphasis on promoting the reuse of treated wastewater.	2021	Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 2.0: The mission mandates that all cities with a population of more than 0.01 million recycle their used water to meet 20 per cent of the city's water demand and 40 per cent of the industrial water demand at the state level.
2015	Atal Mission for Rejuvenation and Urban Transformation (AMRUT): Encourages cities to provide the basic needs of sanitation and water supply. Encourages the reuse of wastewater for sustainability. Smart Cities Mission: Sanitation (particularly wastewater recycling and storm water reuse) is one of the core infrastructure elements included in the programme.	2022	National Framework on Safe Reuse of Treated Wastewater: Published by the National Mission for Clean Ganga (NMCG), the framework acts as a guiding document for states to formulate their reuse water policies and implement the same in a time-bound manner. A draft policy template has also been developed as part of the framework to aid in the preparation of a reuse policy by the respective state governments.
2015	Namami Gange: MOUs were signed by NMCG with the Ministry of Power, Ministry of Railways, and Ministry of Agriculture for reuse of treated wastewater.		
2016	Power Tariff Policy: Mandates thermal power plants to use treated sewage water within 50kms of STPs.		

Drishti Mains Question:

What is water circularity, and how can it help in addressing India's water crisis?

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q.1. Which one of the following ancient towns is well known for its elaborate system of water harvesting and management by building a series of dams and channelizing water into connected reservoirs? (2021)

- (a) Dholavira
- (b) Kalibangan
- (c) Rakhigarhi
- (d) Ropar

Ans: (a)

- The city of Dholavira was located on Khadir Beyt in the Rann of Kutch, where there was fresh water and fertile soil. Unlike some of the other Harappan cities, which were divided into two parts, Dholavira was divided into three parts, and each part was surrounded with massive stone walls, with entrances through gateways.
- There was also a large open area in the settlement, where public ceremonies could be held. Other finds include large letters of the Harappan script that were carved out of white stone and perhaps inlaid in wood.
- This is a unique find as generally Harappan writing has been found on small objects such as seals.
- Being the 6th largest of more than 1,000 Harappan sites discovered so far, and occupied for over 1,500 years, Dholavira not only witnesses the entire trajectory of the rise and fall of this early civilization of humankind, but also demonstrates its multifaceted achievements in terms of urban planning, construction techniques, water management, social governance and development, art, manufacturing, trading, and belief system.
- With extremely rich artefacts, the well-preserved urban settlement of Dholavira depicts a vivid picture of a regional centre with its distinct characteristics, that also contributes significantly to the existing knowledge of Harappan Civilization as a whole.
- **Therefore, option (a) is the correct answer.**

Q.2. With reference to 'Water Credit', consider the following statements: (2021)

1. It puts microfinance tools to work in the water and sanitation sector.
2. It is a global initiative launched under the aegis of the World Health Organization and the World Bank.
3. It aims to enable the poor people to meet their water needs without depending on subsidies.

Which of the statements given above are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (c)

- WaterCredit is a program that addresses one of the major barriers to safe water and sanitation i.e. affordable financing. WaterCredit helps bring small loans (microfinance) to those who need (poor people) access to affordable financing and expert resources to make household water and toilet solutions a reality. WaterCredit is the first to put microfinance tools to work in the water and sanitation sector. **Hence, statement 1 is correct.**
- The model empowers people to address their own water and sanitation needs in developing countries who often lack access to traditional credit markets. It eliminates the need for subsidies. **Hence, statement 3 is correct.**
- WaterCredit is a global initiative launched by Water. org, a non-profit organization working to bring water and sanitation to the world. **Hence, statement 2 is not correct. Therefore, option (c) is the correct answer.**

Mains

Q.1 What are the salient features of the Jal Shakti Abhiyan launched by the Government of India for water conservation and water security? **(2020)**

Q.2 Suggest measures to improve water storage and irrigation system to make its judicious use under the

depleting scenario. **(2020)**

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