Water Supply and Demand Assessment in Chennai City

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Abstract: In order to assess the water supply in Chennai city for a small focusing group of slums, the slum clearance board has been surveyed for Slums the level of water supply Status Assessment and also b) Surveyed for Demand Assessment. The survey format is to provide inputs for the quantitative assessment at the slum level while the latter to provide inputs for qualitative assessment in terms of both the need and the willingness-to-pay for the improved services. All the above data has been adopted quantitative techniques.

Key Words: Fresh Water, Surface Supply, Reservoir, Ground Water, Ground Water recharge facilities.

Introduction

The Chennai Municipal Water Supply and Sewerage Board (CMWSSB) is solely responsible for providing drinking water and sewerage services to the residents of Chennai. One of India's major metropolises, Chennai is situated at the northern coastal edge of the State of Tamil Nadu. The city is more well-known by its older name of Madras. Currently, Chennai is inhabited by more than 7 million people in an area of 176 sq km. The CMWSSB depends on surface reservoirs and ground water sources to maintain water supply to the residents. Supply is maintained through multiple means. Since Chennai is essentially low-lying and water supply is intermittent, most residents build underground sumps that store the water. Subsequently, the water is pumped up to an overhead tank. In other cases, water tankers are dispatched by CMWSSB to various localities and the sumps are filled from the tankers. In other localities, CMWSSB has put in place above-ground water tanks and these are filled by the water tankers. In yet other places, residents collect water directly from the tanker.

Despite the seemingly abundant sources of water, Chennai suffers continuously from water stress since the entire basin is dependent on rainfall. The annual rainfall in Chennai is 1200 mm [2]. This quantum is, given the size of the Chennai basin, sufficient to meet the needs of the population. The problem is with the distribution of the rainfall. There are two rainy seasons in Chennai. The first is the Southwest monsoon, which has patchy rains and contributes about 25% of the total rain and falls between May and September. This does not do much for ground water recharge. However, the Northwest Monsoon (Oct to Dec) is usually characterized by a series of storms that brings the remaining 75% of total rain in extremely short bursts. During this time, Chennai is prone to flooding and, before 2003, a large part of this water would have been lost as run-off into the sea.

CMWSSB traditionally focused its attention on increasing surface storage, transporting fresh water from long distances. Like the Telugu Ganga project - probably one of the longest canals built for water supply to the city that failed to ease the water problem. Another attempt was to divert water from Chembaramabakkam and Veeranam tanks whereby the water rights of the agrarian community were infringed. Drilling of borewells in the Cuddalore belt and installation of turbine pumps to tap 100mld whereby the groundwater which again supports the local agriculture community was depleted. None of these solutions were sustainable in the long run and yet CMWWSSB paid very little attention to ground water recharge that had that potential. In 1997, at the Shri AMM Murugappa Chettiar Research Centre (MCRC), Chennai, [3] a study was conducted to understand the user experience. The study surveyed 10,000 households in 155 corporation wards of Chennai. The focus was on how residents get their

water needs met and how the water is utilised. Raw data from this study was further analyzed by Dr. A Vaidyanathan and J. Saravanan. These studies clearly established that the contribution of ground water could be as high as 80% in some cases.

Objectives of the Study

- To show the sources of water supply in Chennai city specially focusing on slum area.
- To show the provision / facility of water supply available for the slum people in Chennai city.
- To show the contribution of slum people for water supply.

Essential Services and Facilities

Water Supply

Water supply to the Chennai City was affected solely from shallow wells for many years, and it was during 1866 that decision was made to adopt a public supply scheme. This scheme, which combined the Chennai City Water Supply with irrigation of 3500 ha of previously wasteland, was opened in 1872. Water was taken from the Kortalaiyar River to storage in Cholavaram and Redhills Lakes. Further developments, which took place after 1907 included the construction of an outlet tower and roughing filters at Redhills, an underground conduit to convey water to the city and slow-sand filters at Kilpauk. The new works were designed to supply 160 lpcd to an estimated population of 6.6 lakhs in 1961. However, the population of the city grown to about 18 lakhs by the year 1961.

In order to meet the increasing demand for water in the city, the irrigation supply was discontinued for sometime during 1940's or 1950's. The treatment capacity at Kilpauk was increased by a provision of rapid-gravity filters with a capacity of 45 MLD, which was later increased by 135 MLD to 190 MLD. One more conduit to convey the raw water to Kilpauk was also laid, which was strengthened by a third conduit during 1980's. To increase the available yield from the catchment, a new reservoir was constructed between 1940 and 1944 across the Kortalaiyar River at Poondi.

Groundwater continued to be drawn from shallow wells within the city boundaries, particularly in the suburbs. Further, groundwater development occurred after 1968 based on a UNDP study, which recommended development of the Arani-Kortalaiyar aquifer to the northwest of the city. With the increase in population and expansion of urbanized area, distribution lines were extended periodically and eventually led to the establishment of Zonal System of distribution in 1954. Twelve water zones were formed with an aim to supply water to the consumers equitably at adequate pressures; and trunk mains were laid. By 1970-72, additional Head Works were commissioned in Robinson Park (now called Anna Poonga), Southern Head Works and K. K. Nagar. As the requirement of the growing population in Chennai were huge and the investment required in infrastructure was going up, it was decided to form a separate Statutory Board to look after the water supply and sewerage system by getting institutional finance from World Bank and other sources and hence the Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) was formed by an Act of the Legislature of Tamil Nadu.

Sources of Water Supply

Surface Water Sources: Main source of water supply to the city is from three lakes, viz. Redhills, Cholavaram & Poondi, having an aggregate storage capacity of 175 million cu. m. Since January 2000, Chembarambakkam is also used as a supplementary source after meeting the needs of the registered ayacut. Besides this, during the rainy seasons i.e. three to four months, two small lakes namely, Erattai Eri and Porur Lake are also utilized as a source of supply. The source is the runoff from its own local catchment area during monsoon rains. In addition to the above sources, an agreement has been signed by the Government of Tamil Nadu (GoTN) and the Government of Andhra Pradesh (GoAP) to supply about 8 tmc during July to October and about

4 tmc during January to April, to the areas located in the outskirts of Chennai Municipal Corporation limits.

Ground Water Sources

The CMWSSB has developed about 7 Well Fields accommodating about 74 deep bore wells, viz. (i) Poondi; (ii) Tamaraipakkam; (iii) Flood Plains; (iv) Kannigaipair; (v) Panjetty; (vi) Minjur; and (vii) Southern Coastal Aquifer. In addition, the CMWSSB has also executed water purchase agreement with private agricultural owners. From both the sources mentioned above, about 100 MLD of water is extracted to augment industrial and city water supply.

Distribution Supply System

Water is treated at three treatment plants (Redhills, Kilpauk & KK Nagar). Earlier, the water was distributed to the City through 4 Water Distribution Stations. Keeping in view of the water demand of the projected population of Chennai City for the year 2021 and also with a view to remove the existing systemic deficiencies and to ensure equitable distribution of water throughout the city, the CMWSSB has been executing a Water Supply & Sewerage Master Plan. This Plan contemplates introducing a concept of self-sustaining Zonal Distribution System, each having a reservoir, distribution station, necessary pumping systems and a network of water distribution arrangements by dividing the entire Chennai City into 16 Zones as against the present radial distribution system Based on the Master Plan prepared in 1990 under the World Bank aided First Chennai Project, the city distribution system was reorganized into 16 Zones, each with a separate Head Works and 12 additional Head Works.

Water Supply:

Status Assessment

Water supply is one of the core environmental infrastructure services delivered by the local body. The following indicators have been analyzed to assess the existing service levels, coverage and efficiency in delivery.

Table No. 5.4.1: Service Indicators for the Assessment of Water Supply

Sl. No.	Particulars	Service Indicators
1.	*Service levels and coverage*	▪ No. of persons per public tap/public water tank

It was observed that the slums in Chennai City were not served with piped water supply. The sources of water included open wells, bore wells and public water tanks. The public water tanks are generally large PVC water tanks to which the water is filled through a water tanker lorry. Following table provides the number of public water taps/public water tanks available in slums located each zone and their interpretation with respect to the service indicator as number of persons per public tap/public water tank.

Table No. : Zone-wise Break-up of Number of Public Water Tanks/Taps and Number of Persons per Public
Water Tank/Tap for Water Supply

Sl. No.	Zones	No. of Public Water Tanks / Taps	No. of Persons per Public Water Tank / Tap
1.	Zone I	40	297
2.	Zone II	36	438
3.	Zone III	51	689
4.	Zone IV	54	540
5.	Zone V	19	774
6.	Zone VI	70	868
7.	Zone VII	23	813
8.	Zone VIII	28	631
9.	Zone IX	75	587
10.	Zone X	194	561
	Total	**590**	**620**

From the above table, it is evident that the number of persons sharing the public water tank/tap is very high with an average of about 620 persons per water tank/tap. The situation is worse in Zone VI and Zone VII, where number of persons sharing each public water tank/tap is 868 and 813 respectively. The following chart presents the above graphically.

Chart No.: Zone-wise Break-up of Number of Public Water Tank/Tap for Water Supply

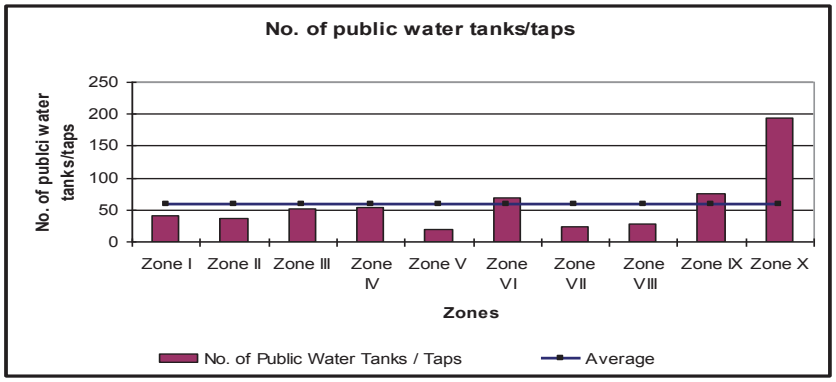
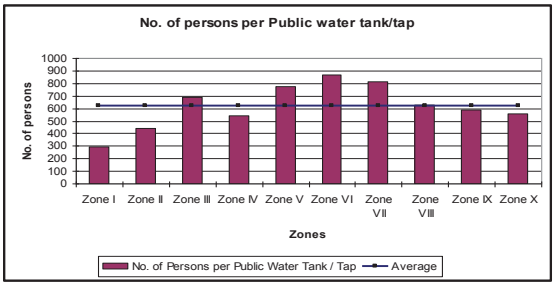


Chart No.: Zone-wise Break-up of Number of Persons per Public Water Tank/Tap



Demand Assessment

Sources of Water

Based on the Demand Assessment Surveys, the slums in all the Zones of the Chennai City predominantly (about 90 percent) depend on supplies through municipal water tankers. Over zones, the response ranges from 83.3 percent to 96.8 percent. Less than one percent of the respondents stated that they have own municipal connections and 3.7 percent revealed that they access public taps. The table below presents the fact base on the survey outcome while the chart presents the rating with respect to the households consuming water from the public water tank.

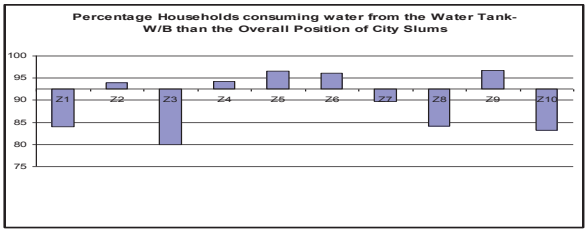
Table No.: Zone-wise Break-up of Responses on Sources of Water

All Figures in Percentage

Sl. No.	Zones	Public Tap	Water Tank	Own Connection	Hand Pump	Community Well	No Response	Total
1.	Zone I	4.9	84.0	0.0	0.0	0.0	11.2	100.0
2.	Zone II	3.0	94.0	0.0	3.0	0.0	0.0	100.0
3.	Zone III	8.0	80.0	7.0	4.0	0.0	1.0	100.0
4.	Zone IV	3.1	94.3	0.7	1.9	0.0	0.0	100.0
5.	Zone V	2.4	96.6	0.0	0.0	0.5	0.5	100.0
6.	Zone VI	1.6	96.1	0.0	2.1	0.0	0.2	100.0
7.	Zone VII	0.4	89.8	0.9	4.4	1.3	3.1	100.0
8.	Zone VIII	0.0	84.2	0.0	14.7	0.0	1.1	100.0
9.	Zone IX	1.5	96.8	0.3	0.0	0.5	0.9	100.0
10.	Zone X	12.4	83.3	0.0	3.7	0.1	0.5	100.0
	Total	**3.7**	**89.9**	**0.9**	**3.4**	**0.2**	**1.8**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Chart No.: Zone-wise Rating of Slums Consuming Water from Water Tank



Source: *Demand Assessment Surveys; 2004*

Frequency of Water Supply

For all zones in the Chennai City, about 73.8% of the respondents have access to daily water supply. Another 24 percent of respondents enjoy supplies on alternate days. The remaining 1.4 percent of households (excluding the 0.8 percent of non-respondents) did not have regular frequency in water supply like twice a week, weekly, fortnightly or monthly as given in the table below. The chart below indicates the zone wise position of households, which do not have regular frequency of water supply.

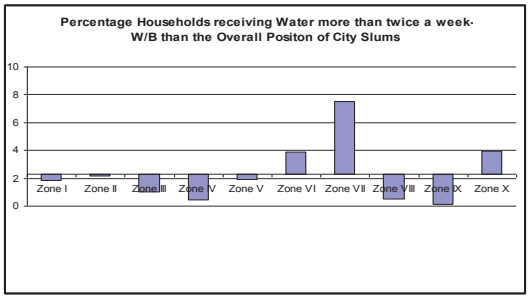
Table No.: Zone-wise Break-up of Frequency of Water Supply

All Figures in Percentage

Sl. No.	Zones	Daily Once	Alternative Days	Twice a Week	Weekly	Irregular	No Response	Total	< Twice a Week
1.	Zone I	71.4	23.5	1.8	0.0	0.0	3.2	100.0	1.8
2.	Zone II	56.0	41.8	0.9	1.3	0.0	0.0	100.0	2.2
3.	Zone III	56.8	42.0	0.0	1.0	0.0	0.2	100.0	1.0
4.	Zone IV	44.7	54.6	0.5	0.0	0.0	0.2	100.0	0.5
5.	Zone V	91.8	5.8	0.0	1.4	0.5	0.5	100.0	1.9
6.	Zone VI	61.9	34.2	2.3	0.2	1.4	0.0	100.0	3.9
7.	Zone VII	74.3	16.8	0.0	1.3	6.2	1.3	100.0	7.5
8.	Zone VIII	49.5	50.0	0.0	0.5	0.0	0.0	100.0	0.5
9.	Zone IX	78.6	20.2	0.2	0.0	0.0	1.1	100.0	0.2
10	Zone X	56.7	38.8	0.0	4.0	0.0	0.5	100.0	4.0
	Total	**64.2**	**32.8**	**0.6**	**1.0**	**0.8**	**0.7**	**100.0**	**2.3**

Source: *Demand Assessment Surveys; 2004*

Chart No. : Zone-wise Status of Respondents Receiving Water More Than Twice a Week



Source: *Demand Assessment Surveys; 2004*

Distance of Community Water Supply

As given in the table below, about 56 percent of the households in all zones had community water supply available within a distance of 50 meters and another 21 percent had within 50 to 100 meters. For the remaining 12.1 percent (excluding the 11 percent of non-respondents), the water sources were available beyond 100 meters. Zone wise position of such households not having community water supply within 100 m distance is presented in the chart below.

Table No.: Zone-wise Break-up of Distance of Community Water Supply

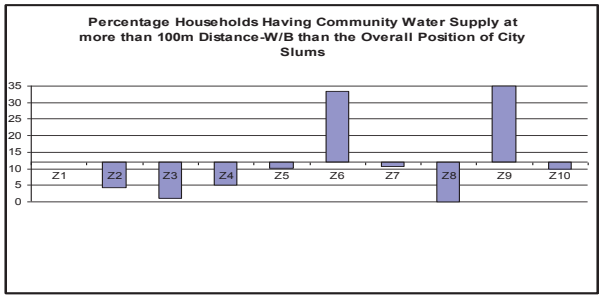
All Figures in Percentage

Sl. No.	Zones	Less than 50 m	51 m to 100 m	More than 100 m	No Response	Total
1.	Zone I	57.2	20.3	12.0	10.5	100.0
2.	Zone II	34.9	50.0	4.3	10.8	100.0
3.	Zone III	74.9	22.0	1.2	2.0	100.0
4.	Zone IV	60.8	17.5	5.0	16.8	100.0
5.	Zone V	75.0	13.0	10.1	1.9	100.0
6.	Zone VI	54.1	10.1	33.3	2.5	100.0
7.	Zone VII	52.7	12.4	10.6	24.3	100.0
8.	Zone VIII	56.3	11.6	0.0	32.1	100.0
9.	Zone IX	32.6	30.9	35.0	1.5	100.0

Sl. No.	Zones	Less than 50 m	51 m to 100 m	More than 100 m	No Response	Total
10.	Zone X	57.2	24.9	10.0	7.9	100.0
	Total	**55.6**	**21.3**	**12.1**	**11.0**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Chart No.: Zone-wise Status of Respondents having Water Supply at more than 100 m Distance



Source: *Demand Assessment Surveys; 2004*

Water Storage Facility within the Property

A majority of households (90.4 percent) had water storage facilities other than overhead tank, underground tank or storage drums, within their property. Across all zones, the status of such respondents varied from 74.4 percent to 95.3 percent as indicated in the table below. About two-fourths of the respondents did not respond in Zone 1.

Table No. : Zone-wise Break-up of Water Storage Facilities within Property

All Figures in Percentage

Sl. No.	Zones	Overhead Tank	Undergro und Tank	Storage Drums	Others	No Response	Total
1.	Zone I	0.0	0.0	0.8	74.4	24.7	100.0
2.	Zone II	0.0	0.9	1.7	95.3	2.2	100.0
3.	Zone III	0.2	5.3	0.0	93.7	0.8	100.0
4.	Zone IV	0.0	7.6	0.0	91.7	0.7	100.0
5.	Zone V	0.5	12.5	0.5	86.1	0.5	100.0
6.	Zone VI	0.2	1.4	0.6	97.5	0.0	100.0
7.	Zone VII	0.0	1.8	3.1	92.5	2.7	100.0
8.	Zone VIII	0.0	3.2	0.0	91.6	5.3	100.0
9.	Zone IX	0.3	1.2	0.5	92.5	5.5	100.0
10.	Zone X	0.4	4.3	0.4	88.3	6.6	100.0
	Total	**0.2**	**3.8**	**0.8**	**90.4**	**4.9**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Water Consumption Pattern and Adequacy

Nearly 66.7 percent of the respondents indicated that water was available more than 50 liters per day, with about 11.4 percent saying that they had more than 100 litres a day. However, 29.4 percent of the households (excluding the 3.9 percent of non-respondents) received less than 50 litres of water per day, as given in the table below (Table No. 5.4.7). The zone wise rating with respect to the availability of water of less than 50 litres per day is presented in the chart below (Chart No. 5.4.6).

Further, a majority of respondents (54.9 percent) expressed that the available water was just manageable and about 1.7 percent of respondents reported that water was grossly inadequate. Another 18.5 percent of the respondents indicated that the water available was just sufficient, as indicated in the Table No. 5.4.8.

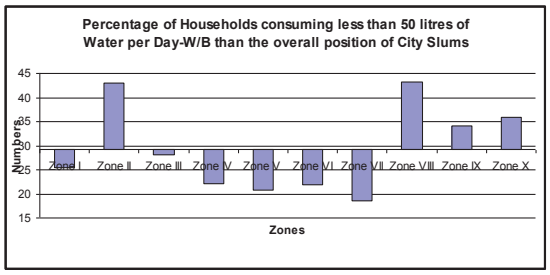
Table No.: Zone-wise Break-up of Quantity of Daily Water Availability

All Figures in Percentage

Sl. No.	Zones	Less than 25 Litres	26 to 50 Litres	51 to 100 Litres	More than 100 Litres	No Response	Total
1.	Zone I	3.0	22.5	37.3	13.8	23.3	100.0
2.	Zone II	8.6	34.5	46.1	9.9	0.9	100.0
3.	Zone III	2.4	25.7	67.9	1.4	2.6	100.0
4.	Zone IV	6.6	15.6	58.6	17.0	2.1	100.0
5.	Zone V	14.4	6.3	53.4	24.0	1.9	100.0
6.	Zone VI	2.7	19.3	76.1	1.4	0.6	100.0
7.	Zone VII	3.1	15.5	67.3	12.8	1.3	100.0
8.	Zone VIII	3.2	40.0	41.6	14.2	1.1	100.0
9.	Zone IX	3.4	30.7	61.8	2.6	1.5	100.0
10.	Zone X	6.2	29.6	43.3	17.3	3.6	100.0
	Total	**5.4**	**24.0**	**55.3**	**11.4**	**3.9**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Chart No.: Zone-wise Rating on Availability of less than 50 litres of Water per Day



Source: *Demand Assessment Surveys; 2004*

Table No.: Zone-wise Break-up of Adequacy of Water Availability

All Figures in Percentage

Sl. No.	Zones	Very Sufficient	Just Sufficient	Manageable	Grossly Inadequate	No Response	Total
1.	Zone I	6.3	20.9	47.1	0.2	25.6	100.0
2.	Zone II	28.9	21.1	47.8	0.4	1.7	100.0
3.	Zone III	11.1	32.9	54.1	0.0	2.0	100.0
4.	Zone IV	13.7	22.2	59.3	1.9	2.8	100.0
5.	Zone V	6.3	3.4	81.3	7.7	1.4	100.0
6.	Zone VI	8.6	4.9	85.8	0.6	0.2	100.0
7.	Zone VII	27.9	7.5	60.6	3.1	0.9	100.0
8.	Zone VIII	42.6	12.6	43.7	1.1	0.0	100.0
9.	Zone IX	49.4	29.4	19.6	0.5	1.2	100.0
10.	Zone X	14.4	30.2	50.1	1.4	3.9	100.0
	Total	**20.9**	**18.5**	**54.9**	**1.7**	**4.0**	**100.0**

Source: *Demand Assessment Surveys; 2004*

It was also reported that a majority of slum dwellers (about 71.64 percent) were purchasing the drinking water all across the zones whereas about 17.01 percent did not respond for the query. Rest 11.35 percent was using public water as drinking water. The table below presents the zone-wise fact base on the purchase of drinking water and the chart below presents the zone wise rating of slum dwellers purchasing drinking water.

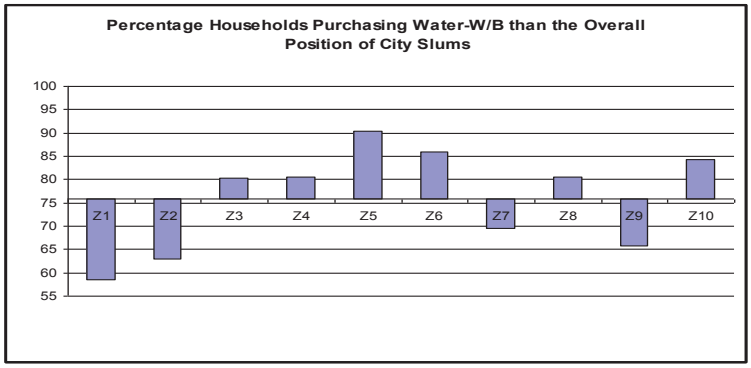
Table No. : Zone-wise Break-up of Status on Purchasing Drinking Water

ll Figures in Percentage

Sl. No.	Zones	Yes	No	No Response	Total
1.	Zone I	58.6	15.4	26.0	100.0
2.	Zone II	62.9	18.1	19.0	100.0
3.	Zone III	80.2	17.4	2.4	100.0
4.	Zone IV	80.6	9.9	9.5	100.0
5.	Zone V	90.4	6.7	2.9	100.0
6.	Zone VI	86.0	8.0	6.0	100.0
7.	Zone VII	69.5	19.9	10.6	100.0
8.	Zone VIII	80.5	7.9	11.6	100.0
9.	Zone IX	65.7	33.2	1.1	100.0
10.	Zone X	84.2	11.1	4.7	100.0
	Total	**71.64**	**11.35**	**17.01**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Chart No.: Zone-wise Rating of Slum Dwellers on Purchase of Water



Source: *Demand Assessment Surveys; 2004*

Quality of Water

While 5.1 percent of the respondents felt that the water quality was good, 75.4 percent of respondents felt that the water quality was average. There were 18.3 percent of non-respondents about half of the respondents did not answer this query in Zone 1), while remaining 1.3 percent felt that the quality of water was bad. The zone-wise fact base on the quality of water is given in the table below and the chart presents the rating of the zones based on the respondents' opinion on quality of water.

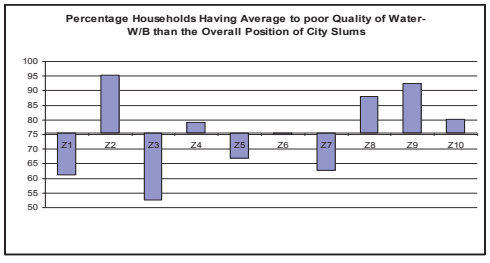
Table No.: Zone-wise Break-up of Status on Quality of Water

All Figures in Percentage

Sl. No.	Zones	Good	Average	Bad	No Response	Total
1.	Zone I	1.6	61.3	0.0	37.1	100.0
2.	Zone II	2.6	95.3	0.0	2.2	100.0
3.	Zone III	7.9	52.7	0.0	39.4	100.0
4.	Zone IV	1.7	79.2	1.7	17.5	100.0
5.	Zone V	2.4	66.8	0.5	30.3	100.0
6.	Zone VI	3.7	75.1	2.5	18.7	100.0
7.	Zone VII	4.9	62.8	8.0	24.3	100.0
8.	Zone VIII	12.1	87.9	0.0	0.0	100.0
9.	Zone IX	6.0	92.4	0.2	1.5	100.0
10.	Zone X	8.2	80.1	0.0	11.7	100.0
	Total	**5.1**	**75.4**	**1.3**	**18.3**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Chart No.: Zone-wise Rating based on the Quality of Water



Source: *Demand Assessment Surveys; 2004*

Monthly Expenditure on Water

The monthly expenditure on water exceeded Rs. 50 for about 62.3 percent of the households and it exceeded more than Rs. 100 for 31.3 percent of the households surveyed. About 31 percent of the

respondents reported that they incurred about Rs. 51-100 per month on water, while about 1.5 percent did not incur any expenditure. About 4.7 percent of the respondents did not answer this query, as presented in the table below. The zone wise rating of slum households spending more than Rs. 50 per month is presented in the chart below.

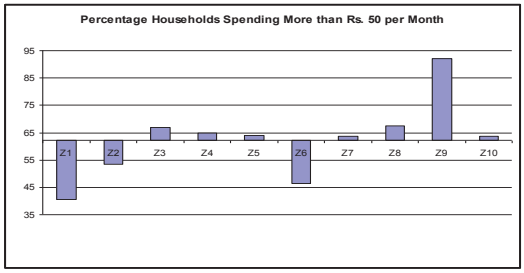
Table No.: Zone-wise Break-up of Monthly Expenditure Incurred on Water

All Figures in Percentage

Sl. No.	Zones	Less than Rs. 50	Rs. 51 to 100	More Than Rs. 100	None	No Response	Total
1.	Zone I	32.7	17.4	23.1	1.4	25.4	100.0
2.	Zone II	44.4	34.5	19.0	0.0	2.2	100.0
3.	Zone III	32.1	32.3	34.7	0.2	0.8	100.0
4.	Zone IV	32.2	40.0	24.8	0.7	2.4	100.0
5.	Zone V	26.4	23.6	40.4	9.1	0.5	100.0
6.	Zone VI	52.3	25.7	20.8	0.6	0.6	100.0
7.	Zone VII	26.1	46.5	17.3	1.8	8.4	100.0
8.	Zone VIII	32.6	30.5	36.8	0.0	0.0	100.0
9.	Zone IX	6.1	28.4	63.6	0.5	1.4	100.0
10.	Zone X	30.5	31.0	32.8	0.5	5.1	100.0
	Total	**31.5**	**31.0**	**31.3**	**1.5**	**4.7**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Chart No. : Zone-wise Rating based on the Expenses Incurred on Water



Source: *Demand Assessment Surveys; 2004*

Willingness-to-Pay for Improved Water Supply

For the query on the willingness-to-pay for the improved water supply, a majority of the respondents (about 65.15 percent) responded favorably while remaining 34.85 percent did not show their willingness. About 40 percent of the households were willing to pay up to Rs. 50 per month while another 19.8 percent were willing to pay Rs. 51-100 per month for improved water supply. Remaining 5.4 percent were willing to pay more than Rs. 100 per month for the improved water supply, as presented in the table below. The charts below present the zone wise rating of the slums in terms of respondents willingness-to-pay for improved water supply and zone wise rating of the slums in terms of respondents' willingness-to-pay up to Rs. 50 per month on the improved water supply.

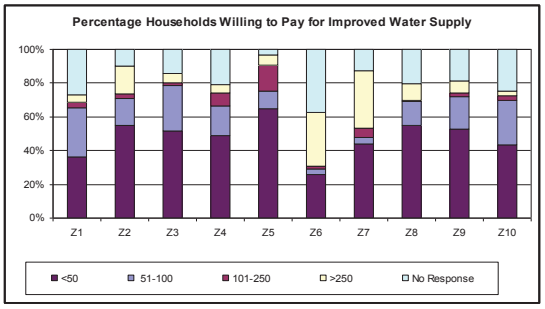
Table No.: Zone-wise Break-up of Willingness-to-Pay for Improved Water Supply

All Figures in Percentage

Sl. No.	Zones	Less than Rs. 50	Rating	Rs. 51-Rs. 100	Rating	Rs. 101-Rs. 250	Rating	More than Rs. 250	Rating	No Response	Total
1.	Zone I	36.4	W	29.2	B	3.3	W	3.9	W	27.1	100.0
2.	Zone II	55.0	B	15.8	W	3.2	B	16.2	B	9.9	100.0
3.	Zone III	51.9	B	26.9	B	1.6	W	5.1	W	14.5	100.0
4.	Zone IV	48.7	B	17.7	B	5.5	B	4.6	W	21.1	100.0
5.	Zone V	64.6	B	10.6	W	15.8	B	6.6	W	3.0	100.0
6.	Zone VI	25.8	W	3.6	W	2.2	W	31.5	B	37.5	100.0
7.	Zone VII	44.0	W	3.7	W	1.7	W	34.3	B	12.5	100.0
8.	Zone VIII	55.0	B	14.4	W	0.4	W	9.4	W	20.6	100.0
9.	Zone IX	52.5	B	19.7	B	2.5	W	7.5	W	18.6	100.0
10.	Zone X	43.2	W	26.7	B	3.5	W	3.1	W	24.7	100.0
	Total	**47.7**		**16.8**		**4.3**		**12.2**		**19.0**	**100.0**

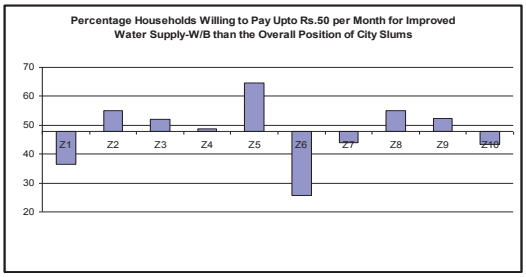
Source: *Demand Assessment Surveys; 2004*

Chart No. : Zone-wise Rating for the Willingness-to-Pay for the Improved Water Supply



Source: *Demand Assessment Surveys; 2004*

Chart No.: Zone-wise Rating for up to Rs. 50 Willingness-to-Pay for the Improved Water Supply



Source: *Demand Assessment Surveys; 2004*

Problems of Water Supply

About 64.7 percent of the households reported that the problems of water supply as poor, irregular or inadequate, as given in the table below. The zone wise variation in this aspect is presented in the chart below. It may be noted that about one-third of the respondents did not answer for this query.

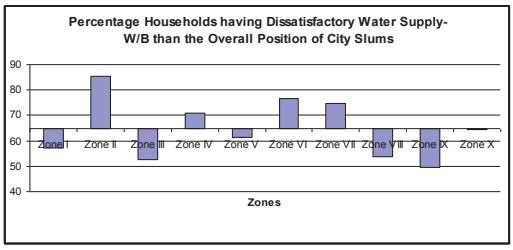
Table No.: Zone-wise Break-up Indicating Problems in Water Supply

All Figures in Percentage

Sl. No.	Zones	Poor Quality	Irregular Supply	Inadequate	None	No Response	Total
1.	Zone I	48.1	4.7	4.5	18.5	24.3	100.0
2.	Zone II	64.7	20.3	0.4	13.4	1.3	100.0
3.	Zone III	42.0	10.5	0.2	46.1	1.2	100.0
4.	Zone IV	63.1	7.6	0.2	28.1	0.9	100.0
5.	Zone V	49.5	10.6	1.4	38.0	0.5	100.0
6.	Zone VI	40.9	35.0	0.8	23.3	0.0	100.0
7.	Zone VII	49.1	20.8	4.9	24.8	0.4	100.0
8.	Zone VIII	52.6	1.1	0.0	45.8	0.5	100.0
9.	Zone IX	47.1	2.1	0.2	49.5	1.1	100.0
10.	Zone X	55.8	8.0	0.8	34.0	1.4	100.0
	Total	**51.3**	**12.1**	**1.3**	**32.1**	**3.2**	**100.0**

Source: *Demand Assessment Surveys; 2004*

Chart No. : Zone-wise Rating Indicating the Dissatisfactory Water Supply



Source: *Demand Assessment Surveys; 2004*

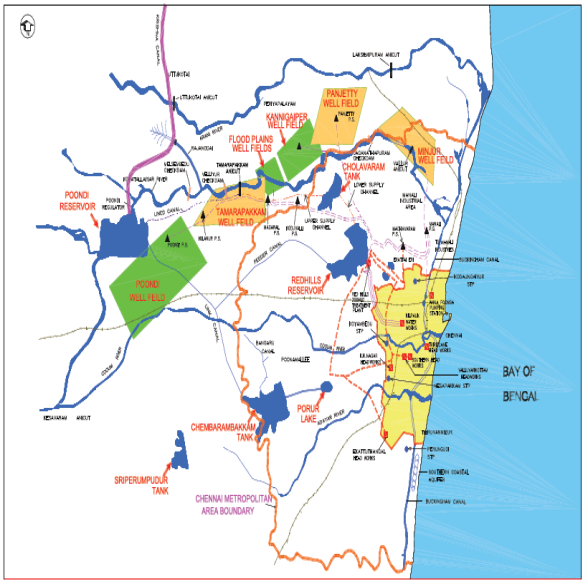


Figure 1.

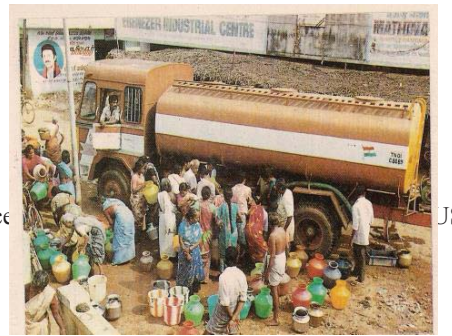


Figure 2: Drinking water collection from tankers directly by residents.

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