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REPORT SERIES

URBAN SMALL WATER ENTERPRISES:
CITY ASSESSMENT

DRINKING WATER SUPPLY FOR URBAN POOR:
CITY OF MUMBAI

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ABOUT THE REPORT

This assessment of the drinking water provision to urban poor in the city of Mumbai has been conducted as a part of a partnership between Safe Water Network and the US Agency for International Development (USAID), entitled Urban Small Water Enterprises (USWEs) under the USAID Urban Water, Sanitation and Hygiene (WASH) Alliance program. This study aligns with the agreement entered into between the Ministry of Urban Development (MoUD) and USAID to contribute towards Swachh Bharat Mission. Other cities studied under this program are Visakhapatnam, Hyderabad, and New Delhi.

The objectives of this assessment were to i) map existing water supply to understand the gap and evaluate the success of augmenting small water enterprises (SWEs) as a solution to unavailability and scarcity piped water; (ii) assess the operational, financial, and technical aspects of SWEs for sustainability so that the urban poor, especially beyond the pipe, can get reliable, safe, and affordable drinking water; (iii) study the policy and enabling environment for SWEs; (iv) assess the existing tools deployed for e-governance, monitoring, and evaluation and propose tools for SWEs. While detailed consumer research and water quality testing was done in select slums, the overall report builds on the field investigation and discussions with various officials of Municipal Corporation of Greater Mumbai (MCGM)

This report begins by introducing the USWE project, including the research methodology. Next, the report provides context on Mumbai—its economy and demography—followed by details of water supply, including that to slums. The next section transitions to our research conducted in slums without USWEs and then to slums with USWEs to capture differences and provide a sense of potential of USWEs that have been set up to complement the piped water in slums. It also includes an assessment of the policy and enabling environment for USWEs in the city, and an evaluation of the need for digital tools.

The assessment was undertaken by the Safe Water Network through the Fixed Obligation Grant Award No. AID-386-F-15-00002, for the program titled: "Urban Small Water Enterprises" Dec. 2014–Dec. 2016.

Front Cover :
Gautam Nagar and Azad Nagar Slums, Mumbai

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EXECUTIVE SUMMARY

Mumbai is a port city located on the western coast of the Indian peninsula and is one of the largest and most densely populated cities in the world.

As per the 2011 census, Mumbai has a population of about 12.5million, out of which 6.5million inhabit slums. The goal of uninterrupted piped water in Mumbai slums is a big challenge due to high infrastructure investment needs and depleting water resources. The situation is exacerbated by a rapid increase in population and an alarming rise in pollution levels in surface water bodies and groundwater. The water supply requirement of the city is around 3,900 million litres per day (MLD). Currently only 3,100 MLD of water is supplied for domestic, commercial, and industrial purposes.

Accessibility, quantity, quality, affordability, and equity are issues in the slums.

While quality of water at the point of production is claimed to be 100% safe and treated, an aging pipe network leads to contamination, and customers experience unreliable and irregular supply. Water is supplied to very few slums, and typically household-level taps get water only for about 1-2 hours per day. In some seasons, 95% of households use less than the World Health Organization (WHO)-recommended minimum water consumption of 50 litres per capita per day. During the monsoon season, 50% of the water samples taken were contaminated. For all other seasons, 76% of stored water showed microbial contamination. In addition, households pay 5-6 times more for water than the standard municipal charge of INR3.50 (USD 0.052) [1] per 1000 litres. [2]

Slum dwellers often depend on informal water distribution systems.

Only structures established prior to 1st January 1995 are entitled to water supply, i.e., a metered water connection to a group of slum dwellers with a tap in a general washing place. The municipal corporation does not provide public taps in slums. Residents of non-notified slums suffer the most in terms of water unavailability. Households that have their own tap connection or that use tankers often resell water to neighbours on a regular basis. Residential resales are often supplemented by other water services, such as public stand posts and water treatment kiosks, if available. Though acknowledged as an illegal activity, resale is a consequence of the utility provider's inability to supply water adequately to all customers. Utility staff is aware of this problem but reluctant to take action against these resellers because of the complexities of dealing with water hoarders and local water mafias in the region.

Packaged drinking water is available in slums in the form of water pouches which are sold in local shops.

The starting price of these pouches is INR 1 (USD 0.015) for 500 ml and they go as high as INR 3 (USD 0.04) for 800ml. These pouches are not used as a sustainable means of drinking water but are often sought because they are refrigerated by the shop owners. Slum dwellers are exposed to diseases like jaundice, typhoid, malaria, dengue, tuberculosis, and food poisoning due to inaccessibility of treated water and proper sewerage channels. Public hospitals that offer subsidized health services also cannot cope with the health care needs of this ever-increasing population.

Upgrading to continuous piped water supply would require demand side measures such as proper metering, proper installation and maintenance of metering systems, and telescoping tariff rates to encourage water-conservation measures along with supply-side measures such as source augmentation through dam works. [3]

[1] T The conversion rate of INR 1 = USD 0.01 is used throughout the report.
[2] Baliga, Linah. Steep Hike in City Water Rates Coming. (Feb 2012). The Times of India.
[3] Ibid.

The use of digital tools has made progress through the Right to Service Act, with an intention to make delivery of services through various governmental agencies an effortless and hassle-free process for the citizens. Several transactions have been transferred to digital platforms, but more sensitization and additional resources are needed.

The presence of water treatment kiosks was observed in 2 of the 7 slums reviewed.

These kiosks provided water directly or by home delivery. Both kiosks were operated by Self-Help Groups formed by women belonging to the slum locality and facilitated by a local non-governmental organization (NGO), with operations and maintenance being covered by water revenues. Water is sold at INR10 (USD 0.15) or INR20 (USD 0.30) for 20 litres.

Market-oriented, decentralized water treatment kiosks in these slums can play an important role in addressing the drinking and cooking needs of the poor and improving their health and life outcomes until safe piped water reaches them. Respondents are willing to try alternatives such as water from small water enterprises (SWEs), and are willing to pay for clean water. To be successful, SWEsmust be treated as legitimate solutions, though, with proper financial incentives for entrepreneurs. Communities must be involved in their establishment, and minimal acceptable standards for compliance should be in place.

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LIST OF ABBREVIATIONS

BMC	Brihanmumbai Municipal Corporation
HH	Household
LPCD	LitersperCapitaperDay
MCGM	Municipal Corporation Of Greater Mumbai
MLD	Million Liters Per Day
MoUD	Ministry of Urban Development
NGO	Non-Governmental Organization
RO	Reverse Osmosis
SWE	Small Water Enterprise
TISS	Tata Institute of Social Sciences
ULB	Urban Local Body
WSSD	Water Supply and Sanitation Department
USWE	Urban Small Water Enterprises
NRW	Non Revenue Water
NFHS	National Family Health survey

UNITS OF MEASUREMENT

cm	centimeter
kl	kiloliter
LPCD	Liters Per Capita per Day
MGD	Million Gallons per Day
mtrs	Meters
ml	Milliliters
MLD	Million Liters per Day
Sqft	square foot
sq km	square kilometer
TMC	Thousand Million Cubic

KEY DEFINITIONS

Urban Small Water Enterprises

Urban Small Water Enterprises (USWEs) generally refer to a range of entities selling water to bottom-of-the-pyramid populations in urban areas, ranging from stationary water points, such as kiosks or standpipes, to mobile units, such as tanker trucks and door-to-door vendors. This assessment, however, was limited to water treatment kiosks that sell affordable water to the urban poor.

Notified/Non-notified Slums

Any compact settlement with a collection of poorly built tenements of at least 20 households, mostly of a temporary nature, crowded together, usually with inadequate sanitary and drinking water facilities in unhygienic conditions. A notified slum is an area notified as a slum by concerned municipalities, corporations, local bodies, or development authorities. The balance is non-notified slums. [Source: Public Information Bureau, Govt. of India]

Resettlement Colonies

Settlements that have been created to relocate some populations that were earlier residing in slums.

Non-Revenue Water (NRW)

NRW is water that has been produced and is "lost" before it reaches the customer, owing to reasons such as leakages, theft, or metering inaccuracies, or which did not yield revenue owing to technical and nontechnical reasons. It is also referred to water supplied free through stand posts or under an exemption policy.

Nallahs

These are concrete or brick-lined ditches/drainswith about6meters width and 3meters depth used to divert monsoon rain from the cities. The smaller drains of the cities open into these nallahs.

A typical slum in Mumbai city. Living under cramped spaces, with no or very little access to basic amenities like electricity, sanitation or water, people living in slums are repeatedly exposed to danger of disease.

1. INTRODUCTION

1.1 Background

In the last two decades, India's urban population has increased at an ever-expanding rate leading to a growth in the number of urban slums due to unchecked land prices, migration, and unaffordable housing. The 2011 census reports that 2,613 statutory towns (63%) reported slums and that 17.4% of urban Indian households live in slums.

Living under cramped spaces, with no or very little access to basic amenities like electricity, sanitation or water, people living in slums are repeatedly exposed to danger of disease. Their status as illegal migrants and illegal encroachers to land also render the slum dwellers unable to access any institutionalized mechanism for daily water supply or other basic necessities. [4]

Significant infrastructure investment is needed to extend piped connections to the urban unserved. Most Indian utilities operate at a deficit and most slum dwellers cannot contribute to capital investment, though they can contribute to operating costs (Bajpai and Bhandari 2001).

In water-short cities such as Delhi, Mumbai, Vizag, Hyderabad,and Ahmedabad, city governments contract tankers to serve areas without piped connections or clean groundwater. City governments should consider contracting and regulating local water entrepreneurs as mainstream rather than "interim" delivery mechanisms.In the absence of official recognition, water vendors will continue to operate, but without quality controls, price monitoring, or accountability.

1.2 Objectives of this Study

The purpose of this assessment is to evaluate the gap in the provision of treated drinking water in slums, and identify the potential role of small water enterprises (SWEs) and digital tools to fill that gap. Survey questions were framed in regards to the issue of water scarcity and unavailability of treated drinking water, especially to poor households in India.

1.3 Hypotheses

The following hypotheses were tested:

- Urban poor have limited access to piped water and other sources of municipal water, leaving them to depend on unreliable sources of water.
- Limited, if any, USWEs are serving the urban poor in Mumbai.
- The civic body, Municipal Corporation of Greater Mumbai, holds the key responsibility of ensuring potable water supply effectively and efficiently in Mumbai.

[2] WHO/UNICEF Joint Monitoring Program 2012
[3] In Census 2011, slum blocks have been enumerated in all statutory towns irrespective of population size.
[4] McFarlane, C. "Sanitation in Mumbai's Informal Settlements: State, 'Slum', and Infrastructure." Environment and Planning A, 40 (1), pp. 88-107.
[5] http://mospi.nic.in/Mospi_New/upload/Children_in_India_2012.pdf

1.4 Methodology

The overall process followed for the study is as depicted in Figure 1.

Secondary Research

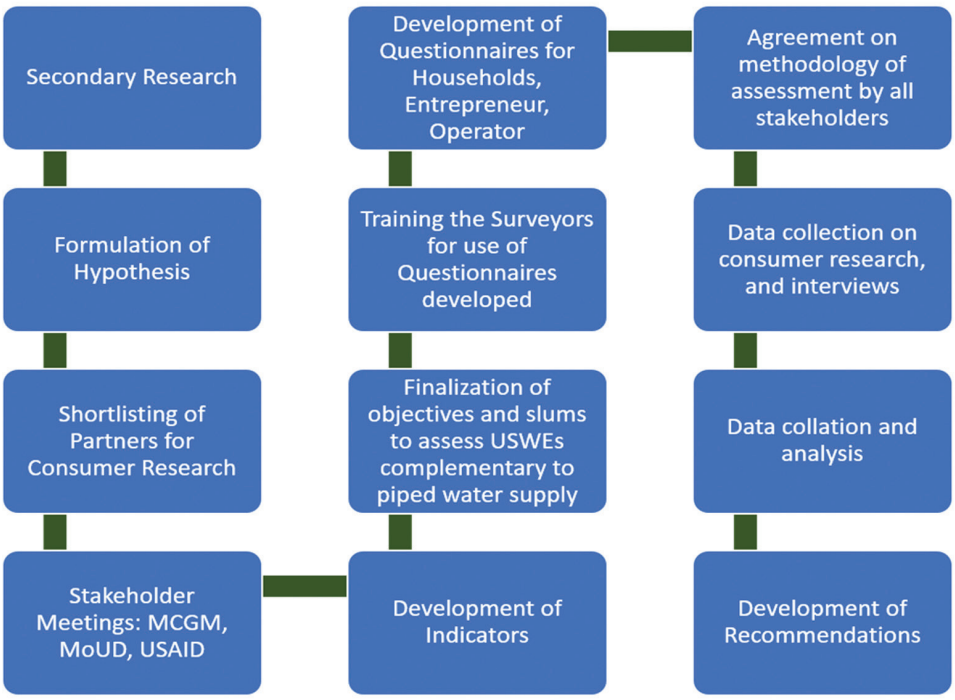
The team conducted secondary research on the water-delivery process to Mumbai city, especially to the urban poor, followed by field surveys in the selected slums.

Primary Research

Questionnaires were developed and administered to a small test group, then refined and finalized. Surveyors were trained on the methodology of selection of households and respondents in the field, delivery of questionnaires,methodology to conduct focus group discussion, and data collection.

- Field visit and interviews of the MCGM officials (annexed)
- Tata Institute of Social Sciences (TISS) conducted the primary research in seven slums in Mumbai, comprising household surveys and interviews with MCGM, water treatment kiosk owners and operators, and local authorities. Using random selection sampling, 100 households in each of the five slums were surveyed in slums without SWEs and 150 were surveyed from the remaining two slums with SWEs (Rafiq Nagar and Shanti Nagar). They conducted household surveys, focus group discussions, and interviews with owners of USWEs (annexed).
- Dipankar Sen (ex IMRB) led 675 consumer interviews through Sigma Research and Consulting Pvt. Ltd. [5]
- Water quality measurement with respect to TDS and pH was conducted.

Figure 1. Process Flow of the Project



[5] More details about the organization can be accessed from www.sigma-india.in.

1.5 Indicators

The following broad sets of indicators were used:

- **Water Source:** availability, affordability, accessibility
- **Water Collection:** gender responsibility, time taken for collection
- **Water Treatment:** methods, reasons for not treating, waterborne disease-affected cases, expenditure

The status of water supply to the city was covered on the following parameters:

- water supply infrastructure
- population served
- per capita availability of water
- sources of water supply and service coverage
- water connections and other physical aspects
- water source treatment technology
- demand projections
- water quality testing
- water tariff
- budget provisions

1.6 Selection of Slums

Slum selection was based on size of the ward, topography, and information from the secondary data available on water scarcity and availability. Prior to the selection of any slum, we conducted a transit walk through the interiors of the slum and met with the ward member. A special focus was put on two slums in M-ward region, where water treatment kiosks were identified, to assess the difference between the water situation in slums having a USWE and slums not having a USWE.

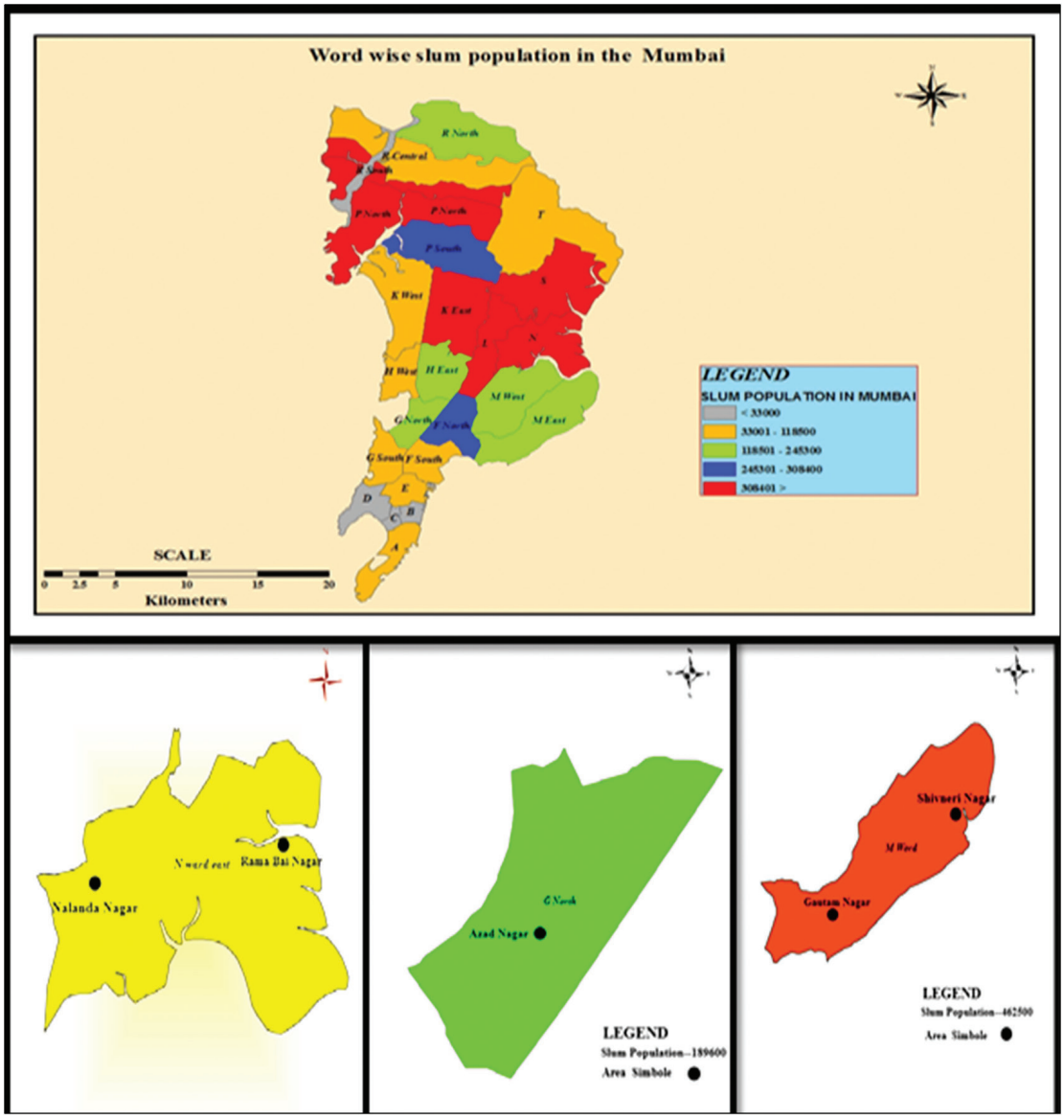
In the last ten years, M-ward has emerged as having the largest slum population in Mumbai. In order to obtain a representative sample, two slums were selected from that ward. N Ward, which includes Ghatkopar slum, is the fastest-growing slum in Mumbai. Moreover, many slums in Ghatkopar area are located in a terrain which is elevated and situated in hillocks. The last slum to be selected was from G-North, which borders Dharavi Slum and has severe paucity of water provision. Below is the ward distribution of slum-wisepopulation in Mumbai according to the 2011 census.

TABLE 1 **Ward-wise population distribution of slums in Mumbai (Census 2011)**

Ward No.	Ward Code	Ward Name	Ward-wise total population (Slum+Non-slum) (2011)	Ward-wise Slum population (2011)	% of Slum Population to the total population in the ward (2011)
1	A	Colaba	185014	63325	**34.2**
2	B	Sandhurst Road	127290	14350	**11.3**
3	C	Marine Lines	**166161**	**NO SLUM POPULATION**	
4	D	Grant Road	346866	32839	**9.5**
5	E	Byculla	393286	76753	**19.5**
6	F South	Parel	360972	95193	**26.4**
7	F North	Matunga	529034	308309	**58.3**
8	G South	Elphinstone	377749	78212	**20.7**
9	G North	Dadar/Mahim	599039	189527	**31.6**
10	H East	Khar/Santacruz	557239	234711	**42.1**
11	H West	Bandra	307581	118498	**38.5**
12	K East	Andheri East	823885	403716	**49.0**
13	K West	Andheri West	748688	108762	**14.5**
14	P South	Goregaon	463507	264928	**57.2**
15	P North	Malad	941366	504423	**53.6**
16	R South	Kandivali	691229	399197	**57.8**
17	R Central	Borivali	562162	104305	**18.6**
18	R North	Dahisar	431368	221483	**51.3**
19	L	Kurla	902225	490352	**54.3**
20	M East	Chembur East	807720	245306	**30.4**
21	M West	Chembur West	411893	217161	**52.7**
22	N	Ghatkopar	622853	385585	**61.9**
23	S	Bhandup	743783	537832	**72.3**
24	T	Mulund	341463	111706	**32.7**
Total			**12442373**	**5206473**	**41.8**

Prior to making a final selection of the slums, a transit walk through the interiors of the identified slums and meetings with ward members were conducted. The slums that were chosen for the study were from Ward M-East, Ward N, and Ward G. Seven slums have been identified and studied, out of which five slums were chosen which did not have urban small water enterprises (USWEs) in them and two slums which did. The slums studied are Gautam Nagar Slum-M Ward East, Shivneri Nagar-M Ward East, Azadnagar (Shahunagar) - G/North Ward, Ramabai Nagar- N Ward, Nalanda Nagar - N Ward,Rafiq Nagar-M Ward, and Shanti Nagar - MWard.

Figure 2. Slums selected for this study



Weundertook field work in seven locations, including five slums without USWEs and two with USWEs, as shown in Table 2.

TABLE 2 **Slums selected for the USWE study in Mumbai**

Slums	Type (Non/USWE)	Sample Households Covered
Gautam Nagar Slum, M-Ward East	Non-USWE	100
Shivneri Nagar, M Ward East	Non-USWE	100
Azadnagar (Shahunagar), G/North Ward,	Non-USWE	100
Ramabai Nagar, N Ward	Non-USWE	100
Nalanda Nagar, N Ward	Non-USWE	100
Rafiq Nagar, M Ward	USWE	75
Shanti Nagar, M Ward	USWE	75
Total	**-**	**650**

1.7 Limitations of the Study

Having described the scope and methodology above, there are limitations to the assessment:

- Geographic location of the areas chosen may not be representative of the slums of the city.
- Skewed response of the consumers is inherent in this type of study and may affect the resulting insights gathered from the field research.

The slums are unending rows of cramped huts with open sewers, and lack of infrastructure facilities for water supply and sanitation.

2. CONTEXT: MUMBAI

2.1 Introduction

Before 1995, Mumbai city was known as Bombay. Mumbai is a metropolitan port city on the western coast of the country and the capital of Maharashtra state.It is one of the largest and most densely populated cities in the world, with a favourable location for establishment of industries. The Brihanmumbai Municipal Corporation (BMC) area, also known as Municipal Corporation of Greater Mumbai (MCGM), is divided into two revenue districts, Mumbai City District and Mumbai Suburban District. The BMC is the largest urban agglomeration in the country, with a population of 12 million people per the 2011 census.The city is also home to one of the largest slum populations of the country. Around 6% of Maharashtra's population lives in the slums of the state capital, Greater Mumbai. (Risbud, Understanding Slums: Case Studies for the Global Report 2003, 2003). The Municipal Corporation of Greater Mumbai hasa Hydraulic Engineer Department, whichoversees the water distribution system of the city.

2.2 Geography

Mumbai, with an area of 437.71 sq km,is located at the southwestern part of the Konkan regionand enjoys a tropical maritimeclimate. It receives an annual rainfall of 2146.6 mm.The city lies just above sea level, with elevation ranging from 33-49ft, and the southern part of the city is surrounded by the Arabian Sea.

2.3 Demographics

2.3.1 City Population

The population of Mumbai is 12,479,608 according to 2011 census. Mumbai is one of the seven densest urban areas in the world, with a population density of about 21,000 per square kilometer. The sex ratio of the region is 848 females per 1,000 males, which is lower than the national average of 914 females per 1,000 males. BMC is divided into two revenue districts, Mumbai City District and Mumbai Suburban District. There are nine municipal wards in the Mumbai City District: A to E, F/South and F/North, and G/South and G/North wards. The Mumbai Suburban District has fourteen municipal wards known as Eastern Suburbs and Western Suburbs.

TABLE 3 **Greater Mumbai (M.Corp):growth rates of population**

Region	Total Population (000), 2001	Growth rate (1981-1991) (%)	Growth rate (1991-2001) (%)	Growth rate (2001-2011) (%)
Greater Mumbai (M.Corp)	11914	20.21	20.03	04.7

(Source [6] : Population Change and Economic Restructuring in Mumbai)

[6] R. B. Bhagat& K. Sita - Population Change and Economic Restructuring in Mumbai.pdf

TABLE 4 **Size of population in Mumbai (M.Corp), by city and suburbs, 1981-2011**

Unit/Year	1981	1991	2001	2011
Island City	3285	3175	3326	3145
Suburbs	4959	6751	8558	9332
Total	**8243**	**9926**	**11914**	**12477**

Figures given in thousands.

(Source: Population Change and Economic Restructuring in Mumbai)

TABLE 5 **Growth and distribution of population in Mumbai (M.Corp) by city and suburbs, 1981-2011(%)**

Segment/Year	Distribution				Growth Rate		
	1981	1991	2001	2011	1981-1991	1991-2001	2001-2011
Island City	39.8	31.9	27.9	25.2	-3.3	4.7	-5.4
Suburbs	60.1	68.1	72.1	74.8	36.1	26.7	9.0
Total	**100**	**100**	**100**	**100**	**20.0**	**20.0**	**4.7**

(Source : Population Change and Economic Restructuring in Mumbai)

2.3.2 Literacy Rate

Per the 2011 census,there are about 10millionliterate people in Mumbai, of which 5.6million are male and 4.4million are female. The average literacy rate of Mumbai city is 89.73%, and male and female literacy rates are 92.56% and 86.39%, respectively.

2.3.3 Ethnicity, Language and Religion

The majority of the population is Hindu (66%), followed by Muslim (21%), Christian (3%), Jain(4%), Sikh (0.5%), and Buddhist(0.5%).Marathi is the official language of the state of Maharashtra and is spoken widely in Mumbai city as well.

2.3.4 Income and Employment

Mumbai city is known as the commercial and financial capital of the country and is the highest GDP contributor in the country, with GDP of $209 billion. [7] Mumbai is the headquarters for major financial regulatory bodies such asthe National Stock Exchange (NSE), Bombay Stock Exchange (BSE), Reserve Bank of India (RBI), and the Mint. [8] The per capita income of Mumbai city was $2,845 (2009-10). Migration has played a major role in the increase in population of the city. The female work participation rate in Mumbai city has gone up 5.1%, from 13.7% in 2001 to 18.8% in 2011.[9]

[7] http://www.siliconindia.com/news/business/Top-15-Indian-Cities-with-Highest-GDP-nid-130942-cid-3.html
[8] http://timesofindia.indiatimes.com/city/mumbai/Mumbai-a-land-of-opportunities/articleshow/9292526.cms?referral=PM
[9] http://timesofindia.indiatimes.com/city/mumbai/No-of-women-in-states-urban-workforce-soars-8/articleshow/21771427.cms

Mumbai has a diverse economic base of industries, including textile, automotive, petrochemical, food processing, electronics, and engineering.

2.3.5 Slum Population

The country's largest slum population is located in Greater Mumbai and includes Asia's biggest slum, Dharavi, which alone has more than 1 million people. As per the Ministry of Housing and Urban Poverty Alleviation report, Greater Mumbai housed about 6,475,440 slum dwellers in 2006. Slum dwellers live in small shanty shacks surrounded by exposed sewer lines.It has been estimated that more than 100 families come to Mumbai every day in search of better jobs, and they end up settling in small,makeshift houses in the slums.These slums appear to bea city within a city, but with more affordable cost of living for the residents. The slums are unending rows of cramped huts with open sewers, and lack infrastructure facilitiesfor water supply and sanitation.

In slums, packaged drinking water is available in the form of water pouches, which are sold in local shops. The starting price of these pouches is INR 1 (USD 0.015) for 500 ml and can go up to INR 3 (USD 0.04) for 800 ml.

3. WATER SUPPLY

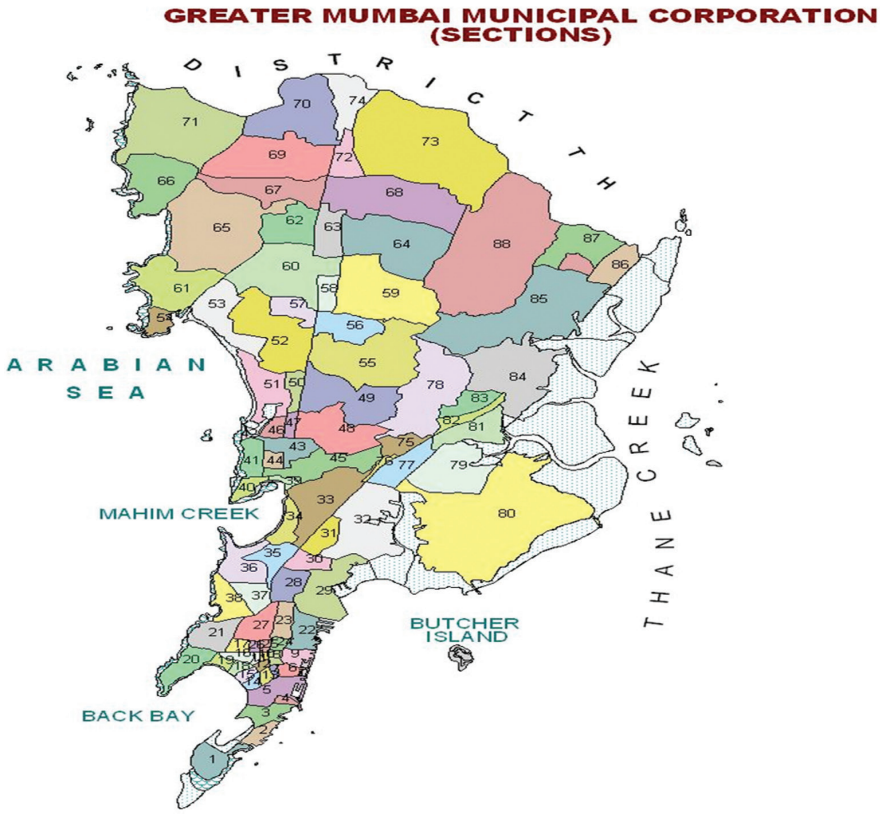
3.1 Overview

The water distribution system in Mumbai is about 100 years old. Water is brought into the city from the lakes after treatment and stored in 28 service reservoirs in Malabar hill, Worli hill, Raoli, Pali hill, Malad, Powai and Bhandup being some of them. Timings of water supply to different parts of the city vary from between 2 to 5 hours. [10]

The Brihanmumbai Municipal Corporation is responsible for providing water, managing and operating the networks, billing and collecting revenues from the population of Greater Mumbai. The department in charge of these functions is the Hydraulic Engineering Department of MCGM in Greater Mumbai. [11] It consists of one Hydraulic Engineer (H.E.), who is head of the water distribution system, and twelve Deputy Hydraulic Engineers. There are around 3,00,000 water connections in Mumbai.

There is also a Water Supply and Sanitation Department in MCGM. The Chief Accountant is the Principal Municipal Finance and Administration Officer to advise the Municipal Commissioner on financial and administration matters pertaining to the Water Supply & Sewerage Department, known as Budget "G." He is also internal auditor, stock verifier andtreasury officer, responsible for internal auditing, financial management, stock verification, and maintenance of accounts of Budget G. [12]

Figure 3. Map showing the reach of the Municipal Corporation of Greater Mumbai



[10] White Paper of Water Department, MCGM, 2009.
[11] Mumbai City Development Plan 2005-2025.
[12] WSSD Manual.

MCGM caters to an area of 437.71 sq. km which holds a population of 12.5 million. 53% of this population lives in slums according to the 2011 Census. [13]

The water is completely treated with pre-chlorination, alum dosing, settling, filtration and post chlorination before supplying to the consumers. The treated water is stored in the Master Balancing Reservoirs (MBRI) at Bhandup Complex (246 ML) and MBRI at Yewai (123 ML). [14] It is then further distributed to 28 service reservoirs which in turn supplies water to the consumers in different water supply zones at suitable times.

3.2 Water Sources and Supply

3.2.1 Status of water sources and supply

Prior to 1870, Mumbai was dependent on existing wells, lakes and tanks for drinking water. Due to the spread of epidemic in the mid nineteenth century, efforts were made in supplying good quality potable water. The history of Mumbai's water supply dates back to the 22nd June 1945. [15] Today the MCGM supplies over 3350 MLD.

3.2.1.1 Availability of water from surface water sources:-

Greater Mumbai has all its major surface water reservoirs located in surrounding districts on the basin areas of the major rivers-Vaitarna, Ulhas, Patalganaga and Amba. The Mumbai Hydrometric Area (MHA) under Department of Irrigation, Government of Maharashtra, comprises of these four major river basins. They have a total catchment area of 5756 sq. km. The total surface water potential of MHA is estimated to be 10439 million cubic meter (MCM) at 75% dependability and 7869 MCM at 90% dependability. The table below gives a detail of the water availability from these sources:-

TABLE 6 **Basin wise water availability to Greater Mumbai**

Basin wise water supply in Greater Mumbai					
Basin	Catchment area	Water availability		Irrigation requirement	Water availability
		At 75% depth	At 90% depth		
Vaitarna	1858	3130	2416	651	2416
Ulhas	3205	6194	4881	1241	4881
Patalganga	338	712	489	147	489
Amba	365	403	283	146	257
Total	5766	10439	8069	2185	8043

Source: Ground Water Information, Greater Mumbai District, Maharashtra; Ministry of Water Resources, Central Ground Water Board.

[13] Report on Groundwater Information, Greater Mumbai district, Maharashtra by Ministry of Water Resources, Central Ground Water Board
[14] Ibid 13
[15] Ibid 13

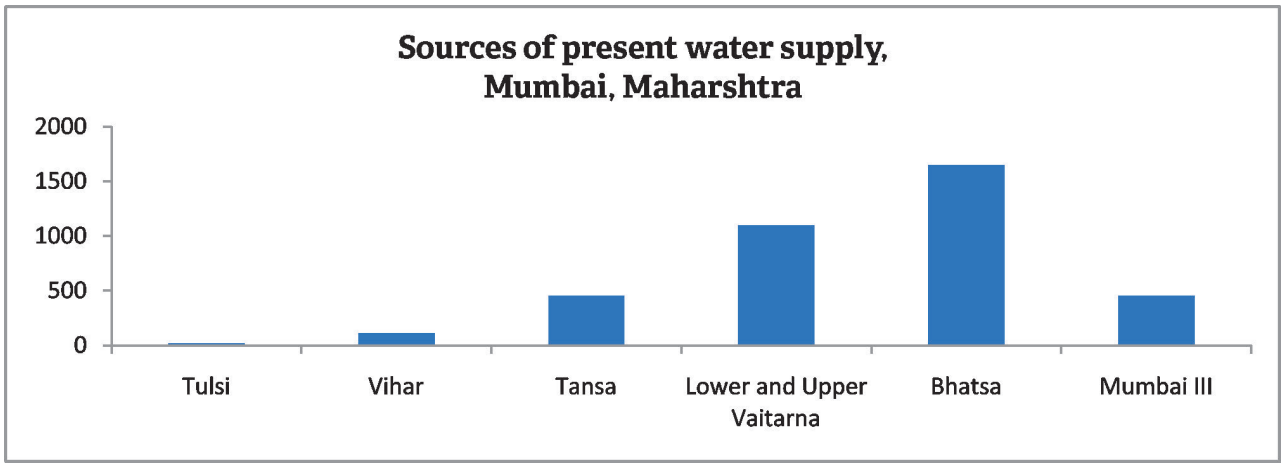
Water supply to Mumbai city is dependent on six lakes as well. These lakes are Tulsi, Vihar, Tansa, Upper Vaitarna, Bhatsa and Mumbai III. From just 32 MLD from Viharlake in 1860 for Mumbai's then population of 0.7 million, the water supply has now reached 3520 MLD for a population of almost 13 million people. Various schemes have been taken up by the MCGM, such as the Vihar Scheme, the Tulsi and Powai Scheme, the Tansa Scheme, the Lower and Upper Vaitarna Scheme, the Bhatsa Scheme etc.

TABLE 7 **Lake wise water availability to Greater Mumbai**

Sources of present water supply. Mumbai, Maharastra		
Name of the sources	**Year of completion**	**Quantity yield (MLD)**
Tulsi	1879	18
Vihar	1860	110
Tansa	1948	455
Lower and Upper Vaitarna	1957	1095
Bhatsa	1981	1650
Mumbai III	2004	452
Total	**3780**	

Source: Ground Water Information, Greater Mumbai District, Maharashtra; Ministry of Water Resources, Central Ground Water Board.

Fig 4: Figure showing the sources of water supply in Mumbai, Maharshtra.



MCGM owns Tulsi Lake, Vihar Lake, and Tansa while the Government of Maharashtra owns Bhatsa and UpperVaitarna. However, MCGM draws from all sources. The Tansa and Upper Vaitarnareservoirs supply the western side of Mumbai, and the Bhatsa reservoir serves the eastern side.

3.2.1.2 Availability of water from ground water sources:-

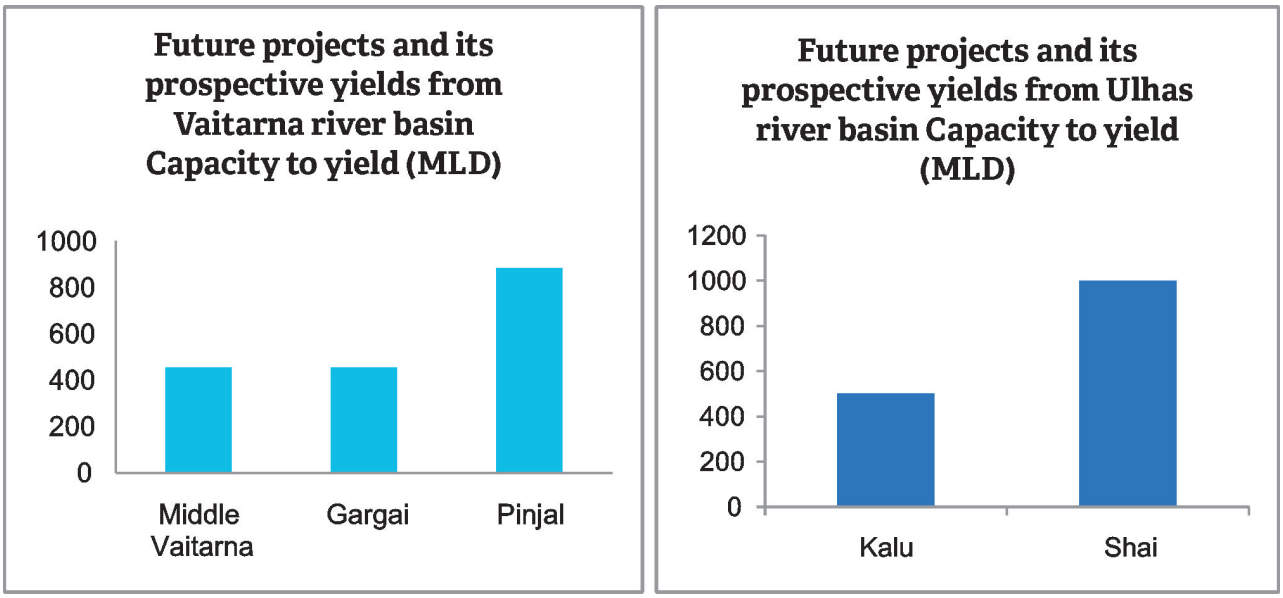
Ground water is not suitable for drinking purposes. In order to mitigate the risk of epidemics, BMC and the Government of Maharashtra had banned the use of water from wells and ponds for domestic use. However, due to the increase in population and the stress on water supply to meet the water demand groundwater is seen as a supplementary source of water during shortfall. There are 3950 dug wells and 2514 bore wells under operation for water supply purpose in the city.

3.2.2 Water reservoirs-Way ahead

In order to meet the future water requirements of the city, the MCGM has taken up projects that involve construction of water intake structures at rivers and natural lakes, impoundment of reservoirs in upstream catchment areas.

The projected demand of water for Greater Mumbai for the year 2021 is estimated to be 5355 MLD. To meet this additional requirement of water, four water supply projects have been brought under construction. These are:-

Fig 5. Future projects to increase water supply on Vaitarna river basin.



- *Mumbai Middle Vaitarna Water Supply Project:* This project will augment water supply to Mumbai by further 455 MLD thereby making the total water supply to 3810 MLD. This project was sanctioned by Irrigation Department of Government of Maharashtra in 1997. [16]
- *Mumbai Ulhas Water Supply Project:* This project will be augmenting water from Kalu and Shai river basins. It will increase the water supply by 750 MLD approximately.

3.2.3 Piped Water Supply Network:

Pipelines bring the raw water from the lakes. Such water is treated before it is supplied to consumers. The treated water is transferred to Bhandup and Yewai master reservoirs and then supplied to the city, eastern and western suburbs. It provides water to A, C, D, K and H ward. The H/East ward is partly served by this reservoir. The Yewai reservoir supplies water to F/N and F/S ward. It is also providing water to M, N and L ward. They are partly served by this reservoir.

The water transmission (650 km) and service pipes (3200 km) cover the entire city. Water supply and water pressure to each ward is dependent on the total water availability.

There are 3 lakh metered water connections in the city. Nearly 83 percent connections are domestic connections including slums. The commercial connections are 15 percent. Industrial connections are very low (2 percent) in the city. There are 1.5 lakh un-metered water connections in the city. [17]

3.2.4 Transmission, Distribution and Service Coverage

The distribution network has been laid and upgraded over the past 136 years. The distribution system includes 28 service reservoirs and allies piping systems to and from 110 water supply zones.

Water mains amounting to approximately 4000km in length, range in diameter from 80mm to 1800mm.[18] There are 383306 metered connections. 83% of these connections are for domestic usage, 15% is for commercial usage and 2% is for industrial purpose. There are about 100000 un-metered connections. 87% of these are used for domestic purposes, 9% is consumed by commercial users and 4% is used by industrial users.

Water from the lakes is brought to the treatment plants through pipes. These treatment plants are Bhandup, Pnajarapur, Vehar and Tulsi treatment plants. From the treatment plants the water is supplied to the 28 service reservoirs-Panjarapur, Bhandup, Raoli being some of them. The supply hours ranges between 1 to 16 hours in a day.

3.2.5 Treatment, Quality Control, Supply

Tulsi and Vihar lakes are located within city limits and their water treatment plant is at the same location. The other reservoirs are around 100 km away from the city and their water treatment plants are located in the Bhandup and Panjarapur treatment works.

[16] Report on Groundwater Information, Greater Mumbai district, Maharashtra by Ministry of Water Resources, Central Ground Water Board
[17] Times of India 2007
[18] Report on Groundwater Information, Greater Mumbai district, Maharashtra by Ministry of Water Resources, Central Ground Water Board

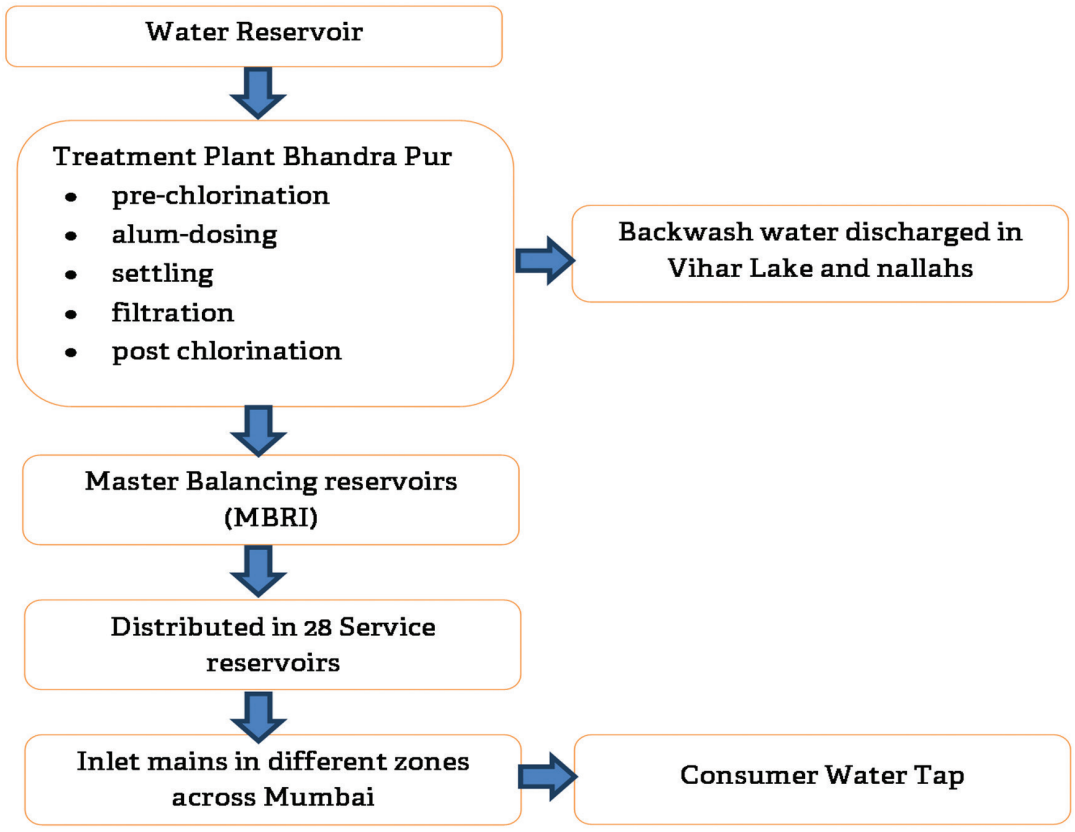
The water goes through a five-stage process of purification which consists of pre-chlorination, alum dosing, settling, filtration, and post-chlorination. The water is backwashed to clean the filters. The backwashed water generated at Bhandup treatment works (45 MLD) is released into Vihar Lake and the backwashed water at Panjarpur treatment works (20 MLD) is discharged in nallahs.

The officials of the Water Quality Control Department located in the B-Ward office in Santa Cruz collect water samples at the source and alert water quality deviations to the respective ward office. [19]

Treated water is stored in Master Balancing Reservoirs (MBRI) at Bhandup Complex (246 ML) and MBRI at Yevri (123 ML), and further distributed to 28 service reservoirs located in the city through inlet mains. These inlet mains are maintained charged for 24 hours. The pressure of 1 to 1.5 kg/cm^2 is maintained during water supply hours.

These service reservoirs supply water in different supply zones for 90 minutes to 24 hours, depending on the area of the zone, topography, and other parameters. According to our conversation with a Deputy Hydraulic Engineer, the eastern suburb areas (e.g., Ghatkopar, Bhandup, Mulund, and some part of Kurla) typically receive 24-hour supply.

Figure 6. Diagrammatic representation of water distribution and purification process[20]



[19] This information was provided by hydraulic engineers of MCGM along with secondary research data from MCGM website
[20] Per MCGM officials

3.2.6 Water Supply Infrastructure

TABLE 7 **Water supply infrastructure in Mumbai, Maharashtra**

Water Supply Infrastructure	
Particulars	**Quantity**
Water treatment pumping stations	4
Primary pumping stations	4
Master Balance Reservoirs	2
Service Reservoirs	27
Length of water mains	4000kms
Number of distribution zones	112
Number of Leak-detection zones	615
Trunk Conveyance(Tunnel and Trunk Mains)	1000kms
Number of daily operative valves	850
Supply hours	1 to 16 hours
Average pressure	
Trunk Maines	50 to 80 MWC
Feeder Mains	20 to 50 MWC
Distribution Mains	3 to 15 MWC
Total connections	
Metered	3833026
Un-metered	100000
Billed water	2242 MLD

Source: Municipal Corporation of Greater Mumbai

3.2.7 Key Indicators of Water Supply

TABLE 8 **Key indicators of water supply**

Key indicators of Water Supply	
Particulars	**Quantity**
Network coverage	100%
Percentage access to piped water supply	76%
Average per capita supply	279 MLD per head
Unaacounted for water	25 to 30 %
Duartion of water supply	1 to 4 hours
Connections per 1000 persons	483
Unit production cost	Rs 11.15 per kilo liter

3.2.8 Water Supply in Slums

As reported by MCGM officials, individual connections are provided to a minimum of five slum households who apply. However, these connections are provided only to legal slum residents who have been residing in the slum prior to 1st January 1995. We observed that residents of non-notified slums suffer the most in terms of water unavailability.

The Water Works Department issues various permits, including new connections, in consultation with other technical advisory departments such as Engineering, Assessment & Collection, and Pest Control. [21]

BMC has a policy regarding water supply to slums, though there is a serious gap in supply. Slum dwellers often depend on informal water distribution systems. Additionally, only structures established prior to 1st January 1995 are entitled to water supply, i.e., metered water connection to a group of slum dwellers with tap in a general washing place. BMC does not provide public taps in slums. The tariff structure for water supply for slums is INR 3 (USD 0.045) per 1000 liter. [22]

Households that have their own tap connection or that use tankers often resell water to neighbours on a regular basis. Residential resales are often supplemented by other water services, such as public stand posts and water treatment kiosks, if available. Though acknowledged as an illegal activity, resale is a consequence of the utility provider's inability to supply water adequately to all customers. Utility staff is aware of this problem but reluctant to take action against these resellers because of the complexities of dealing with water hoarders and local water mafias in the region.

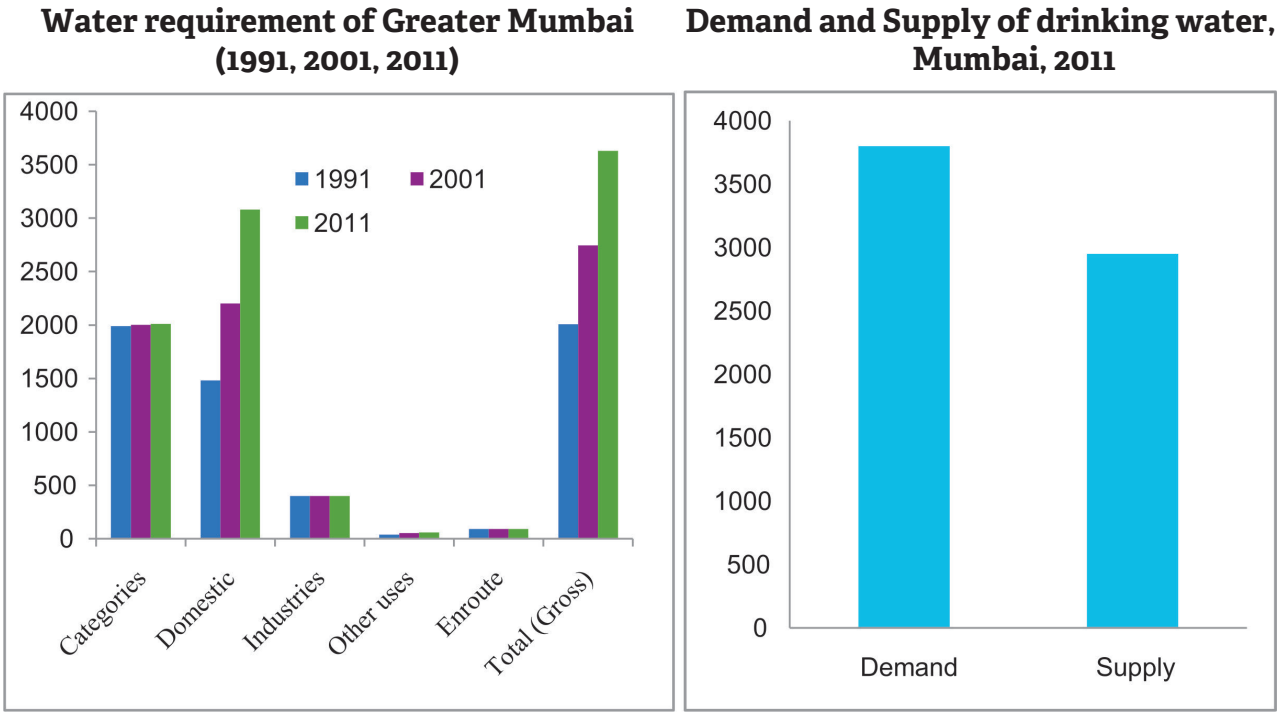
In slums, packaged drinking water is available in the form of water pouches, which are sold in local shops. The starting price of these pouches is INR 1 (USD 0.015) for 500 ml and can go up to INR 3 (USD 0.04) for 800 ml. These pouches are not used as a sustainable means of drinking water but are often sought because they are refrigerated by the shop owners.

[21] MCGM website. (2015).
[22] Ibid.

3.2.9 Water demand projections

For the year 2011 the total water demand for the city was about 3856 MLD against the supply of 3200 MLD. This means there was a shortage of 656 MLD of water. [23]

Figure 7. Year-wise water requirement in Mumbai, 1991 to 2011.



The population figures are expected to increase to 15.61 million in 2021 as per Chitale Committee. Corresponding to this the demand for water is supposed to increase to 5388 MLD. The gap between demand and supply in 2011 was 680 MLD and is said to increase to 1100 MLD by 2021. [24]

3.2.9 Water demand projections

For the year 2011 the total water demand for the city was about 3856 MLD against the supply of 3200 MLD. This means there was a shortage of 656 MLD of water. [23]

3.3 Water Tariff

Tulsi and Vihar lakes are located within city limits and their water treatment plant is at the same location. The other reservoirs are around 100 km away from the city and their water treatment plants are located in the Bhandup and Panjarapur treatment works.

[23] Report on Groundwater Information, Greater Mumbai district, Maharashtra by Ministry of Water Resources, Central Ground Water Board.
[24] Ibid 23

TABLE 9 **Water tariff**

Water tariff for water usage in different sectors, Mumbai, 2011					
Sl. No	Categories	Water charges per 1000 Ltr			
		Upto 150 LPCD	150 to 200 LPCD	201 to 250 LPCD	Above 250 LPCD
1	Slums	3	6	9	12
2	Residential C.H.S Bunglows/Row houses	4	8	12	16
3	Dispensaries, Hospitals	16	32	48	64
4	Commercial establishments	30	60	90	120
5	Industrial establishments	40	80	120	160
6	Bulk consumers. Hotels etcs	60	120	180	240

3.4 Service-Level Benchmark Index

Brihanmumbai Municipal Corporation (BMC)is responsible for water supply provision in Greater Mumbai. As far as BMC is concerned, its status with respect to service-level benchmark (SLB) parameters for the water sector, as of 2012, is as follows:

TABLE 10 **Analysis of BMC on service-level benchmarks [25]**

Sr. No.	SLB Parameter	Expected Efficiency	CurrentStatus
1	Coverage of water supply connections	100%	100%
2	Per capita supply of water	135 liters per person perday	135 liters per person per day
3	Extent of metering of water connections	100%	81%
4	Extent of non-revenue water	20%	20%
5	Continuity of water supply	24 x 7	2 to 6 hours
6	Quality of water supply	100%	99%
7	Efficiency in redressal of customer complaints	within 24 hours	within 24 hours
8	Cost of recovery in water supply services	100%	100%
9	Efficiency in collection of water supply related charges	90%	80%

[25] Bambale, R.B. 2012.Water Reforms – Mumbai, Maharashtra (power point presentation). Mumbai: Municipal Corporation of Greater Mumbai (accessed 18th September 2015).

According to interviews with MCGM Hydraulic Engineers, the water supply requirement of the city is around 3,900 MLD. Currently, only 3,100 MLD of water is supplied is provided, including domestic, commercial, and industrial purposes.

The above table shows that the quality of water is 100%, but an aging pipe network leads to contamination. Customers experience irregular supply,but upgrading to continuous supply in Mumbai would require demand side measures such as proper metering, proper installation and maintenance of metering systems, and telescoping tariff rates to encourage water conservation measures and also supply-side measures such as source augmentation through dam works. [26]

3.6 Budget Provision for Water Supply (2015-2016)

BMC's total budget estimates for 2015-2016 is INR 33,514.15 crore, which is 27.25% more than the revised estimates for 2014-2015.

TABLE 11 **BMC Budget, 2015-2016**

On the revenue account: (budget estimates A, B, E, G and Tree authority)
Total income revenue budget = INR 23,509.10 crore (net)
Total income from water supply and sewerage in revenue budget = INR 4,240.92 crore
Total expenditure revenue budget = INR 21,675.41 crore (net)
Total expenditure water supply and sewerage in revenue budget =INR2,722.40 crore
On the capital account : (budget estimates A, B, E, G and Tree authority)
Total capital receipts: INR 10,005.05 crore
Total capital receipts from water supply and sewerage = INR 1,549.26 crore
Total capital expenditure = INR 11,836.00 crore
Capital expenditure on water supply and sewerage = INR 2,542.73 crore [27]

[26] Ibid.
[27] BrihanmumbaiMahanagarPalika – Statement of SitaramKunte, Municipal Commissioner

Every slum suffers from water hoarders and water mafias. The households without tap connections buy water from neighbours or the community taps.

4. URBAN SMALL WATER ENTERPRISES

Much research activity has been concentrated on the identification and analysis of informal, alternatives system of access to urban water and the resulting new forms of governance in the metro cities. What we see is the emergence of new hybrid arrangements in order to fill the supply gap.

4.1 Need

Much research activity has been concentrated on the identification and analysis of informal, alternatives system of access to urban water and the resulting new forms of governance in the metro cities. What we see is the emergence of new hybrid arrangements in order to fill the supply gap.

4.2 Financial

The survey done by TISS for Safe Water Network, India under USAID indicates that rich and poor, regularized and irregularizedsettlements suffer from an inadequate water supply. There is a lack of adequate planning, funds, political will, transparent pricing, technical capabilities and managerial skills making water supply inadequate and unreliable. ULB are not able to completely satisfy present water needs. Part of the population is not covered under the water supply. The areas which are covered receive intermittent supply of water. Water supply lasts 15 minutes to 2 hours. The access to water depends also from the number of households sharing the connection and arrangements between families. In slums, the scenario is more difficult.

Two third of the households in the slums purchase water through informal distribution system run by private vendors. They draw water from underground water pipes in the city by using motorized pumps. Residents pay on a monthly basis to access water from these systems. Others also purchase water from taps located in other slums by paying the tap owners a specified amount.

Urban slums are not generally acknowledged by the government for legal piped water supply, leading to informal and illegal water mafias with their own distribution systems. These water distribution systems are usually privatelyowned, mostly without any treatment precautions. This poses a high risk to the health of the communities living in the slums.

This study was conducted in seven slums of Mumbai with respect to consumers in slums with USWEs(Gautam Nagar, Ramabai Nagar, Nalanda Nagar, Shivneri Nagar, and Azadnagar) and without USWEs (Rafiq Nagar, Shanti Nagar).

4.2 Finances

The case studies done by TISS for Safe Water Network under USAID's WASH Alliance program revealed certain specificities pertaining to the kind of SWEs involved and the finances required.

- In Nalasopara slum area, the USWE sells each can of 20L for INR 20. The source of water is private tankers supplying 10000 liters for INR 1200-1800. INR 700 is kept aside for maintenance from the revenue that they earn. This is a successful operator-based model.

Thus, the aggregated finances of the USWEs operating in the selected slums can be summed down to:-

TABLE 12 **Typical cost incurred by SWEs whose raw water source is tankers**

Capital expenses	Cost in INR lakhs
Raw water supply from tankers	1200 to 1800 per tanks of 20 Liters
Operational expenses	Cost in INR lakhs
Maintenance cost	700 per month
Water is sold at: 10 to 20 INR per can of 20 liters.	

However, in a typical SWE set by local NGO, raw water supply from bore wells. The USWE in Rafiq Nagar Slum run by Apnalaya NGO, Eureka Forbes and Rotary Club of Bombay cater to the needs of 6500 households in the area. About 100-200 cans are sold at INR 10 per day to walk-in customers. For home delivery they charge INR 15 per can. The station allows for can washing and is well maintained by Self Help Groups. Operating costs varies across SWEs due to electricity costs, maintenance and repairs. Electricity bills vary between INR 500 (USD 7.45) and INR 1,100 (USD 16.4) per month based on hours of operation, which is driven by the demand for water from these kiosks.

TABLE 13 **Typical cost incurred by SWEs whose raw water source is ground water**

Typical Capital Cost at a USWE	
Cost Head	**Cost (in INR)**
Bore well drilling, fixing submersible motor with pump	1.5-2.5
Equipment cost	6.5 (1000 LPH)
Storage Tank	1.0
Total Capital Cost	9.0-10.0
Typical Monthly Operating Cost of a USWE	
Cost Head	**Cost (in INR)**
Operator Salary/SHG	4000-5000
Electricity	2000
Consumables such as chemicals	1500
Security/cleaning personnel	1000
Repairs and electrician visits	1000
Total	9500-10500

4.3 Consumers

This section details the comparativeanalyses of surveys taken from650 households in seven slums of Mumbai. The study focuses on

i) socioeconomic factors;
ii) drinking water source, availability, affordability, and accessibility;
iii) perceptions about drinking water quantity, quality, and water treatment;
iv) incidence of waterborne diseases and health-seeking behaviorto compare and contrast the findings so that clear recommendations could be generated.

The study revealed some alarming details about the quantity and quality of water supply in the Mumbai slums.

TABLE 13 **Findings of the study in the slums with and without USWEs**

	Non-USWE slums	USWE slums
Accessibility:	Apart from serving 4.9% of population in Shivneri slum, the Municipality does not supply water to any other slums. The water supplied to private taps in these slums is only for about 1-2 hours per day.	Only 0.7% of the population used SWE water compared to 50% of the population that used water from either a neighbor's or community tap. About 50% of the residents get water for only an hour a day and 75% of the respondents said that water was not available throughout the year so they resort to secondary sources like municipality trucks and tankers and community taps, which cost about INR400 (USD 6.0) per month.
Quantity	In some seasons, 95% of households use less than the WHO-recommended minimum water consumption of 50 liters per capita per day.	66% of respondents perceive the quantity of available drinking water to be sufficient and nearly 70% of households use 30 liters or less per day.
Quality	During the monsoon season, 50% of the water samples taken from "point of source" (motors connected to BMC supply lines) were contaminated. For all other seasons, stored water showed a rate of 76% for microbial contamination. There is a high incidence of stored water contamination in all seasons, indicating the need for hygienic water storage practices.	Awareness regarding the importance of treated drinking waterexistedin the community. It was also found that about 71% of the respondents treat water before consuming.
Affordability	Households pay 5-6 times more than the standard municipal charge of INR 3.50 (USD 0.05) per 1000 liters.[28] The installation charges for personal water supply pipelines in slums like Shivneri are high and range from INR 10,000-15,000 (USD 150-225).	Almost half of the respondents pay for water, with fees ranging from INR 100-200 (USD 1.5-3.0) to INR 500-600 (USD 7.5-9.0). The expenses for installation are quite high. Water at SWEs is sold at INR10 (USD 0.15) or INR20 (USD 0.3) for 20 liters.
Equity	Non-notified slums lack formal access to municipal water systems and depend on an informal water supply. Female heads of households are responsible for collection of water.	

[28] Baliga, Linah. Steep Hike in City Water Rates Coming. (Feb 2012). The Times of India.

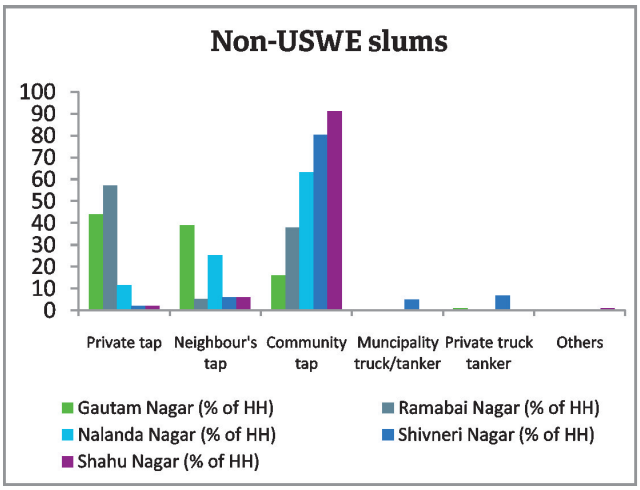
4.3.1 Socioeconomic Profile

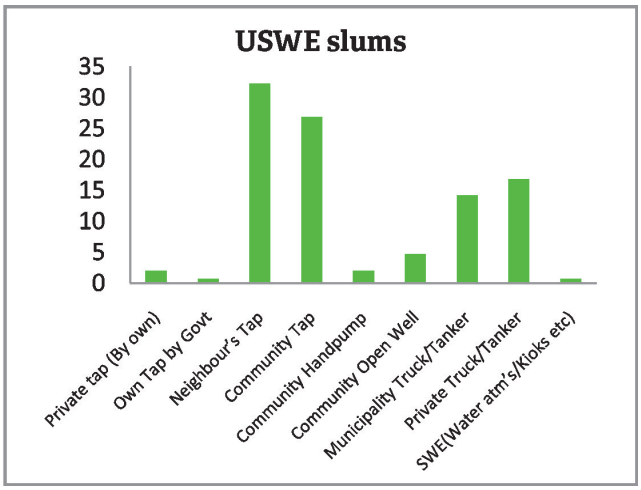
TABLE 14 **Socioeconomic profile in slums without and with USWEs**

Capital expenses	Cost in INR lakhs	
Parameters	**Slums without USWEs**	**Slums with USWEs**
Household Ownership	70%-75%	NA
Caste Distribution	40%-46% scheduled castes	NA
Occupation Status	daily wage laborers, own business, salaried	daily wage laborers, salaried
Average Family Size	4per HH	4 per HH
Average Household Income	up to INR 100,000 annually	up to INR 100,000 annually

4.3.2 Drinking Water Situation

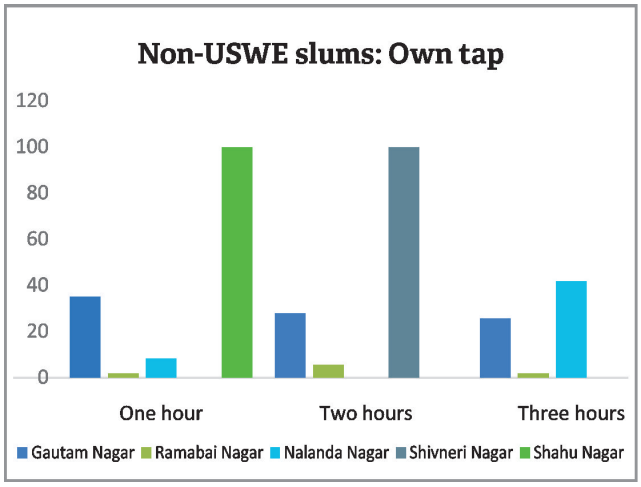
Figure 8. Primary Sources of Drinking Water in non-USWE slums and USWE slums (% households)





In non-USWE slums, a majority of slum households have access to either community-owned or private taps. In Gautam Nagar and Rambai Nagar, the majority of respondents get their water from a private tap. In the remaining three slums, most respondents retrieve water from a community tap. Every slum suffers from water hoarders and water mafias, so those households without their own tap buy water from their neighbors or the community tap. Using a neighbor's tap is common in some areas, but municipality and private tankers are not widely used. In USWE slums, the primary source of drinking water is a neighbor's taps or community tap; in both slums, only 0.7% use a USWE.

Figure 9. Daily average water availability through Own Tap in non-USWE slums and USWE slums (% households)



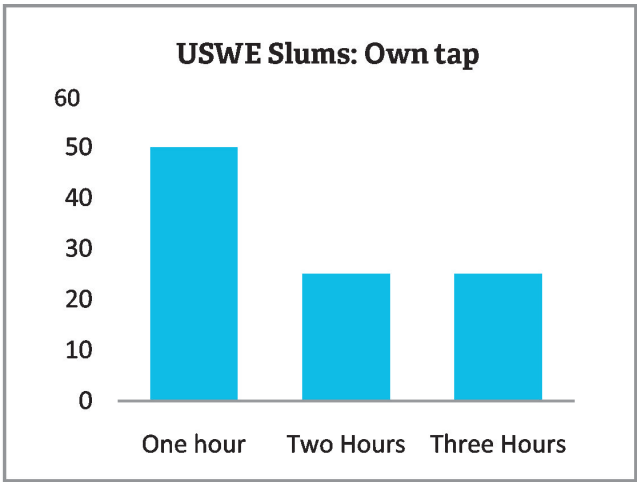
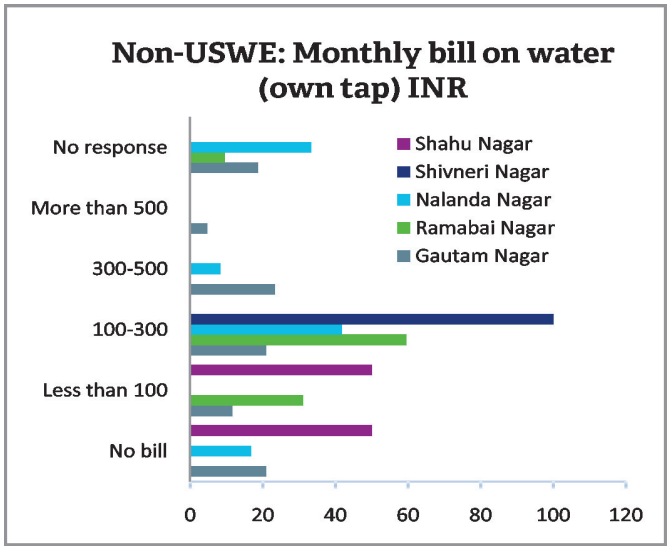
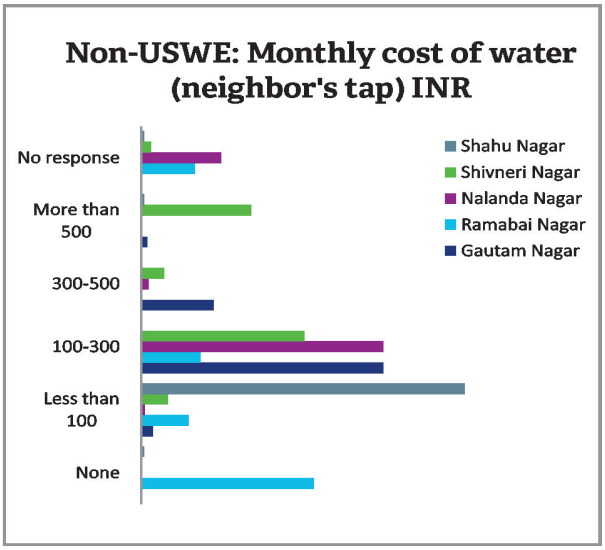
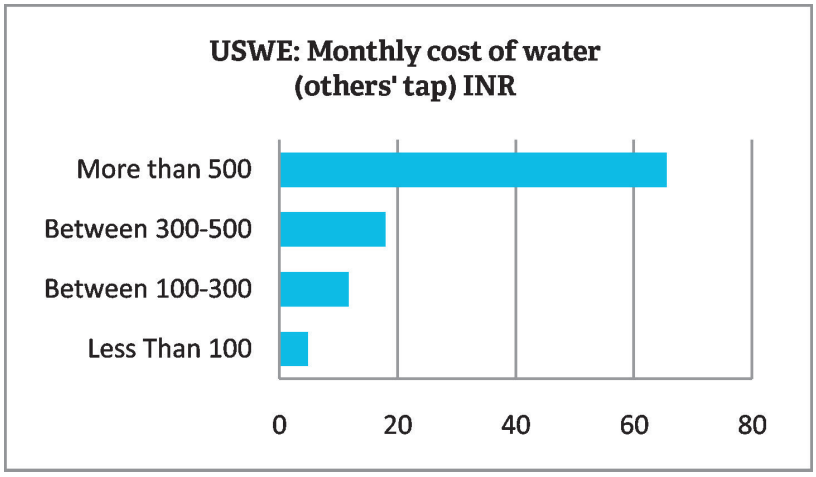


Figure 10. Affordability in terms of monthly expenditure in water collection in non-USWE slums (% households)

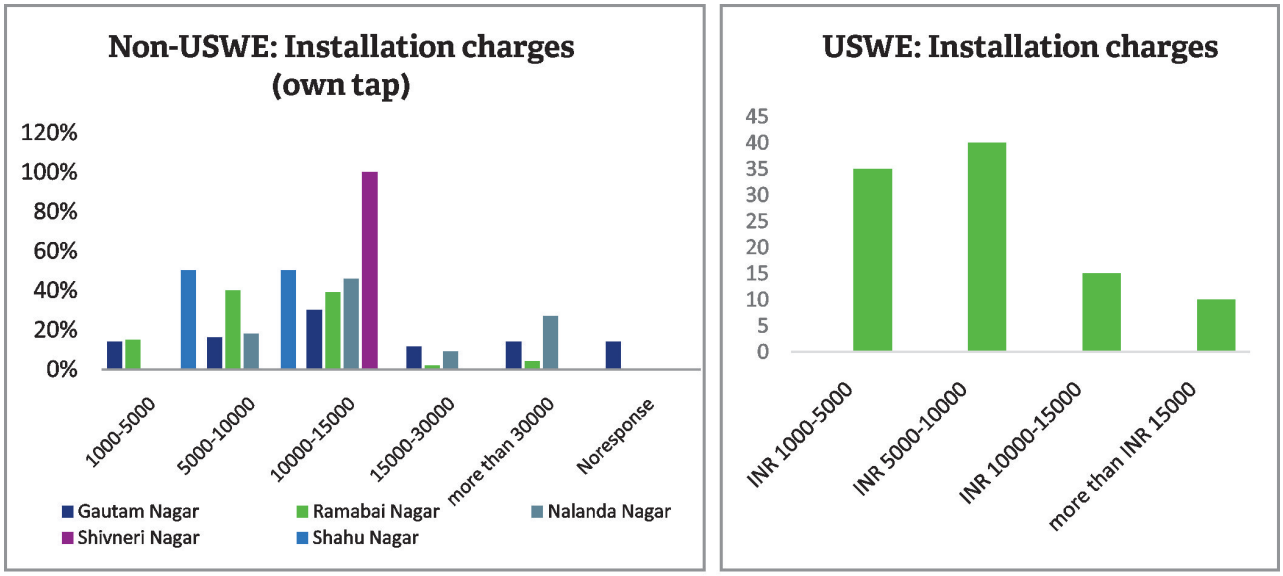






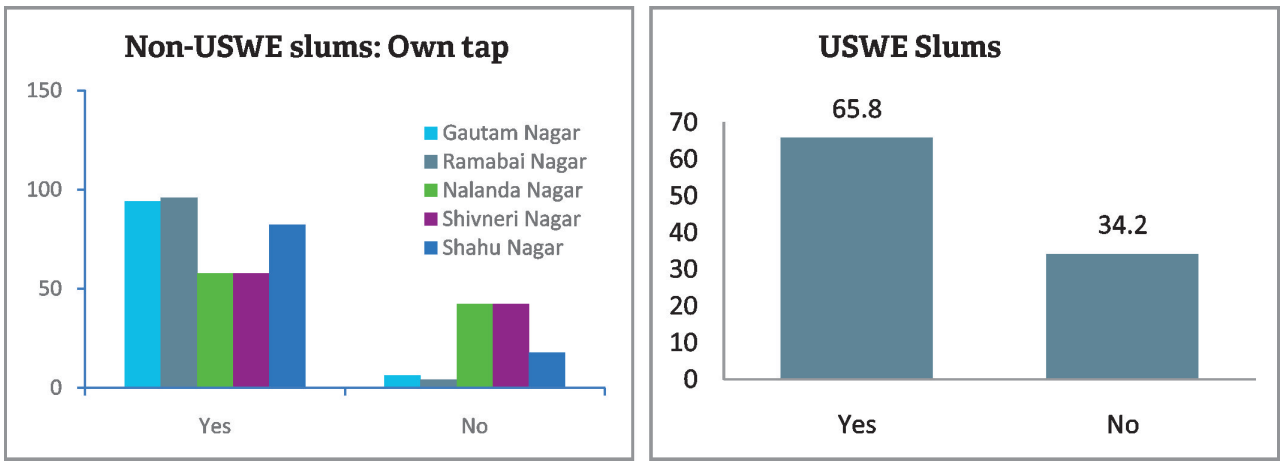
The amount of money paid for water varies from zero to more than INR500 (USD 7.5) in non-USWE slums. But from responses, it was observed that the maximum paid is from INR 100-300 (USD 1.5-4.5) per month for private water supply line in all the slums. The amount remains the same for taking water from a neighbor's tap. In USWE slums,the maximum amount paid is more than INR500 (USD 7.5) monthly.

Figure 11. Expenditure forwater collection from secondary sources



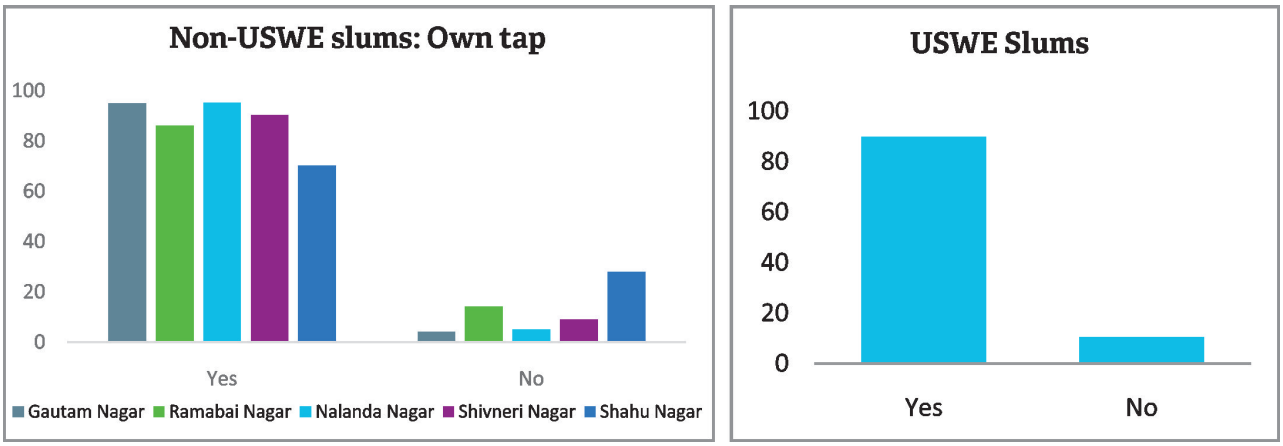
In non-USWE slums, slum dwellers are willing to pay for the convenience of tap water at home. For individual taps, almost 98% of the slum households have paid an installation expense of INR 10,000-15,000 (USD 150-225). In USWE slums, 40% of the slum households pay installation charges of INR 5,000-10,000 (USD 75-150).

Figure 12. Quantity sufficiency for drinking purpose (% households)



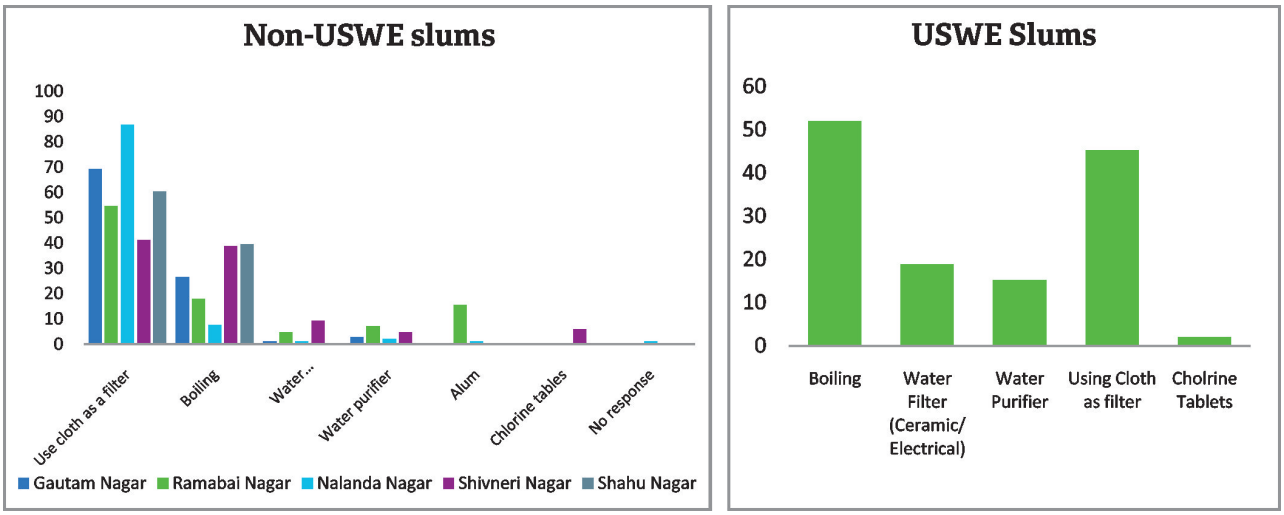
In non-USWE slums, an average of 78% of respondents reported sufficiency of water quantity for drinking purposes. In USWE slums, respondents asserted that the water quantity available is sufficient, yet they are not of aware whether it is fit for drinking purposes.The maximum consumption of water per household is about 300-500 liters, out of which 30-70 liters is used for drinking purposes. The majority of respondents are satisfied with the quantity of water.

Figure 13. Behavior towards treating water before drinking(% households); "yes" indicates treating water before drinking



In non-USWE slums, 95% of the slum dwellers treat water at home before drinking. In USWE slums, 90% of the households treat water at home before drinking.

Figure 14. Methods of water treatment used at home (% households)

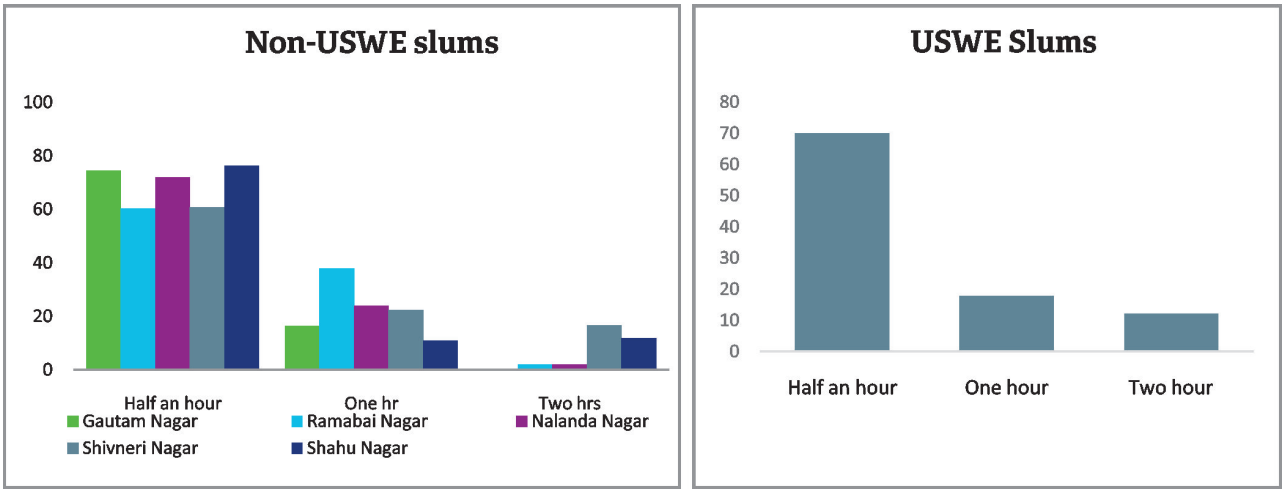


For those that treat their water at home, the majority of households in each slum use a cloth as a filter. Boiling is the second most popular option, partly due to the high price of gasoline.

According to a World Health Organization report, "safe drinking water reduces the likelihood of getting diarrhoea by about 19% compared to unsafe water."[29] Virtually all households use their primary source of water for drinking. Most of the respondents in Rambai Nagar and Nalanda Nagar are satisfied with the quality of their water. More than half the respondents in Gautam Nagar are not satisfied with the quality of their water. Most respondents thought that water should be treated before drinking, but 78% of people (on average) actually treated water.

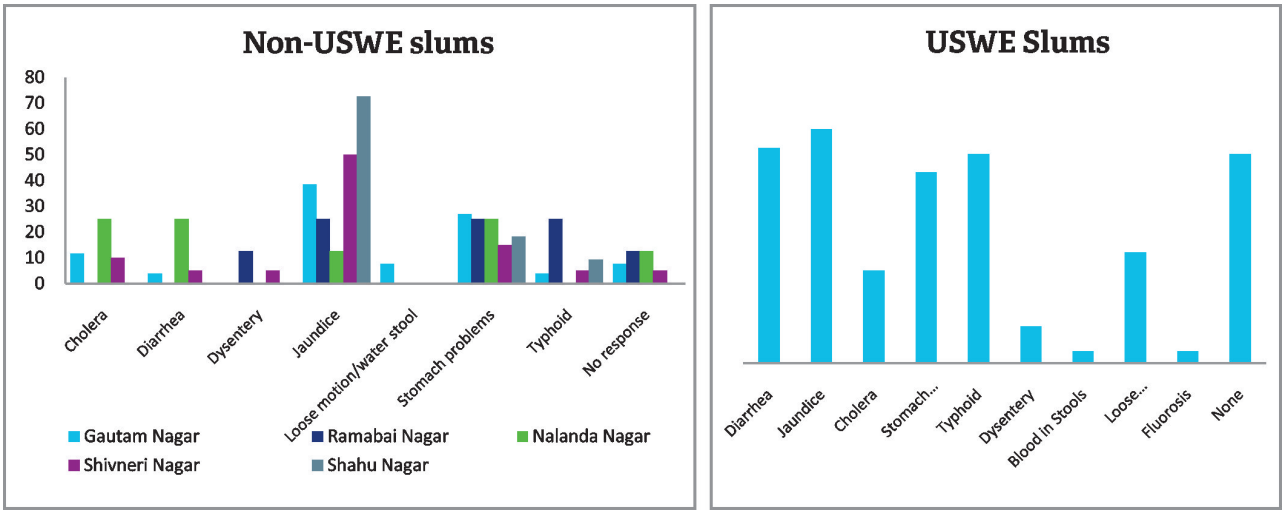
[29] Singh, A. and Singh, M.N. (Jan 2014). Diarrhoea and acute respiratory infections among under-five children in slums: Evidence from India. Peer J Pre-Prints.

Figure 15. Time taken for water collection (% households)



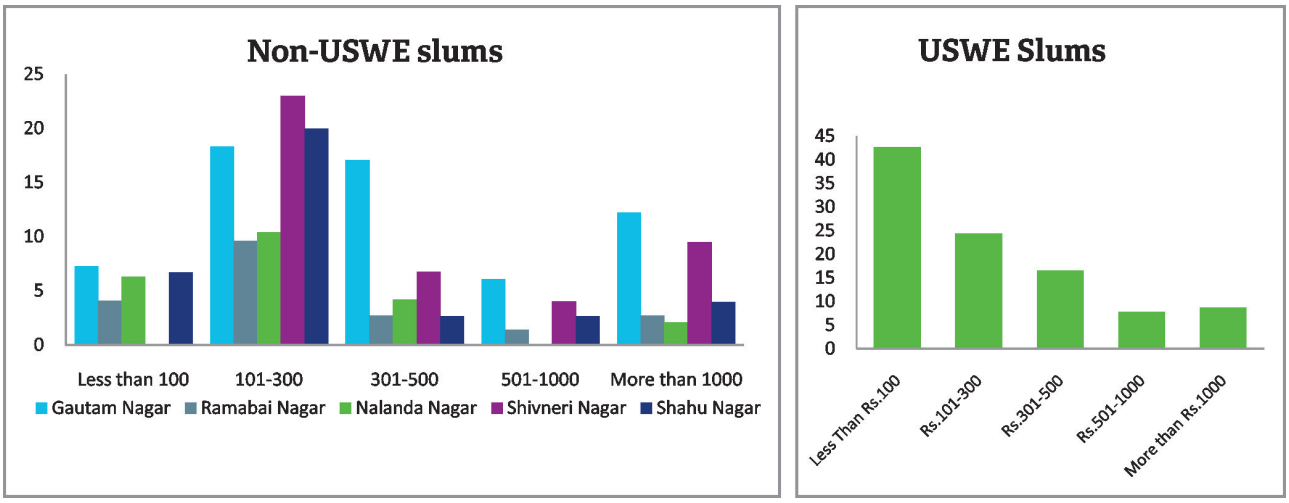
70%-80% of slum dwellers in non-USWE slums spend about half an hour daily collecting water, compared to about65%-70% of slum dwellers in USWE slums.

Figure 16. Prevalence of waterborne diseases(% households)



Waterborne diseases were reported in both USWE slums and non-USWE slums. In non-USWE slums, about 40%-50% slum dwellers suffer from waterborne diseases such as diarrhea, cholera, jaundice, typhoid, dysentery, enteritis, etc.

Figure 17. Expenditure incurred in treatment of waterborne diseases (% households)



4.3.3 Relationship between Water Service Delivery Failures and Adverse Life Impacts Based on Qualitative Findings

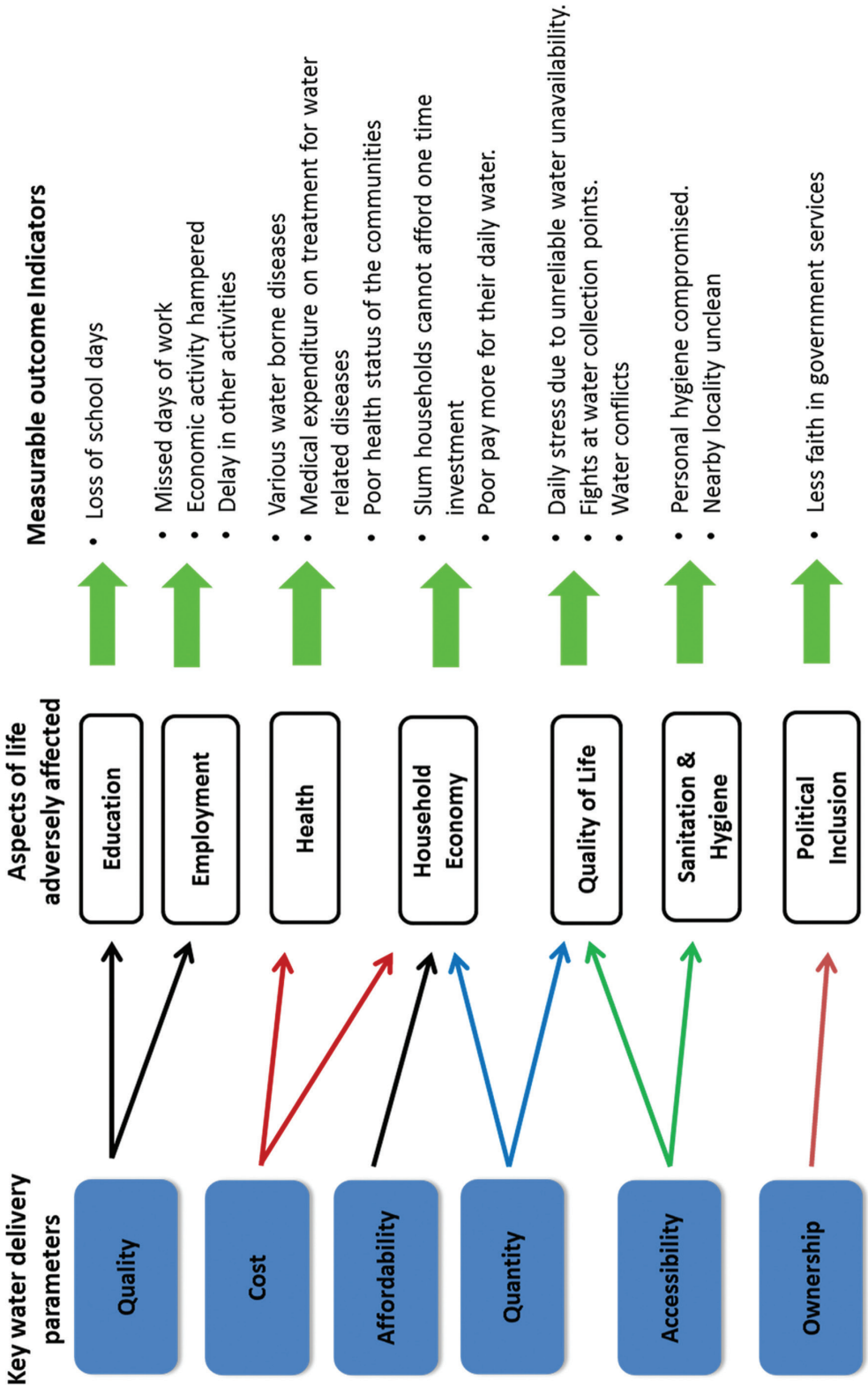
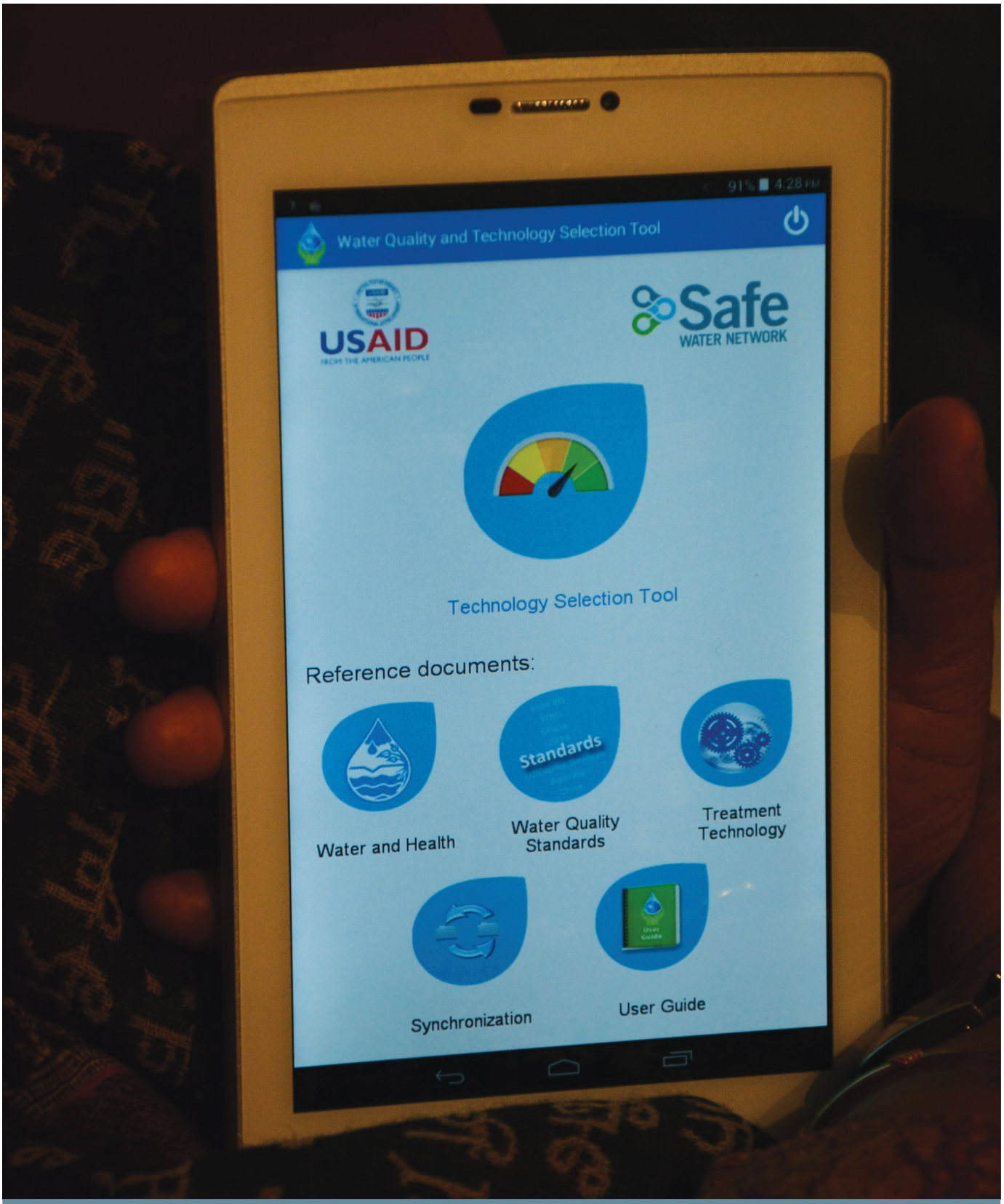


Figure 18. Relationship between water service delivery failures and adverse life impacts

Safe Water Network 2015 Assessment, Tata Institute of Social Sciences (TISS)



A proposed water quality and technology-specific digital tool. Digital tools can serve as go to resource tools for potential SWE entrepreneurs and the sector to facilitate critical water initiatives

5. DIGITAL TOOLS

5.1 Overview

Governments the world over have co-opted technology in their governance process to ensure speedy delivery of information and services and in turn enhance the level of accountability to citizens. One of the key aspects of good practice in e-governance involves a strong and structured context-specific implementation agenda. Thus, it became important to follow a decentralized mechanism to better cater to citizens, andthe central government acknowledged the need to partner with municipal corporations as a common strategy as well as operational framework to interpolate the process of e-governance. The e-governance initiative is being led by the Department of Information Technology (DIT) under the National e-Governance Programme (NeGP) of India. e-Governance in Municipalities has been launched as a National Mission Mode Project (NMMP) within Jawaharlal Nehru National Urban Renewal Mission (JNNURM).

Under JNNURM, the implementation process was taken up in only 35 cities in a phased manner. One of the main areas of focus was payment of utility bills and management of utilities such as water supply, electricity supply, and health services. In this domain, both Mumbai and Hyderabad municipal corporations have played a significant role in enhancing the future potential of such a critical intervention. However, owing to the varying resources of the municipalities and the context-specific demands of the citizens, it is essential to recognize the different digital tools introduced as a part of the implementation process in various municipal bodies.

5.2 Need for Digital Tools

In Mumbai specifically, the use of digital tools was further enhanced by the introduction of the Right to Service Act, with an intention to make delivery of services through various governmental agencies an effortless and hassle-free process. By the end of 2014, the Municipality of Mumbai had adopted methods by which several transactions, such as payment of bills, applications, registration of complaints, tracking of application status, licenses, and approvals for construction, can be done without queuing.

Specific examples of digital tools in Mumbai are:

5.2.1 Municipality Service Website and Android-Based Platforms (Mobile Application)

The Brihanmumbai Municipal Corporation (BMC) has a functional citizens' services website to download various kinds of forms, register complaints, and track applications. In 2014, a further step was taken by initiating a process for payment of bills and many other services at the convenience of a single click by deciding to move from e-governance to m-governance (mobile governance). In August, the civic body launched a 24/7 mobile application for Android-based platforms, keeping in mind the large number of citizens who were using or are likely to use smart phones in the near future. The Android platform acts as a payment gateway for citizens for speedy payment of water bills. The platform has connected with over 72 banks to ensure uninterrupted, timely bill payment. Further benefits for such a setup include application for permissions online, tracking the status of applications, and registering and tracking complaints regarding water issues via mobile application.

5.2.2 Digitalized Document Management System (Computer Application)

Further in the domain of systematic monitoring and management of water services, the municipality has initiated the process of digitizing all documents and generating a unique document management system. Accordingly, citizens with a user key can access pertinent information with regards to water sources, treatment capacity, number of connectors, areas of specific coverage, reservoir details, and even duration of water supply transparent from the cloud.

5.2.3 Geographical Information System (GIS)

A digitized base map of Greater Mumbai was generated containing thefollowing geographic details: water supply network; sewage network; solid waste disposal; storm water drains; development planning; property tax; parks and gardens; other areas such as open spaces; water bodies; religious places; bus stands; petrol pumps; hospitals and health care units; road network; disaster management; fire brigade; and traffic planning. This facilitates graphical display of different layers in a given locality for effective planning, development, and maintenance of facilities.

5.2.4 Biometric-Based Access Control System

A biometric-based access control system ensures accurate recording of attendance of over one-lakh employees, including temporary workers. This digitalized system is used as an effective mechanism of monitoring the human resources involved in the water management system. It leads to convenient operations, timely and accurate information flow, improved control andmonitoring, and better usage of resources and reduce absenteeism.

5.2.5 Support Facilities

a. **Digitalized databases:** In order to facilitate the above, digitized databases have been created (though at a rudimentary phase).

b. **Accounting reforms:** Accounts and Finance functions have undergone changes as a result of implementation of accrual-based accounting systems.

5.2.6 Digital Tools to Come Under Operation for Phase II

The systems that were planned to be developed and implemented in the second phase include Abattoir, Education, Election, Gardens, Legal, Markets, M&E, Museum, Municipal Secretary's office, PRO, Printing Press, Security, Vigilance, and Zoo.

Despite considerable progress in terms of devising digital tools to better cater to citizens, there are multiple challenges such as reluctance to accept the system, funding requirements, and prioritization. A broader approach can catalyze the pace of implementation for better results. The process of digitalization cannot be successful unless the process of sensitization of the importance of e-governance is also simultaneously stressed, at both the state and municipality levels. Adequate awareness is needed for adoption of these tools by the system.

Today, there are no existing digital tools to address SWEs as the decentralized, quick solution for affordable safe water, especially for the urban poor. The three tools that were tested based on direct interviews with local operators (MCGM officials, NGOs, SHG groups, operators, and water entrepreneurs) include:

- **Technology Selection Tool (TST):** to identify appropriate water treatment technology (depending on raw water quality to use ultraviolet, ultrafiltration, reverse osmosis, etc.)
- **Plant Assessment Tool (PAT):** to assess SWEs for i) instilling best practices and ii) protecting investment
- **Financial Viability Tool (FVT):** to understand the economics for viability, significance of maintenance, and need for a sustainability fund for high value

These tools can serve as go- to resources for potential SWE entrepreneurs and the sector to facilitate critical water initiatives. They would seek to establish greater alignment and knowledge-sharing between SWE implementers and optimize SWE operations by sharing best practices and bringing more clarity to USWE entrepreneurs, SHGs, and NGOs for long-term operational and financial sustainability.

A man collecting water from the Small Water Enterprises present there.

6. POLICY & ENABLING ENVIRONMENT

6.1 Overview of Maharashtra Water Policy

The Maharashtra State Water Policy was founded in the year 2003 and was framed with the purpose of enabling the preservation of clean drinking water as a scarce natural resource and its equitable distribution throughout the state. Recently the Chief Minister of the state has declared a revision of the policy. Over the years, the quality of Maharashtra's groundwater and surface water has deteriorated due to the abrasive release of chemicals and untreated effluents by industries and municipalities. Also, industries and agriculture have both demanded greater quantities of water, resulting in poor service delivery and greater dissatisfaction in consumer communities. To meet these challenges, the Maharashtra State water policy was designed on the following principles:

i. The state would adopt a state water policy framework to create an enabling environment for better and more equitable and productive water resource management.
ii. Through the policy, the state would try to fundamentally restructure the relationship between the state and various water users.
iii. The policy aimed to decentralize water planning, development, and management of the basin and sub-basin units by revising their responsibilities.
iv. Production, adoption, and dissemination of new technology to conserve water and improve its efficiency.
v. The state would adopt the appropriate and necessary legislation to enact the above-mentioned strategies in a short time.

The policy speaks to designing a State Water Plan, which would reflect the management plans of all basin agencies of the state. The plan would ensure representation of all people and address concerns of different regions of the state. The policy also identified key actors, such as farmers, industries, communities, and the private sector, who would contribute to water management in the state. The policy also highlights the distributionof sufficient water to rural and urban areas to help meet domestic needs, and emphasizes that water will be drawn directly from the reservoir instead of from canals to avoid wastage. It gives authority to community organizations to manage water on a day-to-day basis. The preparation of river basin plans and sustainable management of basin resources should be developed with the participation of private industrialists, commercial enterprises, and water service providers.

To maintain water quality, the Maharashtra State Water Policy also aims to establish a program to control the discharge of pollutants to the surface and sub-surface waters of the state, including oceans, bays, and salt water marshes. In terms of management of water resources, the policy also speaks to building a robust management information system, water audit, and benchmarking of water resource projects.

Water harvesting and water recycling and reuse have been suggested to conserve water. The policy also speaks about water entitlements, water zoning, and cost effectiveness of water resources. The policy recognizes the importance of creating appropriate and adequate infrastructure for water conservation,such as dams and canals as well as maintenance. Research development and building state-of-the-art technology is also an important component of the state policy. "The state shall undertake to promote the development, adaptation, and dissemination of affordable and appropriate water

[32] http://www.business-standard.com/article/economy-policy/telangana-govt-proposes-to-build-126-000-km-water-grid-114092900900_1.html.
[34] Retrieved from https://www.hyderabadwater.gov.in/en/files/7514/5924/1254/EOI.PDF.

and agriculture technology and expand the knowledge base through its various institutions under the state and the state's education institutions and research institutions by improving coordination among the state existing research institutions." [30] The state policy will be reviewed every five years or whenever deemed necessary.

On December 15, 2014, in response to a Public Interest Litigation filed by the Mumbai-based organization PaniHaqSamiti, the Bombay High Court ruled that "the state cannot deny the water supply to a citizen on the ground that he is residing in a structure which has been illegally erected," directing the Municipal Corporation to formulate a new policy.

6.2 Policy and Enabling Environment for Urban Small Water Enterprises (USWEs)

The supply of uninterrupted 24x7 piped water in the Mumbai slums is a big challenge not only with respect to high infrastructure investment and last-mile connectivity but also to the quantity of raw water. These challenges are further compounded, especially in non-notified slums, by a rapid increase in population, depletion of water resources, an alarming rise in pollution levels in surface water bodies and even groundwater, and enhanced consumer needs. There is an urgent need for market-oriented decentralizedUSWEs in these slums at least to cater to the drinking and cooking needs of the poor and improve their health and life outcomes until they are reached by piped water.

To safeguard the urban poor, there is a need for oversight on water quality, affordability, and inclusion, as well as minimal acceptable standards for compliance.The following recommendations will help create a hospitable environment for USWEs, allowing them to act as a stopgap and address the scarcity of water in slums. They are based on interactions with Eureka Forbes, kiosk operators, and NGO facilitators:

1. Legitimacy: Often, the "illegitimate" character of USWEs inhibits investments that would improve the reliability or quality of supply. This lack of investments applies to both ULBs, who fail to invest in servicing the USWEs, and the USWEs themselves, who cannot secure finance at competitive rates. (Wanjala, 2011).

2. Investments:The main concern of USWEs concerning interaction with the owners and operators of water treatment kiosks was that, due to high land prices and construction costs of plants, many entrepreneurs were discouraged from entering the USWE sector. ULBs should encourage USWE entrepreneurs to enter the urban market by providing land and infrastructure to situate the plants. Many of the constraints faced by USWEs can be overcome by developing mutually beneficial partnerships among the stakeholders. The key categories of stakeholders include (Njiru and Smith, 2002):
    - USWEs
    - Water utilities and authorities
    - Water users

3. Affordability: From the interaction with water treatment kiosk operators and managers, it was observed that 20 liters was priced at INR10 (USD 0.015) and INR15 (USD 0.22) for home delivery. Both the plants were operating at full capacity, showing demand. One kiosk is one and a half years old and the other one recently opened to fulfill excess demand of customers on the first plant. Bisleriwas setting up a mechanism todistribute packaged drinking water to slum households, showing demand for purified potable water.

4. Inclusion of CBOs and NGOs:Most of the water projects fail because communities have not or cannot assume responsibility for maintenance and repair of water systems. This is true in the case of urban slums as well, where upon observation it was found that Self-Help Groups (consisting of eight women each) in the two kiosks were working as the operators in the plants. This helped increase trust and confidence of slum dwellers in the plant and also provide access at affordable price compared to packaged drinking water.

7. CASE STUDIES

The following case studies capture the USWEs studied under the identified slums as well as those located in the vicinity:

7.1 USWE in Rafiq Nagar Slum Run by Apnalaya NGO, Eureka Forbes, and Rotary Club of Bombay

This USWE is operated and managed by 4-5 members of a women's Self-Help Group (SHG). It was launched on 30th June, 2015 and is catering to about 6,500 households in the area. About 100-200 cans are being sold at INR10 (USD 0.15) per day to walk-in customers. They have also introduced home delivery system with charges at INR 15 (USD 0.22). The station is clean, allows for can washing, and is well maintained by SHG members for whom the station is a means of livelihood. Since they received training on operations, the women are running these stations independently with ease. These stations have been found to be an operationally, technically, and financially sustainable model for the slum areas.

7.2 Greater Mumbai, Nalasopara Slum Area

This USWE is operated by local youth, for whom it is a source of income. It is a 500LPH plant. The water is sold at INR 20 (USD 0.3) for 20L. The source of raw water is private tankers supplying 10,000 liters for INR 1200-1800 (USD 18-27). The measured TDS for raw water is recorded as 835 and treated water is 90. The operators claim to sell 30 cans daily, which increases to 45cans per day in peak summers. They keep aside INR 700 (USD 10.5) for monthly maintenance, and earn around INR18,000 (USD 270). The station is well maintained and is providing safe drinking water to these communities throughout the year. This is a successful operator-based USWE model.

8. REFERENCES

The following is a list of resources we used as reference for this report:

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- FAO and UNICEF. (2013). Water in India: Situation and Prospects.
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- Snyder, Shannyn. Water in Crisis – India. The Water Project.
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- National Health Policy 2015: Mapping the Gaps. (Sep 2015). Economic & Political Weekly.
- National Urban Health Mission. National Health Portal.
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9. ANNEXURES

9.1 Scope of Work

Safe WATER NETWORK

USAID Urban WASH Alliance Project

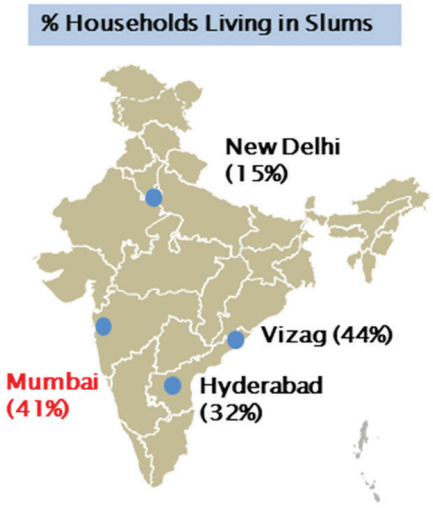
USAID FROM THE AMERICAN PEOPLE

TISS Tata Institute of Social Sciences

Urban Small Water Enterprises (USWEs)

Scope of Work

- Assess need and feasibility of safe water provision in slums.
- Determine role of Urban SWEs to expand access of safe water provision in slums.
- Assess existing digital tools and gather input on proposed digital tools from stakeholders.



9.2 Logical Framework Analysis

PROJECT GOAL			
Narrative summary	**Indicators**	**Data sources**	**Assumptions**
• Reliable and sustainable safe water provision for urban poor, by institutionalizing urban small water enterprises (USWEs), which complement piped water supply, to improve their health	• Consumers' satisfaction and sense of security with regard to water sources, including USWEs • Institutional support from governments and parastatal agencies	• Interviews of leaders of ULBs and other concerned parastatal agencies as well as elected representatives • Consumer household surveys	• Consumer (urban poor) satisfaction, even from pilot projects, is given due consideration by the state government and recommendations are considered for sector development • Proactive policy and implementation support from the Delhi government and operational support from Delhi Jal Board, municipal corporations, and elected representatives can create the right enabling environment for such decentralized systems to thrive • Availability and scalability of such USWEs given the need for and availability of technical skills, financial investments, and social capital to sustain the sector • Lessons derived from the research are representative and thus recommendations replicable to areas which have not been studied.

PROJECT PURPOSE			
Narrative summary	**Indicators**	**Data sources**	**Assumptions**
• Assess need and feasibility gaps of safe water provision in slums • Determine role of USWEs in expanding access to safe water in slums • Assess existing digital tools and gather input from stakeholders on proposed digital tools	• Following aspects of safe water provision for various water sources: - Access - Availability - Reliability - Affordability • Policy and regulatory framework for water provision to urban poor • Prevailing digital tools in this sector being used by ULBs and USWEs • Stakeholders' interest in digital tools for this sector	• Consumer household surveys • Interviews of officials of ULBs and other concerned parastatal agencies as well as USWE implementers • Census data, NFHS data, literature review • Feasibility reports, annual reports as shared by ULBs, USWE implementers	• High degree of collaboration from key stakeholders, including information sharing to allow for assessment of technical, financial, operational, and social viability of the USWEs • Proper schedule and sequence of meetings within a given timeframe with the respective stakeholders

OUTPUT			
Narrative summary	**Indicators**	**Data sources**	**Assumptions**
• Identification and mapping of various water sources available to urban poor • Water supply and demand estimates for urban poor • Assessment of operational, technical, and financial viability of USWEs • Recommendations for enabling a conducive environment and for establishing an appropriatepolicy and regulatory framework for USWEs • Assessment of existing digital tools and feedback on proposed digital tools	• Number of slums studied • Number of USWEs assessed • Number of water sources available to urban poor, split by municipal, private, community-managed, and public-private partnership (PPP) • Water supply and consumption per capita from various sources • HHs expenditure on water from various sources • Demand for USWEs by urban poor • HHs willingness to pay for USWEs • Cost recovery for USWEs • Competition from other sources – free and paid • Urban poor's awareness levels about correlation between safe drinking water and health • Number of existing digital tools along with utility and end users • Suggestions and feedback on features/capabilities of proposed digital tools	• Consumer household surveys • DUSIB/DJB reports on water, Delhi Master Plan, and City Development Plan • USWE reports • USWE operators'/ implementers' surveys • FGDs of specific providers and user groups • Interviews of officials of ULBs and other concerned parastatal agencies • Legislation regarding water provision, acts, provisions of different ULBs and parastatal agencies, recent policy initiatives	• Proper sampling methodology and selection of the slums for HH survey based on reliable sources of secondary information • Insightful, trained, and passionate field investigators • Availability of institutional and household respondents to give time and share reliable information

INPUTS/ACTIVITIES			
Narrative summary	**Indicators**	**Data sources**	**Assumptions**
• Literature review of prevailing water policies, schemes, and programmes for urban poor • Analyzing standard demographic studies – Census, NFHS , NSSO1 • Institutional mapping and key stakeholder interviews • Consumer household surveys • Focus group discussions (FGDs)	• Documentation of various policies, initiatives, projects, etc. related to water provision for urban poor for the various relevant institutions • City-wise profiles for water provision • USWE profiles • Consumer profile-household consumption, affordability, etc.	• Diverse and detailed desk reviews of USWE initiatives, including institutional, technical, and financial arrangements • Key stakeholder mapping and using stakeholder analysis techniques • Key informant surveys for important stakeholders including households • Triangulation of key information from various sources • Household needs, consumption, affordability, willingness to pay, and perception surveys	• Availability of secondary information • Pilot surveys to identify and map locations of slums and kiosks • Appropriate stakeholders' identification and consultation • Trained team for survey

[35] National Family & Health Survey (NFHS), National Sample Survey Organization (NSSO)

9.3 Questionnaires

9.3.1 Household level surveys

IDENTIFICATION PARTICULARS

Before Starting Interview

Name of Slum _____ Code: _____

Ward Number _____ Code: _____

House Number: _____ Code: _____

_____ Code: _____

_____ Code: _____

Date of Interview (DD/MM/YY): _____/_____/_____

Time of starting Interview (HH.MM): _____. _____ AM/PM

After Ending Interview

Time of ending interview (HH.MM): _____. _____ AM/PM

Names of Respondents 1: _____ MID: _____

2: _____ MID: _____

3: _____ MID: _____

Name of Interviewer: _____ Code: _____

After Checking/Editing Questionnaire

Name of Supervisor: _____ Code: _____

Name of Editor: _____ Code: _____

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
A01	Name of the Respondent		
A02	Size of the Family	Please Specify the Number ☐	
A03	Please Specify the Sex Distribution of the Household	Male ☐ Female ☐	

A04 B0 Details for all members of your household :

S.No. (MID)	Name of Member	Relation to Head of Household	Residential Status	Sex (M=1) F=2)	Age Completed	Marital Status (10+)	Education (Years of schooling)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							

Col (3) Relation to Head: 01 Head, **02** Spouse, **03** Son/Daughter, **04** Son-in-law/Daughter-in-law, **05** Grandchild, **06** Father/mother, **07** Father-in-law/Mother-in-law, 08 Brother/Sister, **09** Brother-in-law/Sister-in-law, **10** Uncle/Aunty, **11** Niece/Nephew, **12** Grandfather/Grandmother, **13** Other relative, **14** Servant/Employee/Other

Col (4) Residential status: 1 Currently residing, **2** Studying elsewhere, **3** Working elsewhere, **4** Staying elsewhere but not studying or working.

Col (5) Sex: 1 Male, **2** Female. **Col (6) Age:** Record age in completed years, 00 if not completed one year, 96 if age 96 or above.
Col (7) Marital Status: 1 Unmarried, **2** Married, **3** Widowed, **4** Divorced, **5** Separated/ Deserted, **6** Other

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
A05	Do you come under scheduled caste, scheduled tribe, nomadic tribe, or other backward class? Which one?	SCHEDULED CASTE.....1 SCHEDULED TRIBE.....2 NOMADIC TRIBE.....3 DENOTIFIED TRIBE.....4 OTHER BACKWARD CLASS (OBC)...5 GENERAL.....6 DON'T KNOW.....7	
A06	Occupational Status of Head of Household	Salaried employed.....1 Own Business.....2 Daily Wages.....3 Retired.....4 Unemployed.....5	
A07	Average Annual Income of the Household(Please write an approximation)		
A08	TYPE OF HOUSE (RECORD AS PER GUIDELINES BASED ON TYPE OF WALL, ROOF AND FLOOR)	Kutcha.....1 Semi-Pucca.....2 Pucca.....3	
A09	Is the house your own, rented, rent-free, sanctioned/provided under some scheme?	CONST/PURCHASED/FAMILY(OWN)..1 RENTED.....2	
A10	How many years has your family been living in this slum?		
A11	Is Your House having Electricity Connection?	YES.....1 NO.....2	
B. Sanitation & Hygiene			
B01	What type of toilet facility do you have?	FLUSH TOILET (OWN).....1 PIT TOILET(OWN).....2 PIT TOILET(COMMUNITY)..... .3 OTHER _____4 NONE.....5	
B02	**If you use community toilet,** then what is the total expenditure to use toilet per day for entire Household?	Less than 10 rupees.....1 Between 10-20 Rupees.....2 Between 20-30 Rupees.....3 Between 30-40 Rupees.....4 More than 50 Rupees.....5	

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
B03	Does any Member from Local Municipal Corporation visit your Slum?	Yes.....1 No.....2 Don't Know.....3	Skip to Question B05
B04	If Yes, do they make any intervention in any of the mention areas?	Water Availability.....1 Drainage.....2 Eletricity.....3 Safe Drinking water.....4 Any other.....5 None.....6	
B05	Do you know the name of any NGO/ Organisation who visits to your slum?	Yes.....1 No.....2 Don't Know.....3 }	Skip to question B7
B06	If Yes, do they make any intervention in any of the mention areas?	Water Availability.....1 Drainage.....2 Eletricity.....3 Safe Drinking water.....4 Any other.....5	
B07	Is there sullage nuisance surrounding your house? What is the nature of sullage nuisance? (INTERVIEWER: MAKE AN INDEPENDENT ASSESSMENT AND RECORD)	INTWRRESP NONE.....X WATER STAGNATION.....A DRAINAGE/SEWAGE.....B OPEN AIR DEFECATION.....C WASTE DUMPING.....D OTHER_____E	
C. Status of Water Facility			
C01	From where do you fetch water for your household? (ASK FOR PRIMARY SOURCE)	PRIVATE TAP (BY OWN).....A OWN TAP BY GOVT.....B OWN HANDPUMP/BOREWELL.....C NEIGHBOUR'S TAP.....D COMMUNITY TAP.....E COMMUNITY HANDPUMP.....F COMMUNITY OPEN WELL.....G MUNICIPALITY Truck/Tanker....H PRIVATE Truck/Tanker.....I SWE(WATER ATM'S/KIOKS ETC)....J OTHER_____K	
CO2	Is water available throughout the year?	Yes.....1 No.....2	

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
C03	Is there any Secondary Source of Water Available in your Locality Other than the Primary Sources?	Yes.....1 No.....2	
C04	Please Mention all the secondary sources (Please ask aloud all the options and Tick all available options)	PRIVATE TAP (BY OWN).....A OWN TAP BY GOVT.....B OWN HANDPUMP/BOREWELL.....C NEIGHBOUR'S TAP.....D COMMUNITY TAP.....E COMMUNITY HANDPUMP.....F COMMUNITY OPEN WELL.....G MUNICIPALITY Truck/Tanker....H PRIVATE Truck/Tanker.....I SWE(WATER ATM'S/KIOKS ETC)....J OTHER_____K	
C05	Were you Required to use any Secondary Source in Past Six Months?	Yes.....1 No.....2	
C06	Number of months secondary source used to procure water last year		
C07	Cost incurred in procuring water from secondary source during last year (Include Travelling Cost, Water Charges, other cost incurred) Please include total charges.		

C.1 If Household having own source of water (Primary)

C08	If own Source, what was the expenditure Incurred at the time of :	Installation of Tap/Pipeline etc Charges	Other Charges During Installation	Annual Repair Charges (Please Mention Last Repair Charges incurred)	
C09	How Many hours do you receive water in a day (Primary Source)		One hour.....1 Two Hours.....2 Three Hours.....3 More than three Hours.....4		
C10	Do you receive monthly Bill for water (Municipality Corporation Bill)?		Yes.....1 No.....2		

<table>
<tr><th>Qn.</th><th>QUESTIONS AND FILTERS</th><th>CODING CATEGORIES</th><th>SKIP</th></tr>
<tr><td>C11</td><td>Have you paid bill in last three years, if yes please specify the amount (Specify Monthly/Annum/Other)</td><td></td><td></td></tr>
<tr><td>C12</td><td>What is your Monthly expenditure incurred towards water (Please exclude the water bill charges)?</td><td>None.....1
Less Than 100.....2
Between 101-300.....3
Between 301-500.....4
More than 500.....5</td><td></td></tr>
<tr><td>C13</td><td>Do you allow other households to take water from your Tap/Hand pump/Well?</td><td>Yes.....1
No.....2</td><td></td></tr>
<tr><td>C14</td><td>If Yes, Please specify the Number of Households</td><td>1-5 1
5-10.....2
10-15.....3
20+.....4</td><td></td></tr>
<tr><td>C15</td><td>How much do you charge per Month per household?</td><td>None.....1
Less Than 100.....,2
Between 101-300.....3
Between 301-500.....4
More than 500.....5</td><td></td></tr>
<tr><td>C16</td><td>Please specify, how many months do you provide the water to other households. (Data to be Based on last on average of last 3 years)?</td><td><table><tr><th>Month</th><th>Yes (1)</th><th>No (2)</th></tr><tr><td>January</td><td></td><td></td></tr><tr><td>February</td><td></td><td></td></tr><tr><td>March</td><td></td><td></td></tr><tr><td>April</td><td></td><td></td></tr><tr><td>May</td><td></td><td></td></tr><tr><td>June</td><td></td><td></td></tr><tr><td>July</td><td></td><td></td></tr><tr><td>August</td><td></td><td></td></tr><tr><td>September</td><td></td><td></td></tr><tr><td>October</td><td></td><td></td></tr><tr><td>November</td><td></td><td></td></tr><tr><td>December</td><td></td><td></td></tr></table></td><td></td></tr>
</table>

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
C.2 If Household does not have their own source of water (Primary)			
C17	How far is the water source from your household?	JUST OUTSIDE.....1 WITHIN 1/2 KM.....2 WITHIN 1 KM.....3 MORE THAN 1 KM.....4	
C18	What is your monthly expenditure to get the water (those who do not have their own sources of water, please include travelling charge and other charges, if any) Please write the total charges.	Less Than 100.....1 Between 100-300.....2 Between 300-500.....3 More than 500.....4	
C19	What is the Average Duration per Day You Get Water?	Less Than 10 Min.....1 10-20 Min.....2 21-30 Min.....3 More Than 30 Min.....4	
D. Water Consumption Pattern			
D01	Please Provide the details of water consumption (in liters) on daily basis (Primary Source)	Drinking ☐ Other Domestic Purposes ☐	
D02	How many days do you get water in a week (Primary Source)	☐	
D03	Who in the household is primarily involved to collect water?	Female Head.....1 Male Head.....2 Eldest Female Child.....3 Any Female Child.....4 Eldest Male Child.....5 Any Male Child.....6 Any other.....7	
D04	How much time on an average do you spend time collecting water in a day?	Half hour.....1 One Hour.....2 Two Hours.....3 Others_____4	

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
D05	How many trips do you make in a day?	Xxx One..... ...1 Two.....2 Three.....3 Four.....4 Others..... ...5	
D06	How is the water vessel brought home	Walking.....1 Bicycle.....2 Motor Cycle.....3 Rickshaw.....4 Other_____5 (Please Specify)	
E. Drinking Water Facility			
E01	Is the source of Drinking water same as mentioned in C01?	Yes.....1 No.....2	Skip to Question E03
E02	Please Specify IF other Sources used	Govt. Water Tanker.....1 Private Water Tanker.....2 Packaged Drinking water.....3 Water Pouch.....4 SWE Water Stalls/Kiosks .....5 Others.....6 None.....7	
E03	Do you pay any charges for procuring drinking water?	Yes.....1 No.....2 }	Skip to Question E05
E04	If yes, Please provide the monthly expenditure you incur to get drinking water?		
E05	Do you think drinking water should be treated?	Yes.....1 No.....2	
E06	Do you treat water before drinking?	Yes.....1 No.....2 }	Skip to Question E08
E07	What Are the Methods in which water is treated	Boiling..... .....1 Water Filter (Ceramic/ Electrical).....2 Water Purifier.....3 Using Cloth as filter.....4 Keeping water in Sun.....5 Cholrine Tablets.....6 Bleach.....7 Alum.....8 Others_____6	

<table>
<tr><th>Qn.</th><th>QUESTIONS AND FILTERS</th><th>CODING CATEGORIES</th><th>SKIP</th></tr>
<tr><td>E08</td><td>If No, what are the reasons you do not treat the water?</td><td>Water quality is good 1
No facility available.....2
Not aware of the treatment Methods...3</td><td></td></tr>
<tr><td>E09</td><td>Is the current quantity of available drinking water is sufficient?</td><td>Yes.....1
No.....2</td><td></td></tr>
<tr><td>E10</td><td>Is the current quality of available drinking water is satisfactory?</td><td>Yes.....1
No.....2</td><td></td></tr>
<tr><td>E11</td><td>If No, What are the Reasons?</td><td>Contaminated Water.....1
Smell.....2
Colored.....3
Particles in Water.....4
Other.....5</td><td></td></tr>
<tr><td>E12</td><td>How would you rank the quality of drinking water currently available in your household (Rate in the scale 1 to 5)</td><td>Very Good.....1
Good..... 2
Average.....3
Poor.....4
Very Poor.....5</td><td></td></tr>
<tr><td>E13</td><td>Have you seen/heard/read the messages related to the Safe Drinking water?</td><td>
<table>
<tr><th>Name of the Sources</th><th>YES</th><th>NO</th></tr>
<tr><td>A. TELEVISION</td><td>1</td><td>2</td></tr>
<tr><td>B. RADIO</td><td>1</td><td>2</td></tr>
<tr><td>C. NEWS PAPER/ BOOKS/ MAGAZINE/ PAMPHLET / POSTER/ HOARDING/</td><td>1</td><td>2</td></tr>
<tr><td>D. DRAMA/ SONG/DANCE PERFORMANCE/STREET PLAY/ PUPPET SHOW</td><td>1</td><td>2</td></tr>
<tr><td>E. EXHIBITION /MELA/</td><td>1</td><td>2</td></tr>
<tr><td>F. GROUP MEETING/ PROGRAMS/</td><td>1</td><td>2</td></tr>
<tr><td>G. DOCTOR/ ANM/ AWW/ ASHA</td><td>1</td><td>2</td></tr>
<tr><td>H. FRIENDS/RELATIVES</td><td>1</td><td>2</td></tr>
<tr><td>I. OTHER SOURCE (SPECIFY)</td><td>1</td><td>2</td></tr>
</table>
</td><td></td></tr>
</table>

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
F.IF SWE (Small Water Enterprises) IN THE COMMUNITY			
F01	Do you buy water from the SWE present in your community?	Yes.....1 No.....2	
F02	How much water do you buy in a day? (Please specify Exact Liters)		
F03	How much do you pay per litres? (Please mention the exact Cost)		
F04	Usage of this water (Please tick all the appropriate options)	Drinking.....1 Cooking.....2 Washing utensils.....3 Washing Clothes.....4 Other..... 5 Please Specify)	
F05	What vessel do you buy this water? (Please make an independent assessment by looking at the vessel)	Plastic vessel.....1 Earthen Pot.....2 Metal Vessel.....3	
F06	Monthly expenditure towards procuring water from this SWE? (Please Provide an approximation)		
G. Health And Health Seeking Behavior			
G01	Has your household been affected by water borne diseases in past six months?	YES.....1 No.....2	
G02	Please specify the disease(s) your household has been affected in last three years (Please tick all the appropriate options)	Diarrhea.....1 Jaundice.....2 Cholera.....3 Stomach Problems.....4 Typhoid.....5 Dysentery.....6 Blood in Stools.....7 Loose Motion/Watery Stool.....8 Fluorosis.....9 Browning of teeth in Children..10 Others(water borne).....11 Please Specify	

Qn.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
G03	Can You tell us about any other Diseases caused due to water in your Neighborhood?	1. 2. 3. 4. 5.	
G04	If household members fall sick, where do you go or whom do you consult first?	Govt. Hospital.....1 Consult the local doctor....2 Visit Medical Shop/Chemist...3 Consult the friends/Relatives4 → Home Based Methods.....5 Others (Please Specify).....6 None.....7	Skip to Question G07
G05	Did you receive any Medicine?	YES.....1 No.....2 Don't Know.....3	
G06	Average expenditure to avail treatment. (Please specify –only of water borne diseases, refer to QG02)	Less Than 100.....1 101-300.....2 301-500.....3 501-1000.....4 More than 1000.....5	
G07	Did you take any precautions related to water after treatment?	YES.....1 No.....2	Skip to Question G09
G08	If yes, Please specify		
G09	Please give any suggestions to improve the availability of water facility in your locality		
H. Willingness to pay:			
H01	How likely are you to change your water source if a clean, pure source of water is available?	Will stop the current source 1 Completely and switch to new source.....2 Will try the new source.....3 Will not try the new source..4 Don't Know/Can't Say.....5	

<table>
<tr><th>Qn.</th><th>QUESTIONS AND FILTERS</th><th>CODING CATEGORIES</th><th>SKIP</th></tr>
<tr><td>H02</td><td>How likely are to you change your water source if water from the new source is available some distance away and you have to collect the water?</td><td>Will stop he current source..1
Completely and switch to new source.....2
Will try the new source.....3
Will not try the new source.4
Don't Know/Can't Say.....5</td><td></td></tr>
<tr><td>H03</td><td>How likely are you willing to change your water source if you have to pay nominal charges for the clear, pure water?</td><td>Will stop he current source...1
Completely and switch to new source.....2
Will try the new source.....3
Will not try the new source..4
Don't Know/Can't Say.....5</td><td></td></tr>
<tr><td>H04</td><td colspan="2">And, how willing are you to pay INR 10 per / 20 litre?

And, how willing are you to pay INR 8 per / 20 litre?

And, how willing are you to pay INR 5 per / 20 litre?
(Please ask the question, one after the other and tick on the appropriate box provided below)</td><td></td></tr>
<tr><td></td><td colspan="2"><table>
<tr><th></th><th>INR 10</th><th>INR 8</th><th>Rs. 5</th></tr>
<tr><td>Strongly unwilling to pay</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Slightly unwilling to pay</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>May or may not pay</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Slightly willing to pay</td><td>4</td><td>4</td><td>4</td></tr>
<tr><td>Strongly willing to pay</td><td>5</td><td>5</td><td>5</td></tr>
</table></td><td></td></tr>
</table>

9.3.2Kiosk level questionnaire for operator

USWE (Water treatment kiosks) Survey: June 2015

Investigating Institute: Tata Institute of Social Sciences, Mumbai-400088

Questionnaire No...K/.....

CONFIDENTIAL
For research purpose only

1. Name of the Informal Settlement colony: _____

1.1 Address Location: _____

1.2 Demography details: Population: _____ Households: _____

2. Other Utility Services available:
Water-1, Electricity-2, Sewerage-3, Housing-4, Others-5
(Can be multiple answers) | | | | | |

3. Time and Date of Interview: _____

4. Current Raw Water Supply

4.1 Type of Water supplied:

Piped-1, Jal Board-2, Ground water-3, Other-4 |

(specify) _____

4.2 Quantity of Water Supplied daily: _____

4.3 Water Quality supplied: Raw Water TDS _____ppm

4.4 Time of Water Availability: Morning _____AM Evening_____ PM

Other_____

5. Urban Safe Water Enterprise (USWE)

5.1 Name of the Plant/Station Operator: _____

5.2 Education Qualifications: _____

5.3 Contact Number: _____

5.4 Date of Establishment: _____ Month _____ Year

5.5 GPS Coordinates: _____ Latitude _____ Longitude

5.6 Water Quality supplied (Treated): TDS_____ ppm

5.7 Treated water price at kiosk (INR) _____ per liter _____ 12 liters _____ 20 liters

5.8 Treated water price at ATM (INR): _____ per liter _____ 12 liters _____ 20 liters

5.9 Treated water price at retail outlet/shops (INR):

_____ per liter _____ 12 liters _____ 20 liters

5.10 Treated water price at home (INR): _____ per liter _____ 12 liters _____ 20 liters

5.11 Time of Water Availability: Morning _____AM Evening _____ PM

5.12 Past Visit by any Regulatory Authority

Name of authority _____

Last Visit Date _____ Fees (INR) _____

Comments _____

5.13 How many people are involved in running this kiosk/ATMs on a daily basis? What does each one of them do?

_____

5.14 For how many hours do you run this plant every day? _____

6. Water Quality and its Treatment

6.1 What are the main contaminants in the raw water here? | | | | | | |
Fluoride-1, Microbial-2, Arsenic-3, TDS-4, Nitrates-5, Salinity-6

6.2 Type of Treatment Technology deployed: | |
Chlorination-1, UV-2, Coagulation-3, Ion Exchange-4, R. O.-5 etc.

6.3 Water Testing Protocol: | |
Daily-1, Monthly-2, Quarterly-3, On Wall Display-4

6.4 Date of last treated water quality test: _____
(Please share report/results if possible)

6.5 Testing Laboratory:

Name: _____

Address: _____

Quality Parameters Tested: _____

Testing Fee Per Test (INR): _____

7. USWE Model

7.1 Type of Model: ☐
Community/SHG -1, NGO-2, PPP-2, DWACRA-3, Private-4, Govt.-5

7.3 Entrepreneur-owned:

Funding Source

Land_____

Building_____

Technology_____

Legal Approvals taken if any:_____

7.4 Any approvals taken from Local Authorities (land/water/fire/environmental/etc.)

_____

7.5 Are there any other USWEs operating in this area?

_____

8. Capital Expenditure: Cost of Infrastructure

8.1 Type of Land: ☐
Rental-1, Owned-2, Registered-3

8.2 Water Source/Bore drilling: _____ depth of drilled bore well

8.3 Source of Electricity: ☐ _____Cost/KWH
Single-1, Three-Phase-2

8.4 Station/Plant details:
Building-1, Signages-2, Storage-3, Tanks-4, Skids-5, Plumbing-6, Wiring-7, Electrification-8

_____Costs, etc.

8.4.1. Treatment System:

Manufacturer _____

Litres per hour (LPH) capacity _____

List the purification stages _____

Hours of Operation /Day _____

Daily Volume of Treated Water _____

Remote Monitoring System:
Yes-1, No-2 ☐

RFID Smart Cards (if any) _____

Safety measures like Stabilizer / AVR _____

8.5 Contingencies / Supervision / Training / Consumer Campaign etc.

_____

8.6 Reject Water Disposal mechanism:

8.6.1. Method of Disposal: _____

8.6.2. Cost of Disposal: _____

8.6.3. Local regulatory compliance
(if any): *No-1, Yes-2* ☐

_____documents?

9. Operating Expenditure (Op-Ex)

9.1 Operator salary / month _____

9.2 Rental Cost of Land, if any _____

9.3 Rental Cost of Source Water, if any _____

9.4 Monthly Electricity Bill: _____ Cost per unit _____ (INR/kWh)

9.5 Consumables used:
Anti-scaling chemicals-1, Cartridges-2 etc. ☐

9.6 Can wash/collection vessel cleaning protocol, if any:

_____

9.7 Program / Admin costs:

9.7.1 Consumer activation (or advertising/marketing), if any: _____

9.7.1.1 Brand name, if any _____

9.7.1.2 Activity type _____

9.7.1.3 Cost of activity _____

9.7.1.4 Activity Frequency _____

9.7.1.5 Customer base created _____

9.7.1.6 Cost / month / annum _____

9.7.2 Operator Training:

9.7.2.1 Skill training imparted:

9.7.2.1.1 Plant operation: Yes-1, No-2 ☐

9.7.2.1.2 Book keeping: Yes-1, No-2 ☐

9.7.2.1.3 Consumer handling : Yes-1, No-2 ☐

9.7.2.1.4 Any other _____

9.7.3 Operator experience / education:

9.7.3.1 Number of days of training _____

9.7.3.2 Refresher courses, if any Yes-1, No-2 ☐

If yes, specify _____

9.8 Maintenance Technician

9.8.1 Costs to the Station (including conveyance / month):

9.8.1.1 Number of breakdown (s) _____

9.8.1.2 Type of breakdown _____

9.8.2 High value spares

9.8.2.1 Cost of membranes replacement
<2 years-1, 3 years-2, 5 years-3 ☐

9.8.2.2 Pump replacement
<3 years-1, 4 years-2, 5 years-3 ☐

9.8.2.3 Any other _____

9.9 Buffer Staff / Apprentice for the operator: Yes-1, No-2 ☐

Specify, if yes _____

9.10 Total Op-Ex / month _____

9.11 Profit / Loss per month / per annum _____

10. Distribution

10.1 For each SWE delivery mechanisms, capture the following:

Delivery mechanism	Treated water holding capacity	Litres sold (daily average)	Travelling time to replenish stock (round trip)	Time to replenish stock at the delivery mechanism	Distance from main treatment facility	No. of times stock is replenished daily	Price (INR paise/ litre)
Kiosk							
ATM 1							
ATM 2							
ATM 3							
ATM 4							
ATM 5							
Retail outlets/ shops							
Home delivery							

10.2 Cost of Distribution/month

10.2.1 Vehicle cost (Rs/-) _____

Company owned-1, hired-2, Self-owned-3, hired-4 ☐

10.2.2 Fuel cost _____

10.2.3 Driver salary _____

10.2.4 Maintenance cost _____

11. Pricing of Water Container and Smart Card, if any:

11.1 Cost of container (one time), if any _____

11.2 Cost of subscription (e.g. - RFID Card), if any_____

11.3 Container Cost: _____ 20 liters _____ 12 liters

Additionally, we had used questionnaires for interviewing ULB representatives and USWE management. These can be obtained by contacting Safe Water Network.

9.4 List of People Interviewed

Organization	Designation	Name	
Ramesh Bambale	Chief Engineer, Hydraulic Department	MCGM	9930260377
Santosh P. Methar	Sub Engineer- Civil , Ghatkopar (East) N Ward Mumbai		09619081122
Chavan R.B.	Assistant Engineer, Water Works, M Ward East		09969000228
NandakishorMohit	Sub Engineer, Water Works, M Ward East		
Jogdhale	Sub Engineer, Water Works, N Ward		09987373352
A.V.Suresh	President, International Operations; CEO – Forbes Professional	Eureka Forbes	9821097310
Rama Shyam		a Apnalaya NGO	09320191300

9.5 List of Slums and USWEs

Name of colony/area	Additional information
Gautam Nagar (M ward East)	Without USWEs
Shivneri Nagar (M ward East)	Without USWEs
Azadnagar, G/North ward	Without USWEs
Ramabai Nagar, N ward	Without USWEs
Nalanda Nagar, N ward	Without USWEs
Rafiq Nagar	With USWEs
Shanti Nagar	With USWEs

DRINKING WATER SUPPLY FOR URBAN POOR
CITY OF MUMBAI

- Mumbai is home to 18 million people and is considered the financial capital of India
- 41% HHs in Greater Mumbai area are in slums (Census 2011)
- Referred to as India's least homogeneous city by living standards; lack of affordable housing has led to low-to-middle income families settling in slums

MCGM water supply: Key SLBs[1]	
Piped water coverage	100%
Non-revenue water	20%
Per capita supply (LPCD)	135
Cost recovery	100%

Water Supply for Urban Poor

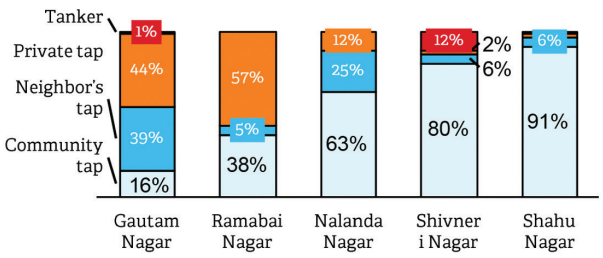
- MCGM provides a water tap connection to a group of minimum 5 HHs if they can prove their residency is from prior to 1st Jan' 95; MCGM owns very few tankers thus tanker is not a common source of water for urban poor
- Reselling of piped water by locals, to further 2-3 HHs, is fairly common through informal arrangements; private and illegal connections to city water network are also common
- HHs pay 5-6 times the standard municipal water charges to neighbors and illegal vendors

USWE landscape

- No ULB promoted pilot USWE scheme; some kiosks in eastern and outer Mumbai
- Studied 2 pilot kiosks in eastern Mumbai's Baiganwadi area- next to Mumbai's largest waste dumping ground; recently set up (2014-15), these kiosks are local NGO facilitated and SHG managed
- Pricing INR 10 at kiosk and INR 15 for home delivery per 20L; reject water sold at INR 3/35L with precautionary messaging
- Typical daily can sales 100-150; monthly operating costs : INR 30,000

Slums without USWEs[2]

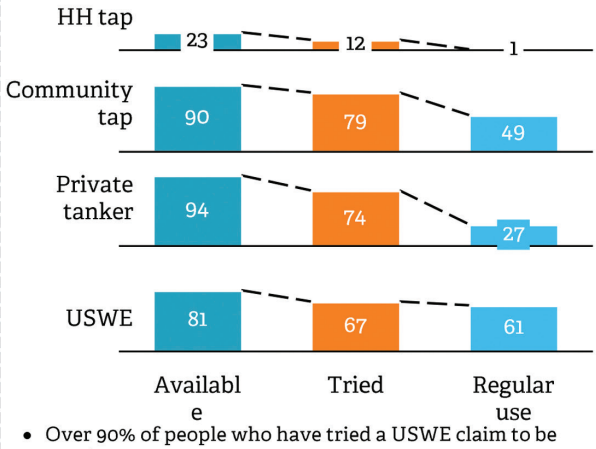
Availability of water sources, % respondents



- High reliance on community taps, shared by up to 30-40HHs
- On an average, ~15% HHs reported a water borne disease incidence in past 6 months
- On an average 78% reported treating their water before consumption; however, 2/3rd of these use cloth as filter

Slums with USWEs[2]

Drinking water sources, % respondents



- Over 90% of people who have tried a USWE claim to be regular users

Strengths

- Privately set up USWEs are strongly linked to local need and market thereby financially viable
- High level of motivation of local NGO and SHGs involved
- Targeted focus on consumer awareness tailored to local scope
- Strict adherence to kiosk hygiene and plant upkeep

Challenges

- No ULB involvement so high charges for raw water (~INR1500 for 10kL) and rent (~INR 8000-12000/month)
- Low potential to scale quickly without ULB support; high reliance on donor funding
- Vulnerable to local water tanker supply; exposed to risk of consumer drops during peak summer

RESEARCH PARTNER: Tata Institute of Social Sciences

SUPPORTING PARTNERS

PEPSICO FOUNDATION · CISCO · NEWMAN'S OWN FOUNDATION · PENTAIR FOUNDATION

[1] Municipal Corporation of Greater Mumbai (MCGM) data
[2] 1330 HHs across 9 slums were studied (5 with USWEs, 5 without USWEs)

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