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Urban Water Supply Management and Sustainability: A Case Study of Ranchi Municipal Corporation Area

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ABSTRACT

Water is indispensable to all biotic life. It recharges soil, flows into streams, evaporates into the atmosphere, and completes its cyclic journey, thereby sustaining ecological balance. Human dependence on water is constant, making equitable access, judicious utilisation, and conservation essential for sustainable development. This paper examines urban water supply in Ranchi city, which relies primarily on surface water from river-fed dams amid rapid urban expansion. It analyses demand–supply dynamics, projected population growth, user charges collected by the Ranchi Municipal Corporation (RMC), and equitable distribution across city subdivisions. Although current supply appears adequate, rising population pressure on land and surface water resources-governed by seasonal rainfall-necessitates robust storage, distribution, and quality management strategies. The Drinking Water and Sanitation Department handles storage and supply, while the RMC manages collection and distribution. Water quality parameters, including dissolved oxygen (DO) and biological oxygen demand (BOD), were assessed at three major dams (Getalsud/Rukka, Hatia/Dhurwa, and Kanke). The study underscores the urgency of supplementary measures such as mandatory rainwater harvesting to ensure long-term sustainability.

KEYWORDS: *Urban water supply, sustainability, population projection, dam management, water quality, Ranchi Municipal Corporation.*

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INTRODUCTION

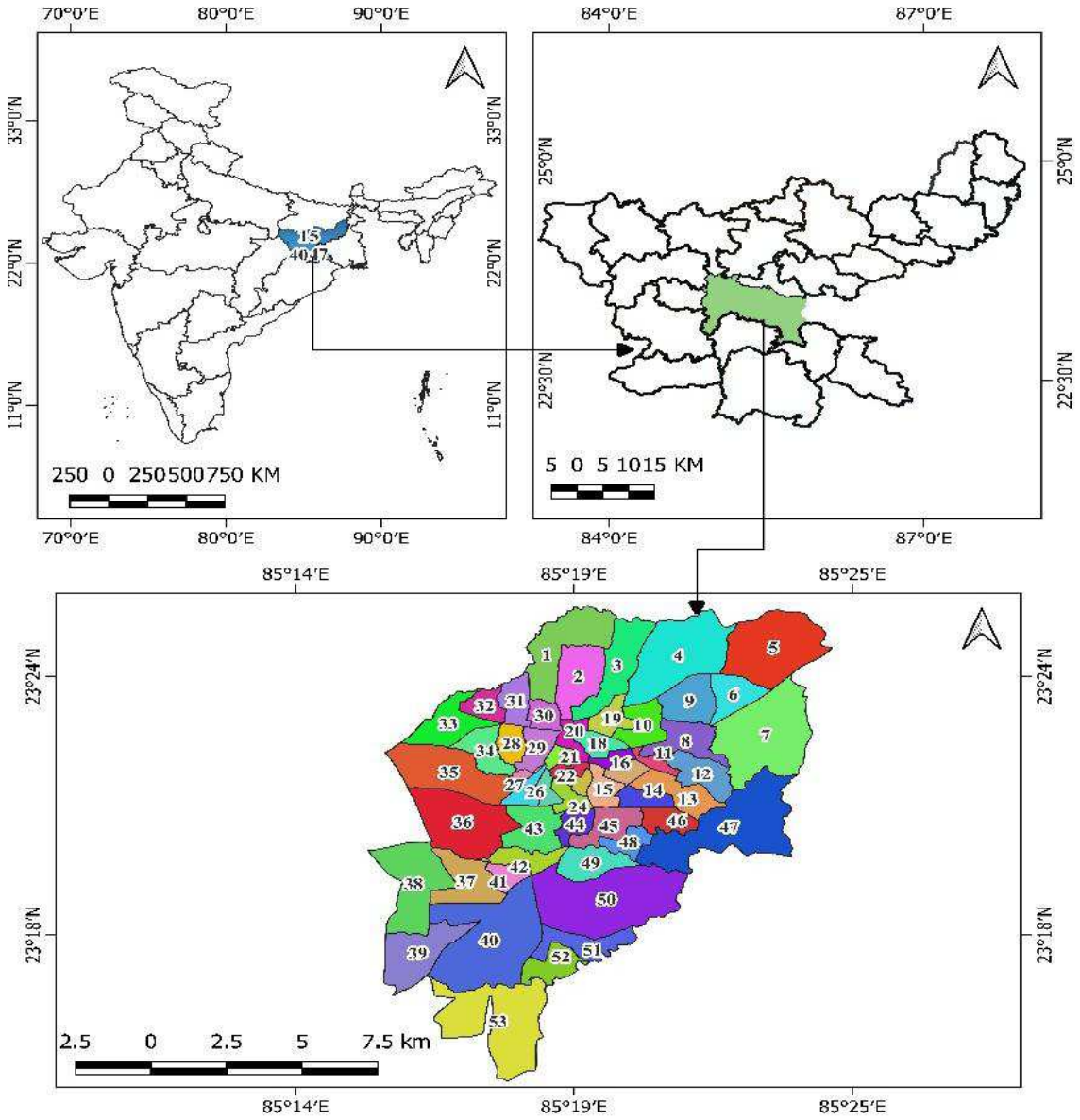
The philosophy of possibilism underscores humanity's capacity to select appropriate technological and managerial solutions in response to environmental challenges. Rapid urbanisation in India, where approximately 32 per cent of the population resides in urban areas (Census of India, 2011), is intensifying pressure on finite resources, particularly fresh water. Only about 1 per cent of global water is readily available as freshwater in lakes, streams, and aquifers. The oft-cited prognosis that "future wars will be fought over water" highlights the imperative for conservation, recycling, and sustainable management.

Ranchi, designated under the Smart Cities Mission, faces escalating water demand due to population growth and migration following the formation of Jharkhand state in 2000. This paper investigates water supply management in the Ranchi Municipal Corporation area, emphasising integrated strategies that balance social equity, economic efficiency, and ecological sustainability in line with the National Water Policy (2012) and Sustainable Development Goal 6.

STUDY AREA

Ranchi, the capital of Jharkhand, lies in the southern part of the Chota Nagpur Plateau. The Tropic of Cancer passes through the city, which has a hilly topography with an average elevation of 651 metres above mean sea level. Known as the "city of lakes and waterfalls,"Ranchi is drained by the Subarnarekha River and its tributaries. The principal water sources for the city are three dams: Getalsud (also known as Rukka) Dam and Hatia (Dhurwa) Dam on the Subarnarekha River, and Kanke Dam on the Jumar River.

LOCATION MAP OF RANCHI CITY



METHODOLOGY

Primary data were obtained from the Drinking Water and Sanitation Department and the Ranchi Municipal Corporation in raw form and subsequently tabulated. Secondary sources included Census of India publications, Central Pollution Control Board reports, and relevant policy documents. The city's spatial expansion was mapped using Quantum GIS (QGIS) software. Population growth trends were analysed using the exponential growth model: **[$Nt = Pe^{rt}$].**

where Nt is the projected population at time t, P is the base population, r is the continuous annual growth rate, and t is the time interval in years.

Population Projection: Ranchi Municipal Area

YEAR	POPULATION (RMC)
2001	847093
2011	10,73,472

Source: Census data

The decadal growth rate (2001–2011) was approximately 26.73 per cent. The continuous annual growth rate r was calculated as:

$$r = \frac{\ln (P2011/P2001)}{10} \approx 0.0237$$

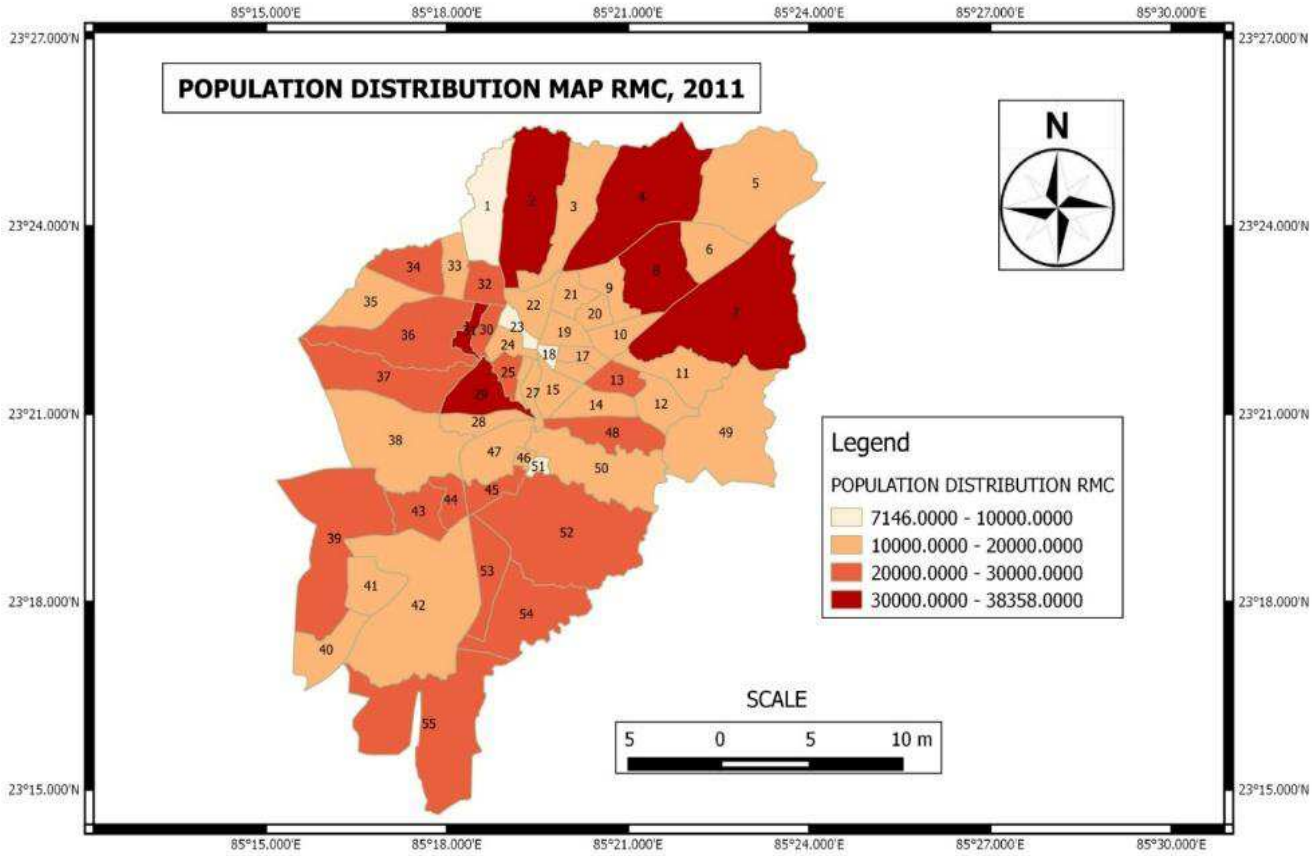
Projecting forward from the 2011 base population:

- By 2021: approximately 1,360,349
- By 2026: approximately 1,531,370

This represents an expected increase of about 42.7 per cent between 2011 and 2026, underscoring the mounting pressure on water resources. Land-use changes and settlement expansion since Jharkhand's formation further illustrate the widening gap between demand and supply capacity.

FACTORS AFFECTING WATER DEMAND

Physical factors-such as the city's moderate size, favourable rainfall regime, and undulating topography with numerous streams and recharge zones-initially supported water availability. However, anthropogenic pressures, primarily rapid population growth and urban sprawl, have become dominant drivers of increased demand. Migration following statehood has intensified land-use changes, converted permeable surfaces, and strained existing infrastructure.



Source: District handbook, Ranchi, Census of India.

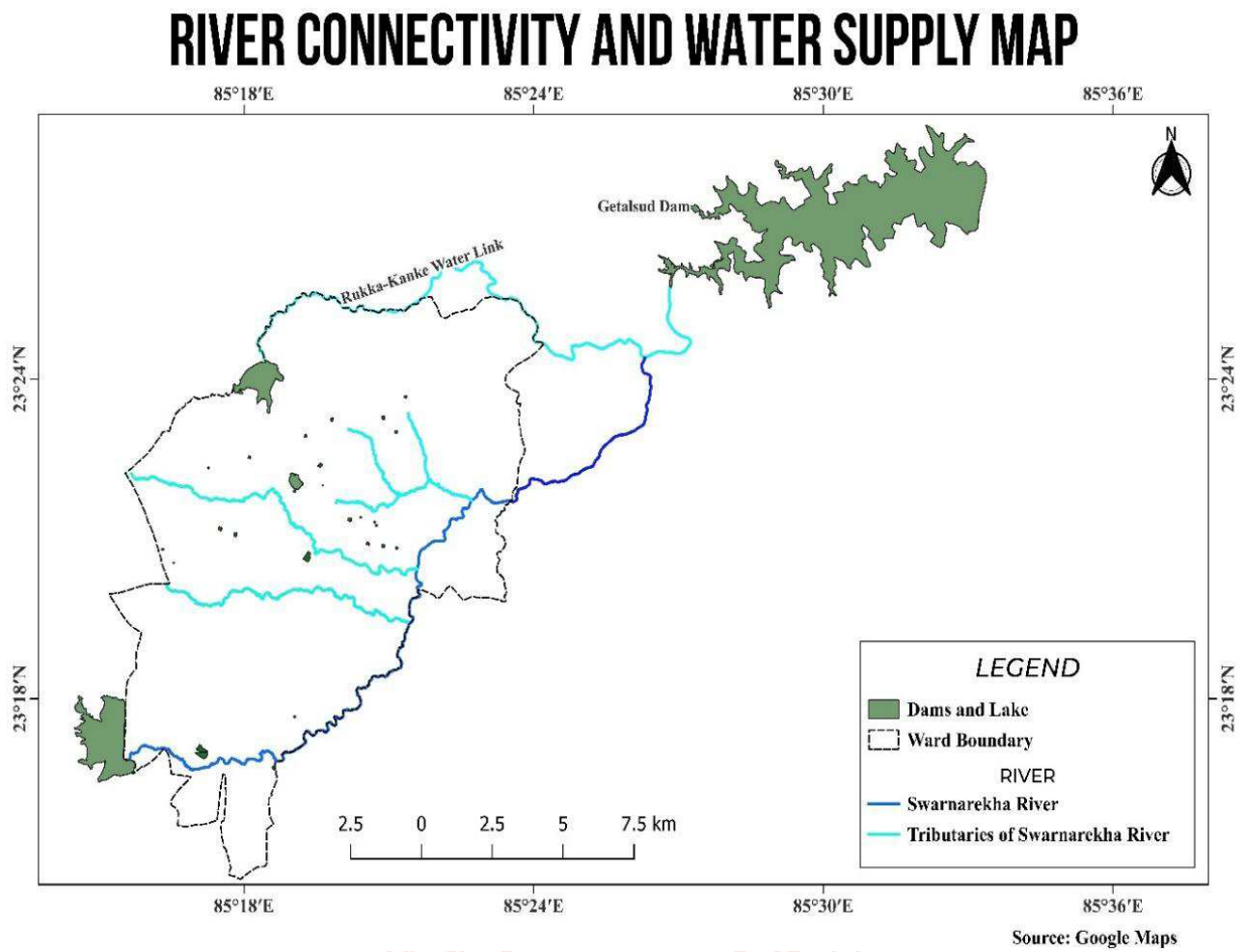
SUPPLY AND MANAGEMENT

Water, though recyclable, is not renewable in the short term. The National Water Policy (2012) recognises water as a precious resource requiring conservation, augmentation, and scientific inter-basin transfer where necessary. Jharkhand's state water policy affirms every citizen's right to equitable access to safe water for basic needs.

India's alignment with global initiatives-such as the World Water Vision (2000), Millennium Development Goals, and subsequent Sustainable Development Goals (SDG 6)-has emphasised integrated water resources management (IWRM). As defined by the Global Water Partnership, IWRM promotes coordinated development and management of water, land, and related resources to maximise economic and social welfare without compromising vital ecosystems. Its core principles include social equity, economic efficiency, and ecological sustainability.

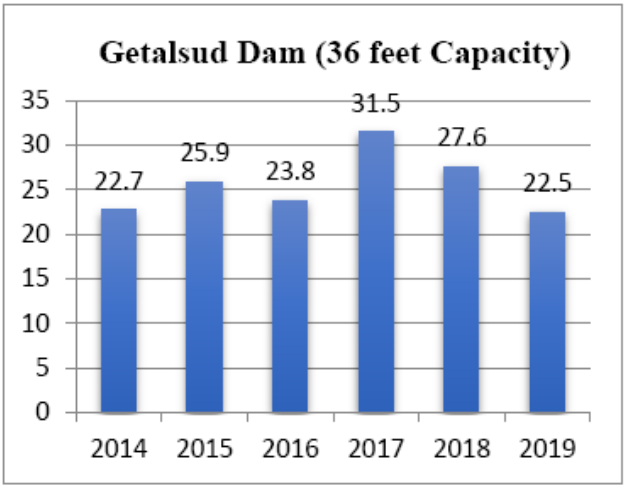
The Subarnarekha River, originating near Nagri in the Ranchi uplands, is the primary surface- water source for the city. It flows southeastward, eventually draining into the Bay of Bengal. The three major dams-Getalsud/Rukka and Hatia/Dhurwa on the Subarnarekha, and Kanke on the Jumar-form the backbone of Ranchi's drinking-water supply. Supplementary groundwater extraction occurs through approximately 540 deep borewells distributed across wards.

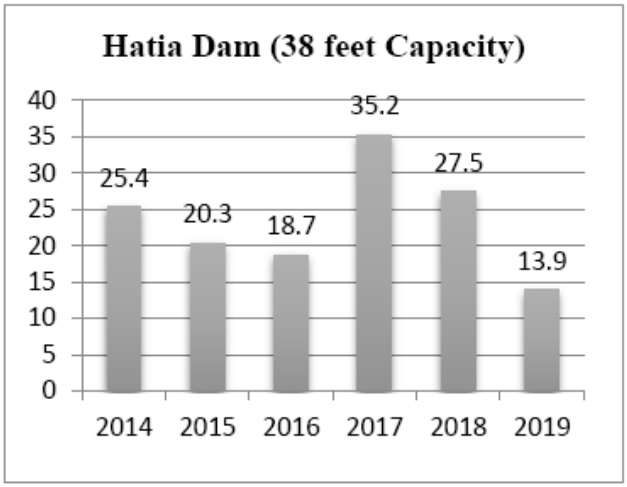
Water supply remains heavily dependent on monsoon rainfall. Deficient rainfall, such as the 40 per cent deficit recorded until mid-August 2019, necessitates rationing. Long-term sustainability therefore requires diversification of sources and improved storage infrastructure.

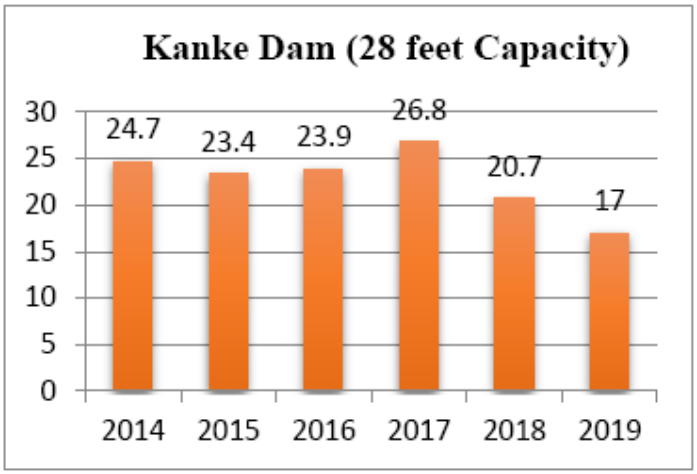


Quantity Measures: Reservoir Capacity

In addition to the primary surface water supplied from the three major dams, the Public Health Engineering Department (PHED), Ranchi, has installed approximately 540 deep borewells across various wards of the city as per the recommendations of ward councillors. These borewells serve as a supplementary source, enabling residents in their immediate vicinity to meet their daily water requirements.





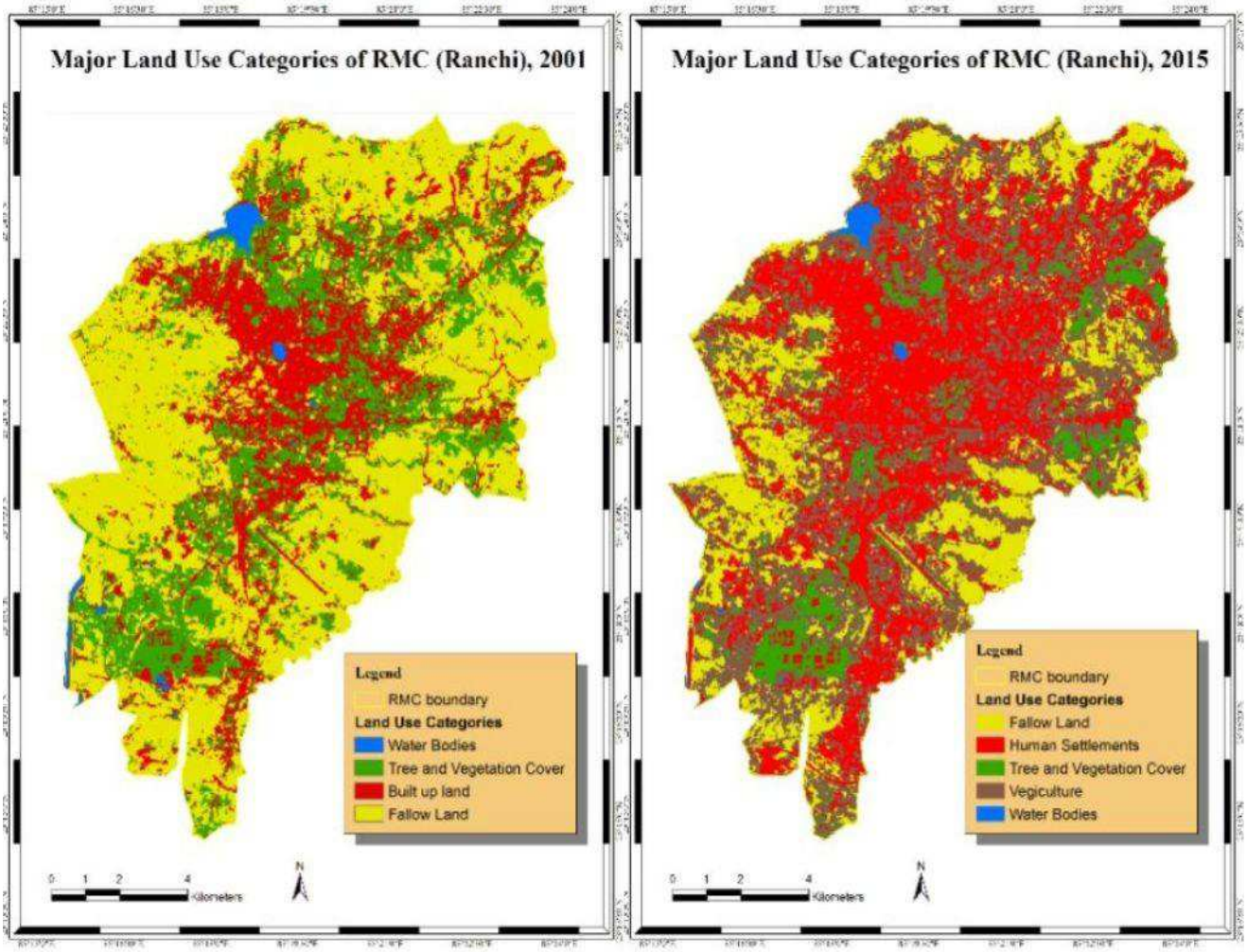


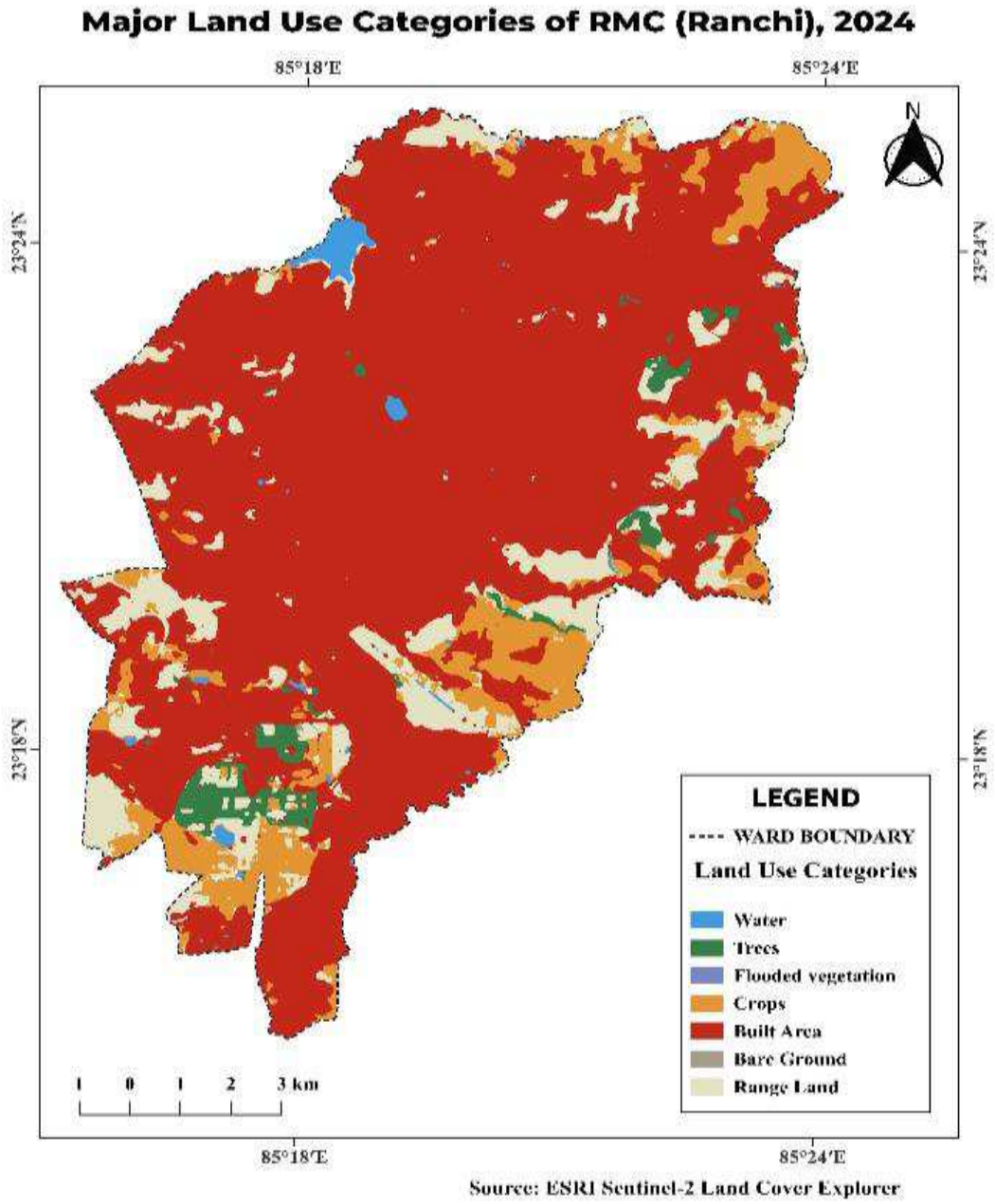
Source: Public Health Engineering Department (PHED), Ranchi.

Water supply and dam management in Ranchi are heavily dependent on seasonal rainfall patterns. As of 14 August 2019, the city had received approximately 40 per cent less rainfall compared to the corresponding period of the previous year. This underscores the monsoon- dependent nature of the water supply system, which remains vulnerable to rainfall deficits and may necessitate rationing by the authorities when required.

The rapid urban expansion of Ranchi has resulted in increasing encroachment and mounting pressure on both land and water resources. The land-use map below illustrates the spatial expansion and changes in land use since the city was designated as the capital of Jharkhand. The pattern of settlement growth clearly reveals that water demand has risen substantially, while supply infrastructure has remained largely static or only marginally enhanced**.**

LAND-USE MAPS





Water Quality Assessment

Biological monitoring is critical for assessing surface-water suitability. Dissolved oxygen (DO) levels indicate the water's capacity to support aquatic life, while biological oxygen demand (BOD) reflects organic pollution load. Clean water typically exhibits DO > 5 ppm and BOD < 4 ppm.

Water quality data (Central Pollution Control Board, 2018) for the three dams are as follows:

Dam	January 2018	June 2018	December 2018
	DO (ppm) / BOD (ppm)	DO (ppm) / BOD (ppm)	DO (ppm) / BOD (ppm)
Getalsud	8.2 / 2.6	8.3 / 3.1	8.2 / 2.7
Hatia	8.5 / 2.0	8.5 / 2.4	8.3 / 1.9
Kanke	5.9 / 3.1	5.9 / 3.3	5.9 / 3.1

Source: Central Pollution Control Board

Overall, pre-treatment water quality at Getalsud and Hatia dams remains satisfactory, whereas Kanke Dam shows comparatively lower DO levels, warranting closer monitoring.

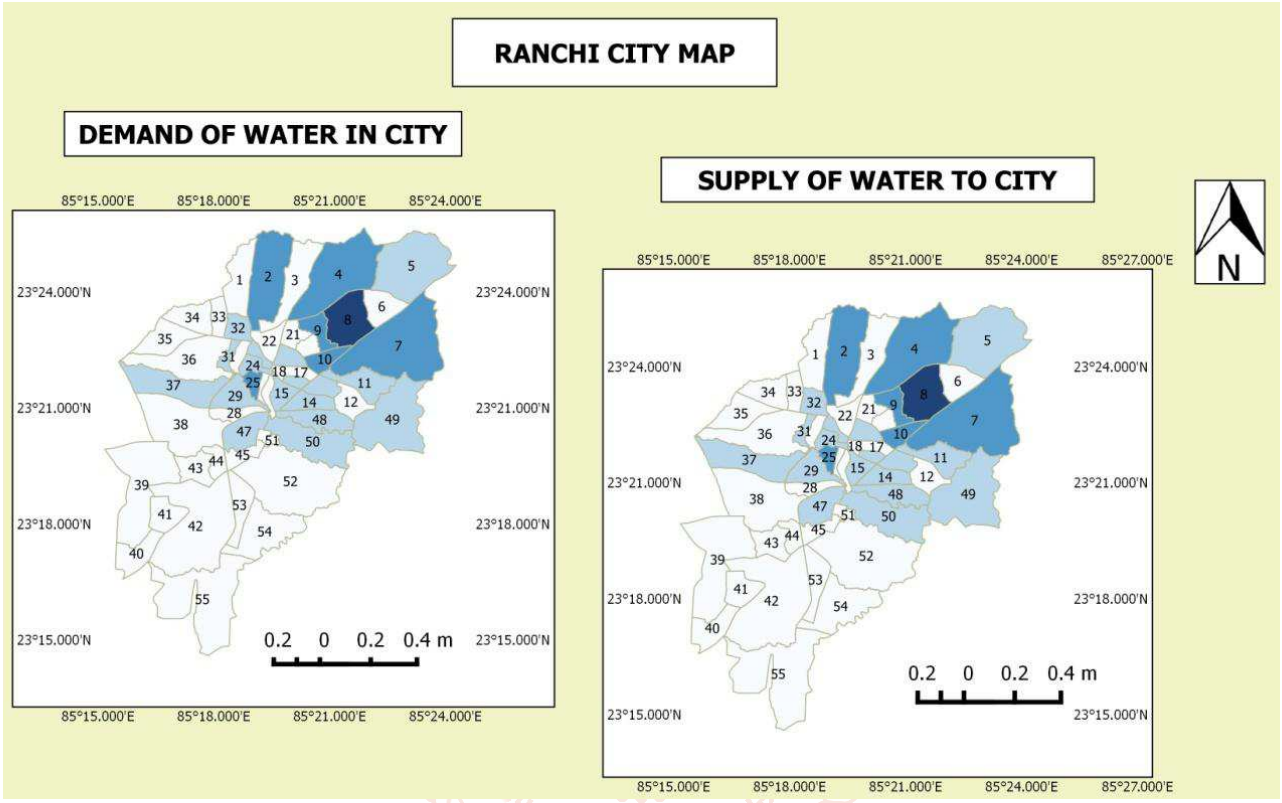
Revenue Generation and Pricing

The RMC generates revenue through water user charges, new connections, machine registration, and fines for illegal connections. Current domestic, institutional, commercial, and industrial water tariffs (per kilolitre) are:

Category	Water Charges(₹per KL)
Domestic	6
Institution/Government	10
Commercial	15
Industrial (SSI)	15
Industrial (Others)	20

Source: RMC.

Recovery rates remain low in several areas due to inefficient collection and non-payment, limiting funds available for infrastructure maintenance.



Source: Ranchi Municipal Corporation, Ranchi Legal Framework

Article 21 of the Constitution of India guarantees the right to life and personal liberty, judicially interpreted to encompass the right to clean drinking water and a healthy environment. National programmes such as the National Drinking Water Mission (1986) and India Water Week initiatives reinforce policy support for universal access to safe water.

CONCLUSION

Water is fundamental to life, yet urban expansion in Ranchi is testing the limits of existing supply systems. While current management by the Drinking Water and Sanitation Department and RMC meets immediate needs, projected population growth to approximately 1.53 million by 2026 demands proactive, sustainable interventions. Urbanisation must be balanced with demand-side management, pollution control, and supplementary sources to safeguard resources for future generations.

POLICY RECOMMENDATIONS

To achieve long-term sustainability, the following measures are proposed:

1. Empower urban local bodies under the 74th Constitutional Amendment by granting greater financial autonomy and decision-making authority, supported by transparent CAG audits.
2. Conduct a city-wide household water metering survey to quantify actual demand, implement rationing where necessary, and repair pipeline leaks.
3. Mandate rainwater harvesting structures for all new and existing buildings, with strict penalties for non-compliance.
4. Desilt reservoirs (Hatia, Kanke, and Getalsud) regularly to restore storage capacity and maintain feeder channels affected by infrastructure projects such as ring roads.
5. Prohibit large-diameter(≥6 inches) groundwater borewells in urban areas to protect aquifers.

6. Develop locality-specific overhead reservoirs to maintain adequate pressure across the distribution network.
7. Explore additional sources, including Remta, Churgi, Tajna, Basuki, and Latratu dams, to support Greater Ranchi and emerging settlements.
8. Formulate a comprehensive migration management strategy and promote satellite growth centres to reduce pressure on core urban areas through planned de-concentration.

Implementation of these recommendations, aligned with IWRM principles, will enhance resilience and ensure an equitable, sustainable water supply for Ranchi's growing population.

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