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WATER MANAGEMENT IN AURANGABAD DISTRICT: EVOLUTION OF STORAGE AND SUPPLY SYSTEMS FROM MEDIEVAL PRACTICES TO MODERN INFRASTRUCTURE WITH A CRITICAL ANALYSIS OF CONTEMPORARY WATER PLANNING

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ABSTRACT

"Water is life. Water is essential for all forms of life on Earth". Along with food and oxygen, water is one of the most essential components for living. Water is used by people on a regular basis for drinking, cooking, cleaning, and sanitation, which is vital for cleanliness and avoiding illness.

In recent years a cause of concern in most of the regions due to its unavailability, inaccessibility, and deteriorating quality. Cities like Aurangabad, where tourists from around the world come to visit expecting good quality of drinking water, sanitation, and hygiene. Because this represents India in front of the world canvas. Therefore, water is an important aspect of tourism development. Aurangabad is one of the drought-prone regions in Maharashtra state. Where the water supply and storage network has a long history.

This study emphasis on the old water storage and supply network of Aurangabad district along with modern water supply network. It also critically examines the projected water supply network program to analyze challenges in the present functioning of the water supply and distribution network to provide solutions on contemporary challenges.

For this I am using the descriptive and analytical method, in which secondary data analysis techniques played a crucial role. To study previous models of water storage and distribution, I am relying on field visits and secondary data such as the District gazetteer. To know about modern water supply networks, I prefer secondary data such as Aurangabad Municipal Corporation water department plans, reports, and other case studies.



KEYWORDS: water, supply, network, Aurangabad, projected water plan, challenges, solutions.

INTRODUCTION

"Water is life. Water is essential for all forms of life on Earth". Along with food and oxygen, water is one of the most essential components for living. It comprises between 60 and 70 percent of the human body; aids in the control of body temperature, circulation, and digestion in living things. used by people on a regular basis for drinking, cooking, cleaning, and sanitation, vital for cleanliness and avoiding illness. In summary, the quality of water has a major impact on human health. All living things have this essential need; for example, plants need it to produce food through photosynthesis. It is utilized in agriculture to irrigate crops, which are necessary for producing cattle. Used in industries for manufacturing, cooling and power generation or electricity through hydropower plants. In addition, it

maintains ecosystems such as rivers, lakes, and oceans, which support aquatic life and biodiversity. In short, water is life. Without water, survival of humans, plants, and animals and the balance of nature would not be possible.

In recent years' water is a cause of concern in most of the regions due to its unavailability, inaccessibility, and deteriorating quality. Cities like Aurangabad, where tourists from around the world come to visit expecting good quality of drinking water, sanitation, and hygiene. Because this represents India in front of the world canvas. Therefore, water is an important aspect of tourism development.

Aurangabad is one of the drought-prone regions in Maharashtra state. Where the water supply and storage network has a long history. During the medieval time, the Nahar (canal) system was made by Malik Ambar (1610 onwards), the founder of Aurangabad (then Khadki), and called 'Nahar-e-Ambari'. He initiated the city's first aqueduct in 1610-1612 to address acute water scarcity in the region. The landscape, devoid of natural reservoirs, demanded innovative solutions. Therefore, Aurangabad district has a distinctive history of water management that represents a form of medieval hydraulic engineering. The notable medieval water reservoirs and distributing networks are Nahar-e-Ambari, Panchakki, Harsul Talab, Shakkar Bawadi, etc.

OBJECTIVES:

1. To study the structure of old water storage and supply network of Aurangabad district, with special reference to medieval to modern practices
2. To critically evaluate the planned water supply network program in terms of sustainability, feasibility and long-term effectiveness
3. To analyze the administrative, technical and socio-economic challenges that affecting the present water supply and distribution system
4. To suggest feasible and sustainable solutions for addressing contemporary challenges in water storage, supply and distribution in Aurangabad district

METHODOLOGY:

This is a descriptive and analytical type of study in which field visits and secondary data analysis techniques were used to gather data. To study previous models of water storage and distribution, I am relying on field visits and secondary data such as the District gazetteer. To know about modern water supply networks, I prefer secondary data such as Aurangabad Municipal Corporation water department plans, reports, and other case studies.

Water is a most important part of life, which affects all spheres of daily routine. In the case of urban structure again, it emerges as a crucial problem regarding water management and supply to fulfill water need of a continuously growing population.

This study can help policymakers, environmentalists, and civil society at large to know about regional water constraints and to take steps as soon as possible to use water efficiently.

NAHAR-E-AMBAR:

An underground tunnel (aqueduct), built with brick and lime mortar, collected spring water through thousands of small cracks within the earth's crust. Nahar-e-Ambari's water system was conceptualized and initiated by Malik Ambar, (prime minister of the Nizam Shahi dynasty between 1604 and 1617) coinciding with the transformation of a village Khadki (later Aurangabad) into a major urban center. The flagship system, drawing from the Sawangi and Kham valleys, supplied water to the mosques, palace, markets, and public fountains; over time, it was expanded by Aurangzeb and later administrators. The system tapped into subterranean water from the mountainous valleys north of the city. The city's location in a hard-rock, dry region necessitated the construction of elaborate aqueducts to transport water from distant springs and streams, supplementing the meager natural water sources like the Kham and Bayan Kham streams. At its peak, Aurangabad boasted at least 14 principal canals and numerous smaller channels, feeding cisterns, fountains, and public water points across the city and its suburbs. The tunnel with a slope to ensure gravity-fed flow toward the city. Then the aqueduct fed into a network of earthen pipelines, supplying over public cisterns

across the city. These cisterns were the primary source of drinking water for the population, especially during the Mughal era. The system included manholes for cleaning and repairs, and 'bambas' elevated masonry chambers, were built along the route to regulate water pressure, allow sunlight and air to purify the flow, and provide access for maintenance. Some of these structures still stand, notably in the Begampura region. Subsequently, the rulers, including Aurangzeb, expanded the canal network to support the city's growing population and to fulfill the military needs. Additional canals were constructed between 1612 and 1803 by engineers like Shah Mehmood and Shah Ali Nahri, as per official data.

The Neher-e-Ambari is found in the following subsections:

- **Underground Aqueducts (Nahar):** Water was channeled from elevated hills (e.g., Sawangi, Kham river valleys) via underground masonry conduits made of brick or stone tunnels, buried several meters below ground to prevent evaporation and contamination.
- **Gravity-Fed Flow:** The system relied entirely on gravity, using the natural slope of the terrain to move water from source to city, much like Roman aqueducts.
- **Bamba (Distribution Chambers):** At intervals, elevated masonry chambers (bamba) were constructed. These regulated water pressure, allowed sunlight and air to purify the flow, and provided access for maintenance. Many of these structures remain in Begumpura and other neighborhood regions
- **Manholes (Abgir Nali):** The aqueducts included manholes, or access shafts, at regular intervals for cleaning, repair, and monitoring, ensuring the system's longevity and hygiene.
- **Pipelines:** Within the city, networks of earthen, clay, or stone pipes distributed water to public cisterns, private residences, palaces, markets, and military camps.
- **Reservoirs and Cisterns:** Large storage cisterns were built at terminal points, from which water was further distributed via smaller pipelines and fountains.
- **Multiple Sources:** Different canals drew from various springs, wells, and streams (e.g., Harsul, Palsi, Devlai, and Garkheda), each serving specific parts of the city.
- **Backup Systems:** Some aqueducts featured parallel or backup pipes to ensure uninterrupted supply if the main conduit was blocked.
- **Public Access:** Water was distributed freely to the populace, with cisterns and fountains scattered throughout the city for domestic, drinking use.
- **Strategic Routing:** Channels were routed to key locations, including Naukhanda Palace, Gulshan Mahal, Town Hall, Shahgunj, Lotakaranja, Qila-e-Ark, and old markets.
- **Persian Influence:** Some later systems (e.g., Thatte houd, pond) were built with Persian-style architectural features: masonry chambers, ornamental pillars, and arched conduits; adding both beauty and functionality.
- **Surviving Structures:** Despite urban expansion, several distribution chambers, cisterns, and remnant aqueducts can still be found, particularly in Begumpura and near old market areas.

Aurangabad's water canal structures, especially the Nahar-e-Ambari system, represent a remarkable fusion of medieval engineering and urban planning. Designed to harness scarce water resources through gravity-fed aqueducts, pressurized distribution chambers, and an extensive network of pipelines and cisterns, this system sustained a large population and military garrison for centuries. While much has been lost to time, the surviving elements stand as a reminder of the city's pioneering role in water management and its enduring legacy in the Deccan. Aurangabad's historical water channels represent a fusion of Persian, Indian, and medieval engineering principles adapted to local geology and climate. They enabled the city to thrive as a Mughal capital in the arid Deccan and remain a living heritage of hydraulic ingenuity.

Panchakki:

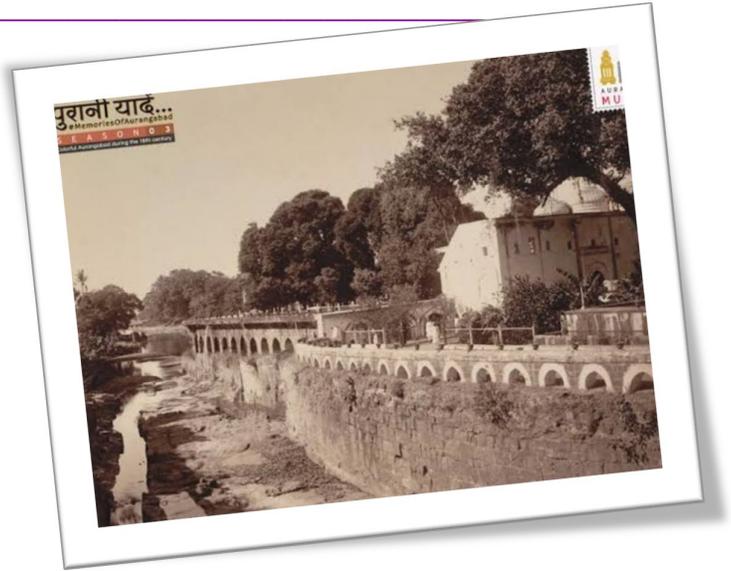
Panchakki (literally “water mill”) is a celebrated Mughal-era engineering marvel in Aurangabad district, renowned for its sophisticated hydraulic system and spiritual significance. The Panchakki was made by Shah Mehmood (as documented). It was established in the early 17th century by Baba Shah Musafir, a revered Sufi saint and spiritual advisor to Emperor Aurangzeb. The complex, originally a place of retreat for Sufi saints, became an important center for spiritual and community life. Most buildings in the complex, including the water mill, were later erected around 1695 by Turktaz Khan, a noble in the service of Nizam-ul-Mulk Asaf Jah. The oblong reservoir and fountains were added about 20 years later by Jamil Beg Khan.

The mill was designed to grind grain for pilgrims, disciples of the saints, and the troops stationed at Aurangabad’s garrison. After Baba Shah Musafir’s death in 1689, the mill continued to serve the community. In 1744, significant restoration work was carried out by Raja Shah Mahmud of Ichalpur, who sold his palace to fund the project.

Panchakki’s most remarkable feature is that it is fed by a 6–8 km long underground conduit that draws water from a hill spring near Jatwada or the Harsul River, channeled through clay or earthen pipes using gravity and siphon principles. This system was designed to ensure a steady, reliable water supply without electrical or mechanical pumps. The water is transported through earthen or clay pipes, using gravity and occasional masonry pillars to maintain flow and pressure.

Panchakki stands as a symbol of the scientific and architectural achievements of the Mughal era in the Deccan, blending functionality with aesthetic beauty. Panchakki is more than a water mill—it is a living monument to medieval Indian ingenuity, Mughal architectural grandeur, and the spiritual legacy of Sufism in the Deccan. Its sophisticated hydraulic system and culture of Aurangabad.

The cistern’s bottom forms the ceiling of a spacious underground hall. Water flowing above keeps this hall naturally cool—an early form of air-conditioning, hence the nicknamed as “AC Mahal.” The reservoir features fountains, enhancing both the beauty and the cooling effect of the complex. Therefore, Panchakki is more than a water mill; it is a living monument to medieval Indian architectural legacy in the Deccan.



Harsul Talav (Lake):

In Aurangabad is a crucial water source, reaching its full capacity around 26 feet of water level, which is considered its maximum storage for supplying water to old city areas, often overflowing during heavy monsoon. It is used to supplies drinking water to about 14 wards in the old city. The Aurangabad Municipal Corporation (AMC) manages pumping, lifting millions of liters (MLD) daily as needed, especially in summer.

Other Notable Examples:

Shakkar Bawdi: A historic reservoir in Himayat Bagh, used for irrigation and feeding the royal gardens, was part of the broader Mughal-era hydraulic network.

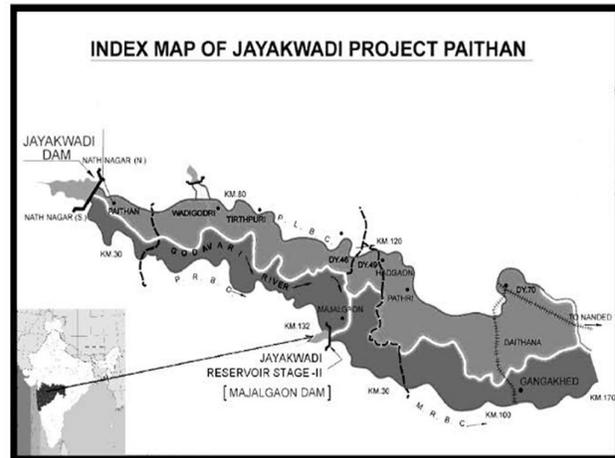
Open Irrigation Channels: At least 14 principal watercourses were recorded in the 19th century, supplying different parts of the city and suburbs. Some, like the canal branching at Gaumukh, supplied Shah Ganj and the Naukonda palace, while others served Juna Bazaar, Chauk, and Gul Mandi. In addition to the underground system, open channels drew water from dams near the cantonment and villages like Palsi and Devlai.

Thatte Neher: Built in the 18th century, drawing water from the Harsul River 12 km from the city, featuring ceramic pipelines and backup conduits; still partially functional

JAYAKWADI DAM:

Also known as Nath Sagar Dam, a modern form of water storage. The Jayakwadi dam is an earthen dam situated in the Paithan block of Aurangabad district in Maharashtra State. It serves multiple purposes, primarily irrigating agricultural land in the Marathwada region and providing drinking and industrial water to nearby towns and villages. The construction of the dam began in 1965 and finished in 1976. It was built on upstream at Paithan on the Godavari River. It is Asia's longest earthen dam, with a storage capacity of approximately 2,909 MCM and a catchment area of 21,750 square km. It has 27 water gates. It has overflowed more than 17 times and recorded the highest discharge of in 2006. The provision of water for adjacent towns and villages, as well as the municipalities and industrial zones of Aurangabad and Jalna districts, was another crucial part of this project. It is fed by the Godavari and Pravara rivers.

It generates 12 MW of energy along with Majalgaon Dam. It acts as a balancing reservoir in addition to harnessing the Sindaphana tributary of the Godavari River. The water used for power generation is pumped back to the main reservoir from the tail-shaped pond using a reversible hydro turbine. Water is provided daily from the dam to various industries located in the Aurangabad and Jalna MIDC areas. Jayakwadi Dam's total storage capacity is 2,909 million cubic meters (MCM), also expressed as 102 TMC (Thousand Million Cubic Feet). Jayakwadi Dam's pumping contains lift irrigation schemes like Brahmagavhan, relying on high-capacity pumps and running on KV lines, with water pumped back into the reservoir for peak-demand hydroelectricity, making it cost-effective for peak power but a huge infrastructure investment for water supply to cities like Aurangabad and Jalna. Pumping vast quantities of water requires substantial electricity, supplied via KV lines, making power tariffs a major operational expense for the Godavari Marathwada Irrigation Development Corporation (GMIDC) and other water users. The dam has a 12 MW hydroelectric plant, which is efficient for peak demand but involves maintenance costs and is sometimes offline for repairs. Eighty percent of water is used for irrigation, five to seven



percent for drinking water to nearby cities like Aurangabad and Jalna, and the remaining fifteen percent is lost due to evaporation.

The dam was linked with pipelines, water filtration plants and approximately 47 elevated storage reservoirs and overhead tanks throughout the city, which is maintained by the Aurangabad Municipal Corporation (AMC). Additionally, to supplement the piped water supply, the AMC operates around 600 water wells (electric pumps and hand pumps) scattered across various sectors of the city, water tankers were provided by the AMC and some private sector suppliers.

Today, Aurangabad's water supply is supplemented by modern reservoirs, dams (like Jayakwadi on the Godavari), groundwater extraction, and some of the medieval system, which remains a symbol of the city's historical ingenuity. Aurangabad's water supply primarily relies on water piped from supply sources from the Jayakwadi Dam, the main source for the city. In the city there were some water tanks made of cement concrete to fulfill the needs of residents. In addition, the Sillod Water Supply Scheme is a major project bringing water to villages and including a large treatment plant still at planning stage.

Requirement of Water at Aurangabad and its actual cost for Consumers :

About a decade ago (around 2015-2016), the average daily water consumption in Aurangabad was approximately 117 liters per person daily for a population of around 1.2 million.

At present in Aurangabad, the estimated population of the Aurangabad Municipal Corporation area in 2026 is roughly 1.7-1.8 million people, and the average daily water consumption per person is around 100-117 liters, though actual supply, with some studies showing residents receiving around 72 LPCD (Liters Per Capita Per Day) from the municipality, highlighting a significant deficit between demand and supply, with ongoing projects aiming for daily supply by 2026. This is indicating the potential scarcity and reliance on private supplies despite official arrangements. While the DPR focuses on urban residential water for households, industrial, public, firefighting, and loss allowances can push total design need much higher (another ~100+ MLD in some standards).

Some comprehensive studies use higher standards (e.g., 270 LPCD inclusive of all uses), which would increase total requirement significantly if adopted. The present requirement is ~265 MLD with the current population and planning norms. Actual reliable supply is much lower, causing water scarcity.

Future requirement by 2038: ~382 MLD based on projected population growth and standard service norms. Projected plans are in place considering populations up to 2 million by 2045, indicating increased demand.

Basic Urban Water Supply Standards:

Water planning often uses liters per capita per day (LPCD) as a benchmarks to calculate needs. The standards like 200 LPCD (Bureau of Indian Standards) or 135 LPCD (NBC) denote the basic services in Indian cities for domestic use. On average it is in between 135 and 165 LPCD for Municipalities.

Cost For Consumers:

- New Connections (Cantonment): Require application with charges, e.g., • 2000 advance, • 600 road cutting
- Annual Water Supply Tax = more than 4,200 per connection (more than major metropolitan cities)
- Tanker Costs: Cantonment tankers cost around • 649 for 5000 L.
- AMC Tanker Supply: About 40,000 people get tanker water on alternate days within a year, specifically during summer season.

The Aurangabad Municipal Corporation faces considerable challenges in its water supply management, primarily characterized by a significant demand-supply gap. The city requires approximately 250 million liters per day (MLD) to cater to its population, alienated with national standards, but current supply levels fall drastically short, often providing only around 100 MLD, which leads to irregular water distribution. As a result, residents increasingly depend on private tankers for

their water needs. Currently, Aurangabad's water supply is predominantly sourced from the Jayakwadi Dam, supplemented by several concrete water tanks within the city. Recent initiatives like the Sillod Water Supply Scheme are aimed at enhancing access to water through the development of treatment plants that serve surrounding villages. Despite these efforts, the existing supply inadequate to meet the Bureau of Indian Standards, which calls for more than 200 liters per capita per day (LPCD), and the National Building Code's recommendation of 135 LPCD. The projected increase in demand to approximately 380 MLD by 2038, driven by population growth and the need for improved service standards, underscores the urgency of addressing this gap.

Recent Projected Development Plan for Water Supply in Aurangabad:

This plan aims to achieve a daily water supply by March 2026 and to provide 24x7 clean, treated water from Jayakwadi Dam to Aurangabad, ending reliance on scarce groundwater. Completion of the first stage of a 26 MLD project, with the second stage (200 MLD) starting. An ₹ 822 crore loan was secured for these projects. Initially ₹ 1680.50 crore, later revised to ₹ 2714 crore. Aims to serve the entire city, benefiting around 16 lakh people initially. It includes a large water treatment plant (275 MLD) and extensive pipeline networks. Implemented by Maharashtra Jeevan Pradhikaran (MJP).

Critically analysis of the new plan for water supply and storage in Aurangabad:

1. **Long-distance supply chain and delay:** The city's internal pipelines across wards and zones. Frequent supply, ensure equitable coverage, trying to reduced tanker dependency. While the program framework aligns with national urban water goals (e.g., provide 24x7 reliable supply), planning seemed overly optimistic given existing infrastructure, demand growth, and execution capacity. The original deadline (e.g., Feb 2024) has repeatedly slipped. As of late 2025, key components like water lifting, testing, and extensive distribution pipelines remain incomplete. In several categories, only small percentages of work has been done despite deadlines having passed. Deadlines repeatedly extended due to:

1. Contractor inefficiencies
2. Land acquisition issues
3. Poor interdepartmental coordination
4. Benefits of new infrastructure are not reaching citizens on time.

As an impact, residents still receive water once a week, and many areas remain dependent on tanker supply or bore wells.

2. **Coordination Issues:** Lack of coordination between the Maharashtra Jeevan Pradhikaran and agencies like NHAI has caused pipeline alignment errors, creating risks for future maintenance and safety. Road construction happened over untested pipelines, indicating weak project supervision.

3. **Quality & Execution Challenges:** Reports of substandard works and contractor disputes have surfaced, with arrests tied to threats and alleged poor practices on the 2,000 km internal pipeline project. Cost escalation from the initial ₹ 1,680 crore to circa ₹ 2,740 crore has provoked public and political opposition.

4. **Existing Network Limitations:** Even before the new project, the city's distribution network suffered. Only ~70–80% geographic coverage; remaining areas depended on tankers or bore wells. High Non-Revenue Water (NRW) (~50%), with 33% real losses. Very short service hours, often once weekly for ~45 minutes.

5. **Unpredictable Supply:** Residents report frequent schedule changes, sometimes unpredictable timing, and operational confusion; undermining planning for daily water needs.

6. **Mass investment:** focused on trunk infrastructure risks neglecting last-mile connections, which is the heart of equitable service provision.

7. **Political Tokenism:** Election-period promises on water improvements reflect political rather than technical approaches to the crisis, with short-term announcements overshadowing long-term planning.

8. **Emerging Prospects & Small Gains:** Smaller pipelines and treatment facilities have improved supply frequency slightly in some network areas—and testing shows potential for better rotation supply.

9. **Long-Term Potential:** Once fully complete, the new infrastructure could deliver significant reliability, reduce dependence on tankers, and expand equity—if accompanied by systematic leak control and management reforms.

Current Challenges in front of Water supply department of Aurangabad Municipal Corporation:

1. **Demand-Supply Gap:** The city faced significant deficits, with increased demand due to population growth, leading to reliance on private tankers in some areas; with total demand estimated around 250 MLD (Million Liters per Day) for its population, but supply often lagged, leading to irregular water schedules (e.g., every few days) and increased dependence on private tankers.

Thus, present demand is ~265 MLD based on planning norms, but only ~100 MLD is considered reliably available in the design baseline; leaving a significant deficit. This means that by 2038 the city will need around 380 MLD of reliable water supply to meet basic urban demands if it continues to grow as projected. Even today, the required water (~265 MLD) far exceeds available supply levels, leading to intermittent deliveries or reliance on tankers and groundwater.

2. **Water Scarcity:** Groundwater levels are a concern, with some areas experiencing contamination (fluoride, nitrate). Rapid urbanization and population growth threaten water security. Inadequate Water Sources: Heavy dependence on Jayakwadi Dam, which is rainfall-dependent. Drought years severely reduce allocations. Limited diversification of sources (reuse, rainwater harvesting, local reservoirs) worsen the condition.

3. **Infrastructure Gaps:** The gap between actual supply and required supply highlights ongoing infrastructure challenges. Despite old water supply systems are insufficient; a new one are planned and started to execute.

4. **Rapid Population Growth:** Urban population is growing faster than infrastructure expansion. Future demand (≈ 380 MLD by 2038) risks outpacing supply capacity. Urban sprawl and inclusion of peri-urban villages strain existing networks.

5. **High Water Losses (Non-Revenue Water):** due to Leakage, illegal connections, and old pipelines cause 40–50% water loss. It reduces effective supply even when water is available and increases cost of operation and maintenance.

6. **Unequal Distribution:** Central city areas receive a better supply (sourced by Nahar-e-Ambari and Harshul talab) than peripheral and newly merged areas (sourced by Jayakwadi Dam). Many localities still depend on water tankers. Slums and low-income areas face irregular and insufficient supply.

7. **Intermittent Water Supply:** Water supplied once every few days instead of daily for approximately 45 minutes. It encourages excessive household storage, contamination of water and increases inequity and health concerns.

8. **Weak Operation & Maintenance:** Poor monitoring of pipelines, valves, and meters. Lack of skilled manpower for modern network management. Insufficient preventive maintenance leads to frequent breakdowns.

9. **Financial Constraints:** Rising project costs and cost overruns. Limited revenue due to low rate of water tax payers increasing its dependence on state and central funding, exacerbate delays.

10. **Governance and Institutional Issues:** Overlapping responsibilities between agencies. Limited transparency and accountability. Political interference affecting technical decision-making.

11. **Climate Change & Rainfall Variability:** Increasing frequency of droughts. Unpredictable monsoon patterns affect reservoir storage. Long-term water security is uncertain without adaptive planning.

Overall, the key challenge is not just building infrastructure but shows constraints in water delivery in the face of population growth, climate stress, and governance limitations.

CONCLUSION:

Sustainable water supply in Aurangabad district requires a shift from supply-only solutions to integrated water management, combining infrastructure development, conservation, governance reforms, and community participation at large. This anticipated deficit necessitates strategic planning and investment to ensure that the city can manage its water supply effectively in the face of ongoing

urbanization and the requirement for enhanced service delivery. Any work is incomplete without civilian support. Therefore, it is important to gain public support by organizing public awareness campaigns on water project, water scarcity and its conservation.

SUGGESTIONS:

Diversification of Sources:

1. Reduce overdependence on Jayakwadi Dam by giving equal importance to more regional historical gravity-fed water systems, water treatment plants (like at Phulambari), and better groundwater management (check dams, drip irrigation) as Jayakwadi Dam.
2. Start to redevelop Local reservoirs and barrages, check dams and percolation tanks, inter-basin transfer (long-term option)

Needs to do critical reforms in monitoring, improved internal distribution, leak reduction and efficient management, better contractor management, and transparent citizen communication. Without these reforms, even completed physical infrastructure may prove inadequate to deliver sustainable, reliable water for all residents.

Treated Wastewater Reuse:

Expanded treatment and storage infrastructure. Use treated sewage water for:

- Industries
- Agriculture
- Gardening
- Construction via tanker supply from treatment plants to required area.

But don't use it for drinking purposes. It could harm the gut health of residents. This move can save 30–40% of fresh water for drinking purposes.

Need of Efficiency:

Needs to working on efficient collection networks and sewerage treatment plants and adopting best practices in water management are crucial for future resilience.

1. Program intent is strong, but execution is weak, monitoring suffer with systemic delays undermining benefits.
2. Infrastructure gaps, governance issues, and inequitable access persist, especially for peri-urban neighborhoods.
3. Reducing Water Losses (NRW Control)
4. Replace old and leaking pipelines.
5. Use pressure management and leak detection technology.
6. Install bulk or ward-based water meters

Demand Management & Conservation efforts:

1. Adopt Rainwater Harvesting methods by mandatory rooftop harvesting for:
2. New buildings
3. Large housing societies
4. Industries and institutions
5. Schools and higher Institutional buildings

Recharge groundwater and reduce surface water demand:

1. Adopt Water-Efficient Practices
2. Promote low-flow taps

Enables accurate billing and demand control

1. Improves water quality and reduces contamination.
2. Improving Distribution Network

Equitable Coverage:

1. Prioritize no-network and peripheral areas.
2. Ensure last-mile connectivity to all households.
3. Shift from intermittent to continuous supply zones.

Strong Monitoring:

1. For faster & Better Project Implementation:
2. Independent technical audits.
3. Time-bound milestones with penalties for delays.
4. Strict quality checks.
5. Performance-based contracts

Financial Sustainability:

1. Rational Water Tariffs: Affordable but cost-reflective pricing.
2. Cross-subsidy for low-income households.
3. Improved Revenue Collection:
 - Reduce illegal connections.
 - Digital billing and payment systems.

Governance & Institutional Reforms: Single Nodal Authority: Clear roles for planning, execution, and operation and Reduce overlap between departments.

Transparency & Citizen Participation

- Public dashboards on water supply status.
- Ward-level water committees.

Climate-Resilient Planning: Drought Preparedness: formation of Emergency water plans. Reservoir operation optimization. Do Long-Term Planning to design systems for a 2 million-plus population.

Skilled Manpower:

1. Training for modern water management systems.
2. Use of SCADA and GIS-based monitoring.

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