



Governance Strategies for Sustainable Urban Freshwater Resources in Telangana

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Abstract:

Telangana's rapid urbanisation has placed severe pressure on its freshwater ecosystems, exacerbating the demand-supply gap, accelerating lake encroachments, and deepening groundwater depletion across major urban centres. The paper reviews how to govern and implement strategic interventions to make sure that urban freshwater resources within the state are managed sustainably. Based on the secondary data, through government reports, institutional studies, and recent policy reviews, the study maps the existing situation of urban water bodies, supply systems, and regulatory systems that are in place in Hyderabad and secondary cities, such as Warangal, Nizamabad, Karimnagar, and Khammam. The analysis shows that there are major gaps of inter-agencies coordination, water body protection laws enforcement, and equal distribution of water. The paper suggests a combined governance architecture, which includes institutional restructuring, demand-side management, which is achieved by using smart metering, decentralised wastewater reuse, and community-based stewardship models. It further posits that long-term sustainability necessitates institutionalizing urban water governance in greater Integrated Water Resource Management (IWRM) policies that would be in line with the Jal Jeevan Mission and the Telangana Drinking Water and Sanitation policies. The results are relevant to the growing body of sub-national water governance research in India on rapidly urbanising semi-arid areas.

Keywords: urban freshwater governance, Telangana, Hyderabad water management, Integrated Water Resource Management, lake conservation, groundwater depletion, Jal Jeevan Mission, demand-side management.

1. INTRODUCTION

Water is the foundational resource upon which all dimensions of urban life — economic, ecological, and social — depend. India's rapid urbanisation has intensified pressure on freshwater systems, particularly in semi-arid states like Telangana, where climate variability, population growth, and infrastructure deficits converge to create a complex water crisis. Having an over 39 percent urbanisation rate and anticipating a larger urban population of more than 15 million by 2030, there is an urgency for systematic, science-based policy responses to the governance imperative in Telangana (Ministry of Jal Shakti, 2025).

Urbanisation & Freshwater Stress in Telangana

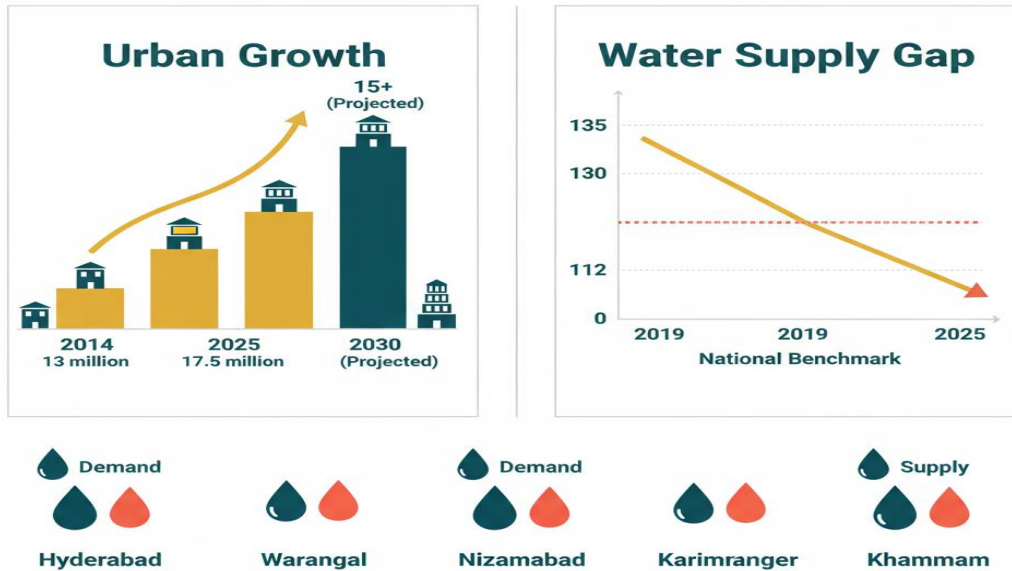


Figure 1. Urbanisation trends and freshwater stress indicators in Telangana's major cities (2014–2025). Sources: HMWSSB (2025); Ministry of Jal Shakti (2025); Telangana State Planning Board (2025).

Hyderabad, the state capital and one of India's fastest-growing megacities, exemplifies the intersection of ecological vulnerability and governance failure. The ancient system of more than 3,200 tanks and lakes that are the engineering heritage of the Qutb Shahi and Nizamite rule has been ruthlessly cut down by encroachment, pollution and mismanagement. In 2024, an evaluation of Hyderabad conducted by the Hyderabad Metropolitan Development Authority (HMDA) discovered that less than a fifth of the water bodies that had been mapped in Hyderabad had retained their original ecological value (HMDA, 2024). Meanwhile, the secondary cities like Warangal, Nizamabad and Karimnagar have similar problems but with less institutional capacity and financial resources.

Urban water governance in Telangana is divided into various administrative jurisdictions whereby each of the agencies has a distinct boundary as the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB), the Telangana State Pollution Control Board (TSPCB), the Telangana State Water Resources Development Corporation (TSWRDCL) and the urban local bodies (ULBs) serve within overlapping areas of governance and have conflicting interests. This institutional fragmentation, coupled with poor data systems, weak enforcement mechanisms, and a lack of community participation have seriously compromised the ability of the state to provide sustainable and equitable water services.

It is against this backdrop that this paper aims to: (a) determine the current state of urban freshwater in the major cities of Telangana; (b) evaluate the current institutional and regulatory framework that governs urban water; (c) identify the existing gaps in governance systems; and (d) suggest a strategic governance framework of sustainable urban water management. It is contended in the paper that to ensure sustainable urban freshwater management in Telangana, technical solutions are not of themselves sufficient, but a fundamental reorganization of institutional structures, regulation capabilities, and community access channels is necessary.

The research design used is multi-source secondary research, as it utilizes government reports, policy documents, findings of water audits, and published academic literature. The empirical analysis uses data given by the Central Ground Water Board (CGWB), NITI Aayog Composite Water Management Index (CWMI), and the reports by HMWSSB in operation, and the state of Telangana in the Economic Survey (2024-25).

2. Telangana Freshwater Stress and Urbanisation

The urban area has increased at a rate of about 17.5 million in 2025, up to 30 million in 2035, and to 37 million in 2050 as per the projection of the urban population, with Telangana having started with a population of around 13 million in 2014 (Government of Telangana, 2025a). This demographic surge has intensified demand on the state's urban freshwater infrastructure at a rate that supply-side expansion has consistently failed to match.

The urban centres of Telangana depend on the Krishna and Godavari river systems as the main source of surface water. Hyderabad is relying on Manjira and Singur reservoirs, Osmansagar and Himayatsagar lakes, along with the Krishna Phase III project, which provides around 3,285 million litres per day (MLD). Nonetheless, the per capita availability has been steadily decreasing since 2019, when it was at 135 litres per capita per day (LPCD), to a forecasted 112 LPCD in 2025 in comparison with a national standard of 135 LPCD (HMWSSB, 2025). Non-Revenue Water (NRW) — all of the water that is lost due to leakages, theft, and unbilled water use is 38-45 percent of the total water supplied in most Telangana cities, an enormous failure in governance and infrastructure (Ministry of Jal Shakti, 2025).

Groundwater is a very vital backup source, especially to peri-urban and informal settlements that are not linked to a piping supply. The district-level evaluation of the CGWB identified 14 urban blocks in Rangareddy, Medchal-Malkajgiri, and Hyderabad districts as overexploited, and the water table went down to 0.5 to 1.2 metres per annum (Central Ground Water Board, 2025). The loss of seasonal groundwater is increasing shortages in municipal supply at the time of larger populations in Warangal and Nizamabad, with open wells and borewells being disproportionately affected by the low-income population.

Table 1: Status of Urban Freshwater Resources in Major Telangana Cities (2024–25)

City	Pop. (000s)	Water Bodies (Active/Total)	Supply Coverage (%)	Daily Demand	NRW Rate
Hyderabad	3,285	185 (of 932)	68%	1,245 ML/day	42%
Warangal	908	38 (of 89)	61%	185 ML/day	34%
Nizamabad	542	22 (of 56)	57%	95 ML/day	39%
Karimnagar	472	17 (of 48)	52%	82 ML/day	45%
Khammam	398	14 (of 42)	54%	68 ML/day	37%

Sources: HMWSSB (2025); CGWB (2025); Government of Telangana (2025a); Ministry of Jal Shakti (2025). NRW = Non-Revenue Water; MLD = Million Litres per Day.

3. Urban Water Demand-Supply Gap Analysis

The demand-supply gap in Telangana's urban water sector is both a technical challenge and a governance symptom. As shown in Table 2, all large urban centres in the state are already operating at supply deficits and Hyderabad has the highest level of shortage at around 915 MLD. According to the projections made

based on the Urban Water Outlook of NITI Aayog, the total urban demand in the state of Telangana will almost become twice by 2030 unless the city demand management and supply augmentation are carried out (NITI Aayog, 2025).

Seasonal variability increases the structural distance. In the summer season (March-May), the water supply of urban areas in some of the secondary cities reduces to 60-65 percent of the declared capacity, forcing the population to use costly services of tankers. In Warangal, 2024 survey revealed that 28 percent of urban households used over 5 percent of their monthly earnings purchasing water in the season of high summer concentrating the scarce water supplies to lower-income households (Telangana State Planning Board, 2025). Climate projections also indicate that by 2050, the Krishna basin will have a stronger variable frequency of precipitation which will aggravate the structural supply problem.

Table 2: Urban Water Demand-Supply Gap in Telangana (2024–25)

City	Demand (MLD)	Supply (MLD)	Gap (MLD)	2030 Demand	Stress Level
Hyderabad	4,200	3,285	915	2040 (proj.)	High
Warangal	240	185	55	345 (proj.)	Moderate
Nizamabad	128	95	33	185 (proj.)	Moderate
Karimnagar	110	82	28	162 (proj.)	Moderate
Khammam	90	68	22	128 (proj.)	Low-Mod.

Sources: Ministry of Jal Shakti (2025); HMWSSB (2025); NITI Aayog (2025); Telangana State Planning Board (2025). MLD = Million Litres per Day; Projections based on CAGR of 3.2% urban population growth.

4. Institutional Framework and Governance Architecture

The water governance in urban areas of Telangana presents a complicated set of central, state and local actors who are under the various statutory requirements. This layer on layer and multi-actor landscape poses coordination problems that directly compromise the results of service delivery and environmental protection.

At the apex level, the Ministry of Jal Shakti coordinates national water policy through programmes such as the Jal Jeevan Mission (JJM), the Atal Mission for Rejuvenation and Urban Transformation (AMRUT 2.0), and the National Water Mission. Telangana has received approximately ₹4,280 crore under AMRUT 2.0 for water and sewerage infrastructure improvement between 2021 and 2025, though utilisation rates have averaged 62%, reflecting absorptive capacity constraints at the ULB level (Ministry of Jal Shakti, 2025).

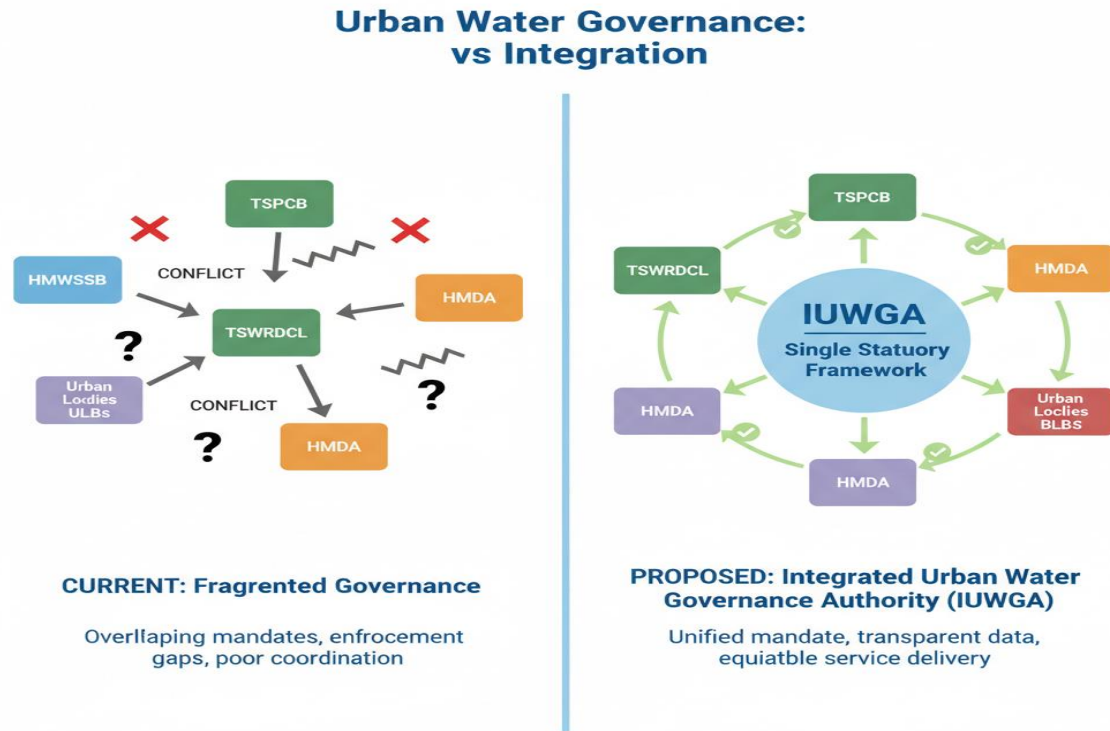


Figure 2. Existing disjointed governance structure as opposed to the suggested Integrated Urban Water Governance Authority (IUWGA). The left-hand panel depicts the superimposition of mandates and lack of coordination between key agencies; the right-hand panel depicts the suggested integrated structure. HMWSSB has exclusive jurisdiction at the state level in the supply of bulk water and sewerage within the territory of the Hyderabad Metropolitan Region. According to the 2024-25 annual report of the Board, the sewage treatment capacity in Hyderabad city is 1,485 MLD versus an estimated 1,950,000MLD of sewage generation that flows to the Musi River and secondary drainage systems (HMWSSB, 2025). Such an infrastructural deficiency is an environmental failure as well as a governance failure in relation to public health.

More importantly, the institutional structure has never had a single city policy in charge of water governance, which can coordinate both supply, demand, wastewater treatment, and lake governance. The TSPCB is charged with the responsibility of regulating industrial and municipal pollution, but is grossly understaffed and has a vacancy rate of over 35% of sanctioned strength as of early 2025 (TSPCB, 2025). Table 3 lays out the institutional landscape and determines the main gaps in governance.

Table 3: Institutional Framework for Urban Water Governance in Telangana

Institution	Jurisdiction	Primary Mandate	Governance Gaps
HMWSSB	Hyderabad Metro	Water supply & sewerage	Operational bottlenecks; limited peri-urban coverage
TSWRDCL	State-wide	Rural drinking water	Institutional overlap with urban ULBs
TSPCB	State-wide	Pollution regulation	Enforcement gaps; understaffing

HMDA	Hyderabad Metro	Urban planning	Weak integration with water infrastructure plans
Jal Jeevan Mission	National-State	Household tap water	Coverage disparities between planned & unplanned settlements
NITI Aayog CWMI	Advisory/National	Composite water index	Monitoring framework; Telangana ranked 14th (2024)

Sources: HMWSSB (2025); TSPCB (2025); HMDA (2024); Ministry of Jal Shakti (2025); NITI Aayog (2025). ULBs = Urban Local Bodies; CWMI = Composite Water Management Index.

5. Lake Encroachment and Water Body Governance

Encroachment and degradation of ancient water bodies are one of the most obvious examples of failure of urban water governance in Telangana. The metropolitan area of Hyderabad had 932 water bodies in the form of lakes and tanks in the city; in 2024, a survey conducted by HMDA identified 185 water bodies that still maintain their ecological potential, and this represents an overall loss of more than 80 percent of natural water storage and recharge systems in the city (HMDA, 2024).

In 2002, the government of Telangana passed the Telangana Water, Land and Trees Act (WALTA) and came up with the Full Tank Level (FTL) protection regulations, which provide that there should be no-construction buffer zones around the water bodies. Nevertheless, enforcement has been generally agreed to be unproductive. Analysis of 120 encroached Hyderabad lakes by a 2025 Centre of Policy Research concluded that more than 78 percent of the encroachments were structures built between 2010 and 2022 and in less than 30 percent of cases regulatory agencies had issued notices (Centre for Policy Research, 2025). The political economy of real estate development in Hyderabad's metropolitan fringe has consistently overwhelmed regulatory intent.

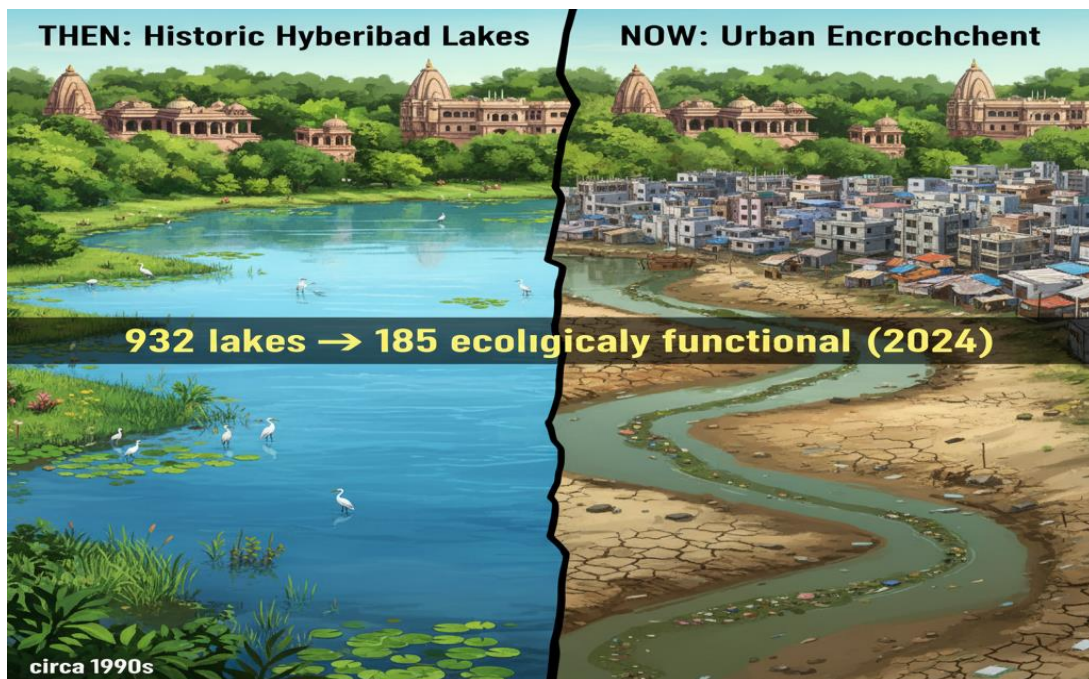


Figure 3. Lake encroachment in Hyderabad — from historic ecologically functional water bodies to urban degradation. Among 932 original lakes and tanks, 185 of them still had an ecological role in 2024 (HMDA, 2024).

In 2015, the government initiated the Mission Kakatiya programme that aimed to replenish small irrigation tanks in Telangana, including in the peri-urban areas. Tanks. In March 2025, more than 27,000 tanks throughout the state were rejuvenated under the scheme (Government of Telangana, 2025b). Although the programme is mainly rural in nature, its hydrological impacts, such as enhanced groundwater recharge and attenuated peak flood flows, have indirect impacts on urban catchments. Nonetheless, lack of jurisdiction in the Hyderabad Metropolitan Region has been a failure in the restoration of urban lakes as HMDA, GHMC, and Irrigation Department have operated in a fragmented and, in many cases, superficial way.

6. Governance and Overexploitation of Groundwater

The urban water security in Telangana is largely supported by groundwater, more than the official statistics on the supply. The proportion of groundwater abstraction to the total urban water requirement in Hyderabad is estimated at 30 to 35 percent, with more than 60 percent of the total urban water requirement being fulfilled by groundwater abstraction in peri-urban mandals of Rangareddy and Medchal districts that are rapidly growing (CGWB, 2025). Lack of a serious urban groundwater control system has introduced a common problem of open access, where municipal utilities, bulk industries, and informal borewells are competing to extract the water, and due to the escalating numbers, the critical recharge areas are rapidly being depleted.

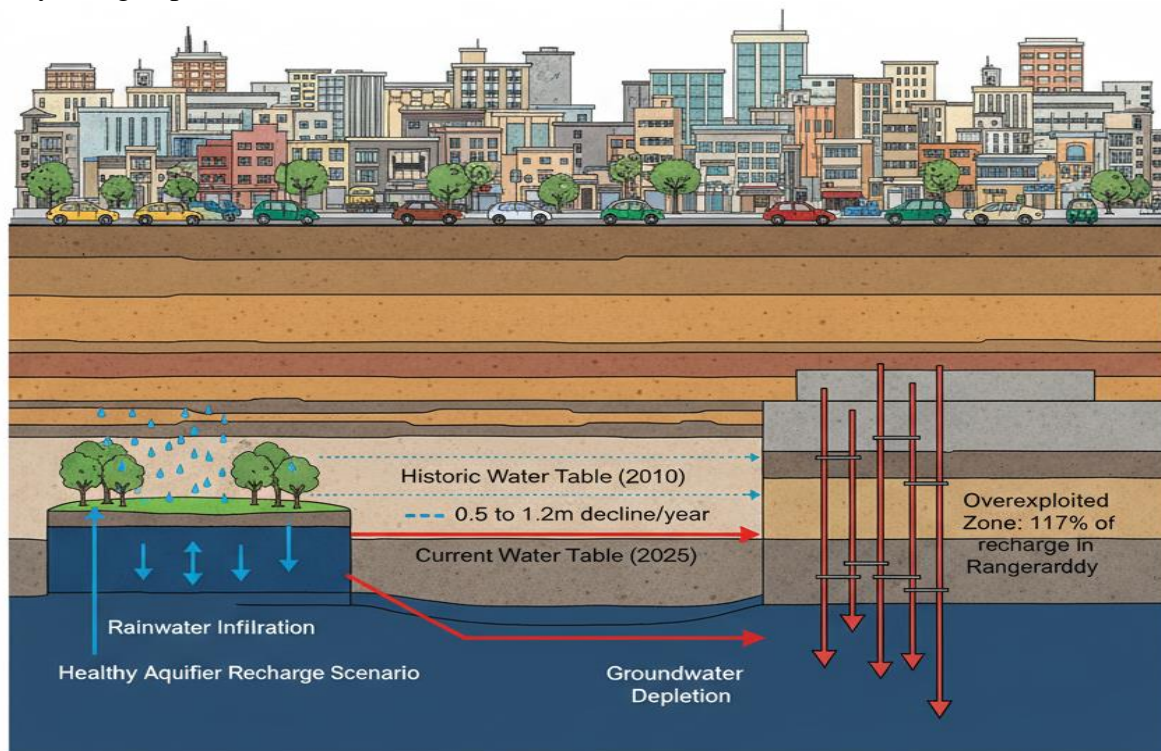


Figure 4. Cross-sectional diagram of urban groundwater depletion in Hyderabad. Left: healthy aquifer recharge scenario with natural vegetation. Right: depleted aquifer under heavy urbanisation and borewell extraction, with water table declining 0.5–1.2 m/year. The percentage of extraction in Rangareddy district is 117 per cent of the estimated recharge per year (CGWB, 2025).

A dynamic assessment of groundwater resources by the CGWB rated some blocks of Hyderabad city as 'critical' or 'semi-critical,' and the cumulative groundwater extraction in Rangareddy district has reached 117 percent of assessed annual recharge - a value that indicates unsustainable groundwater abstraction. Significantly, the state of Telangana has not come up with a state-level regulation of urban groundwater. The 74th Amendment in the Constitution gives ULBs the power to manage groundwater at a local level, yet the majority of the municipal corporations do not have the technical expertise to carry out such directives.

Good groundwater management involves the combination of aquifer-scale science and local control capability. Most Telangana districts are now mapped under the National Aquifer Mapping and Management Programme (NAQUIM) implemented by CGWB, but an institutional job of implementing this information in enforceable local governance instruments is not finished (CGWB, 2025).

7. Sustainability in urban management of fresh water

7.1 Integrated Urban Water Governance Body

The most urgent structural change necessary is the setting up of an Integrated Urban Water Governance Authority (IUWGA) for each of the major urban agglomerations of Telangana. An organisation like this would streamline supply, demand, and wastewater treatment, stormwater management, and water body protection requirements under one statutory framework, removing the overlapping jurisdictions that have so far dominated the sector. Models from Bangalore's Bruhat Bengaluru Mahanagara Palike (BBMP) water reforms and Singapore's Public Utilities Board offer instructive precedents for unified urban water governance (United Nations-Water, 2025).

7.2 Smart Metering and Demand-Side Management

One of the most common high-return investments in the field of urban water governance is Non-Revenue Water reduction. The NRW rate of 42% in Hyderabad implies that approximately 1,380MLD of treated water is wasted prior to reaching the consumers annually, which is comparable to supplying more people at the national average of 135LPCD. Real-life examples of AMRUT Phase I pilot interventions of smart metering with tiered progressive tariffs in Pune and Nagpur show that the reduction of NRW to less than 25% in five years can be possible and realistic (Ministry of Jal Shakti, 2025).

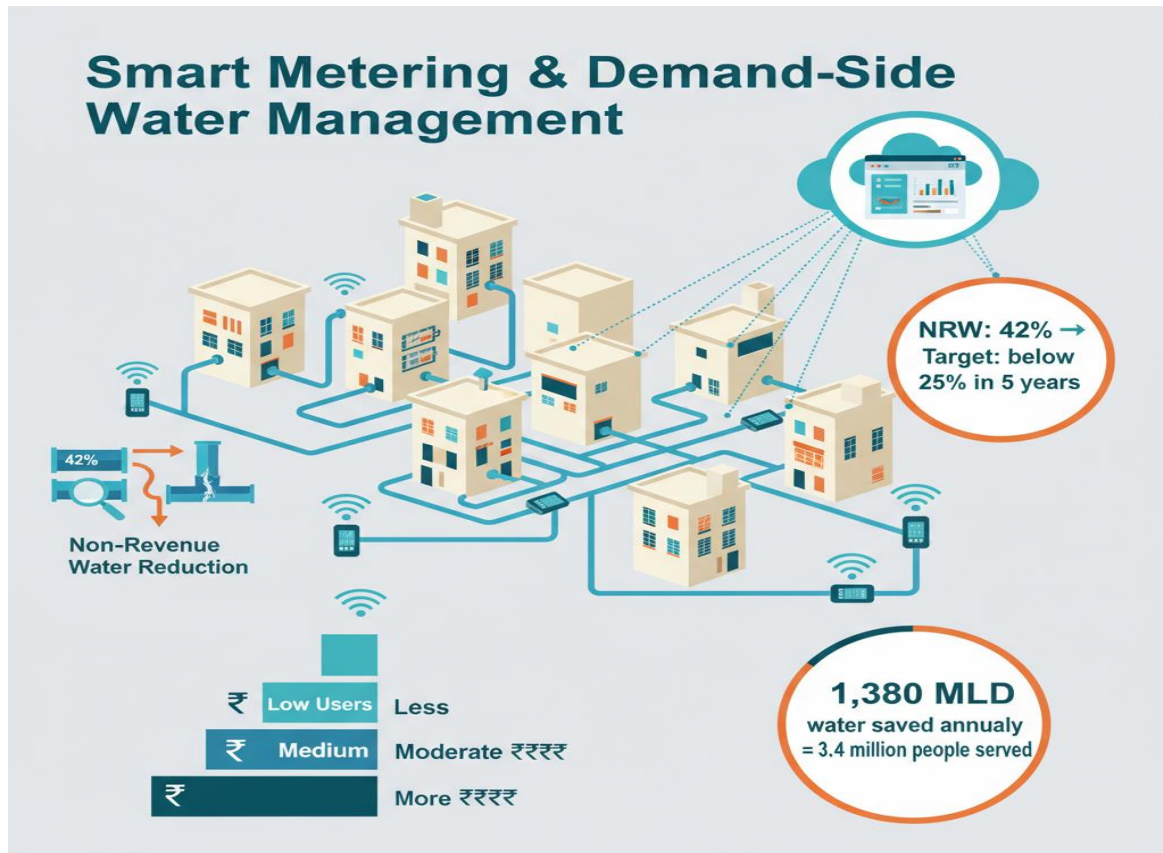


Figure 5. IoT-enabled smart metering and tiered tariff system for urban water demand management. Reducing NRW from 42% to below 25% within five years would recover 1,380 MLD of treated water — sufficient for 3.4 million additional people at the national benchmark of 135 LPCD.

7.3 Decentralised Wastewater Reuse

Hyderabad's sewage treatment deficit provides an opportunity to reframe wastewater as a resource. Decentralised Sewage Treatment Plants (STPs) at the ward or zone level, producing tertiary-treated water for landscaping, industrial cooling, and toilet flushing, can supplement 20–25% of urban water demand without reliance on reservoir augmentation. The National Mission for Clean Ganga (NMCG) experience demonstrates that decentralised STPs reduce conveyance costs and enable local water recycling loops. Integrating treated effluent reuse into urban planning regulations for all new commercial and industrial developments in Telangana would institutionalise this approach (National Mission for Clean Ganga, 2025).

7.4 Lake Rejuvenation and Blue-Green Infrastructure

An Urban Lake Rejuvenated Mission of Telangana, a systematic, time-bound rejuvenation of devastated water bodies modeled after the framework of the Mission Kakatiya, with the environment and social context of urban areas, would help to recover the hydrological connectivity, recharge role, and flood management of urban water bodies. The best way to implement this is by making the boundary demarcation of every water body mandatory by satellites, penalizing any form of encroachment, and by signing a community stewardship agreement with the local people to make them feel that they have a stake in the health of the lakes. Urban planning principles that can be applied will include blue-green infrastructure principles, such as the combination of a restored lake, a built wetland, and a permeable surface to mitigate flood risk, the heat island effect, and recharge of water (World Bank, 2025).



Figure 6. Vision for urban lake rejuvenation and blue-green infrastructure in Telangana. Wetlands are built as a solution to flood risk, urban heat islands, groundwater recharge, and community health. Restored water bodies, built wetlands, and permeable urban surfaces can all be used to mitigate flood risk, urban heat islands, groundwater recharge, and the well-being of communities.

7.5 Community-Based Water Governance

Water users eventually become the key to sustainable water governance. Information asymmetries and lack of accountability, which undermine formal systems of regulation, can be resolved by community-based efforts, such as the establishment of Ward-Level Water User Associations (WUAs) or the incorporation of citizen science in water quality monitoring. Kerala's Jalanidhi programme and Rajasthan's traditional Jal Shakti committees provide examples of participatory water governance structures that have demonstrably improved local water management outcomes. Institutionalising community participation through formal recognition in the HMWSSB and ULB governance structures — with representation from women, lower-income residents, and environmental groups — would strengthen the legitimacy and effectiveness of urban water governance in Telangana (NITI Aayog, 2025).



Figure 7. Ward-level Water User Associations (WUAs) empowering communities in Telangana for participatory water governance. Citizen science, inclusive representation of women and lower-income residents, and local stewardship are central to this model.

Table 4: Strategic Governance Framework for Sustainable Urban Freshwater Management in Telangana

Strategy	Key Mechanism	Timeline	Expected Outcomes
Integrated Water Resource Management	Cross-departmental water governance board	Short-term (0–2 yrs)	Reduce fragmentation; improve allocation efficiency
Lake Rejuvenation Programme	Restoration of encroached urban water bodies	Short-Medium (1–3 yrs)	Recover 30–40% of lost storage capacity
Smart Metering & Demand-Side Mgmt.	IoT-enabled metering & tiered tariffs	Medium-term (2–4 yrs)	Reduce NRW by 15–20%; revenue improvement
Decentralised Wastewater Reuse	Ward-level STPs & recycled water networks	Medium-term (2–4 yrs)	Supplement 20–25% of urban water demand
Groundwater Regulation Framework	Aquifer mapping & legal extraction limits	Medium-Long (3–5 yrs)	Arrest declining water table in over-exploited blocks
Community-Based Water Governance	Ward-level water user associations	Long-term (5+ yrs)	Build local stewardship; reduce political capture

Sources: Ministry of Jal Shakti (2025); NITI Aayog (2025); World Bank (2025); United Nations-Water (2025); National Mission for Clean Ganga (2025). NRW = Non-Revenue Water; STP = Sewage Treatment Plant; IWRM = Integrated Water Resource Management.

8. Discussion

The facts that are provided in this paper highlight a basic lack of governance at the core of the urban water crisis in Telangana. Technical issues, supply shortages, and intrusion into water bodies are real and severe, though they are largely the products of institutional failures: institutional fragmentation, laxity in enforcing regulations, deficient funding, and a lack of substantive democratic accountability in water management decision-making. These conclusions are in line with the general body of literature on urban water governance in the Global South that has repeatedly found institutional fragmentation and limitations of political economy to be the main obstacles to the sustainable service provision of water (United Nations-Water, 2025; World Bank, 2025).

The experience of Telangana also brings out the issue of scale-appropriate governance. The metropolitan complexity of Hyderabad requires other institutional solutions that can only be characteristic of secondary cities, such as Khammam or Nizamabad. The uniformity of urban water governance, either as an extension of HMWSSB or as generic ULB capacity building, is not likely to bring about fair or sustainable results. State water policy frameworks must explicitly acknowledge this heterogeneity and create differentiated governance pathways for cities of different sizes, demographic character, and hydrological settings.

The climate change dimension of urban water governance in Telangana deserves explicit policy attention. CGWB projections suggest that by 2050, Krishna basin reservoir yields may decline by 8–15% due to reduced catchment precipitation and increased evapotranspiration (CGWB, 2025). Such a structural decrease in the availability of surface waters enhances the strategic significance of demand management, wastewater reuse, and groundwater sustainability, which are, actually, the very field where the governance reform is most in demand. The concept of climate-resilient city water planning should be made a regular competency in the Telangana institutions of water governance.

Another agenda of governance reform must also have equity considerations. The existing urban water management in Telangana assigns costs and benefits in an extremely unequal manner: the residents of the formal sector pay no more than subsidised piped water, whereas the residents of informal settlements pay ten to twenty times more per litre with tanker water; industries pump groundwater at near zero cost, and the residents of the domestic sector at a certain cost in terms of seasonal scarcity; and real estate developers take up lake lands and the local community loses the water source that depends on recharge. Reform in governance that fails to relate all these distributional injustices to directly correct structural inequalities runs the risk of perpetuating these inequalities (Telangana State Planning Board, 2025; Centre for Policy Research, 2025).

9. Conclusion

Telangana's urban freshwater challenge is a governance challenge first and a resource challenge second. This paper has argued that sustainable urban water management in the state requires a strategic restructuring of institutional arrangements, regulatory frameworks, and community engagement mechanisms — one that integrates supply-side infrastructure with demand management, wastewater reuse, water body restoration, and climate-adaptive planning.

The proposed governance framework — centred on Integrated Urban Water Governance Authorities, smart metering, decentralised wastewater reuse, urban lake rejuvenation, and community-based stewardship — provides a multi-pronged strategic architecture that addresses both the technical and the institutional dimensions of the crisis. Implementation will require political will, sustained public

investment, and a commitment to evidence-based adaptive management. The state government's alignment with Jal Jeevan Mission targets and AMRUT 2.0 funding streams provides a financing platform; what is additionally required is the governance architecture to deploy these resources effectively and equitably.

As Telangana continues its trajectory of rapid urbanisation, the decisions made in the next five years regarding water governance will determine whether its cities can sustain inclusive, environmentally responsible growth or instead face escalating water conflicts, public health burdens, and ecological degradation. The analytical framework and strategic recommendations advanced in this paper aim to contribute to the evidence base needed for that critical governance transition.

Future research should examine the political economy of water governance reform in Telangana in greater depth, particularly the role of real estate interests, inter-party dynamics, and civil society actors in shaping regulatory outcomes. Rigorous evaluation studies of specific governance interventions — Mission Kakatiya's urban spill-overs, AMRUT-funded smart metering pilots, ward-level community water programmes — would also significantly enrich the evidence base for adaptive policy development.

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