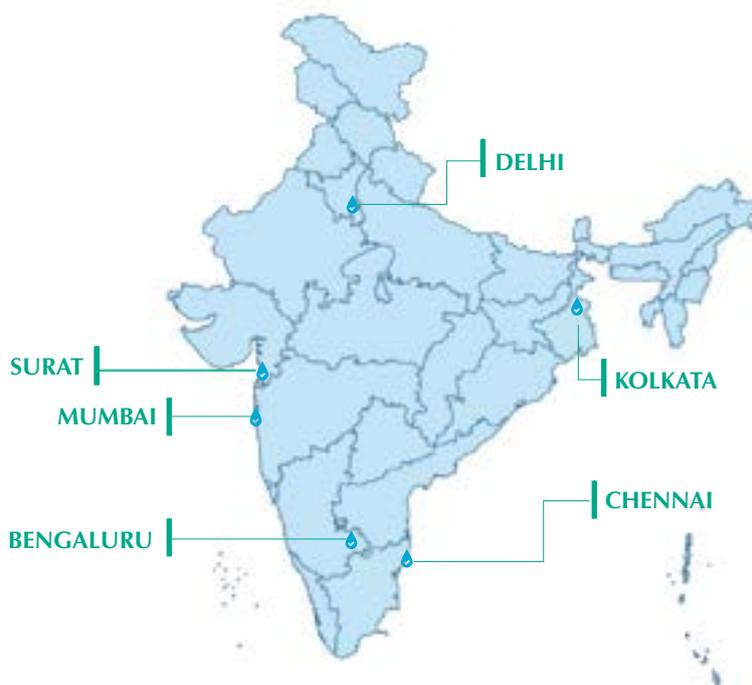


**Working Paper:1**  
**The Challenges of**  
**Urban Water**  
**Security and Growth**

# INTRODUCTION

India is one of the most water stressed nations in the world, largely due to poor management of resources, over abstraction of ground water and an uneven distribution of seasonal and regional precipitation. Water and its various components – excess and shortage, supply and demand, use and availability, and sanitation – are all interconnected and have an impact on the economic functioning of the country. Indian cities are some of the fastest growing in the world, and it is projected that over half the population in the country will live in urban centres by 2030. It is important to note here that **no Indian city supplies 24/7 water to all its residents** as of 2020. The ambitious Jal Jeevan Mission aims to rectify this and provide potable water connections to all across the country. If the mission succeeds it could be a game-changer. However, urban water security is a multi-faceted issue: if the supply side is not combined with adequate demand management, alternative sources of water, widespread wastewater and sewage treatment and an integrated circular system, our cities will continue to be water stressed.

This working paper aims to bring to light the varying degrees of water stress in six cities across India that collectively and individually are major contributors to the nation’s economic output, either through production, industrial development or by virtue of human resources. Thus, bringing to focus the potential economic gain each city places at risk from inaction over water resources. Each of the six cities, **Mumbai, Delhi, Bengaluru, Surat, Chennai and Kolkata**, under study, in their own way, are important pieces of India’s economy that aims to reach USD 5 trillion by 2024. Each of the cities also face different aspects of water stress, either because of



drought, flooding, poor storage and access, contamination of groundwater, and other factors or a combination of issues. While the problems may be myriad, one thing that is common across these cities, as well as others in the country, is the lack of adequate water. This increases the strain on human capital and ultimately a citizen's ability to contribute to the country's growth in a meaningful manner. While further study is required to delve deeper into the various points of correlation between urban water stress and the lack of integrated planning on the one hand and a city's economic development and growth on the other, the linkages are clear. The health security of the population is one such clear linkage, brought to even greater focus due to the ongoing pandemic. At Kubernein Initiative we aim to bring to light these linkages that must be taken into account with greater emphasis in emerging urban governance structures and the planning and implementation of any policy that is directly or indirectly affected by water shortage.

Growing global water stress has prompted study and analyses at a country and regional level: the World Resources Institute estimates a cost of **USD 215 billion** annually from flooding alone in South Asia by 2030. Studies indicate that **India could face a GDP loss of 6 per cent from lack of better water management by 2050** (World Bank, 2016), which is approximately the entire economic contribution of Mumbai to India's GDP (2018-2019 PPP). Water stress and inability of governments, both at the local and national level, to effectively tackle these issues is also beginning to shape investment decisions in emerging markets. It is imperative that we undertake similar scholarship at the city level, the future drivers of economic growth. We hope this paper will advance the discussion and debate on this subject and bring a diverse set of actors together to ensure that the future of our cities is truly water smart.

# EXECUTIVE SUMMARY

**“ In the world of water resources, economic data is insufficient, management is often opaque, and stakeholders are insufficiently linked. ”**

2030 Water Resources Group

Water security is not only about availability of the resource and ensuring supply for human needs, but is also closely connected to health, energy security, industry and agriculture of a country. Water stress can directly impact the socio-economic future of a community and nation, however, compounded with food, energy or health challenges, it becomes a risk multiplier. This paper provides a brief snapshot of the state of water in six Indian cities, relying on data from government sources where available, with a projection for demand and supply in 2030. There is also a snapshot of the economic sector in each city, with an attempt to highlight the stress water scarcity places on the economy and growth potential of the city.

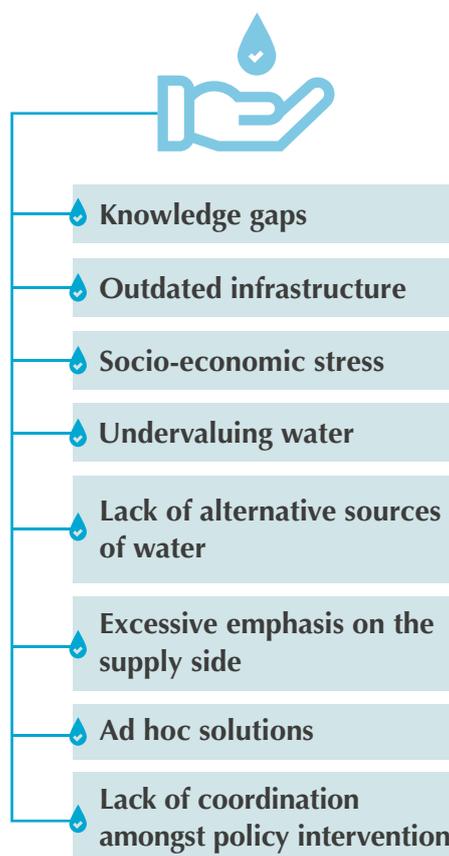
Some of the challenges faced by the cities are exacerbated by their unique geography, while others are symptoms of other problems seen across India. Chennai and Bengaluru, once water abundant cities, have both faced challenges related to water security in the recent past. While Chennai faced one of its worst water crises in 2018-19, Bengaluru delayed impending water day zero in 2019 by further exploiting the Cauvery river with tankers supplying water to over 50 per cent of the city. In both cities, water resources are overworked and overused, and not adequately replenished; instead, many natural spaces that allow for recharge have been built upon and concretised. Mumbai and Kolkata, while not yet completely water scarce, face selective water stress largely due to unequal distribution of water, an over dependence on monsoon precipitation, and little attention to over consumption. Kolkata has water hydrants to cater to the needs of the poor, but these hydrants are some of the largest culprits of wastage in the city. Slums in Mumbai accommodate a large section of the population but have access to the least number of water connections. Delhi is naturally water scarce and dependent on neighbouring states for their supply. While the provision of excess water supply is a constant political promise in Delhi, many have failed to deliver.

Most cities in India (including the selected six) have poorly laid-out infrastructure plans, some dating back to the pre-independence era, leading to large volumes of unaccounted for water loss (UFW). Extreme fluctuation in water availability invariably increases dependence on ground water, and in all six cities, as well as others across India, the levels of groundwater are depleting. Indiscriminate extraction of groundwater (such as in Kolkata for example), is not just an issue of water shortage but a serious health hazard and potential risk to built structures. The lack of

proper disposal and treatment of sewage has been another common challenge; impeding the rejuvenation of groundwater and also leading to flooding. Further, agricultural activity in the periphery of many cities that depend on some of the same resources are in constant battle with urban management.

At present our civic infrastructure is unable to accommodate the different levels of water, store it for future use and augment supply with alternative sources. India can currently only store, on an average, about 30 days of rainfall (Briscoe & Malik, 2006). Take for example the case of Surat, declared as the fastest growing city of India and recognised for water management with tertiary wastewater treatment plants and sewage treatment plants. Despite that, in 2019, the city experienced water cuts as it struggled with a delayed monsoon. Later in the year, the Ukai dam overflowed with the onset of extended monsoon and the water had to be released into the sea without being stored to combat future needs.

**Many of the challenges to achieving urban water security are common:**



For the next steps, this working paper proposes a number of ideas from greater use of technology to more investment and participation from the private sector along with aligning current and future water management policies within the changing governance frameworks of our cities. For our part, the next steps will include further research and analysis on the inextricable linkages between economic growth and the future of urban water stress and expand the study to other cities. We invite governments and ministries, state and central, private sector enterprises, research institutes and other interested organizations to work with us on this.

# BENGALURU

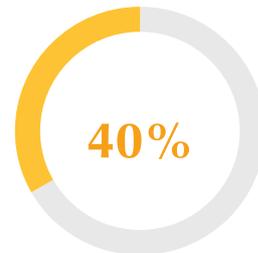
Bengaluru, a city established around numerous lakes, which in the past served as plentiful water sources, has seen rapid development and urban encroachment over the last few decades. The implications of this on the economic output are grave, as Bengaluru is a hub for Information Technology and services, a major employer and GDP contributor to the state of Karnataka and the country overall.

## CHALLENGES

- 💧 Curbing excess ground water usage
- 💧 Reviving natural aquifers and flood plains



POPULATION  
5.7 MILLION



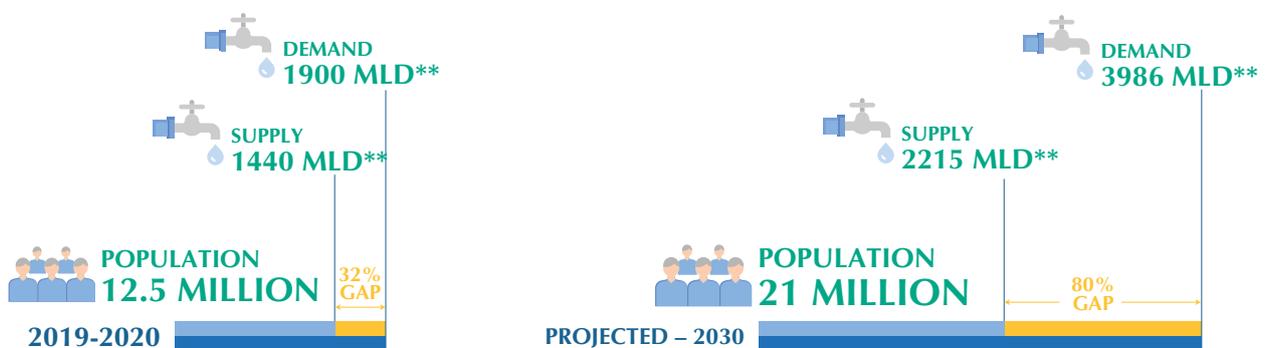
OF USD 148 BILLION  
IT SECTOR

# WATER SNAPSHOT

The Arkavathi River (rain fed) and Cauvery River (perennial) are the official sources for Bengaluru’s water supply. The main source of water, distributed by the Bengaluru Water Supply and Sewerage Board (BWSSB), is the Krishna Sagar Dam built on the

Cauvery River. According to estimates by the Karnataka Water Resources Department, actual demand outstrips the water supplied through official channels, due to population rise, forcing residents to rely on groundwater and over-priced tankers.

**Table 1**



\*Report by MS Ramaiah University of Applied Sciences predicts it to be approximately 1900 MLD in 2020, largely based on BWSSB’s past estimations (Deekshithashetty et al., 2017)

\*\*At present BWSSB is supplying treated Cauvery Water to Bengaluru City under the Cauvery Water Supply Scheme (CWSS) Stage I, II, III & Stage IV Phase I & II with total installed capacity of 1440 MLD. However, with the rising demand, the Stage V scheme will be taken in two phases, where Phase I will add 500 MLD to the existing supply and Phase II will add another 275 MLD

\*\*\* As per an article in [IndiaSpend](#)

As per BWSSB data, government water supply covers only 570 sq km out of the total 800 sq km of the city area. Supply from the Cauvery River travels over more than 100 km and needs to be pumped uphill at a cost of USD 6 million a month to the government. It is also estimated that more than **20 per cent** of water supplied is lost/unaccounted for (UFW) due to leaks from old and corroded pipes and poor storage units, as well as illegal connections. The BWSSB has invested in trying to reduce UFW during storage and transport, however, they have managed only a reduction from 48 per cent in

2012-13 to 38 per cent in 2018-19.

As only 55 per cent of the population has access to piped water from government sources, Bengaluru is heavily dependent on groundwater, which is also rapidly receding. Groundwater recharge in **2019** was at its lowest due to insufficient rainfall in the pre-monsoon and monsoon period, forcing them to dig even deeper. It is also becoming increasingly difficult for populations to afford tankers (that transport groundwater), which can cost as much as **INR 2,000** per tanker.

The idea of building a city around lakes was so that they act as aquifers, recharge groundwater, and thus provide a perennial water supply. However, from a city with over 260 lakes in the 1960s, Bengaluru now has only around 80 lakes, most of which are either too polluted with industrial waste or unusable. The largest, Bellandur Lake, has caught fire more than once due to heavy volume of domestic and industrial waste - about **70 million gallons**

of sewage is discharged into the lake every day. Increased use of concrete curtails the percolation of rainwater and as a result, less than 10 per cent of rainfall seeps into the natural aquifers underground and causes severe floods during the monsoon period. While schemes for rainwater harvesting and an increase in sewage treatment plants are underway, implementation is poor, piecemeal, and far from sufficient.

## INDUSTRY SNAPSHOT

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Bengaluru is an important contributor to the state of Karnataka according to a [study](#) and accounts for USD 197 billion of Karnataka's total GDP of USD 226 billion (2019-20). The city is home to 40 per cent of India's Information Technology industry (ranging from electronics, telecommunications, aerospace, biotechnology, artificial intelligence, and others), which accounts for 55 per cent of Karnataka's GDP. As a well-regarded startup hub Bengaluru has recorded more tech companies founded than Delhi and Mumbai combined since 2016. The city attracts start-up investments to the tune of **USD 3.5 billion** on average annually, leading to a further influx in population growth and demand for water.

The second major industry is biotechnology,

and Bengaluru is home to the largest bio cluster, which has been generating a revenue of USD 341 million as early as 2008. Bengaluru's textiles and apparel industry are the next largest contributors to Karnataka's textile and garment industry, which produces 20 per cent of India's cotton and silk - valued at **USD 1.56 billion**. According to a 2017 study by Ashoka Trust for Research in Ecology and the Environment, this thriving industry uses 396 ML of water per day, or about 144 billion liters annually. Other major industries contributing to Bengaluru's economy include agro-processing, mining, steel, and cements production, all significant users of water. As per the projected population growth, water demand, and supply (see Table 1), Bengaluru will face a shortage of 1,771 MLD of water by 2030.

# CHENNAI

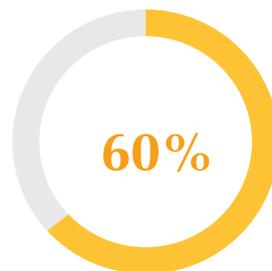
Chennai, known as the 'Detroit of Asia', is an automobile hub and home to one of the largest and most important IT centres in the country. In 2019 the city catapulted into national news for facing extreme water stress following a poor monsoon that had left the four main reservoirs feeding the city at 0.2 per cent of their capacity. A situation made worse by inefficient systems to augment natural water resources. While the city brought in water via trains to push back an inevitable day zero scenario, it is an unsustainable situation in the long term. A study estimates that by 2030, the gap between demand and supply of water for Chennai could reach 400 million litres per day, if recycling and reuse plans are not put into effect (Paul & Elango, 2018). This will not only impact the city's estimated 14 million residents in terms of health security and livelihoods, but it will also adversely affect the industrial zones and growth sectors that are significant contributors to India's progress.

## CHALLENGES

- 💧 Unsustainable urbanization
- 💧 Reviving natural wetlands and flood plains
- 💧 Lack of effective rain-water harvesting and other re-use methods



POPULATION  
11 MILLION



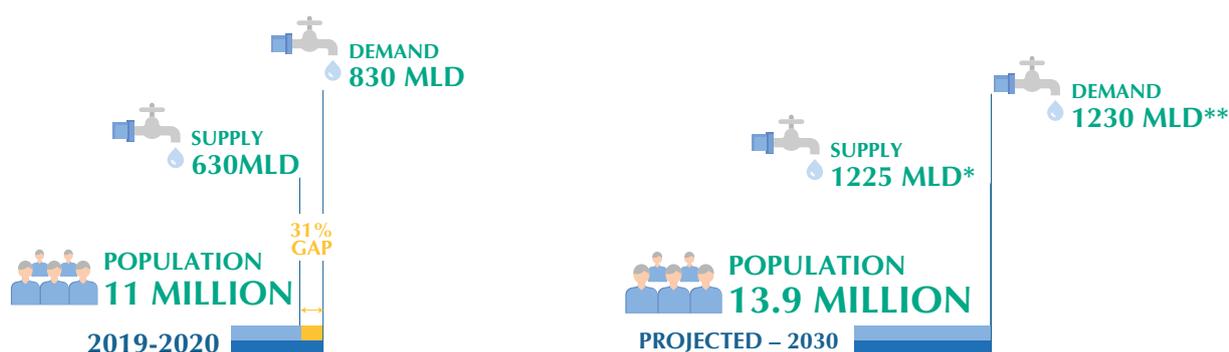
OF INDIA'S  
AUTOMOBILE EXPORTS

# WATER SNAPSHOT

Chennai lacks a perennial source of water and is heavily dependent on rain fed reservoirs: Red Hills (Puzhal Lake), Poondi Reservoir and Cholavaram Lake. Chembarambakkam, another large reservoir, is contaminated with sewage and has a water treatment plant with a total planned capacity of 530 MLD. **Other sources** of water for the city include Veeranam Lake (180 MLD) in Cuddalore, and desalination plants in Vada Nemmeli and Minjur. Groundwater extraction takes place from about 0.42

million private wells within city limits, and 66 per cent of households **have** their own private wells. The result is overexploitation, rapidly falling groundwater levels, with the city extracting almost twice the annual recharge. In the last few years, the demand for water in Chennai has outstripped the supply by almost 200 MLD. In 2019, during severe drought, the municipal authorities arranged for trains to bring 2.5 MLD of water every day into the city, barely meeting the demand-supply gap.

**Table 2**



\*Calculations based on the assumption that planned WWT and desalination plants will come into effect, and that de-silting efforts will increase capacity of clean water in the reservoirs.

\*\*An approximate estimate based on population growth and linear increase of demand assuming BAU scenario.

Water stress in Chennai can largely be attributed to increased urbanization, a lack of effective methods to harvest and reuse water and poor consumption control measures. Rampant development has occurred by clearing marshlands and filling up smaller water bodies. The area of water bodies has reportedly come down to **3.2 sq. km in 2017 from 12.6 sq. km in 1893**, according to a report by Anna University. From a chain of 16 tanks that used to exist in Vyasarpadi,

several were converted post 1950's into settlements, leading to repeated flooding and decreased groundwater recharge capabilities. The vanishing water bodies have resulted in a decline in **surface water storage, from 37.8 billion liters in 1893 to 9.5 billion liters in 2017** (Lakshmi, 2018). Jayashree Venkatesan, a managing trustee with the NGO Care Earth in Chennai, **explains** that big developers cut off the water from streams and lakes, effectively turning them into dry lands fit for

construction. In a move to restore the city's waterways, slums and illegal housing from banks of rivers and water bodies are set to be demolished and the dwellers relocated to settlements on the outskirts, ironically built on wetlands.

Chennai has two desalination plants, each with a capacity of 100 MLD. Two others under construction, purported to be completed by 2021 and 2024, will add an additional **550 MLD** to the overall supply. Over the last few years there has been a push towards making rainwater harvesting mandatory in every building but according to Sekhar Raghavan from the NGO Rain Centre, 40 per

cent of buildings in 2019 had systems that were not collecting water, also, these systems were missing in most government buildings (Sreevatsan, Khanna, & Choudhary, 2019). Tertiary water treatment plants have been installed in Koyambedu, with a capacity of 45 MLD and will likely cater to the needs of SIPCOT industrial belt (automobile industry). This additional water supply will allow **20 MLD** of water to be diverted for domestic purposes from Chembarambakkam. The government has also begun de-silting of this reservoir to revive functionality, where the Water Resources department will remove more than **15 million cubic meters** of silt in the span of next eight years.

## INDUSTRY SNAPSHOT

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Chennai contributes nearly 40 per cent to the Tamil Nadu's GDP. **It is the automobile hub of India**, producing 1.4 million cars a year, and contributing to **60 per cent** of the country's total automotive exports. The city is a centre for **small-scale manufacturing** of rubber and plastic, metal and transport products. The Madras Export Processing Zone (MEPZ), spread over **262 acres**, has more than 100 industries engaged in textile and leather, electronic hardware and software, chemicals, pharmaceuticals and others, and has contributed to exports worth **USD 13.54 billion** in 2018-2019, which is over **14 percent of India's exports** from special economic zones. Several manufacturing units, however, are in special economic zones built on water catchment areas, like **Irungattukottai**.

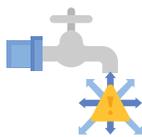
Chennai has a growing tertiary sector that provides software services and hardware manufacturing. The city's famed IT corridor has more than 150 mega structures holding 650 companies (including TCS, Wipro, Infosys, Cognizant, Mindtree, Mastek, Polaris, Hexaware and Tech Mahindra) that employ over a half-million people. During the severe drought of 2019 companies were forced to close offices or pay 30 per cent more for private water tankers. Citizens were spending hours waiting for water at public taps and tanks, reducing economic output and in many cases spending close to **half their income** on buying water. In **May 2019**, the Madras Chamber of Commerce and Industry found that most industries had suffered production disruptions and higher operating cost, likely to lead to a reluctance to invest further if the state does not take adequate measures.

# DELHI

Delhi, the national capital of the country, is home to almost 20 million people (over 30 million if we consider the wider region) and several small and medium scale industries. It is one of India's fastest growing cities, with a total GDP of USD 122 billion (2019) and over 12 per cent average annual growth rate. The city is one of the fastest growing in terms of population in the world, and the most urbanized region in India with 97.5 per cent urban population, that adds to the high degrees of water stress especially in the summer months. The city and immediate neighborhoods (National Capital Territory) are projected to overtake Tokyo by 2028 with an expected population of 37.2 million. Is the capital of one of the most populous countries in the world ready for this?

## CHALLENGES

- 💧 Curbing excess groundwater usage
- 💧 Unplanned development
- 💧 High levels of contamination of water bodies



**AT RISK**



**POPULATION  
3.8 MILLION  
AND GROWING**

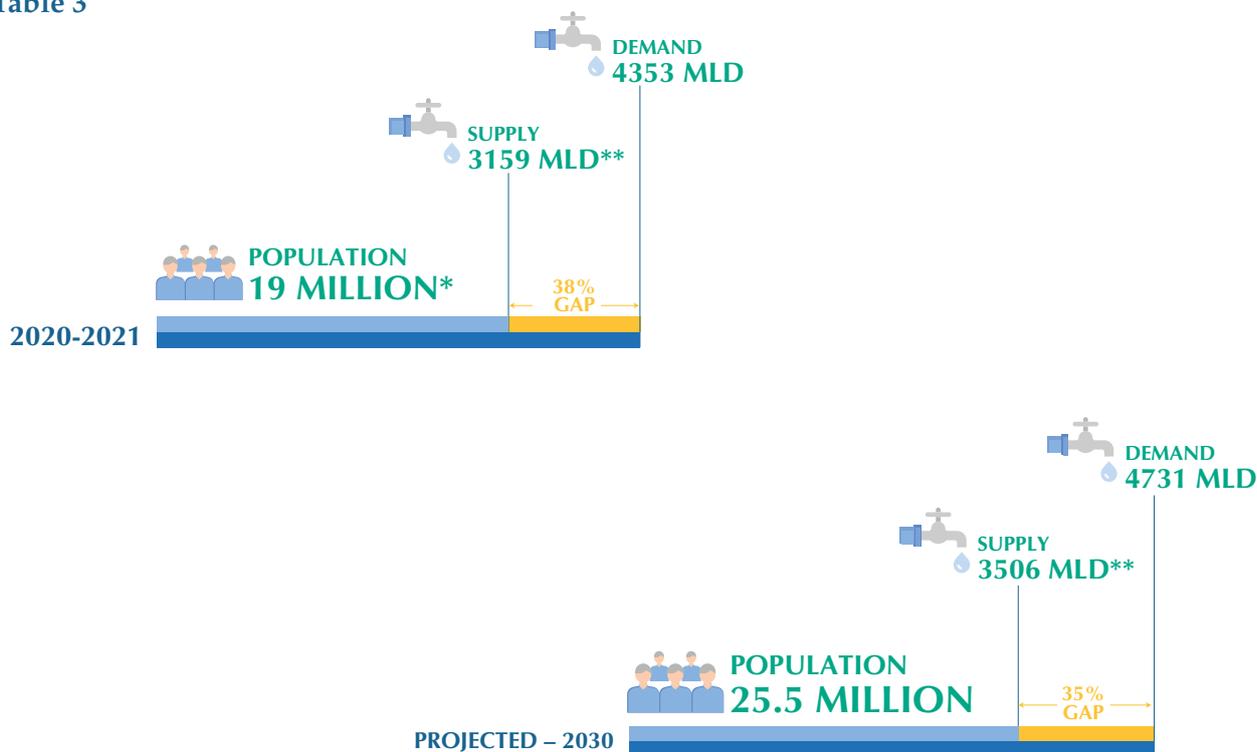
# WATER SNAPSHOT

The Delhi Jal Board (DJB) is responsible for the production and distribution of drinking water in the city. It is also responsible for collection, treatment and disposal of domestic sewage. DJB gets raw water, which is then treated and supplied as potable water to New Delhi Municipal Council (NDMC) and Delhi Cantonment Board. According to the DJB, approximately 82 per cent of the city receives piped water supply.

The DJB draws water from varying sources: **34 per cent** from Ganga, **60 per cent** from Yamuna, and the rest from Bhakra Storage

and underground water. Additional sources also include Tehri, Renukal, and Kishau dams (Safe Water Network, 2016). There are 14 water treatment plants in Delhi and DJB has received funding for another in Okhla, which is set to be the largest sewage treatment plant in India. The plant in Okhla is expected to increase the water supply capacity by 11 per cent. The treated water will be used to recharge **56 water bodies** in the area around the plant. DJB also offers 50 per cent subsidy to Cooperative Group Housing Societies for rainwater harvesting. Implementation of the scheme, however, has been poor.

Table 3



\*Population here is for Delhi City that the DJB supplies water to and not the entire NCR which stands much higher at over 30 million

\*\*Source: National Capital region Planning Board (NCRPB); Safe Water Network, 2016

\*\*\*Assuming that the Okhla plant is operational within the decade

The water policy in Delhi by the AAP government promises 20,000 liters of free water to every household per month. However, **40 per cent** of DJB's water supply is non-revenue water i.e. water that is produced but lost due to leaks, theft, metering issues, etc. before it reaches the customer. This, coupled with the problem of unplanned housing, leads to further groundwater abstraction. Delhi is not only facing an issue of over consumption, rising demand and poor supply management, but also a fast decreasing availability of clean water. The Yamuna river is highly polluted and

other nearby rivers are changing their course and shifting towards the north eastern region. This has increased pressure on groundwater, which is now extracted to the **maximum level** of aquifers, increasing the geostatic pressure that can lead to higher load on the land.

Water ATMs have been installed in various parts of the city, which dispense drinking water at a cheaper rate. It is a good policy in the short run, but it is likely to magnify the problem of water stress in the long term through overdependence and complacency.

## INDUSTRY SNAPSHOT

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Delhi has **29 approved industrial** areas and the largest metro rail network in the country. The milk market is a key industry in Delhi-NCR, the organized sector of which, according to a **study**, produces approximately 5 MLD of milk with a growth of 6-8 per cent. Global estimates indicate that it takes about **120 litres** of water to produce one litre of milk. Other key sectors for industry in Delhi include the real estate market, and the service sector (primarily IT and start-ups). The start-up sector in Delhi attracted funding investments of up to **USD 7.4 billion** in 2019.

The areas of Anand Parbat, Wazirpur and Okhla, which have water intensive industries such as dyeing and electroplating, are severely affected by water stress, almost annually. According to a report by Central Pollution

Control Board (CPCB), pollutants are generated from 20 large, 25 medium and almost 93,000 small-scale industries. While the large and medium industries constitute only **0.05 per cent** of total industries in Delhi, they contribute approximately 50 per cent of the industrial waste generated in the city. These industries are engaged in engineering, textile, chemicals, electronic and electric goods.

According to the CPCB every day, almost **40 per cent** of untreated sewage is either left as is, or is discharged into the Yamuna, further highlighting the lack of capacity and efficiency of water treatment plants. Several programs that are in place for cleaning Yamuna have failed to realize their goals. Cleaning of the 8 km belt of the river, will serve to revive the dying river and aid in supply of clean water to the city.

# KOLKATA

Kolkata, the capital city of West Bengal, built along the banks of the Hooghly River, is one of the most important economic hubs in eastern India. Kolkata's Syama Prasad Mookerjee, one of the two major ports in West Bengal, handled 63.8 million tons of traffic in goods in 2018-2019. The port is of strategic value to Nepal, Bhutan and Bangladesh and is an attractive destination for investment: domestic and foreign. Kolkata is the seventh most populated city in India, therefore population growth and economic activity will be severely curtailed if plans are not put in place to manage the growing water stress, and uneven demand and distribution of water. A growing gap in demand and supply, high instances of UFW, theft and depleting groundwater, will not only result in acute water shortage for Kolkata's 5 million people, but also uncertainties and potential loss of revenue for industries, including the paper industry, IT and financial sectors.

## CHALLENGES

- 💧 Curbing excess groundwater usage
- 💧 High degree of unaccounted for water loss

 **AT RISK**



**POPULATION  
5 MILLION AND GROWING**



**OF NATIONS  
PAPER INDUSTRY**

# WATER SNAPSHOT

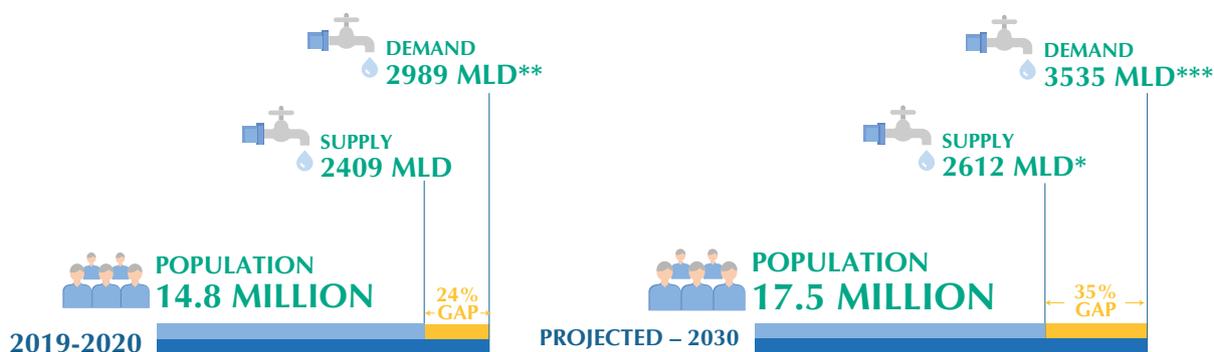
Kolkata Municipal Corporation (KMC) has three major Water Treatment Plants (WTP) that draw water from Hooghly River and supply 2045 MLD to the residents (Palta Waterworks- 1227 MLD, Garden Reach WTP- 682 MLD, and Dhapa WTP- 136 MLD). An additional 59 MLD is supplied by WTPs of Jorabagan and Watgunj. About 305 MLD, drawn from groundwater, increases official supply to **2409 MLD** (approximately 879 billion litres) annually. The government plans to install new plants at Garden Reach additional **113.6 MLD** capacity) and at Palta Waterworks (additional 90 MLD capacity), in order to manage the increasing demand of water in the city. Per capita consumption of water in Kolkata is around **202 liters per day**.

According to official figures, there are 17,000 water hydrants, 12,000 hand tube wells and

2,500 large tube wells in the city that draw groundwater, however, the actual figures may be much higher. Several new apartments in the city have installed their own bore wells to draw water from the ground. A KMC report anticipates a likely drop to **11 meters from the current level of 7 meters** of Kolkata’s groundwater level. This will not only increase the stress on groundwater (11 per cent of the city depends on groundwater), but will also lead to a drop in quality of the water available. According to a study by Jadavpur University, nearly **55 per cent of groundwater contains high levels of arsenic, making it unfit for use**.

Poor access to adequate water supply affects 35 per cent of Kolkata’s population. Abolition of the water tax in 2011 has led to exploitation by private companies and tankers. Water tankers supplied by the government charge

Table 4



\*Here it is assumed that the supply from new WTP’s will be operational.

\*\* Per capita consumption\*

\*\*\*Demand figures are estimated accounting for rise in population and official per capita consumption figures. However, this does not account for industrial growth and thus actual demand and future shortage is likely to be much higher.

one rupee for two liters, but many private tankers charge as much as INR 40 per liter in areas where the groundwater is contaminated. Further, an estimated **30 per cent** of UFW loss occurs largely due to outdated and poorly managed pipes and taps, and water theft.

It is estimated that 247 billion liters of water can be amassed through rainwater harvesting by conservation and artificial methods in Kolkata Metropolitan Area, however these plans need to be part of a larger basket of solutions and put into action (Kolkata Municipal Corporation).

## INDUSTRY SNAPSHOT

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West Bengal is ranked 10th on the [ease of doing business ranking of states in India](#) with Kolkata being one of the top performing cities in terms of GDP for the state and the wider North East region. Major sectors include manufacturing and textile industries, both water intensive. The city also has the largest tea auction market in the country. As it is much less expensive to start a business in Kolkata, in comparison to other Indian metropolitan cities, it has become a favorite among foreign investors and companies; **in 2018-19, the city received USD1.2 billion in FDI compared to USD218 million in 2017-18.**

A large part of Kolkata's economy comprises of micro and small [enterprises](#): primarily textile, leather, Jute, furniture, machinery products, rubber and plastics, PVC cables, electronics etc. Paper and paper products sector is the largest among small enterprises with **206 units** in Kolkata. The paper industry is water-intensive and also a major employer. Approximately 32 mills across the state produce 2.1 million tons of paper products per year, contributing about 10 per cent to the nation's consumption and growth. The growth of Indian paper industry is projected at 12 per cent per annum to reach consumption of 24 million tons of paper in the country.

West Bengal was one of the leading states in the '[Paperex2019](#)', the world's largest paper show held in Delhi.

West Bengal, according to real estate consultant JLL, reported land investments in warehousing amounting to more than USD 570 million (2018-2020), a majority of which are concentrated in Kolkata and its suburbs. Kolkata has registered an increase of warehousing investment of **191 per cent** from 2017 to 2018, as compared to 147 per cent in Bengaluru and 96 per cent in Hyderabad. As peripheral areas are predicted to grow, the city is expanding quickly, including to Tartala-Maheshtala (one of the four warehousing clusters, located in the south of the city), a water stressed region. Kolkata has witnessed exponential growth in the IT industry owing to a promising financial services scenario and educated manpower, with over 500 companies engaged in domestic businesses and exports. In 2018, the government announced the Silicon Valley Hub project and initially earmarked 100 acres for the same, which was later expanded to 200 acres. Expecting a post-pandemic manufacturing boost in the electronics and IT sector, [West Bengal's Housing Infrastructure Development Organization \(Hidco\)](#) has

begun offering plots of land to private enterprises in Bengal Silicon Valley, which is located in New Town of Kolkata. Many large groups, including Reliance Jio, Capgemini, CTS, TCS and Indian Statistical Institute, have already [acquired land](#) in the earlier phases. Reliance Jio has also started construction of its data center, and IT giant Wipro is planning to build a second campus in the city. New Town is the fastest growing planned satellite cities of Kolkata, and along with the rest of the city

regularly reels from water stress especially in the summer months with residents shelling out at much as [INR 3000 per month](#) on bottled water.

If Kolkata and important suburbs such as New Town do not manage their water scarcity and safeguard against the future, it could adversely affect the growth potential of these companies, similar to what was seen in Chennai during the 2019 drought.

# MUMBAI

The commercial capital of India and summer capital of Maharashtra, the bustling overcrowded city of Mumbai, is one of the many cities named by the 2018 NITI Aayog Report that is likely to face acute stress by 2021. While the report might be considered alarmist and extreme, there is no doubt that the city is severely water stressed with unequal distribution of water, lack of access, poor infrastructure in parts of the city, limited means to augment natural water sources and minimal rainwater harvesting. Mumbai is also overly dependent on annual rainfall precipitation, which is increasingly affected by the erratic changes in the climate. Some of Mumbai's growing commercial spaces such as Bandra-Kurla Complex, Worli and Parel, especially for new media and advertising agencies, banks and pharma companies, and key industrial zones such as SEEPZ and Marol are prone to excessive flooding in the monsoon and water shortages in the summer.

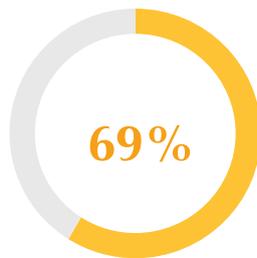
## CHALLENGES

- 💧 Unsustainable Urbanization and development
- 💧 Reviving natural wetlands and flood plains
- 💧 Lack of effective rain-water harvesting and other methods to augment water supply

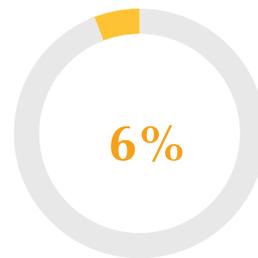
 **AT RISK**



POPULATION  
8 MILLION  
AND GROWING



OF INDIA'S  
JEWELLERY EXPORTS



OF COUNTRY'S GDP

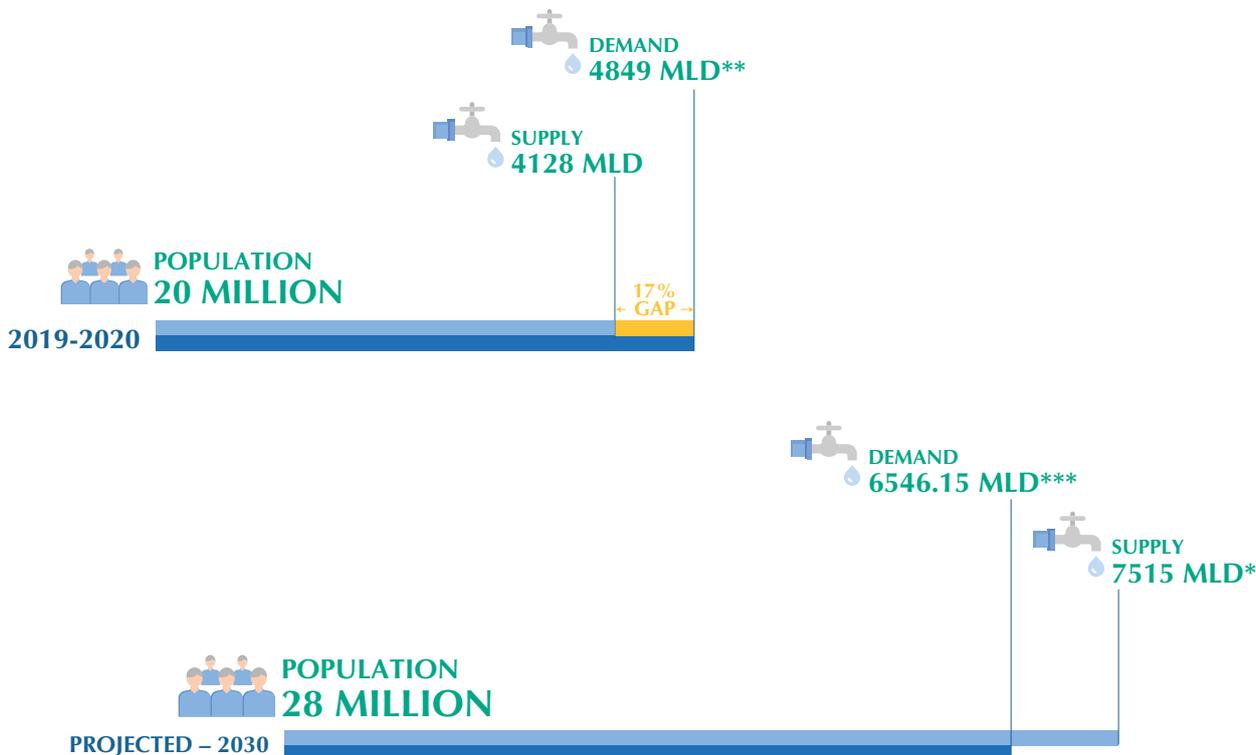
# WATER SNAPSHOT

The city of Mumbai has a high population density with a significant floating population. Water supply for Mumbai city is governed by the Municipal Corporation of Greater Mumbai (MCGM). Water is drawn from a system of water reservoirs and lakes. All of Greater Mumbai’s water reservoirs are located in the catchment area of four major rivers- Vaitarna, Ulhas, Patalganga and Amba. The basin area of these rivers is jointly known as the Mumbai Hydrometric Area (MHA), managed by the Department of Irrigation. Mumbai city relies on six lakes (Tulsi, Tansa, Vihar, Upper Vaitarna, Bhatsa and Mumbai

III) that are primarily dependent on monsoon precipitation. Bhatsa and Vaitarna are the major water suppliers followed by Mumbai III and Tansa. These **six lakes together have the capacity of 1447 billion litres** and provide 3800 million litres of water every day.

While the current supply is approximately at 4128 MLD, a **2018 BMC report** titled ‘Equitable and 24x7 Water Supply for Greater Mumbai’ has found that projected demand for 2021 is expected to be at 4849 MLD, leaving a shortfall of 721 MLD per day. For the same period, **a report has projected a gap of**

**Table 5**



\*Assuming that proposed dam activity and river-linking projects will fructify, along with the wastewater treatment plants.

\*\*The 2020-21 demand as projected by a 2018 BMC report

\*\*\*Linear calculation based on 2018 BMC report projects for 2041 where demand expected to rise by 71 % to 8291.8 if all else remains the same and rate of demand is steady. However, if effective policies are put into place demand could be lower.

**1100 MLD** between the demand and supply (Safe Water Network, 2016). The shortfall, however, is expected to be much higher, especially in summer months. The shortage of water is more acutely felt in lower income neighbourhoods and slum areas of the city that make up over 40 per cent of the population according to the 2011 census. These neighbourhoods are largely dependent on the informal water distribution systems, including tankers that can be prohibitively expensive.

The government has banned groundwater usage for drinking due to its limited potability, but irrespective of that, there are 3950 dug wells and 2514 bore wells in the city to draw water from the ground (Safe Water Network, 2016). According to the Ministry of Water Resources Central Ground Water Board, industrial effluents from oil refineries, fertilizers and sewage are dumped regularly into surface water reservoirs in Mumbai causing the contamination of ground water with heavy metals.

While an increase in domestic demand and consumption is expected with a rising population (set to increase by 50 per cent in the next two decades), the city will also witness unprecedented demand from industrial growth and commercial use of water. This is likely to result

in **71 per cent** surge in demand by 2041.

Wastewater treatment plants will potentially add an additional supply of 496.8 MLD by 2025, and a proposed desalination plant at Gorai beach is projected to supply **200 MLD**. In 2019, Chief Engineer at BMC's hydraulic department, Ashok Tawadia, suggests that an additional **2891 MLD** of water could be added to supply in Mumbai. The Pinjal and Gargai dam projects, and Damanganga-Pinjal river linking project, which are proposed to be functional by 2030, would be essential in realizing this target. However, there are issues between Maharashtra and Gujarat over the Damnganga-Pinjal link project as **55 per cent** of land that will be submerged in water owing to one of the proposed dams being housed in Gujarat. The 2019 state water policy has a number of good initiatives: addressing drought prone areas of the state, encouraging greater involvement of the industrial sector, and restoring and increasing the storage capacity of water bodies.

However, without effective implementation and working in tandem with other departments and aspects of urban governance, ad hoc policies will do little to alleviate Mumbai's growing water stress.

## INDUSTRY SNAPSHOT

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Mumbai, the capital of Maharashtra state, is the commercial hub of India with an annual GDP of approximately USD 310 billion (ppp 2017-18). This makes up **87 per cent share in the state's GDP**, and 6 per cent of the country's GDP. The services sector is the major contributor to Mumbai's economy, including finance; gems and jewellery are a substantial contributor, along with leather exports from the slum of Dharavi.

The district of Mumbai is home to the headquarters of several multinational companies as well as a number of small-scale industries. There were 635 large scale units and 69 medium units in Mumbai as early as 2012. These industries are responsible for major exports from the city, including engineering and chemical products, textile and leather products, agro-based products, and pharmaceuticals. The jewellery industry is a major economic contributor and accounts for **69 per cent share of the country's jewellery exports**, amounting to USD 28.32 billion (Dezan Shira & Associates, 2019). Of this the Santacruz Electronic Export and Jewellery Processing Zone (SEEPZ), a special economic zone, is responsible for approximately 50 per cent. SEEPZ and neighbouring Marol, another key industrial cluster, are home to almost 250 units, with Powai village known as the start-up hub

of the city. Apart from these, electronics and IT industries also have a strong foothold in Mumbai, with a steady growth trend. While Maharashtra contributes over **11 per cent**, as of 2016, to the country's pharmaceutical industry, the headquarters of all major companies are located in Mumbai.

The leather industry in Dharavi is substantial with approximately 20,000 units. India's leather exports to the world exceeded USD 5.69 billion in 2018-19 (Council for Leather Exports), with Maharashtra at about **32 per cent** of the country's overall production capacity in leather sandals, and **15 per cent** in other leather goods. A major portion of it comes from Dharavi, which is also a major employment generator. The crowded mini city has a high population density of **354,167 per square kilometre** and faces numerous challenges including perpetual water scarcity, placing stress not only on the residents and their well-being but also on the productivity of the leather and other small-scale industry.

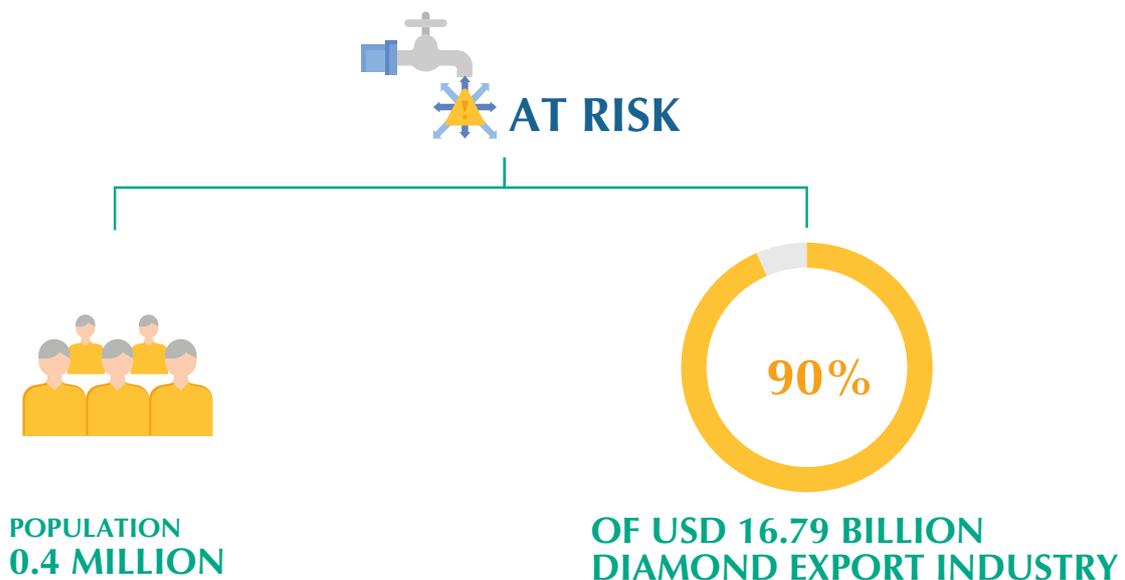
Many of the economic zones and commercial hubs of the city including Dharavi, Marol, SEEPZ, Parel amongst others face high levels of water stress, leading to not only a health issue but an overall productivity concern for the city.

# SURAT

Surat, located on the banks of the Tapi River, is an important industrial city of Gujarat and one of the top ten contributors to India's GDP. One of the fastest growing urban centres in the world, it also ranks in India's top ten richest cities. A 2019 report by Oxford Economics predicts that the city will see an average annual GDP growth rate of 9.2 per cent from 2019 to 2035. Economic demand coupled with population growth (at a rate of over 7 per cent) has seen Surat face water shortages, especially in the summer months. Interestingly, Surat is one of the first cities in the country to develop a unique resilience action plan to tackle extreme heat, which could aid in water sustainability measures for the future.

## CHALLENGES

- 💧 Contamination of surface and groundwater
- 💧 Concretization of creeks, riverbanks and natural flood plains



# WATER SNAPSHOT

The Surat Municipal Corporation (SMC) draws water primarily from the Ukai Dam on the Tapi River. According to [government data](#), the intake capacity to draw water from the dam stood at 2033 MLD in 2015, and the water treatment capacity stood at 1468 MLD. The total water supply to the city is 1250 MLD, where the SMC provides piped supply to 95 per cent of its residents.

Summer months, however, see a drastic drop in supply. The lack of maintenance has led to malfunctioning of intake wells where water hyacinth and vegetation choke the flow of water. It is reported that SMC was supplying

as much as **25 per cent** less than the normal amount to its residents during certain periods of 2019. Another major challenge for Surat has been unpredictability of the monsoon and scanty rainfall. The 1995 master plan for SMC, included plans to increase capacity of intake well up to 2425 MLD by 2041 to meet the expected demand of 2367 MLD. However, by the end of the decade in 2030, the shortage is likely to be close to 200MLD, or 73 billion litres of water.

Surat generates 800 MLD of sewage and has eight Sewage Treatment Plants (STPs) with a capacity of 726 MLD. Ongoing projects

**Table 6**



\* Increase due to fully functional proposed STPs

\*\* SMC Water Supply Master Plan Details

are set to increase the capacity by 150 MLD, whereas proposed projects will take it up to 1306 MLD (SMC Treatment Plants). If the proposed projects do come into effect, treating the water to be used, it will add close to 500 billion litres of treated waste water to the city, relieving stress on natural resources, including the Tapi River and groundwater. It

will also ensure that the government is adequately prepared for periods of low rainfall and drought. Currently, the SMC plans to provide recycled water of **115 MLD** for the industrial clusters of Pandesara and Sachin, which house a number of dyeing units. Surat has faced the challenge of increasingly deteriorating quality of surface water due to

pollution caused by industrial effluents. There are many creeks within the city limits, and while the quality of water in the river is regularly monitored, the implementation does not extend to the creeks in the city. Water pollution in creeks can have harmful impacts on the neighbourhoods, primarily low income, alongside these creeks, and cause creek

floods. Excessive construction near the mouth of Tapi River has also exacerbated flood risk, with floodplains within the fast-growing city now hampered due to heavy construction and increasing population; at least 71,000 households are vulnerable to creek floods, and as many as 250,000 households face risks of river flooding (Bansal, 2018).

## INDUSTRY SNAPSHOT

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The Gujarat Industrial Development Corporation has helped set up several industrial clusters in and around Surat that contribute substantially to the economy of the state and the country. The two primary industries of Surat are textiles and diamond cutting. Over 40 per cent of India's art-silk fabric is produced in Surat. About **90 per cent** of the diamonds produced in India are processed and polished in over 3500 units spread across in the city. Surat contributes **USD 16.79 billion** of Indian diamond exports, close to 90 percent in total. Surat's population is expected to increase substantially by the end of the decade and with the growing gap between demand and supply of water, the billion dollar diamond industry and textile mills are at risk.

There are several clusters within Surat where a majority of 41,300 small and micro industrial units are located (MSME Development Institute of India). In nearby Hazira, larger industries (companies such as Reliance, Essar Steel, Essar Power, Larsen & Toubro, Adani, NTPC, ONGC etc.) have set up their units. While these industrial units have the economic capacity to install their own wastewater treatment facilities, the smaller industries in

the clusters do not. Keeping that in mind, the government has set up Common Effluent Treatment Plants (CETP) so the waste from these industry clusters can be treated. There are five CETPs in Surat with a combined capacity of 310.5 MLD to treat industrial wastewater (Bansal, 2018).

Sachin is the oldest among the clusters of Surat and has the largest number (at 3000) of functioning industrial units, including many textile units. This industrial area often faces water scarcity issues: drying up of a local pond and canal has led to severe water shortage, temporarily halting dyeing and printing activities by **half**. The shortage is usually met by 3,500 water tankers, each costing from **INR 800- 1,000**, amounting to large bills to the small-scale industries. In 2017, **60 textile mills** were on the verge of closure due to severe water scarcity. Water shortage resulted in losses amounting to **USD 2.7 million** for the mills (YarnsAndFibres 2017). This is a recurring issue, a few years earlier in 2014, it was noted that 125 textile mills in Pandesara were forced to cut down shifts due to water shortages, leading to production losses.

The textile industry is the second largest employer in the country and contributed to 15 percent of export earnings [in 2019](#). As a growing hub in the sector, contributing to over 12 per cent of the fabric produced in the nation,

Surat needs to put into place water policies that ensure adequate supply and sustainable consumption patterns for the future to safeguard not only the livelihoods of citizens but the overall economic growth of the city and country.

# NEXT STEPS

The Sustainable Development Goal (SDG) 11 calls for inclusive, safe, resilient, and sustainable cities. This cannot be achieved without innovation in the water sector that leads to urban water security. Just as water risks originate from multiple causes, the effects of poor water security are widespread and cannot be solved in a piecemeal manner. The complexity of the challenges, that include food and energy security, health and environment and the growth of a community and country require a systemic approach. This systemic approach needs to take into account long term policy planning that is cross-cutting and multisectoral. As this paper has shown, we can no longer view 'water security' in isolated terms. While the water sector has created frameworks for the application of a technical and governance approach, not only do these two tracks need to come together in India, they need to be brought into the larger discourse on a circular economy.

A brief study of six cities across India has highlighted the deep impact urban water security has on the growth of these cities and the risk factor to the country from inaction. While there is a belief that current policies and governance intervention will strive to decrease this risk, it is not sufficient. It is observed that in all the cases in this study, accessibility, particularly for low income communities and informal settlements. These communities are more often the key components of production and labour in industrial growth and basic running of the economy. Thus, any wider stakeholder conversation needs to also bring these perspectives into the picture. Another common thread is the rampant development in all these cities often at the cost of natural habitats that aid in water conservation and flood prevention, such as marshlands, wetlands, floodplains, embankments and others. We need to employ a multi-pronged approach with greater investment in water

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infrastructure including green and gray infrastructure; renovation and improvement of supply networks; greater use of technological innovations; creation of better community awareness and responsibility; ensure protection of natural sources of water and generation of new sources, and ultimately aim to keep the value of water at its highest.

To strive towards a more comprehensive urban water policy India needs to employ in parallel several tracks. First and foremost is rectify the paucity of data that exists, not only in the space of water availability and supply for the future, moving away from a pure supply side approach, but also in ensuring they are studied in tandem with quality and growing demand from citizens, communities and industry. Second is the need for more technology deployed at all

stages from the source to the user, ensuring that water is preserved and conserved where possible and a more circular system is maintained. A circular system is not only transformative where we rethink avenues of water management in relationship with other spaces such as energy, housing, pollution, sanitation etc, but it is also functional connecting the city with its water and surrounding natural resources. Third, is greater participation and investment, both financial and R&D, from the private sector, that will be attracted to and gain from urban spaces that are water secure. Lastly, as we view our cities as urban innovative centres that are the drivers of growth for the nation, we need to reinforce the understanding and subsequent implementation that urban management is about aligning governance, public policy, financial and regulatory frameworks and water security initiatives and systems.

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# ABOUT KUBERNEIN INITIATIVE

Kubernein Initiative is a Mumbai based, boutique geopolitical advisory that seeks to strengthen intellectual capabilities in an increasingly multipolar world, through conducting intersectional foresight-based insight and analysis from a wider, more inclusive global perspective, while keeping in mind the domestic realities of India. Our name takes inspiration from the ancient Greek verb 'Kubernaein', which means 'to steer' and provides the root for governance. We believe that issues can no longer be debated in sector created silos and solutions that lead to a better future require innovative thinking. We aim to have this research inform policy in India, both at domestic and at the international level.

Kubernein Initiative is co-founded by Ambika Vishwanath and Priyanka Bhide, who bring their combined skills of research, analysis and strategic communications to successfully execute projects relating to security, governance, and development. They have worked together on a variety of issues such as nutrition, transboundary water security, multilateralism and education. Their clients and partners include Forum for the Future, Futterra Network, Agora Strategy Institute, Carnegie India, Revolve Media and Changing Markets amongst others.

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