Revisiting the “Business Case” for Wastewater Reuse in India

Structural Constraints and Lessons from Urban Models

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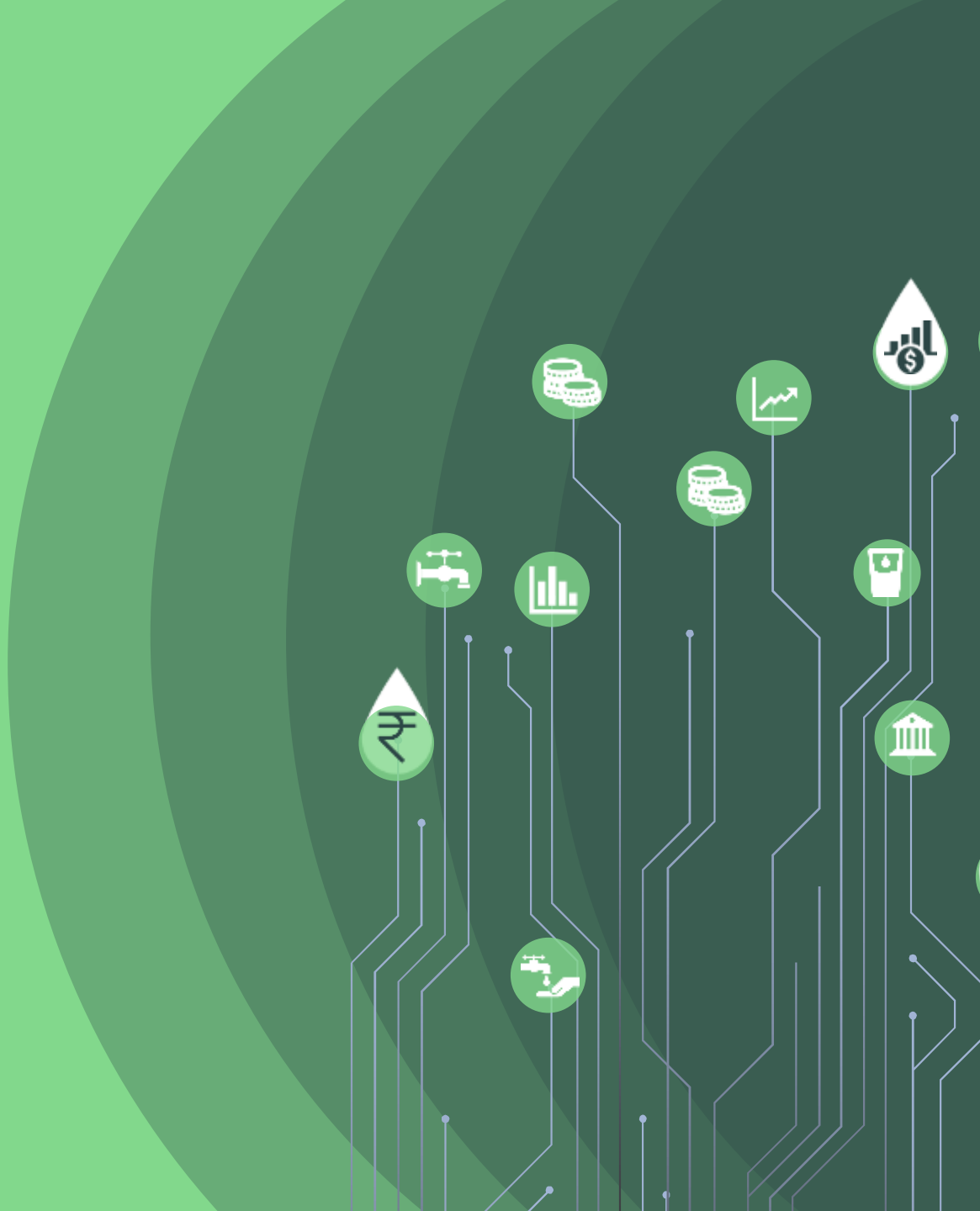

The Urban Water Crisis

The Context

- India's cities are growing faster than their infrastructure can keep up
- Rising wastewater generation vs. rapidly depleting freshwater
- Surface water availability increasingly variable across seasons

The Conflict

- Intensifying competition between urban, peri-urban, and agricultural water users
- Treatment capacity lags generation: most cities that treat, can treat <50% of sewage generated

The Opportunity — and the Risk

- Policy has reframed wastewater as a resource — and a revenue source
- But the 'business case' framing sets expectations that the evidence does not support

Shifting the Paradigm

Traditional View

- Wastewater = a disposal problem requiring public expenditure
- STPs funded by municipal budgets and state grants; no expectation of revenue

Current Policy Framing

- Circular economy narrative: treated effluent as a tradable commodity
- 'Business case': tariff revenues can recover capital and operating costs
- PPP models expected to attract private capital without ongoing subsidy

Critical Question

- Does the evidence support the business case claim?
- This paper systematically tests that claim across seven Indian cities and global benchmarks

Methodology and Case Selection

Analytical Approach

- Secondary data + policy documents from 7 cities: Bengaluru, Ahmedabad, Rajkot, Chandigarh, Surat,
- Nagpur, Chennai
- Financial data for Surat, Nagpur & Chennai
- International benchmarks: Singapore, Israel, Spain, Australia, USA

Four Frameworks

Framework	Core Question	Assessment Dimensions
Cost Recovery as Business Case	Can wastewater sales finance treatment infrastructure without subsidy?	Revenue potential; bankability
Cost Recovery	Can tariffs cover O&M + capital costs?	Financial viability; breaking even
Willingness-to-Pay	Do users demand of reclaimed water at cost-reflective prices exist?	Sufficient price effective demand vs alternatives; trust in quality
Differentiated Tariff	Can tiered pricing cross-subsidise low-value users from industrial revenue?	Cross-subsidy design; enforcement capacity; agreement on fair price
Market Valuation	Can permit-style trading mechanisms create economic incentives for reuse?	Certificates in practice; robust trading mechanism

Literature Review: Infrastructure Governance and Political Ecology

Infrastructure as Politics

- Urban water infrastructure is deeply embedded in political and economic structures
- STPs are built to protect public health + environment — not to generate revenue

Path Dependence

- Major investments shape future governance choices and lock in institutional arrangements
- India's urban water is fragmented: no single agency coordinates across treatment, supply, and, regulation

Function	Agency
STP operation	Urban Local Body / Municipality
Water supply	State parastatal board
Environmental regulation	State PCB / CPCB
Land-use planning	Development authority

Snapshot of Reuse Across Selected Case Cities

City	Generated (MLD)	Treatment Cap. (MLD)	Reuse (MLD)	Main Reuse Sector
Bengaluru	2,000+	1,400	~400	Lake recharge / Industry
Ahmedabad	1,200	900	~80	Agriculture
Chandigarh	300	250	~50	Landscaping & parks
Rajkot	350	316	~17	Lake / Landscaping / Agriculture
Surat	1,100	700	~120	Industrial cooling
Nagpur	525	340	~190	Thermal power plants
Chennai	1,200	700	~150	Industrial supply

Source: CPCB 2021; World Bank 2016; ICRA 2012

The Scale of the Gap

Treatment Does NOT Equal Reuse

- India treats ~28% of sewage generated nationally (CPCB 2021)
- Of treated water, only a fraction reaches formal reuse arrangements
- Most treated effluent is discharged into rivers and drains — or used informally

Why the Gap Persists

- Missing link: dedicated distribution networks for treated effluent
- No tertiary treatment in most plants — quality inadequate even for non-potable uses
- No organised market: buyers, sellers, and contracts rarely aligned

The Informal Reuse Reality

- Peri-urban farmers already use wastewater for irrigation — without contracts or payment
- This informal reuse is larger in volume than all formal reuse schemes combined
- Formalising it is a bigger opportunity than building new commercial schemes

Framework I (Business Case) — The Myth of the 'Self-Financing' STP

Design Intent

- Wastewater reuse projects are 'bankable' without ongoing public subsidy.
- Private capital finances STPs; tariffs/offtake recover CAPEX + O&M.
- Private investors can finance STPs and recoup through user charges.
- Self-financing circular economy model attracts investors.

Challenges in Practice

- Capital Expenditure (CAPEX) are almost always financed by public grants or viability gap funding.
- Full life-cycle costs such as replacement, upgrade, decommissioning rarely included in capex.
- Distribution infrastructure with pipelines to industrial clusters add major cost.
- Quality assurance necessitates monitoring and are expensive add-ons.

Limitation and Opportunity

- 'Business Case' do not account for public benefits 9pollution control) and they remain unpriced externalities.
- 'Cost Recovery' for large sewerage networks require user charges + tax; they could theoretically expand to cover treatment costs on polluter pays principle.

Framework I (Business Case) — Case Study Rajkot JWIL

The Model

- Jindal Water Infrastructure Limited (JWIL) proposed to bear all financial, operational, and revenue risks.
- It was based on their demand estimation of industrial off-take.
- It did not include part charges as sanitation fee from Rajkot residents.

Why It Failed

- Demand estimation in wastewater markets neglects informal existing uses
- Based on polluter pays principle, no revenue generated from wastewater producers
- No CAPEX support was given for treatment or distribution

Item	Value
Proposed STP Capacity	45 MLD BOOT STP
Pre-feasibility Estimated Demand	82 MLD Industrial
Actual Demand (Full Study)	45 MLD (50%short)
JWIL Scaled Back to	5 MLD
Project Outcome	Unviable, Terminated
RMC Action	Rejected, Terminated
JWIL Consequence	Blacklisted
Revenue Risk Model	100% on private partner
Agricultural Reuse	Ignored

Framework I (Cost Recovery) — Mistaken Full Cost Recovery

Design Intent

- Tariffs from treated wastewater sales recover STP O&M costs.
- Partial capital recovery possible via PPPs and long-term industrial contracts.
- Polluter-pays principle enables self-financing via user fees.

Challenges in Practice

- Full life-cycle costs (replacement, upgrades, decommissioning) excluded in O&M cost calculations.
- No domestic contributions; reliant on industrial enclaves which most cities lack.

Limitations and Opportunity

- Partial O&M recovery in select cases, but embedded in public finance.
- Full recovery remains exceptional, not scalable without subsidies.
- Strengthen existing reuse over chasing illusory full recovery.

Framework I (Cost Recovery) — Case Study: Surat, Gujarat

The Model

- Tertiary-treated wastewater sold to Sachin & Pandesara industrial estates
- Long-term bulk contracts with O&M-linked tariffs
- Industries pay Rs. 34.73/kl vs. GIDC freshwater at Rs. 36–49.8/kl

Key Lesson

- Works because saline groundwater leaves no alternative for industry
- Dense co-located industrial cluster is essential — not replicable elsewhere
- CAPEX fully covered by municipal/state grants — excluded from 'success' narrative

Item	Value
Annual OPEX (3 STPs, 314 MLD generated)	Rs. 219.8 crore
Revenue (115 MLD sold)	Rs. 145.8 crore
Operational Deficit	Rs. 74 crore (~34%)
CAPEX Recovery	Zero (public grants)
O&M Cost Recovery	~66% of OPEX only
Tariff to industries	Rs. 34.73/kl
Competing freshwater (GIDC)	Rs. 36–49.8/kl

Framework I (Cost Recovery) — Case Study: Nagpur, Maharashtra

The Model

- India's largest wastewater PPP — 200 MLD BOOT scheme
- Vishvaraj Environment builds & operates; sells to MAHAGENCO thermal plant
- Tripartite agreement: Vishvaraj + MAHAGENCO + Nagpur Municipal Corporation

Why It Works — Preconditions

- Guaranteed anchor buyer (thermal power plant) adjacent to the STP
- Water-scarce Vidarbha region — reclaimed water is Rs. 3.4/m3 vs Rs. 9.6/m3 freshwater
- Viability Gap Funding (VGF) essential — not self-financing
- Cannot be replicated without all three enabling conditions

Item	Value
Total Investment	Rs. 195 crore
NMC Share	Rs. 90 crore
MAHAGENCO Share	Rs. 105 crore
Treated Water Tariff	Rs. 3.4/m³
Freshwater Equivalent	Rs. 9.6/m³
Annual Revenue to NMC	Rs. 17 crore
O&M Cost (SMS Envocare)	Rs. 11/KLD
O&M Cost Recovery	70–80%
CAPEX Recovery	Partial (via VGF)
Freshwater Substituted	190 MLD

Framework II (Willingness to Pay) — Fallacy of Demand-Driven Reuse

Design Intent

- User demand drives uptake when reclaimed water is cheaper than alternatives.
- Reliability of wastewater availability will ensure demand.

Challenges in Practice

- Low and politically-constrained freshwater tariffs reduce the price differential.
- Tariffs set are below treatment costs (Rs 7- 30kl) (Treatment cost Rs 43 kl)
- Poor reliability of reclaimed water supply — industries cannot depend on it.
- Quality uncertainty: reclaimed water quality varies and is often unverified.

Limitations

- Genuine WTP emerges only under scarcity or mandates.
- Users shift demand based on price signals.
- Trust deficits cap payments regardless of quality.
- Not a potential stand-clone case of market.

Framework II(Willingness-to-Pay) — Case Studies: Ahmedabad, Chandigarh, Bengaluru

WTP Comparison Across Cities

- In all three cities, reclaimed water is priced below treatment cost — none approaches cost recovery

City	Reclaimed Water Price	Competing Alternative	Outcome
Ahmedabad (Gujarat)	₹43/kl (initial proposal, rejected) ₹30/kl (revised; AMC forced below cost)	Groundwater ~₹17/kl (incl. pumping & treatment)	Industries rejected ₹43/kl; price gap vs. groundwater made reuse uneconomical
Chandigarh (UT)	₹7/kl (proposed nominal tariff)	Subsidised utility supply; low municipal tariffs	Flat charges below treatment cost; uptake limited to non-potable uses
Bengaluru (Karnataka)	~50% of Cauvery potable tariff (discounted; not cost-recovering)	Groundwater + low-cost Cauvery utility supply	~1,300 MLD from 34 STPs mostly not reused; weak demand from residential & industrial users

Framework III (Differential Tariff) — Delusion of Equitable Pricing Slabs

Design Intent

- High tariffs for industrial users generate revenue surplus
- Surplus cross-subsidises low-cost or free supply to agricultural / public users
- Designed to balance revenue generation with social equity and large reuse volumes

Challenges in Practice

- Most cities have not achieved industrial volume large enough to generate surplus revenues.
- Agricultural demand exists but cannot pay rates that cover treatment costs.
- Misdirects subsidies without diverse users.
- Volume low-income users such as agriculture market are untapped due to precautionary perceived health impacts.

Limitation and Opportunity

- Peri-urban agriculture: large volume, existing informal use, lower price tolerance
- Israel model: state ensures low agricultural tariffs while subsidising infrastructure
- India: potential exists but requires formal contracts + affordable tariff bands for farmers

Framework III (Differential Tariff) — Case Study: Chennai (CMWSSB)

What Makes Chennai Different

- India's only city with a systemised multi-tier differential tariff
- Sewerage billing integrated with property tax: 7% annual rental value
  - 1.5% water tax + 5.5% sewerage tax on assessed value
- ~60% O&M recovery — highest among major Indian metros

Enabling Factors

- Anchor industrial buyers: CPCL, Madras Fertilisers, Madras Petrochem
- State backing essential — not a standalone commercial model
- Domestic users receive no reclaimed water

Revenue Stream	Amount
TTRO water — Manali industries	Rs. 80/kl
TTRO water — SIPCOT parks	Rs. 65/kl
Secondary-treated (gardening)	Rs. 1.80 cr/month
Total TTRO revenue (2020–2026)	Rs. 550.56 crore
Freshwater saved	74,249 million litres
Monthly TTRO income	Rs. 7.63 crore
Property tax sewerage component	7% of annual rental val.
Overall O&M cost recovery	~60%

Framework IV (Market Valuation) — Inoperability of Tradable Markets

Design Intent

- Tradable certificates (e.g., Maharashtra WRC) reveal scarcity value.
- Compliance trading incentivizes over-target reuse.
- Enables efficiency via buy/sell between users.

Challenges in Practice

- No active trading, compliance tools only.
- Weak monitoring, reporting, and verification systems.
- Most cities are below basic reuse targets.

Limitation and Opportunity

- Certificate schemes devolve to compliance burdens without liquid markets.
- Requires mature treatment infrastructure first.
- Focus on direct industrial contracts outperforms theoretical markets.

Framework IV (Market Valuation) — Case Study: Maharashtra WRC

Cap-and-Trade Experiment

- Over-compliers earn Wastewater Reuse Certificates (WRC).
- Under-compliers must buy them.
- Assigned reuse targets

How It Is Intended to Work

- Creates incentive for over-compliance through tradable certificates
- Entities with low marginal reuse costs sell to those with high marginal costs

Current Status

- Functions as a regulatory compliance tool — NOT an active price-discovery market
- No documented routine trading of WRCs between cities since launch
- Most ULBs cannot yet meet basic treatment norms, let alone generate surplus WRCs

Item	Detail
Framework Type	Cap-and-Trade (WRC)
Covered Entities	ULBs, MIDC, large industries
Compliance Mechanism	Buy WRCs if under target
Incentive for Over-Compliance	Sell surplus WRCs
Registry / Trading Platform	Central registry; bid-offer match
Active Price Discovery	NOT yet — regulatory tool only
Inter-city WRC Trading	None documented since launch
ULB Treatment Compliance	Most cannot meet basic norms

International Lessons: What Advanced Systems Actually Show

International Systems: What They Actually Show

- In every advanced system, the ‘market’ layer sits atop a foundation of public finance, state coordination, and mandated targets

Country/System	Apparent Model	Reality Behind the Market
Singapore NEWater	Industrial tariff recovery	100% govt-funded infrastructure; national security rationale; tariffs raised in 2017 to fund expansion
Israel	Farmers pay for effluent	State grants finance treatment + conveyance; national law mandates reuse; Mekorot coordinates allocation
USA (industrial)	Long-term supply contracts	Recover only incremental treatment costs; base sewerage is fully public; not full-cost-recovery
Spain / Australia	Large-scale agricultural reuse	Public infrastructure investment; revenues cover marginal costs only; capital publicly subsidised
India (Surat/Nagpur)	Partial commercial recovery	Highly specific conditions; 50%+ revenue gap; capital costs excluded; not replicable without all preconditions

Toward a Reframing: Wastewater Reuse as Public Infrastructure

The Core Argument

- Wastewater reuse in India cannot be a self-sustaining commercial venture
- ‘Business case’ framing overestimates revenue potential and underestimates required public investment

A Public Infrastructure Framing

- Treat reuse revenues as complementary income within a public finance model — not the primary driver
- Integrate tariff design across freshwater and wastewater; plan cross-subsidies explicitly
- Anchor investment in long-term urban water security, not short-term commercial viability

Start With Existing Informal Reuse

- Formalise, strengthen, and price extensive peri-urban agricultural reuse that already exists
- Lower risk: builds on established social and technical arrangements; generates incremental revenue

Cross-Cutting Structural Constraints

Chronic Underpricing

Tariffs rarely cover O&M costs. Political reluctance to raise user charges persists across all cities studied.

Weak Enforcement

Tariff billing integration is limited. Penalties for non-payment or non-compliance are seldom applied.

Low User Trust

Poor service reliability reduces willingness-to-pay. Users prefer cheaper alternatives, especially groundwater.

Regulatory Ambiguity

Absence of enforceable contracts and unclear water rights undermine market-based mechanisms.

High Capital Requirements

Tertiary treatment and dedicated distribution infrastructure require investment that tariffs alone cannot service.

Subsidy Misdirection

Differentiated tariff systems can overburden low-income users and misdirect subsidies away from the needy.

Conclusions

Not Commercially Self-Sustaining

- Persistent underpricing + political resistance to tariff reform in all case cities
- Limited high-value industrial demand outside a few geographic enclaves (Surat, Nagpur, Chennai)

Public Good, Not Private Commodity

- Treatment generates broad public benefits not capturable through market pricing alone
- International evidence (Singapore, Israel, US) confirms this even in the most advanced settings

Revenues as Complement, Not Driver

- Reuse revenues play a complementary, not dominant, role in the overall financing architecture.

Policy Directions

- Formalise existing informal reuse first; integrate wastewater + freshwater tariff reform + property tax
- Plan cross-subsidies to include agriculture and low-income users; invest in governance infrastructure first
- Treat reuse revenues as complement to — not substitute for — public investment in urban water security

Thank You

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