# Water Consumption Patterns in Domestic Households in Major Cities

*Supply-led water deprivation prevails in major cities in India. The per capita water availability in these cities is nowhere near the standards laid down by the World Health Organisation or the Bureau of Indian Standards (1993), and it is also far lower than that in other large cities in the world. The availability of water in Indian cities varies with socio-economic groups and areas. Households with incomes below Rs 3,000 a month suffer a lot – about 72 per cent of such households in these cities lack sufficient water.*

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Predicting the future is a hazardous business but one thing is certain, that the world in the future, at least in some respects, is going to be different from that of today [Figueres et al 2005]. It is certain that societies are going to have to confront, among other things, demographic transitions, geographical shift of population, technological advancement, growing globalisation, degradation of the environment and emergence of water scarcities. Water, the need of life, is likely to pose the greatest challenge on account of an increased demand with population rise and economic development, and shrinking supplies due to over-exploitation and pollution. Although water is an abundant and renewable natural resource covering two-thirds of the planet, a very small proportion of this is effectively available for human use. In India, as a result of development, the demand for water is increasing both in urban and rural areas. This may increase tensions and disputes over sharing and command of water resources. The emerging scarcity of water has also raised a host of issues related to sustainability of the present form of economic development, sustained water supply, equity and social justice, water financing, pricing, governance and management.

This study mainly focuses on domestic use of water in seven major Indian cities; Delhi, Kanpur, Kolkata, Ahmedabad, Mumbai, Hyderabad and Madurai. Besides analysing activity-wise and socio-economic group-wise consumption of water, the paper examines the sources of water supply, perception of households about quality of municipal water, duration of municipal water supply, and awareness about water conservation. Section I deals with methods used for data collection and analysis, while Section II discusses the recommendations of various agencies about the per capita need of water in urban areas. Analysis of socio-economic group, area and city-wise domestic consumption of water is presented in Section III. Section IV extends the analysis presented in Section III by analysing activity-wise consumption of water. Sources of water and perception of households about the safety of water are analysed in Section V, while Section VI deals with the duration and frequency of supply of municipal tap water and distance of sources of water. Rainwater harvesting can play an important role in meeting the water supply challenge in urban India. This necessitates spreading awareness about rainwater harvesting. In this context, Section VII examines the level of awareness in households about rainwater harvesting. The last section presents the summary and conclusions of the study.

## I
## Data and Methodology

The household survey reveals the consumption, availability, access and methods adopted for conservation of water in domestic households in seven major Indian cities, Delhi, greater Mumbai, Kolkata, Hyderabad, Kanpur, Ahmedabad and Madurai, and was conducted in March 2005. As per the Census of India 2001, these cities, except Madurai (Municipal Corporation) are among 27 municipal corporations with a million plus population, and their populations are 9.8, 11.9, 4.6, 3.5, 2.5, 3.5 and 0.92 million respectively. The number of sample households selected from each of these cities was 507 in Delhi, 500 in Mumbai, 400 in Kolkata, 398 in Hyderabad, 303 in Kanpur, 361 in Ahmedabad, and 265 in Madurai totalling 2,734 households. The cities were categorised according to five different areas, (i) high income group (HIG) areas with well planned buildings, (ii) middle income group (MIG) areas with well planned buildings, (iii) low income group (LIG) areas with well planned buildings, (iv) slum areas, and (v) mixed areas. Within these identified clusters, a random sampling of households from electoral rolls was undertaken. In each of these cities, several clusters of the same kinds of areas can be found, hence from each cluster at least eight interviews were conducted. The data was collected through a structured schedule and the target respondents were housewives. The volume of vessels in which households stored water was measured and the number of vessels of water used in different activities was ascertained. Where running tap or piped water was used in some activities, the duration for which the tap was used was arrived at and the quantity of water per minute coming out from the tap was measured. By multiplying the time with the quantity of water per minute, the volume of water used through running taps was estimated. The quantity of water used in a toilet was assessed by volume of bucket used, and flush tank capacity.

Households were classified in various economic classes, such as the "very poor", "poor", "lower", "middle" and "upper" classes.

We assigned certain weights to the assets possessed by households, and by summing up the scores for each asset, the "asset score" for a household was arrived at. The assets for which data were collected and the weights assigned to them are as follows: four-wheeler/car (weight 5.0), refrigerator (2.0), washing machine (2.0), microwave oven (2.0) three/two-wheeler (1.5), colour-television (1.5), computer/laptop (1.0), music devices like cd/dvd/vcd/MP3 player (0.5), internet connection (0.5), black and white television (0.5), mobile phone (0.5), cable for television (0.25), and radio/tape recorder (0.25). The following ranges of asset scores were used to classify the households in the above mentioned economic/asset classes. (1) Very poor class: asset score 0.00 (has no assets on which data is collected). (2) Poor class: asset score between 0.01 to 0.99 (at least has radio/tape recorder and/or black and white television). (3) Lower class: asset score between 1.00 to 4.99 (at least has black and white television, radio/tape recorder, cable, mobile phone, or some of them with other assets). (4) Middle class: asset score between 5.00 to 9.99 (at least has colour-television, refrigerator, washing machine or some of them with other assets). (5) Upper class: asset score 10.00 and above (at least has four-wheeler, refrigerator, washing machine and colour television, or some of them with other assets).

The annual income data of households were also collected. The Pearson correlation coefficient between the household asset score and income was found to be 0.722 (p-value 0.0001). However, we have used the household assets score rather than monthly income for classifying households in various economic categories, as there is a greater possibility of under or over reporting of income. Besides categorising households on the basis of asset score, we have also classified the households in five socio-economic classes (SEC)[1] based on education and occupation of the main wage earner of the household. These five SEC classes are SEC-A, SEC-B, SEC-C, SEC-D and SEC-E.

## II
## Water Required for Different Activities

A number of factors like climate, culture, food habits, work and working conditions, level and type of development, and physiology determine the requirement of water. As per the Bureau of Indian Standards, IS:1172-1993, a minimum water supply of 200 litres per capita per day (lpcd) should be provided for domestic consumption in cities with full flushing systems. IS:1172-1993 also mentions that the amount of water supply may be reduced to 135 lpcd for the LIG and the economically weaker sections (EWS) of the society and in small towns [Modi 1998].

Besides domestic requirement, water is also demanded for commercial, industrial, and civic or public use. The IS:1172-1993 gives the total requirement of water in industrial and commercial towns with full-flushing system as 280 lpcd. The Ninth Plan (1997-2002) had advocated the requirement of water in urban areas as 125 lpcd in cities with planned sewerage systems; 70 lpcd in cities without planned sewerage systems; and 40 lpcd for those collecting water from public stand-posts. However, in the Tenth Plan (2002-07), the cities with planned sewerage systems are classified into two groups based on population, i e, metropolitan or megacities and non-metropolitan cities. In the former, the recommended minimum water supply level is 150 lpcd and in the latter 135 lpcd. [Government of India 1997, 2002]. The National Commission on Urbanisation (1988) recommended that a per capita water supply of 90-100 litres per day is needed to lead a hygienic existence, and emphasised that this level of water supply must be ensured to all citizens [quoted in Ramachandraiah 2001].

Notwithstanding the IS:1172-1993 and the Five-Year Plan recommendations, we find that almost every municipal corporation/municipality has defined the requirement of water per capita per day in its own way. One agrees that industrial and commercial development of towns and cities may differ and hence the amount of water required will also vary, but the requirement for domestic use seems unlikely to vary so much. The municipal corporation of greater Mumbai (MCGM) advocates 135 lpcd as the domestic requirement of water, but the Delhi Development Authority (DDA) considers 225 lpcd per day as the water required for domestic use. The DDA further assess as a water requirement of another 75 lpcd for industrial, commercial and civic or public use, thus making the total requirement of water in Delhi 300 lpcd. This wide variation in recommendations/prescriptions for domestic use of water seems inexplicable, particularly when both the megacities have well-developed sewerage/flushing systems.

The World Health Organisation (WHO) classifies the supply and access to water in four service categories. These categories are: (i) no access (water available below 5 lpcd); (ii) basic access (average approximately 20 lpcd); (iii) intermediate access (average approximately 50 lpcd); and (iv) optimal access (average of 100-200 lpcd) [WHO 2003; see also Bartram 2003]. Considering the fact that various agencies recommend different quantities of requirement of water for domestic use, we have taken 100 lpcd consumption (or availability, as consumption is determined by availability) as a benchmark for identifying water deficient households. It must be noted here that there is no strong basis for this benchmark but it is a rough average requirement in order to maintain a minimum standard of health and hygiene.

## III
## Domestic Consumption of Water

It is important to note here, and this will be amply clear later, that the quantity of water consumed in most of the Indian cities is not determined by the demand but the supply. People attempt

**Table 1: Domestic Water Consumption Per Household and Per Capita Per Day**
*(in litres)*

| Cities | Per Household | | Per Capita | |
|---|---|---|---|---|
| | Mean | Std Deviation | Mean | Std Deviation |
| Delhi | 377.7 | 256.8 | 78.0 | 49.9 |
| Mumbai | 406.8 | 158.6 | 90.4 | 32.6 |
| Kolkata | 443.2 | 233.6 | 115.6 | 64.9 |
| Hyderabad | 391.8 | 172.0 | 96.2 | 43.8 |
| Kanpur | 383.7 | 286.2 | 77.1 | 58.2 |
| Ahmedabad | 410.9 | 224.1 | 95.0 | 54.6 |
| Madurai | 363.1 | 182.1 | 88.2 | 44.4 |
| Total | 398.3 | 220.20 | 91.56 | 51.51 |

*Source:* Calculated using data from field survey.

to adjust to the quantity (as well as quality) of water supplied. The 54th round of National Sample Survey Organisation (NSSO) data reveal that 80 per cent of the households in urban India, across different segments, consider that they have sufficient water supply [Bajpai and Bhandari 2001], while the present study finds that about 71 per cent of the households in these seven cities consider the water supply adequate. The city-wise figures are 73 per cent in Delhi, 77 per cent each in Mumbai and Kolkata, 49 per cent in Hyderabad, 75 per cent in Kanpur, 63 per cent in Ahmedabad and 82 per cent in Madurai. In reality, this shows nothing but an adjustment made by people to the supply such that they do not feel that more water is needed. This, in turn, creates hygiene and sanitation problems resulting in several health consequences.

Table 1 shows per household as well as per capita consumption of water in seven major cities in the country. It is very obvious from the table that in all the cities, the consumption (indication of availability) of water per capita is much lower than what is recommended by the Bureau of Indian Standard and the Tenth Five-Year Plan. Moreover, it is even lower than the recommended level for LIG colonies and weaker section households. The data is also an indication of the lower public hygiene and sanitation conditions in Indian cities. The average per capita water consumption in domestic households for all the seven cities is about 92 lpcd. The highest consumption is in Kolkata (116 lpcd), followed by Hyderabad (96 lpcd), Ahmedabad (95 lpcd), Mumbai (90 lpcd), Madurai (88 lpcd), Delhi (78 lpcd), and Kanpur (77 lpcd). It is surprising to find that in Delhi water consumption is so low when Delhi Jal Board claims that it supplies, on an average, 211 lpcd per household. Similarly, the Brihanmumbai Municipal Corporation (BMC) claims a supply of 198 lpcd (total water supply to the city 2,950 million litres per day – less 20 per cent lossess), but the consumption in Mumbai, as mentioned above, is only about 92 lpcd. Compared internationally, Indian cities consume for less water. For example, domestic water consumption in Munich is 130 lpcd, in Amsterdam it is 156 lpcd and in Singapore it is 162 lpcd [Down to Earth 2005].

Overall, in terms of per capita consumption of water, the condition in the two north Indian cities of Delhi and Kanpur seems the worst. The dispersion statistics (standard deviation) also show that wide variations in per capita consumption of water exist in these cities. Further, despite the highest level of water consumption, Kolkata also has wide variation in consumption of water per capita. In terms of the variation, Kanpur, Ahmedabad and Delhi follow Kolkata.

It is not that the consumption is lower only in LIG areas and slums in major Indian cities; in HIG and MIG areas the consumption is also constrained. Table 2 shows that where slum areas in the seven selected cities consume, on an average, about 82 lpcd, it is only about 100 lpcd and 94 lpcd in the case of HIG and MIG areas respectively. LIG areas consume only about 90 lpcd.

Further, the analysis reveals that although there are socio-economic classwise variations in the consumption of water, the variations are not very significant (Table 3). Thus, the supply side constraints are responsible for a high degree of equality in consumption of water in Indian cities. For example, where the SEC-E consumes 78.9 lpcd, it is 102.1 and 95.2 lpcds for the SEC-A, and SEC-B, respectively.

In these seven cities, a very small proportion of population consumes water above 100 lpcd. As shown in Table 4, only about 35 per cent of the total population in the cities consumes water above 100 lpcd. There also exist wide variations in the proportion of households in different cities consuming water above 100 lpcd.

Kanpur has the dubious distinction of least consumption with more than a third of the population using water below 50 lpcd.

As mentioned earlier, the consumption of water is low not only in LIG and slum areas of these cities but also in HIG and MIG areas. Table 5 shows interesting results in that the water consumption among different areas in a city is not very different from each other, except that the model class of consumption for HIG, MIG and LIG areas is formed by the consumption class of 75-100 lpcd, and in the case of slums and mixed areas, 50-75 lpcd. However, where 23.4 per cent of the population in HIG areas uses water above 135 lpcd, in slum areas only 9.6 per cent

**Table 2: Area-wise Consumption of Water Per Household and Per Capita Per Day**
*(In litres)*

| Area | Per Household | | Per Capita | | N |
|---|---|---|---|---|---|
| | Mean | Std Deviation | Mean | Std Deviation | |
| High income group (HIG) areas with well planned building | 402.5 | 230.3 | 99.9 | 59.8 | 551 |
| Middle income group (MIG) areas with well planned building | 396.4 | 248.6 | 94.2 | 57.6 | 571 |
| Low income group (LIG) areas with well planned building | 393.5 | 176.4 | 90.2 | 40.6 | 552 |
| Slum areas | 398.7 | 216.8 | 81.9 | 41.1 | 530 |
| Others (mixed areas) | 400.5 | 222.0 | 91.3 | 53.1 | 530 |
| Total | 398.3 | 220.2 | 91.6 | 51.5 | 2734 |

*Source:* As for Table 1.

**Table 3: Socio-economic Class-wise Consumption of Water Per Household and Per Capita Per Day**
*(in litres)*

| Socio-economic Class | Per Household | | Per Capita | | N |
|---|---|---|---|---|---|
| | Mean | Std Deviation | Mean | Std Deviation | |
| SEC- A | 407.1 | 233.3 | 102.1 | 62.8 | 639 |
| SEC- B | 399.2 | 239.0 | 95.2 | 56.7 | 684 |
| SEC- C | 399.9 | 213.9 | 88.4 | 42.0 | 619 |
| SEC- D | 390.0 | 198.7 | 84.9 | 41.1 | 461 |
| SEC- E | 387.9 | 192.5 | 78.9 | 39.3 | 331 |
| Total | 398.3 | 220.2 | 91.6 | 51.5 | 2734 |

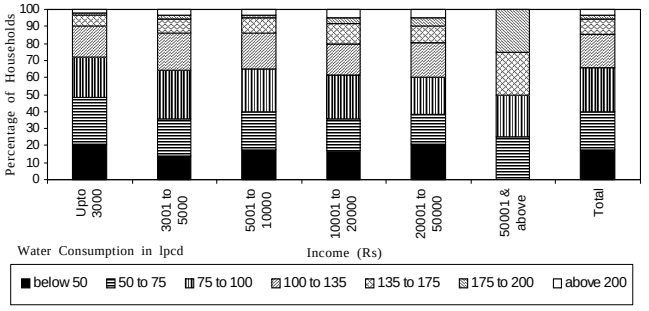
*Source:* As for Table 1.

**Table 4: Water Consumption Category-wise Distribution of Households**
*(Per cent)*

| Litres/ Capita/ Day | All 7 Cities | Cities | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Delhi | Mumbai | Kol-kata | Hydera-bad | Kanpur | Ahmeda-bad | Madu-rai |
| Below 50 | 17.5 | 29.8 | 5.4 | 11.8 | 9.0 | 33.7 | 19.4 | 17.0 |
| 50 to 75 | 22.6 | 22.1 | 29.4 | 13.5 | 21.6 | 24.4 | 20.8 | 26.4 |
| 75 to 100 | 25.3 | 20.7 | 34.2 | 22.0 | 32.4 | 17.2 | 21.9 | 26.0 |
| 100 to 135 | 20.2 | 17.2 | 23.6 | 24.3 | 23.4 | 14.2 | 18.8 | 17.4 |
| 135 to 175 | 8.7 | 5.3 | 5.0 | 15.0 | 8.3 | 6.9 | 12.7 | 10.2 |
| 175 to 200 | 2.2 | 2.2 | 1.4 | 4.8 | 2.3 | 1.3 | 2.2 | .8 |
| Above 200 | 3.4 | 2.8 | 1.0 | 8.8 | 3.0 | 2.3 | 4.2 | 2.3 |
| Total | 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* As for Table 1.

**Figure 1: Monthly Incomewise Distribution of Households in Various Water Consumption Categories in Seven Major Cities**




*Source:* As for Table 1.

of population uses water above 135 lpcd. The consumption of water by various socio-economic classes shows that although a sizeable proportion of households in all the classes consume water below 50 lpcd, it is in the SEC-E that consumption is very low. More than one-quarter of households in this class consumes water below 50 lpcd (Table 6). Also, as compared to 23.3 per cent of the SEC-A consuming above 135 lpcd, it is only 8.1 per cent of the population in SEC-E which consumes water above this limit. The consumption patterns by socio-economic classes largely correspond with consumption based on the asset classes. Whereas 25.7 per cent of the population in SEC-E consumes below 50 lpcd, 28.1 per cent of the population in the "very poor" category consumes water below this figure (Table 7).

Inadequate water supply in Indian cities seems to be a rule rather than an exception. Even if we take 100 litres per capita per day as the criterion for defining water deficient and sufficient households, 65 per cent of the sample households remain water deficient. The proportion of deficient households is the highest in Kanpur (75.2 per cent), followed by Delhi (72.6 per cent). In fact except Kolkata, in all the other cities, over 60 per cent households are water deficient. Analysis shows that households with monthly income up to Rs 3,000 suffer the most as about 72 per cent of such households are found to be water deficient (Figure 1). Area-wise classification of water deficient households (Table 8) shows, as expected, that these are slum areas which have the largest percentage of water deficient households in all the cities. In Ahmedabad and Kanpur, the percentages of water deficient slum households are as high as 86.1 per cent and 82.1 per cent respectively, while it ranges between 70 per cent to 75 per cent in the case of Delhi, Mumbai, and Hyderabad. Among the cities, the least percentage of water deficient households are found in Kolkata (47.3 per cent). Per capita water consumption in different areas, asset-classes and SECs of households are highly correlated with each other, as they have very similar percentages of water deficient/sufficient households (see Tables 5, 6, and 7).

## IV
## Activity-wise Consumption of Water

At the household level, bathing consumes the highest amount of water, in all the seven cities, at about 28 per cent of total consumption (Table 9). This is followed by consumption in toilets (20 per cent), washing clothes (18.6 per cent) and washing utensils (16.3 per cent). On an average, less than 10 per cent of the total water in a household is used for drinking and cooking. Table 10 shows activity-wise share of water consumption for various SECs.

## V
## Sources and Perception about Safety of Water

A majority of households in major cities in India depend on the municipal water supply for their daily needs. The 54th round NSSO data show that 70.1 per cent of the households in urban India depend on tap water (municipal supply), 21.4 per cent on tube wells, 6.7 per cent on wells/open wells, and the rest on other sources [Bajpai and Bhandari 2001]. However, the present study shows that as high as 92 per cent of the households in

**Table 5: Area and Consumption Category-wise Distribution of Households**
*(Per cent)*

| Litres/ Capita/Day | Area | | | | |
|---|---|---|---|---|---|
| | High Income Group Area with Well Planned Building | Middle Income Group Area with Well Planned Building | Low Income Group Area with Well Planned Building | Slum Area | Others (a Mixed Area) |
| Below 50 | 19.8 | 17.7 | 13.2 | 21.3 | 15.5 |
| 50 to 75 | 16.3 | 20.5 | 23.4 | 27.0 | 26.2 |
| 75 to 100 | 21.2 | 26.4 | 31.0 | 24.2 | 23.8 |
| 100 to 135 | 19.2 | 20.0 | 21.4 | 17.9 | 22.5 |
| 135 to 175 | 12.9 | 8.4 | 7.6 | 6.2 | 8.5 |
| 175 to 200 | 3.8 | 2.1 | 1.4 | 2.3 | 1.3 |
| Above 200 | 6.7 | 4.9 | 2.0 | 1.1 | 2.3 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* As for Table 1.

**Table 6: Socio-economic and Consumption Category-wise Distribution of Households**
*(Per cent)*

| Litres/Capita/ Day | Socio-economic Category | | | | |
|---|---|---|---|---|---|
| | SEC-A | SEC-B | SEC-C | SEC-D | SEC-E |
| Below 50 | 18.0 | 17.7 | 14.1 | 15.2 | 25.7 |
| 50 to 75 | 17.7 | 19.3 | 25.5 | 27.5 | 26.6 |
| 75 to 100 | 22.2 | 24.9 | 27.8 | 29.1 | 22.7 |
| 100 to 135 | 18.8 | 21.9 | 21.6 | 20.0 | 16.9 |
| 135 to 175 | 13.1 | 9.6 | 7.6 | 5.4 | 5.1 |
| 175 to 200 | 2.8 | 3.4 | 1.1 | 1.1 | 2.1 |
| Above 200 | 7.4 | 3.2 | 2.3 | 1.7 | .9 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* As for Table 1.

**Table 7: Asset and Consumption Category-wise Distribution of Households**
*(Per cent)*

| Litres/Capita/ Day | Asset Class | | | | |
|---|---|---|---|---|---|
| | Very Poor | Poor | Lower | Middle | Upper |
| Below 50 | 28.1 | 16.7 | 13.1 | 21.5 | 21.7 |
| 50 to 75 | 23.1 | 25.9 | 25.3 | 18.8 | 15.8 |
| 75 to 100 | 24.0 | 28.4 | 25.9 | 24.1 | 22.2 |
| 100 to 135 | 15.7 | 19.5 | 22.6 | 18.8 | 16.3 |
| 135 to 175 | 5.0 | 6.2 | 8.6 | 9.5 | 13.1 |
| 175 to 200 | 1.7 | 1.7 | 1.9 | 2.6 | 3.6 |
| Above 200 | 2.5 | 1.5 | 2.6 | 4.8 | 7.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* As for Table 1.

the seven major Indian cities under focus are using municipal water supply (tap water). Of this 92 per cent of the population, 9.5 per cent are dependent on community taps and the rest (90.5 per cent) on their own private taps provided by municipalities (Table 11). The proportion of households using community tap water is lower in this study than the 54th round figures of NSSO mainly because the latter covered all the urban areas in the country while the present study covers only seven major cities having relatively developed water infrastructure. Table 11 also shows that some households are using water from not multiple sources. Although, as mentioned above, about 92 per cent of the households use municipal tap water supply, the proportion of the households dependent only on this source is significantly lower in all the cities, except in Mumbai. The gap between the share of households using municipal tap water and the share of households dependent only on this source is very high in Madurai, Hyderabad, Kanpur, Ahmedabad, and Kolkata. This indicates a lack in reliability, regularity, and sufficiency of water supply through municipal taps. Mumbai seems to be the only exception among the seven cities, as in this city only about 5.6 per cent of the total households are dependent on sources other than municipal tap water supply. Overall, in all these seven cities about two-fifth of the households use groundwater, and about 7 per cent are solely dependent on this source. Thus, the second largest source of water for a majority of households in major cities in the country is groundwater. The rapid increase of population in these cities is making people more dependent on it leading to a rapid decline in groundwater table. Delhi, Hyderabad and Kanpur are suitable examples in this regard [Soni 2003].

Households in these cities also face wide seasonal fluctuations in municipal tap water supply. More than 85 per cent of the households in these cities say that shortage in water supply becomes acute during summer. The seasonal variations in municipal tap water supply leads to ground water exploitation by households as this is seen as the easiest, fastest and to an extent, a durable "solution" to the water crisis. This overuse of groundwater resources has lead to increase in arsenic concentration in many wards in Kolkata, and similarly fluoride concentration in majority of cities and towns in Rajasthan and Gujarat.

About 11 per cent of the households in Hyderabad are dependent on tanker water supply. Out of this, 46 per cent are dependent on private tankers. About 2 per cent of the households in Delhi and 1.1 per cent in Madurai are also using tanker water supply. The packaged/mineral water, particularly for drinking purposes is also making inroads into urban households. Kolkata seems to be an exception as none of the surveyed households in the city reported using packaged water for drinking purpose. It is interesting to note that although about 10 per cent of the households in Kolkata say that the water is "not so safe" and "not safe at all", and about 26 per cent express their inability to say anything about the quality of tap water supplied by the municipal corporation, none of these households report using packaged/mineral water (Table 12). Table 12 also shows that only about 40 per cent of the households in Kolkata view municipal water as "quite safe" or "very safe". In Madurai, Mumbai and Delhi, about 74 per cent, 65 per cent and 52 per cent of the households respectively, view municipal water supply quite safe and very safe, but in the case of Kanpur, only about 11 per cent say so. Thus, one finds that a sizeable share of households do not consider municipal tap water as safe or very safe for drinking.

A study by Karn et al (2003) in some selected slums in Mumbai shows that the percentage of households boiling water before consumption varies from slum to slum: the highest being 14 per cent, and the lowest 5 per cent. However, the present study shows that about 12 per cent of the slum households boil water before consumption, 80 per cent filter it by cloth, and remaining 8 per cent do not use any purification method before consumption. In Delhi's slums, about 9 per cent of the households filter the water before its consumption, 6 per cent boil it and 85 per cent use no purification methods. In Kolkata, about 78 per cent of the slum households use no purification method. In Kanpur, none of the households in slum areas reported using any water purification methods.

**Table 8: Percentage of Water Deficient Households in Different Areas (Consuming Below 100 lpcd)**

| Areas | All 7 Cities | Delhi | Mumbai | Kol-kata | Hydera-bad | Kanpur | Ahmeda-bad | Madu-rai |
|---|---|---|---|---|---|---|---|---|
| HIG areas | 57.3 | 68.4 | 48.8 | 39.8 | 64.6 | 75.0 | 42.5 | 66.7 |
| MIG areas | 64.6 | 78.1 | 69.2 | 42.1 | 61.7 | 66.1 | 56.3 | 76.8 |
| LIG areas | 67.4 | 71.7 | 76.2 | 55.7 | 61.7 | 70.2 | 69.2 | 66.7 |
| Slum areas | 72.5 | 72.4 | 74.1 | 58.1 | 65.4 | 82.1 | 86.1 | 70.0 |
| Mixed areas | 65.5 | 72.0 | 73.1 | 40.5 | 62.0 | 82.8 | 57.8 | 67.3 |
| Total | 65.4 | 72.6 | 69.0 | 47.3 | 63.1 | 75.2 | 62.0 | 69.4 |

*Source:* As for Table 1.

**Table 9: Activity-wise Distribution of Water Consumption in Cities**

(Per Cent of Total Consumption by Households/Day)

| Activity | All 7 Cities | Delhi | Mumbai | Kol-kata | Hydera-bad | Kanpur | Ahmeda-bad | Madu-rai |
|---|---|---|---|---|---|---|---|---|
| Bathing | 28.2 | 31.7 | 23.7 | 37.1 | 25.6 | 29.1 | 22.8 | 26.6 |
| Washing clothes | 18.6 | 14.2 | 24.3 | 14.0 | 20.9 | 16.3 | 21.4 | 18.9 |
| Drinking | 4.2 | 5.0 | 4.2 | 2.6 | 4.3 | 3.8 | 4.9 | 4.9 |
| Cooking | 3.0 | 3.7 | 1.7 | 2.3 | 3.1 | 3.2 | 3.3 | 4.2 |
| Toilets | 20.0 | 16.5 | 21.6 | 15.9 | 24.1 | 20.1 | 19.1 | 25.7 |
| Cleaning house | 7.3 | 7.0 | 6.6 | 11.7 | 3.5 | 5.7 | 12.4 | 1.9 |
| Washing utensils | 16.3 | 16.5 | 17.4 | 16.1 | 16.5 | 15.4 | 15.2 | 16.1 |
| Others | 2.4 | 5.6 | 0.5 | 0.3 | 2.0 | 6.3 | 0.9 | 1.7 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* As for Table 1.

**Table 10: Activity-wise Consumption (Per Cent) of Water in the Domestic Household Level**

| Activity | SEC-A | SEC-B | SEC-C | SEC-D | SEC-E |
|---|---|---|---|---|---|
| Bathing | 29.0 | 26.4 | 28.2 | 28.9 | 29.9 |
| Washing clothes | 19.6 | 19.3 | 18.3 | 17.4 | 17.3 |
| Drinking | 3.9 | 4.2 | 4.3 | 4.4 | 4.5 |
| Cooking | 2.9 | 3.1 | 3.0 | 3.0 | 2.9 |
| Toilets | 17.0 | 19.0 | 21.6 | 22.4 | 21.9 |
| Cleaning house | 8.0 | 8.1 | 6.7 | 6.7 | 6.0 |
| Washing utensils | 16.4 | 16.4 | 16.2 | 16.0 | 16.5 |
| Others | 3.2 | 3.6 | 1.7 | 1.2 | 1.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* As for Table 1.

## VI
## Duration of Water Supply and Distance of Source of Water

Cleanliness of municipal water in Indian cities is not the only issue, the supply is also very erratic and for a very limited duration. A basic need and service like tap water for 24 hours a day has been unheard of for decades in most Indian towns [ADB 1993]. As the supply is highly erratic and for a very limited duration, the households and housing societies store water in their tanks and drums. In the seven cities, about 18 per cent of the households who reported using municipal tap water supply, stated that the tab water supply was available for 24 hours, while about 25 per cent and 27 per cent claimed that it was available for a few hours (less than 4 hours) twice a day, and once in a day, respectively (Table 13). About 21 per cent of the households in these cities report that tap water comes for a few hours in two days. Hyderabad, has the dubious distinction that about 90 per cent of households in the city report that tap water is supplied only for a few hours once in two days. In Kanpur, the situation is worse, where more than two-fifths of the households inform that the supply of municipal tap water is not predictable at all.

Only about 68 per cent of the total population in the seven cities under focus have a source of water supply within their premises. The 54th round NSSO data also reveals that a total 65.7 per cent of the households in urban India have a source of water supply within their dwelling or premises [Bajpai and Bhandari 2001]. There is a wide variation among the cities in terms of location of the source of water. Where about 62 per cent of the households have the source of water outside the dwelling and premises in Kanpur and 50 per cent in Kolkata in Mumbai, only about 13 per cent of the households have a source of water outside their premises. In Ahmedabad and Delhi, about one-fifth and one-fourth of the total households collect water from outside their residential premises respectively.

Table 14 shows that among the households (in the seven cities) which have their source of water outside their premises, about two-thirds make up to two trips to collect water sufficient for consumption for a day. City-wise analysis indicates that about one-half of the total households in Delhi, Mumbai, Hyderabad, Ahmedabad, and Madurai make three and even more trips to bring sufficient water for their daily consumption. Overall, the source of water for a majority of households is located near the residence, as it takes less than 5 minutes for more than 80 per cent of the households to make a trip for water collection.

## VII
## Rainwater Harvesting

The awareness about rainwater harvesting is also spreading fast in urban India. In all the seven cities, where about 64 per cent of the households belonging to SEC-A are aware of rainwater harvesting, only about 29 per cent of households in SEC-E are aware of such methods.

In fact in this city, none of the households belonging to SEC-D and SEC-E reported that they knew of rainwater harvesting. Ahmedabad, Kanpur and Delhi face a perpetual problem of water shortage and the tragedy is that in these cities a very limited proportion of households are aware of rainwater harvesting methods. Awareness leads to adaptation, and so the local and state governments need to put special emphasis to spread awareness about various methods of water conservation and management.

It is found that about 73 per cent of the total households covered by the present study in Madurai practise rainwater harvesting, while together in all the seven cities only about 10 per cent of the households do so. In fact in Delhi, Kolkata, Hyderabad, Kanpur, and Ahmedabad, the share of total households practising rainwater harvesting methods is negligible (1 per cent or below)

**Table 12: Perception of Households (Per Cent) about the Quality of Water from Municipal Taps**

| Safety Level | All 7 Cities | Delhi | Mumbai | Kolkata | Hyderabad | Kanpur | Ahmedabad | Madurai |
|---|---|---|---|---|---|---|---|---|
| Not safe at all | 2.9 | 2.96 | .20 | 3.25 | 2.76 | 9.90 | 1.11 | 1.89 |
| Not so safe | 5.0 | 6.71 | 2.40 | 6.50 | 3.02 | 12.54 | 2.49 | 1.89 |
| Somewhat safe | 21.5 | 30.97 | 28.40 | 24.25 | 12.06 | 20.46 | 7.20 | 21.13 |
| Quite safe | 28.6 | 30.97 | 31.80 | 15.50 | 22.36 | 10.23 | 43.49 | 47.55 |
| Very safe | 25.6 | 20.51 | 33.60 | 24.25 | 57.04 | .99 | 9.14 | 26.04 |
| Cannot say | 16.8 | 7.89 | 3.60 | 26.25 | 2.76 | 45.87 | 36.57 | 1.51 |
| Total | 100.0 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

*Source:* As for Table 1.

**Table 11: Dependence of Household (Per Cent) on Various Sources of Water (Multi-Source Possible)**

| Source | All 7 Cities | Delhi | Mumbai | Kolkata | Hyderabad | Kanpur | Ahmedabad | Madurai |
|---|---|---|---|---|---|---|---|---|
| 1 Municipal tap water | 92.0 | 91.9 | 98.6 | 98.8 | 99.7 | 54.1 | 94.2 | 98.5 |
| – of which community tap | 9.5 | 8.1 | 1.5 | 1.9 | 0.3 | 45.9 | 20.0 | 1.5 |
| *Depend only on Municipal Tap water* | 57.6 | 71.4 | 94.4 | 68.5 | 39.7 | 15.5 | 59.6 | 17.7 |
| 2 Groundwater | | | | | | | | |
| a Tube well/hand-pumps | 38.1 | 24.5 | 3.6 | 27.8 | 48.5 | 79.2 | 38.5 | 81.1 |
| – of which private tube-well/hand-pumps | 24.0 | 6.3 | 3.6 | 1.0 | 41.8 | 36.4 | 37.2 | 76.7 |
| b Well/open well | 1.0 | 0.2 | 0.6 | 2.8 | 3.3 | | | |
| Depend only on groundwater | 6.9 | 7.5 | | 1.3 | 0.3 | 40.6 | 5.0 | 1.5 |
| 3 Tanker | 2.1 | 2.0 | | 0.5 | 10.6 | | | 1.1 |
| – of which municipal tankers | 59.3 | 60.0 | | 100.0 | 54.5 | | | 100.0 |
| 4 River/canal /tank | 0.4 | | | 2.8 | | | | |
| 5 Packaged/mineral water | 0.8 | 2.2 | 1.0 | | 0.5 | 0.3 | 0.2 | 1.5 |
| 6 Others (railways supply, broken pipes, mill compounds, etc) | 1.1 | 0.2 | 0.6 | | | 5.3 | 2.5 | |

*Source:* As for Table 1.

while in Mumbai, it is 8.8 per cent. However, quite a contrast is seen in the case of Madurai. The success of rainwater harvesting in Madurai can be attributed to NGOs working in this area and also to efforts made by the state and local governments. The efforts of the Tamil Nadu government towards spreading awareness and encouraging the practice of rainwater harvesting has been commendable. The Madurai Municipal Corporation Act 1971 was amended in 2003 for making rainwater harvesting structures mandatory to every building owned by the government and other statutory bodies.

Of the households practising rainwater harvesting, about 98 per cent reported harvesting 500-100 litres in Madurai in a season. In Mumbai, 85 per cent of the households harvested below 50 litres in a season. Largely, for these households, the capacity of storage tank determines the quantity of harvested water. Discussions with such households revealed that in the rainy season they collect water in drums and utensils and use it mainly for toilet and washing clothes and utensils.

## VIII
## Summary and Conclusions

Although recycled by nature, fresh water is a limited resource. High water consuming economic activities and population growth are responsible for declining per capita water availability. Increased consumption more so by the "privileged," puts further pressure on this diminishing natural resource. Indian cities have been appropriating water resources traditionally meant for "subsistence" in rural areas. This process stands accelerated due to a high degree of migration of the rural people to large cities in search of livelihood. The urban population is quite large in sheer numbers, viz, around 290 millions. This would need a systematic augmentation of water supply to urban areas, without threatening the available water resources for rural areas.

The key observations of the study are summarised here:

It is observed that water consumption in Indian cities (more so in large cities) is far lower than the norms laid down by the Bureau of Indian Standards. The lower consumption is mainly because the water supply is not keeping pace with population growth and increasing needs of users.

It is interesting to observe that though a majority of households consume water below the specified norms, by and large, they show satisfaction with available supply. This is mainly because they have limited their aspirations and requirements of water in relation to available supply from the municipalities or water authorities.

Some household activities, like washing clothes, bathing, use in toilets, and washing dishes and utensils are the most intensive water consuming activities in the cities. It has also been found

**Table 14: Distribution by Households (to Total) of Number of Trips for Collection of Water from Outside**

*(In per cent)*

| No of Trips | All 7 Cities | Delhi | Mumbai | Kol-kata | Hydera-bad | Kanpur | Ahmeda-bad | Madu-rai |
|---|---|---|---|---|---|---|---|---|
| 1 | 9.6 | 6.3 | 2.4 | 23.5 | 8.5 | 14.5 | 5.5 | 10.2 |
| 2 | 9.3 | 8.1 | 4.0 | 17.3 | 1.8 | 25.1 | 5.8 | 7.2 |
| 3 | 3.5 | 3.4 | 1.4 | 3.0 | 3.8 | 8.6 | 2.8 | 3.8 |
| 4 | 2.3 | 3.4 | 0.8 | 1.5 | 0.8 | 6.9 | 1.1 | 3.0 |
| 5 | 4.1 | 3.2 | 1.8 | 2.5 | 5.3 | 3.0 | 2.8 | 14.0 |
| 6 | 1.2 | 1.0 | 0.4 | 1.5 | 2.0 | 2.0 | 0.3 | 1.9 |
| 7 | 0.6 | 0.4 | 1.2 | 0.5 | 0.5 | 0.3 | 0.8 | 0.4 |
| 8 | 1.0 | 0.6 | 0.8 | 0.5 | 1.3 | 1.3 | 1.1 | 2.3 |
| 9 | 0.04 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| Total (per cent) | 31.7 | 26.4 | 12.8 | 50.3 | 24.0 | 62.0 | 20.2 | 42.8 |

*Source:* As for Table 1.

**Table 15: Percentage Distribution of Households by Time Taken for a Trip to Collect Water from Outside**

*(In per cent)*

| Time | All 7 Cities | Delhi | Mumbai | Kol-kata | Hydera-bad | Kanpur | Ahmeda-bad | Madu-rai |
|---|---|---|---|---|---|---|---|---|
| 1 to 5 minutes | 26.0 | 18.1 | 8.6 | 45.8 | 19.8 | 59.4 | 14.1 | 32.1 |
| 6 to 10 minutes | 3.6 | 5.5 | 1.0 | 1.5 | 3.0 | 2.6 | 5.3 | 7.9 |
| 11 to 15 minutes | 0.7 | 1.6 | 0.2 | 0.3 | 1.2 | | | 1.5 |
| 16 to 20 minutes | 0.3 | 0.4 | | 0.5 | | | 0.8 | |
| 21 to 30 minutes | 0.9 | 0.6 | 1.8 | 2.3 | | | | 1.3 |
| Above 30 minutes | 0.2 | | 1.2 | | | | | |
| Total | 31.7 | 26.4 | 12.8 | 50.3 | 24.0 | 62.0 | 20.2 | 42.8 |

*Source:* As for Table 1.

**Table 16: Awareness of Households (Per Cent) about Rain Water Harvesting in Different SEC**

| SEC | All 7 Cities | Delhi | Mumbai | Kol-kata | Hydera-bad | Kanpur | Ahmeda-bad | Madu-rai |
|---|---|---|---|---|---|---|---|---|
| SEC-A | 63.8 | 58.1 | 59.1 | 77.0 | 71.6 | 55.8 | 32.3 | 98.0 |
| SEC-B | 45.6 | 24.3 | 49.5 | 70.0 | 51.0 | 47.0 | 12.4 | 98.0 |
| SEC-C | 40.7 | 10.0 | 49.3 | 48.1 | 48.3 | 35.6 | 5.7 | 70.1 |
| SEC-D | 41.2 | 8.7 | 50.9 | 49.2 | 36.2 | 18.2 | | 73.3 |
| SEC-E | 28.7 | 5.3 | 54.9 | 43.6 | 21.3 | 7.8 | | 76.4 |
| Total | 46.0 | 24.5 | 51.8 | 62.0 | 53.0 | 35.0 | 12.7 | 83.2 |

*Source:* As for Table 1.

**Table 13: Availability of Tap Water to Households (Per Cent) in Indian Cities**

| Supply | All 7 Cities | Delhi | Mumbai | Kolkata | Hyderabad | Kanpur | Ahmedabad | Madurai |
|---|---|---|---|---|---|---|---|---|
| 24 hours/round the clock | 17.9 | 13.6 | 5.0 | 47.3 | 0.3 | 5.6 | 50.1 | 2.6 |
| For a few hours once in a day | 27.0 | 15.4 | 84.4 | 2.8 | 7.0 | 7.3 | 38.5 | 14.7 |
| For a few hours twice a day | 24.9 | 64.3 | 7.4 | 39.3 | | 44.2 | 6.4 | 1.5 |
| Once in two days | 20.7 | | 0.2 | | 88.9 | | 2.2 | 77.0 |
| Once in four days | 0.0 | | | | | | | 0.4 |
| Once in a week | 0.2 | | | | | | | 3.4 |
| Not predictable | 1.8 | 3.7 | 2.8 | 0.5 | 2.0 | 1.7 | | |
| Cannot say | 7.3 | 3.0 | 0.2 | 10.3 | 1.8 | 41.3 | 2.8 | 0.4 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* As for Table 1.

that in these cities, a majority of the households perceive these activities as the most wasteful. This shows that given appropriate and affordable technologies to save water in specified activities, the households would be willing to adopt them. In fact, there exists large scope for reducing water consumption in washing clothes by adopting appropriate soap/detergent and machines; and in toilets by changing and modifying the flushing system. An awareness campaign about the best practices in these activities can play a big role in conserving water.

It is found that information availability is highly class-biased in large cities in India. Rain water harvesting methods, which have a large potential to solve emerging water crises in the cities are not known to a majority of people, more so those belonging to the poorer classes. However, it is found that a large number of households from the lower socio-economic class reuse water, and this is a result of limited availability of water to this class.

As expected, the availability and mode of use of water varies across the socio-economic classes within the cities. Surprisingly, however, the difference is not very high. On an average, the higher classes consume only 20 litres more than the lower classes.

City-wise variations in the supply and quality of water are very much visible. Water supply in cities like Kolkata and Hyderabad is far better, while Kanpur and Delhi perform the worst in this regard. However, it is also true that water supply in Hyderabad is a mixed bag, where multiple agencies pitch in to meet the city's needs. The municipal corporation supplies water to a majority of households once in two days. Water tankers and bore-wells compensate for the deficiency of municipal water in this city.

Twenty-four hour water supply in municipal taps is a dream for a majority of households in the large cities in the country. The study reveals that only about 18 per cent of the total households in these cities get 24 hours of municipal water supply. This has forced the households in a majority of these cities to depend on groundwater and other sources of water, like private vendors who supply water through tankers and drums. These sources, in turn, result in depletion of groundwater. In fact during summer private water vendors are the ones who profit in these cities.

The much talked of commodification of water and water services is also impacting the role of government departments as the key suppliers of water in cities. For instance, in cities like Delhi, Mumbai, Hyderabad, Ahmedabad, and Madurai some households have started using packaged water for drinking. However, it is also true that so far none of these cities have permanently handed over the task of water supply to private bodies (NGOs or corporations).

To conclude, it can be stated that the supply of water in the large cities of India is going to be a serious challenge in the future. The rapid increase in the population in these cities, depleting water resources and enhanced consumer needs are going to create a difficult situation. Market-oriented development with new needs in sectors like the entertainment industry, the building industry, new technologies with increasing water needs, enhanced supply in shopping malls, and simultaneously, the alarming rise in pollution levels in surface water bodies and even in groundwater is going to exacerbate the situation. Therefore, an urgent need is felt for a comprehensive water policy for cities which satisfactorily addresses the growing needs of citizens. The prevailing "adhocism" in measures conserve water and enhance supply needs to be done away with. EPW

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## Note

1 The matrix given below has been used to locate households in various socio-economic categories. The subcategories have not been reported in the main text.

| Occupation | | Illiterate | School up to 4 Years | School 5-9 Years | SSC/ HSC | Some College but Not Graduate | Graduate/ PG General | Graduate/ PG Professional |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Unskilled workers | 1 | E2 | E2 | E1 | D | D | D | D |
| Skilled workers | 2 | E2 | E1 | D | C | C | B2 | B2 |
| Petty traders | 3 | E2 | D | D | C | C | B2 | B2 |
| Shop owners | 4 | D | D | C | B2 | B1 | A2 | A2 |
| Businessmen/ industrialists with no of employees: | | | | | | | | |
| - None | 5 | D | C | B2 | B1 | A2 | A2 | A1 |
| - 1-9 | 6 | C | B2 | B2 | B1 | A2 | A1 | A1 |
| - 10 + | 7 | B1 | B1 | A2 | A2 | A1 | A1 | A1 |
| Self-employed professional | 8 | D | D | D | B2 | B1 | A2 | A1 |
| Clerical/ salesman | 9 | D | D | D | C | B2 | B1 | B1 |
| Supervisory level | A | D | D | C | C | B2 | B1 | A2 |
| Officers/ executives – junior | B | C | C | C | B2 | B1 | A2 | A2 |
| Officers/ executives – middle/senior | C | B1 | B1 | B1 | B1 | A2 | A1 | A1 |

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