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The Hydrological Inflection Point

Corporate Stewardship, Market Mechanisms and Climate-Resilient Landscapes

March 2026

Drafted by
Intueri Consulting LLP

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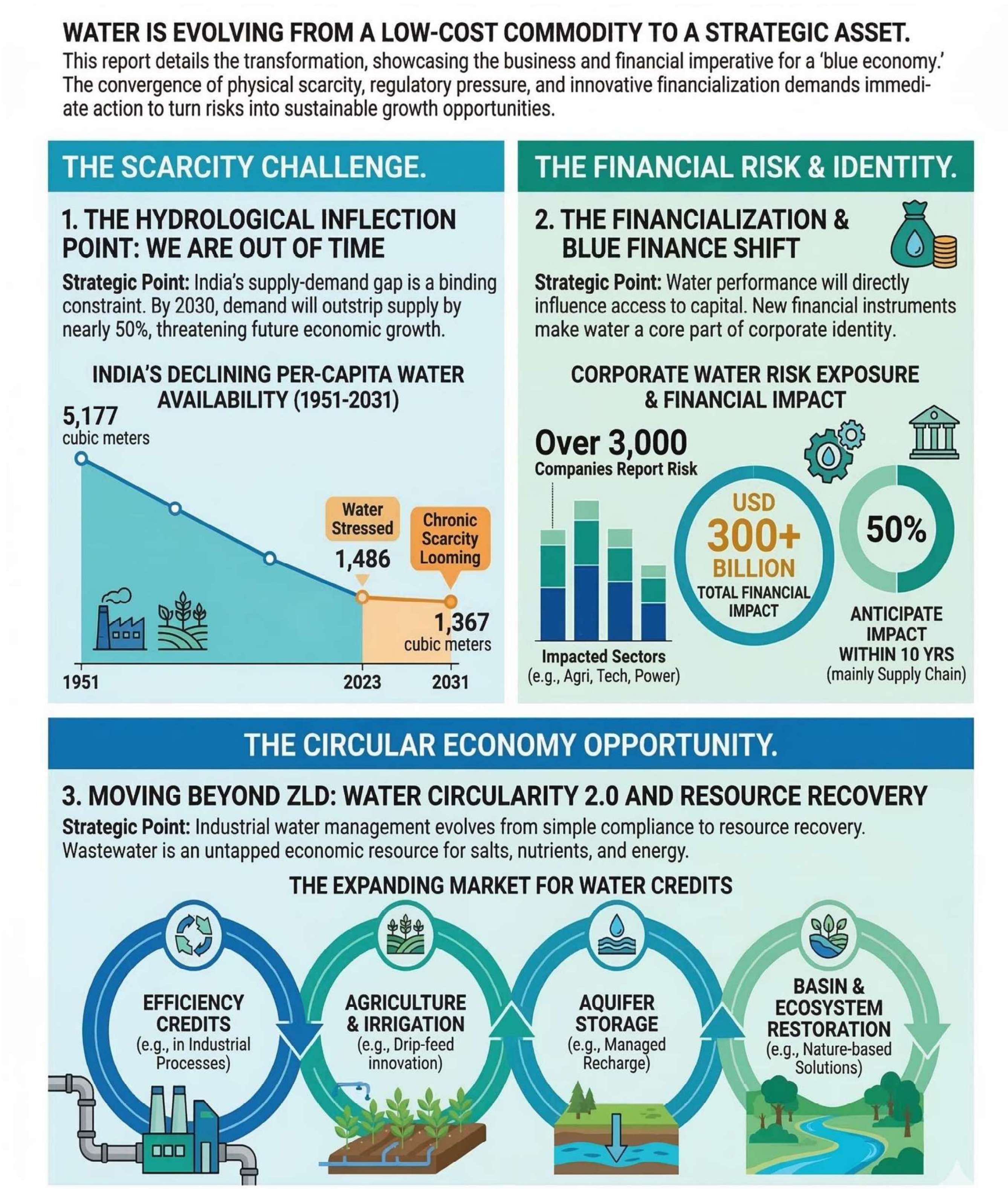
Key Trends at a Glance



Section 1: Executive Summary

India is approaching a hydrological inflection point, a moment where water availability, climate variability, industrial expansion and agricultural demand intersect in ways that will define the trajectory of economic growth over the next decade. Collapsing groundwater tables, shrinking rivers and the increasing perception of water as free and exhaustible could make water security as one of the most binding constraints on India's economic and human development. (Policy Insights for Informal Governance)

These trends indicate that water management is no longer simply a matter of environmental compliance. It has become a strategic determinant of industrial competitiveness, agricultural productivity and economic resilience.

This knowledge paper explores how India is transitioning toward a new water paradigm defined by five structural shifts:

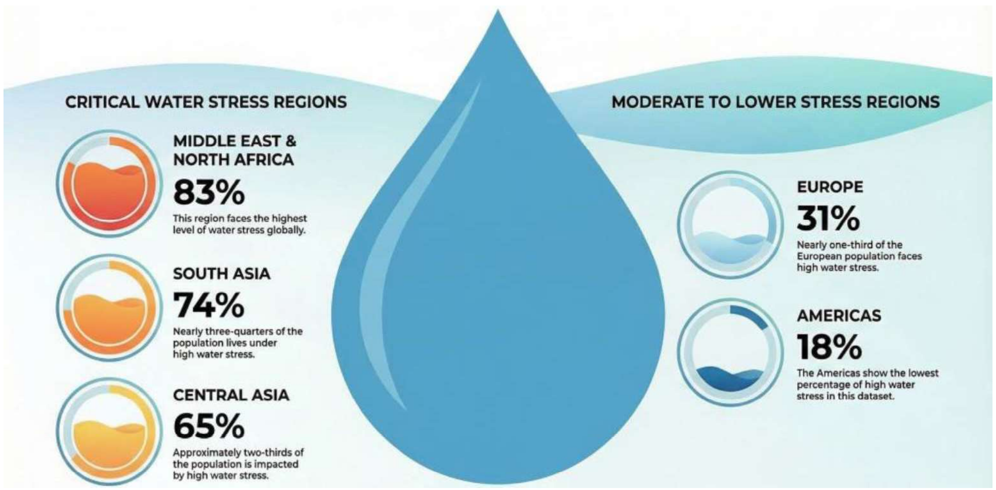
1. Regenerative watershed stewardship
2. Circular water systems and resource recovery
3. Market mechanisms such as water credits
4. Digital governance using AI and IoT
5. Agriculture–industry symbiosis

Together, these shifts signal the emergence of a new "blue economy" framework, where water is managed not merely as a resource but as a strategic asset requiring stewardship, measurement and investment.

Section 2: Introduction

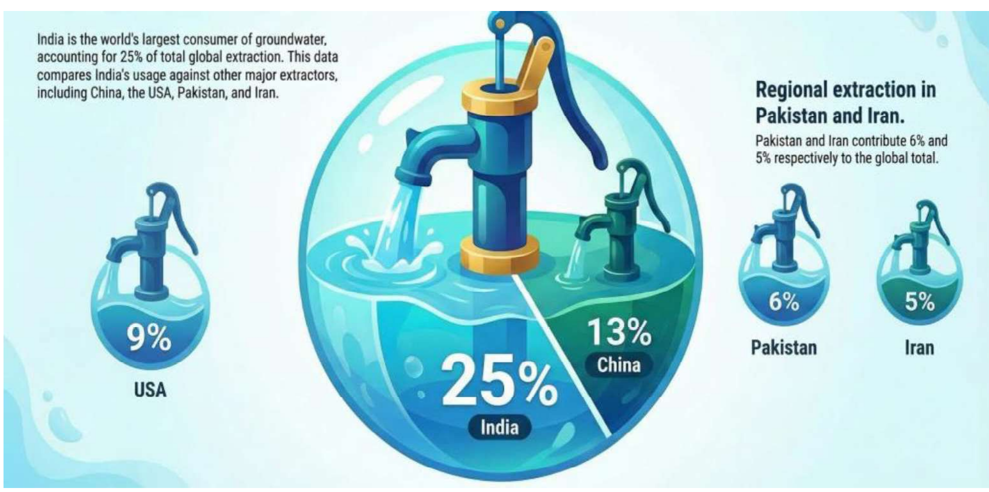
Despite supporting nearly 18% of the global population, India possesses only around 4% of the world's freshwater resources. A t the same time, the country has become the largest extractor of groundwater globally, accounting for roughly 25% of total global g roundwater withdrawals (Food and Agriculture Organization; World Bank). Falling under the "water-scare" categories, water scarcity in India poses imminent threats and could lead to potential conflicts that has a deep-arching impact on different aspects of life ranging from personal consumption to industrial availability. Water being a core economic necessity, therefore must become one of the focal points of present and future sustainability discussions.

Global Water Stress Distribution



Source: World Resources Institute – Aqueduct Water Risk Atlas

Groundwater Extraction: India vs Global

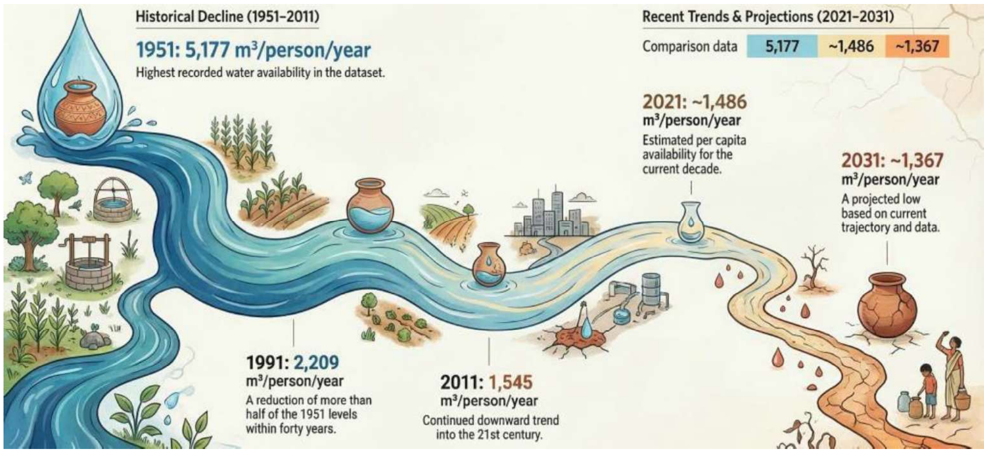


Source: Food and Agriculture Organization

The statistics reflect a deeper structural insufficiency that characterizes India's water profile.

- India's per-capita water availability has declined from 5,177 cubic meters in 1951 to about 1,486 cubic meters today, placing the country in the "water-stressed" category (Ministry of Jal Shakti).

India's Declining Per Capita Water Availability



Source: Ministry of Jal Shakti

- Agriculture consumes nearly 80–85% of total freshwater resources, creating systemic pressure on urban and industrial supply (Food and Agriculture Organization).

India's Water Consumption by Sector

Source: Food and Agriculture Organization – AQUASTAT

- Approximately 600 million Indians face high to extreme water stress (NITI Aayog).

This structural insufficiency is further complemented by climate change which only contributes to hydrological volatility. Climate change has the capacity to cause significant shits in the spatial and temporal patterns of precipitation which can cause unprecedented challenges for water resource management on local and regional scales (The Impacts of Climate Change on the Hydrological Cycle and Water Resource Management, MDPI). Altering rainfall patterns, accelerating groundwater depletion and increasing the frequency of extreme weather events has consolidated the pressing water availability crisis that India has to face (Intergovernmental Panel on Climate Change).

India's Hydrological Inflection Point

Water scarcity in India is not simply a question of insufficient rainfall; rather, it reflects a combination of structural in efficiencies, policy distortions and climate variability.

Three structural dynamics are particularly significant.

Groundwater Dependence

Groundwater is a major lifeline for India's water utility with agriculture and drinking water drawing heavily from its underg round deposit. The International Water Management Institute estimates that approximately 65% of irrigation, 85% of rural drinking water and 45% of urban water supply is derived from groundwater systems. However, groundwater extraction in many regions now exceeds recharge capacity, leading to falling aquifer levels and rising pumping costs. The heavy dependence on groundwater resources has resulted in strained conditions in several regions such as Delhi, Gujarat, Punjab, Haryana and Bengaluru. The demographic, therefore, ref lects both agriculture-friendly regions and urban setups facing an aggravated crisis. Over-extraction due to excessive pumping, often driven by unregulated agricultural practices and increasing water demands, has led to a decline in water tables in various regions. The depleting groundwater resources has become a major cause of concern for India's overall growth.

Agricultural Water Intensity

Agriculture accounts for most of the water consumption in India. With a large section of the Indian population depending on a griculture as their primary source of livelihood, the availability of water becomes a crucial crisis requiring policies to go beyon d short-term solutions and incorporate a more long-term approach to India's water-management structure. Traditional flood irrigation methods result in substantial water losses, while crop patterns often prioritize water-intensive crops such as rice and sugarcane in regions that are naturally water-scarce.

The adoption of micro-irrigation technologies represents a critical shift toward sustainable agriculture, capable of slashing water use by 330-70% while increasing productivity. The need is to maximize evert drop and helping farmers lower their operational costs. In water-scarce regions, this efficiency does more than saving a resource and ensures long-term food security and allows cultivation of high-value crops.

Climate Variability

Climate change is intensifying both droughts and extreme rainfall events, complicating water management strategies. The Intergovernmental Panel on Climate Change has warned that South Asia will face increasing water variability and heightened ri sks to agriculture and water infrastructure. Therefore, climate resilient water governance must acknowledge how water systems follow hydrological boundaries. Ecological health of water and existing water basins must evolve into empowered climate-adaptation platforms, with legal authority, multi-state financing, and real-time hydrological data (Observer Research Foundation). In such pressing times governments, corporations and communities have moved toward new models of water governance and stewardship.

Climate Change and Water Risk

Source: Intergovernmental Panel on Climate Change

Section 3: Beyond the Fenceline: Regenerative Water Stewardship

Water scarcity is a growing challenge for businesses, with the global demand projected to exceed supply by 40% by 2030. Companies that fail to manage water risks face financial losses, operational disruptions, and reputational damage (UN Global Compact). Water is being reported as a material risk for the private sector. Water risks like scarcity, floods and droughts can cause operational and supplier disruptions, higher operational costs, brand damage and heightened regulatory uncertainty becoming a larger economic threat not only to the business but also to people dependent on them (World Resources Institute).

Corporate Water Risk Exposure

Source: CDP – Water Security Report

Corporate water management historically focused on improving efficiency within factory boundaries. The emerging paradigm of watershed stewardship is where companies engage with the broader hydrological landscape in which they operate. Water stewardship is the responsible use and management of water in a socially equitable, environmentally sustainable, and economically beneficial way. It takes a stakeholder-inclusive approach, addressing water challenges at both the site and catchment levels. A combination of essential practices ranging from water audits, rainwater harvesting, water recycling, low-flow fixtures and smart meters will have to play a key role in bringing forth the transition from water neutrality to water positivity.

Water stewardship aims to take water management practices beyond the factory boundaries and create support for the broader ecosystem by replenishing water consumed by operations. The ultimate objective is to restore more water to ecosystems than is withdrawn. This becomes a monumental feature for communities at large as well who are dependent on water for their home and beyond.

COCA-COLA'S WATER RESILIENCE STORY

The Challenge:

Operating in water-stressed regions, Coca-Cola faced significant operational risks and reputational pressure regarding local groundwater depletion. In India, this led to legal challenges and the closure of a major bottling plant.

The Strategy:

The company launched a "Water Neutrality" initiative focused on:

Replenishment: Returning 100% of the water used in finished beverages to nature and communities.

Internal Efficiency: Reducing the "water-use ratio" by upgrading manufacturing equipment.

Sourcing: Requiring suppliers to adhere to strict sustainable agriculture standards.

The Impact:

100% Water Neutrality: Achieved five years ahead of the 2020 goal.

Efficiency Gains: Improved water efficiency by 20% across global operations.

Risk Mitigation: Stabilized supply chains and rebuilt community trust in high-risk watersheds.

These initiatives generate shared value by:

1. Improving groundwater recharge

The rate of recharge exceeds the rate of extraction in high-stress aquifers. In 2024, Coca-Cola returned 157% of the water used in its finished beverages back to nature and communities (Coca-Cola Sustainability Update)

2. Strengthening rural livelihoods

Water circularity and regenerative management serve as catalysts for gender equity by stabilizing local water tables and "buying back" time for women previously lost to the burden of fetching water. This transition transforms women from passive water carriers into active managers and entrepreneurs, creating new livelihoods in recycling operations and high-value agriculture. Ultimately, these decentralized systems lift rural communities out of the "poverty trap" by converting unpaid labor into productive economic resilience.

3. Stabilizing agricultural productivity

Agriculture accounts for roughly 92% of Coca-Cola's total water footprint. Improved irrigation efficiency and replenishment projects have allowed farmers to move from one crop per year to 3-5 crops per year in areas like Rajasthan and Uttar Pradesh (TheCSRUniverse: "Coca-Cola India Initiatives" (March 2025); CCEP Annual Report 2024.)

4. Enhancing long-term water security for industry

For a business, water risk is a financial risk. Inaction on water security can cost companies more than the cost of implementing management strategies.

Increasingly, corporate water stewardship strategies are structured around a 5R framework:

1. **Reduce:** Minimize operational water intensity by optimizing processes and upgrading to high-efficiency infrastructure.
2. **Reuse**: Capture and redirect process water within the same application to lower the demand for fresh intake.
3. **Recycle**: Treat wastewater to meet quality standards for secondary uses, such as cooling, irrigation, or sanitation.
4. **Replenish**: Restore local watersheds by returning a volume of water to nature equal to or greater than what is consumed.
5. **Report**: Disclose water performance and risk data transparently to build stakeholder trust and meet ESG standards.

The addition of "Reporting" reflects the growing importance of transparent disclosure through ESG frameworks such as GRI 303 and BRSR Core.

Section 4: Water Circularity 2.0: From ZLD to Resource Recovery

Industrial water management has traditionally focused on Zero Liquid Discharge (ZLD) systems that prevent untreated wastewater from entering natural ecosystems. ZLD is a strategic wastewater management system that eliminates industrial wastewater discharge into the environment completely. It works as a closed-loop cycle that treats wastewater through intensive recycling, recovery, and reuse processes for industrial applications. Large scale water scarcity, long-term economic considerations and environmental compliance become important factors making industries adopt ZLD. ZLD becomes a strategic advantage for compliance, sustainability goals, and long-term water security.

In the evolving landscape of sustainable engineering, Zero Liquid Discharge (ZLD) has transitioned from a regulatory compliance tool to a sophisticated cornerstone of the circular economy. By integrating high-recovery membrane filtration with advanced thermal evaporation and crystallization, industrial facilities are now able to reclaim up to 99% of their effluent as high-purity distillate. This "new" water is uniquely suited for demanding thermal applications; because it is virtually free of scale-forming ions like calcium and silica, it serves as an ideal makeup source for high-efficiency cooling towers and HVAC systems, where it minimizes blowdown and prevents the fouling of heat exchangers. Furthermore, by capturing the latent heat during the ZLD evaporation phase through technologies like Mechanical Vapor Recompression (MVR), plants can repurpose thermal energy back into district heating or industrial pre-heating cycles, effectively turning a wastewater liability into a high-value thermal and hydraulic asset.

While effective in pollution control, ZLD systems often consume significant energy and may not capture the economic value embedded in wastewater streams. The emerging model, Water Circularity 2.0, focuses on resource recovery.

Wastewater can contain valuable materials such as:

- industrial salts
- nutrients like nitrogen and phosphorus
- organic matter that can generate biogas.

The United Nations Environment Programme has highlighted wastewater as a largely untapped economic resource capable of supporting circular industrial ecosystems. Wastewater is an undervalued and sustainable source of water, energy, nutrients and other recoverable by-products, rather than something to be despised of. Improved wastewater management can generate social, environmental and economic benefits essential for sustainable development and is essential for achieving the 2030 Agenda for Sustainable Development.

Industrial Water Capacity Potential

Source: UN Environment Program

In industrial clusters, shared treatment infrastructure can enable industrial symbiosis, where the output of one facility becomes the input for another. Wastewater can play a critical role in the context of a circular economy; whereby economic development is balanced with the protection of natural resources and environmental sustainability. Such systems significantly reduce freshwater demand while lowering operational costs.

Section 5: The Financialization of Water

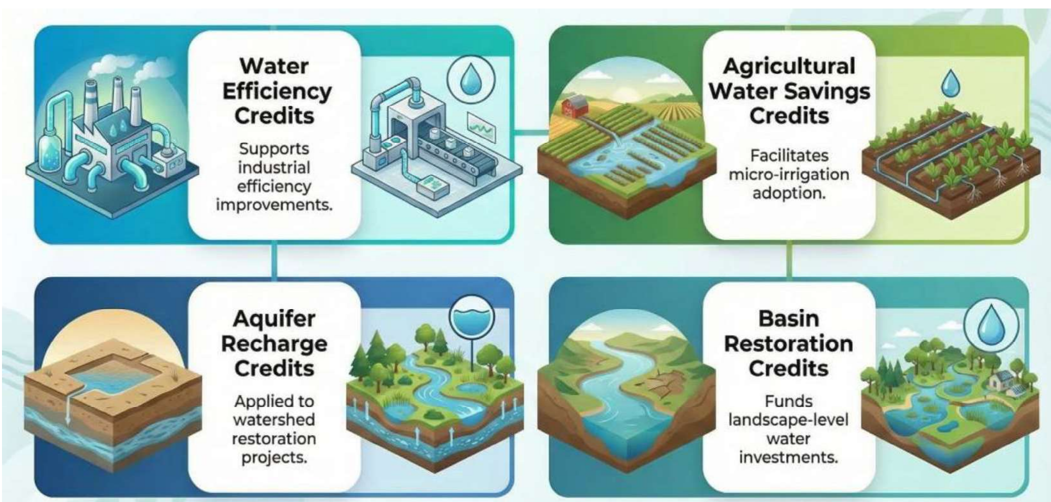
Water is increasingly being understood not only as a natural resource but also as an economic asset requiring governance, valuation and market mechanisms. The valuation of water helps us understand what it creates for a business, the health it provides to a community, and the cost of the disaster, and the cost of the disaster that would happen if it ran out. Governance structures help water management to become a coordinated plan where laws and policies determine the distribution and use of water. The idea is to turn water efficiency into a competitive advantage that rewards those who use the resource most wisely.

As water scarcity intensifies, the utility of water is being fundamentally redefined from a low-cost commodity to a high-value strategic asset essential for industrial continuity. India's water demand is projected to double and outstrip supply by nearly 50 % by 2030, leading to a "blue economy" framework where market incentives and transparent pricing are increasingly used to drive efficiency. Industrial water tariffs are reflecting this shift; for instance, the Maharashtra Industrial Development Corporation (MIDC) implemented a 10% tariff hike effective September 1, 2025. Furthermore, the tightening of Zero Liquid Discharge (ZLD) mandates and the emergence of market-driven mechanisms like Water Green Credits mean that companies failing to optimize usage will face not only higher direct costs but also steep regulatory penalties.

Water Credits

Water credits are emerging as a potential mechanism analogous to carbon credits. It refers to a strategic approach designed to manage and allocate water resources more effectively. It involves the use of water credits as a tool to promote water conservation, improve efficiency, and address water scarcity issues. The broader approach of the Indian government is to enhance water resources management and address challenges faced by water scarcity.

Water Credit Market Potential



Source: World Bank – Water Economics Research

The Indian government's Mission LiFE initiative has introduced Water Green Credits, modelled after carbon credits, to promote water conservation, rainwater harvesting, and efficient usage. This market-driven mechanism aims to address India's alarming groundwater depletion by incentivizing industries, farmers, and individuals to optimize water use and trade conservation credits. Under the system, companies that improve water use efficiency or restore aquifers can generate verified savings that can potentially be converted into tradable credits.

The different mechanisms through which water credits work include:

1**. Water Credit Mechanism:** This involves the issuance and trading of water credits**.** The mechanism allows individuals and organizations to earn credits through water-saving actions, which can then be traded or used to offset water usage.

2**. Irrigation Credits:** In the agricultural sector, irrigation credits are used to incentivize farmers to adopt efficient irrigation practices. This includes technologies such as drip irrigation and sprinkler systems that reduce water wastage.

3. **Water Efficiency Programs**: The policy supports various water efficiency programs aimed at improving the efficiency of water use in different sectors. These programs often involve the implementation of new technologies and practices that help conserve water.

4**. Policy Guidelines**: The Government provides detailed policy guidelines to ensure effective implementation of the Water Credit Policy. These guidelines cover aspects such as eligibility for credits, measurement and verification of water savings, and the trading of credits.

5**. Water Credit Framework:** The Water Credit Framework outlines the structure and operational aspects of the policy. It includes rules and procedures for the issuance, trading, and monitoring of water credits.

The Bureau of Water Use Efficiency, established under India's National Water Mission, has proposed sectoral efficiency improvements of around 20% across water-intensive industries. Market-based incentives such as water credits could accelerate adoption of efficient technologies while mobilizing private investment in watershed restoration.

The Future of Water Markets in India

India's water governance system has historically been dominated by administrative allocation and regulatory control. The evolution of India's water economy is underscored by a significant transition in investment structures, moving from conventional Public-Private Partnerships (PPPs) toward the Hybrid Annuity Model (HAM). Earlier longitudinal assessments by Intueri identified that while the sector was once defined by nascent market stages and occasional distressed sales in Build-Own-Operate-Transfer (BOOT) projects, the current shift toward annuity-based models has drastically de-risked developers and lenders. This institutional maturity is reflected in the improved financial health of core EPC players and the rising interest from global private equity and foreign investors, signaling the imminent emergence of a viable secondary market for water assets.

However, as water scarcity intensifies, there is growing interest in market-based mechanisms that can allocate water more efficiently. Several emerging trends suggest that water markets may become a defining feature of India's water economy.

1. Tradable Efficiency Credits

Similar to the Carbon Credit Trading Scheme, water-efficiency markets could allow industries that exceed mandated water-efficiency targets to generate tradable credits. Such credits would incentivize technological innovation and conservation investments.

2. Watershed Investment Markets

Corporate funding for watershed restoration projects could generate verified recharge credits, allowing companies to offset water consumption. Watershed Investment management could become a strategic business necessity by means of which companies move from being competitors for water to creators of water, securing community trust and regulatory goodwill. Recharging local aquifers ensures that the groundwater your facility relies on remains available during drought years. These mechanisms would also channel private capital toward community-based water infrastructure.

3. Blue Finance Instruments

Financial markets are beginning to recognize water risk as a material factor in investment decisions. Blue Finance is an emerging subset of sustainable finance dedicated to water-related projects. While green finance covers the entire environmental spectrum, blue finance specifically targets ocean health, freshwater sustainability, and coastal resilience.

Potential instruments include:

- sustainability-linked bonds tied to water efficiency targets

- blended finance for watershed restoration
- water-positive corporate bonds.

The World Bank has emphasized that water scarcity could reduce economic growth by up to 6% in some regions by 2050, highlighting the need for innovative financing mechanisms.

Global Investment in Water Infrastructure

Source: Organization for Economic Co-operation and Development – Water Infrastructure Outlook

Section 6: Climate-Resilient Landscapes: Agriculture–Industry Symbiosis

With agriculture consuming a large majority of water resources, long-term water security requires integrated management across sectors. Corporations increasingly recognize that their water risk is closely tied to agricultural practices in surrounding regions.

Regenerative agriculture, therefore, can unlock significant water savings which includes:

1. **Drip Irrigation**

This system uses a network of tubes to deliver water directly to the base of each plant. It ensures giving a plant the precise amount of water exactly where it needs it and prevents waste from evaporation or runoff.

2. **Soil Moisture Monitoring**

This involves using sensors buried in the ground to understand the soil, enabling farmers understand how much water is needed in real-time. This prevents both over-watering and under-watering.

3. **Drought-resilient Crop Varieties**

This helps in the selection of specific types of seeds that scientifically need very little water to survive. They can produce high yield even when the weather is hot and dry.

4. **Watershed Restoration**

This is a nature-based solution that focuses on fixing the surrounding landscape by planting trees and restoring wetlands. The land acts as a sponge through which water soaks into the ground to refill wells rather than just washing away.

These measures can reduce irrigation water consumption while improving farmer incomes and resilience to climate variability. Such strategies also strengthen the sustainability of corporate supply chains.

Section 7: Analytical Framework - The Corporate Water Value Chain

To manage water strategically, corporations must move beyond operational efficiency toward end-to-end water value chain management.

The Corporate Water Value Chain framework can be understood across five stages.

1. Water Sourcing

This stage acknowledges that a company's water supply is only as secure as the ecosystem surrounding it. The water stress of the range of sources from groundwater extraction, surface water withdrawal and municipal supply must be studied. Using tools like Aqueduct Water Risk Atlas developed by World Resources Institute can help companies map physical and regulatory risks and if their current extraction is sustainable for the next decade.

2. Operational Efficiency

Companies are redesigning entire processes to remove water dependency altogether. This includes deploying closed-loop processes where cooling or process water is continuously treated and recirculated, cutting fresh intake by up to 90%. The integration of Digital Monitoring (IoT) helps in instantly flagging leaks or inefficiencies that would otherwise go unnoticed for months.

3. Wastewater Management

Wastewater treatment has evolved from compliance-driven treatment toward resource recovery and circularity. Advanced treatment technologies can convert wastewater into a secondary resource for industrial water while recovering nutrients and energy. High-tech filtration allows plants to reuse their own effluent for non-potable needs.

4. Watershed Stewardship

This encourages collective action which enables companies realise how total water security requires looking beyond the operational boundaries. By investing in Aquifer Recharge Structures, companies put back water into the communal bank. Recharged aquifers stabilize local water table, ensuring reliable water supply for both the factory and the surrounding community during periods of drought.

5. Disclosure and Financial Integration

The final stage is about making water security a part of the company's financial identity. Integration into ESG frameworks such as CDP Water Security, GRI 303, and India's BRSR core helps companies access sustainability-linked loans where interest rates are tied to water reduction targets. This transparency is increasingly linked to Blue Finance which ensures that water performance is visible to investors and lenders.

Together, these stages form an integrated approach to managing water as a strategic resource across the corporate value chain.

Section 8: Policy Insights: Karnataka and Odisha

State-level innovation offers valuable lessons for national water governance.

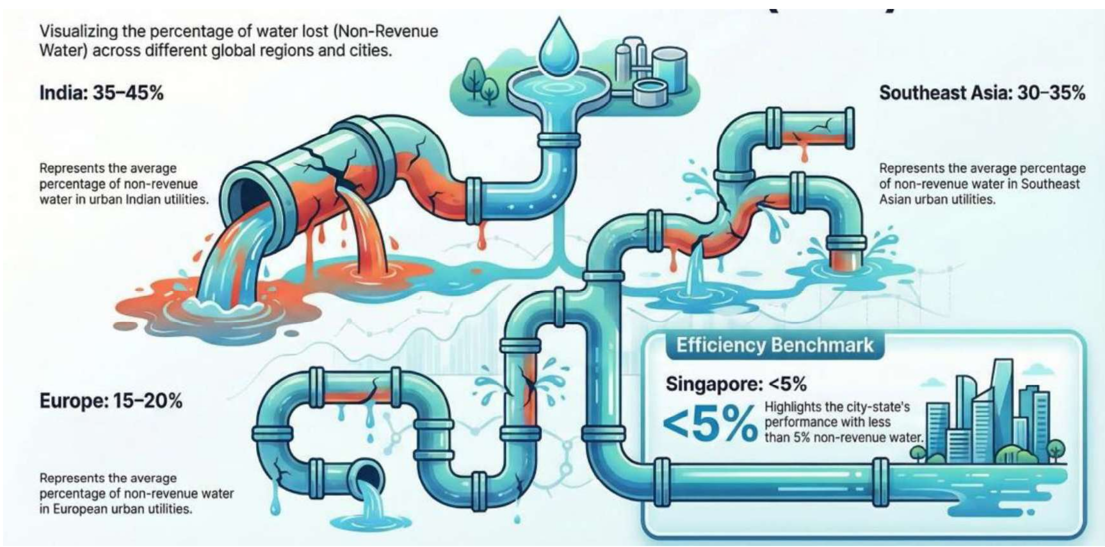
Karnataka

Karnataka has been experimenting with AI-driven water management systems that use sensor networks to detect pipeline leaks and optimize urban water distribution. The Bangalore Water Supply and Sewerage Board (BWSSB) has emerged as a global model for integrating Artificial Intelligence (AI) into urban water management. Developed in collaboration with scientists from the Indian Institute of Science (IISc), the Central Ground Water Board (CGWB), and the Karnataka Groundwater Authority, it promises to revolutionize the monitoring and management of groundwater levels in the city.

The AI-based system will enable real-time data collection, analysis, and reporting, providing comprehensive insights into groundwater availability and trends. BWSSB aims to adopt a targeted approach to water management. Decision-making related to groundwater recharge systems and other water conservation measures will be driven by data, leading to more effective solutions. This initiative will aid in planning and executing groundwater level-rise programmes, optimising resource allocation, and reducing costs. Moreover, it'll provide insights into enhancing groundwater levels in lakes.

Reducing Non-Revenue Water (NRW), water lost through leaks or theft, can significantly improve urban supply without increasing extraction.

Non-Revenue Water in Urban Facilities



Source: World Bank – Urban Water Utilities Performance

Odisha

The Odisha Integrated Irrigation Project for Climate Resilient Agriculture demonstrates how integrated water management can support both rural livelihoods and climate resilience. The project aims at demonstrating climate smart agriculture in irrigation command of about 56,400 hectares of command area under 536 minor irrigation projects and about 70,000 Ha of rain-fed area under the influence area of these Minor Irrigation Projects for augmenting the capacity and income of the farmers in the project area (OIIPCRA).

The project played a crucial role in improving crop productivity and helping farmers adopt resilient agricultural practices and technologies. It also helped in crop diversification, especially during the winter season that helped to adapt to climate change. A better framework for more efficient and sustainable management of surface and groundwater resources helped improve produce marketing in 15 districts in Odisha.

Section 9: Strategic Recommendations and Conclusion

A 2030 Roadmap

1. **Adopt Water Positivity Targets**
   Corporates should move beyond compliance toward net-positive water impact.
2. **Deploy Digital Monitoring Systems**
   AI-enabled monitoring platforms can improve water accounting and transparency.
3. **Develop Cluster-Based Water Infrastructure**
   Shared treatment plants and recharge systems can help MSMEs participate in water stewardship.
4. **Integrate Water into ESG Finance**
   Water performance should increasingly influence access to capital and sustainability-linked financing.
5. **Strengthen Agriculture–Industry Partnerships**
   Supporting water-efficient agriculture can unlock water resources for sustainable industrial growth.

Conclusion

India’s water challenge is entering a decisive phase.

The coming decade will determine whether water scarcity becomes a binding constraint on economic growth or a catalyst for innovation in resource governance and sustainability.

The emergence of water stewardship, circular water systems, digital monitoring technologies and water markets signals a profound shift in how water is valued and managed.

Corporates, policymakers and communities must collaborate to transform India’s water economy, from extraction to regeneration, from scarcity to stewardship.