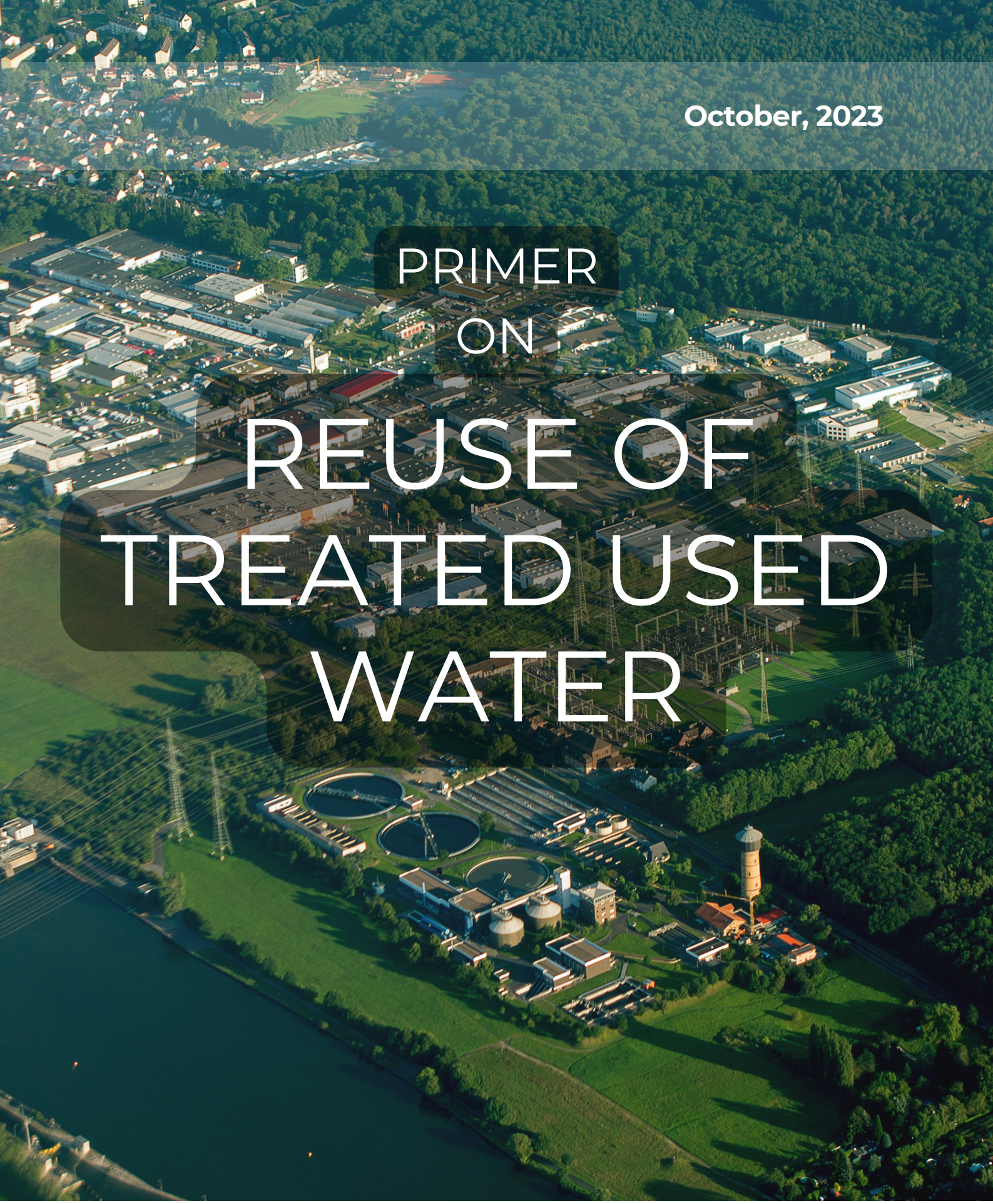


October, 2023

PRIMER ON REUSE OF TREATED USED WATER

NAMAMI GANGE

RIVER CITIES ALLIANCE
A city led movement

NIUA
National Institute of Urban Affairs

CEEW
THE COUNCIL

Abbreviations

AMC	Ahmedabad Municipal Corporation
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BOD	Biological Oxygen Demand
BWSSB	Bangalore Water Supply and Sewerage Board
CEEW	Council on Energy, Environment and Water
CMWSSB	Chennai Metro Water Supply and Sewerage Board
CPCB	Central Pollution Control Board
CWC	Central Water Commission
DJB	Delhi Jal Board
GVMC	Greater Visakhapatnam Municipal Corporation
IMC	Indore Municipal Corporation
JJM	Jal Jeevan Mission
MLD	Million Litres per Day
NIUA	National Institute of Urban Affairs
NMCG	National Mission for Clean Ganga
RCA	River Cities Alliance
SBM	Swachh Bharat Mission
STP	Sewerage Treatment Plant
SPCB	State Pollution Control Board
SMC	Surat Municipal Corporation
TUW	Treated Used Water
ULBs	Urban Local Bodies
UTs	Union Territories
ZLD	Zero Liquid Discharge

1 Background

River Cities Alliance (RCA) under the National Institute of Urban Affairs (NIUA) and the National Mission for Clean Ganga (NMCG) is a platform for river cities to ideate and discuss aspects pertaining to urban river management. One of the core mandates of RCA is to develop the capacities of the Urban Local Bodies (ULBs) on various aspects of managing the river within urban limits in a sustainable manner.

One of the key needs in cities today is to adopt large-scale reuse treated used water within urban limits. This aspect has been mandated under missions like Namami Gange, AMRUT, and SBM. Given the ever-increasing water demand in cities coupled with the decrease in the availability of freshwater sources, it is imperative for cities to mainstream re-use of treated used water as part of the city's overall water strategy. However, cities are facing challenges in implementing measures on the ground due to lack of knowledge around the practical application.

To help cities understand the practical applications of treated used water and develop an action plan that will help them reach their reuse goal, NIUA along with NMCG and Council on Energy, Environment and Water (CEEW) as the knowledge partner, has developed a toolkit and primer on the reuse of treated used water.

2 India’s Urban Used Water Scenario

Urban Used Water Generation	**72,368 MLD** of sewage is generated in urban areas in India
Installed Sewage Treatment Capacity	**31,841 MLD** (44% of total used water generated)
Operational Capacity	**26,869 MLD** (84% of the installed capacity; 37% of the total used water generated)
Actual Treatment Capacity	**20,236 MLD** (28% of total used water generated)
Quantity of Reuse	**≈1000 MLD** (3% of treated used water and 1% of used water generated)

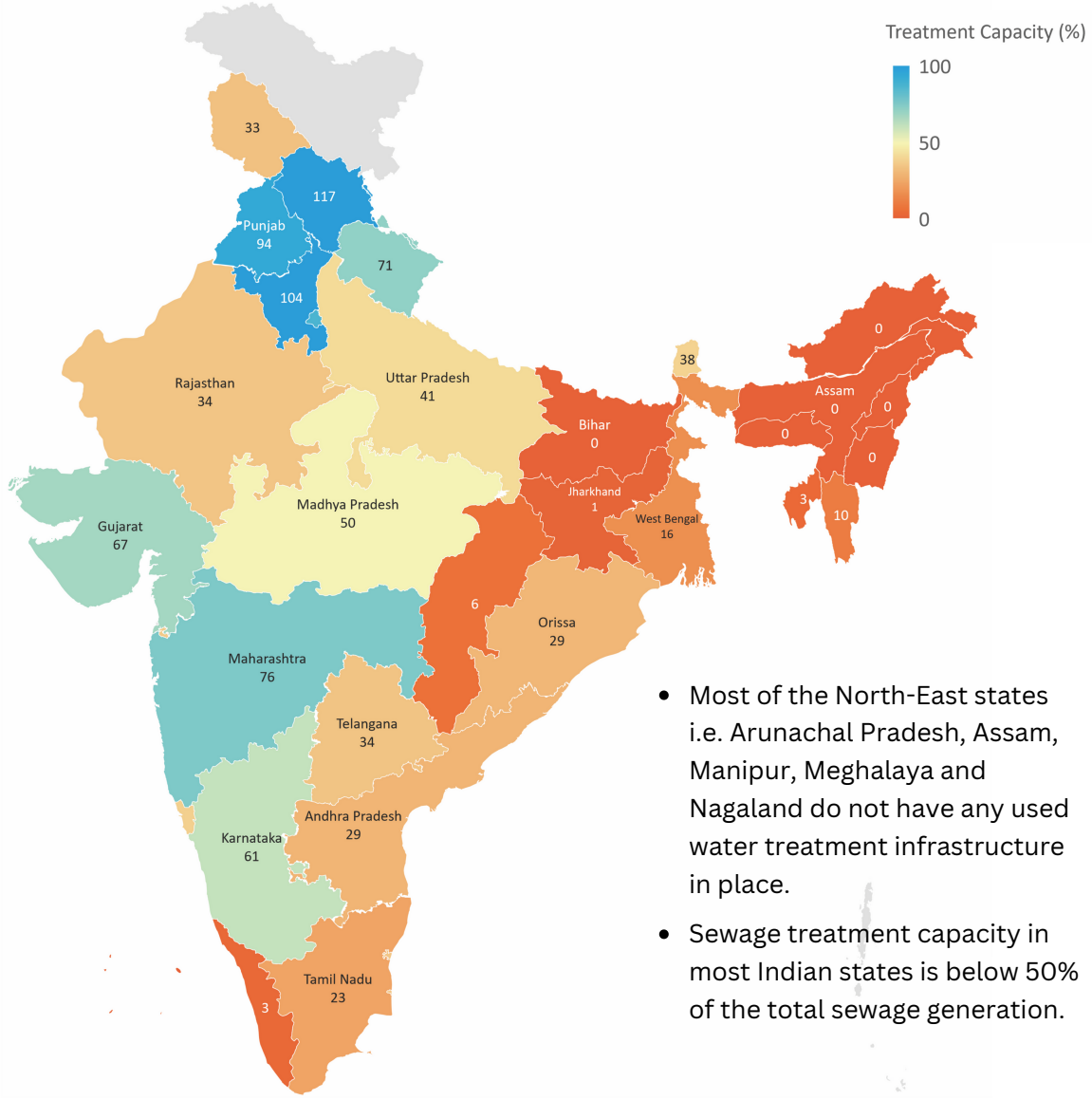
Source:

1. *Central Pollution Control Board (CPCB), 2020-21*
2. *Reuse of Treated Wastewater in Urban/Peri-Urban Agriculture in India, NITI Aayog, 2023*

3 State-wise Used Water Treatment Capacity

- There are 1,631 sewage treatment plants (STPs), including proposed STPs, with a total capacity of 36,668 Million Litres per Day (MLD) covering 35 States/UTs. **Out of 1,631 STPs, 1,093 STPs are operational**, 102 are non-operational, 274 are under construction and 162 STPs are proposed for construction.
- Out of 1,093 operational STPs, compliance status of 900 STPs is available and only **578 STPs having a combined capacity of 12,200 MLD are found complying with the consented norms prescribed by the State Pollution Control Boards (SPCBs).**

State-wise comparison of installed treatment capacity
(% of daily sewerage generation)



- Most of the North-East states i.e. Arunachal Pradesh, Assam, Manipur, Meghalaya and Nagaland do not have any used water treatment infrastructure in place.
- Sewage treatment capacity in most Indian states is below 50% of the total sewage generation.

Source:

1. *National Inventory of Sewage Treatment Plants, CPCB, 2021*
2. *Bassi, Gupta and Chaturvedi 2023*

4 Reuse of Treated Used Water

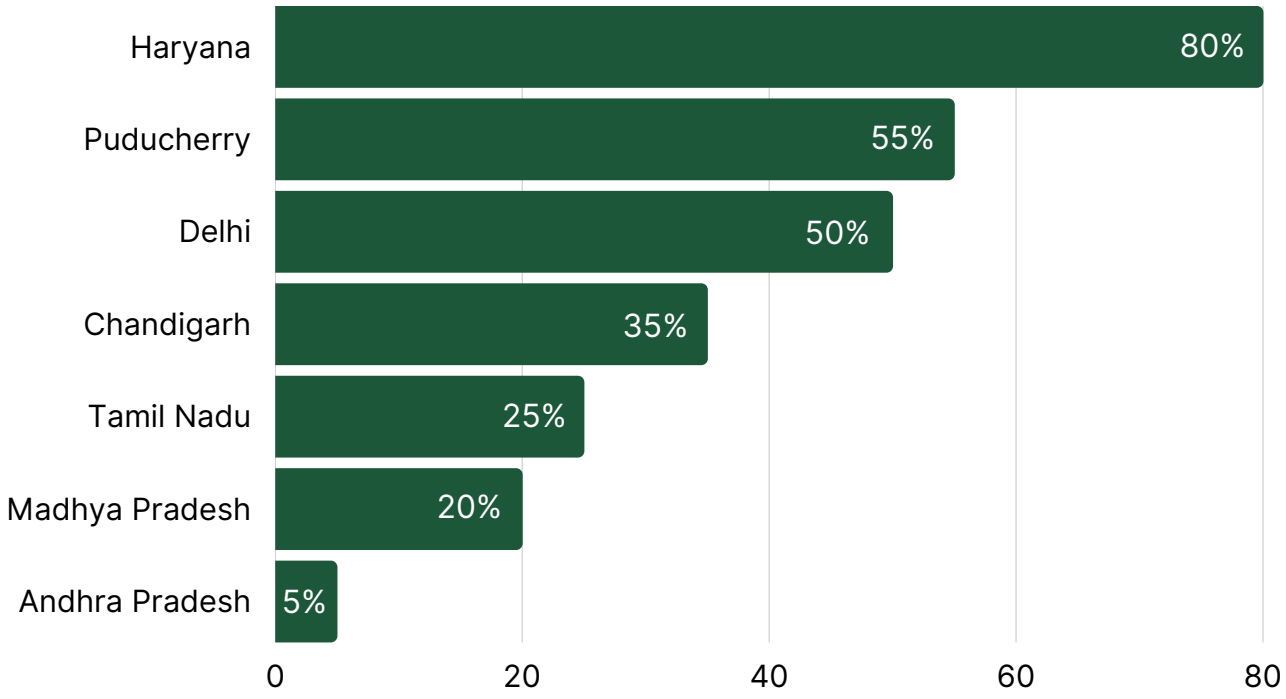
The treateused water in almost entirety, is either discharged to the watercourses or being used for irrigating parks, lawns or public places. Its reuse for non-potable purposes, such as crop irrigation, industrial processes, and groundwater recharge, is still relatively uncommon.

Only a small fraction of treated used water in India which is about **3% of treated used water and 1% of used water generated** finds its way back into productive use, representing an untapped resource that could alleviate water scarcity concerns.

Cities in India have initiated reuse in the following areas:

- Horticulture and Landscaping
- Discharge into lakes, ponds, drains, river
- Industrial Use
- Cleaning of Roads
- Flushing of Storm Water Drainage
- Compaction of Pipeline Trenches
- Fire Hydrants
- Irrigation
- Groundwater Recharge
- Pisciculture

Top 7 States/UTs with the highest % of reuse of treated sewage



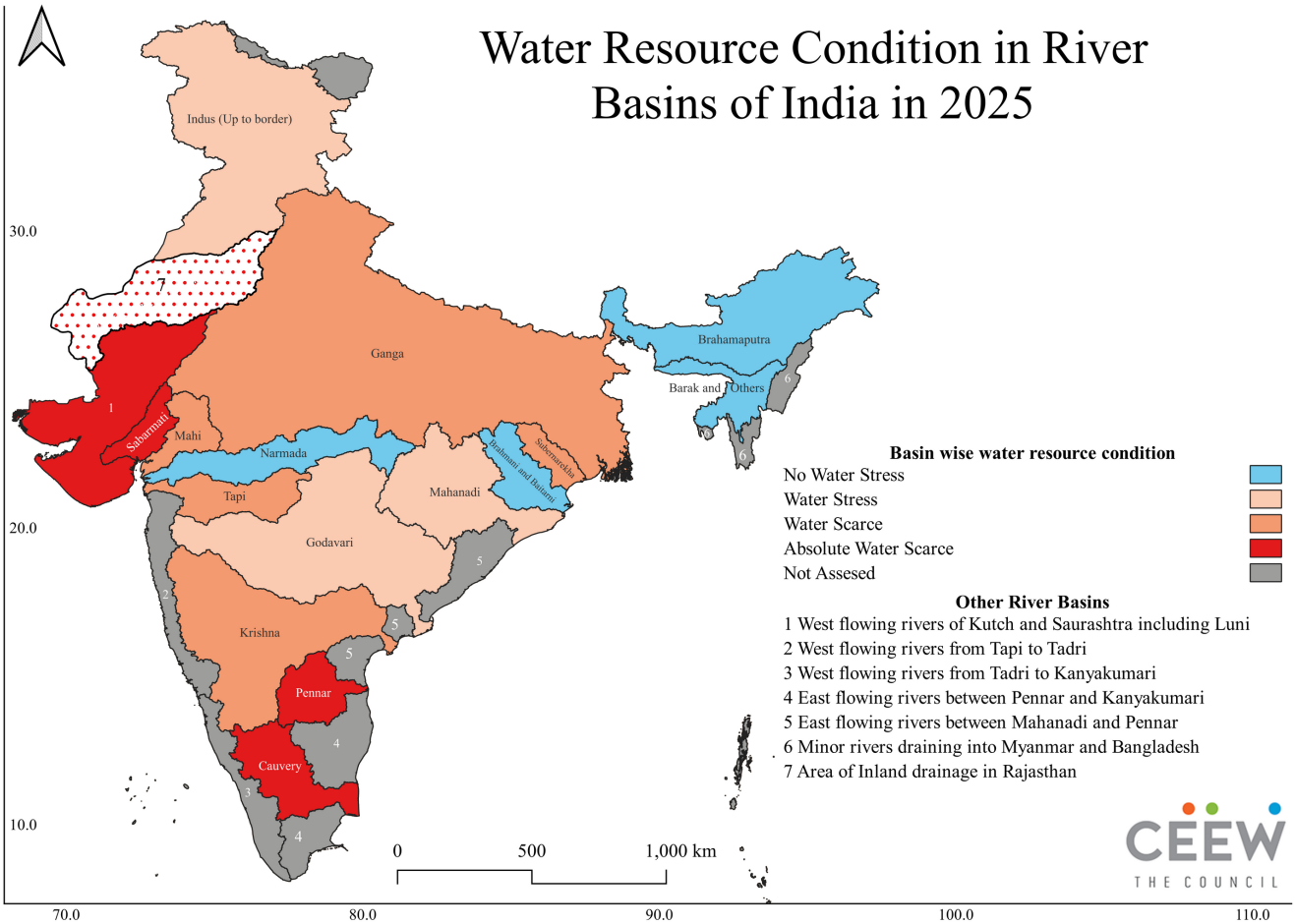
Source: National Inventory of Sewage Treatment Plants, CPCB, 2021

5 Why Reuse?

India is witnessing high pressure on its limited freshwater resources. Both the **quantity of freshwater available and its quality are of concern**.

- 351 river stretches on 323 rivers are polluted with biological oxygen demand (BOD) above the desired criteria, i.e., 3 mg/l (CPCB 2018).
- As per the Composite Water Management Index of India, about 70 per cent of India's water supply is contaminated (NITI Aayog 2019).

- 11 out of the 15 major river basins in India will experience water stress by 2025, a situation where the annual per capita renewable water availability will be below 1,700 cubic metres.



Source: Central Water Commission (CWC) 2021 and CEEW

6 Key Highlights of National Policies for the Reuse of Treated Used Water

National Water Policy 2012

- Mandates recycling and reuse of treated used water.
- Advocates treatment to specific standards before reuse of used water.
- Provides for a properly planned tariff system to incentivise the reuse of treated water in various sectors including industries, agriculture and others.

National Framework on Safe Reuse of Treated Wastewater

- Guiding document for the States to formulate their Reuse Water Policy.
- Provides draft policy template to aid the preparation of reuse policy by the respective State Governments.

Arth Ganga Initiative

- Includes components for monetisation and reuse of treated used water and sludge for irrigation and industrial purposes.

Power Tariff Policy 2016

- Mandated all Thermal Power Plants to use the treated sewage water from Sewage Treatment Plants situated within 50 km radius.

National Guidelines on Zero Liquid Discharge

- CPCB directed high water consuming and polluting industries like paper and pulp, oil refineries, textiles, distilleries, tanneries, pharmaceuticals etc. to achieve Zero Liquid Discharge (ZLD) i.e. no discharge of industrial used water into the environment.

7 National Missions

contributing to Nation's Reuse Goal

Atal Mission for Rejuvenation and Urban Transformation

Aimed at making cities water secure and enhancing circular economy through recycling of used water in 500 cities in India. Envisages recycling of treated used water to meet 20% of the total city water demand and 40% of industry water demand at the state level.

Smart City Mission

Under Smart City Mission, the components of water management include used water recycling, stormwater management and energy efficiency in used water treatment. Encourage decentralized wastewater treatment and reuse using micro-STPs.

Swachch Bharat Mission (Urban) 2.0

Involves a component of used water management to ensure that no untreated used water 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 with less than 1 lakh population.

Jal Jeevan Mission

Jal Jeevan Mission includes components for water treatment facilities and greywater recycling.

Namami Gange Programme

Under NMCG, projects for the expansion and enhancement of sewerage networks and in-situ sewage treatment options have been sanctioned.
MoUs have been signed by NMCG with the Ministry of Power, Ministry of Railways and Ministry of Agriculture for reuse of treated used water.

15th Finance Commission

15th Finance Commission allocates funds to Urban Local Bodies tied to their performance on water and sanitation services. One of the Service Level Benchmarks is the reuse of treated used water.

8 State Level Policies

for the Reuse of Treated Used Water in India

Parameter	States								
	PB	RJ	GJ	HR	JH	CG	KA	MP	AP
Need for Policy									
Address water scarcity and distributional inequity	✓	✓	✓	✓	✓	✓	✓	✓	✓
Improve water quality and public health	✓	✓	✓	✓	✓	✓	✓	✓	✓
Develop a tangible action plan	✗	✗	✗	✓	✗	✗	✗	✗	✗
TUW Reuse Options									
User categories defined	✓	✓	✓	✓	✓	✗	✓	✓	✓
Priorities among users defined	✓	✓	✓	✓	✓	✗	✗	✓	✓
Mentions specific industries and industrial purposes for reuse	✓	✓	✓	✓	✓	✗	✗	✓	✓
Lists mandatory and non-mandatory provisions	✗	✗	✓	✓	✗	✗	✗	✓	✗
Technology Recommendations									
Mentions process for used water treatment	✗	✗	✗	✗	✓	✗	✗	✓	✓
Suggests technologies for treatment	Partial	✓	✗	✗	✗	✗	Partial	✓	✗
Has provisions to explore and identify innovative technologies	✓	✓	✓	✓	✓	✗	✗	✓	✓
Focuses on nature-based solutions	✗	✓	✗	Partial	✓	✗	✓	✓	✗
TUW Allocation Mechanism									
Mentions principles guiding the allocation of treated used water	✗	✗	✗	✗	✗	✗	✓	✗	✗
Mentions criteria to decide allocation priorities	✗	✗	✓	✓	✗	✗	✓	✗	✓
Has a layout enforcement mechanism	✗	✗	✓	✓	✗	✗	✗	✓	✗

Parameter	States								
	PB	RJ	GJ	HR	JH	CG	KA	MP	AP
TUW Pricing									
Defines pricing mechanism	✓	✓	✓	✓	✓	✗	✓	✓	✓
Mentions pricing criteria	✓	✓	✓	✓	✓	✗	✓	✓	✗
Identifies authority for managing revenues	✓	✓	✓	Partial	✓	✗	✓	✓	✓
Institutional Arrangements									
Suggests institutional structure	✓	✓	✓	✓	✓	✓	✓	✓	✓
Has provisions for interdepartmental coordination	✗	✓	✓	✓	✓	✓	✓	✓	✓
Has provisions to involve stakeholders	✓	✓	✓	✓	✓	✓	✓	✓	✓
Quality Standards and Performance Benchmarking									
Mentions standardising TUW quality	✓	✓	✓	✓	✗	✓	✓	✓	✓
Lists key objectives behind standards and regulations	✓	✓	✗	✗	✓	✗	✓	✓	✓
Has provision for performance monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓
Provides quality standards for TUW reuse	✗	✗	✗	✗	✗	✗	✗	✗	✗
Supporting Legal Framework									
Enshrines constitutional principles	✗	✗	✓	✓	✗	✓	✗	✓	✗
Mentions national policies and acts	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mentions state policies and acts	✓	✓	✓	✗	✗	✓	✓	✓	✗
Makes reference to CPHEEO manual, 2013	✓	✓	✓	✓	✗	✓	✓	✓	✓
Business Models									
Sets priorities for project sanctioning	Partial	✓	✗	✗	✓	✗	✓	✓	✗
Discusses scope for PPP	✓	✓	✓	✓	✓	✓	✓	✓	✓
Makes linkages with sustainable infrastructure	✗	✓	✗	✗	✓	✗	✗	✓	✗

Source: Source: Bassi, Gupta and Chaturvedi 2023

Abbreviations: PB, Punjab; RJ, Rajasthan; GJ, Gujarat; HR, Haryana; JH, Jharkhand; CG, Chhattisgarh; KA, Karnataka; MP, Madhya Pradesh; AP, Andhra Pradesh

9 International Frameworks

for the Reuse of Treated Used Water

Some countries such as Israel, Spain, and Singapore have successfully implemented the reuse model which an be useful for deriving actionable pointers for strengthening the relevant policies in India.

Spain witnesses a regional imbalance between water resource demand and annual rainfall, especially between the north-west and south-east regions. The former region has higher rainfall and lower water demand than the latter. The Spanish Water Law, established in 1985, focused on pollution control through used water discharge regulations and abstraction control. However, with Spain joining the European Economic Community (EEC) in 1986, it needed to broaden its approach to focus on urban used water treatment and reuse. Hence, to align with the EEC directive, Spain formulated the Spanish Royal Decree, 2007, which provides a legal framework for the reuse of TWW. Furthermore, the National Investment Plan (NIP) of 2020 focused more on improving governance to align and comply with the objectives of the EEC. It involved setting up of priorities, strengthening administrative cooperation, improving financing mechanisms, promoting the reuse of treated used water, and improving the efficiency of treatment plants. As a result, the south-east region of Spain (with relatively low rainfall), consisting of regions such as Murcia and Catalonia, has one of the highest desalinated water and reuse rates in the world.

Israel suffers from chronic water shortage problems, with frequent droughts. Furthermore, rapid urbanisation, increased water consumption by different sectors, and a large amount of sewage generation pose the threat of polluting already scarce water resources. Israel defined sewage as an integral part of its water resources way back in 1959 with its first Water Law. The Israel Water Authority (IWA) was established in 2007 as an autonomous government agency with planning and regulatory responsibilities for all the elements in the water chain. A centralised institutional framework that took into account the country's size and population provided a strong footing for mainstreaming used water treatment and reuse in the country. In the current scenario, almost 90 per cent of used water is reused in Israel.

9 International Frameworks

for the Reuse of Treated USed Water

Singapore has a high annual rainfall of 2,340 mm. However, because of limited availability of land area for constructing reservoirs and the absence of proper aquifers, it had to rely on the water imported from Malaysia to meet its demand. After its separation from Malaysia in 1965, Singapore developed a long-term water security strategy focusing on comprehensive water resource management. The objective was to diversify the water supply options to meet the rising demands, put the principles of a circular economy into practice, and most importantly, reduce import dependency. The Water Master Plan, 1972, defined a strong institutional and legal framework with clear roles and responsibilities. It led to the institutionalisation of the Public Utilities Board (PUB), the primary statutory agency responsible for Singapore's water supply and drainage networks, the construction and maintenance of reservoirs, the development of pricing mechanisms for different categories of users, the collection and treatment of used water, and the regulation of treated effluent discharge. Currently, the reuse of TWW accounts for about 40 per cent of total water demand, which is likely to become 55 per cent in 2060.

10 Challenges & Gaps

in Implementing the Reuse Policies in the Cities

Quality

- Quality of treated used water being reused is poor.
- Demand for clean water is rising faster than used water treatment solutions.
- Encouraging reuse while ensuring human health and ecological safety.

Institutional

- ULBs lack the capacity to plan and implement reuse of TUW projects.
- deficiencies in planning and financial management of reuse projects.
- Spatio-temporal data on used water treatment and reuse is infrequently monitored/published or is scattered due to institutional fragmentation

Regulatory

- Diversity of pollutants
- Variety of targeted uses
- Dilution may occur when the pollution load is released
- Ambient water quality standards are absent

- Capacity gap (between the generated sewage and present treatment capacity) is very large.
- Smaller cities/towns face difficulty in finding necessary resources for setting up STPs.
- High capital discourages the entry of private players.

Economic

- Over-dependence on older technologies.
- Limited funds and higher expenditures push the government to choose technologies with lower capital costs.
- Knowledge gap, along with ignorance regarding newer technologies.

Technological

- Citizens are usually not well informed.
- Despite the awareness created, people are reluctant to use reclaimed water.
- Aesthetic aspects of reclaimed water shape the public acceptance of treated water.

Social

11 Best Practices
from India

Ahmedabad

- The city generates 1080 MLD of used water.
- Ahmedabad Municipal Corporation (AMC) provides water supply and sewerage services to the city.
- AMC has so far established 12 Sewage Treatment Plants (STPs) in the city with a total treatment capacity of 990 MLD treated through secondary treatment process like Activated Sludge Process.
- Out of 990 MLD, around 512 MLD is reused mainly for irrigation and agriculture purposes and 2 MLD is being supplied for industrial purposes.

Existing recycle and reuse of used water projects in Ahmedabad

STP Name/Location	Present Installed Plant Capacity (MLD)	Existing Reuse Recycling Capacity (MLD)	Treated Sewage Reuse
Vasna	240	240	Irrigation to agricultural land through Fatewadi canal by Irrigation department of Govt. of Gujarat.
Vasna	126	126	
Vasna	35	35	
Vasna	48	48	
Jalvihar	60	60	
Vastrapur Lake	0.5	0.5	Gardening, central verge plantations and nuisance tanker filling and mission million tree watering.
Rasala	1	1	Law garden and Parimal garden, zone level plantations and nuisance tanker filling and mission million tree watering.
V.S. Hospital	1	1	Gardening and flushing purposes by dual plumbing installation at new SVPIMSR hospital.
Vinzol	70	2	2 MLD treated sewage is being supplied to Vatva CETP for their reuse purpose.
Nikol	0.5	0.5	Gardening, central verge plantations and nuisance tanker filling and mission million Tree Watering.
Total existing reuse & recycling capacity		514	

11 Best Practices
from India

Bangalore

- The city generates 1440 MLD of used water.
- Bangalore Water Supply and Sewerage Board (BWSSB) provides water supply and sewerage services to the city.
- BWSSB has so far established 32 Sewage Treatment Plants (STPs) in the city with a total treatment capacity of 1182.5 MLD with an actual capacity of utilization of 920 MLD.
- Out of 920 MLD of the total treated used water, around 460 MLD is reused for minor irrigation, commercial, industrial, horticultural, landscape etc.

Existing recycle and reuse of used water projects in Bangalore

Name / Location of the STP	Cubbon Park STP	Lalbagh STP	Yelahanka New Town STP	Devanahalli	Jakkur	K&C Valley	Bellandur	Raja Canal	Horamavu
Capacity	4 MLD	1.5 MLD	10 MLD	40 MLD	15 MLD	298 MLD	90 MLD	60 MLD	20 MLD
Total Capital Cost	Stream A- Rs.8.0 Cr Stream B- Rs.20.90 Cr	Rs. 8.0 Cr	Rs. 8.0 Cr	NA	NA	NA	NA	NA	NA
Technology Adopted	Membrane Bio Reactor Technology followed by chlorination	Extended Aeration followed by Conventional and UV technology	Activated Sludge Process followed by F-Type Rapid Gravity sand Filters	Tertiary treated water	Tertiary treated water	Secondary Treated Water		Secondary Treated Water	
Quantity of Recycle and Reuse	4 MLD	1.5 MLD	6 MLD	NA	NA	370 MLD		80 MLD	
Area / Purpose of Reuse	1.5 MLD – Cubbon Park Horticulture, 1.0 MLD – Construction activities like tunnelling /connecting, 1.5 MLD – For Public Office gardening, walking, fountain, etc.	1.5 MLD - horticulture and landscaping	Commercial – 4 MLD Industrial – 2 MLD	Karnataka Industrial Area Development Board (KIADB) Industrial area	KPCL gas based power 12 plant at Yelahanka	Minor irrigation for filling the lakes/tanks of Kolar District		Minor irrigation for filling the lakes/tanks of Chikaballapur District	
Revenue from sale of treated used water	Rs. 13.75 Lakh/month	Rs. 8.5 Lakh/month	Rs. 36.98 Lakh/month	NA	NA	NA	NA	NA	NA

***NA** - Data is not available*

11 Best Practices
from India

Chennai

- The city generates 1199 MLD of used water.
- Chennai Metro Water Supply and Sewerage Board (CMWSSB) is responsible for providing water supply and sewerage services to the city.
- CMWSSB has so far established 13 Sewage Treatment Plants (STPs) in the city with a total treatment capacity of 745 MLD. However, 530 MLD of used water is actually being treated.
- From the 530 MLD treated used water, 22 MLD of secondary treated used water and 30 MLD of tertiary treated used water is reused for industrial purposes, landscaping, gardening etc.

Existing recycle and reuse of used water projects in Chennai

Name / Location of the STP	Kodungaiyur	Koyambedu	Perungudi
Capacity of STP (MLD) Secondary Treatment	270 MLD	214 MLD	126 MLD
Capacity of Tertiary Treatment Plant (MLD)	45 MLD	45 MLD	10 MLD (Under Construction)
Total Quantity reused (MLD)	21.79 MLD - Secondary treated 20 MLD (Avg.) - Tertiary treated	10 MLD - Tertiary treated	0.21 MLD – Secondary treated
Places of reuse	52 MLD treated used water is recycled and reused at various industries and horticulture purpose.		
Capital Cost, Tertiary Plant	Rs. 348 Cr	Rs. 396.50 Cr	Rs. 43.36 Cr
Technology for Secondary Level Treatment	Activated Sludge Process	Activated Sludge Process	Sequential Batch Reactor
Technology For Tertiary/Advanced Level Treatment	Reverse Osmosis	Reverse Osmosis	Ultra filtration
Mode of treated water supply/sale/disposal:	Through lorries for horticulture purposes, through pipeline for industrial usage and disposal.		

11 Best Practices
from India

Delhi

- It is one of the major and fastest urbanising cities in the country, generating 3268 MLD of used water.
- Delhi Jal Board (DJB) has so far established 40 Sewage Treatment Plants (STPs) out of which 35 are operational, 03 are under rehabilitation and 02 have been closed.
- The total capacity of these STPs is 3058 MLD, of which the operational capacity is 2383 MLD.
- Out of 2383 MLD of total treated used water around 340 MLD is reused for various purposes like horticulture, industrial reuse etc.
- Three STPs located at Rithala, Phase II, Delhi Gate Nalla I and Dr. Sen Nursing Home Nallah have been presented as successful recycle and reuse of used water projects in Delhi:

Some of the successful recycle and reuse of used water projects in Delhi

Name / Location of the STP	Rithala Phase II	Delhi Gate Nalla I	Dr. Sen Nursing Home Nallah
Capacity	182 MLD	10 MLD	10 MLD
Total Capital Cost	INR 80 Crore	INR 6.31 Crore	INR 5.4 Crore
Technology Adopted	Activated Sludge Process and bio film	Densadeg and Biofor technology	Densadeg and Biofor technology
Quantity of Recycle and Reuse	24 MLD	10 MLD	10 MLD
Area / Purpose of Reuse	23 MLD for power plant 1 MLD for Horticulture (DDA Japanese Park)	10 MLD for power plant	10 MLD for power plant
Cost of Production per KLD	Rs. 2.20 per KL	Rs. 7.60 per KL	Rs. 7.50 per KL

11 Best Practices
from India

Indore

- The city generates 312 MLD of used water.
- Indore Municipal Corporation (IMC) provides water supply and sewerage services to the city.
- IMC has so far established 10 Sewage Treatment Plants (STPs) in the city with a total treatment capacity of 412.5 MLD based on secondary treatment technologies like Activated Sludge Process, Sequential Batch Reactor etc.
- Out of the 412.5 MLD, 101.5 MLD of used water is reused for different purposes like horticulture, landscaping, irrigation, construction, vehicle washing in IMC, urinal washing, fountains, divider washing, footpath cleaning, etc.

One of the successful recycle and reuse of used water projects in Indore

Name/Location of the Sewage treatment Plant	Kabitkhedi
Capacity	245 MLD
Total Capital cost	Rs. 194 Cr.
Technology adopted	Sequential Batch Reactor (SBR)
Quantity of used water reused	91 MLD
Area of reuse	Horticulture, landscaping, irrigation and construction
Sludge generation	7.95 m3/day
Mode of treatment & disposal of sludge	Sludge is collected from all the STPs and is sent to the landfill site of the city where it is get mixed with wet waste and is treated further for the making of compost.

- Reuse of used water from Kabitkhedi 245 MLD plant is done through pipe line network of around 34 km and overhead tank of 3ML located at Meghdoot Garden.
- Treated used water is supplied through overhead tank to 101 gardens and fountains via pipeline network and 38 hydrants which are installed within the city to supply treated water to tankers for horticulture, landscaping, construction purpose etc.

11 Best Practices
from India

Surat

- At present, the city generates about 956 MLD of used water.
- Surat Municipal Corporation (SMC) provides water supply and sewerage services to the city.
- SMC has so far established 11 Sewage Treatment Plants (STPs) in the city having a total treatment capacity of 1373 MLD and used water is treated through secondary treatment process. Out of 956 MLD, 115 MLD is treated up to tertiary level treatment.
- Out of the total treated used water about 319 MLD is being reused for different purposes in the city. Treated water is being reused for various industrial and horticultural purposes.

One of the successful recycle and reuse of used water projects in Surat

Name / Location of the Sewage Treatment Plant	Bamroli
Capacity	100 MLD
Total Capital cost	Rs. 112.16 Cr. (Sewage Treatment Plant) Rs. 85.10 Cr. (Tertiary Treatment plant)
Technology adopted	Secondary treatment - Up-flow Anaerobic Sludge Blanket Process + Integrated Fixed Film Activated Sludge process + Extended Aeration. Tertiary treatment - Sand Filtration / Disc Filtration + Ultra Filtration (UF) +Reverse Osmosis (RO) + Activated Carbon Filtration (ACF).
Quantity of used water received & treated	99 MLD
Quantity of used water reused	40 MLD net output
Area of reuse	Non potable water in various industrial clusters, gardening purposes at STPs & Road Dividers, sprinkling at MSW disposal site, Sewer Jetting Machines in Surat.
Sludge generation	15 - 18 Tonne/Day
Mode of treatment & disposal of sludge	Mechanical filter press. Sold as manure & remaining disposed in landfill sites.

11 Best Practices
from India

Surat (cont.)

- Surat supplies treated used water to industries in the Pandesara cluster at INR 28.58 per KL.
- At present, 57 MLD secondary treated used water (40 MLD net output - tertiary treated used water) is used for various industrial purposes (dyeing and printing) at Pandesara GIDC Area, 2 MLD is used for landscaping and 1 MLD is used internally in STP for chlorination system, sludge dewatering system etc.
- After this success and due to additional demand from Pandesara Industries, an additional 40 MLD TTP has been set up similarly at Dindoli STP by Surat Municipal Corporation. This plant is operational and supplies 40 MLD of tertiary treated used water to Pandesara Industries.
- Further, Sachin GIDC Industrial setup, adjacent to the city has come forward to buy 35 MLD treated used water from the newly constructed 35 MLD capacity Tertiary Treatment Plant at Bamroli STP.

11 Best Practices
from India

Visakhapatnam

- The city generates 289.80 MLD of used water.
- Greater Visakhapatnam Municipal Corporation (GVMC) is responsible for providing water supply and sewerage services to the city.
- GVMC has so far established 5 Sewage Treatment Plants (STPs) and 11 Mini STPs in the city with a total treatment capacity of 165.50 MLD.
- At present 102.05MLD is being collected and treated by a secondary treatment process. Of this, 12MLD is reused for commercial and industrial uses by Visakhapatnam Port Trust (VPT), ESSAR Industry and Vizag Golf Course.

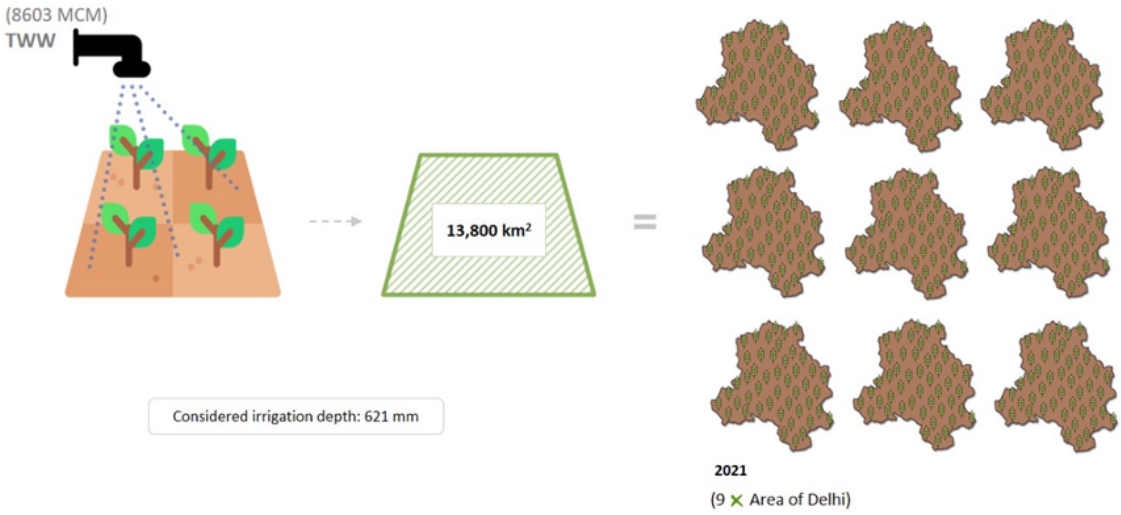
One of the successful recycle and reuse of used water projects in Visakhapatnam

Name/Location of the Sewage Treatment Plant	Narava
Capacity	54 MLD upgrading to 108MLD (Upgrading work is in progress)
Total capital cost upto Secondary Treatment only	Rs. 48.6 Crores
Technology adopted	Secondary treatment –Activated Sludge Process with diffused aeration system Proposed tertiary treatment – Ultra filtration (UV) and Reverse Osmosis (RO)
Quantity of used water received and treated by secondary treatment at present	20 MLD
Cost of production of Per KLD	Rs. 3.34 per KL for secondary treatment process Rs. 7.94 per KL for tertiary treatment process (proposed)
Sludge Generation	At present generation is 2 tons (one truck)/day for 20MLD sewage
Mode of treatment & disposal of sludge	Converting into sludge cakes by centrifuge and is used for horticulture purposes

12 Economic Value of Treated Used Water

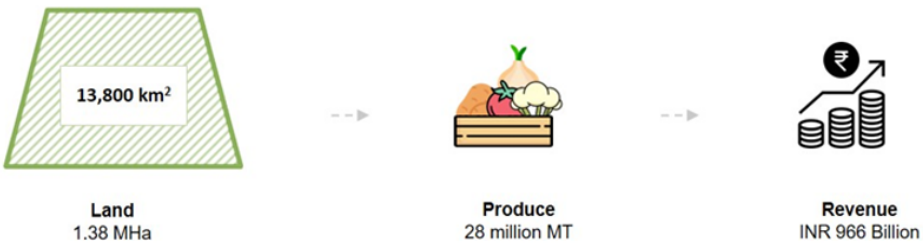
For promoting circularity in used water management, it is important to assess the economic and market potential associated with the reuse of used water. A study by CEEW estimates the market potential for the reuse of treated used water (domestic sewage) at the national scale to establish that it is a financially viable proposition in addition to being an environmentally beneficial one.

- **11,622 million cubic metres (MCM) is the estimated amount of treated used water that was available in India for reuse in 2021.**
- **Nine times the area of New Delhi could have been irrigated using the available TUW in 2021** (based on the CEEW analysis, about 8,603 million cubic metres (MCM) of treated used water was available for reuse in the irrigation sector in 2021).



Source: CEEW, 2023

- **Reusing TUW for irrigation in 2021 could have generated INR 966 billion in revenue** (28 million metric tonnes (MT) of the produce of selected horticulture crops could have been generated using the available treated used water).



Source: CEEW, 2023

12 Economic Value of Treated Used Water

- **Around 6,000 metric tonnes (MT) of nutrients could have been recovered from the available TUW in 2021, generating savings of INR 50 million** (the nutrients supplied by currently available TUW (for irrigation use in 2021) amount to more than 6,000 tonnes. Further, considering the market value of the nutrient load, the total savings from the reduction in fertiliser use through irrigation using TUW would have been more than INR 50 million).

Source: CEEW, 2023

- **Reusing TUW in irrigation could have reduced greenhouse gas (GHG) emissions by 1.3 million tonnes in 2021** (available treated used water would have irrigated 1.38 Mha in 2021, which would have reduced pumping in 3.5 per cent of the groundwater-irrigated area. Further, this would have led to a reduction of 1 million tonnes of GHG emissions. Additionally, on account of the inherent nutrient value of TUW, fertiliser consumption would have reduced, resulting in further reduction of GHG emissions by 0.3 million tonnes).

- **INR 630 million would have been the market value of treated used water in 2021** (market value of the treated used water available in 2021 (11,622 MCM) would have been over INR 630 million, if we had the mechanism to sell treated used water to different sectors for reuse. The market value will substantially increase to over INR 830 million in 2025 and INR 1.9 billion in 2050 at the current market rate).

13 Innovative Business Models

S. No.	Business Model	Implementation	Case Study
1	Fixed price model (industrial reuse)	The ULB enters into a long-term contract with an industry or a cluster of industries for bulk consumption of TUW at an agreed price.	The Water Reuse Project, Nagpur
		The ULB can set up an additional tertiary treatment unit and operate it on its own. Alternatively, the ULB enters into a PPP arrangement with a private entity for the installation and O&M of a tertiary treatment unit.	
		The ULB ensures that the private entity supplies the agreed quantity of TUW to the bulk user (industry), and makes a net annuity payment to the private entity to ensure minimum revenue.	
		The private entity can further sell additional TUW to other consumers.	
2	Investment by end-user model (industrial reuse)	The ULB sells secondary treated water to an industry or industrial board at rates lower than industrial water tariffs paid by them otherwise.	Chennai Metropolitan Water Supply and Sewerage Board
		The industry or industrial board is responsible for setting up the tertiary treatment unit and conveyance of the TUW to other participating industries at an agreed price.	
3	Sale of TUW and other by-products	The ULB can sell secondary treated water and treated sludge (biosolids) to farmers for reuse.	
		TUW can also be sold to the forest department for agroforestry reuse.	
4	On-site reuse of TUW	A private ownership model can be explored through incentives to residents' welfare associations/housing colonies for setting up decentralised used water treatment facilities within the vicinity of gated colonies.	
		Gated colonies, apartment buildings, and institutions that are already required to have treatment plants can use TUW for landscaping, flushing, cleaning, etc. by implementing a dual piping system (one for freshwater and one for used water).	
5	Corporate Social Responsibility (CSR) model	The private sector can be approached to invest in treatment infrastructure under their CSR programs.	
		Industries with in-house treatment units may be encouraged to provide a portion of their treated water for landscaping of urban greens as part of their CSR programs.	
		ULBs can engage with private companies to train farmers for the safe reuse of TUW and with supermarket chains to buy back crops from farmers practicing safe cultivation using TUW, as part of their CSR programs.	

Source: CEEW, 2023

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