Water Management

The Mahindra Way
Mahindra Institute of Quality, Nashik

21st May 2026

Dhruv Bhavsar
With support from team at the Center for Water and Sanitation, CRDF, CEPT University

Center for Water and Sanitation (CWAS), CRDF, CEPT University

About CWAS at CRDF CEPT University

CEPT University's core focus is human habitat. Through its education, research and advisory activities, it strives to improve the impact of habitat professions in enriching the lives of people in India's villages, towns and cities.

CEPT Research and Development Foundation (CRDF) has been established by the University to manage their research and capacity building activities. There are nine domain-focused centers in the CRDF. The Center for Water and Sanitation (CWAS) is among the first center to be established.

CWAS began its work in 2009 with focus on improving water and sanitation services in India. It carries out activities related to action research and capacity building – working closely with city and state governments, enabling them to improve delivery of services.

About CWAS – Approach and areas of work

Core values

Public Goods Mindset

Government Engagement at All Levels

Learning Culture and Academic Roots

Action-oriented Research and Innovation

Working At scale

Thematic areas of work

MONITORING WASH SERVICES

From Infrastructure creation to Service Delivery

Data driven decision making for improved service delivery

ACTION RESEARCH FOR SANITATION

Sanitation services in small and medium towns that are sustainable, inclusive and equitable

Action research from cities be scaled up at the state and national level

GOVERNANCE AND FINANCING

Strengthening municipal finance and governance, planning and financing urban WASH

WATER SECURITY

Water Governance, management and climate resilience

Water supply service delivery and managing water resources

GENDER INCLUSION AND EQUITY IN SERVICES

Gender inclusion urban WASH

Ensuring sustainable and equitable access to safe water and sanitation at scale

CLIMATE CHANGE

Energy Transition in WASH services

Mitigation and Adaptation measures for WASH

Mahindra group of companies

Automotive

Farm Equipment's

Financial services

Technology

Hospitality services

Logistics

Real Estate

Renewable Energy

Other emerging businesses

Mahindra Group in various sectors

Mahindra Group Sustainability policy

Mahindra Group Sustainability Mandate

Ambition 2030: Global ESG Leader

Vision: Together we Rise for Planet Positive

Greening Ourselves

1. **Net Zero on Scope 1+2 emissions*** (RE usage & energy efficiency)
2. **Net Zero on water and waste *** (reuse, reduce & recycle)
3. **Adopting material circularity#** (reduce, recycle & green material)

Decarbonizing Our Industries (addressing Scope 3)

4. **Transition to green portfolio** (EVs in auto, LMM & Logistics; Green Buildings & Resorts; Green Energy - solar, hybrid, storage)
5. **Supporting transition to net-zero supply chain#** (e.g.- Logistics)
6. **Industry circularity#** (e.g.- auto recycling)

Rejuvenating Nature

7. **Promoting regenerative agriculture** (via improved farming techniques)
8. **Afforestation at scale** (Hariyali program)
9. **Biodiversity conservation** (impact assessment and restoration)

Enablers

- Leading on Reporting & Disclosures
- Incubator for Green Technology
- Leadership positioning through Communication
- Active voice for Climate Advocacy
- Practical capability building Plan

Source: Environment and Sustainability policy, Mahindra & Mahindra Limited

Core question

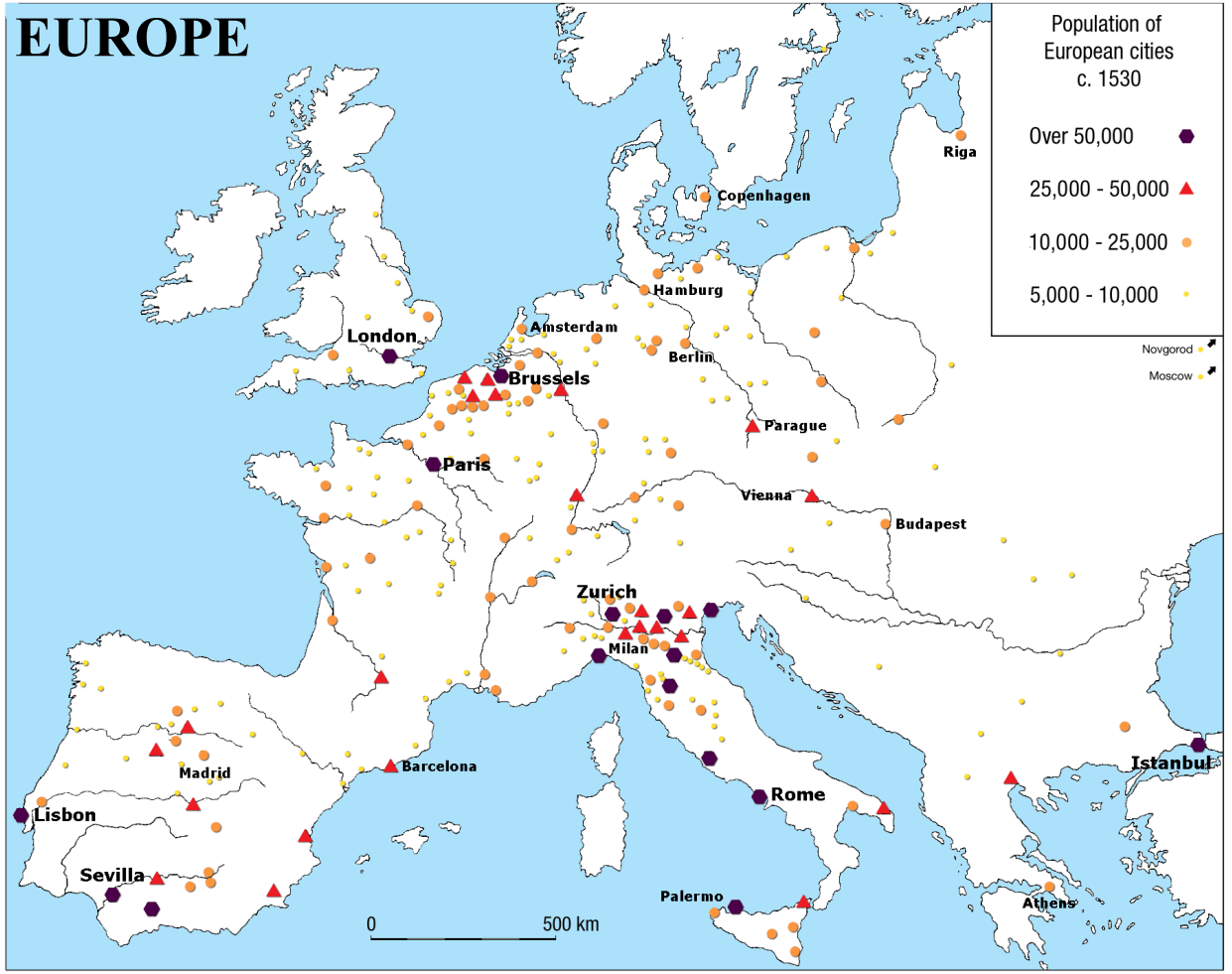
“Is water management a core business issue or only an environment concern?”

Key questions…

1. Why is water becoming a major business risk in India?
2. How can better water management improve business competitiveness and profitability?
3. What role should businesses play in achieving India's water security and sustainability goals?
4. How are regulations, ESG expectations, and global supply chains changing water practices?
5. What partnerships and innovations are needed to secure water for future business growth in India?

Cities and water through history

Most cities emerged next to sources of water…



Sources: India: http://sitemaker.umich.edu/mladjov/files/indiageneral.jpg ; Europe: http://galleryhip.com/europe-cities-map.html

Growing demand and climate change are intensifying Global Water Stress

*Water demand may increase by **20–30%** by 2050*

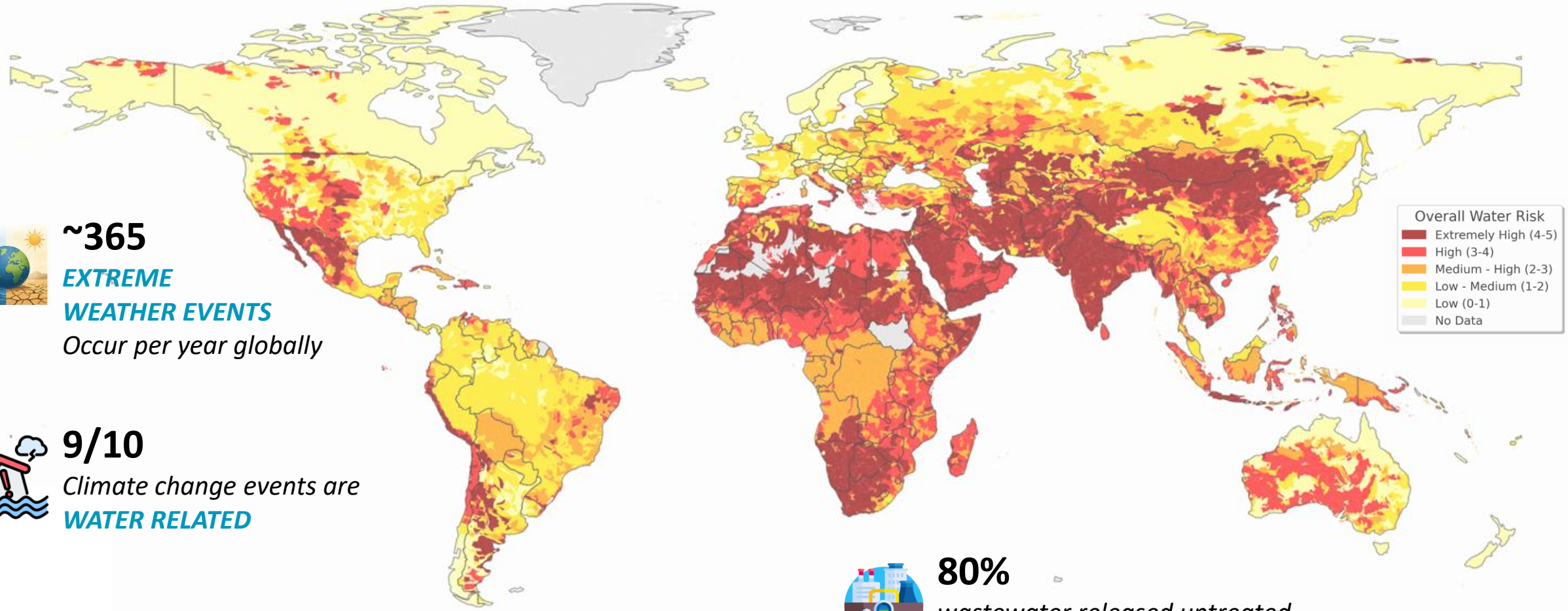
~365

EXTREME WEATHER EVENTS

Occur per year globally

9/10

*Climate change events are **WATER RELATED***



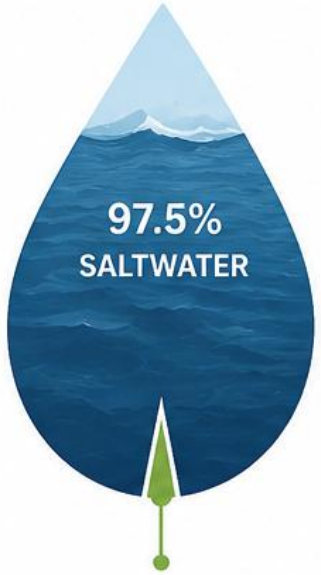
80%

wastewater released untreated (major contributions by industries)

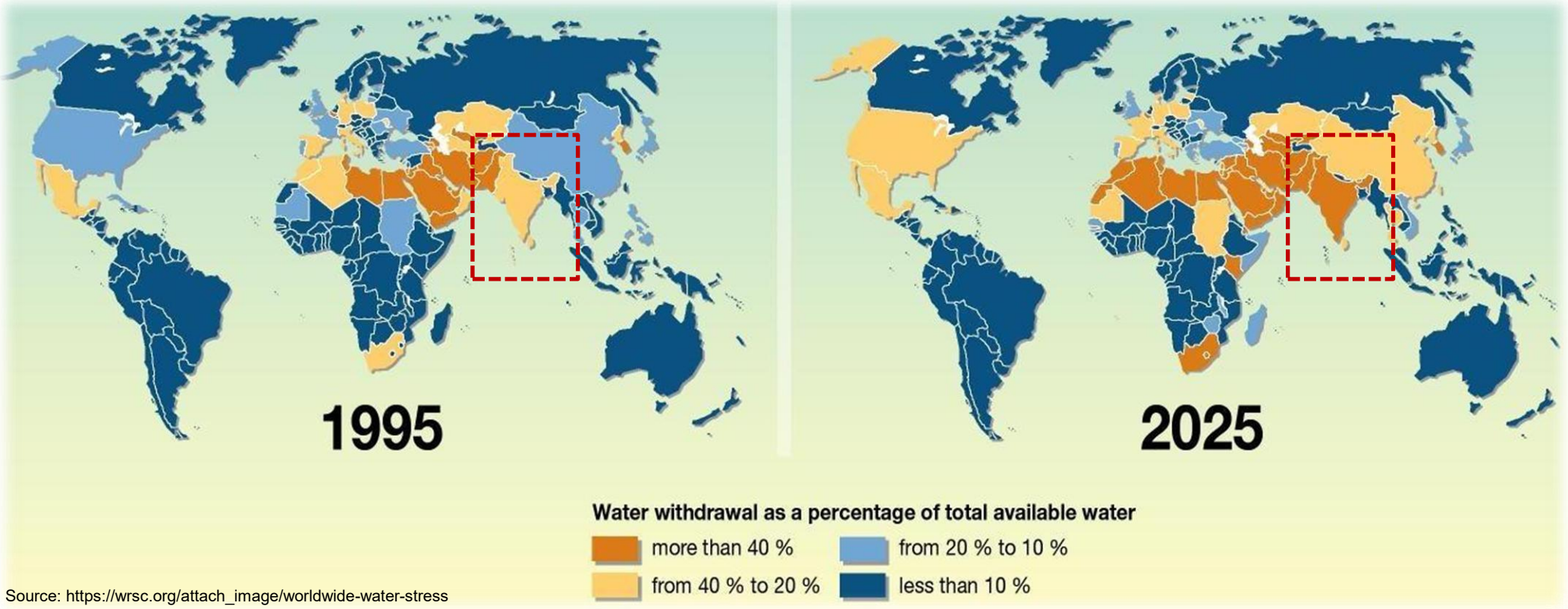
*Nearly **4.2 billion** people face water scarcity at least **one month/year***

Source: https://www.undrr.org/news/un-report-dramatic-rise-climate-disaster-over-last-twenty-years;

2026 an era of global water bankruptcy declared by United Nations



2.5%
FRESHWATER



Source: https://wrsc.org/attach_image/worldwide-water-stress

<1%
of the freshwater is accessible for human use

70%
of the freshwater is used in ***AGRICULTURE***

20%
of the freshwater is used in ***INDUSTRY***

30%
of the freshwater is stored as ***GROUNDWATER***

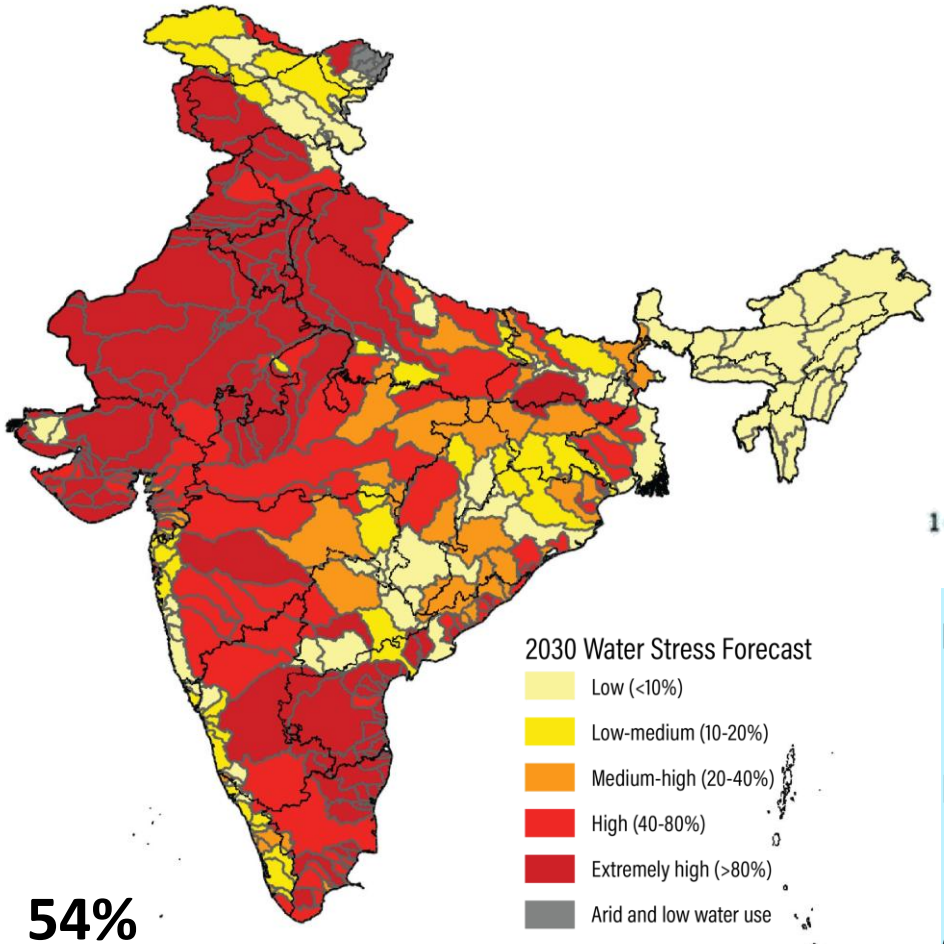
1.5%
of the freshwater is stored as ***SURFACEWATER***

Rest used for Domestic/Municipal purposes

Rest stored in Glaciers & Icecaps

Source: https://www.usgs.gov/water-science-school/science/where-earths-water; https://ourworldindata.org/water-use-stress

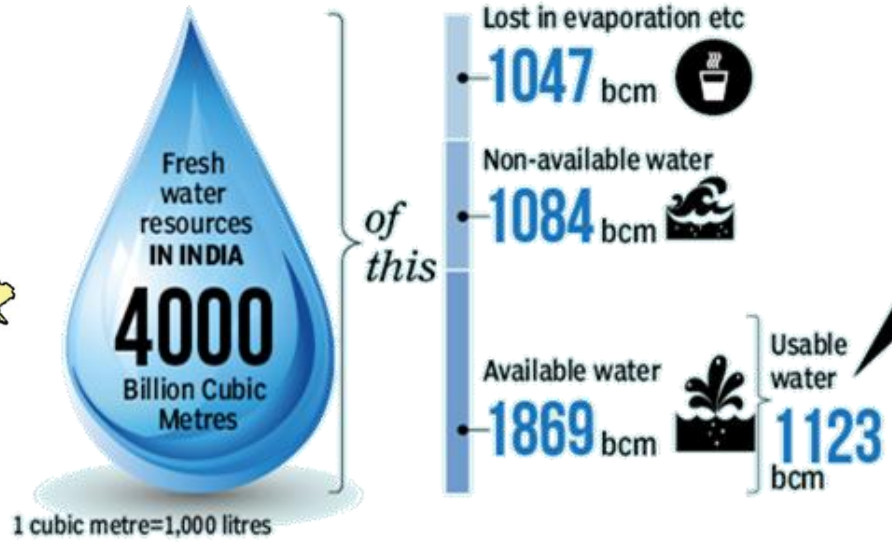
India has 18% of World's population but only 4% of global freshwater resources ..



54%

of India faces High to Extreme High

WATER STRESS



83%

Water consumption in ***AGRICULTURE***

12%

Water consumption in ***INDUSTRIES***

5%

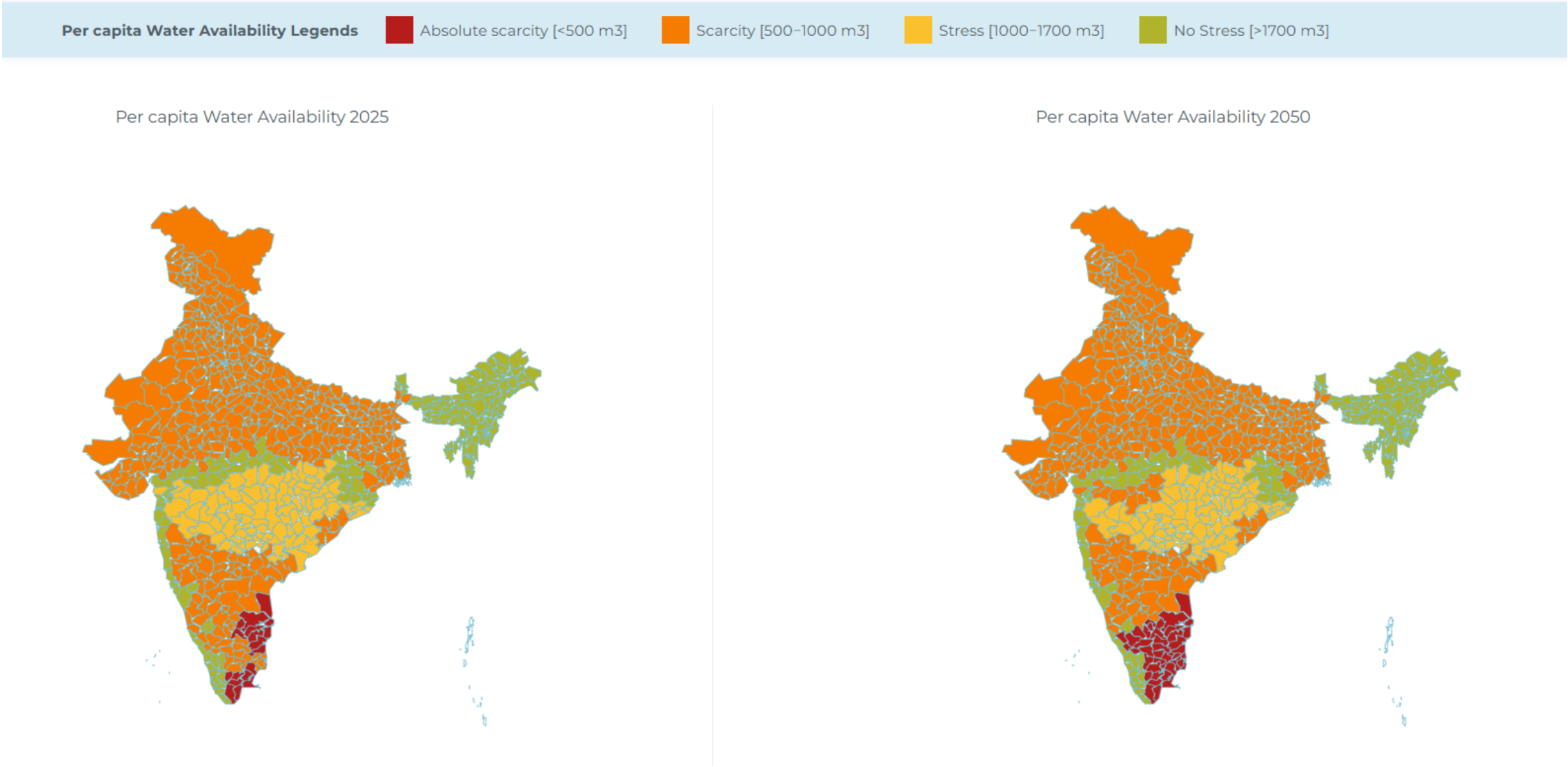
DOMESTIC *Water consumption*

Major sources of water supply by Industries

- **Surface Water (41%):** Rivers, streams, and lakes are tapped directly, though this is heavily impacted by seasonal rainfall and pollution.
- **Groundwater (35%):** Extracted via borewells. Reliance on groundwater increases during dry months when surface water levels drop.
- **Municipal Supplies (24%):** Used mostly by small to medium-scale industries located in urban or peri-urban areas.

Source: https://timesofindia.indiatimes.com/india/india-may-run-out-usable-water-in-a-few-years/articleshow/58803493.cms; https://wri-india.org/blogs/how-water-challenges-threaten-indias-energy-security;

Any region with less than 1,700 cubic meters annually is considered water-stressed. Per capita water availability is steadily declining…

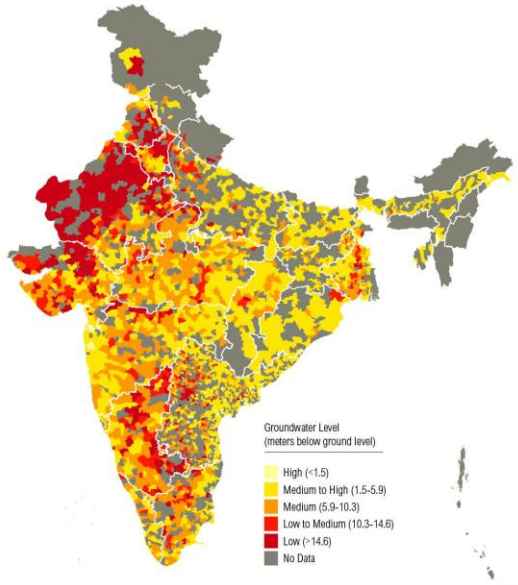


Source: https://iced.niti.gov.in/climate-and-environment/water/per-capita-water-availability

Groundwater - The invisible dependency

India Extracts more Groundwater than any other country

54% of India's Ground-water Wells Are Decreasing



www.indiawatertool.in

WORLD RESOURCES INSTITUT

News / Explained / Explained Climate / Bengaluru and Cape Town: A tale of two cities hit by water scarcity

Premium

Bengaluru and Cape Town: A tale of two cities hit by water scarcity

Dr T V Ramachandra, Coordinator, Energy and Wetlands Research Group in Bengaluru's Indian Institute of Science, was asked about this comparison in a recent interview with The Indian Express.

Written by Sanath Prasad
Bengaluru | Updated: April 7, 2024 11:26 IST

WATER

No end in sight for Delhi's water shortage as Himachal does U-turn; says 'No surplus water left'

Supreme Court expresses irritation at flip flop by hill state; top lawyer offers apology

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By Pratyaksh Srivastava
Published: Thursday 13 June 2024

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Floods without water, droughts without rain: The quiet crises beneath India's ground

We need to change how we think about groundwater, from a private resource to a shared one

WATER

Bengaluru water crisis: Is the southern metropolis heading towards Day Zero?

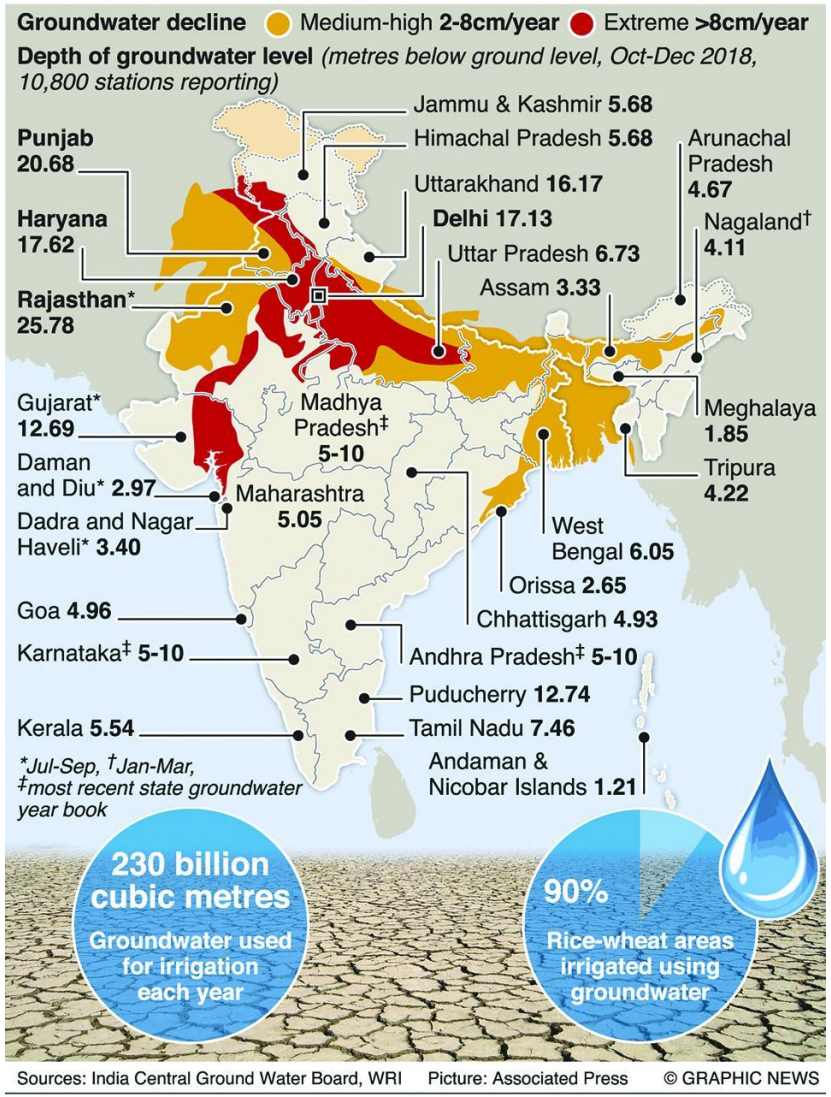
City founded by Kempe Gowda following same pattern as Cape Town in 2018

NEXT NEWS >

By M Raghuram
Published: Saturday 09 March 2024

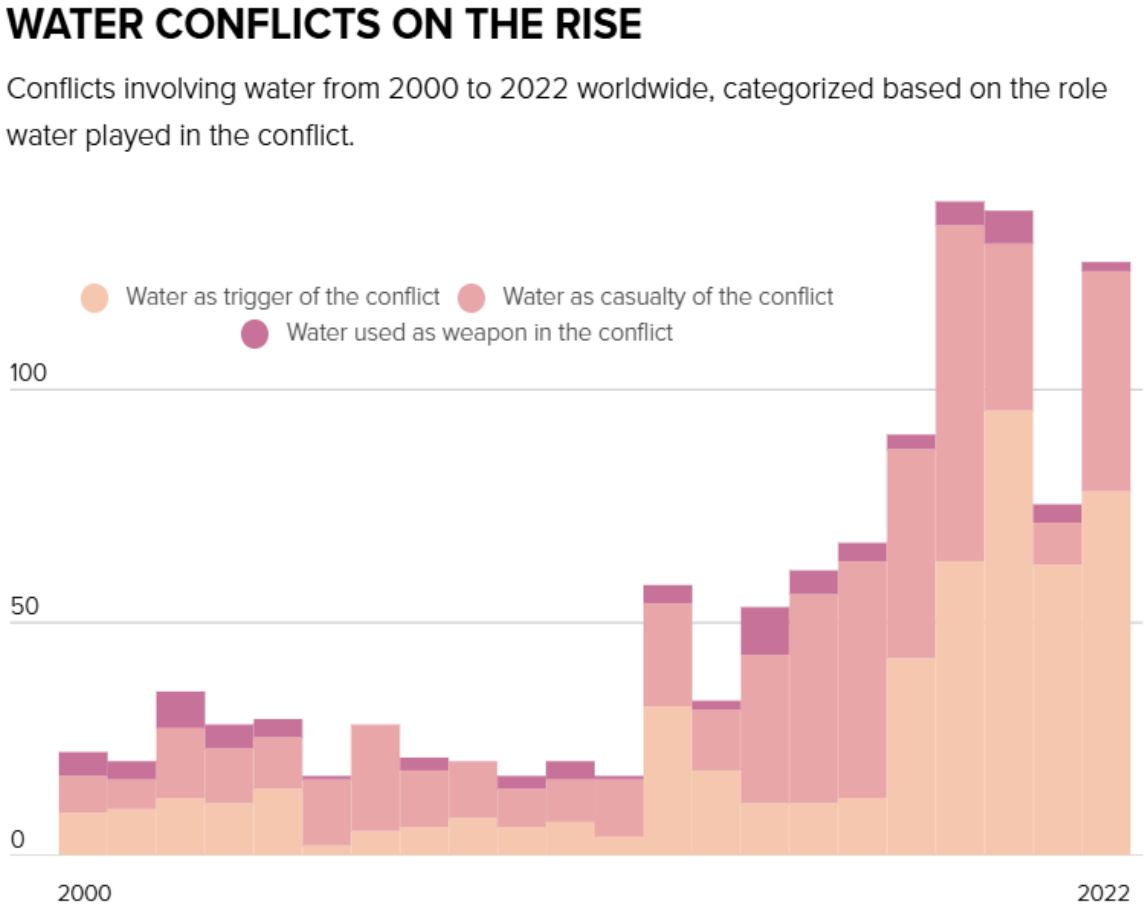
India's water scarcity challenge

India, the world's largest groundwater user, is seeing levels declining across the country with farmers in Punjab, Haryana and Rajasthan facing the prospect of having no groundwater left for irrigation by 2025



Sources: India Central Ground Water Board, WRI Picture: Associated Press © GRAPHIC NEWS

Risks associated with water - Water conflict, social challenges



Retrieved from: https://www.politico.eu/article/russias-war-on-water-in-ukraine/

Retrieved from: https://www.arabnews.com/node/2080876/world

Do our decision take into account climate change?

Water Scarcity and Droughts

Variable Seasonal Rainfall, floods

Temperature rise and Heatwaves

Rise in Sea Level and threat to coastal cities

COP27 SHARM EL-SHEIKH EGYPT 2022

COP28 UAE UNITE. ACT. DELIVER.

COP29 Baku Azerbaijan

COP30

UN News Special Coverage

WATER is at a central place in the climate talks at COP talks

Increased access to water as climate adaptation and resilience

Countries to integrate water and climate agendas at national level

Climate Change is experienced through water

Climate Impacts on Water Systems

Intense rainfall events

Longer dry periods

Flooding

Groundwater stress

Seasonal unpredictability

Operational Impacts

Supply instability

Infrastructure stress

Increased operational uncertainty

Higher emergency response costs



25% population of the world is already living in

DAY ZERO scenario.

UN estimates that global demand for fresh water will outstrip supply by 40% in 2030

WRI - https://www.wri.org/insights/highest-water-stressed-countries

According to JMP **ON-PREMISE ACCESS IMPROVED** significantly for water since 2000

33% → 73% however,

DISPARITY IN ACCESS

In the least developed countries, this coverage is still at 37%. In sub-Saharan Africa, 31%

JMP - Progress on household drinking water, sanitation and hygiene 2000-2022: special focus on gender

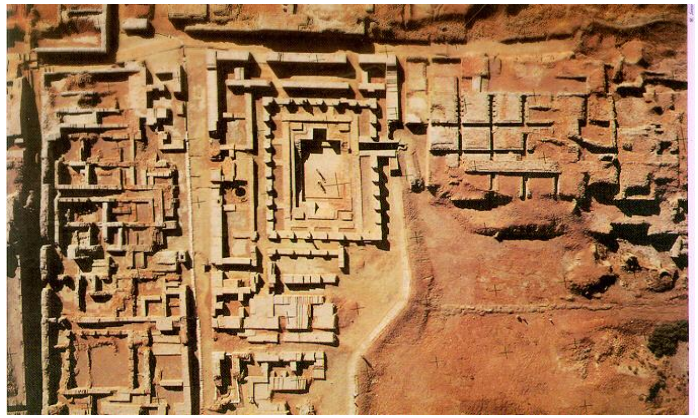
By some estimates, this **water scarcity** is affecting nearly 400 million people and **costing $4.8 trillion** in economic activity.

Learning from Crises to Build Urban Water Security
https://www.rand.org/pubs/visualizations/DVA3540-1.html

What does history tell us? Civilization/Cities have collapsed due to lack of water

Mayan civilization: Drought led famine?

Indus Valley Civilization: From sewers and trade ports to abandoned cities



Fatehpur Sikri: Grand capital but dying water source

Modern disasters?

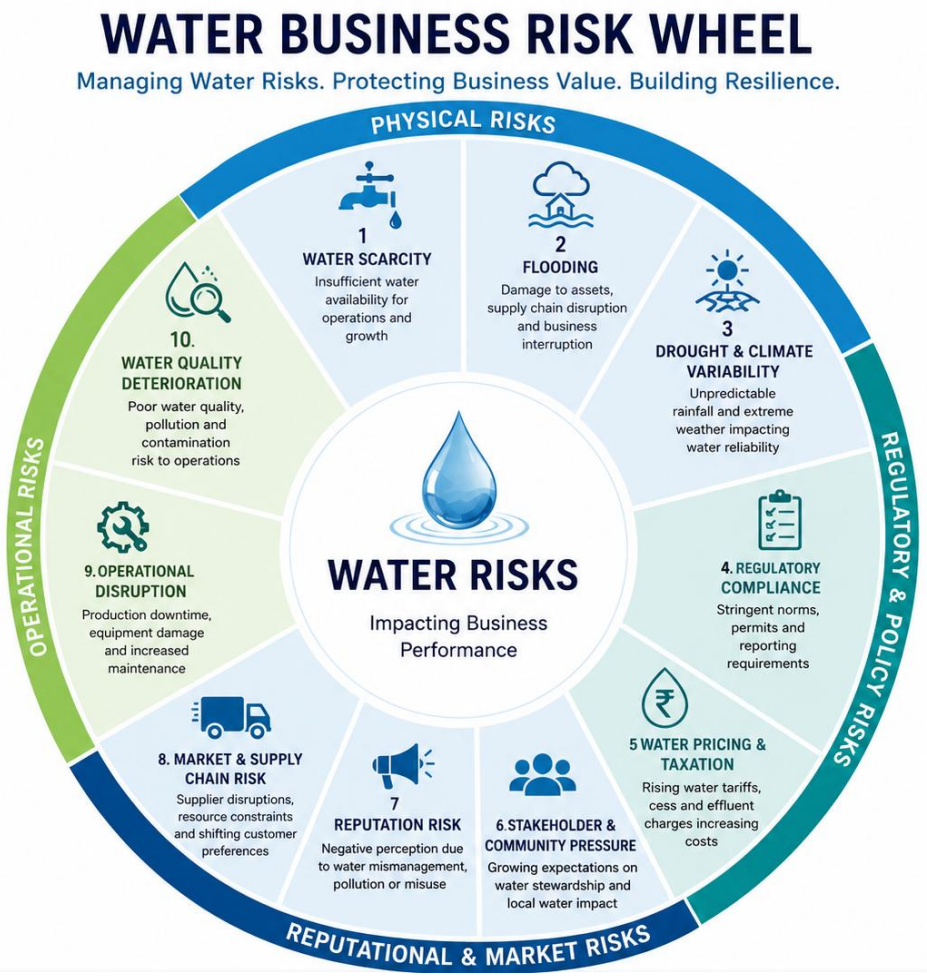
Mexico City Day Zero scare

Cape Town Day Zero

Chennai – Floods followed by drought and Bengaluru Day Zero

Water risks

WATER ISSUE	BUSINESS IMPACT
1. WATER SHORTAGES	1. PRODUCTION DISRUPTION
2. GROUNDWATER DEPLETION	2. RISING EXTRACTION COSTS
3. FLOODING	3. INFRASTRUCTURE DAMAGE
4. POOR WATER QUALITY	4. OPERATIONAL INEFFICIENCIES
5. WASTEWATER NON-COMPLIANCE	5. REGULATORY PENALTIES
6. SUPPLY VARIABILITY	6. BUSINESS UNCERTAINTY



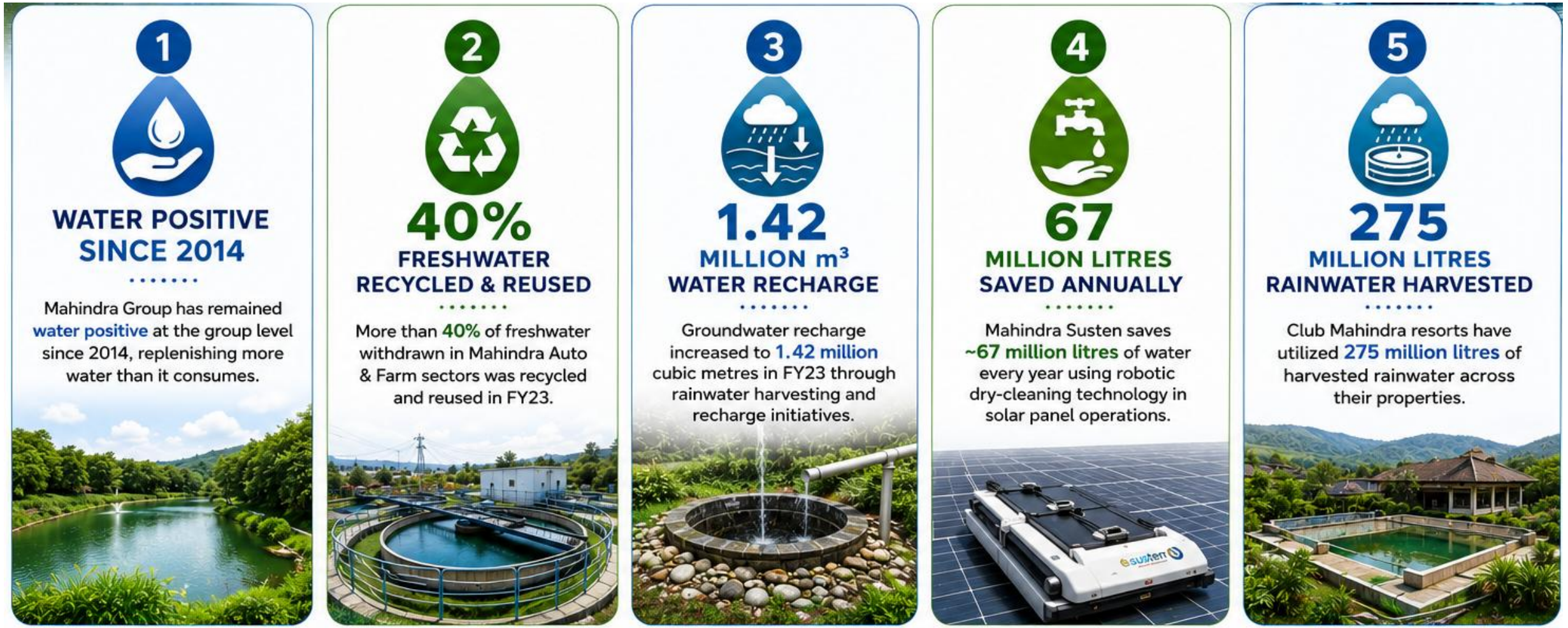
"Water security is now a core operational and strategic issue."

AI-generated visual conceptualized by CWAS team

Industrial water risks as a driver for sustainable water management

Source: https://www.mahindra.com/blogs/mahindra-has-been-water-positive-at-the-group-level-since-2014; https://www.mahindralifespaces.com/sustainability-impacts/water;

Mahindra Group: Water management and sustainability leadership…



Source: https://www.mahindra.com/blogs/mahindra-has-been-water-positive-at-the-group-level-since-2014; https://www.mahindralifespaces.com/sustainability-impacts/water;

The story of rising water tables and enchanting wedding bells

Published : 3/14/2024 | Category : ESG

Mahindra and Mahindra increased the water table in the Zaheerabad region significantly from a low of

Executive Summary

Mahindra and Mahindra's 20+ year-long journey in Zaheerabad led to transforming the drought-hit region and the challenges faced along with the able support of the state government. Several initiatives like rainwater harvesting, water treatment plants, check

Concept of water neutral and water positive

WATER CONSUMING

Net withdrawal from natural systems exceeds what is returned or replenished. The baseline state for most industrial operations.

WATER NEUTRAL

Total water consumed = Total water replenished/offset. Net zero impact on freshwater availability in the operational watershed.

WATER POSITIVE

Returns MORE water to local watersheds than consumed. Measurably improves the health & availability of freshwater ecosystems.

HOW TO ACHIEVE WATER NEUTRAL

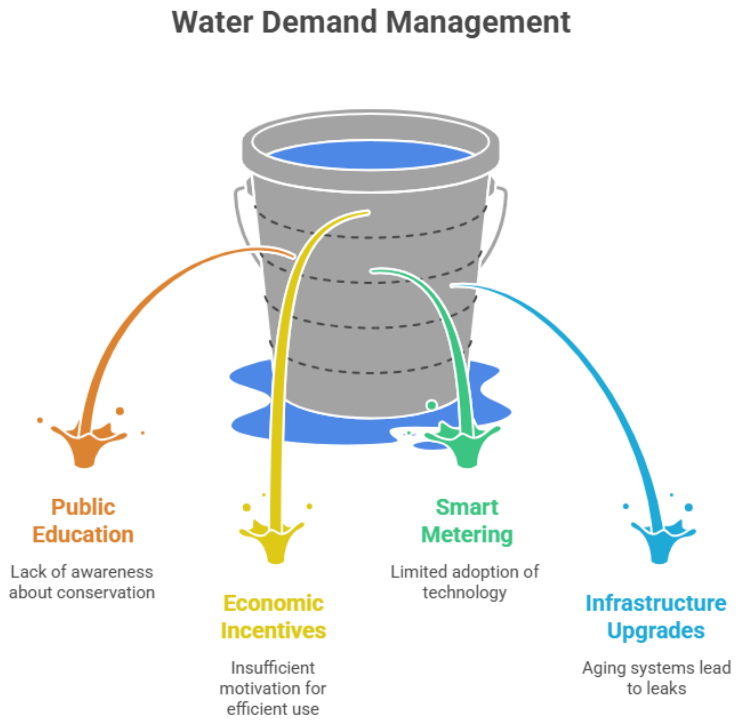
- Reduce absolute water consumption through efficiency
- Implement on-site water recycling & Zero Liquid Discharge
- Offset residual consumption through watershed restoration
- Invest in community water supply projects near operations
- Purchase certified water credits (emerging market)

HOW TO ACHIEVE WATER POSITIVE

- Restore wetlands, rivers & ecosystems beyond operations
- Fund watershed programs: afforestation, soil conservation
- Rainwater harvesting beyond internal needs (community)
- Partner with NGOs on rural groundwater recharge projects
- Report positive replenishment vs. consumption ratio (>1.0)

Water demand management

Water Demand Management (WDM) is a strategy to maximize the efficient use of existing water supplies. It shifts the focus from finding new water sources (supply management) to optimizing how water is used, conserved, and reused.



Pillars of Water Demand Management

Focus on Efficient Use (Behavior Change)

- Shifting user mindsets from water consumption to water stewardship.
- Implementing public awareness campaigns.
- Introducing tiered water pricing to penalize heavy usage.
- Rewarding water-saving practices.

Reduce Wastage (Efficient Fixtures)

- Upgrading infrastructure to minimize physical water losses.
- Mandating low-flow faucets, aerators, and dual-flush toilets.
- Conducting regular audits to detect and fix hidden pipe leaks.
- Enforcing strict building codes for water efficiency.

Promote Conservation, Recycling & Reuse

- Creating a circular water economy.
- Installing greywater systems for garden irrigation and toilet flushing.
- Mandating rooftop rainwater harvesting.
- Treating Industrial wastewater for agricultural or municipal reuse.

Smart Metering

- Deploying digital technology for real-time tracking.
- Replacing mechanical meters with IoT-enabled smart meters.
- Providing consumers with mobile apps.
- Using data analytics to pinpoint distribution leaks instantly.

WDM is no longer optional; it is essential for climate resilience.

CWAS work in water management

Long-standing relationship working with Government of Maharashtra for water, sanitation and environment

UDD, DMA and SBM

MEMORANDUM OF UNDERSTANDING

between

Urban Development Department
Government of Maharashtra

and

Center for Water and Sanitation (CWAS),

Majhi Vasundhara

महाराष्ट्र शासन
पर्यावरण व वातावरणीय बदल विभाग

MOU

MY EARTH
Majhi Vasundhara 6.0
#majhivasundhara

with

CWAS CENTER FOR WATER AND SANITATION
CRDF CEPT UNIVERSITY

MoU signed between Department of Environment and Climate Change and CWAS, CRDF-CEPT University to support environmental conservation and sustainable development under Maharashtra's flagship mission – Majhi Vasundhara Abhiyaan.

Making cities and villages water secure – our experiences

Water security is

Reliable and Affordable Access

of adequate

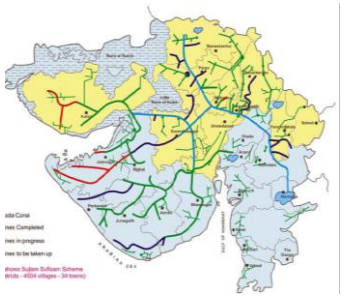
Quantity | **Quality**

of water for

Basic Human Needs | **Livelihood** | **Local Ecosystem Services**

with a

Well managed risk of water-related disasters



Source sustainability

- Groundwater management
- Rainwater harvesting
- Reducing distant source dependence

Municipal service efficiency

- Access to all
- Non-revenue water
- Equity in services

Climate resilience

- Avoid “Day Zero”
- Erratic rainfall
  - Urban flooding
  - Coastal and mountain risks

Urban water security toolkit

Measures to move towards water security and reducing urban flooding through water recharge / water harvesting projects

Ironical situation- floods vs. water scarcity

On the one hand there is **acute water scarcity** and on the other, the **streets are often flooded** during the monsoons


Printed from
THE TIMES OF INDIA

Rains pound Gandhidham, Anjar towns in Kutch

TNN | Jul 12, 2020, 04.32 AM IST

Rajkot: Heavy rain lashed Kutch's commercial city Gandhidham and Anjar on Saturday evening causing severe water-logging in many areas. However, the people welcomed the rain that gave them some respite from the humid heat.

Demonstrations

Rainwater Harvesting

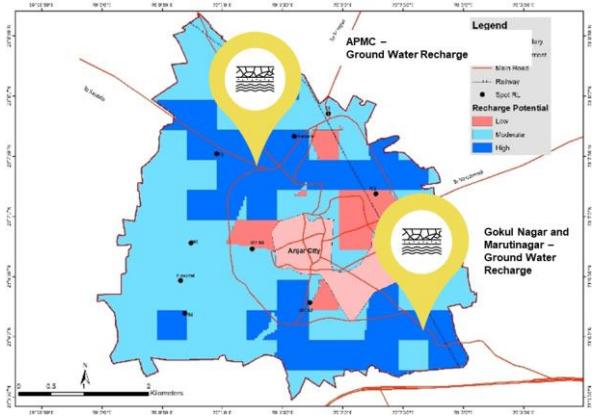
Rainwater harvesting in schools for drinking water supply

Groundwater recharge

Flood control through GW recharge for housing colonies

Scaling up plan

Urban Watershed Delineation
Groundwater Recharge Potential Map at city level



Revival of traditional lake catchment system; Well rejuvenation

35 Million liters of ground water recharged during monsoon

Rainwater Harvesting (RWH)

Rainwater harvesting is the process of collecting and storing rainwater that falls on our rooftops and open grounds for later use. This can be stored for direct use or can be recharged into the ground water.

Where can be install ?

These Rainwater harvesting structures can be installed at anywhere including;

Aanganwadi


Gov. Buildings


Community level


Flooding Area


Farms

Schools/ colleges

Catch the rain

Where it fall, When it falls

For Water Security!

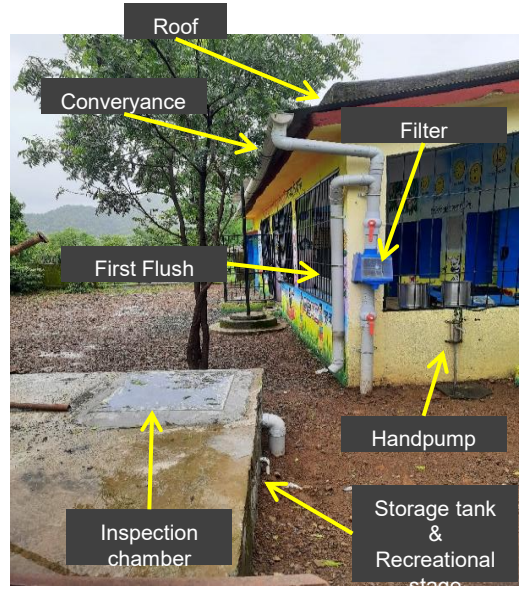
Rainwater Harvesting

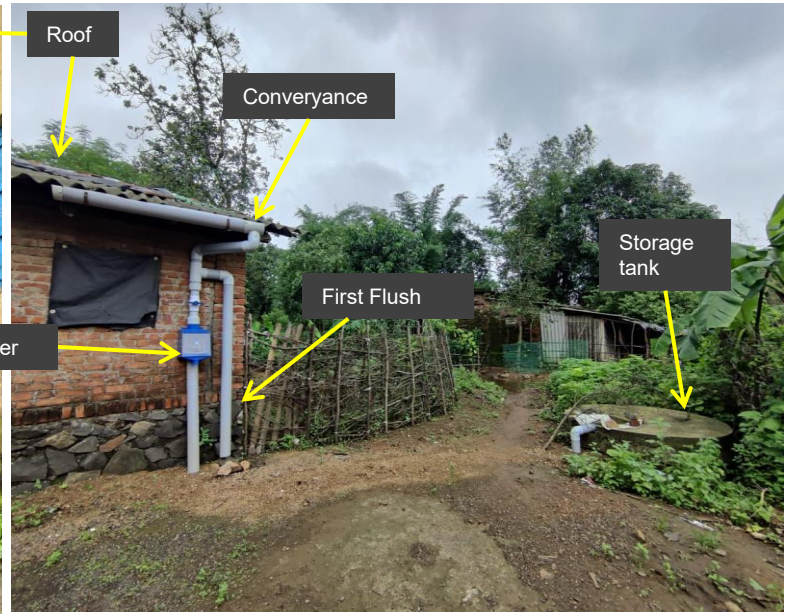
Effective RWH requires:

- Hydrogeological understanding
- Proper filtration
- Adequate storage
- Recharge planning
- Regular maintenance

Common challenges

- Poor maintenance
- Clogged recharge systems
- Low recharge efficiency
- Lack of monitoring

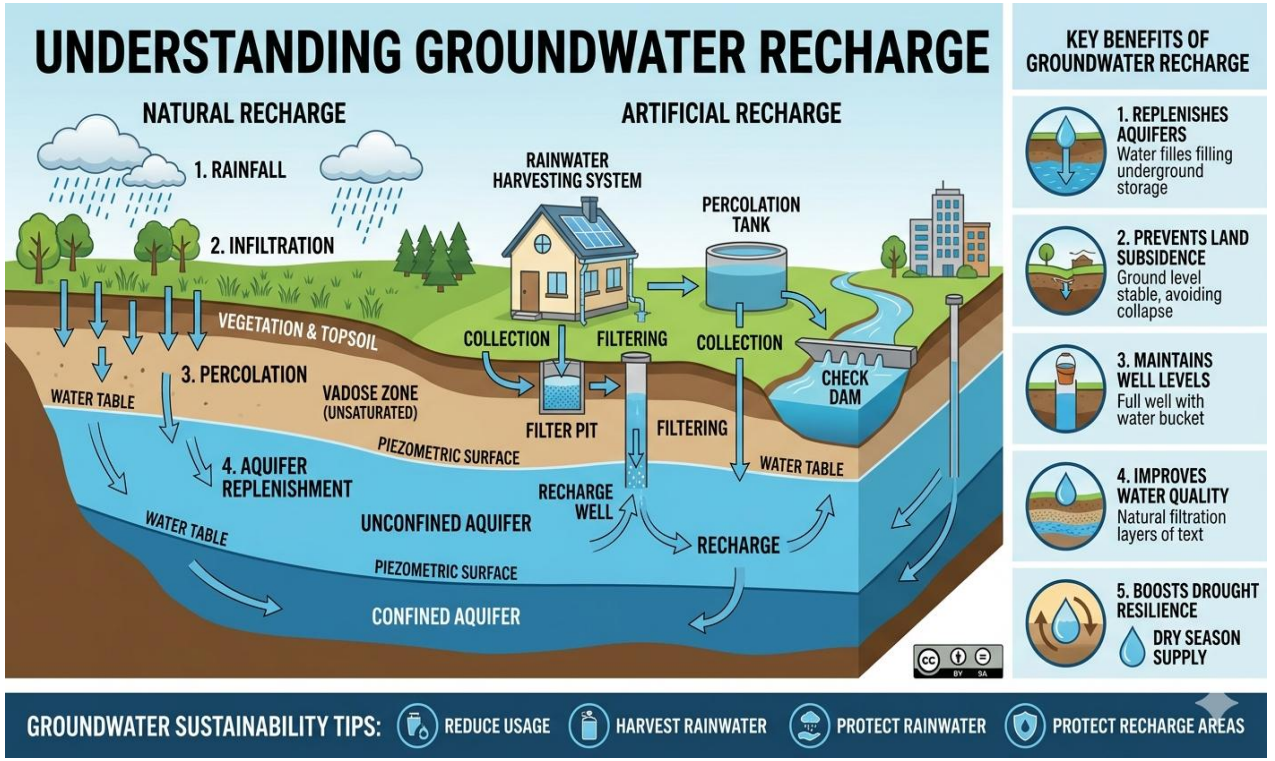




Ground Water Recharge (GWR)

1. What is Groundwater Recharge?
Groundwater recharge is the process of **allowing rainwater and surface runoff to seep into the ground**, helping to restore depleted aquifers and improve long-term water availability.

2. Why is it Important?
Recharge helps **increase groundwater levels, reduce tanker dependence, and ensure water availability during dry periods**, making cities more resilient to droughts and climate variability.

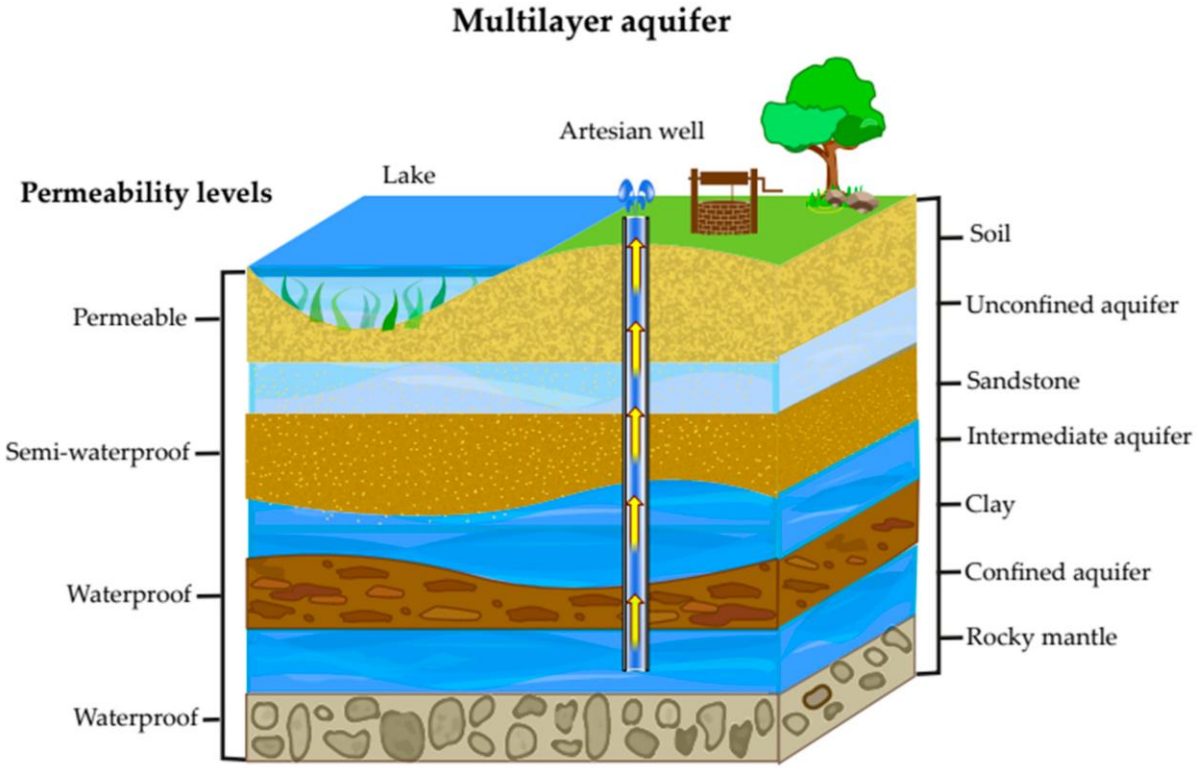


GWR systems: Recharge pits, recharge wells, rainwater harvesting systems, and revival of water bodies.

Aquifer recharge

Why Aquifers Matter

- Urban water supply
- Industrial operations
- Rural livelihoods
- Drought resilience



Source: Aquifers and Groundwater: Challenges and Opportunities in Water Resource Management in Colombia

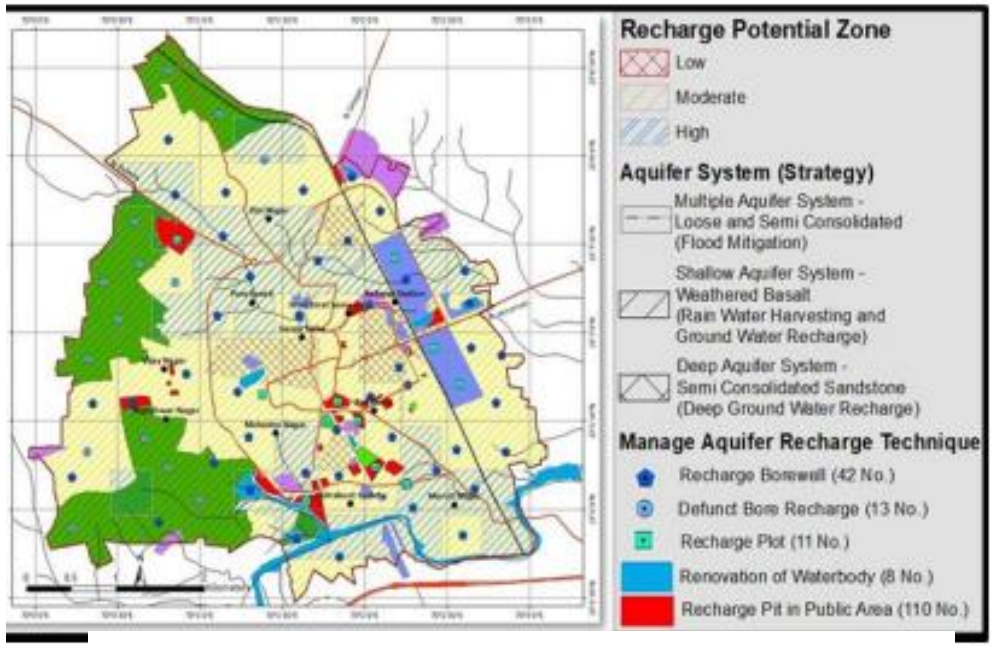
Recharge through

- Recharge wells
- Percolation structures
- Stormwater recharge
- Watershed management

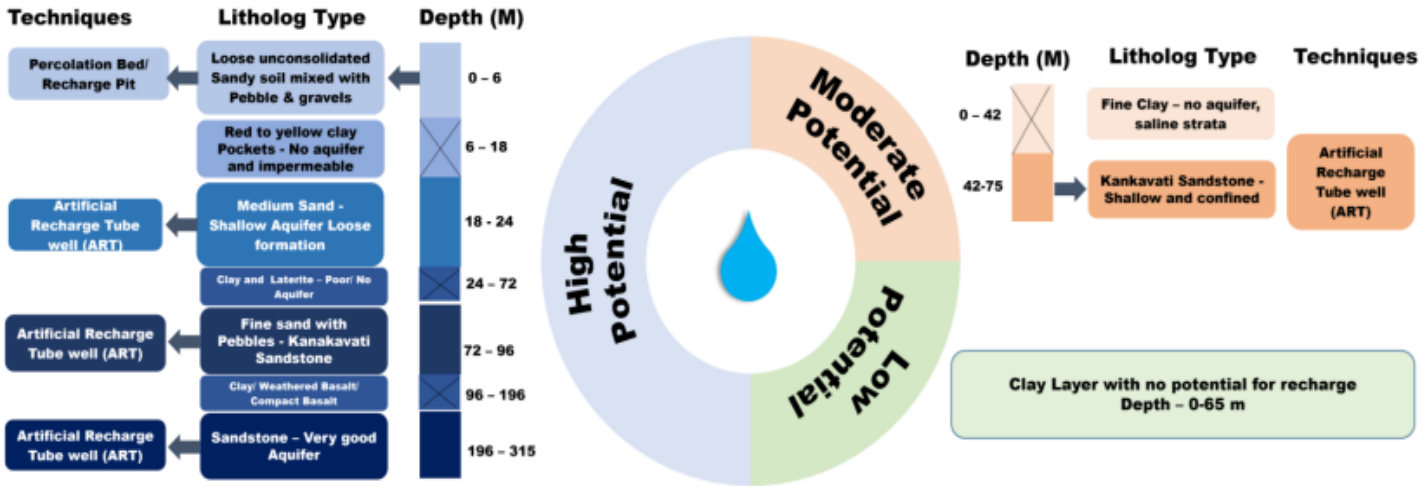
Source: Ground water year book of Maharashtra and Union Territory of Dadra and Nagar Haveli, 2019, CGWB, GoI

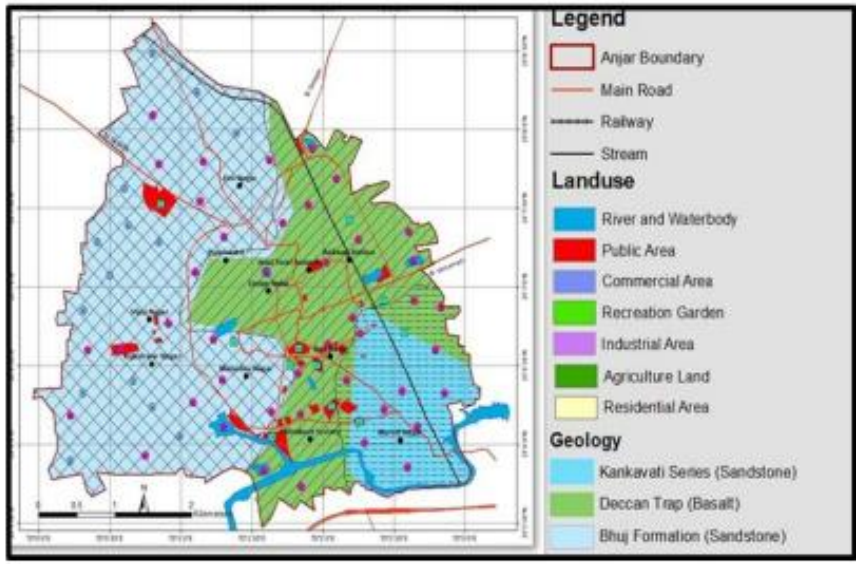
Geo-hydrological and aquifer studies for Anjar and Gandhidham

- **Comprehensive Assessment:** Executed detailed geo-hydrological evaluations to understand underground aquifer systems.
- **Core Objective:** Identified high-priority zones critical for effective groundwater recharge.
- **Technical Output:** Outlined exact, scientifically backed techniques required for successful implementation.



Zone-wise Recharge Techniques - Anjar



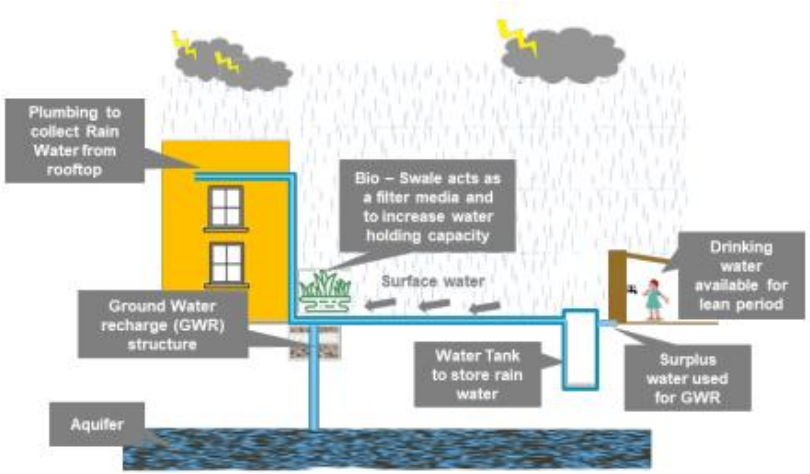


Source: https://cwas.org.in/cwas-resources/geo-hydrological-and-aquifer-studies-gandhidham-and-anjar

Water security action plan and Geo-hydrological and Aquifer Studies for Anjar and Gandhidham

- **City Support:** CWAS directly empowers Anjar and Gandhidham to transition toward robust water security.
- **Goal:** Guarantees equitable access to high-quality water for all urban residents.

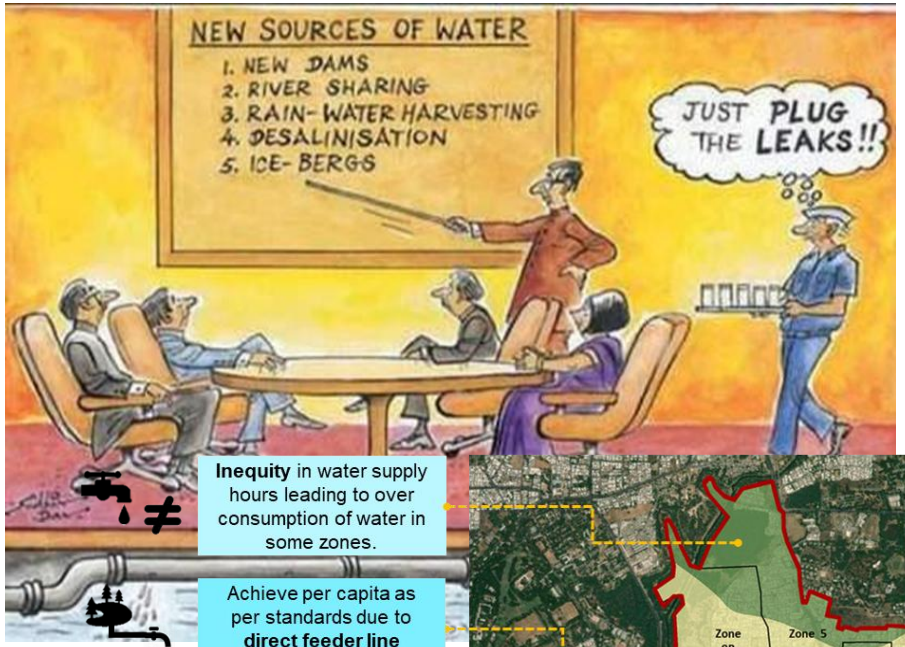
- The plan provides a roadmap for effective water resource management, ensuring long-term sustainability and equitable access to good quality water for all residents.



Source: https://cwas.org.in/cwas-resources/geo-hydrological-and-aquifer-studies-gandhidham-and-anjar

Plugging the leaks - Reducing non-revenue water in cities

In India, household level metering non-existent – losses in distribution largely unregulated



Preliminary Water Audit Methodology

- Preliminary water audit studies in 10 cities
- NRW varies from 35% to 77%
- Rajkot city installed monitoring system and regularized illegal connections

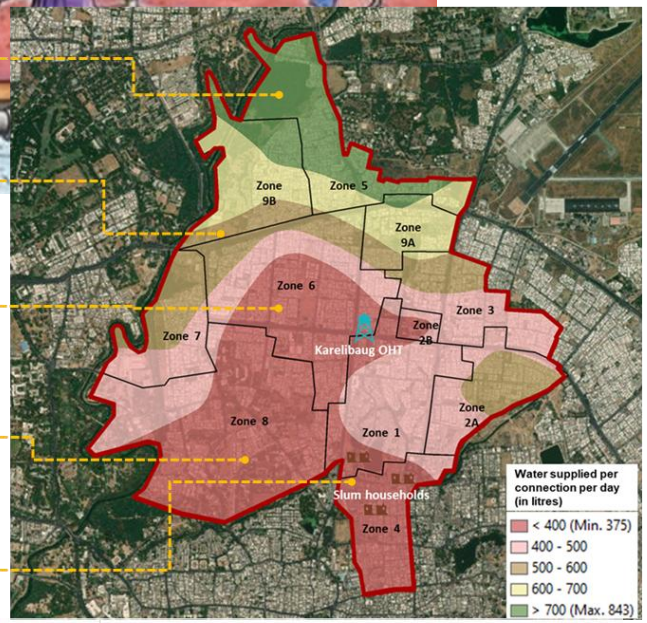
Inequity in water supply hours leading to over consumption of water in some zones.

Achieve per capita as per standards due to **direct feeder line connections** in the area

Issues related to poor **water pressures** in areas with topographical differences.

Unaccounted water supply from Warasia booster pump in few areas.

Water theft observed in slum pockets of Hathikhana due to low water pressure.



Map showing water received at consumer ends

Avg. Water supplied per Connection

451 Litres / Connection / Day

Area with slum observes lower per capita water supply

609 Litres / Connection / Day

Wide variation in water supply at non slum area is noted from survey

851 Litres / Connection / Day

Due to variation in pipe diameters commercial zones receive higher per capita water supply

Pilot water audit in Vadodara city

- SCADA reporting only transportation loss – distribution network unregulated
- Bucket surveys and sampling
- Results, extrapolated to the city, reflect an annual loss of ~ $ 8 million to the city government
- Results also highlighted inequity in supply across localities

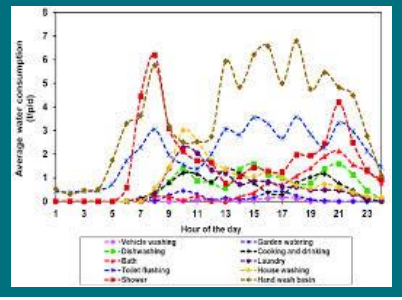
Water audits to water circularity: Making water visible

Water Audit Helps To:

Quantify water inflows and outflows

Identify leakages and inefficiencies

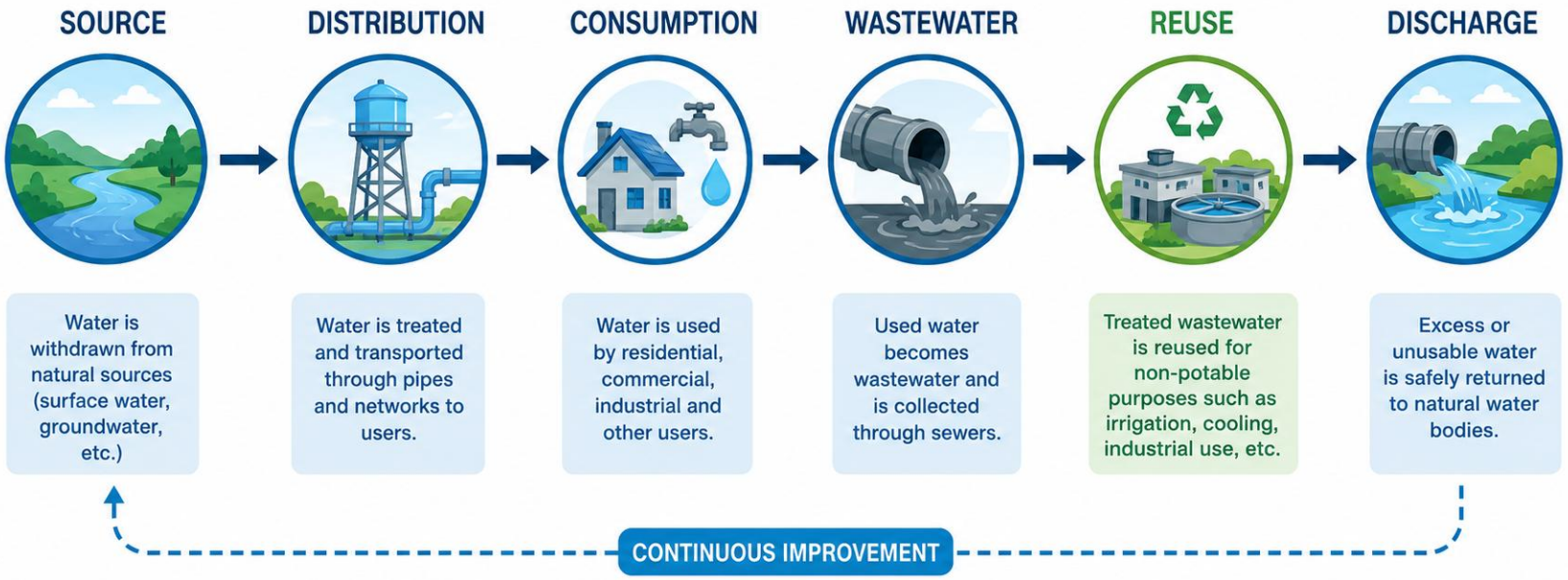
Understand usage patterns



Assess reuse opportunities

Improve accountability

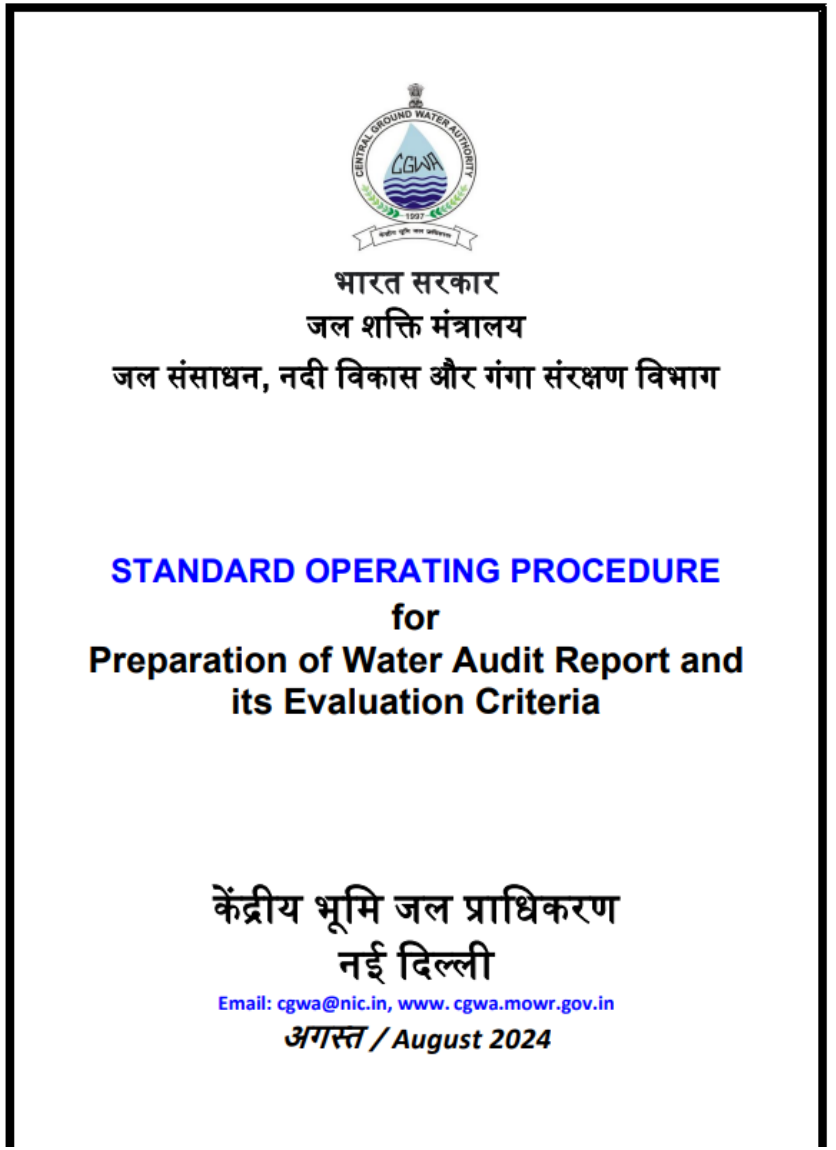
Water Circularity



Water audits: CGWA requirements for industries

Water audits are now a regulatory necessity for industries abstracting >100 m³/day of groundwater, as per CGWA Notification (24 Sept 2020).

- Mandatory Annual Audit Industries must conduct water audits annually through certified auditors and submit reports to CGWA within 3 months of completion.
- 20% Reduction Target Industries are expected to reduce groundwater usage by at least 20% over 3 years, based on audit findings.
- Standard Operating Procedure (SOP) CGWA has issued a detailed SOP for audit report preparation, including volumetric analysis, source mapping, and seasonal consumption tracking.
- Compliance and Transparency Audit reports are published online by CGWA/SGWA, and independent agencies verify adherence to NOC conditions.



भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

STANDARD OPERATING PROCEDURE
for
Preparation of Water Audit Report and its Evaluation Criteria

केंद्रीय भूमि जल प्राधिकरण
नई दिल्ली
Email: cgwa@nic.in, www. cgwa.mowr.gov.in
अगस्त / August 2024

https://cgwa-noc.gov.in/LandingPage/UserAssistance/ApprovedSOPSG.pdf

Reuse of used water – urban “greening” through circularity

Sinnar city: reuse of water for treatment plant for development of garden and urban forest

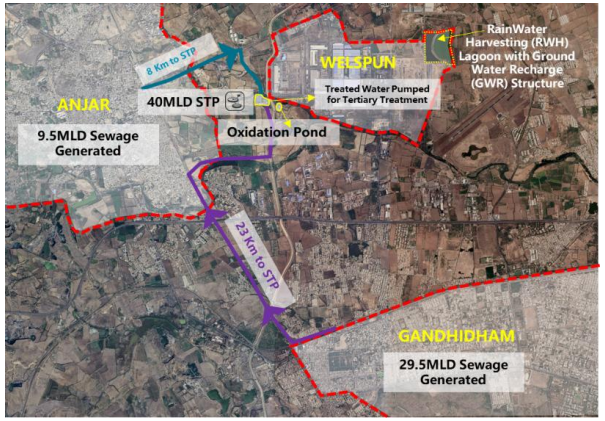
Scaling up with faecal sludge treatment plants across the state of Maharashtra

Other examples and potentials with public-private partnerships

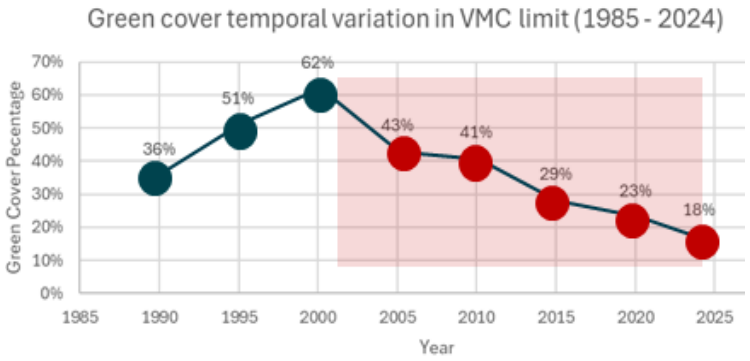
Energy sector and municipal STPs - Example of Nagpur – 90% treated water reused. Tie ups with - NTPC and Mahagenco

Maharashtra reuse policy - municipalities responsible for recycling wastewater and reusing treated wastewater in thermal power plants, industrial estates, and for other non-potable purposes

Textile industry and municipal wastewater Example from Gujarat – Welspun (Textile secotor) set up STP to treat water from Anjar and Gandhidham for own industrial reuse. Cities generating revenue from selling sewage.



Increasing urban green coverage can combat rising temperature and heat waves – reuse of treated waste water

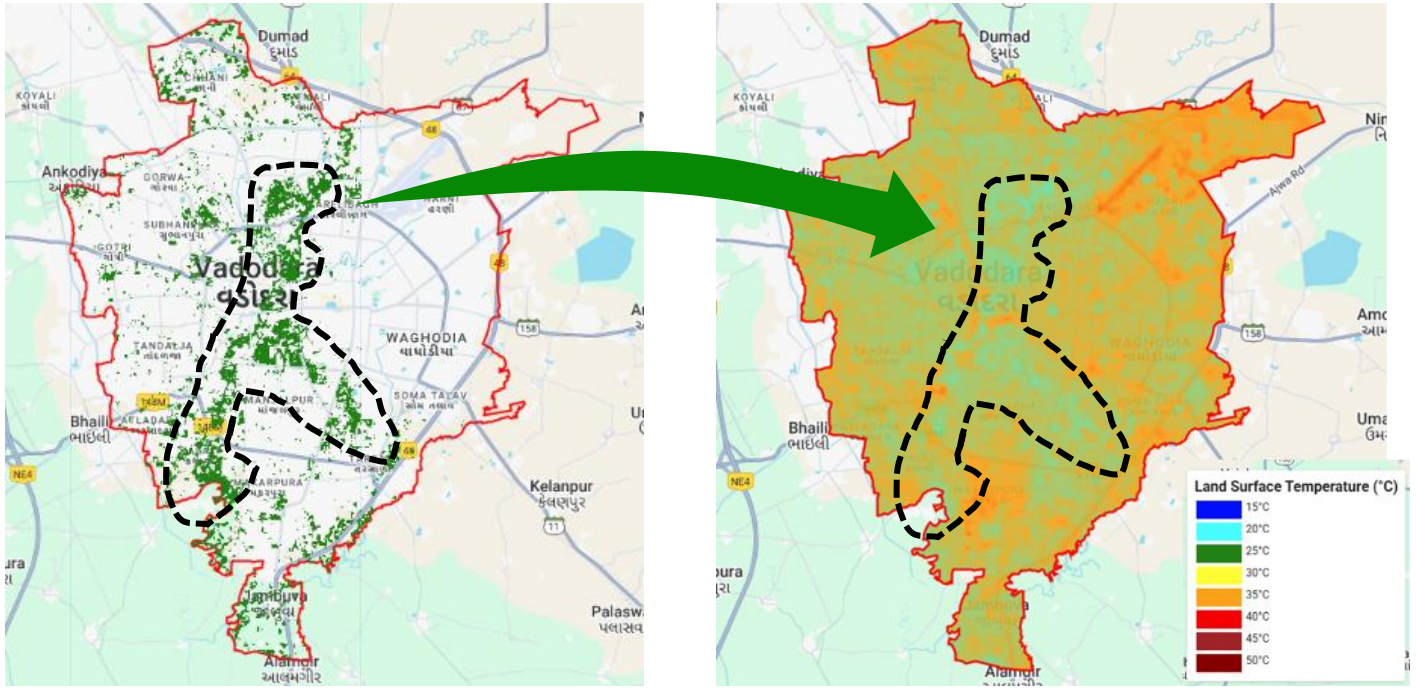


← Reducing green cover in Vadodara over the years. Over the last decade, average temperature increased by 0.8 ⁰ C

Remote sensing techniques show a relation between green cover and surface temperature

Building circularity – an opportunity to reuse wastewater?

Municipal corporation	% collected wastewater treated	% treated wastewater reused
Ahmedabad	100%	47%
Surat	100%	33%
Vadodara	**93%**	**0.9%**



Gujarat reuse policy – 100% Reuse of treated WW by 2030

Onsite reuse of treated wastewater for landscaping at Ahmedabad STP

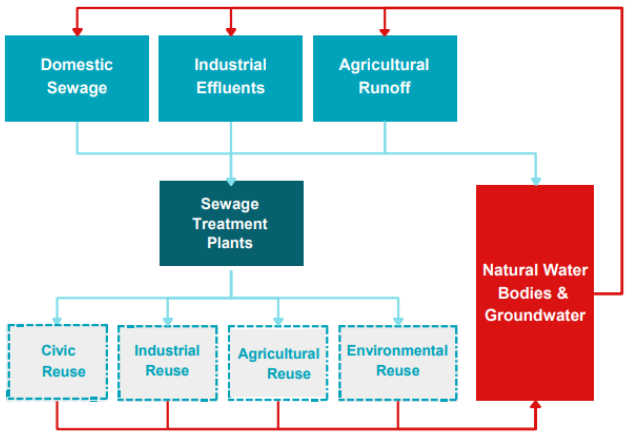
Source: 1. Aayog, N. I. T. I. (2021). Urban Transformation Sector report. *Development Monitoring and Evaluation Office, NITI Aayog, Government of India*.; 2. Figures are estimated using the remote sensing technology using the Landsat images; 3. Sethi, S.S., Vinoj, V. Urbanization and regional climate change-linked warming of Indian cities. Nat Cities 1, 402–405 (2024). https://doi.org/10.1038/s44284-024-00074-0

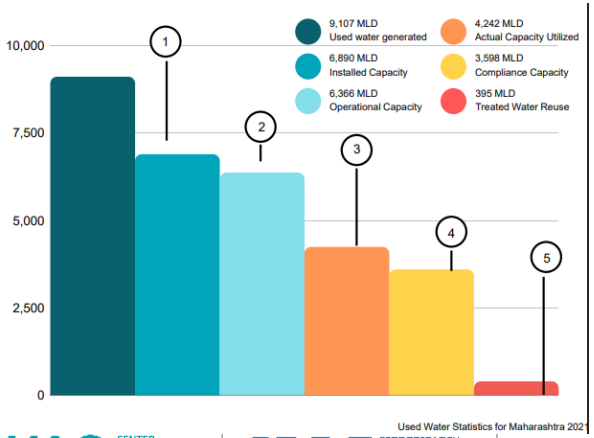
Reuse of used water – Potential applications

Why Reuse Matters

- Reduces freshwater demand
- Improves water security
- Reduces discharge pollution
- Improves resilience during shortages

Used Water Cycle in Maharashtra





Used Water Statistics for Maharashtra 2021

Reuse Potential for Used Water and Sludge for Maharashtra

Industrial Reuse

- Cooling Towers
- Data Centers and IT
- Chemical Manufacturing
- Textile Industries
- Automobiles

Agricultural Reuse

- Irrigation
- Fertilizer Substitute
- Horticulture
- Fisheries

Ecological Reuse

- Gardening & Landscaping
- Groundwater Recharge
- Social and Urban Forestry
- Water Bodies and Tanks Recharge
- Other Public Spaces

Civic Reuse

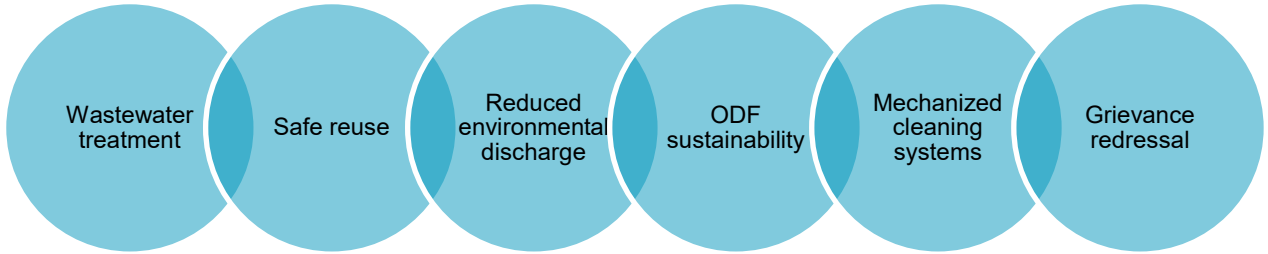
- Railways
- Construction
- CT and PT Cleaning
- Fire Department
- Others (vehicle washing, roads, etc.)

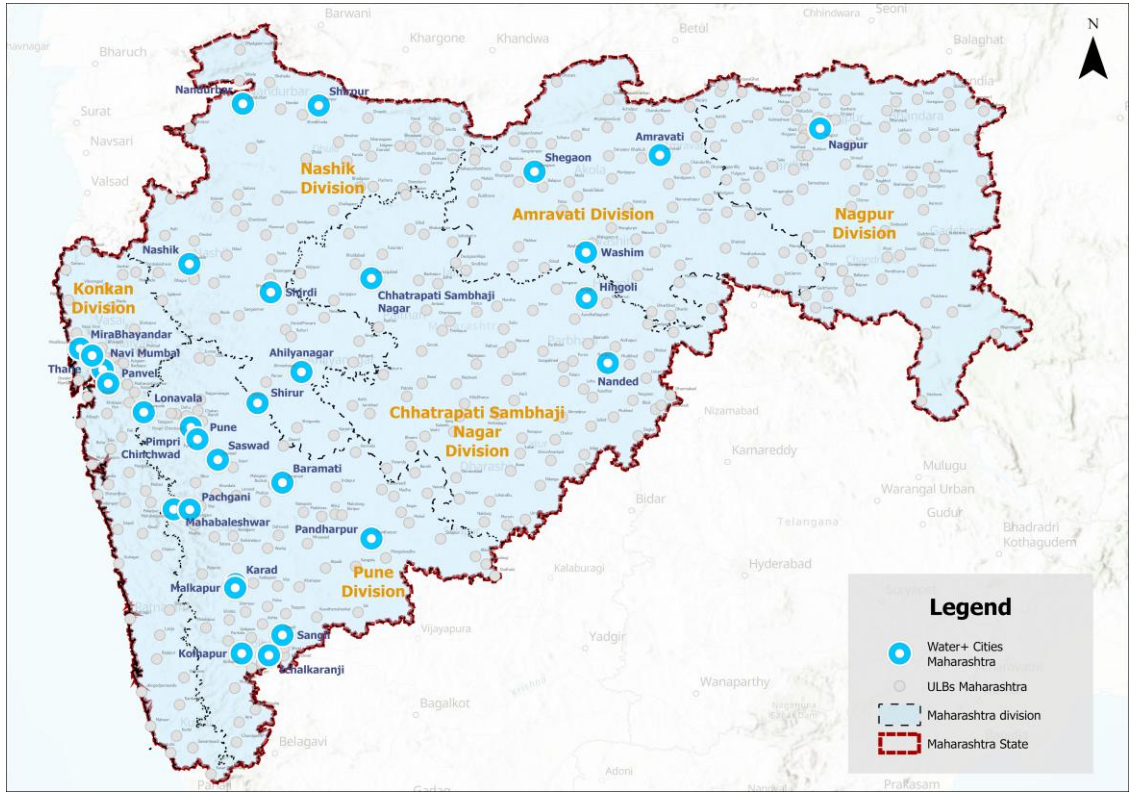
Source: Landscape Review and Strategic Roadmap for Used Water Management in Maharashtra

CWAS CENTER FOR WATER AND SANITATION | CRDF CEPT RESEARCH AND DEVELOPMENT FOUNDATION | CEPT UNIVERSITY

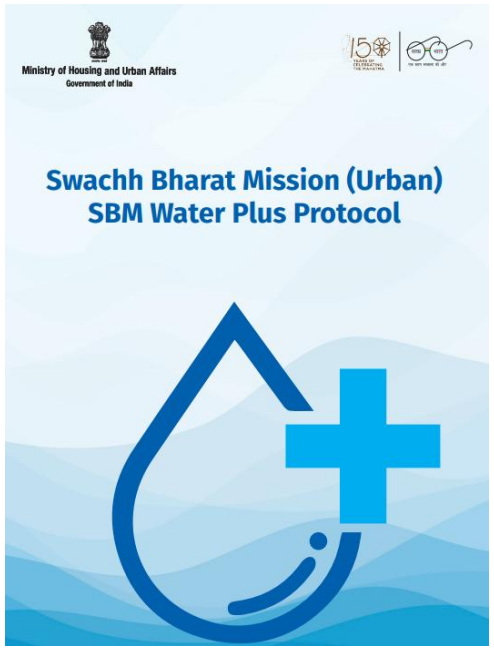
Maharashtra Water+ Cities

Water+ Focus Areas





Source: Swachh Certification Protocols, 2024

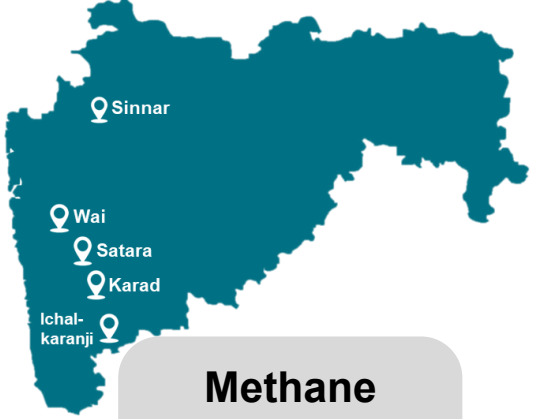


Water+ Scoring Matrix

	Parameters
1	Safe discharge of sewage including septage from CT/PT/IHHL
2	Adequate treatment capacity of STP and operational efficiency
3	Safe cleaning of Sewer and Septic tanks through mechanised equipment and availability of PPEs and availability of RSA and SRU
4	Sufficient capacity of desludging vehicles and jetting machines for cleaning of septic tanks with soak pits and sewers respectively in the city
5	Re-use of treated water
6	Municipal drains receiving sullage be well maintained and Bar Screens/ trash arrester are placed at strategic locations
7	100 % Operations and Maintenance costs of sewer networks / STPs / FSTPs are being recovered through dedicated revenue streams/ users
8	Complaint mechanism such as 14420, Swachhata App etc available and complaint redressal status available

Source: Swachh Certification Protocols, 2024

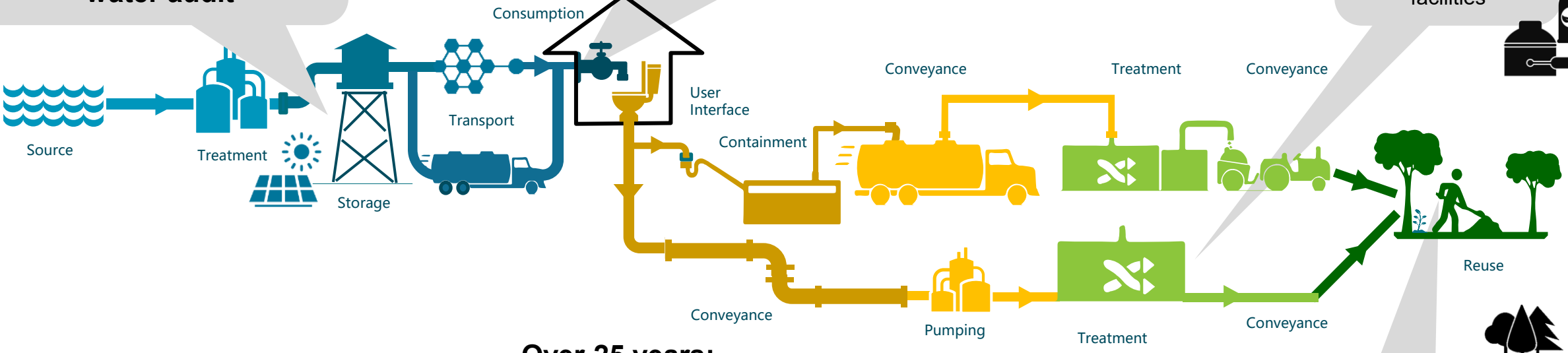
Making WASH services Carbon Neutral - across the service chain in small towns



Assessment of water and sanitation services and emissions in operations – **energy and water audit**

Use of clean energy such as **solar power** for various WASH operations. Use of energy efficient machinery

Methane capture units at treatment facilities



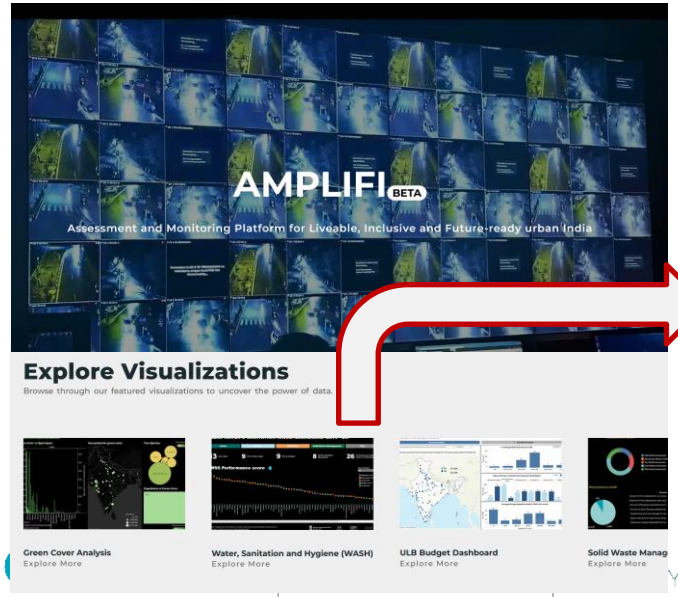
Over 25 years:

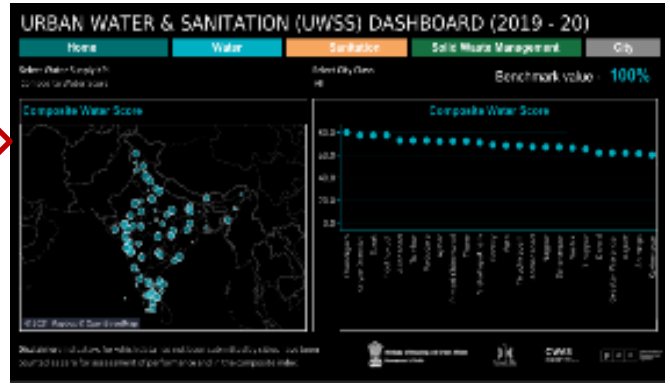
Clean energy generation potential	**8550** MWH	**Emission reduction Potential**	**7,011** tons CO2

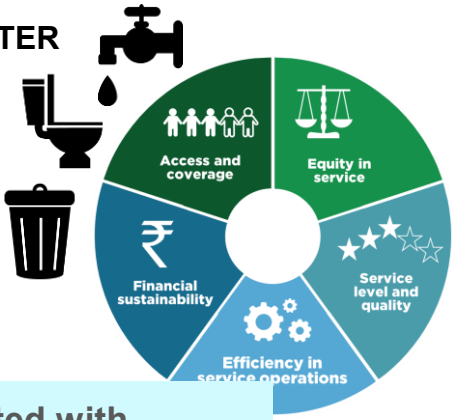
Urban forests as **carbon sink units** at treatment facilities

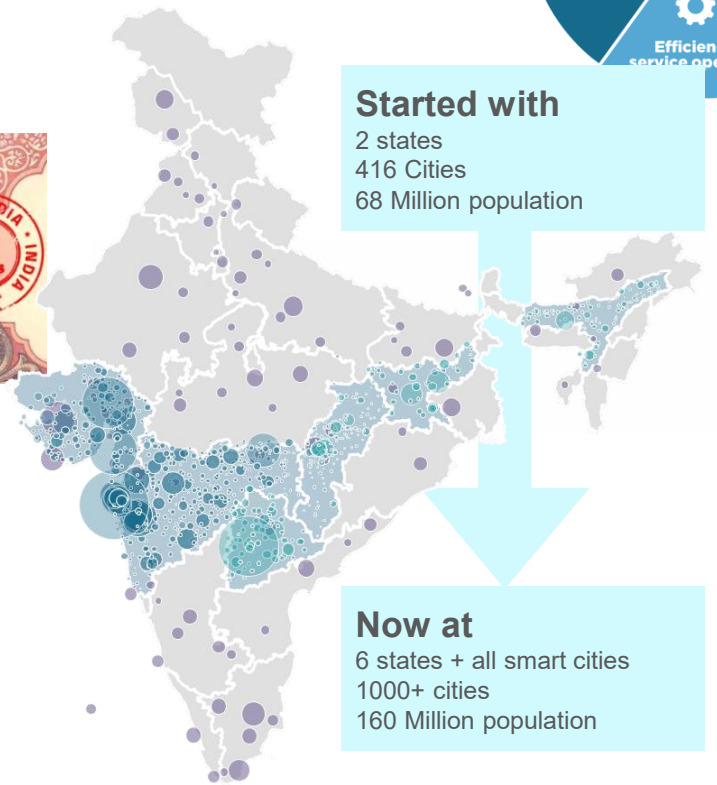
Performance Assessment System at CWAS – tech platform enabling cities to assess their services and access central govt funds

- Measure and monitor performance of water and sanitation services by urban local governments
- Online self-assessment portal – filled by city officials annually
- Various validation checks and calculation to generate “Service Level Benchmarks”
- SLBs published by state governments for cities to avail central grants – 13th / 14th / 15th Finance commission
- Data driven governance – Dashboards enabling informed decisions for improvement actions
- Dashboard integrated in SMART cities AMPLIFI portal









Started with
2 states
416 Cities
68 Million population

Now at
6 states + all smart cities
1000+ cities
160 Million population

A range of digital innovations applied

SMART MOBILITY SYSTEMS

- Intelligent Traffic Management Systems (ITMS), use 4i a signal timing and congestion
- GPS-based tracking for buses
- Automatic Number Plate Recognition rearıors parknesз
- e-ticketing for public transport
- Smart parking

E-GOVERNANCE & CITIZEN SERVICES

- Digital platforms enable grievance redressal, utility payments and mobile feedback

SMART WATER UTILITIES

- SCADA systems monitor and manage water pipelines and treatment plants
- Smart meters for real-time usage data and leak reduction

PUBLIC SAFETY & SURVEILLANCE

- CCTV networks
- Emergency call systems
- Safety audits
- AI-supported video crime mo-nitoring

WASTE MANAGEMENT TECH

- Smart bins with RFID e roıute optimization
- GPS-tracked garbage trucks
- IoT-enabled tracking to enforce waste segregation
- Waste to-energy, compost and liel

SUSTAINABLE ENERGY

Solar panel installations

LED street lighting

Green buildings

ENVIRONMENTAL MONITORING & RESILIENCE

- Sensors for air/water quality measurement
- LiDAR-based **3D digital twins** for flood risks and emergency planning.
- AI & satellite tools map urban heat vulnerability at granular levels.

https://en.wikipedia.org/wiki/Safetipin
https://pubadmin.institute/urban-local-governance/smart-cities-transforming-urban-india
https://en.wikipedia.org/wiki/Chennai_Smart_City

Robotics and AI for sewers and storm water drain maintenance

"Manhole" to "Machine hole" - Can AI help mitigate manual scavenging?

Stormharvester Intelligent sewer suite - Wessex, UK

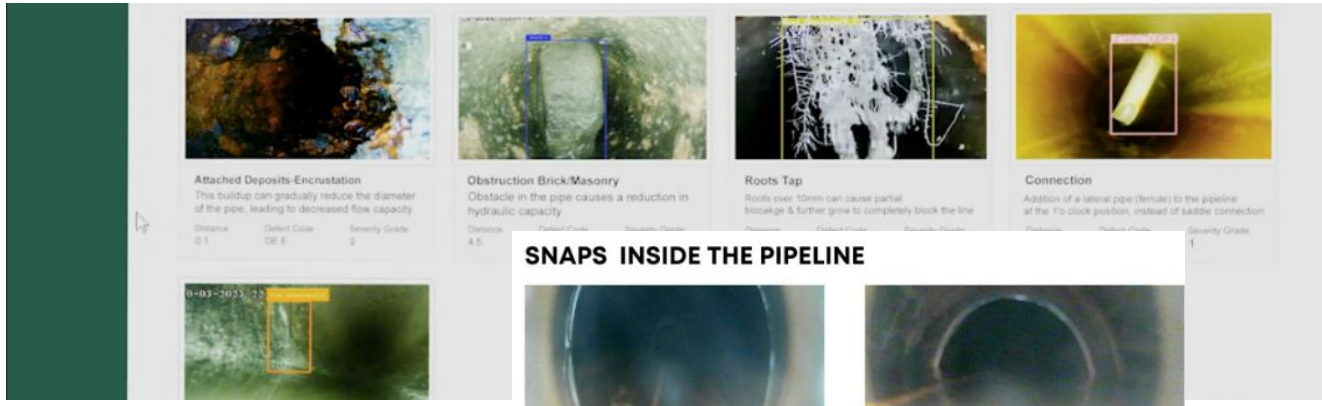
- IoT sensors under access covers and at outlets
- Alerts about blockages and potential pollutants
- Anomaly detection

SMS: Near real-time predictions and alerts

Bandicoot robot – Kerala

- Equipped with human-like arms and a range of gas sensors to identify and assess sewage conditions inside drainage chambers
- Machine Vision: It uses machine vision technology for operators to see inside manholes, even in low-light conditions.

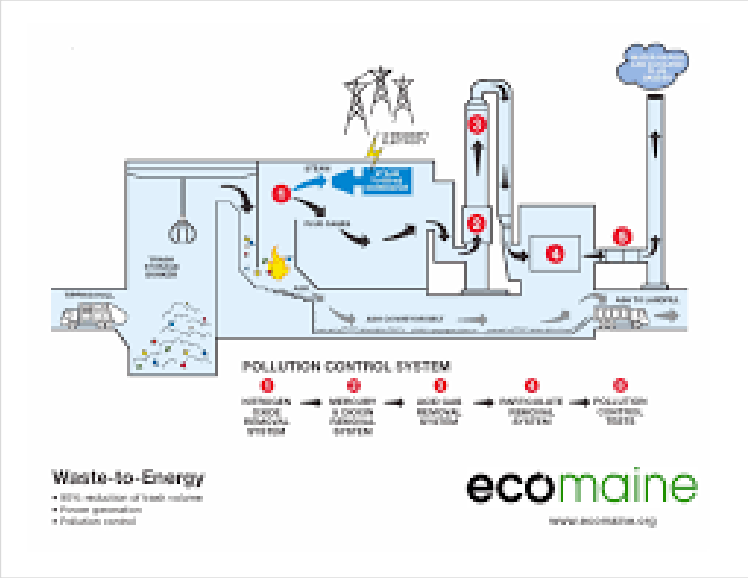
Endobot robot and Swasth AI – Chennai, Goa



- Crawls inside the water pipelines in the area and helps identify contamination points, cracks, leaks, encrustations, and broken pipe walls
- Inclination calculations / network mapping for old infrastructure

AI applications - optimising treatment facilities, predictive maintenance

Toronto - AI for optimizing treatment facilities



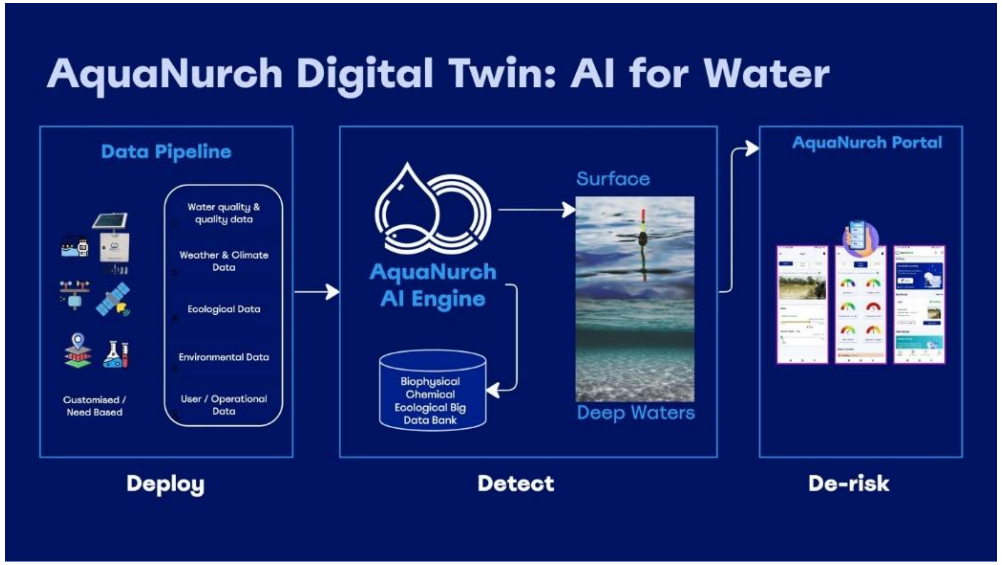
- AI models can predict chemical dosing requirements in treatment plants based on influent quality data.
- AI can optimize aeration systems in STPs to reduce energy consumption.
- Integration of AI-driven models to enhance process efficiency and to maximize biogas yield from waste in Singapore.

Use of geo-spatial information to track health of water bodies

Clearbot robot – Hong Kong & Meghalaya

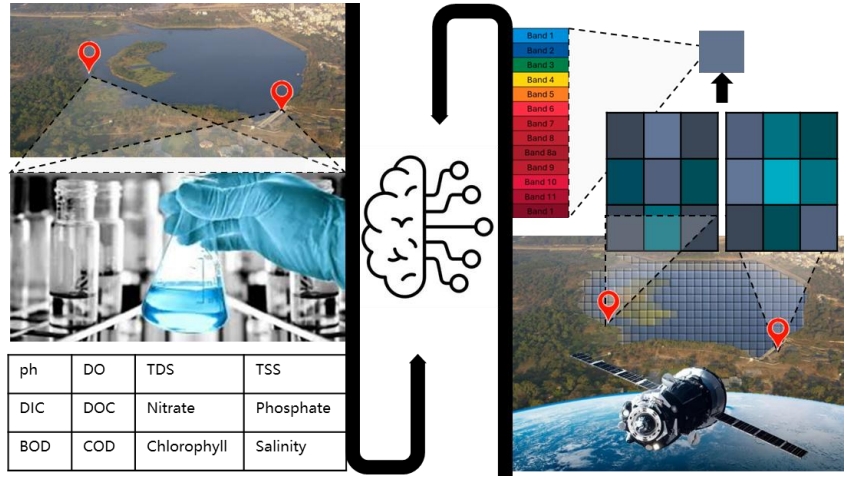
- Lake cleaning and pollution detection-trash, water hyacinth
- Autonomous – swim on its own
- One robot is able to collect a metric ton of trash a day
- Computer vision - “We generate data about what’s in the water, what’s the make-up of the stuff that’s there, how much of it is recyclable and what materials we should be focusing on.”

AquaNurch digital twin models for water bodies

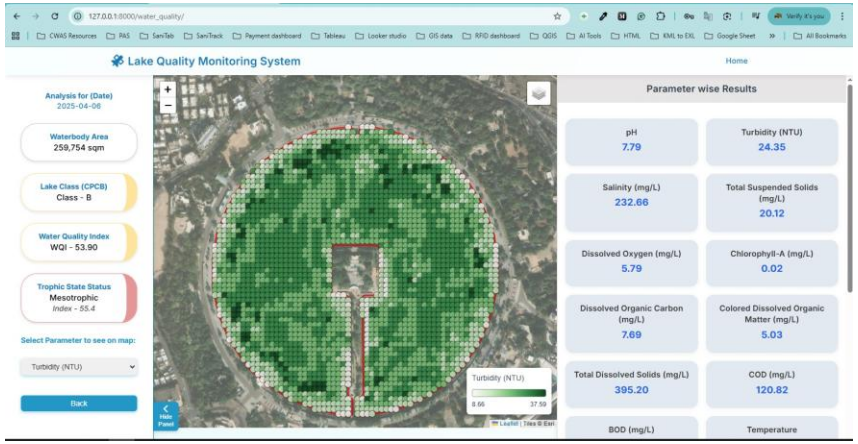


- Weather and climate data + water quality data from sensors to maintain health of water body for improving fish farming / ecological restoration

CWAS research – Machine learning to estimate lake water quality using satellite imagery



ph	DO	TDS	TSS
DIC	DOC	Nitrate	Phosphate
BOD	COD	Chlorophyll	Salinity



Water credit

In a first, Junagadh civic body gets water credits for rainwater harvesting

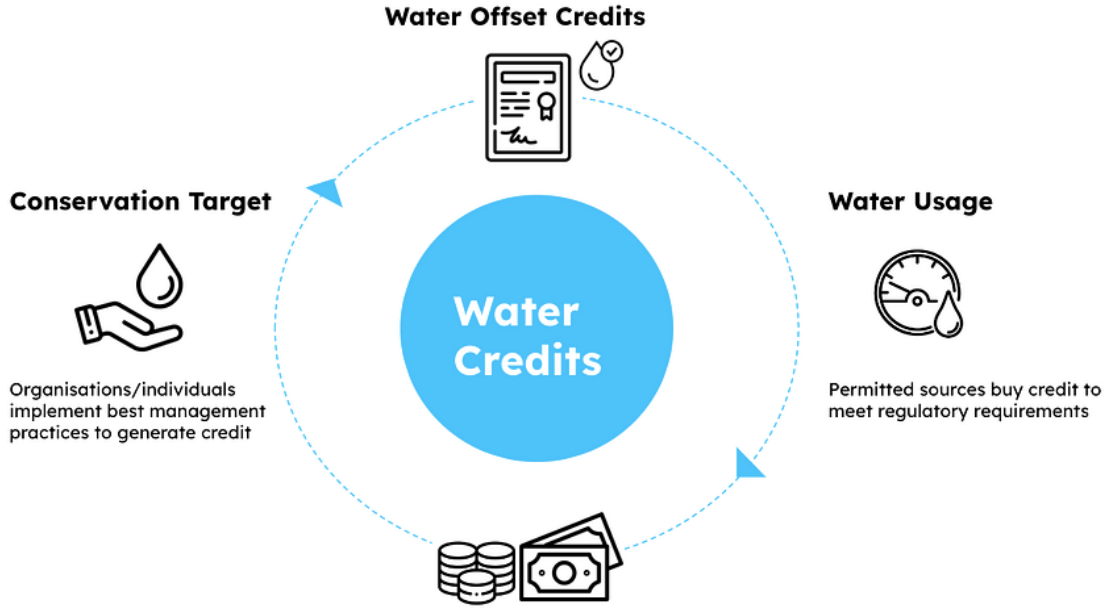
Nimesh Khakhariya / TNN / Oct 25, 2023, 10:09 IST SHARE AA FOLLOW US

The Junagadh Municipal Corporation (JuMC) in India has become the first civic body to earn water credits by saving rainwater. The United Nations Framework for Convention on Climate Change (UNFCCC) began issuing water credits in 2014 to incentivize ... Read More

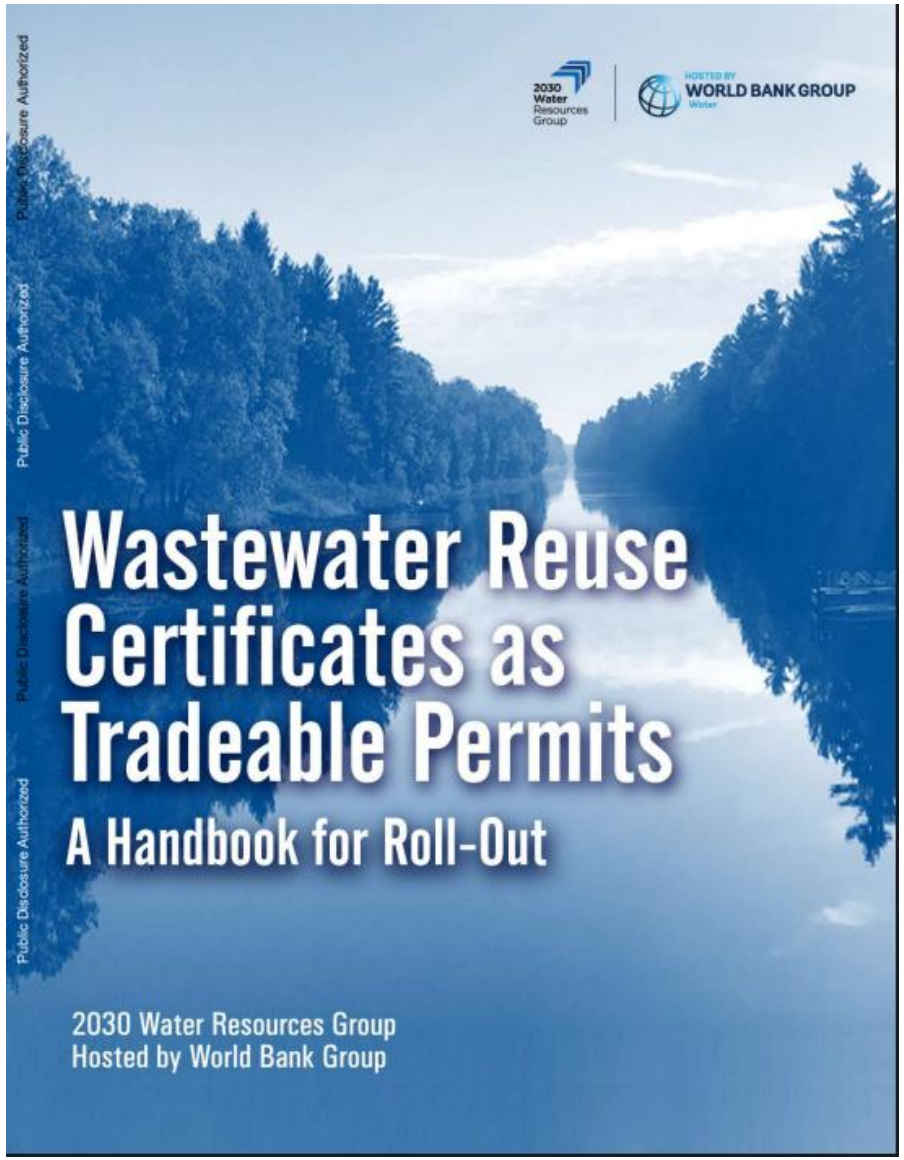
Hasnapur water reservoir in Junagadh

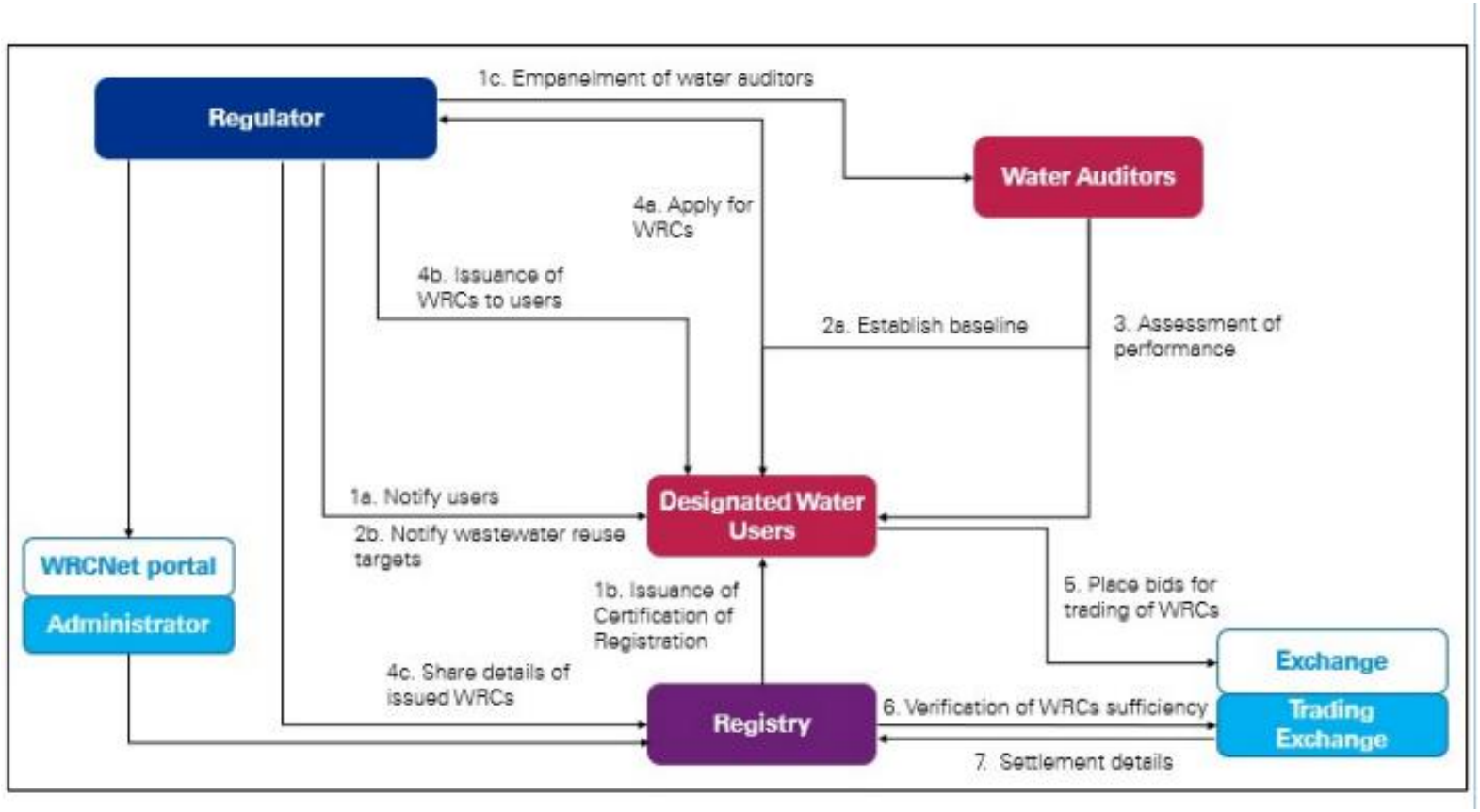
RAJKOT: Harvesting rainwater can not only quench thirst, but this elixir of life can also help coffers swell.
The Junagadh Municipal Corporation (JuMC) has cashed in on the heavy rainfall and become the first civic body in India to earn water credits. As part of global efforts to save fast-depleting

A water-surplus entity (or municipality) generates credits by conserving water. Water-deficit entities (such as industries) buy these credits to offset their consumption and meet sustainability goals.



Wastewater reuse certificates





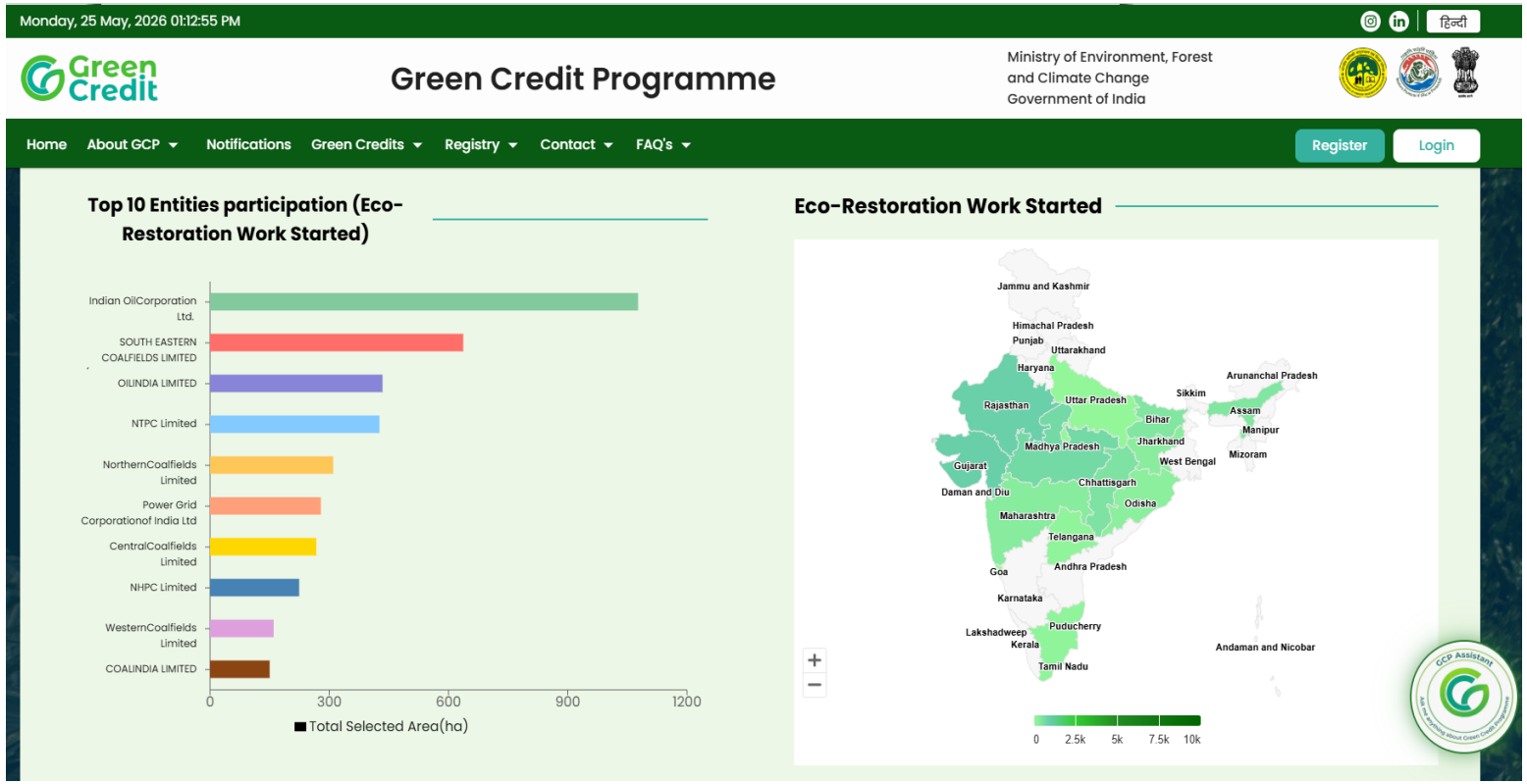
Reference
https://documents1.worldbank.org/curated/en/321971634109366996/pdf/Wastewater-Reuse-Certificates-as-Tradeable-Permits-A-Handbook-for-Roll-Out.pdf

Green Credit Programme by MoEFCC

Green Credits (GCs) are a form of environmental rewards that represent the positive environmental actions awarded to entities who participate in tree plantation initiatives under the Green Credit Program.

Green Credit covers a broader range of environmental activities — such as tree plantation, water conservation, waste management, and pollution reduction — that improve overall ecological health.

Reference https://www.moefcc-gcp.in/



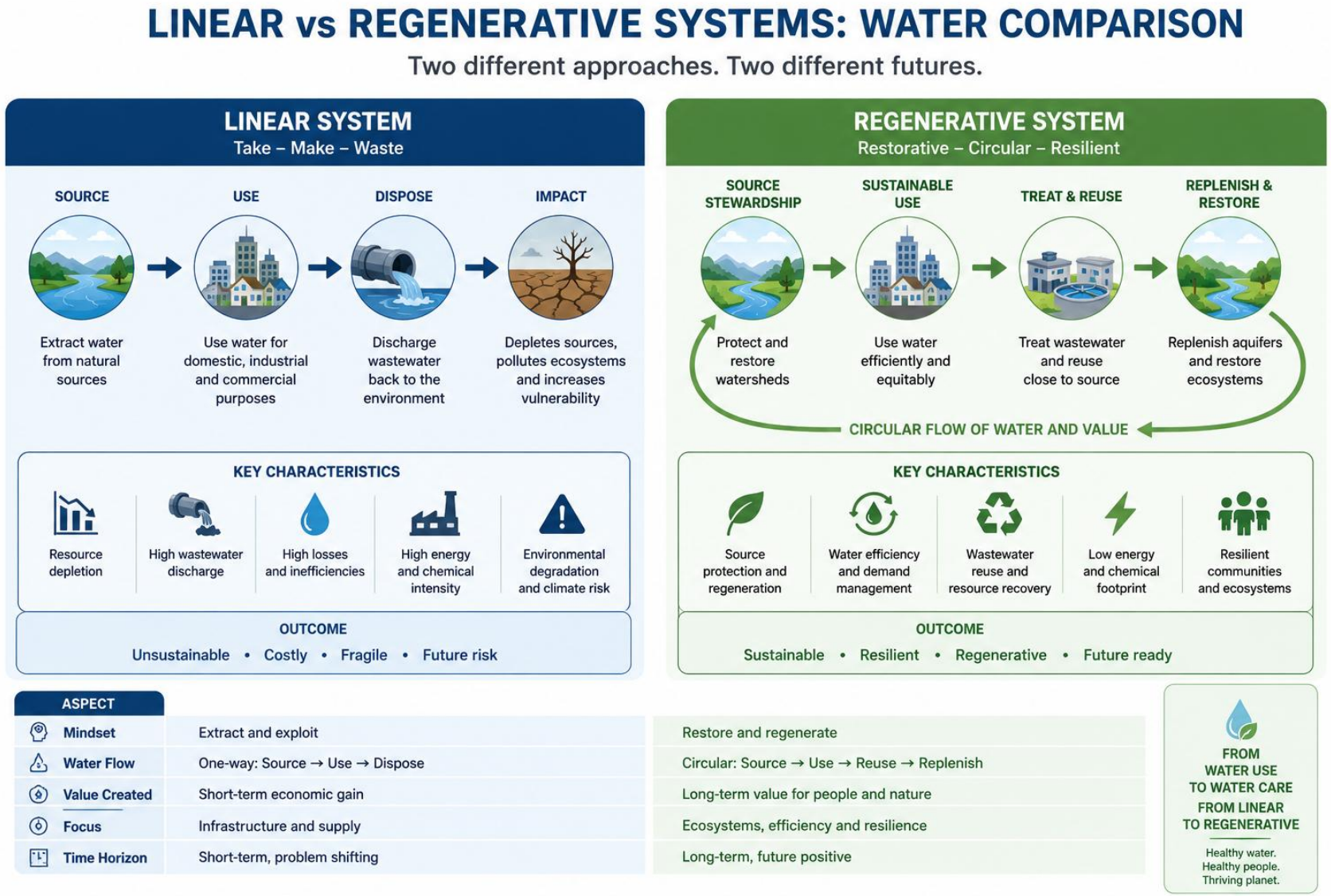
Moving towards water neutrality to water positive

Water Neutral

- Reducing demand
- Improving efficiency
- Balancing operational consumption

Water Positive

- Replenishing water systems
- Restoring aquifers
- Increasing reuse
- Improving watershed resilience



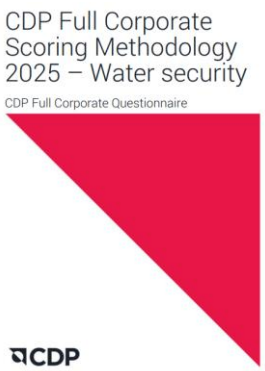
AI-generated visual conceptualised by CWAS team

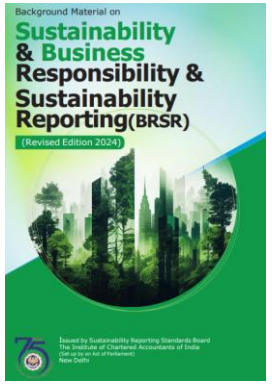
ESG and water stewardship

Increasing Expectations Around:

- Water disclosure
- Resource efficiency
- Climate resilience
- Supply chain sustainability
- Responsible sourcing

Relevant Frameworks





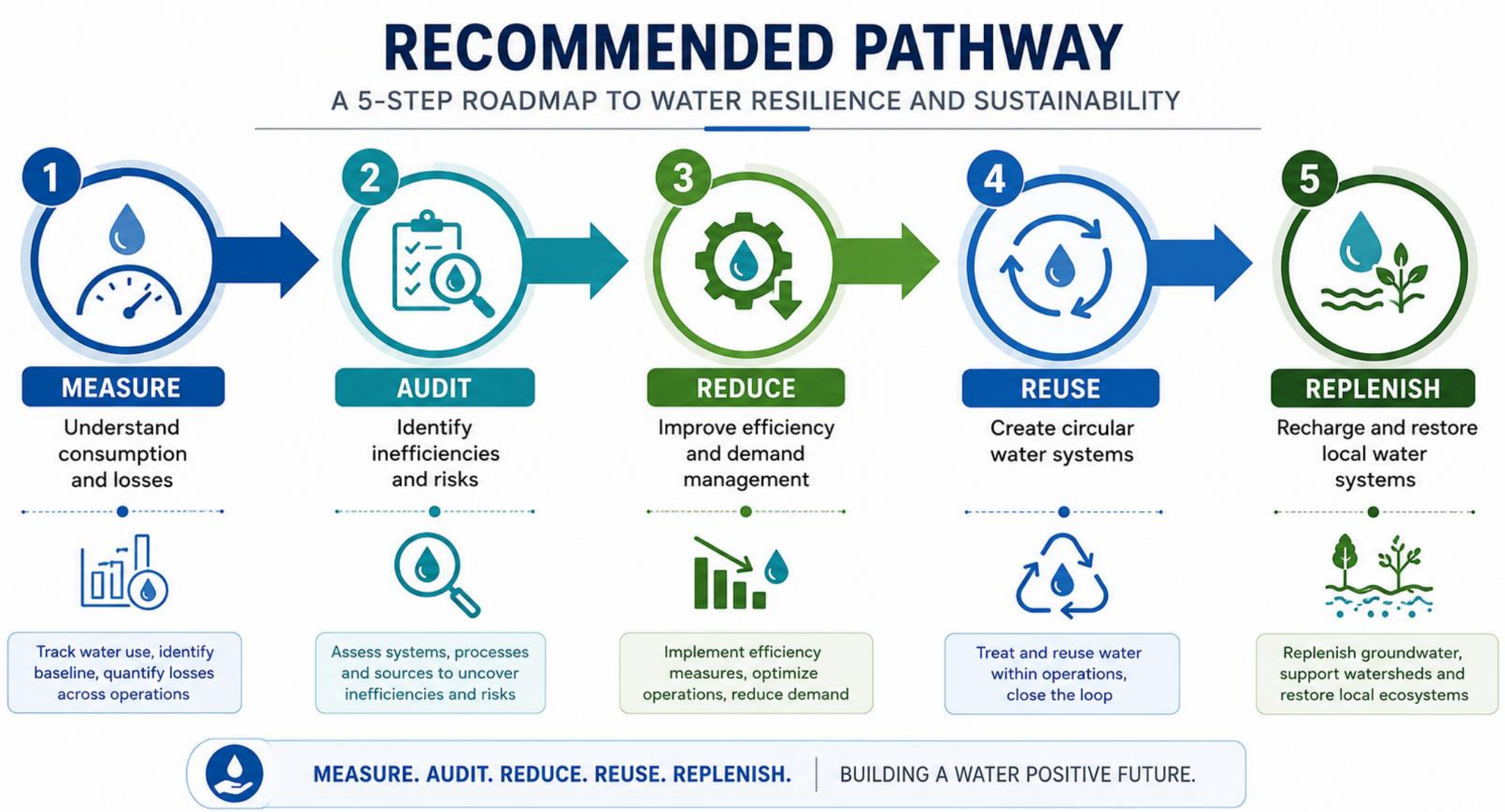
AI-generated visual conceptualised by CWAS team

Institutionalise the new thinking is need of the hour…

Old	New Thinking
Human waste is a nuisance	Human waste is a resource
Storm water is a nuisance	Storm water is a resource
Build to meet the demand	Manage demand
Demand is a matter of quantity	Demand is multifaceted
One use (throughput)	Reuse and reclamation
Grey infrastructure	Green infrastructure
Bigger/centralised is better	Small/decentralised is possible, desirable
Use standard solutions	Allow diverse solutions
Integration by accident	Design physical & institutional integration
Collaboration = public relations.	Collaboration = engagement.

Source: Pinkham, R. (1999). *21st Century Water Systems: Scenarios, Visions, and Drivers,.* Mountain Inst., Snowmass, Colorado

The future of business resilience will depend on water resilience...



AI-generated visual conceptualised by CWAS team

Key actions…

1. How can better water management improve business competitiveness and profitability? **Focus on efficiency, reuse, cost savings, and long-term resilience.**

2. What role should businesses play in achieving India's water security and sustainability goals? **Moving from compliance to responsible water stewardship.**

3. How are regulations, ESG expectations, and global supply chains changing water practices? **Aligned with emerging policy and global benchmarks.**

4. What partnerships and innovations are needed to secure water for future business growth in India? **Exploring collaboration, technology, recycling, and circular water systems.**

Thank you

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About us

The Center for Water and Sanitation (CWAS) is a part of CEPT Research and Development Foundation (CRDF) at CEPT University. CWAS undertakes action-research, implementation support, capacity building and advocacy in the field of urban water and sanitation. Acting as a thought catalyst and facilitator, CWAS works closely with all levels of governments - national, state and local to support them in delivering water and sanitation services in an efficient, effective and equitable manner.

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Further Learning & Resource Videos

Catch the rain - https://www.youtube.com/watch?v=plZiE3XLArU

Rainwater Harvesting - https://www.youtube.com/watch?v=yINR0rZm7vU

Making 50 Villages Secure for Drinking Water - https://www.youtube.com/watch?v=YfJz7cH_59s