

CHAPTER II

Water Resources in Delhi

Introduction

Delhi, India's vibrant and fast-growing capital, hosts a population of 32,941,308 (World Population Review 2023), ranking it among the world's most populous and dense cities. The city stands as a testimony to India's progress and urbanization, with its population growing from 1.47 million in 1951 to 32.94 million in 2023. Similarly, its urban area has expanded from 201.36 sq.kms. in 1951 to 1467 sq.kms. in 2011 (Census 2011).

Amidst the substantial increase in urban population in this metropolis, the availability and management of water resources are of paramount importance for its sustenance and growth. As the economic hub of northern India, the adequate provision of water resources in Delhi is a vital lifeline, supporting the city's diverse needs, ranging from domestic consumption to industrial and agricultural demands.

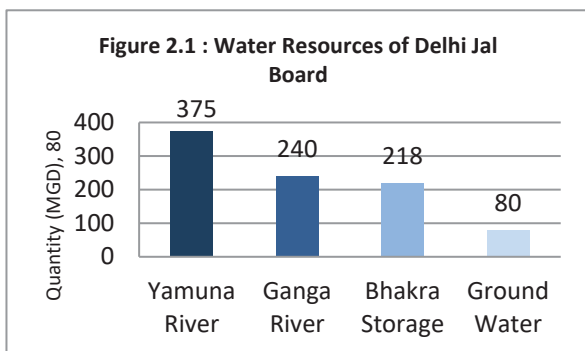
Over the years, the city has witnessed significant changes in its water resources, evolving from traditional water bodies, river system and wells to a more complex network of reservoirs, transporting water from distant places through pipelines, and building water treatment facilities for recycling and sustainable uses. As urbanization continues to reshape the face of Delhi, ensuring sustainable water resource management becomes an ever-pressing concern. This chapter seeks shed light on the intricacies of water availability and quality in the city through an examination of surface water sources and groundwater aquifers and look for opportunities of roof top rainwater harvesting initiatives and offer valuable insights and recommendations that can guide policymakers, stakeholders, and communities towards a more resilient and equitable water future for the vibrant heart of India - Delhi.

2.1 Delhi's Water Resources Situation

Delhi, being located in a semi-arid zone, receives about 61.18 cm annual rainfall and about 81% of this rain fall is received during the months of July to September. The balance is received in the remaining months of the year. With this low rainfall, Delhi faces significant challenges in managing its water resources due to its rapidly growing population, urbanization, and limited access to natural water bodies. In the past, this limited amount of rainwater was able to fall on the forest surface, infiltrate the soil, and be converted into groundwater for use by people. Since last few decades the area of impervious surfaces, like roads, and buildings has increased manifold in the city, which ultimately prevents rain water from infiltrating, or soaking, into the ground. Therefore, a large amount of rain water over Delhi translates into surface runoff and empties into the nearby storm drains. Point of concern is that the intensity of urbanization in Delhi is increasing day by day and as a result the runoff generation will continue to increase in the years to come. Till now, Delhi is somehow managing its water demand, however, is likely to face increasing water crisis if the government doesn't take any concrete steps.

At present, Delhi relies on various types of water resources to meet its diverse needs. The major types of water resources managed and utilized by the Delhi Jal Board and other agencies in the city include: (i) Surface water, which includes water from Yamuna River (ii) Water from neighbouring states (Ganga River & Bhakra Storage) and (iii) Ground Water. The Yamuna River flows along the eastern border of Delhi and serves as one of the

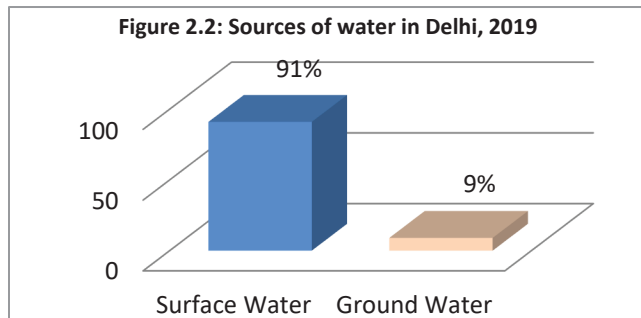
primary surface water sources for the city. Water is withdrawn from the river and treated at water treatment plants before being distributed to consumers. Delhi receives a significant



Source: Delhi Jal Board, 2022

portion of its water supply from neighboring states, such as Haryana and Uttar Pradesh, through various inter-state water sharing agreements. These agreements govern the allocation and distribution of water from rivers and canals that originates from multiple river basins (Ganga, Yamuna and Sutluz River). At present neighboring states are supplying nearly 86 percent of Delhi's water needs. Consequently, the groundwater resource of Delhi is coming under immense pressure and it is adversely affecting Delhi's water supply condition. However, these sources have also become increasingly stressed due to the growing demand from Delhi's expanding population. Moreover, the water quality of some of these sources is also a matter of concern due to pollution and inadequate treatment.

In addition to surface water sources, DJB also manages and extracts groundwater from wells and tube wells.



Source: Delhi Jal Board, 2022

Groundwater

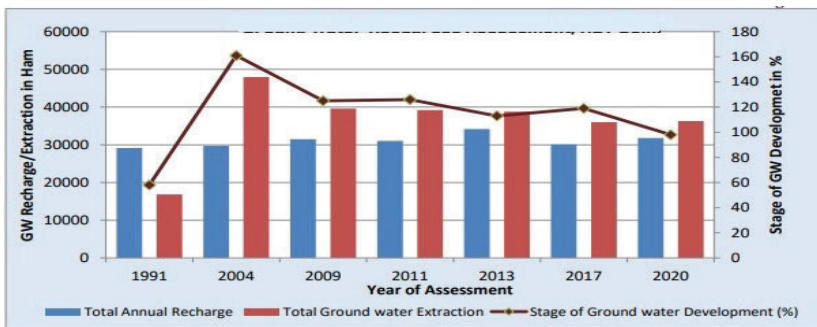
serves as a valuable supplement to the city's water supply, particularly during periods of high demand or scarcity. Furthermore, the Delhi has undertaken initiatives to promote rainwater harvesting to recharge groundwater and capture rainwater runoff. These efforts are aimed at augmenting the water resources and mitigating the impact of water scarcity during the dry seasons. Despite its tireless efforts, Delhi faces numerous challenges in managing water resources effectively. Rapid urbanization, population growth, pollution, and climate change are some of the critical factors that put immense pressure on the available water sources. As a result, Delhi has become one of the water deficient cities in the world and it is going to become a water scarce city in the coming times. According to the recent Parliamentary Standing Committee Report, 2023, groundwater levels in Delhi, Ghaziabad, Faridabad, and 20 other cities dipped by more than 20 metres from 2017 to 2020. This scarcity of water

in the city gets accentuated by many factors. The growing population, coupled with ever-increasing pollution, increasing demand from industrial and commercial water along with the leakage in the supply systems and wasteful consumption practices (The Economic Times 2017) pose major challenges for the City Administrators.

2.2 Overexploitation of Ground Water

The total area of Delhi is only 1483 sq. km and except a small sub-basin of the Yamuna River, the city has very limited surface water resources (i.e., rivers, lakes, and canals) (Singh 2022). Therefore, for water supply, Delhi also relies on groundwater for its daily water needs, with over 9 percent of the city's water supply coming from groundwater (Figure 2.2). However, the Central Ground Water Board's Report "Ground Water Year Book" states that the extraction of groundwater in the city far exceeds its recharge rate, leading to a decline in the groundwater table. The report says that the annual groundwater extraction in Delhi was more than 100 percent during 2017 (CWGB 2021). Figure 2.3 portrays the ground water resource assessment of NCT Delhi, which clearly indicates that after the year 1991, the total ground water extraction has always exceeded the total ground water recharge. In about 75% area of NCT Delhi the ground water level is declining at a high rate which is 0.4 m to 2.0 m/per year. Therefore, the groundwater table has dropped by more than 50 meters in the last few decades.

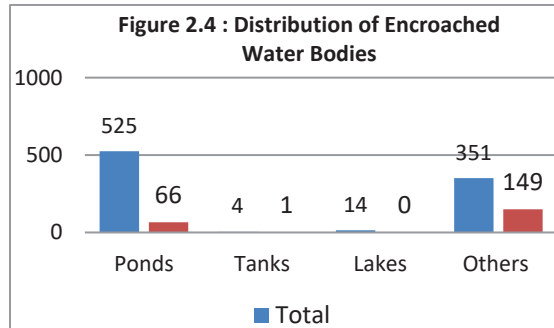
Figure 2.3: Ground Water Resources Assessment, NCT Delhi



Source: Central Ground Water Board, 2022, Report Dynamic Ground Water Resources of NCT, Delhi

2.3 Encroachment of Water Bodies

Ministry of Jal Shakti, Government of India has conducted the First Census of Water Bodies in 2021. Delhi was also included in the initial Water Bodies Census, which comprehensively considered all forms of water body usage. The objective of the Census



Source: Delhi Jal Board, 2022

of Water Bodies is to develop a database for all water bodies by collecting information on all important aspects of the subject including their size, condition, status of encroachments, use, storage capacity, status of filling up of storage etc. As per this report, total 893 water bodies have been enumerated in the Delhi, out of which 525 are ponds, 14 are lakes, 4 are tanks and rest of the 350 water bodies are enumerated as others.

The analysis also reveals that out of total 893 water bodies 216 (24.19%) are encroached upon in Delhi and it is highest among all the States of India. The report further said that 66 ponds (small water bodies) in the city were found to have been encroached, while out of the 14 lakes, (larger and deeper than ponds) that it identifies, none was encroached. The category of 'others' had the highest number of encroached water bodies — 149 out of 349. The report does not specify what sort of water bodies fall in the 'others' category.

2.4 Possible solution to Delhi's water problem

At present, Delhi Jal Board has managed to mitigate the water scarcity in Delhi. Yet, the uncertainty surrounding its capacity to fulfill future demand and to provide a sustainable solution from alternative sources will be very challenging. Therefore, there is a need to develop a comprehensive and strategic approach to tackle the impending water crisis effectively in Delhi. The water crisis in Delhi can be addressed through a combination of short-term and long-term remedies. Apart from enhancing

the efficiency of water management in Delhi which can help in to optimize water usage and reduce wastage, regulating groundwater extraction and increasing green cover and blue zone in the city, one effective long-term solution is rainwater harvesting, which can significantly increase the availability of water in the city. Here are some remedies for the Delhi water crisis and the scope for rainwater harvesting:

Rainwater harvesting involves collecting and storing rainwater during the monsoon season for future use. It can be implemented at various scales, from individual households to large commercial buildings. Here's its scope and benefits:

- a. **Rooftop Rainwater Harvesting:** Delhi has a vast urban area with numerous buildings and rooftops. Implementing rooftop rainwater harvesting can help capture rainwater and direct it into storage tanks for later use, reducing the burden on groundwater and other water sources.
- b. **Community Rainwater Harvesting:** Large residential colonies or apartment complexes can also set up community rainwater harvesting systems. These systems can collect rainwater from various buildings and common areas, providing a sustainable source of water.
- c. **Water Recharge Ponds:** Constructing rainwater recharge ponds in open areas can help replenish the groundwater levels, leading to a more sustainable water supply in the long run.
- d. **Incentives and Policies:** The government can offer incentives or enforce policies that encourage rainwater harvesting adoption across the city.

In conclusion, the implementation of rainwater harvesting and other water management techniques can play a crucial role in mitigating the water crisis in Delhi. However, a comprehensive approach involving sustainable practices, public awareness, and government policies is necessary to address this issue effectively.

2.5 Rainwater Harvesting Potential in Delhi

In view of this, Delhi has no options other than to look for multi-faceted and a long term water resource management plan in order to meet its future water demand. The efficient utilization of water and rainwater harvesting is an important method to improve the ground water level in Delhi. Delhi

has an average annual rainfall of about 658 mm. This translates to about 3.34 billion cubic meters of water that can potentially be harvested. If even a fraction of this is captured and used, it can help alleviate the water shortage in the city.

A large amount of storm water runoff is being generated from a number of constructed zones including residential areas, commercial and industrial areas, roads, highways and bridges. So tapping of storm water from the localized catchment surfaces such as roofs of housing colonies, educational institutions, official buildings, and open areas surfaces etc is a good option either to recharge the groundwater aquifers or storing it for direct use (HMWSSB 2023).

Basically, rainwater harvesting can be done at individual household level and at community level in both urban as well as rural areas (Sundaravadivel 2002). At household level, harvesting can be done through roof catchments, and at community level through ground catchments. In case of Delhi, there are a large number of housing societies, industrial premises; commercial and institutional establishments which have huge surface areas. Realizing the huge potential of Rain Water Harvesting (RWH), Ministry of Urban Development and Poverty Alleviation, GoI has made Rain Water Harvesting mandatory for all new buildings on plots 100 sqm and above in 2001 and asked States Governments to make modifications in Building Bye Laws (Rumi 2020). Accordingly in 2002, the Delhi government had implemented a financial assistance scheme to support installation of RWH structures. Under the scheme, grants-in-aid up to 50 percent of the total cost of RWH structure or INR 50,000, whichever is less, was given to eligible groups, such as registered Resident Welfare Associations (RWAs), Cooperative Group Housing Societies, recognised private and government schools, hospitals, charitable institutions, and NGOs.

Recently, Ministry of Housing and Urban Affairs, Government of India has issued new guidelines for Urban Water Conservation under Jal Shakti Abhiyan. Thrust areas include Rain Water Harvesting (RWH), Reuse of Treated Waste Water, Rejuvenation of Water Bodies and Plantation. As per the above guidelines it is the responsibilities of Urban Local Bodies (ULBs) to ensure that all government buildings (Central/State/ULB) must

have RWH structures as per building bye laws, and same should be checked before issuing Occupancy-cum-Completion Certificate (OCC).

Table 2.1: Criteria for disbursement of Financial Assistance

S. No.	Size of Plot	Financial Assistance
1.	100 sqm. and above up to 199.99 sqm.	50% of the total cost of RWH structure or Rs. 10,000 wherever is less
2.	200 sqm. and above up to 299.99 sqm.	50% of the total cost of RWH structure or Rs. 20,000 wherever is less
3.	300 sqm. and above up to 399.99 sqm.	50% of the total cost of RWH structure or Rs. 30,000 wherever is less
4.	400 sqm. and above up to 499.99 sqm.	50% of the total cost of RWH structure or Rs. 40,000 wherever is less
5.	500 sqm. and above	50% of the total cost of RWH structure or Rs. 50,000 wherever is less

Source: Delhi Jal Board, 2021

Accordingly, the Delhi government has revised the building byelaws for Delhi and Delhi Water & Sewer (Tariff and Metering) Regulations in 2019. Now all Govt. departments have to make provision of RWH in their buildings. As per the Delhi Government Cabinet decision 2709 dated 02.07.2019, Delhi Jal Board has been assigned to implement Rain Water Harvesting Systems in Government Buildings/ installations which are not maintained by the PWD, GNCTD. For Delhi Government buildings which are maintained by PWD, GNCTD, the implementation of Rain Water Harvesting System is to be carried out by PWD, GNCTD itself.

Since 2019, DJB has made RWH mandatory in Delhi in new buildings for measuring at least 100 sq.ft. or more to improve the water table which falling alarmingly across the city. To encourage and ensure installation of rooftop RWH in houses and buildings over 100 sqm, the Delhi Government now gives financial assistance up to Rs. 50,000 depending on the size of the projects (Table 1.1) and a rebate of 10 per cent on water bills. However, provision has been made that if the RWH system is found non functional, rebate for RWH may be withdrawn and those who fail to

install the system have to pay 1.5 times the bill amount (DJB 2019). To facilitate this RWH scheme, the Delhi Jal Board has roped in its 12 Jal Shakti Kendras, located in every District.

The success of the Rainwater Harvesting (RWH) initiative hinges on the active cooperation of the public. The Delhi Jal Board (DJB) has implemented its rainwater harvesting schemes at community level to promote sustainable water management and recharge the groundwater table. The main objective of these schemes is to collect rainwater, store it for later use and recharge the ground water at local level and, thereby reduce the depletion of groundwater and other sources of water.

The DJB has implemented two main rainwater harvesting schemes in Delhi:

1. **Rooftop Rainwater Harvesting:** Under this scheme, the rainwater falling on rooftops is collected and stored in underground tanks or recharge wells. The collected rainwater is used for various non-potable purposes such as gardening, washing, and cleaning. The DJB has made it mandatory for all new buildings in the city to have rainwater harvesting systems installed.
2. **Groundwater Recharge through Artificial Recharge Structures:** Under this scheme, artificial recharge structures such as recharge pits, trenches, and borewells are constructed to recharge the groundwater. The structures are designed to allow the rainwater to percolate into the ground and recharge the aquifers. The DJB has identified several areas in the city where groundwater recharge structures have been constructed.

The DJB has also implemented several other initiatives to promote rainwater harvesting and groundwater recharge in the city, such as:

1. Creation of awareness and training programs for the local community.
2. Encouraging the use of rechargeable devices such as soak pits, recharge wells, and recharge trenches.
3. Promotion of rainwater harvesting in schools and other educational institutions.

4. Development of rainwater harvesting models for public spaces such as parks and gardens.
5. Implementation of rainwater harvesting in government buildings and institutions.

Delhi Jal Board also provides financial assistance to those RWH units which have waste water recycling plant with an additional rebate of 5% on the monthly water bills, thus making 15% total rebate if both the systems have been set up and are functional. The penalty for non-implementing rain water harvesting systems will not be applied where ground water levels are shallower than 5.0 m. below ground levels.

**Table 2.2 Number of RWH System installed in Delhi as on
31.08.2022**

S. NO.	Departments	Total	Installed	RWH System yet to be installed
1.	Delhi Jal Board	594	594	0
2.	Other than DJB	89	89	0
3.	Schools, Colleges	4549	4144	405
4.	Other Deptt	5472	3705	1767
	TOTAL	10704	8532	2172

Source: Delhi Jal Board, Govt of Delhi

In total, the Delhi Jal Board has identified 10,704 Institutions/Organizations/RWAs for rainwater harvesting system installations. As of 2022, they have successfully installed RWH systems in 8532 of these institutions, leaving 2172 RWH systems yet to be installed across Delhi (Table 2.2). Further analysis reveals that the Delhi Jal Board has already installed all its 594 RWH systems, and the other departments have also installed all 89 RWH systems. However, in schools and colleges, out of 4549 systems, 4144 have been installed, leaving 405 yet to be installed. Similarly, in other departments, out of 5472 systems, 3705 have been installed, and 1767 are yet to be installed.

To make the RWH system cost-effective, the Delhi Government has decided to adopt the Durgapur model, also known as inline RWH system.

This system does not require a complex setup. It channelizes the rain water directly to a bore well, instead of a regular rainwater-harvesting pit. While setting up a conventional RWH system costs Rs 75,000-1 lakh, the Dungarpur model can be set up for as little as Rs 16,000 (ToI 2021).

2.6 IEC Activities Organized by DJB to promote Rainwater Harvesting

The Delhi Jal Board (DJB) took part in the 'Catch the Rain: Where It Falls, When It Falls' initiative, led by the National Water Mission under the Ministry of Jal Shakti. As a part of this endeavor, DJB collaborated with Water Digest to conduct a series of specialized training programs focused on "Rainwater Harvesting and Management" for Resident Welfare Associations (RWAs) and schools across Delhi.

- In order to encourage active community involvement, the Delhi Jal Board (DJB) organizes workshops and awareness programs on water conservation and Rainwater Harvesting (RWH) at both the circle and division levels. During the months of June and July 2019, a total of 33 workshops were conducted, drawing the participation of 1,051 individuals.
- The Delhi Jal Board took a proactive step in organizing a series of training programs for Delhi colleges. These programs were held on 7th and 8th June 2022 with the aim of creating awareness, enhancing capacities, and encouraging active participation of students and faculties from Delhi colleges in conserving and managing water resources.
- To ensure a wider reach, common citizens are sensitized about Rainwater Harvesting (RWH) through various channels, including print and electronic media. This approach aims to promote a deeper understanding of the significance of sustainable water management practices.
- Furthermore, the Delhi Jal Board provides information regarding rebates and penal provisions related to the implementation and non-implementation of Rainwater Harvesting Systems at the Rain Centres/Jal Shakti Kendras. This initiative aims to incentivize the

adoption of RWH systems and reinforce the importance of responsible water usage among citizens.

- The Delhi Jal Board took the initiative to organize online training programs for the citizens of Delhi and Resident Welfare Associations (RWAs) across 11 Jal Shakti Kendra zones. These training programs were designed to enhance knowledge, build capacities, and provide technological solutions concerning grey water management, emphasizing best practices.
- The primary objective behind these programs was to empower every citizen of Delhi with the necessary skills and understanding to effectively manage wastewater. By doing so, the aim was to alleviate the burden on fresh water resources and promote sustainable water usage throughout the city.

2.7 Conclusion

In conclusion, the water situation in Delhi remains a critical concern, demanding immediate and sustainable solutions. The increasing demand for water resources, coupled with erratic monsoon patterns and depleting groundwater levels, underscores the urgency for proactive measures.

One promising avenue is the implementation of rooftop rainwater harvesting systems. This approach not only holds the potential to alleviate the strain on conventional water sources but also empowers individual households and communities to contribute to their water security. By capturing and utilizing rainwater through innovative technologies, such as rainwater harvesting systems, Delhi could substantially augment its water supply, particularly during the monsoon season.

However, studies have shown that the successful implementation of rooftop rainwater harvesting requires a comprehensive strategy. This includes public awareness campaigns to promote adoption, supportive policies and incentives from the government, effective monitoring and maintenance mechanisms, and collaborative efforts involving stakeholders across sectors.

As Delhi grapples with its water challenges, integrating rooftop rainwater harvesting systems could signify a significant step towards a sustainable

and resilient water future. The scope for innovation, policy reform, and community participation presents a beacon of hope for addressing the pressing water crisis while fostering a culture of responsible water management.

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