URBAN WATER SUPPLY AND SANITATION

B.C. Barah

with

Vandana Sipahimalani

Purnamita Dhar

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3.1 Scope and organisation

The problems of environmental pollution are acute in urban areas. Water scarcity and pollution, emission of hazardous chemicals and automobile and industrial pollution in and around cities are the major sources of urban pollution. Of these, the problems of water pollution are most critical. The huge quantity of waste water and sewage generated by industries as well as by the domestic sector and contamination of ground water from the urban toxic solid waste cause severe water pollution. The hazardous toxic pollutants contaminate the drinking water of shallow tubewells in the slum areas. Shallow hand pumps are a major source and an easy mode of water supply in the slums and squatter settlements. Owing to lack of treatment facilities, a great proportion of untreated waste and sewage flows into open drains. Heavily loaded with pollutants, waste water and sewage enter the water distribution system, especially during the monsoon season, giving rise to many water-borne diseases such as cholera, gastro-enteritis and dysentery. These diseases take a heavy toll of human lives and give rise to severe health hazards. Existing control measures, regulation and fiscal instruments have failed to contain the deteriorating water utility services and pollution abatement in the urban areas.

Against this background, this chapter analyses the factors influencing the demand for and supply of urban water, costs of water supply, prevailing pricing practices and policies relating to sanitation. This chapter is largely based on data collected from four cities—Delhi, Hyderabad, Madras and Bombay. The first three cities have independent undertakings or boards for exclusive management of water supply and sewerage system while the Bombay Municipal Corporation provides water supply services to the residents of the city.

3.2 Water supply

Of the total population of 844.32 million as per the 1991 census, 217.18 million or 25.72 percent lived in urban areas. Between 1981 and 1991 the annual compound rate of growth of urban population was 3.14 percent while the overall growth rate was 2.14 percent. The annual growth rate in the big cities during the decade varied from 5.27 percent in Hyderabad to 2.37 percent in Madras. (Table 3.1.) The share of the slum population in urban population was 24.68 percent.

Table 3.2 provides estimates of statewise population coverage by water supply in urban areas. It shows that while the coverage was 95 percent or above in the metropolitan cities, the figures are rather low in non-metropolitan cities and towns.

Estimates of per capita availability of water and demand for water are given in Table 3.3. The per capita figures for Hyderabad and Madras are even below the norm of 70 litres per capita per day (lpcd) recommended by the WHO for urban areas without a sewerage system. Of the total water distributed, the share of the domestic sector was 87 percent in Delhi for the year 1993-94; the corresponding figures were 63 percent in Bombay and 69 percent in Hyderabad.

Table 3.1
Growth of Population in Urban Agglomerations in India (1981 to 1991)

Urban agglomerations	Population in (millions)		Annual compound growth rate (%)
	1981	1991	
Greater Bombay	8.24	12.60	4.33
Delhi	5.73	8.42	3.92
Madras	4.29	5.42	2.37
Hyderabad	2.55	4.25	5.27
All India urban population	159.46	217.18	3.14
All India population	683.33	844.32	2.14

Source. Census of India (1991).

There is a wide variation in per capita water consumption across consumer groups classified by income even in Delhi which has the highest average per capita availability of water. A communication from Delhi Water Supply and Sewerage Board (DWSSB) in 1995 states that the per capita water consumption in 1992-93 varied from 313 lpcd by the affluent consumers to 140 lpcd by the urban poor and to a mere 16 lpcd by the slum dwellers (Table 3.4).

Table 3.2
State Wise Population Coverage by Water Supply

Name of state/city	Estimated urban population (million) 1991	Population coverage water supply 1988	
		Number (million)	%
Andhra Pradesh (excl. Hyderabad)	13.430	8.400	62.54
Hyderabad	2.670	2.670	100.00
Maharashtra (excl. Bombay)	28.046	27.968	99.72
Bombay	10.500	9.975	95.00
Tamil Nadu (excl. Madras)	18.381	7.456	40.56
Madras	4.352	4.162	95.63
Delhi	8.081	7.965	98.56
All India Total	221.315	185.474	83.80

Note. Coverage figures denote the piped connections only.
Source. Central Pollution Control Board (1988); Ramasubhan, 1988.

Table 3.3
Per Capita Availability of Water and Demand for Water in the Metropolitan Cities

	Per capita availability of water* (lpcd)	Water demand* (lpcd)
Bombay	137	180
Delhi	237	363
Hyderabad	65	120
Madras	47	200

* Availability of water is defined as the total supply of water per person. This supply includes transmission loss of water. The demand for water is estimated by the water authorities based on biological needs, local conditions and the consumption habit of various consumer groups. For example, the estimates take into account the approximate individual requirements of the domestic consumers, industrial and commercial requirements @ 45000 litres per day per hectare in Delhi, 28 percent of total demand in Bombay etc., (fire protection @ 1 percent of total demand), garden use (@ 67000 litres per hectare), requirement for floating population, special use like embassies and hotels and free hydrant supply to the slums.

Source. Individual Water Boards and Municipalities.

Many cities and towns provide water supply for one or two hours per day during normal periods and only one or two hours twice a week during lean periods. The intermittent supply and insufficient pressures keep the pipelines in many areas empty for larger durations. As a result, many high income households, industrial and business users either invest in developing their own water sources or buy water from private sources. Low income households and slum dwellers are the worst affected in periods of water scarcity.

Table 3.4
Average Daily Consumption of Water by Consumer Category: New Delhi (1992–93)

Consumer group	Water consumption (lpcd)	Monthly household water bill (Rs)	Effective price* (Rs /kl)
Affluent consumers	313	34.14	0.726
Middle income	227	22.18	0.625
Lower income	167	13.90	0.556
Urban poor	140	10.22	0.486
Average			0.633

* Effective price is obtained by dividing the water bill of the household with the actual monthly consumption of water by a typical family of five members. A water bill in Delhi consists of water charges (for various slab rates), an extra charge @ 30 percent on water charge, a pollution surcharge @ two paise per unit of water consumption and an overall 5 percent surcharge.

Source. Personal communication with DWSSB, 1995. A special survey was conducted for this purpose.

3.3 Water costs and tariffs

It is well known that the cost of providing water supply in an urban area depends on factors such as the source of water, cost of transportation of water, pretreatment of water, consumer characteristics and methods of distribution. The cost of water also exhibits spatial and temporal (i.e., season to season in a year) variations. Ideally, measures of current social costs of water to different consumer categories are necessary in order to evolve rational tariffs that would provide correct signals to the users regarding the social scarcity of this resource.

It is very difficult to estimate the social costs of water from the data available with the municipal corporation and water boards. The existing costs are based on historical prices and not at current prices. As the costs are increasing with time, the reported costs underestimate the current incremental costs. No attempt has been made to estimate the social cost of water. Even in an accounting sense, reliable cost data are available only for operation and maintenance costs. Further, as water supply and sanitation services are provided jointly, very often the joint costs are allocated between water supply and sanitation on the basis of some accounting principle.

Estimates reveal that the cost of water per kl is Rs 0.95 in Bombay, Rs 1.70 in Delhi, Rs 5.00 in Hyderabad and Rs 2.94 in Madras. The estimated unit costs for new sources are much higher. For example, the unit cost of water for Madras city from Veeranam tank which is at a distance of 253 km is Rs 14.39 per kl. The unit cost of water for the city of Hyderabad from Nagarjunasagar dam which is situated at a distance of 160 km from Hyderabad is Rs 18.34 per kl.

Slum inhabitants are provided free but inadequate water through public standposts or free hydrants. As many as 40 to 400 families share water from a single hydrant which supplies water up) to a maximum of two hours per day (National Commission on Urbanisation 1988). The per capita water supply is between 15 and 20 litres per day (lpd). In 1992-93, water supply via free public standposts accounted for 14.37 million litres per day (mld) in Hyderabad (3.5 percent of total water supply). Delhi's free distribution of water in 1992–93 was 164 mld or 8 percent of its total water supply.

Consumers who get municipal water supply through pipelines are divided into two broad categories: (i) metered and (ii) non-metered. Non-metered users pay flat rates. In Delhi the monthly charges in 1991–92 consisted of (i) Rs 12.00 up to three taps and Rs 5.00 for each additional tap and (ii) a surcharge of 30 percent. In Hyderabad the fixed monthly charge was Rs 60 per connection in 1991. In Bombay the non-metered charges consist of (i) tax on rateable value (about 9 percent) and (ii) water benefit charge (6 percent of rateable value). In Madras domestic piped water supply is not metered and the flat rate is Rs 30 per month.

The metered charges for different categories of consumers in Delhi and Hyderabad are given in Table 3.5. Two broad features emerge from this table. First, for every category one can observe a multipart inverted tariff which means the average water charge per kilolitre (kl) is higher for large consumers than for small consumers. Second, the water charges are lower for domestic consumers compared with non-domestic consumers. In Bombay the charge per kl is the same irrespective of consumption in each category. The rate is only Rs 0.30 per kl for domestic purposes, but it varies from Rs 2.00 to Rs 6.00 for different categories of industrial and commercial consumers.

Table 3.5
Water Tariffs in Delhi and Hyderabad (metered charges)

	Consumption level	Rs per kl/ minimum
Delhi 1991–92		
Domestic & residential	up to 20 kl per month	0.35
	above 20 kl per month	0.75
	Surcharge 30%	
Non-domestic (shops, offices household industries)	up to 50 kl per month	3.00
	above 50 kl per month	5.00
	surcharge 30%	
Other non-domestic	up to 50 kl per month	5.00
	50 to 100 kl per month	6.50
Hyderabad		
Domestic	15–25 kl per month	2.50
Multistoreyed buildings	above 25 kl	3.00
(a) 90% or more plinth area in domestic use	up to 500 kl	2.50
	above 500 kl	3.00
	above agreed quantity	5.00
(b) 70% - 90% of plinth area in domestic use	up to agreed quantity	4.00
	above agreed quantity	5.00
(c) more than 30% of plinth area in non-domestic use	up to 20 kl	100 minimum
	up to 50 kl	5.00
	above 50 kl	7.00
Industrial	up to 25 kl	200 minimum
	25 to 500 kl	7.50
	above 500 kl	10.00
Commercial	up to 20 kl	100 minimum
	20–50 kl	5.00
	above 50 kl	7.00
Institutional		4.00

3.4 Cost recovery, subsidies and need for reforms

A recent study by Sipahimalani (1995) shows that, among the four cities covered in this study, only in Bombay the average revenue per kl is close to the average cost of water supply. The overall satisfactory financial performance in Bombay is due to heavy cross subsidisation of domestic consumers by non-domestic consumers. Table 3.6 gives details regarding estimates of subsidies for Municipal Corporation of Hyderabad for 1992–93. The non-domestic category's cross-subsidy to the domestic category amounted to Rs 11.284 million per month. As a result the overall subsidy was limited to Rs 6.146 million.

Estimates of subsidies and cross-subsidies given by the boards do not reflect even the current private costs. As noted earlier, the incremental cost of providing water is far above the average accounting cost. As the cost of supplying water varies from one customer category to another, the measurement of unit subsidy as the difference between the average cost for the entire system minus the average revenue for each category becomes questionable.

Underpricing of water perpetuates budget deficits of local bodies. It makes them financially dependent on State governments and other sources for undertaking new projects. The price mechanism is suppressed in relieving growing water shortage as the local bodies often resort to quantity rationing. Irregular and uncertain supply conditions have led many large users to find private sources of water.

Table 3.6
Estimates of Subsidies per month to Various Consumer Categories in Hyderabad (1992–93)

Consumer category	Water supply mld	Tariff Rs /kl	Total cost Rs million	Revenue Rs million	Subsidies Rs million
Free public standpost (#4788 connections)	14.37	Free	2.181	0	2.181
Domestic					
– Unmetered (#5700 connections)	5.70	60/pm	0.864	0.342	0.520
– Metered					
Slab 1 (<15kl/m)	66.38	2.00	5.814	3.988	1.831
Slab 2 (15–25)	71.08	2.50	10.79	5.629	5.161
Slab 3 (>25)	4.937	3.00	7.494	6.370	1.124
Multistoreyed buildings	51.54	3.50	7.824	4.638	3.186
Domestic total	258.44	–	–	–	–
Bulk supply					
– Municipalities	–	2.25	–	–	–
– Enroute villages	–	1.75	–	–	–
– Housing colonies	–	2.25 (up to 300 kl/pm) 3.00 above			–
Total bulk supply	69.64	–	10.572	7.152	3.420
Sub-total	328.08	–	–	–	17.423
Non-domestic	71.23	–	10.813	22.097	(–)11.284
Grand total	399.31	–	–	–	6.146

Source. Hyderabad Water Supply & Sewerage Board (1993).

There is an urgent need for structural and price reforms in the water delivery system. Except for the poor, there is no justification for providing water at zero or very low price. The poor consumers should be targeted and they should be provided at least 40 litres per capita per day (lpcd). For all other consumers water charges should be based on meter readings. The Hyderabad experiment in modernisation and upgradation of water connections with tamper-proof meters deserves recognition. It involves a one time investment of Rs 10,000 per connection and at a 12 per cent rate of interest. This amount can be recovered on the basis of a monthly charge of Rs 52 per connection over a period of 10 years. Installation of a meter and introduction of a charge system where the charge reflects the marginal cost of water can bring not only more revenue to the boards but also conserve water use.

The Bureau of Industrial Costs and Prices has in an analysis shown that technological upgradation and modernisation of Indian industries has promoted conservation of scarce water to a great extent. Water requirement per tonne of area has declined from 14 cubic metres to 6 cubic metres through water conserving technologies. Bhilai steel has demonstrated a saving of upto 83 percent of total water use with appropriate technology upgradation and other means of conservation. In cities such as Madras and Goa, a cut in water supply to large industrial users (e.g. refineries, fertilizer units) has prompted these industries to undertake investments for recycling of water.

Using the data for Hyderabad and Delhi for the years 1989-90 to 1996-97 a demand function for municipal water was estimated with effective price and total household expenditure as explanatory variables. An own price elasticity of -0.21 was obtained. The relatively low value is due to factors such as the absence of any close substitute for water, supply constraints and small observed variations in the prices. At higher prices, excess demands will decrease and demand would become more elastic. Hence setting prices right would not only generate funds for financing investments but also encourage conservation of water.

There is also ample scope for improving efficiency on the supply side. In Bombay, the distribution loss (between the city reservoir and the consumers, including leakages and illegal tapping of water) is estimated at 20 percent. The transmission losses in Madras, Hyderabad and Delhi are much higher owing to the importation of water from distant sources. The revenue loss because of water losses in Delhi in 1993–94 in terms of cash are estimated at Rs 434.37 million.

3.5 Sanitation

Compared with water supply, the sewerage service has a distinctly larger externality and hence the case for government intervention in the management of waste water and sewerage needs adequate emphasis. About 80 percent of the water used enters into the waste water stream. Urban India is, by and large, deficient in infrastructure to provide adequate treatment facilities for huge quantities of waste water and sewage. According to a CPCB report (1988), the percentages of waste water treatment capacity to total waste water generated were 5 in Bombay, 35 in Hyderabad and 50 in Delhi. In the absence of adequate treatment facilities waste water and sewage are disposed of in the creeks or into rivers and the sea directly. As a result, there is a deterioration in the quality of water in natural water bodies.

It is only in Bombay that the expenditure on sewerage and drainage exceeds its income. In Delhi, the income under this category contributed only 36 percent of the expenditure in 1992–93. At present there is no user charge for sewerage and drainage, based on the volume of waste water and concentration of pollutants. In Bombay sewerage tariffs are set at 50 percent of water charge for metered users; for non-metered users a 5 percent tax on rateable value of real property and a sewerage benefit tax at the rate of 4 percent of rateable value of real property are levied. In Hyderabad a sewerage cess at 20 percent of water charges is levied in respect of connections served by the sewerage system.

In the context of the deteriorating urban environmental quality and the need for augmenting the resources of municipal bodies, there is a case for rationalising user charges by linking the charges to the quantity of waste water generated.