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Seeking smart and sustainable solutions to Delhi's water woes

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ABSTRACT

Water is one of our most basic needs but it is also among the most poorly managed resources. A safe and assured supply of water is a crucial element of sustainable development. Sustainable Development Goal 6 is directly related to universal and equitable access to drinking water and sanitation but water is indirectly related to a number of other SDGs. It has strong cross-cutting linkages with issues like health, child development, poverty reduction, gender equity and ecosystem stability. Today humanity is already using more than half of the earth's accessible renewable fresh water. As population grows and per capita demand increases, water shortages will become a cause of conflict. Climate change will further exacerbate the situation.

Water stress is already a harsh reality for a half of the world population that faces an acute shortage of water at least during one month of the year. The UN World Water Development Report, 2024 estimates that the global urban population facing water scarcity will double from 930 million in 2016 to 1.7 to 2.4 billion people in 2050. In 2018, Cape Town's Day Zero showed that cities could indeed run out of water if corrective measures were not implemented. A similar crisis was faced by parts of Bengaluru in 2024.

This paper will attempt to study issues related to water resource management in Delhi, focusing especially on the supply of water for domestic needs. After identifying the major problems in supply and demand for water in Delhi, it will suggest strategies that could help in addressing these issues. Changes in public policy that involve adoption of digital technology and smart initiatives would help in providing sustainable solutions to problems related to water supply in Delhi. Data will be collected from secondary sources. These include Economic Survey of Delhi, reports of the Delhi Jal Board and the Planning Commission. As the authors also wish to understand the lived experiences of Delhi's citizens, face-to-face interviews will be conducted with selected respondents. These respondents will be from different locations and different social strata so that a diversity of experiences can be captured.

Key words: Water scarcity, Day Zero, Smart solutions

Introduction

The importance of water as a resource cannot be overstressed. It is essential for the existence of all life forms on earth. Apart from being a major environmental issue, water availability determines the quality of human life. Lack of access to safe and adequate water and sanitation is the single largest cause of illness across all age groups while water-borne diseases are a leading cause of child mortality. In areas suffering from hydrological poverty, a situation where livelihoods are threatened by a scarcity of water, water holds the key to poverty reduction and food security. In many developing countries, poor women and girls take time away from education, leisure and economic activity to spend numerous hours every day in finding and fetching water for the family needs, making water availability an important gender issue. The distribution of shared water resources between states and communities is a major threat to national and global security. Recognising that "water is essential not only to health, but also to poverty reduction, food security, peace and human rights, ecosystems and education", (UNSD, 2023) the United Nations identified water as a key part of the Sustainable Development Goals. According to international benchmarks, a region with per capita renewable water availability of less than 1,000 cubic meters per year is defined as an area with water scarcity (White, 2012). By this standard, India is perilously close to water scarcity (Indian School of Public Policy, 2023).

More than half of the world's population currently lives in urban areas, with cities in developing countries experiencing rapid growth. Urban planners and administrators are facing the dual challenge of providing adequate water to their citizens whilst also developing strategies and infrastructure to deal with hydrological disasters, especially urban floods. Cape Town (2018) and Bengaluru (2024) came perilously close to Day Zero, a day when the water supply completely dries up, reminding us how close the impending water crisis can be. Cities cannot be sustainable without efficient and equitable management of water and a shift in approach that integrates the use of freshwater, wastewater and storm water in an urban system is the need of the hour. The present study examines the challenges in meeting the water requirements of Delhi and suggests solutions to these challenges.

Objectives and methodology

Almost every city in India faces water stress and a twenty-four hour supply of water is not available in any of them. Population growth has not been accompanied by infrastructure development and an efficient and accountable water governance that provides water security to urban dwellers. The fact that the task of formulating a water policy for Delhi, the national capital, was initiated by the Delhi Jal board only in 2011 and the policy was declared only in 2015, speaks volumes about the importance accorded to the issue by those responsible for managing and developing Delhi's water resources. Meeting the water requirements of the citizens of Delhi equitably and sustainably is an existing problem that will only worsen as the population of the city increases and as new challenges are posed by climate change. The earlier rulers of Delhi had put in place a hydraulic system that took into account the topography and natural drainage of the area to conserve water. This included urban tanks (hauz), step wells (baoli) and natural drains (pulla). These gradually became dysfunctional after years of neglect as the city began to rely on modern technology to meet its growing water requirements. The solution to the water problems in Delhi could lie partially in reviving these traditional water

conservation systems and blending these measures with the use of modern smart technology. The objectives of the study are:

- To study the problems related to the supply of and demand for water in Delhi
- To highlight the problems of water availability using the lived experiences of a few residents
- To propose solutions to the problems

The study is based largely on secondary data. The data has been sourced from the National Water Policy, the Water Policy for Delhi, Economic Survey of Delhi and Delhi Jal Board reports. In order to understand how water affects the lives of Delhi's citizens, detailed interviews were conducted with 20 citizens. These citizens were from different colonies and belonged to different socio-economic strata. These interviews were non-structured and lasted between 30 and 45 minutes each. Respondents spoke freely about issues like the quality and quantity of water available to them, the problems with regard to water availability, steps they take to conserve water, whether they believe that water needs to be conserved and who should be responsible for water conservation.

Review of Literature

Water is an important resource and a basic need. However, it is in short supply in many parts of the world. This has generated a large body of work both at the global level as well as in the Indian context. Calling water scarcity "one of the defining issues of the twenty first century" the Aqueduct Water Risk Atlas (World Resources Institute, 2023) uses a peer-reviewed approach to assess water risk around the world. Its high-resolution maps are based on indices like water supply, water quality, regulatory pressure, governance, climate change impacts, socio-economic dynamics, population and water use across sectors. According to the report, water scarcity affects a quarter of the world's population. India ranks 13th among the 17 countries that are facing high levels of water stress, with the northern states of India suffering from significant depletion of ground water. A study by Bashier and others (2015) focuses on sustaining water supply and sanitation under the pressure of growing population in Gezira state, Sudan. It finds that there is currently a gap of 22.5 litres and 55 litres per capita respectively for rural and urban population in the area. This gap is expected to widen by 2025 as population was projected to increase at an estimated rate of 2.2%. The authors suggest the development of new sources of water to meet the growing needs of the population. Tariq Bhat (2014) discusses the water sector challenges faced in India. Comparing water availability across continents, he finds that the water crisis is most severe in Asia which has only 36% of the global freshwater resources but 60% of the world population. By 2050, various degrees of water scarcity will affect 2 to 7 billion out of the 9.3 billion people living on earth. He highlights the fact that while India has sizeable water resources, they are unevenly distributed over space and time. India houses 16% of the world's population on 2.5% of the world's land area which has 4% of the world's freshwater resources. Increase in demand for water stems from the increase in population, growing urbanization, rapid industrialization and rising demand from the agricultural sector. As per capita availability of water decreases continuously, careful and efficient management becomes imperative. Alina Mahadevan finds that water scarcity is a multi-dimensional phenomenon as access to water is affected by economic, social and political factors in addition to the physical availability of water (Mahadevan, 2024).

Gimpei, Drasch and their co-authors (2020) stress upon the need for the use of Information Systems technology for sustainable use of water in smart cities. While this technology is being increasingly applied towards the attainment of several SDGs, the field of urban water scarcity has somehow remained a blind spot. The paper presents a vision for a smart city water system that is based on a novel Information System. Biswas and Gangwar explain the spatial dynamics and water consumption pattern in Delhi employing statistical and spatial evidence. They analyse the impact of land use and land cover changes on water demand and supply patterns. The study also highlights the inequality in water supply between the districts of Delhi.

Aijaz (2020) studies the growth of rain water harvesting sector in Delhi. His analysis shows that while the programme has been partially successful, its development has been hampered by many institutional, governance and technical factors. He believes that a focus on the neighbourhood rather than on an individual would yield better results. In another study, Aijaz (2024) discusses the sourcing of raw water by Delhi Jal Board, its treatment and distribution. A study by The Delhi Urban Arts Commission (DUAC 2018) highlights how much of the rain water in Delhi is now allowed to flow down the drain because rapid urbanization and rampant concretization of open areas prevent water from seeping into the ground. Simultaneously, uncontrolled extraction of ground water has caused lowering of the water table in many parts of the city. The study identifies the existing historic structures like step wells (baolis), tanks (hauz) waterways (pullas) and garden water systems associated with tombs and highlights their role in water conservation. Welch (2018) shows how population growth, prolonged drought and perhaps also climate change is pushing Cape Town towards the most dramatic urban water crisis the world has ever seen. Similarly, Raghuram (2024) discusses the water crisis faced by the city of Bengaluru and how the Government and RWAs worked together to avert the impending crisis.

Water in Delhi: policy, demand, supply and challenges

Under the Constitution of India, water is a state subject. In the first few decades after independence, the thrust was on the utilization of water for irrigation in order to enhance agricultural production. It was in the 1970s that the consequences of overexploitation of surface and ground water resources became apparent. In the absence of any guidelines on water from the central government, states did not formulate any policies of their own. The first National Water Policy came only in 1987. Subsequently, modified and updated policies were announced in 2002 and 2012. The National Water Policy of 2002 favoured an Integrated Water Resource Management and Development approach. The policy announced in 2012 acknowledged that "large parts of India have already become water stressed" and that "issues related to water governance have not been addressed adequately." The national policies provided a framework and guidelines within which states could formulate policies suited to their conditions.

Delhi too lacked a holistic and scientific approach towards its water sector despite the fact that its population was growing rapidly and its water resources were limited. Water supply and sanitation were under the charge of the Delhi Water Supply and Sewage Disposal Undertaking. The Delhi Jal Board was constituted in 1998 to oversee the production and distribution of potable water as well as the collection, treatment and disposal of domestic sewage. It was only in 2011 that Shri Ramesh Negi, the then CEO of Delhi Jal Board, took the initiative to formulate a water policy for Delhi in order to ensure its water security. A Water Policy for Delhi was formally announced in 2016.

Among all the states of India, Delhi has certain unique characteristics. Part of the administrative powers are vested in the Central Government. There is therefore a possibility of friction between governments at the national and state levels. Physically, the state is small, densely populated and highly urbanized. In addition to its political and administrative functions as the national capital, it also serves as a commercial and economic centre. It has grown in size both in area and population. The growth has been explosive after Independence in 1947. While part of this growth has been planned by various administrative bodies, much of it has been spontaneous and unplanned. Even planned growth has taken place with scant regard to the topography, drainage and ecology. The planners have shown great faith in modern engineering methods to find solutions to the city's water problems, allowing the traditional systems of water conservation to be encroached upon or to become dysfunctional due to neglect. The city relies heavily on external sources of water that it shares with other states and over which it has limited control.

Water demand in Delhi

As Delhi became more and more urbanized, the demand for water for irrigation has decreased. There has also been a shift from manufacturing activity to commercial activity, and therefore a decline in the demand for water in the secondary sector (Delhi Jal Board, 2016). The domestic sector thus creates the major demand for water. The water policy for Delhi takes into account projections from different agencies like the Population Foundation of India and the Census of India and concludes that the population of the city could stabilize by 2031 at a figure below 25 million. Taking the projected population and the benchmark for per capita water supply (in lpcd: liters per capita daily) norm accepted by the Delhi Development Agency (DDA), the National Water Commission (NWC) and the National Capital Region Planning Board (NCRPB), the Delhi Water Policy estimates for demand for water (in MGD: Million Gallons per Day) are summarized in Table 1. According to its policy, Delhi Jal Board has planned for a population of 27 million in 2031 in order to have a safety net. It also allows for 15% losses due to leakage.

TABLE 1: ESTIMATED DEMAND FOR WATER IN DELHI

Author	Supply norm	2021 (Pop 23 million)	2031 (Pop 25 million)	2051 (Pop 27 million)
DDA	172 lpcd	868 MGD	942 MGD	1018 MGD
NWC	160 lcpd	807 MGD	877 MGD	947 MGD
NCRPB	225 lcpd	1150 MGD	1250 MGD	1332 MGD

Source: Delhi Jal Board

Sources of water supply in Delhi

External sources: Delhi depends on external sources for the bulk of its water supply. It derives surface water from rivers over which it has limited jurisdiction. Sometimes its neighbouring states fail to supply to Delhi its full share of water, thus precipitating a crisis. The city lies in the Yamuna Basin and the river is the main source of water for the city. Water drawn by the Western Yamuna Canal at the Tajewala Barrage in Haryana is conveyed to Delhi through the Delhi Tail Distributary. After processing at the Haiderpur and Chandrawal Water Treatment Plants (WTPs), the water is distributed within Delhi. Water from the Yamuna is also abstracted at the Wazirabad Barrage and treated at the Wazirabad WTP. Under the Upper Yamuna

Agreement signed between the states of Uttar Pradesh, Haryana, Rajasthan, Himachal Pradesh and the NCT of Delhi, Delhi is entitled to 0.724 billion cubic meters (BCM) of water every year from the river Yamuna. Of this, 580 million cubic meters (MCM) are to be received between July and October, 68 MCM between November and February, and 76 MCM between March and June. As Delhi does not have the capacity to store water, 298 MCM of the 580 MCM received in the monsoon season between July and October is allowed to flow without being used. Delhi is also bound to release over a million MCM of treated effluent back into the Yamuna.

TABLE 2: RAW WATER AVAILABLE IN DELHI FROM ALL SOURCES

SOURCE/ WATER CARRIER	RAW WATER QUANTITY (million gallons per day)
Carrier Line Channel (CLC)	370
Delhi sub-branch (DSB)	178
Yamuna River Course	65
Upper Ganga Canal	254
Groundwater	117
Total Raw Water	**984**
Rainwater	--
Waste water/ Sewage generated	792

Source: Economic Survey of Delhi 2023-24

In addition to water from the Yamuna, Delhi also receives water from the Ganga and the Indus basins. Water abstracted from the Ganga at Muradnagar in Uttar Pradesh feeds the WTPs at Sonia Vihar and Bhagirathi. This water caters to the needs of East, Northeast and parts of South Delhi, accounting for roughly a fourth of Delhi's water supply. Water abstracted from the Ravi-Beas (Indus) basin reaches Delhi through the Carrier lined Channel and the Delhi Sub Branch. Some new dams are proposed in the Himalayas which may augment Delhi's water supply in the future. These include the Renuka Dam on the Giri River in Himachal Pradesh, the Kishau Dam on the Tons River and the Lakwar Vyasi Dam on the Yamuna, both in Uttarakhand. However, it may be a long time before these projects materialize.

TABLE 3: SOURCES OF WATER SUPPLY IN DELHI

YEAR	External Sources (Surface Water)	Internal Sources (Ground water)	Total (million gallons per day)
2007	650 MGD	100 MGD	750 MGD
2014	821 MGD	80 MGD	901 MGD
2021	826 MGD	95 MGD	921 MGD

Source: Economic Survey of Delhi 2021-22, Economic Survey of Delhi 2012-23, Economic Survey of Delhi 1999-2000.

Internal sources: As is evident from Table 3, Delhi cannot meet its demand for water from surface water alone. A significant amount of ground water is extracted by authorized and unauthorized tube wells and ranney wells. The Central Ground Water Board (CGWB) 2023 Report for Delhi points towards a heavy strain on the ground water resources of the city. Ground water recharge in 2023 was only 0.38 billion cubic meters (bcm), much lower than 0.41 bcm in 2022. The annual extraction of ground water in 2023 was 99.13%, higher than the already high

figure of 98.16% in 2022. Ground water in 41% of the city area is "overexploited". According to the report, the number of assessment units in Delhi categorized as safe in terms of ground water extraction increased from 12% in 2022 to 15% in 2023, but the number of assessment units categorized as critical increased drastically from 21% to 35% in the same period. In addition to the bore wells operated by the Delhi Jal Board, there are some registered bore wells and many illegal ones. So while on the one hand Delhi "plunders its aquifers" (Delhi Jal Board, 2016), construction and concretization impedes their recharge. Delhi Jal Board (2016) also found that 45.5% of ground water samples contained unacceptable levels of heavy metals, dissolved salts, nitrates, fluorides and trace elements, which made them unsuitable for drinking. The CGWB Report on the water quality in shallow aquifers in Delhi (CGWB 2023-24) evaluated water samples collected from 95 ground water monitoring wells (GWMs) in May 2022 and found the occurrence of high concentrations of some water quality parameters. The results are summarized in Tables 4 and 5.

TABLE 4: GROUND WATER QUALITY IN DELHI

CONTAMINANTS	LIMIT CATEGORIES	NUMBER OF SAMPLES	PERCENTAGE OF SAMPLES
Chloride	Desirable Limit (<250)	53	55.78 %
	Permissible Limit (251-1000)	33	32.63 %
	Beyond permissible limit (>1000)	11	11.57
Fluoride	Desirable Limit (<1.0)	66	69.47
	Permissible Limit (1.0-1.5)	14	14.73
	Beyond permissible limit (>1.5)	15	15.78
Nitrate	Permissible Limit (<45)	63	65.26
	Beyond permissible limit (>45)	32	34.73

Source: Central Ground Water Board Report

TABLE 5: GROUND WATER QUALITY HOTSPOTS IN UNCONFINED AQUIFERS OF NCT OF DELHI

PARAMETER	AREAS WITH PERMISSIBLE VALUES	AREAS WITH ABOVE PERMISSIBLE VALUES
Electrical Conductivity (reflected in TDS)	Central and South-Eastern Parts including South, South-east, East, Shahadara, North-east, Central and New Delhi districts	North, North-west, South-west and West districts
Chloride	South, South-east, North-east, Central, New Delhi and Shahadara, parts of North, North-west, West and South west districts	Parts of North, North-west and West districts
Fluoride	Most parts of Delhi	Pockets of Central. North, North-west, South, South-west and West districts
Nitrate	North-east and South-east disticts	Most of North-west, South, many parts of North and New Delhi districts

Source: Central Ground Water Board Report, 2023-24

Additional sources -Rainwater harvesting and waste water: Rain Water Harvesting (RWH) was made mandatory by the Government of India in 2001 for all new buildings constructed on plots larger than 100 square meters. Following this, the Delhi Government launched a scheme to offer financial assistance for installation of RWH structures in 2002. In 2019, RWH became mandatory in Delhi for all new and existing buildings measuring 100 square feet or more. While 594 buildings of the Delhi Jal Board, 4144 schools and colleges, metro rail properties and some

other institutions had adopted RWH practices, it was found that the implementation of the scheme was only partially successful as many buildings had not installed RWH systems (Singh, 2021). Aijaz (2020) too found several factors that hampered the success of RWH scheme. He also found that water collected by RWH systems was mostly used to recharge ground water because it was contaminated as it drained into the system, making it unfit for most other purposes.

The consumption of water is directly related to the generation of waste water. Waste water generated in the city is carried by its sewer system to sewage treatment plants where contaminants are removed from it and the effluent becomes clean enough to be discharged into the Yamuna. According to the Delhi Jal Board website, Delhi currently has a network of 58 waste water treatment plants with a capacity of 607 MGD. The focus is on treating waste water as a resource. Waste is used to generate energy, the sludge is used as fertilizer, and the treated water is used for many purposes, reducing the demand for potable water. It already supplies treated effluent to several agencies that use it for purposes like horticulture, firefighting, power plant cooling and even for recharging ground water.

Distribution of water and water lost in transit: According to the website of Delhi Jal Board, water is distributed through a network of pipelines that measure 14, 355 km in length. There are 107 primary underground reservoirs which help in maintaining a supply of water at sufficient pressure. Water is supplied twice a day, usually in the mornings and evenings. The Board has extended its piped water supply to 1482 unauthorised colonies. Delhi Jal Board also maintains a fleet of 1033 tankers of various types that deliver water wherever and whenever water cannot be supplied through pipes. Areas where it was not possible to lay pipelines due to technical reasons are served by 60 Water ATMs. A significant proportion of the water that leaves the water treatment plants does not reach the end users. The amount of non-revenue water that is produced but lost in transit is variously estimated to be about 47% (Delhi Jal Board) or even 58% (Economic Survey of Delhi). The losses could be because of physical leaks in the pipelines, pilferage through illegal connections, non-functional meters or institutional corruption.

Shortfall in water supply and private water tankers: The Economic Survey of Delhi, 2023-24 shows that the demand for water in the city was 1290 MGD while the supply was only 946 MGD. This created a shortfall of 344 MGD. As water is a basic requirement, people who do not have access to water supplied by the Delhi Jal Board have to make their own arrangements. Some tap into ground water sources by digging their own bore wells or tube wells. Since ground water is not potable, they often buy bottled drinking water. Private water tankers also play a very important role in fulfilling this unmet demand. Private water tanker owners operate almost as a mafia and they have divided up the Delhi NCR region among themselves. They operate in collusion with the police, politicians and Jal Board officials, becoming particularly active in summer when water shortage becomes more acute. Water is drawn by these private suppliers from private bore wells, Jal Board bore wells and sometimes it is even diverted from water pipelines. The water is sold at exorbitant prices. A 4000 litre tanker sells for Rs. 5000 in times of water crisis against a normal rate of Rs. 500 (Pillai, 2024).

Challenges faced by Delhi Jal Board

Lack of control over external sources: As discussed previously, Delhi depends on its neighbouring states for its water supplies. With the demand for water increasing everywhere,

the other riparian states are clamouring for a greater share of water of the Himalayan Rivers. Delhi is also not in a position to construct dams across any of these rivers. It has to wait for other states to plan and execute the projects which could potentially provide water for its needs. These projects may also encounter resistance from environmentalists and the local population that would be affected by them.

TABLE 6: RESPONDENTS AND THEIR PLACE OF RESIDENCE AND WATER SUPPLY SYSTEMS

	NUMBER OF RESPONDENTS	AREA OF RESIDENCE (WITH ATTRIBUTES)	SOURCE OF WATER	ARRANGEMENTS TO ENSURE 24-HOUR WATER AVAILABILITY
1	12	Middle income colonies such as DDA flats – Saket, Vasant Kunj, Plotted independent house floors –Rajouri Garden, group housing societies – Vikaspuri, Bhalaswa	Piped Water Supply – Metered water supply	DJB supply stored in huge storage tanks. Additional water drawn from underground sources, either individually or at the society level.
2	8	Jhuggi Clusters or slums – Near Vikaspuri, Chuna Bhatti (Kirti Nagar furniture market)	Community water taps – With individual pipes laid out from these taps to houses (only by selective people) – unmetered water supply DJB Tanker	Limited water supply in the morning and evening (for 1 to 4 hours per day). Water stored in large containers inside the house.
		Kaccha Tihar	Piped Water Supply with metered connections (usually maintain low water consumption so as to have no water bill)	Limited water supply with rooftop water storage tanks and additional water from underground sources managed individually.

Threats to water security: There are several externalities such as climate change, erratic rainfall and declining river flow that threaten the water security of Delhi. The reduction in soft surfaces reduces infiltration, preventing recharge of aquifers on the one hand and aggravating the problem of waterlogging on the other. All these are existing threats to Delhi's water security which are likely to become more acute in future.

Lack of coordination with other bodies: The Delhi Development Authority (DDA) which is responsible for planned growth of Delhi, does not consult the Delhi Jal Board while sanctioning new colonies. Policy changes, such as an increase in FAR are announced by other agencies, leaving the Board to cater to an increased demand for water and sewerage with the old infrastructure (DJB, 2016).

Water in Delhi: The lived experiences of some citizens

This section examines the water-related experiences of a cross section of Delhi's ordinary citizens. 20 respondents were interviewed at length to understand their concerns regarding water availability and quality. The location of the respondents, the source of water and the arrangements made by them to ensure adequate water for their needs are summarized in Table 6.

Source: field work

Broadly speaking, the respondents represent two contrasting categories of people. On the one hand are those with limited income, residing either in slums or unauthorized colonies that were regularized later. On the other hand are the people living in planned DDA colonies and group housing societies. (The names of all respondents have been changed so as to conceal their identities). Jamuna, aged 45, lives in Chuna Bhatti in Kirti Nagar. Her family depends on a community tap for its water supply. For this, a family member has to stand in a queue every morning and evening. This has become a part of the routine for all families in the community, but sometimes fights break out in summer when the supply of water dwindles. Sandhya lives in a jhuggi cluster in Vikaspuri. The entire community depends on water supplied by a Delhi Jal Board water tanker. Every morning, residents line up their containers and rush to fill them up when the tanker arrives. As there is a limit to the amount of water her family can store in their small dwelling, they also use water from a nearby public park to wash clothes and some other chores. Both Jamuna and Sandhya laughed when they were asked about water quality. For them, just getting enough water for their daily needs was a challenge in itself. Although they did not pay for water, the limited supply of water forced them to use the resource with care. Apart from Jamuna and Sandhya, the other respondents had made arrangements to ensure a 24-hour supply of running water. They had installed overhead tanks which they filled up with the help of a motor. However, almost all respondents faced some problems related to the quantity and quality of water supplied to them. Ramesh, a resident of Vasant Kunj complains that the supply of water is very erratic as his colony lies at the tail-end of the pipeline that comes from Sonia Vihar. When the water reservoir in one pocket of Vasant Kunj does not fill up, the supply in other pockets is also affected. Neeta, a resident of DDA flats in Saket also experiences occasional shortages of water, especially in summer. She says," every once in a while I have to phone Delhi Jal Board for a tanker." But she adds that the tanker arrives quite promptly. Geeti, who lives in a group housing society in West Delhi, says that her society uses water extracted from a bore well to augment the municipal supply. Owing to this, the quality of water is very poor and pipes and electrical equipment corrode very fast. Shweta lives with her family in an independent multi-storeyed house in Bhalaswa. They have arranged to store water in overhead tanks. However, the supply of water is very erratic. "When the water is supplied at a time when there is no one at home", she says, "there is a problem. We have a handpump in our premises, but we are not allowed to use ground water because it is contaminated due to proximity to the Bhalaswa landfill". Then the family has to buy bottled water, which is a major expense.

All respondents other than Jamuna and Sandhya used filters or RO systems to purify water before drinking it. Sheela, who lives in Beri Wala Bagh and works as a cook in some houses, says that her family decided to invest in an RO system because two members out of her family of four contacted jaundice and typhoid. "It was a choice between paying medical bills and investing in an RO system. We chose the RO even though it was beyond our means. We were

spending a lot on medical expenses," says Sheela. They were all aware about the importance of water and the need to save it. Yet none of them did anything to conserve water as they also did not think that they wasted water. Geeti says that in her society, houses are not billed individually for the water they use. This encourages wasteful use of water by some members who use hose pipes to wash their cars and verandahs and sometimes even the spaces around their houses. The society has also installed a Rain Water Harvesting system but she doubted that it worked at all.

Saving Water: Solutions to Delhi's Water Woes

Given the limitations in increasing the supply of water in Delhi, solutions to Delhi's water woes lie in more efficient management of existing resources and demand control. The following are some suggestions:

Enhancing Supply

As discussed earlier, Delhi has limited jurisdiction over its water resources. Given that other states with whom Delhi has to share surface water resources are aggressive in asserting their rights, it will be difficult for Delhi to enhance its access to water from the existing sources. Availability of water from other Himalayan rivers is a distant dream. Supply can therefore be augmented by rain water harvesting and by recycling waste water. A first step in this direction would be the restoration and revitalization of the traditional water conservation and distribution structures in Delhi. These include the baolis and hauzs which should be desilted and revived in order to store water and recharge ground water. Also, ecological management by increasing green cover and soft areas will increase infiltration of water into aquifers. Simultaneously, it will reduce the problem of waterlogging. The laws regarding installation of Rain Water Harvesting systems in all buildings should be implemented with greater stringency to ensure that the systems are actually functional and do not exist only on paper. While it is important to restore ground water, it must be remembered that this resource is to be used only as a buffer in times of severe water crises.

Another strategy of augmenting water while also deriving several other benefits is to close the water resource loop by recycling waste water. A key to sustainable cities is decentralized treatment of waste water. This reduces the need to transport sewage from the point of origin to a centralized treatment plant and then pumping the treated water back to the end user. The grey water generated after onsite treatment of sewage can be used locally. In the long run this will also help in checking pollution levels in the Yamuna.

Reducing Demand

Reducing demand for water by encouraging a culture of responsible water use is crucial to maintaining the demand-supply balance in water use. There is urgent need to create awareness about water being a finite, and increasingly also a scarce resource. Strict measures that helped Cape Town avert a Day Zero could be in place at all times, instead of being implemented only in times of crisis. Some suggestions for reducing demand for water are as follows:

- Raising tariffs for increasing consumption. Lifeline rates can be charged from low-income consumers with low levels of consumption, but charges should increase exponentially as consumption rises.
- Installation of water saving devices should be made mandatory. Water saving toilets, dual flush tanks, showerheads and washing machines can go a long way in reducing water use.
- Use of greywater in flush tanks should be encouraged.

Adopting Smart Solutions

Several smart city initiatives can help in better management of urban water resources. Adoption of smart technology can enhance the ability of cities to respond to modern day challenges in a more effective way. The Internet of Things (IoT) can be used for collecting real time data on critical metrices. Smart water management systems use sensors to monitor water levels, water flow, and water pressure. Data collected by these sensors is sent to cloud servers where it is analysed with the help of Artificial Intelligence (AI) to detect leaks and flooding. Smart technology can help in the following ways:

- It can help in wise use of water by monitoring hourly consumption of water in homes and industries.
- It can help in detecting leaks in supply lines and thus reduce loss of water.
- It can increase revenue by accurate billing and reduction in non-revenue water.
- It can help authorities in decision making by providing information on the state of water infrastructure.
- It can provide additional benefits such as sending alerts to social services if any changes are detected in the water consumption in the home of a vulnerable persons.

Institutional measures

It is necessary that the Delhi Jal Board which is responsible for supplying water to Delhi be made autonomous and free of government control. It should have the authority to fix tariffs so that costs can be recovered and the water supply system can be operated and maintained efficiently. It should also be freed from the burden of populist policies of elected governments.

Conclusion

Water issues in Delhi have so far been treated with a firefighting approach. What is needed is a farsighted policy that takes into account long-term projections regarding supply and demand for water. It will also have to be prepared for alternative scenarios as the impact of climate change, population growth and technological innovation cannot be predicted with certainty. Urban planners must display hydrological sensitivity in all aspects of planning. There must also be perfect coordination among all agencies involved in the development of Delhi. As stated in the National Water Policy, 2012, good governance through transparent informed decision making is crucial to the objectives of equity, social justice and sustainability.

REFERENCES

Aijaz, R. (2020) Bridging Water Demand and Supply in Delhi: The Potential of Rainwater Harvesting. *ORF Special Report No. 117*, 2020, Observer Research Foundation.

Aijaz, R. (2024) Exploring Ways to Fill Delhi's Unmet Water Needs, *ORF Issue Brief No. 706*, April 2024, Observer Research Foundation.

Bashier, Bashir et al (2015). A challenge of sustaining water supply and sanitation under growing population: A case of the Gezira State, Sudan. *International Journal of Water Resources and Environmental Engineering*.

Bhat, T. (2014) An Analysis of Demand and Supply of Water in India. *Journal of Environment and Earth Science*, Vol. 4, No. 11, 2014.

Biswas and Gangwar (2021). Studying the water crisis in Delhi due to rapid urbanisation and land use transformation. *International Journal of Urban Sustainable Development* Volume 13, Issue 2, 2021.

CWGB (2023) *Dynamic Ground Water Resources of India, 2023*. http://cgwb.gov.in

CGWB (2023-24*) Report on Ground Water Quality in Shallow Aquifers of NCT of Delhi.* Central Ground Water Board, Ministry of Jal Shakti, Government of India.

Delhi Jal Board (2016) *Water Policy for Delhi, 2016*. https://delhijalboard.delhi.gov.in.

DUAC (2018*) Water and Heitage. Rejuvenation of Baoli Precincts*. Delhi Urban Arts Commission.

Gimpei, Drasch, Hawlitschek and Neumeier (2020). Information Systems for Sustainable Use of Water in Smart Cities: A Review and Call for Future Research. Conference: SIGGreen Pre-ICIS Workshop, 2020

Government of NCT of Delhi, *Economic Survey of Delhi 2023-24*, Water Supply and Sewerage.Delhi: Planning Department

Indian School of Public Policy (2023) *From Scarcity to Sustainability- The Evolution of Water Policies in India*. https://www.ispp.org.in

Mahadevan, AV (2024) A Parched Nation: Analysing India's Water Scarcity Challenges. *EPW*, Vol. 59, Issue No. 20, 18 May, 2024.

Pillai, S. (2024) Delhi's tanker mafia begins from Jal Board borewells- pipes, profits, politics. *The Print*. https;//theprint.in/ground-reports/delhi-water-tanker-mafia-jal-board-borewells-pipes-profits-politics/2149003/

Raghuram, M. (2024) Bengaluru after Day Zero: "City's government and people took water scarcity head-on and will convert crisis into opportunity." *Down To Earth* https://www.downtoearth.org.in./water/bengaluru-after-day-zero-citys-government-people-took-water-scarcity-head-on-will-convert-crisis-into-opportunity

Singh, AK, Rain Water Harvesting in Delhi- Role of Civil Society. *Nagarlok,* Vol. LIII, Part 2, April-June 2021.

UNSD (2023) *The Sustainable Development Goals Repor*t https://unstats.un.org

Welch, C. (2018) Why Cape Town Is Running Out of Water, And Who's Next. https://www.nationalgeographic.com/sciene/article/cape-town-running-out-of-wter-drought-taps-shutoff-other-cities

White, C. (2012) Understanding water scarcity: Definitions and measurements. *Global Water Forum.* http://www.globalwaterforum.org/2012/05/07/understanding-water-scarcity.

World Resources Institute (2023*) Aqueduct Water Risk Atlas.* https://www.wri.org

Websites Accessed

www.delhiplanning.delhi.gov.in/planning/economic-survey (accessed on 5th November, 2023)

-- https://delhijalboard.delhi.gov.in › …/water_policy_20112016 (accessed on 5th November, 2023)