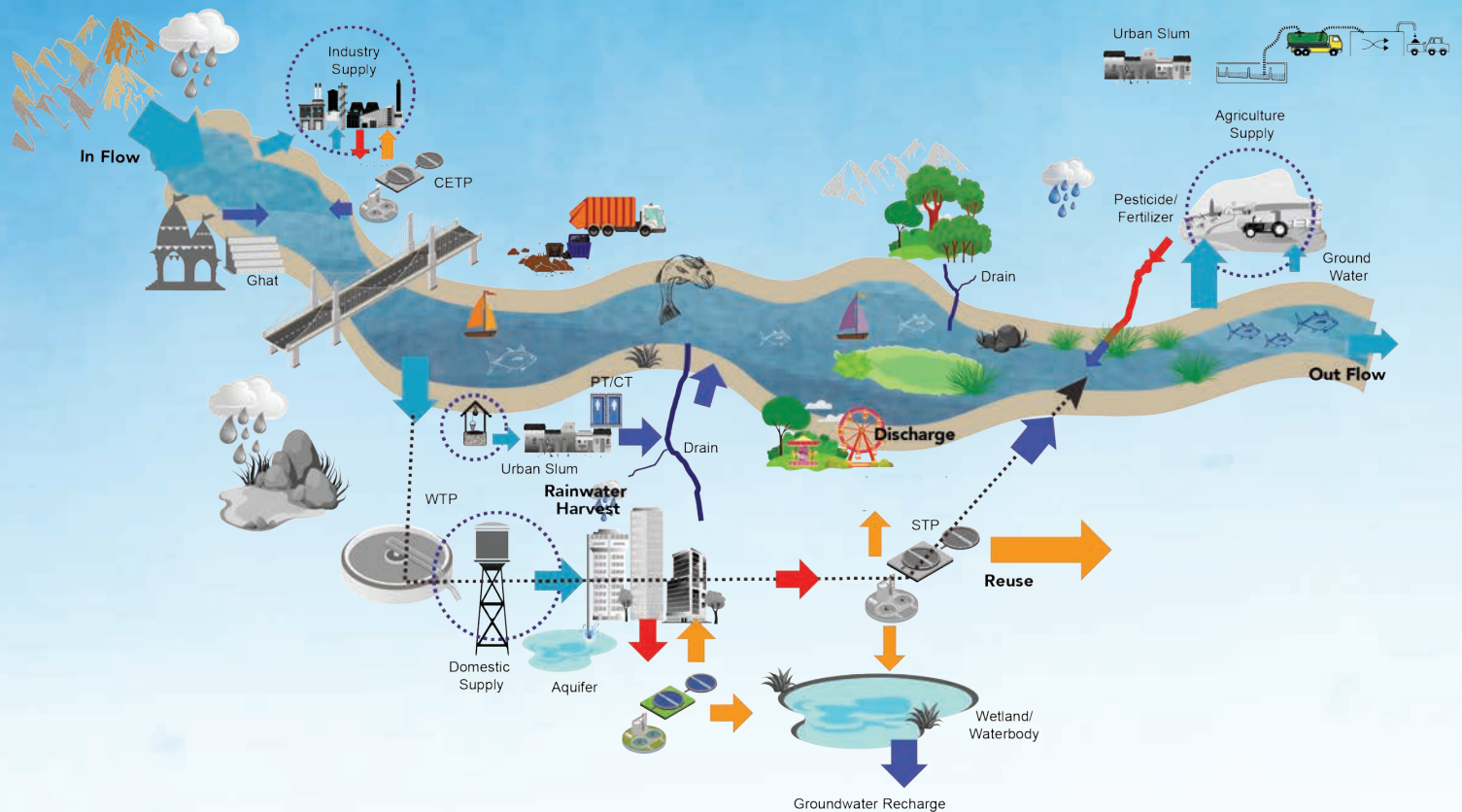


WHITE PAPER

# A Qualitative Framework to Evaluate the Extent of Integrated Urban Water Management in Indian Cities & Applying the Framework to Delhi





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**A Qualitative Framework to  
Evaluate the Extent of  
Integrated Urban  
Water Management  
in Indian Cities  
&  
Applying the Framework to Delhi**

February 2021

## Title

**A Qualitative Framework to Evaluate the Extent of Integrated Urban Water Management in Indian Cities & Applying the Framework to Delhi**

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# Executive Summary

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**I**ntegrated Urban Water Management (IUWM) has been widely promulgated as a contemporary philosophy across the globe for managing the urban water sector. Often seen as the more doable version of the basin-scale Integrated Water Resources Management, the philosophy essentially propagates that the water supply, wastewater, and stormwater elements are looked at holistically in order to augment the water security of a city. In India, IUWM has been acknowledged as a sound and robust solution to manage the urban water sector since 2015. However, it has not been taken up as enthusiastically as envisaged, for different reasons. One of these could be attributed to lack of awareness of the IUWM philosophy in some cities, especially the smaller ones. However, in larger proactive cities, attempts are being made to explore the adoption of IUWM.

The existing knowledge about IUWM and its role in managing the urban water sector is quite comprehensive, however, the challenge appears to be in translating this knowledge into practice. To do so would require a thorough understanding of the city's water dynamics from multiple perspectives—hydrology, economics, institutional mechanisms, governance, and social structures, among others. This study is targeted to address this need. It has established a framework with a set of ten criteria that can help qualitatively evaluate the extent of IUWM implementation in a city, with a view to provide useful insights for areas that a city should target in order to progressively move up the IUWM ladder. The criteria are categorized under three heads—enabling environment, institutional arrangements, and management instruments.

The study then evaluated the capital city of India, Delhi, against the designed framework to assess the city's standing in terms of IUWM adoption.

The analysis revealed that Delhi has a very good enabling environment for IUWM, in terms of progressive policies and thinking. Furthermore, it has a strong financial standing which can help step up the level of ambition required for IUWM proliferation. The institutional arrangements in Delhi for scaling up IUWM are quite adequate. There are dedicated agencies to manage the different elements of urban water management, but the coordination among these agencies needs to be improved. From the management instruments perspective, Delhi is a bit of mixed bag. On one hand, it has adopted state-of-the-art interventions such as a centralized database for water-related information, District Metering Areas, trenchless sewer remediation, wastewater reuse, among others. On the other hand, the city has a relatively poor record with citizen engagement. Furthermore, while it invests in research and innovation, this is more an 'end of pipe' approach to find a cure for the problem rather than for preventive or transformational solutions that fit the philosophy of IUWM better. Overall, the extent of IUWM implementation in Delhi is moderately good. It certainly has some things that work in its favour, and has the potential to improve on most of the areas where it is lagging.

An element of subjectivity is always associated with qualitative assessments. Hence, it is important to highlight that the framework has been designed as an "introspective" instrument for cities to make a honest internal assessment of where they stand in terms of IUWM. In its current form, the framework should not be used for benchmarking or comparing cities. This paper hopes to trigger some critical thinking and discussion among water managers and decision makers that can set the stage for tangible actions for enhanced water security.



# Message

It is quite evident that Indian cities are facing a water crisis. Over the last decade or so, incidences of water shortages, flooding, groundwater depletion, polluted water bodies have become alarmingly more frequent and intense. A growing body of policy literature suggests that averting a larger calamity will require prioritizing water security at a national level, supported by efficient institutions and management instruments. The country has signalled its intent for the former by launching several notable initiatives that address water security. These include the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Smart Cities Mission, Jal Jeevan Mission, Jal Shakti Abhiyaan, National Mission for Clean Ganga, among others. Hence, a very favourable enabling environment has already been created at the highest level. It is now important to leverage on this to make a difference on the ground.

The first step to setting things right is adopting a sound philosophy for managing the water sector in cities. Integrated Urban Water Management (IUWM) is one such philosophy that is widely recognized across the world, including India. However, despite its universal appeal, the application of IUWM in Indian cities has been relatively limited. One of the reasons for this anomaly is lack of awareness and knowledge among different stakeholders on the finer details of IUWM. This white paper is an attempt to plug this knowledge gap to some extent, while also adding to the rich body of scientific literature on this topic. The paper introduces a unique, first-of-its-kind qualitative framework that can be easily adopted to ascertain how well or otherwise a city is progressing up the IUWM ladder. It then applies this framework to the city of Delhi.

Such frameworks are important for cities to have a sound understanding of the water sector in the city that bring to light the pain points and challenges that will need to be overcome in order to ensure sustainable urban water security. I commend the team from NIUA and UNESCO New Delhi Office for developing this timely white paper. I hope the contents of this paper will find the required buy-in from diverse stakeholders, and usher in an era for mainstreamed IUWM application in our cities

A handwritten signature in blue ink, appearing to read 'Hitesh Vaidya', with a stylized flourish.

**Hitesh Vaidya**

Director

National Institute of Urban Affairs

# Message



“Leaving no one behind” is at the heart of the commitment of the 2030 Agenda for Sustainable Development.

Three billion people worldwide lack the access to basic handwashing facilities at home. The COVID 19 pandemic has reemphasized the critical importance of water security for inclusive, sustainable economic growth, and social well-being.

By 2030, over a billion people will live in 100 large cities and 60 % of the world’s population will live in urban areas. Coping with current and future challenges, require innovative solutions to ensure access to water and sanitation for all including equality of service and economic viability.

UNESCO, through its Intergovernmental Hydrological Program, the Centres under auspices of UNESCO, the UNESCO Chairs and the World Water Assessment Program, supports Member States in their efforts to achieve water security, particularly with regard to governance, the management and development of knowledge and skills.

This White Paper is the result of a collaborative effort of the UNESCO New Delhi and National Institute of Urban Affairs, India. It presents a framework for the sustainable and holistic water management approach for Indian Cities through Integrated Urban Water Management, ensuring equitable allocation of water resources for all.

I am convinced that the paper will help city officials in making informed decisions to build resilient, water secure cities, leaving no one behind.

A handwritten signature in blue ink, appearing to read 'Eric Falt'. The signature is stylized and fluid.

**Eric Falt**

Director and UNESCO Representative  
to Bhutan, India, Maldives and Sri Lanka



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Picture Credit: Arghyam, Bengaluru

# Introduction

Water security is a top global priority today. It has multiple dimensions, among which water availability has traditionally been the most in focus. Rapid population growth, coupled with unsustainable water withdrawals, poor infrastructure and governance is resulting in sub-optimal water supplied in many parts of the world. Approximately 700 million people in 43 countries are currently suffering from water stress and scarcity (Global Water Institute, 2013). Furthermore, about 4 billion people experience severe water scarcity during at least one month of the year (Mekonnen and Hoekstra, 2016).

Another dimension of water security is that of water-related disasters. Recent statistics suggest that around 74% of all natural disasters between 2001 and 2018 were water-related. During the past 20 years, the deaths caused only by floods and droughts exceeded 166,000, while floods and droughts affected over three billion people, and caused total economic damage of almost US\$700 billion (UN WWDR, 2020).

A third dimension of water security that has been gaining increasing prominence in recent times is that of water pollution. Again, the global situation in this regard is a cause of concern as well. 80% of all wastewater flows back into the ecosystem without being treated or reused (UN WWDR 2017).

The alarming condition of water security has also been recognized by the World Economic Forum (2020), which has consistently highlighted water crises among the top five global risks in terms of impacts on society since 2014, as seen in Figure 1.

Going forward it is estimated that by 2030, the world will have shortage of 40% in freshwater (UN Water 2018). This will be compounded by the effects of climate change by increased competition within water use sectors resulting in reduction of water availability by as much as two thirds by 2050, compared to 2015 levels, and a decline of 6% in Gross Domestic Product (GDP) by 2050 because of water related losses in agriculture, health, income and property (World Bank 2016).

Figure 1: Top global risks and challenges in terms of impact

Ranking of Risk	2014	2015	2016	2017	2018	2019	2020
1st	Fiscal crises	Water crises	Climate action failure	Weapons of mass destruction	Weapons of mass destruction	Weapons of mass destruction	Climate action failure
2nd	Climate action failure	Infectious diseases	Weapons of mass destruction	Extreme weather	Extreme weather	Climate action failure	Weapons of mass destruction
3rd	Water crises	Weapons of mass destruction	Water crises	Water crises	Natural disasters	Extreme weather	Biodiversity loss
4th	Unemployment	Interstate conflict	Involuntary migration	Natural disasters	Climate action failure	Water crises	Extreme weather
5th	Infrastructure breakdown	Climate action failure	Energy price shock	Climate action failure	Water crises	Natural disasters	Water crises
	Economic	Environmental	Geopolitical		Societal	Technological	

Source: As adapted from World Economic Forum, 2020

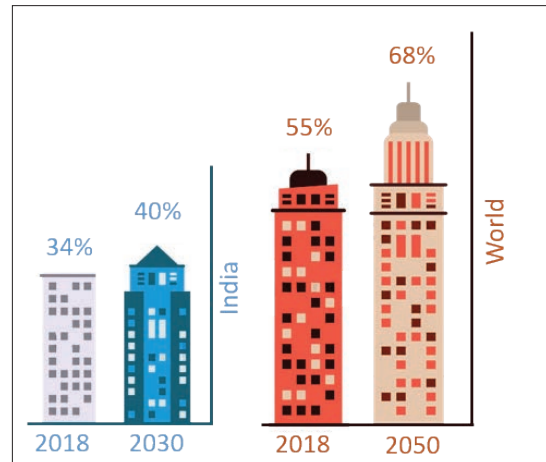
As seen in Figure 2, today, 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050 (UN DESA 2018). Hence, it is not surprising that the water security crisis is more pronounced in cities. One of the most vivid examples in this regard is the Cape Town (South Africa) water crisis of 2017-18, where the city was within days of reaching Ground Zero.

About 34% of India's population lives in urban areas, and by 2030, this number is expected to go up to 40% (UN DESA 2018). The increasing rate of urbanization is exerting pressure on the already stressed and finite water resources. In 2011, the domestic water demand of urban India was 50,895 Million Litres per Day (MLD). However, the water supplied was only 26,107 MLD (TERI 2018). It is quite evident that there is a vast gap between the demand and supply of water in urban areas of India. This problem is further exacerbated considering that more than 40% of water supplied in many Indian cities does not earn any revenue (WaterAid 2018), leading to poor cost recovery and impacting service quality and coverage.

In terms of water availability, India has only about 4% of the world's renewable water resources but

is home to nearly 18% of the world's population (Centre for Science and Environment, 2016). Urban centres rely heavily on groundwater, and this caters to about 50% of the water demand in cities (National Institute of Urban Affairs, 2015). However, indiscriminate abstraction of groundwater have led to its depletion in several cities across India. The impervious ground cover in cities compounds the situation by reducing natural groundwater recharge.

Figure 2: Projected trend of Urban Population



Picture Credit: Deccan Herald



Picture Credit: Danfoss

Both surface and groundwater are also being contaminated, mostly by untreated wastewater from urban settlements. In 2016, the Central Pollution Control Board reported that 63% of sewage flows into rivers untreated every day.

All the aforementioned issues highlight the need for inter-disciplinary and a multi-sectoral cooperation in order to enhance the water supply outlook of urban India. This will require a deeper understanding of the urban water cycle and its interaction with society. The way water is managed in cities will determine the success in achieving the Sustainable Development Goals (SDG) targets, given that water cuts across most of the SDGs.

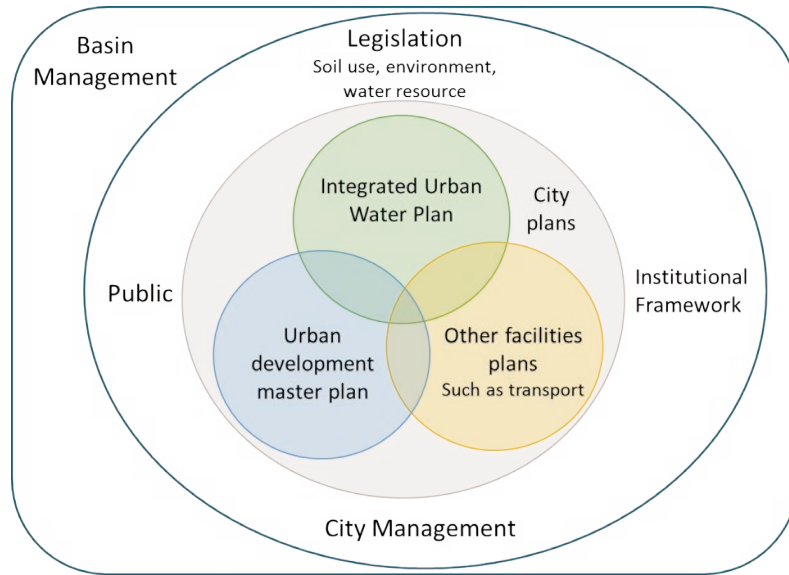
The water-related challenges in Indian cities (and any city for that matter) can no longer be addressed through the conventional supply side, purely engineering solutions that typically look at problems in isolation. There is a need to make a transition from a 'silo' style of management to a 'systems' approach that considers the entire urban water cycle and water use sectors in an integrated manner. Integrated Urban Water Management (IUWM) is one such approach where all components of the urban water cycle (water supply, sanitation, storm water) are managed in a holistic manner (Kirshen et al. 2018).

As opposed to the traditional model of expanding and augmenting water sources, IUWM focusses on diversifying the urban water supply portfolio through used water, storm water, and rain water harvesting for different uses, in the endeavour to manage the water demand effectively. While the conventional approaches are mostly top-down and rarely factor stakeholder engagement, IUWM, on the other hand, is an adaptive and iterative process that involves engagement with stakeholders and also encompasses environmental, economic, technical, social and political aspects of water management. Furthermore, IUWM seeks to leverage on natural systems through concepts such as constructed wetlands, soil aquifer treatment, bank filtration systems as a means to complement existing grey infrastructural solutions like water treatment plants, centralized sewerage systems, etc. Several global cities such as Singapore, Amsterdam, Melbourne, Los Angeles have adopted the IUWM philosophy to manage the urban water sector. There is no universal IUWM model. What works in one city may not necessarily work in another. Cities need to discover their own models based on the core principles of the IUWM philosophy that would be most relevant and suitable for their own contexts.

#### Text Box 1

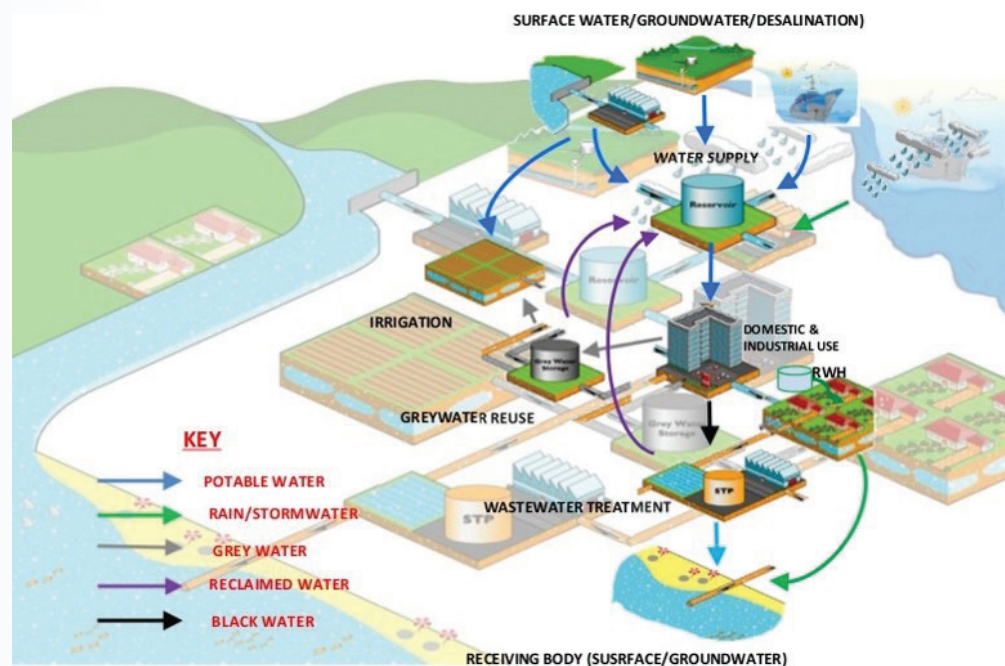
The World Bank defines Integrated Urban Water Management (IUWM) as “a holistic mode of strategic planning which takes a landscape view of water challenges by looking at competing water users in an urban area” and implemented “through coordinated and flexible planning among water using sectors, allowing for optimal sequencing of traditional and new infrastructure with alternative management scenarios that leverage on efficiencies and conservation” (World Bank, 2012).

Figure 3: Institutional framework for municipal land and water planning



Source: Adapted from Tucci, 2010)

Figure 4: System of Integrated Urban Water Management



Source: Global Water Partnership

In India, IUWM has been propagated as a contemporary philosophy to manage the urban water sector since 2015. However, it has not been taken up as enthusiastically as envisaged, for different reasons. One of these, of course, could be attributed to lack of awareness of the IUWM philosophy in some cities, especially the smaller ones. However, in larger proactive cities, attempts are being made to explore the adoption of IUWM

The existing knowledge about IUWM and its role in managing the urban water sector is quite robust, however, the challenge appears to be in

translating this knowledge into practice. To do so would require a thorough understanding of the city's water dynamics from multiple perspectives - hydrology, governance, institutional mechanisms, economics, social structures, among others. This study seeks to explore this aspect in detail in a structured manner. It does so by identifying some vital criteria that are crucial for the implementation of IUWM in cities. Any city can be evaluated against these criteria to get a sense of how it fares on the IUWM spiral, and if it does not, the assessment will provide useful insights for improvement.

# Methodology

The overarching objective of this paper is to develop a framework to help evaluate the current status of IUWM in Indian cities, with a view to

provide useful insights for areas that a city should target in order to prepare itself for proliferating IUWM. The specific objectives of this study are to:

- A** Develop a framework with a set of key criteria to evaluate the extent of IUWM implementation in a city
- B** Evaluate the city of Delhi against this framework

A simple two-step methodology was followed for the study

**1. IUWM literature review**

- A thorough literature review of the IUWM case studies across the world was carried out. This was to understand and identify the critical factors for success, pain points, challenges, and lessons learnt.
- Ten of the most relevant criteria for implementing IUWM were then identified and contextualized to the Indian conditions, based on the authors' expert judgement with a clear rationale and reasoning as described in the next section.
- Although the framework has been developed for Indian cities, it can be used for cities in other parts of world as well with some customization.

**2. Grouping the criteria**

The identified criteria were grouped under three heads:

- enabling environment,
- institutional arrangements,
- management instruments.

This was done to ensure a link with the overarching philosophy of Integrated Water Resources Management (IWRM), whose pillars correspond to the three heads.

**B** The methodology for the second objective involved an exhaustive data collection exercise to quantify the information presented here to the extent possible. It also involved a thorough literature review of the policies, plans, project reports of the various water-related agencies in Delhi to help understand the status quo of the city.



Picture Credit: Purnima Shrestha for The New York Times

# Framework for Assessing a City's Status of IUWM Adoption

A framework comprising a set of ten criteria was established to assess the extent of implementation of IUWM in a city. These criteria have been categorized under three heads, in line with the pillars of Integrated Water Resource Management (IWRM).

Table 1 presents the details of these criteria, and the rationale for choosing these.

- enabling environment;
- institutional arrangements;
- management instruments



Enabling Environment



Institutional Arrangements



Management Instruments






Picture Credit: Asian Development Bank



Picture Credit- J. Carl Ganter / Circle of Blue

**Table 1: Framework to assess the implementation of IUWM in a city**

	SN	Criteria	Rationale
 <b>Enabling Environment</b>	1	Water-related policies and strategies	Forward looking water-related policies and strategies, ideally that encourage systems approach to managing the water sector, create a firm foundation for IUWM implementation.
	2	Centre-State-City equation	This criterion is important from a political point of view to ensure that the city receives adequate support (financial and administrative) from the Centre/State in order to implement IUWM interventions.
	3	Financial status	A stronger financial status of the city is more likely to result in higher levels of ambitions for IUWM, particularly in areas that are cost intensive.
 <b>Institutional Arrangements</b>	4	Coordination among various water-related agencies	The central tenet of IUWM is an integrated approach to manage the urban water sector. In a city there are typically a number of agencies tasked with managing different elements of the urban water sector. For a successful IUWM model, there is a need for these agencies to work together in a coordinated manner.
	5	Target reforms and regulations	If cities already have contemporary reforms and regulations for water management that are grounded in the principles of sustainable development, it makes it easier to implement IUWM.
	6	Human resources capacity	Having an adequate number of suitably qualified staff in the concerned agencies will help the agencies dynamically adapt to the challenges of the water sector, which is imperative for IUWM to sustain.
 <b>Management Instruments</b>	7	Database of water-related information	Good quality, reliable, disaggregated data for the various water-related aspects in the city is the first step for developing sound IUWM interventions.
	8	Technological advancement	A high level of technological advancement in the city indicates a willingness to innovate and adapt to changing times. It also helps in rolling out IUWM interventions more effectively, given that many these are non-conventional.
	9	Citizen engagement	The success or failure of IUWM interventions is largely dependent upon public support.
	10	Research and innovation	The urban water sector is facing increasing threats on multiple fronts. A robust research and innovation program is crucial to evaluate these threats and devise adequate response mechanisms.



## 3.1 Enabling Environment

### 3.1.1 Water-related policies and strategies

In India, policies are usually made at the Centre or State level, which are then adopted by cities in their city-specific plans and strategies. Some cities do this better than the others. Legislation and national and sub-national policies are an important enabling factor for transformation in the water sector, including proliferating IUWM in cities. There are multiple reasons for this. First, while policies are made at the National/State level, the implementation is done at the city level, which is usually the smallest administrative unit of significance in the urban context. Hence, cities are essentially the ‘playground’ for the policies to be translated into practice. Second, national priorities (through relevant policies, missions, or projects) invariably have a funding component attached to it. Cities, therefore, have a clear funding stream for the interventions required for implementation. If water management (especially along the broad contours of IUWM) is prioritized at the a higher level, cities are not only more inclined to take it up to align themselves with the national mandate; they are also able to secure the finances for implementation that are usually vital for the success of any initiative.

### 3.1.2 Centre-State-City relationship

The emphasis on coordination in IUWM is not just horizontally among the various stakeholders of the city but also vertically between the city and higher administrative levels (i.e. state and national). This vertical coordination is an important criterion in the Indian context for two reasons. One, most aspects of water management are a State mandate in India. For example, the States usually design and execute water supply projects, while the maintenance of these projects is done by the cities. Second, the Central Ministries such as the Ministry of Housing and Urban Affairs, Ministry of Jalshakti are mostly responsible for financing projects related to water management through various schemes. Hence, very often cities have

to solely rely on the Centre for funding, which is crucial for mobilizing the ‘hardware’ required for IUWM. When there are multiple levels of governance, there are bound to be conflicts. Invariably, these arises in regions where water is scarce and the demands from different users are high. In India, water conflicts reach every level and divide every segment of the society - political parties, states, regions and sub-regions within states, industries, farmers and households (Water Aid, 2018). A city’s equation with the State/Centre, therefore, has a bearing on the implementation of IUWM in the city.

### 3.1.3 Financial status

One of the biggest barriers to water security enhancement in cities is lack of financial resources. Some water infrastructure required for IUWM is typically capital intensive, long-lived with high sunk costs. It requires a high initial investment followed by a very long payback period. Many of the benefits achieved from these cannot be easily monetized, undermining potential revenue flows and thus the “risk-return” balance for potential investors (OECD, 2016). The financial health of a city, in many ways, is key to determining the level of ambition that it can target for IUWM. As described earlier, some degree of financing can be procured from Centre- or State-funded schemes. However, many cities in India have begun to look at non-governmental financing through innovative models such as Viability Gap Funding (where the government makes a seed funding of up to 20% of the project cost and invites a private company to develop and operate a project); Value Captured Finance (revenue generated by increase in land value because of the implementation of key infrastructural projects); Municipal bonds, Corporate Social Responsibility funds, etc. A city’s financial status, and its financial acumen in generating these financial resources, therefore goes a long way in determining its IUWM trajectory.

Picture Credit- Lars Mortensen



## 3.2 Institutional Arrangements

### 3.2.1 Coordination among various water-related agencies

Implementing IUWM requires the inclusion of a greater number of actors in decision making, integration with urban planning, understanding trade-offs between multiple competing objectives, and the coordination of multiple water sources including from decentralized reuse schemes (CSIRO, 2010). This becomes far easier if there is an apex body to coordinate and manage these elements. Singapore's Public Utility Board is a classic example of such an arrangement. However, in most cities there are different agencies to manage the different elements. For example, in many Indian cities, the water supply and wastewater infrastructure is set up by one agency, while another agency manages it. A third agency is responsible for storm water management. A fourth is tasked to maintain the lakes and water bodies in the city. Such an arrangement is not necessarily a problem. It may even be argued that in large cities it is best to have dedicated agencies responsible for managing the different elements, which could lead to improved efficiency in these sectors. However, often there is very little interaction among the agencies, leading to the cliched 'silos' approach of management. Melbourne has shown that it is possible to have different water-related agencies with their own mandates but still work together towards a common goal, which ultimately is the central purpose of IUWM.

### 3.2.2 Target reforms and regulations

Reforms in the water sector are changes in policies, institutions, and practices made to move up the water security ladder. The kind of reforms that a city targets can give a good indication of its maturity in understanding the water-related

challenges it is facing and its approach to tackle those. IUWM typically requires contemporary forward-looking reforms. A city may have already adopted some of these, such as encouraging reuse of wastewater. Similarly, regulations are a set of tools intended at creating checks and balances to manage and sustain the urban water sector. Examples of typical regulations in this context include that for groundwater abstraction, pollution control, encroachment of water bodies, permissible and non-permissible uses in water sensitive areas, buffers, etc. In absence of relevant regulations, the accountability and liability of players, processes and products in water sector may be compromised.

### 3.2.3 Human resources capacity

Institutions and their capacity are critical to allow a transformation to sustainable development. The 'Human Capital' theory is increasingly used as a measure in the 'knowledge economy' paradigm, suggesting that investment in knowledge and skills of people is vital to countries' prosperity. This rationale can be applied to the water sector's capacity in general and particularly its capacity for transformation. For the urban water sector, the overall human capacity in its institutions can be assessed by the presence of key technical expertise. To plan and implement IUWM, availability of specialist water engineers who have graduated from institutions with good credentials is a key indicator. Conversely, vacancy rates in senior technical positions are an indication of limitations in capacity for transformation. Beyond a formal educational background, skills are also developed through training and exposure. The opportunities for on-the-job training are an additional measurement of capacity of urban water institutions.

## 3.3 Management Instruments

### 3.3.1 Database of water-related information

Accurate and comprehensive data for water related information in the various urban water elements are critical for informing decision making in IUWM. The quality and resolution of the data is often a deciding factor in determining the level of planning ambition. The data attributes critical for IUWM planning are existing land use maps; sources of water; water users by categories; water demand water and wastewater infrastructure; drainage network and infrastructure; green cover; spatial spread of water bodies; water quality of sources; among others. The availability of a GIS-based centralized database of spatially disaggregated water-related information would be an ideal scenario. This can ensure regular updating of water data, uniformity in data usage, reduced duplication of similar efforts, and avoiding redundancy of data. However, in most Indian cities centralized databases do not exist. Individual agencies collect the data (if at all) as per their need and requirement. In such cases, it is important that there is a data sharing mechanism among the agencies, which can make up for the lack of a centralized database.

### 3.3.2 Technological advancement

Managing the urban water sector, particularly in view of the challenges posed by climate changes, requires cities to upgrade their practices and technologies to match the need. Such technologies would aim at reducing water losses, increasing the use of treated wastewater, providing real time early warning for floods, reducing energy usage; among others. These technologies would also ensure: water accessibility for all segments of the society, low cost and energy requirements, less land for implementation, etc. The level of technological advancement in a city is a good indicator of how much it has kept abreast with the current drivers of the urban water sector. It points out to the willingness of a city to change as per the demand. IUWM also requires the city to change some of its management approaches. A city that has already demonstrated its willingness to change is, therefore, well suited for IUWM on this front.

### 3.3.3 Citizen engagement

Citizen engagement and their involvement in the management of the city's water sector is among the core principles of IUWM. The idea is to make the planning as inclusive and participatory as possible so that there is a sense of ownership

among the residents for the interventions carried out under the IUWM plan. The World Bank (2014) defines citizen engagement as the two-way interaction between citizens and governments. This is very crucial because in many cities the engagement is a one-way process where citizens are only informed about what concerns them. Their opinions are hardly ever solicited, and even if they are, it does not reflect in the final outcome. A robust engagement strategy would particularly enable inclusion of the poor, women, and other potentially marginalized groups, not commonly involved in decision-making that affects their lives. A city that already has some level of citizen engagement through various media would fare well on this criterion for IUWM implementation.

### 3.3.4 Research and innovation

The ultimate objective of IUWM is to make cities water secure, which takes time to achieve. Furthermore, as already mentioned, there is no universal IUWM model. Quality research and innovation will help cities in discovering the model that is best suited for their context. Research can proceed through multiple modalities. One modality would be to have a strong in-house research and innovation units within the implementing agencies. Cities like Los Angeles, Amsterdam, Singapore follow this model. Another could be to foster partnerships between public agencies and universities/research institutes, where the former drive the research agenda and the latter implement it. Bangkok and Melbourne follow this model. Likewise, there could be other models. The research and innovation criterion is also very important for IUWM to ascertain a city's preparedness to address the impending challenges that the water sector is likely to face. This becomes critical in the face of a quickly changing environment, technological growth, and advancement of knowledge in areas that are currently uncertain.



Picture Credit <https://www.flickr.com/photos/meter-reading/>



Picture Credit- Dhiraj Singh


# Analysis of Delhi's Ability to Adopt IUWM

## 4.1 Study Area Description

Delhi is the capital of India, covering an area of 1483 sq. km with a population of almost 19 Million (2019). One of the biggest mega cities in the world, it is located in North India and has witnessed growth in terms of both area and urbanization

over the years. If the current trends continue, Delhi is expected to replace Tokyo as the most populated city in the world by 2018 (UN DESA, 2018). Table 2 presents a brief fact sheet of the urban water sector in Delhi.

Table 2: Factsheet of Delhi's water-related information

 Rainfall- 611.8 mm/year	 NUMBER OF WATER-RELATED AGENCIES -15	
<b>WATER SOURCES</b> <ul style="list-style-type: none"> <li>○ Yamuna River : 380 MGD</li> <li>○ Ganga River : 250 MGD</li> <li>○ Bhakra Dam : 221 MGD</li> <li>○ Groundwater. : 86 MGD</li> </ul> <b>Total : 937 MGD</b>	 <b>WATER DEMAND</b> 1140 MGD (Estimated at 60 GPCD)	<b>NON REVENUE WATER - 40%</b> 
<b>WATER USE</b> <ul style="list-style-type: none"> <li>○ Domestic : 63%</li> <li>○ Industry and Commerce :18%</li> <li>○ Institutional :19%</li> </ul>	<b>WATER INFRASTRUCTURE</b> <ul style="list-style-type: none"> <li>○ Coverage. : 87.5%</li> <li>○ Pipe network. : 14,697 km</li> <li>○ Underground reservoirs : 110</li> <li>○ Water treatment plants : 7</li> <li>○ Connections : 234,800</li> <li>○ Tube wells : 4150</li> <li>○ Ranney wells : 9</li> </ul>	
 <b>WASTEWATER GENERATED</b> 720 MGD	<b>WASTEWATER MANAGEMENT INFRASTRUCTURE</b> <ul style="list-style-type: none"> <li>○ Coverage : 55%</li> <li>○ Sewerage network : 8300km</li> <li>○ Wastewater treatment plants : 20</li> <li>○ Effluent treatment plants : 13</li> </ul>	
<b>STORM WATER MANAGEMENT</b> <ul style="list-style-type: none"> <li>○ Natural drains : 201</li> <li>○ Artificial drains : 1296</li> <li>○ Drainage network : 3740 km</li> </ul>	<b>WASTEWATER REUSE</b>  89 MGD	<b>WATER BODIES</b> 1009 
 <b>OPERATING BUDGET OF DJB</b> USD 316.70 Million		

Data Sources: Planning Department, Govt of NCT (2020); Irrigation and Flood Control Department (2016); Delhi Development Authority (2020); Delhi Jal Board (2016)

The city is a classic case of an urban agglomeration, i.e. a continuous urban spread constituting a town and its adjoining outgrowths. Because of this characteristic, there is a large floating population from neighbouring towns, that exert additional pressure on the already stressed natural resources, especially water. Delhi is quite unique in its administrative set-up, with some sectors managed by the State and others managed by the Centre. Administratively, the city is divided into five municipal areas—North Delhi Municipal Corporation, East Delhi Municipal Corporation, South Delhi Municipal Corporation, New Delhi Municipal Council, and the Cantonment Board.

The climatic conditions of Delhi are similar to that of the temperate grasslands with hot, dry summers, and cold winters. There has been a

noticeable trend of warmer summers in the last few years. In June 2019, Delhi recorded the hottest day in its history when the temperature soared to 48°C. The city receives a normal annual rainfall of 611.8 mm. Out of total rainfall, 81% is observed during July, August and September (Central Ground Water Board, 2016).

Water supply and sewerage in Delhi is a State subject, and is managed by the Delhi Jal Board (DJB). The city relies on water from four sources (Yamuna River, Ganga River, Bhakra Beas storage, and groundwater), with a total 937 Million Gallons per day (MGD). Using the current population of 19 Million, with a supply norm of 60 Gallon per capita per day (GPCD), the water demand in Delhi is estimated at 1,140 MGD. Hence, there is already a deficit of 203 MGD.

## 4.2 Analysis of Delhi's Enabling Environment for IUWM

### 4.2.1 Water-related policies and strategies

Water management is among the top priorities in India at the moment. Since 2012, it has a draft Water Policy that defines the broad contours of the strategy for water management in India. Integrated management of water resources at different spatial scales features quite prominently in the Policy. In 2019, the government merged two central ministries, Ministry of Drinking Water and Sanitation and the Ministry of Water Resources, River Development and Ganga Rejuvenation into a single unit called Ministry of Jalshakti. One of the main reasons for doing so was to enable a holistic and integrated mechanism to address the supply-side demand-side aspects of water in unison. Given its political importance as the national capital, Delhi is strategically placed to translate national aspirations to on-the-ground action.

Water management in Delhi is addressed through several policy/planning instruments. First, in 2016 the city produced a draft Water Policy with the objective of ensuring water security for Delhi in the face of an uncertain resource scenario. The Policy covers aspects related to demand projections; demand management; uncertainty and risk; improved databases; efficient use of resources; recycle and reuse; resource protection; equity of water supply distribution; and innovation. Second, the need for sound water management has been emphasized strongly in the overarching Master Plan for Delhi 2021 (Delhi Development Authority, 2020), which is a statutory document that covers

the entire city and all development sectors. Third, Delhi has draft sector-specific Master Plans for Drainage, and Sewage. The Sewerage Master Plan for Delhi 2031 (Delhi Jal Board, 2014) presents a comprehensive roadmap for covering the non-sewered area of Delhi (pegged at almost 44%) by setting up additional physical infrastructure in a phased manner. Likewise, the Drainage Master Plan (Irrigation and Flood Control Department, 2016) has outlined a number of interventions to mitigate the flooding risk in Delhi. Hence, it is quite evident that Delhi has an excellent enabling environment for IUWM in terms of policies and strategies.

### 4.2.2 Centre-State-City relationship

Delhi is a State with a democratically elected government. At the same time, some aspects of governance come under the jurisdiction of the Centre. While water is a State subject, some aspects that are crucial for ensuring overall water security of the city—such as urban planning and design—come under the Centre's jurisdiction. The coordination between the Centre and Delhi becomes easier if the same political party is in power in both places. However, this is not a necessity. There have been instances in the past when different political parties governed at Delhi and Centre levels but the coordination between the line agencies of the two governments was never a problem. From an IUWM perspective, the Centre-State relationship in Delhi is not a major problem because of two reasons. First, Delhi is among the richer cities/states in India and therefore its



Picture Credit: <https://www.nippon.com/hk/views/b063011>



Picture Credit: The Tribune

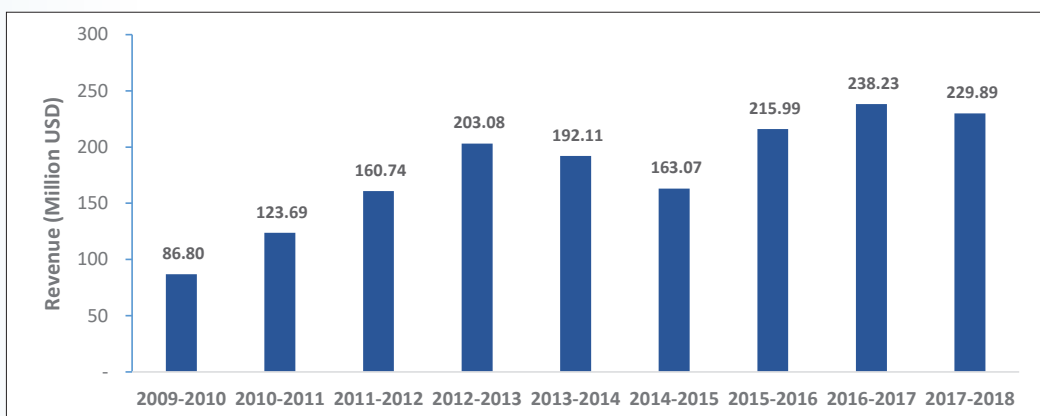
reliance on the Centre for funding is relatively low. This offers it the flexibility to establish its own initiatives and projects and take them to completion. Second, even though the present relationship between the Centre and Delhi may not be on the best terms, there is enough mutual support for implementing the interventions for enhancing water security.

#### 4.2.3 Financial status

As already highlighted, the per capita financial standing of Delhi is among the highest in the country. It ranked second among all the States and Union Territories in India in this aspect with a per capita domestic product of USD 4,681 in 2018. This

offers the city a lot more flexibility to invest in water infrastructure and technology to enhance the water management landscape in the city—something which it has done quite earnestly over the years. For example, the budget earmarked for water supply and sanitation increased from USD 184 Million in 2007-08 to USD 316.7 Million in 2018- 19 (Planning Department, 2020). The operating revenue of the DJB has also been increasing over the last few years (as gleaned from Figure 5). While this does not account for full cost recovery yet, the increasing trend of revenue collection is certainly promising. Hence, from a financial perspective Delhi is well equipped to invest in projects, interventions, and technologies to facilitate IUWM in the city.

Figure 5: Trend of the operating revenue of Delhi Jal Board



Picture Credit: Planning Department, 2020

## 4.3 Analysis of Delhi's Institutions for Enabling IUWM

### 4.3.1 Coordination among various water-related agencies

The water supply and sewerage sector in Delhi is managed by a single agency, DJB. However, there are eleven agencies to manage the stormwater management sector in Delhi, which is quite unique and not found in other Indian cities. The division of responsibility among the agencies is based mostly on the length, flow and location of the drains. However, in some cases multiple agencies are responsible for a single drain. For example, the construction and maintenance of the large natural drains is the responsibility of the Irrigation and Flood Control Department of the Delhi Government, while the disposal of the silt removed from these drains is the responsibility of the respective Municipal Bodies. There are challenges with coordination and cooperation in managing these drains as would be expected when a number of stakeholders are involved. Storm water management requires a holistic consideration of the drainage patterns within the city and cannot be conducted in isolation. The large number of agencies responsible for it makes the case for IUWM quite weak in this context. Unlike the city of Mumbai which faces recurring floods almost every year, Delhi is relatively less flood prone. However, all this could change with climate change beginning to manifest its effects. Some degree of lack of coordination between agencies is also apparent in the relationship between the DJB, and the Delhi Development

Authority (DDA). Hence, the urban development of the city has not accounted for the carrying capacity of city in terms of water resource, increasing the reliance on long distance transfers and exploiting groundwater reserves. While the situation in terms of coordination has improved much in recent years, it will take a few years before the indigenous water situation, especially groundwater, improves. The multiplicity of agencies involved in the management of the water sector, and issues with coordination, are a certain impediment to IUWM in the city.

### 4.3.2 Target reforms and regulations

Delhi has a number of significant city-wide target reforms and regulations in almost every relevant domain to help it manage the water sector. For example, the Draft Delhi Water Policy (Delhi Jal Board, 2016) has proposed targets that include ensuring adequate access of water to every resident; stepped pricing for water and wastewater; reducing the per capita norm of 172 LPCD by a minimum of 10 litres every 5 years; increasing the recycled wastewater reuse to 80% by 2026; curtailing distribution losses to under 5% by 2030; neutralizing aquifer exploitation by 2022 and attain water table recovery to 1995 levels by 2030; achieving 100% metering by 2022; and restoring river water quality to bathing quality by 2020. Although the policy has not been officially notified, actions are being taken by the agencies, especially DJB, to achieve the targets



Picture Credit: Raconteur.net

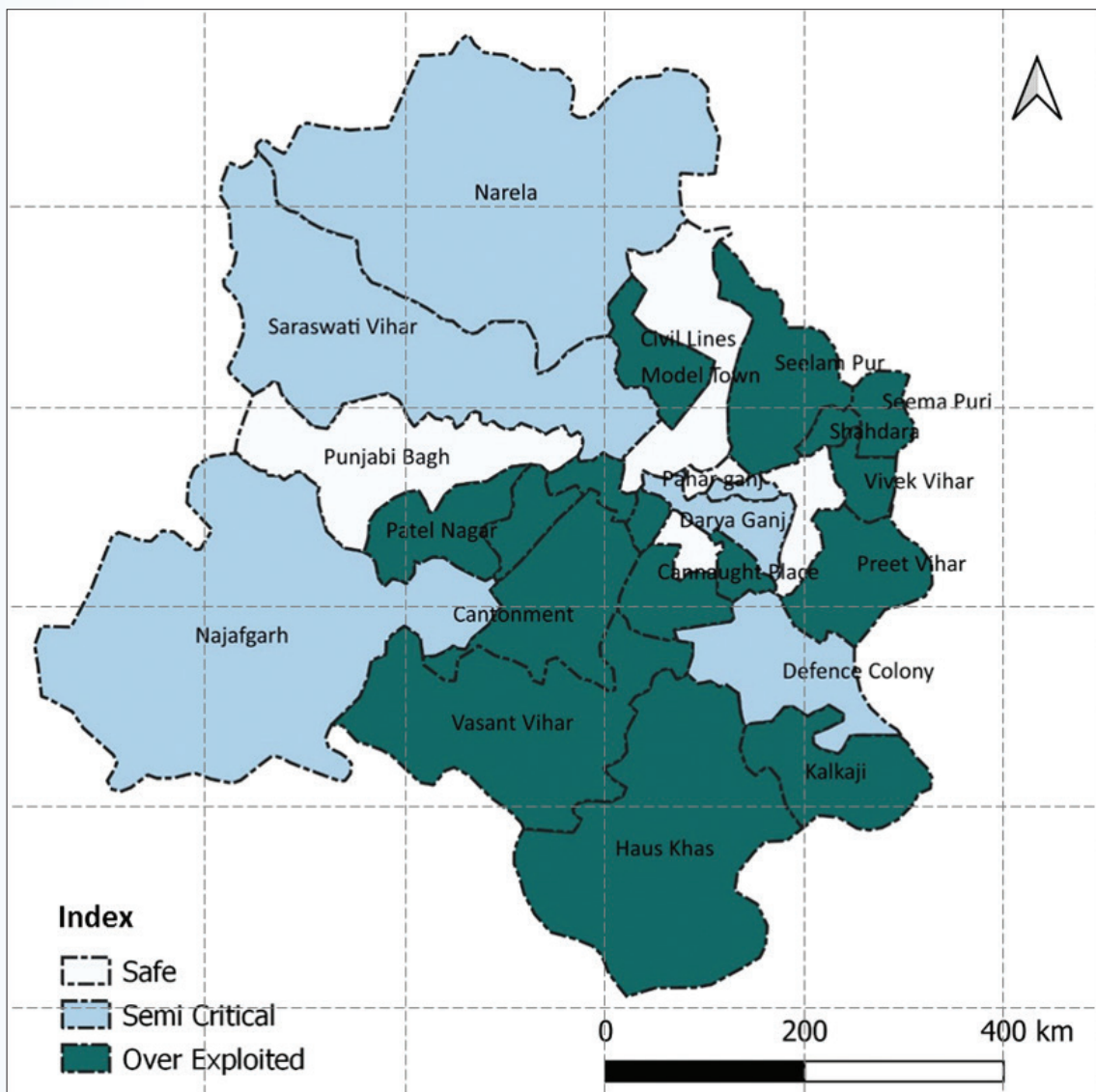
set in the Policy. While there is no question about the intent of the Policy, the challenges faced are in the operationalization. Furthermore, some of the reforms, while launched for the benefit of the residents, are counterproductive for water security at large.

For example, every household in Delhi is entitled to 20 cubic meters of free water supply every month. Although the water utility does not face any monetary loss because of this arrangement given that the Delhi government absorbs these costs, it creates a premise for water to be taken for granted and its value is underscored. Another

area of concern is the inadequate regulation for groundwater extraction in the city. The groundwater reserves in most areas is already in a critical or semi-critical state as shown in Figure 6.

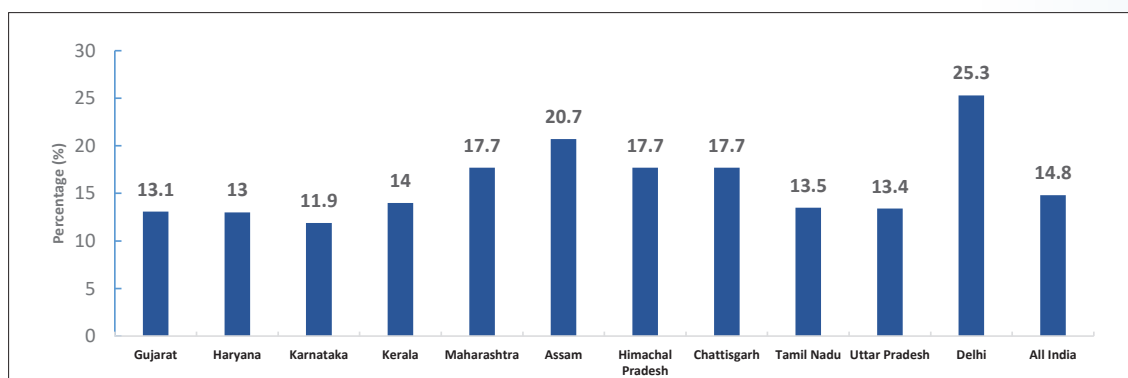
However, even today industries are allowed to operate their own tube wells and bore wells at a nominal cost of USD 22/month (for non-water packaging industries) to USD 56/month (for water-packaging industries). It can be concluded that the reforms and regulations in Delhi for supporting IUWM are, therefore, a mixed bag, supporting in some areas and inhibitive in others.

Figure 6: Status of the groundwater condition in Delhi



Picture Credit: Central Ground Water Board, 2016)

Figure 7: Expenditure on education as percentage of the State Domestic Product



Picture Credit: Planning Department, 2020

### 4.3.3 Human capacity of water-related agencies

In most water-related agencies in Delhi, there are broadly two categories of staff: permanent and contractual. The permanent staff are hired through an extensive procedure in line with requisite qualifications, experience, and reservation policies applicable at that time. The decision makers and top management are usually permanent staff, although exceptions exist. The hiring of contractual staff, on the other hand, is a quick process and done on short-term basis for specific project-based requirements. They are usually required to report to one of the permanent staff. There is an increasing trend in agencies to hire contractual staff for a number of reasons. First, the agencies are relieved from long-term liabilities of human resources. Second, they are able to hire job-specific specialists. Third, the contractual staff bring with them fresh ideas and enthusiasm, which helps in creating a lively and proactive environment within the organization. The salaries paid to contractual staff are significantly higher than the permanent staff, especially since they do not get the ancillary benefits (e.g. pension,

housing allowance, dearness allowance, etc.) that the permanent staff enjoy. Delhi is a metropolitan city, and hence the salaries paid to the staff are much higher than some of the other cities. Delhi is, in fact, among the top five highest paying cities in the countries along with Bangalore, Pune, Mumbai and Hyderabad. Hence, the city attracts some of the best talent in country, especially since the city is home to all central government head offices. The literacy rate at 86.2 per cent is higher than the all India average of 73 per cent (Planning Dept, 2020), which also to some extent reflects on the capacities of the ground level operating staff in the agencies. Furthermore, as gleaned from Figure 7, Delhi has invested heavily in education and professional training.

It can be gathered that the capacity of water-related agencies in the city is quite adequate in terms of qualification and quality of the staff. However, the challenge has been in the numbers. For example, the DJB has 798 engineers across all ranks (2014 data), which works out to 1 engineer per 21,000 residents (Sheikh et al. 2015). While it is difficult to define an ideal ratio, 1 engineer per 21,000 residents is clearly inadequate.



Picture Credit: The Hans India

## 4.4 Analysis of Delhi's Management Instruments for Facilitating IUWM

### 4.4.1 Database of water-related information

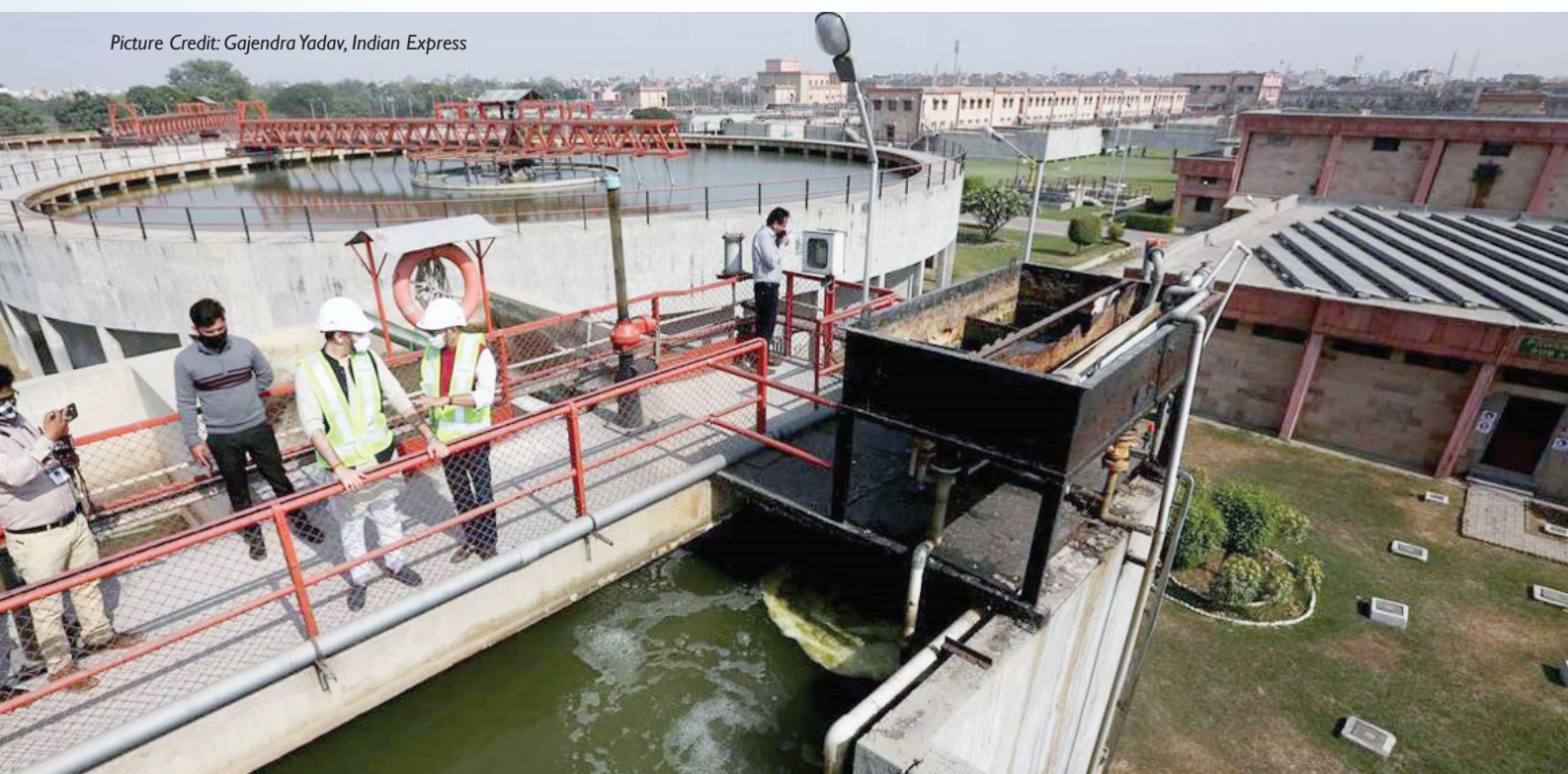
Delhi has a unique spatial data resource centre called Geospatial Delhi Limited (GSDL), which integrates the data from various agencies and departments and makes it available for use (at a cost) to any agency that may require it. A large amount of water-related data and information is provided by the agencies to GSDL. For example, the DJB has mapped water supply and sewerage in terms of area coverage, number of households served, disaggregated non-revenue water, locations of infrastructural elements, spatial records of water quality, and other related aspects. The Irrigation and Flood Control Department monitors and reports real time measurement of the water level in the Yamuna River and the major drains. The Delhi Pollution Control Committee disseminates monthly information on water quality in major drains and the River Yamuna with respect to parameters such as pH, Dissolved Oxygen, Biochemical Oxygen Demand; Total Suspended Solids; E-Coli, and Total Coliform. Likewise, the Forest Department produces maps of the forest and tree covers in Delhi. Despite all this, some critical data gaps exist even today. For example, there is no map that shows the number and layout of drains in the city. The last available map in this regard is from 1976. Even the Drainage Master Plan (Irrigation and Flood Control Department, 2016) does not have this map. Similarly, the Delhi Parks and Gardens Society has a comprehensive list of the 1009 water bodies that

are located within the city boundaries but there is no map to show their exact location. Furthermore, there is no existing land use map of the city. Delhi has a Master Plan but even this only has a proposed land use map. From an IUWM perspective, Delhi is fortunate to have an operational integrated data resource Centre. However, data and information about some crucial areas are not available in Delhi, which will have to be addressed in order to proliferate IUWM in the city.

### 4.4.2 Technological advancement

Delhi has always had an open mind towards new technologies and has led the way in adopting these technological solutions. For example, Delhi was among the first cities in India to adopt trenchless sewer technology (cured in-place piping, CIPP) for replacing the sewer lines, particularly in old settlement areas. CIPP is a jointless, seamless pipe system in which pipes are changed and rehabilitated without the need for humans to enter the trunk sewer or manholes. Similarly, the city has begun to create District Metering Areas (DMAs) for more effective management of water supply, distribution, and reduction of NRW. It has also established a Master SCADA Centre at its Headquarters to measure the flow and pressure at more than 3,000 strategic points in both the primary and secondary networks. The city is establishing a real time system to monitor the water quality in the Yamuna River. The city has also recently launched the "Seva App" for

Picture Credit: Gajendra Yadav, Indian Express





Picture Credit- P. Ravikumari/Reuters

bill generation, online payments and resolution of inflated bills. Furthermore, it also hosts one of the most prestigious technological institutes in the country—The Indian Institute of Technology, Delhi— which has made significant technical and knowledge contribution to the water management of the city.

For example, it led the development of the Drainage Master Plan for Delhi using state-of-the-art technology and modelling techniques. From an IUWM point of view, the level of technological advancement in Delhi is quite satisfactory.

#### 4.4.3 Citizen engagement

The citizen engagement modality in Delhi is mostly centred around advocacy and awareness raising. For example, DJB conducts yearly water conservation campaigns to help residents understand the need and importance of conserving water. It also organizes public outreach programmes in various schools to sensitize the next generation on the value of water, and its judicious use. The Department of Environment organizes regular events for the cleaning up of the Yamuna involving the participation of Residents Welfare Associations, Market Traders Associations, Industrial Associations, Schools/Colleges, Institutions, and Corporates. Likewise, the National Mission for Clean Ganga organizes similar events for the cleaning of river banks. Most of the water-related agencies have a dedicated channel on their websites for citizens to express their concerns regarding any issue that they may have. Citizen feedback is solicited for any major plan or policy. There is, however, little involvement of citizens in the actual management of the urban water sector. The role of citizens is

restricted to recipients of advocacy content or as critics. The current citizen engagement modality is quite one-way and not in line with the IUWM philosophy. To proliferate IUWM, the city will require a deeper and two-way engagement of citizens in diverse areas of water management.

#### 4.4.4 Research and innovation

The research and innovation in water-related agencies in Delhi is fairly limited and appears to be mostly 'reactive' to address the wide range of problems as opposed to being 'proactive' to prevent the problems from happening in the first place. An example of this is a pilot project carried out by the DJB and Irrigation and Flood Department that involved the construction of a Sewage Treatment Plant on one of the most polluted drains in Delhi (Shahdara drain) to not just make sewage water fit for drinking but for recharging groundwater as well. The DJB has also installed water ATMs in areas where the water supply coverage is relatively lower. Delhi is quite fortunate to be the focus of research of several research organizations and universities, who take on the role of research partners. An example in this regard is the association between the DJB and the University of Virginia for the Yamuna River Project that aims to place riverfront restoration and development at the forefront of national consciousness. Likewise, the Irrigation and Flood Control Department collaborated with the Indian Institute of Technology, Delhi to prepare the Drainage Master Plan, which had some elements of research. However, such instances are few and far between. Furthermore, not all of the research is translated into practice. There is certainly sufficient scope for Delhi to improve against this criterion.



Picture Credit: Royal Enterprises Pvt. Ltd.

# Conclusions

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At the national level, the enabling environment for IUWM is quite robust in terms of the appropriate policies, plans, and other instruments. A major catalyst for this has been the reporting that the country does against the targets for SDGs (especially SDG 6 and SDG 13 in this context), of which IWRM is one. Measuring ‘integration’ is challenging but going forward the country will need to arrive at innovative models to do so, which will ultimately trickle down to the cities. This paper has developed a framework with a set of ten criteria under three heads —enabling environment, institutional arrangements, and




management instruments—to ascertain the extent of IUWM implementation in a city, and evaluated the city of Delhi against these criteria through a qualitative assessment.

Delhi is a megalopolis in the truest sense, with a large population (second only to Tokyo), high financial growth, rapid urbanization, and dense settlements. All these have led to an increased water demand in the city. From an IUWM perspective, although there are a large number of agencies concerned with water in the city, the management is reasonably smooth because the



Picture Credit: The Hans India

Table 3: Evaluation of Delhi's extent of IUWM implementation as per the established criteria

	SN	Criteria	Performance (Qualitative)
<b>Enabling Environment</b> 	1	Water-related policies and strategies	Low → Moderate → High
	2	Centre-State-City equation	Low → Moderate → High
	3	Financial status	Low → Moderate → High
<b>Institutional Arrangements</b> 	4	Coordination among various water-related agencies	Low → Moderate → High
	5	Target reforms and regulations	Low → Moderate → High
	6	Human resources capacity	Low → Moderate → High
<b>Management Instruments</b> 	7	Database of water-related information	Low → Moderate → High
	8	Technological advancement	Low → Moderate → High
	9	Citizen engagement	Low → Moderate → High
	10	Research and innovation	Low → Moderate → High



Picture Credit: LiveLow.in

DJB takes on a bulk of the responsibility. Table 3 presents a summary of the analysis.

While Delhi's relation with the Centre may not be on the best of terms, this has relatively little bearing on the water management in the city. The financial status of Delhi is quite healthy which can help step up the level of ambition required for IUWM proliferation. The institutional arrangements in Delhi for scaling up IUWM are adequate. There are dedicated agencies to manage the different elements of urban water management, but the coordination among these agencies needs to be improved. Some of the reforms and regulations adopted by the agencies are quite progressive. However, reforms like supplying free water to the residents make a dent in the case. The human resources capacities are among the highest in the country.

From the management instruments perspective, Delhi is a bit of mixed bag. It has a centralized database for water-related information, something that very few cities in India can boast of, but there are some critical data gaps—e.g. locations and extent of water bodies; drainage network; and existing land use—that may hinder the implementation of IUWM in the city. Plugging these gaps is not very difficult, especially given the

resources that Delhi has. Delhi has a great affinity for technology and its willingness to change with time cannot be questioned.

The city, however, has a relatively dismal record with citizen engagement. Furthermore, while it does invest in research and innovation, this is more an 'end of pipe' approach to find a cure for the problem rather than for preventive or transformational solutions that fit the philosophy of IUWM better. Overall, the extent of IUWM implementation in Delhi is moderately good. It certainly has some things that work in its favour, and has the potential to improve on most of the areas where it is lagging.

An element of subjectivity is always associated with such qualitative assessments. Hence, it is important to highlight that the framework has been designed as an "introspective" instrument for cities to make a honest internal assessment of where they stand in terms of IUWM. In its current form, the framework should not be used for benchmarking or comparing cities. The study hopes to trigger some critical thinking and discussion among water managers and decision makers that can set the stage for tangible actions for enhanced water security.



Picture Credit: Thomson pipe group

# References

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Central Ground Water Board (2016). Aquifer mapping and groundwater management plan of NCT Delhi. Accessed 30 August 2020 from [http://cgwb.gov.in/AQM/NAQUIM\\_REPORT/Delhi/old/Naquim%20Report%20Delhi%20.pdf](http://cgwb.gov.in/AQM/NAQUIM_REPORT/Delhi/old/Naquim%20Report%20Delhi%20.pdf)

---

Centre for Science and Environment (2016). Why India needs to change the way it manages water resources. Accessed 30 August 2020 from <https://www.downtoearth.org.in/blog/water/challenges-in-the-management-of-water-in-india-58275>

---

CSIRO (2020). Integrated Urban Water Management Planning Manual. Water Research Foundation, Highett.

---

Delhi Development Authority (2020). Master Plan for Delhi-2021. Accessed 30 August 2020 from [http://119.226.139.196/tendernotices\\_docs/aug120/Report\\_of\\_Master\\_Plan\\_for\\_Delhi\\_-\\_2021\\_\\_updated\\_incorporating\\_notifications\\_till\\_31st\\_March\\_2020\\_15042020.pdf](http://119.226.139.196/tendernotices_docs/aug120/Report_of_Master_Plan_for_Delhi_-_2021__updated_incorporating_notifications_till_31st_March_2020_15042020.pdf)

---

Delhi Jal Board (2014). Sewerage Master Plan for Delhi-2031. Accessed 30 August 2020 from [http://www.indiaenvironmentportal.org.in/files/file/Sewerage\\_Master\\_Plan%20for%20Delhi%202031.pdf](http://www.indiaenvironmentportal.org.in/files/file/Sewerage_Master_Plan%20for%20Delhi%202031.pdf)

---

Delhi Jal Board (2016). Water Policy for Delhi (draft). Accessed 30 August 2020 from [http://delhijalboard.nic.in/sites/default/files/All-PDF/water%20policy\\_21112016\\_0.pdf](http://delhijalboard.nic.in/sites/default/files/All-PDF/water%20policy_21112016_0.pdf)

---

Global Water Institute (2013). Future water (in)security facts, figures, and predictions. Accessed 30 August 2020 from [https://img1.wsimg.com/blobby/go/27b53d18-6069-45f7-a1bd-d5a48bc80322/downloads/1c2meuvon\\_105010.pdf](https://img1.wsimg.com/blobby/go/27b53d18-6069-45f7-a1bd-d5a48bc80322/downloads/1c2meuvon_105010.pdf)

---

Irrigation and Flood Control Department, Govt of NCT Delhi (2016). Drainage Master Plan for NCT Delhi. Accessed 30 August 2020 from <http://tte.delhigovt.nic.in/wps/wcm/connect/e73833004aa42c7b022f10d0d3667b7/DMP.pdf?MOD=AJPERES&lmod=1099605968&CACHEID=e73833004aa42c7b022f10d0d3667b7>

---

Kirshen, P., Aytur, S., Hecht, J., Walker, A., Burdick, D., Jones, S., Fennessey, N., Bourdeau, R. and Matherg, L. (2028). Integrated urban water management applied to adaptation to climate change. *Urban Climate*, Vol 2, <https://doi.org/10.1016/j.uclim.2018.03.005>

---

Mekonnen, M.M. and Hoekstra, A.Y. (2016). Four billion people facing severe water scarcity. *Science Advances*. Vol. 2, no. 2, e1500323 DOI: 10.1126/sciadv.1500323

---

National Institute of Urban Affairs (2015). Urban water supply and sanitation in Indian cities. Accessed 30 August 2020 from [https://pearl.niua.org/sites/default/files/books/GP-IN2\\_WATSAN](https://pearl.niua.org/sites/default/files/books/GP-IN2_WATSAN)

---

OECD (2016). Water, Growth and Finance. Policy Perspectives. Accessed 30 August 2020 from <https://www.oecd.org/environment/resources/Water-Growth-and-Finance-policy-perspectives.pdf>

---

Planning Department, Govt of NCT Delhi (2020). Economic Survey of Delhi 2019-2020. Accessed 30 August 2020 from <http://delhiplanning.nic.in/content/economic-survey-delhi-2019-20>

---

Sheikh, S., Sharma, S. and Banda, S. (2015). The Delhi Jal Board: Seeing beyond the Planned. A report of the Cities of Delhi project, Centre for Policy Research, New Delhi (April 2015).

---

TERI (2018). India's rampant urban water issues and challenges. Accessed 30 August 2020 from <https://www.teriin.org/article/indias-rampant-urban-water-issues-and-challenges>

---

UN DESA (2018). World Urbanization Prospects, 2018 Revision. Accessed 30 August 2020 from [https://www.un.org/en/events/citiesday/assets/pdf/the\\_worlds\\_cities\\_in\\_2018\\_data\\_booklet.pdf](https://www.un.org/en/events/citiesday/assets/pdf/the_worlds_cities_in_2018_data_booklet.pdf)

---

UN Water (2018). High-Level Panel on Water outcome document. United Nations, New York. Accessed 30 August 2020 from <http://www.unwater.org/high-level-panel-on-water-outcome-document/>.

---

UN WWDR (2017). United Nations World Water Development Report 2017: Wastewater: The untapped resource, Paris, UNESCO. Accessed 30 August 2020 from <http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2017-wastewater-the-untapped-resource/>

---

UN WWDR (2020). United Nations World Water Development Report 2020: Water and Climate Change, Paris, UNESCO. Accessed 30 August 2020 from <https://www.unwater.org/publications/world-water-development-report-2020/>

---

WaterAid (2018). State of urban water supply in India. Accessed 30 August 2020 from <https://www.wateraidindia.in/sites/g/files/jkxoof336/files/state-of-urban-water-supply.pdf>

---

World Bank (2014). Strategic framework for mainstreaming citizen engagement in World Bank Group operations : Engaging with citizens for improved results (English). Washington, D.C. World Bank Group. Accessed 30 August 2020 from <http://documents1.worldbank.org/curated/en/266371468124780089/pdf/929570WP0Box380ategicFrameworkforCE.pdf>

---

World Bank (2016). High and Dry – Climate Change, Water and the Economy. World bank, Washington DC. License: Creative Commons Attribution CC BY 3.0 IGO. Accessed 30 August 2020 from <http://documents1.worldbank.org/curated/en/862571468196731247/pdf/105130-REVISED-K8517.pdf>

---

World Economic Forum (2020). The Global Risks Report 2020, 15th Edition. Accessed 30 August 2020 from [http://www3.weforum.org/docs/WEF\\_Global\\_Risk\\_Report\\_2020.pdf](http://www3.weforum.org/docs/WEF_Global_Risk_Report_2020.pdf)

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