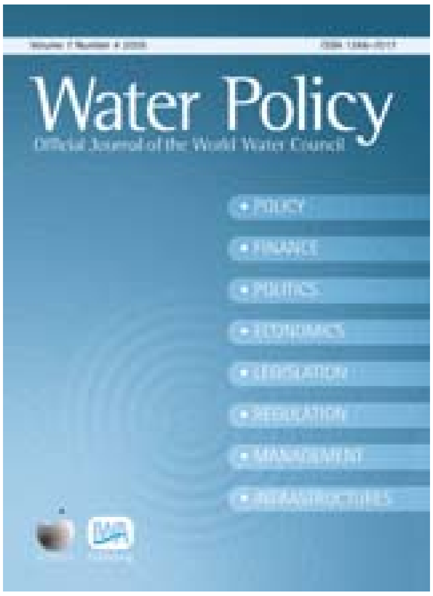
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Urban water supply in India: status, reform options and possible lessons

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Abstract

Large numbers of households in cities around the developing world do not have access to one of the most basic of human needs – a safe and reliable supply of drinking water. This paper uses the experience of India as a lens through which to view the problems of access to water in urban areas and the various options available for reform. Using two sets of data from the National Family Health Survey, as well as published and unpublished secondary sources, the paper presents the status of access to drinking water in urban India, the performance of India's urban water sector compared to other Asian metropolitan regions and the reform efforts that are under way in several Indian cities. A review of these ongoing reforms illustrates some of the political economy challenges involved in reforming the water sector. Based on this analysis, we draw out directions for more effective research, data collection and policy reform. While each country faces unique challenges and opportunities, the scope and range of the Indian experience provides insights and caveats for many low-income nations.

Keywords: India; Urban water; Water policy

1. Introduction

In over 50 years of political independence and economic development, India has not been able to ensure the most basic of human needs – safe drinking water – for all its citizens. Rural areas contain the largest number of people without access to safe water but, in common with many developing countries, the fastest growing unserved populations live in urban and peri-urban areas. Given the primacy of drinking water as a national objective (GoI, 2002, Section 6.1) and recent policies of devolution through private sector participation and local governments, we ask: How can urban India alleviate its household-level drinking water deprivation, in the near-to-medium term and in

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cost-effective ways[1]? This question and this policy shift are central to resource planning, not only in India, but in many low-income nations struggling to provide universal access to drinking water.

The objective of this paper is to assess the ongoing water sector reforms in urban India in order to determine key barriers to more effective reform and to suggest policy-relevant avenues for future research. We first provide a brief overview of the state of access to drinking water, using data from the National Family Health Survey (NFHS) (Section 2). We assess the current state of urban water provision with respect to water quality, water sector efficiency and pricing structures (Section 3). We then review, through case studies from India and elsewhere, the economic and institutional options[2] for urban and peri-urban water delivery with a focus on pricing reform, financial reform and private sector participation (Section 4). We analyze the status of ongoing attempts, including those involving civil society, to reform the water sector. Finally, we draw on the literature and on our own field experience to recommend directions for more effective data collection and research that will be relevant to policy reform in India and beyond (Section 5).

2. Access to water

To examine patterns in household water delivery across different geographic and socio-economic dimensions we employ data from the NFHS taken in 1992/93 and 1998/99. This is India's version of demographic and health surveys taken worldwide. Table 1 provides a breakdown of the various water delivery mechanisms for all of India and separately for urban and rural areas. Looking across India, we note substantial heterogeneity in water delivery. Piped water supplies 69% of households in large cities, 45% in smaller cities and towns and only 9% of rural households. Hand pumps are still the predominant source of drinking water in rural areas.

Overall, 80% of households in 1998/99 were estimated to receive their drinking water from improved sources[3]. The NFHS does not collect income data at the household level, but does ask households questions on ownership of a number of durable assets. Table 2 reports our estimates of the percentage of households with access to piped water by asset decile. We note the strong relationship between asset wealth and access to water.

3. The current state of urban water supply

3.1. Water availability and quality

The water supply in most Indian cities is only available for a few hours per day, pressure is irregular and the water is of questionable quality. Table 3 summarizes some key indicators of irregularity and poor

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[1] An earlier and longer version of this paper presented at the 5th Stanford Conference on Indian Economic Development (http://scid.stanford.edu/pdf/SCID224.pdf) also considers options for rural water provision.

[2] Apart from economic and institutional reforms, technological innovations such as roofwater harvesting are also under way in cities such as Delhi and Chennai (http://www.rainwaterharvesting.org/Urban/Model-Projects.htm). These efforts, however, are mostly at the pilot or demonstration level. Reliable data on costs and effectiveness at much larger levels of coverage have been difficult to acquire. For these reasons, we do not discuss such alternative technologies in this paper.

[3] Improved sources are household connections, public standpipes, protected wells, rainwater collection, boreholes and protected springs. "Not improved" sources include unprotected wells and springs, vendor provided water and tanker truck water. "Improved" sources may not contain water that is significantly free of disease causing pathogens.

Table 1. Source of household drinking water: percentage of households receiving their drinking water from each source.

	All India		Urban		Rural		Small city/town		Large cities	
Source of drinking water	1992/93	1998/99	1992/93	1998/99	1992/93	1998/99	1992/93	1998/99	1992/93	1998/99
Piped into residence/yard/plot	18.4	21.0	48.1	51.6	7.1	9.3	43.3	45.3	57.6	69.1
Public tap	14.8	17.6	21.5	22.7	12.2	15.7	20.7	24.9	23.1	16.9
Hand pump in residence/yard/plot	13.6	15.4	9.6	9.9	15.1	17.5	12.1	11.7	4.6	4.9
Public hand pump	21.6	23.8	8.5	8.3	26.5	29.7	8.5	8.9	8.5	6.5
Private wells	7.2	7.4	4.7	3.8	8.2	8.7	6.3	4.7	1.6	1.5
Well in residence/yard/plot		1.2		0.7		1.4		0.8		0.4
Open well		6.2		3.1		7.4		3.9		1.1
Public wells	18.6	11.4	4.6	2.2	23.9	14.8	5.5	2.9	2.7	0.4
Public covered well		1.0		0.3		1.2		0.4		0.1
Public open well		10.4		1.9		13.6		2.5		0.3
Spring	0.7	0.5	0.1	0.1	0.9	0.7	0.1	0.1	0.0	0.1
River, stream	1.9	1.2	0.5	0.1	2.5	1.6	0.7	0.1	0.3	0.0
Pond, lake	1.2	0.8	0.3	0.3	1.5	1.0	0.4	0.4	0.1	0.0
Dam	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Rainwater	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Tanker truck	0.4	0.2	1.0	0.3	0.1	0.1	0.9	0.4	1.2	0.2
Other	1.6	0.5	1.1	0.7	1.8	0.5	1.4	0.7	0.5	0.5
Water from improved source (excluding wells)	68.3	77.9	87.7	92.5	60.9	72.3	84.7	90.8	93.7	97.3
Water from improved source (including wells in residence and covered wells)[1]	71.0	80.0	89.2	93.5	64.1	74.9	86.5	92.0	94.6	97.8

Source: Population weighted values calculated from the National Family Health Survey. Urban areas consist of large cities, small cities and towns. [1]1992/93 figures calculated assuming that wells in residence constitute same proportion of private wells as in 1998/99, and that public covered wells constitute the same proportion of public wells as in 1998/99.

Table 2. Access to piped water by asset deciles: percentage with access by relative asset levels.

Location-specific Asset decile	All India	Urban	Rural	Small cities & towns	Large cities
1	2.8	15.9	2.4	12.3	26.4
2	3.0	31.0	5.5	23.4	42.1
3	5.8	34.9	3.2	28.4	50.2
4	8.9	43.3	4.6	35.6	60.2
5	13.9	53.7	6.9	45.4	66.3
6	19.1	60.5	10.3	48.7	78.3
7	29.5	68.1	13.1	60.0	85.1
8	40.8	77.1	19.4	66.8	86.5
9	54.2	81.2	22.9	74.9	90.0
10	71.3	83.7	35.7	78.3	88.6

Source: NFHS 1998/99 (http://www.nfhsindia.org/index.html). Asset deciles based on first principal component for location.

performance of municipal water suppliers in the largest Indian cities. For comparison purposes, these same indicators are also provided for Lahore, Kathmandu, Bangkok, Beijing and an average of 50 cities surveyed by the Asian Development Bank in 1997 (ADB, 1997). No major Indian city has a 24 hour supply of water, with 4 to 5 hours of supply per day being the norm. This compares with the Asian-Pacific average of 19 hours per day supply. These averages conceal a great deal of heterogeneity within cities. In a survey of Delhi households with in-house connections, Zérah (2000) finds that 40% had a 24-hour supply of water, while more than 25% had under 4 hours of service each day. McIntosh (2003) notes that consumers without a 24-hour supply tend to use more water than those with continuous supply because consumers store water, which they then throw away to replace with fresh supplies each day.

Intermittent water supply, insufficient pressure and unpredictable service impose both financial and health costs on Indian households. Based on a survey conducted in Delhi in 1995, Zérah (2000) estimated that each household on average spent around 2,000 rupees (Rs) annually in coping with unreliable supply of water, which is 5.5 times as much as they were paying their municipality for their annual water consumption. Many households with in-house connections were found to have undertaken long-term investments in the form of water tanks, hand pumps or tube-wells. Households with water tanks install booster pumps on the main water line itself and pump water directly to water tanks. This increases the risks of contamination of the general water supply and reduces the pressure in the network for other users, leading them also to install motors on the main line.

The WHO Guidelines for Drinking-water Quality (WHO, 1993, 1997, 1998) assess the health risks posed by contaminants in drinking water. The WHO's primary health requirement is a sufficient water supply, which the Government of India takes to mean 40 litres per person per day. The second requirement is that the water be microbiologically safe. In most developing countries, India included, the primary contaminant of surface and ground waters is human and animal waste. The WHO guidelines suggest that *E. coli* (the indicator organism for bacterial contamination) should not be detectable in a 100-ml sample of water, but with fewer than 10 coliforms, the water is considered to be of "moderately" good quality. The Government of India accepts these guidelines but has been unable to ensure that they are met. Waterborne diseases from fecal contamination are one of the biggest public health risks in the country – it has been argued that India loses 90 million days a year owing to waterborne diseases, costing Rs 6 billion in production losses and treatment (Chaudhuri, 1998).

Table 3. Indicators of irregular supply and wastage.

City	Source	Year	Hours per day of water supply	Unaccounted for water (%)	Metering (%)	Staff per 1,000 connections	Cost recovery (% of operating costs)	Accounts receivables (months)
Bangladore	4	2002/03	4	34–44	100	8	95	
Calcutta/Kolkata	5	2004	9		5			
	4	2002/03	6–7	30–40	very low	14	15	
	1	1997	10	50	0	17.1	19	1.5
	2	1993		36				
Chennai	6	2001			<5			
	1	1997	4	20	1	25.9	106	5.8
Delhi	1	1997	4	26	73	21.4	68	4.5
	3	1995	5					
	2	1993		30				
Mumbai	1	1997	5	18	67	33.3	93	19.7
	2	1993		24				
Hyderabad	4	2002/03	0.5–4	33		13	66	
Comparison cities								
Lahore	1	1997	17	40	24	5.7	141	7
Kathmandu	1	1997	6	40	83	15	139	4.5
Bangkok	1	1997	24	38	100	4.6	112	2
Beijing	1	1997	24	8	100	27.2	77	0.1
Asian-Pacific average	1	1997	19	35	83	11.8	95	4

Cost recovery is annual billing as percentage of operation and maintenance costs.

Sources: ADB (1997); Zérah (2000) reports of Asian Development Bank 1993 figures; Zérah (2000) reports of her own 1995 survey; Own communication with Kolkata Municipal Corporation; Brocklehurst *et al.* (2002).

Monitoring of water quality in Indian cities is haphazard. While municipal boards claim to conduct regular tests of water supply, the results of these tests are generally not made public[4]. The Sukthankar Committee (2001) report to the Government of Maharashtra reported results from 136,000 daily tests carried out on water samples from various municipal corporations in Maharashtra in 1999. 10% of samples were contaminated, with 14% of samples from Mumbai being contaminated. Water monitoring conducted from January to March 2003 by Clean India in 28 cities found that ground water in most areas exceeded permissible limits in terms of fluoride, ammonia and hardness. Municipal water supply in some cities also contained high numbers of contaminants. A 2003 survey of 1,000 locations in Kolkata found that 87% of water reservoirs serving residential buildings and 63% of taps had high levels of fecal contamination[5]. Even bottled water is not completely safe. A 2003 study (subsequently repeated in 2006) by the Centre for Science and Environment in Delhi found that most popular brands of bottled water had high levels of pesticides (CSE, 2003). Standards for drinking water that are actually enforced could have enormous positive impacts on public health, but for this to occur, the procedures for water testing and data sharing have to be made regular, standardized and public[6].

3.2. Inefficiencies in the supply of water

A standard indicator of inefficiency is the percentage of water produced that does not reach water board customers. Unaccounted for water results both from leakages and illegal connections. In addition to the financial costs to the water utility, high levels of unaccounted for water are also a major reason for intermittency in the supply of water, since leaks and illegal connections lower water pressure in the distribution system. Table 3 shows that unaccounted for water accounts for 25–40% of water produced by utilities in the main urban areas in India. While this is no higher than the Asian-Pacific average, the large number of obvious leaks means there is still substantial scope for improvement.

A second indicator of inefficiency is staffing levels. A good utility will have two staff for every 1,000 connections (McIntosh, 2003). Such levels have been attained by utilities in Taipei, Kuala Lumpur, Singapore and Seoul. The Asian-Pacific regional average is 12 staff per 1,000 (Table 3). Hyderabad and Bangalore are around this level, but staffing levels are double this in Chennai and Delhi and higher still at 33 per 1,000 in Mumbai[7]. While staffing levels are high, the average quality of workers in many utilities is low. Based on visits to water utilities across Maharashtra, the Sukthankar Committee (2001: 90) reported that “most of the operating staff was not qualified to work in water works installations”.

The consequence of overstaffing, underpricing and high levels of unaccounted for water is that most urban water utilities in India are unable to cover even operating and maintenance costs out of revenues from tariffs, let alone provide capital for the expansion and improvement of the network. Table 3 shows

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[4] For example, the BWSSB in Bangalore now collects 1,200 samples a month from several parts of Bangalore City and tests them in a Central Lab to measure water quality. However, results from these tests are not readily accessible.

[5] See “Warning over Calcutta water quality”, BBC News UK edition, 29 August, 2003.

[6] Households themselves could improve the quality of the water they receive. Possible mechanisms range from simple technologies such as straining with a cloth, using chlorine and safe storage vessels, to more sophisticated technologies like electronic filters. However, using the 1999 NFHS, Jalan *et al.* (2003) report that 47% of households do not use any point-of-use (or in-home) purification method, with 32% of the top wealth quartile also not purifying their water.

[7] It should be remembered that the number of connections is not a proxy for the number of people served. An in-home connection can from serve 5–15 people; a yard connection can serve 50. Thus high staffing levels per connection need not translate to high levels per customer served.

that only Chennai has managed to cover operating costs, while Bangalore and Mumbai came close. The situation is most severe in Kolkata, with only 15% of operational costs being recovered[8].

3.3. Pricing of water

State governments in India are responsible for choosing urban tariff structures and the result is wide variety in pricing practices. Average tariffs in India are low relative to costs. A cross-region study by the Asian Development Bank in 1997 found average rates in Calcutta and Delhi of 1–3 US cents/kiloliter (kl), 6 cents/kl in Mumbai and 25 US cents/kl in Chennai. In comparison, rates were 9 cents/kl in Dhaka and Karachi, 20 cents/kl in Lahore and 34 cents/kl in Kuala Lumpur. With the exception of Chennai, Indian cities therefore tend to have much lower prices than other Asian cities.

Raghupati & Foster (2002) surveyed water charging practices in all 23 metropolitan areas (cities of over 1 million population) and 277 smaller cities with populations of 50,000 to 1 million. They find that most cities operate a mixture of measured and unmeasured tariffs. For unmeasured areas, a flat rate is the most common form; for metered connections, the predominant charge is a constant rate per kiloliter. 42% of metropolitan areas and 23% of smaller cities use an increasing block tariff (IBT).

Under an increasing block tariff, a low rate is charged for the first few units of water and then higher amounts of use are charged at higher rates. Increasing rates for higher amounts forces wealthy households to subsidize poorer households, which is seen as desirable for equity and public health reasons (Boland & Whittington, 2000). Table 4 provides examples of prevailing tariff structures in Hyderabad, Bangalore, Delhi and Chennai and Table 5 compares tariffs for the same units of use across cities. All four cities use IBTs for metered customers. The size of the blocks varies across cities, with the initial monthly block being 6 kl in Delhi, 8 kl in Bangalore, 10 kl in Chennai and 15 kl in Hyderabad.

Brocklehurst *et al.* (2002) note that the size of the first block in all the Indian cases exceeds what would generally be considered a true lifeline level. Coupled with the low tariffs in the first couple of blocks, the result in, for example, Bangalore is that 93% of the customers account for less than 15% of revenues and are paying less than 41% of the cost of providing them with water. The past two years have seen some reductions in this initial block size, with Hyderabad lowering the initial block from 30 kl to 15 kl, Bangalore lowering it from 15 kl to 8 kl and Delhi lowering it from 10 kl to 6 kl.

In practice then, the IBT has resulted in a large initial block, with the majority of households consuming in the first couple of blocks. Boland & Whittington (2000) find this to be a general phenomenon in many places across the world. They note that since poorer households are less likely to have a metered connection in the first place, many poor households do not benefit from the IBT structure.

With respect to metering, Table 3 reports that customers with metered connections ranges from fewer than 5% in Chennai in 2001, to approximately 70% in Delhi and Mumbai and 100% coverage in Bangalore. Of course in order to benefit from the advantages of metering, the meters must be operational. Data on whether or not the meters are functioning is even scarcer than the scattered data on metering itself, but available evidence shows high levels of non-functioning meters. Zérah (2000) reports that officially three-quarters of all connections in Delhi in 1994 were metered, but that one-third of these were no longer working. 81% of meters in Mumbai in 2000 were also reported to be non-functional (Mathur, 2001). More recently, in June 2005, the Delhi water board launched a

[8] See The Tribune, online edition, June 9, 2005: http://www.tribuneindia.com/2005/20050610/delhi.htm

Table 4. Water tariffs in several large Indian cities.

	Chennai 2005/06 Consumption slab (kl/month)	Rate (Rs/kl or Rs)	Hyderabad 2005/06 Consumption Slab (kl/month)	Rate (Rs/kl or Rs)	Bangladore 2005/06 Consumption Slab (kl/month)	Rate (Rs/kl or Rs)	Delhi 2005/06 Consumption Slab (kl/month)	Rate (Rs/Kl or Rs)
Metered connections:	Up to 10	2.5	Up to 15	6	Up to 8	6	0–6	0
	11–15	10	16–30	8	8–25	9	7–20	3
	16–25	15	31–50	15	25–50	15	21–30	10.5
	Over 25	25	51–100	20	50–75	30	30+	15
			101–200	25	75–100	36		
			201+	35 on all units	101+	36		
Minimum monthly tariff		50		90		90		40
Unmetered connections	All	50 (flat rate)	15 mm pipe	100 (flat rate)				40 (flat rate)
			20 mm pipe	270 (flat rate)				
			25 mm pipe	600 (flat rate)				
			40 mm	1,500 (flat rate)				
			50 mm +	3,200 (flat rate)				

Flat rates are monthly rates in Rs. US$1 = Rs 43 (April, 2004)

Sources: Hyderabad Metropolitan Water Supply and Sewerage Board (MWSSB), http://www.hyderabadwater.gov.in/; Bangladore Water Supply and Sewerage Board (BWSSB), http://www.bwssb.org/; Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB), http://www.chennaimetrowater.com/; Delhi 2005/06 rates from Delhi Jal Board (DJB), http://www.delhijalboard.nic.in [accessed October 2006]

Table 5. Comparison of metered prices of the first 50 kl, 2005/06.

kl per month	Hyderabad	Bangalore	Chennai	Delhi
10	90	90	50	40
20	130	156	150	68
30	210	276	350	138
40	360	426	600	238
50	660	576	850	338

Source: own calculations from block and minimum tariffs in Table 4.

campaign to replace over 300,000 faulty meters, over 20% of the total number of metered connections[9].

4. Areas for urban reform

4.1. Scope for pricing reform

Recovering at least part (if not all) of the cost of a new water system or of upgrading and maintaining an existing water system is the primary rationale for pricing reform. Several studies have argued that poor people will pay for water if it is conveniently and reliably supplied (e.g. WSP, 1999) and that appropriate pricing reform can promote both efficiency and equity (e.g. Rogers *et al.*, 2002). Existing evidence suggests that many low-income households in India can afford to pay more for water, particularly if the increase in prices is accompanied by a better service. At present, households may pay several times the municipal charges in coping costs arising from the irregularity and unreliability of supply (Connors, 2005). Raghupati & Foster (2002) calculate that that (on average) a five-member family with a per capita monthly budget of Rs 350 could pay up to Rs 6 per kl for a block of up to 10 kl per month. But given estimates of operating and maintenance costs in the range of Rs 15 per kl, some subsidization would remain necessary.

Although subsidization appears inevitable, the current system effectively directs most of the subsidies towards the non-poor. Foster *et al.* (2003a, 2003b) calculate that the state and federal governments in India spend US$1.1 billion or 0.5% of GDP in subsidizing water, but that 70–80% of these subsidies do not reach the poor. They suggest that a geographically targeted system would result in significant improvements in performance– for example lifeline rates could be set at lower levels in slum areas. Additionally, subsidizing connections–with the connection fee spread over several years, rather than monthly use, appears to be a better way of directing subsidies towards the poor.

Boland & Whittington (2000) suggest replacing the IBT with a system of uniform pricing with rebates. Under this method, a volumetric charge is set equal to marginal cost and coupled with a negative fixed charge, or rebate. Of course, some form of metering is necessary in order for suppliers to charge in proportion to water used. Metering also has other advantages such as helping suppliers keep track of how much water is being used and where, and providing for identification of leakages.

One might question whether metering in very low-income areas (and keeping the meters functional) is cost-effective for the water utilities. In general, piped connections to homes in slums

[9] See The Tribune, online edition, June 9, 2005: http://www.tribuneindia.com/2005/20050610/delhi.htm

are not metered, therefore we do not have the data to answer this question. However, even among low-income households there may be scope for metering with some adaptation. For example, the private concessionaire in Manila put banks of meters in low-income areas, from which families who wanted a private connection could install and run rubber piping to their own homes (WSP, 2001). This resulted in an increase in coverage from 67% to 80% of households, providing direct connections to one million urban poor.

4.2. Scope for financial reform

A traditional mechanism for raising the capital needed for water and sewerage system expansions and upgrades is the municipal bond, usually issued without guarantees by the state or the federal government. Through such bonds, private credit markets lend money to local governments for a fixed period of time and at predetermined interest rates. Financing water and sewerage expansions through bonds is not common in South Asia, but in 1998 Ahmedabad Municipal Corporation (AMC) became the first Indian municipality to use this mode of raising capital (Dutta, 2000).

An ambitious project to extend water and sewerage to 3.5 million unserved people in Ahmedabad was financed through multiple mechanisms, including municipal bonds issued within India and USAID-guaranteed loans from international banks. AMC first worked to gain the trust of the credit markets by lowering its budget deficits, increasing the transparency of its financial administration and the capacity of its water sector staff. These reforms made it the first Indian city to earn an A + rating from the Credit Rating Information Services of India and with this rating the AMC raised over US$20 million through municipal bonds sold both to the public and to institutions[10]. As the Indian credit markets mature, it seems possible that other municipalities could replicate Ahmedabad's example. In fact, both Hyderabad and Chennai Municipal Water Supply Boards have now issued municipal bonds to raise investment capital (World Bank, 2006). But we note that it was essential for AMC to prove its reliability and creditworthiness before issuing bonds without any guarantees from the state and that even before its attempts to get a bond rating AMC was considered one of the best-run municipalities in the country (Dutta, 2000).

4.3. Private sector participation in urban water delivery

Over the last decade, privatization to a greater or less degree has been seen as one of the primary ways to infuse capital into the urban water sector and to overcome some of the inefficiencies of municipal management. It has been urged upon developing countries by international lending agencies as an essential component of water sector reform. Although widespread in much of the developing world, especially in Latin America, private sector participation (PSP) in water delivery is still rare in India. However, the 2002 National Water Policy of the Government of India for the first time called for the encouragement of PSP in water resources. Section 13 reads: "Private sector participation should be encouraged in planning, development and management of water resource projects for diverse uses, wherever feasible" (GoI, 2002: 5).

[10] See http://www.epa.gov/usctcgat/file/toolmanager/O86C299F62936.pdf; http://mirror.undp.org/switzerland/wacap/en/experiences/ahme.htm.

Private sector participation incorporates a wide range of private sector involvement. At one end lies contracting out of services to the private sector, such as mains repair, billing and collecting. Such arrangements are relatively straightforward and involve short-term (3–5 year) renewable contracts. More private involvement occurs under longer-term (20–30 year) concession and build-own-transfer (BOT) contracts. Under a concession, a private firm manages and operates the whole utility at its own commercial risk, while BOT contracts are used for major investment in new facilities. At the other end of the public–private spectrum lies full divestiture, whereby the government sells the assets of the water supply company to a private firm, who runs it on a permanent basis subject to government regulation[11].

Evaluation of the effects of PSP on urban water supplies has been constrained by the overall poor quality of data available and the small number of cases from which to draw conclusions. As in India, in many parts of the world the public utility does not release regular information on costs, water quality, the size of the network, and so on, making it difficult to measure the pre-privatization trends in access, costs and quality and thus to determine what would have happened in the absence of private involvement. The literature provides some empirical support for greater efficiency under private operation than under the formerly public firms (Megginson & Netter, 2001)[12]. However, much of the criticism regarding privatization is that it will result in large increases in water tariffs, making water unaffordable for the poor (e.g. Sridhar, 2003b). The evidence on water prices post-PSP is mixed (Shirley, 2002; McKenzie & Mookherjee, 2003), with more documented cases of monthly tariffs rising post-PSP than otherwise (Davis, 2005).

Overall, the experience of other countries suggests that PSP in the urban water sector can, but may not, improve efficiency and provide better service for the poor. While it is too soon to evaluate the effects of private involvement in urban water in India, several projects are now under way. We comment here on three ongoing efforts.

An example of contracting out services to the private sector can be seen in a pilot project which began in June 2003 in Bangalore. Larsen and Toubro and Thames Water-UK in a 70:30 joint venture received a Rs 500 million contract from the Bangalore Water Supply and Sewerage Board (BWSSB) for a project to reduce leakage and unaccounted for water through district metering, replacing consumer meters and re-laying of supply lines. The project is funded by the Japan Bank for International Co-operation (JBIC). Competitive bidding was used to select the contractor, which was awarded a service contract for a pilot area of 35,000 house water connections. By 2005, unaccounted-for-water had been reduced by 50% in some of the pilot service areas[13]. Upon successful completion of the pilot, the BWSSB originally proposed to invite global tenders to expand the project to cover 400,000 household connections[14], but the overall project has run into some delays[15].

There has been some controversy regarding the leak reduction project (see The Hindu, 2004), but much less so than for other privatization efforts even within Bangalore. For example, BWSSB has

[11] See ADB (1997) and UN- HABITAT (2003) for an expanded discussion of the pros and cons of each arrangement and examples of where each type of system has been applied.

[12] See also the literature survey in Clarke *et al.* (2003) for more studies explicitly focused on the water sector.

[13] See http://www.niph.go.jp/soshiki/suido/omn/eventsactivities/Hue2005/Huefile/NRWcontrol-ArakiPCI.pdf.

[14] See D. S. Madhumathi in The Hindu Business Line, December 26, 2002 “Project to plug leakages: BWSSB to shortlist bids” (http://www.blonnet.com/2002/12/26/stories/2002122600811100.htm).

[15] See *The Hindu*, Wednesday, Jan 05, 2005. “Daily water supply only from March”.

announced plans for the Greater Bangalore Water Supply and Sanitation Project (GBWSSP), to supply piped water to eight townships on the outskirts of the city. The sewerage component of this project is likely to be financed by loans from JBIC and the International Finance Corporation. That private sector participation may be sought for this project has galvanized opponents (see Rao, 2006), because there is, so far at least, no clarity about how the poor will be served, how they will pay, or whether there will even be enough water supply in the pipes to serve the entire mandated area. Indeed, the lack of transparency and citizen participation on questions of the role of the private sector in the GBWSSP have led Janaagraha, a leading NGO, to disengage from the project altogether[16].

India's furthest step towards full privatization of water supply is the build-own-operate-transfer (BOOT) contract carried out by the New Tirupur Area Development Corporation Limited. Tirupur in the state of Tamil Nadu is India's largest producer of cotton knitwear and the textile exporters depend on water for their production. The industrial sector played a lead role in the development of a project to supply water to the dyeing and bleaching industries along with domestic consumers in Tirupur Local Planning Area. A BOOT contract was awarded after an international bidding process to a consortium of India's Mahindra and Mahindra, Bechtel and United Utilities JVC of the United Kingdom. These companies became equity owners in the project along with the Governments of India and Tamil Nadu and the Tirupur Exporters' Association. The project is expected to supply 185 million liters per day, with 125 million liters destined for the knitwear industry, 25 million liters for domestic users in Tirupur municipality and a further 35 million liters for surrounding villages and towns[17].

Although the Tirupur project has not met with too much resistance, anti-privatization activists have raised several objections. The first is that the groundwater in the area is of poor quality owing to pollution from effluents from the textile producers and now these producers will come to control the community's water supply. The involvement of Bechtel has also led to comparisons with the participation of a Bechtel subsidiary in the failed privatization effort of Cochabamba, Bolivia, which had little citizen consultation and resulted in large price increases (AID, 2003).

Further private sector engagement, such as concessions and leasing agreements, will be difficult without prior pricing reform. The proposed operation and management contract in Bangalore has encountered resistance, while a construction management project was cancelled in Pune, in part owing to pricing concerns (Sule, 2005). Opponents cited a lack of transparency and corruption allegations in both projects. While there are possible gains from private management of utilities, given current pricing levels it is easy for critics to argue that privatization causes rises in price. Indeed Davis (2005) finds that, where water sector efficiencies have been realized through PSP, unpopular tariff hikes were almost always present. Successful PSP therefore requires public awareness campaigns about the true costs of the current policies and for price rises to be clearly linked to improvements in access, quality and service. It is equally important not to oversell the reforms possible under private sector involvement through unrealistic goals and exaggerated public statements. Barja *et al.* (2005), for instance, posit that overselling of the capitalization process in Bolivia was one reason behind public disillusionment with the privatization process.

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[16] The Hindu, Feb 02 2006. "Janaagraha walks out of water project" (http://www.hindu.com/2006/02/02/stories/2006020223190300.htm).

[17] Sample sources: http://www.water-technology.net/projects/tirupur/; FIRE(D) (1999); The Hindu, February 16, 2004 "Tirupur water supply may begin by April 2005".

4.4. Water vendors, the "other private sector"

Residents who are outside the reach of the water utilities meet their water needs in different ways. The three most common supply options are shared standpipes operated by the municipality, illegal water siphoning and water vendors. In order to extend access to these areas within a reasonable time frame, low- to intermediate-level technologies and delivery mechanisms will continue to play a significant role (Brown & Holcombe, 2004; Sekhar *et al.*, 2005).

Water vendors are common in urban India, especially in the unserved areas of water-short cities such as Rajkot, Ahmedabad and Chennai. The vendors play an intermediary role, either reselling water from a municipally-supplied standpipe or obtaining water from a groundwater source and transporting it by tanker to slum areas where residents purchase it. Such privately vended water–which seldom has any quality controls–sells for from 5 to 50 times the price of piped city-supplied water. Few urban residents in India (1% according to the National Sample Survey, 54th Round) depend exclusively on water vendors, but during periods of scarcity they are the mechanism of water service provision for the poor (and in some cases the rich as well).

Though the *bhishti* (water carrier) is a traditional figure in India, water vendors today are generally vilified for exploiting the poorest. However, Solo (1999) reports that small-scale water and sanitation providers play a key role in extending access to these services, especially in Latin America. Kjellén (2000) shows that, given the inadequate state of Dar-es-Salaam's water infrastructure, small-scale water providers complement the public distribution system and do not provide poorer quality water to the slums than the city does to its official customers. Similar arguments in favor of water utility–small entrepreneur partnerships have been made for urban settlements in sub-Saharan Africa (Njiru, 2006). Chennai's Metro Water Board, as reported by Ruet *et al.* (2002), offers an example of devolution to local contractors as a way of coping with the joint scarcity of water and funds.

Chennai provides tap water for an average of just 4 hours a day and has a slum population of about 400,000, but 97% of its residents are covered via tap and tanker services (MIDS, 1995). The water board has contracted with 500 private entrepreneurs to supply various parts of the city, including slums that do not have public standpipes. Exnora, a Chennai-based NGO, works with the board to organize the slum dwellers into committees that distribute the tanker waters. The tanker transporters buy water from farmers outside the city centre, paying them just over Rs 3 per cu m and being paid Rs 15 per cu m by the water board (this includes the cost of transport and maintenance, in addition to the cost of water)[18]. Approximately 10% of the Chennai Water Board's annual expenses go towards hiring and monitoring these tankers. The contract is monitored by the Water Board–the tanker owners attend regular vigilance committee meetings (at which Exnora is also represented) and train their drivers. In return, they are guaranteed daily business and prompt payments. Private tankers that are not under contract to the board, in contrast, also buy water from farmers and sell the water in bulk to consumers. But the board has a chance to monitor the quality of water and service provided by those under formal contract.

Ruet (2004) suggests that such public–private-civil partnerships, some of which are already under way, should be expanded and formalized in several Class I cities. He argues that cities could start

[18] Today, these groundwater withdrawals are unregulated. Boreholes with electric or diesel-operated pumps deplete the common aquifer unless their numbers and spacing are regulated. Thus *unregulated* pumping from rural areas for sale to urban centres, as in the Chennai case, is clearly not viable in the long term. See Krithika Ramalingam, "Chennai sucking up rural water", *India Together*, April 25 2005.

with delivery arrangements through local entrepreneurs and only then consider contracting out to national or global companies. This would lower the risks borne by the companies (who would not have to reach distant and unconnected households) and reduce the chance of cutting out the poor and unconnected–at least where institutional safeguards exist. This implies that exclusivity provisions in concession contracts, such as those granted to the privatized Aguas del Ilimani in Bolivia, should generally be discouraged, lest they "close down the possibility of employing competition in the market to reduce prices, improve service, or provide alternative service options" (Komives, 2000).

In water-short cities such as Delhi, Rajkot and Ahmedabad, city governments already contract out to tankers to serve areas without piped connections or clean groundwater. We suggest that, given the significant infrastructure investment needed to extend piped connections to the urban unserved, the operating deficits of most Indian utilities, the inability of most slum dwellers to contribute to capital–though not necessarily operating–costs (Bajpai & Bhandari, 2001) and the unattractiveness of peri-urban areas to the formal private sector (Cairncross, 2003), more city governments should consider recognizing, contracting with and regulating local water entrepreneurs as mainstream rather than "interim" delivery mechanisms. In the absence of official recognition, water vendors will continue operating anyway, but without quality controls, price monitoring or accountability.

4.5. Political economy of reform

In light of the widespread inefficiencies in the Indian water sector, there is clearly ample scope for reform. However, as in most democracies, any major reform needs to survive (indeed, be part of) the political process, while even small changes in prices require public approval. As Noll *et al.* (2000) argue, several features of urban water systems make reform difficult. The political benefits of water reform are often low, while reform may involve giving up command of employment and investment in the public enterprise. Changes in prices and staff layoffs are more visible to the public than improved operating efficiency, reductions in state subsidies and small improvements in quality.

The longer reform is delayed, the more difficult it becomes. As Table 6 shows, water rates in Delhi remained constant between 1998 and 2004, at rates much lower than other cities and far below operating costs. In December 2004, tariffs were increased and a two-part IBT introduced. The first 6kl per month remained free. Although the Delhi Jal Board publicly justified the increase in terms of rising costs of production and with reference to the fact that prices were much lower than in other cities, the tariff rises were met with protests[19]. In particular, critics viewed the price rises as laying the ground for privatization of water, with little apparent recognition that even an efficient public utility in Delhi would require prices substantially higher than those prevailing pre-reform.

Promoting changes in the water sector therefore requires finding a way to raise the political benefits of reform efforts, or of increasing the political costs of not reforming. One key element in this regard is increased information and public awareness. The Sukthankar Committee (2001) suggests that local bodies should be made to publish fact sheets containing data on operations

[19] Sample sources: http://www.hindu.com/2004/12/01/stories/2004120116320300.htm, http://www.tribuneindia.com/2004/20041217/delhi.htm#1

Table 6. The slow evolution of tariffs in Delhi.

	Delhi Consumption slab (kl/month)	1995/96 Rate (Rs/kl or Rs)	1997/98 Rate (Rs/kl or Rs)	2003/04 Rate (Rs/kl or Rs)	2005/06 Consumption slab (kl/month)	Rate (Rs/kl or Rs)
Metered connections	Up to 10	0.46	0.53	0.53	0–6	0
	10–20	0.46	1.50	1.50	7–20	3
	20–30	0.91	2.25	2.25	21–30	10.5
	over 30	0.91	4.50	4.50	30 +	15
Minimum monthly tariff			30	30		40
Unmetered connections	all	9.75 (flat rate)	30 (flat rate)	30 (flat rate)		40 (flat rate)

Sources: Delhi 1995/96 and 1997/98 rates are from Zérah (2000: 74) and include 30% and 50% surcharges. Delhi 2003/04 rates from Delhi Jal Board (DJB), http://www.delhijalboard.com [accessed April 2004].

periodically and subject themselves to public review[20]. This would increase the transparency of the existing system and would allow for benchmarking of local water utilities with other cities. Taking this further, it would seem that benchmarking against neighboring countries, such as Nepal and Pakistan, might be a good way of increasing public dissatisfaction with the *status quo*. Public awareness could be further increased by reporting the results of water quality tests, along with information about hours of service and pressure. This information could be coupled with accessible data on how much water subsidies take from the state budget and price increases could be explicitly linked to targeted improvements in key sectors.

Public information and awareness appear to have played a key role in recent reforms initiated by Bangalore's Water Supply and Sewerage Board (BWSSB). In recent years Bangalore has witnessed citizen action concerning urban services, such as "report cards" on urban services undertaken by prominent local NGOs (Connors, 2005). Between 2000 and 2005, BWSSB implemented a series of pilot projects aimed at expanding its coverage for the poor. These pilots accepted non-traditional items such as ration cards and voter cards as proofs of tenure (Connors & Brocklehurst, 2006) and approximately 5% of Bangalore's (notified) slums were able to connect to the network, receive bills and make payments. In the Bangalore case, the motivation behind granting tenure security and thus network connections, while potentially pro-poor, is tied to the utility's own priorities of cost recovery.

5. Conclusions and directions for future research

The literature on drinking water in India is characterized by an overall sense of policy failure and barriers to access, punctuated with numerous examples of successful "cases". But what is each case a case of? Cases tend to be written up as examples of what their particular authors are interested in–of private sector participation, of fiscal reform, of willingness to pay, of civil society participation. It remains a challenge to answer the key question for designing an affordable and sustainable urban drinking water program–that is, what are the lessons from these diverse experiences? In this section, we return to the prominent themes in the literature and draw attention to some unexplored but policy-relevant questions. Because both the constraints on and the pressures for water sector reform in urban India mirror those of many rapidly-growing cities elsewhere, our suggested directions for more effective research, data collection and policy reform are relevant beyond the Indian context.

A major gap in the vast literature on cost recovery is the question of how the poorest urban citizens can be subsidized. Too often cost recovery is treated as a goal in itself rather than as a means to extending universal access. Targeting methods have both direct and hidden costs for the administration and for the poor (Van de Waal, 1998). Few empirical studies on cost recovery contain thoughtful discussions on cross-subsidization, though they may admit that it is necessary (e.g. WSP, 1999). While increases in price are required, the evidence suggests that subsidies will still be needed to provide for the poor. Geographical targeting of subsidies along with an emphasis on connection subsidies should probably be used to provide for lifeline water needs while increasing prices for non-poor users.

[20] Several NGO service providers do this already. As a result of a campaign led by Mazdoor Kisan Shakti Sangathan in Rajasthan, the right to information on public spending became the law of the state. In 2005, the Right To Information Act was passed as a national law.

With respect to private sector participation, relative to the burgeoning literature on efficiency or prices, analyses of the kinds of contracts, regulatory regimes and citizen oversight that can ensure accountability and the inclusion of low-income communities, are less common. Cairncross (2003) further points out that it is precisely those countries with severely malfunctioning water systems that most lack experience in negotiating contracts and establishing regulations with the large water companies. Some Indian states are more capable than others in this regard and have more effective citizen oversight. Without case-specific analyses of the environment in which PSP may succeed, the debate about privatization is likely to remain polarized at a yes/no or good/bad level.

There is remarkable consensus in the literature that governments should not be in the water provision business, but should ensure that private providers are regulated with respect to price structures and water quality and should provide incentives for these providers to serve the poor. This new role for government translates into developing partnerships with the private sector and with civil society for water delivery. To some extent, this is how the Chennai Water Board and Ahmedabad Municipal Corporation have begun to operate. Such partnerships could provide much-needed separation between the service provider and the regulator.

However, the consequences of devolving some responsibilities to neighborhood or residents' associations, as recommended by the Sukthankar Committee and implied in the 74th Amendment to the Indian Constitution, are poorly understood. Such devolution is no guarantee of equity or accountability and different communities are differently capable. There is at once the danger that a two-tier system will be cemented whereby the urban core continues to be subsidized while the margin is forced into "participation" and "partnership" (Jaglin, 2002), and the danger that only a select number of organized communities will get their demands met through their partnership efforts. Indeed Bangalore's citizen–state participatory movement has already been critiqued on the latter ground (Ghosh, 2005).

Finally, a major barrier to research and the design of appropriate policies is the lack of reliable, up-to-date and publicly accessible information on many aspects of the Indian water system. Baseline information is necessary in order to evaluate various reforms in progress and in order to allow for benchmarking against government targets, other states and nearby countries. A lack of transparency over the true costs of under-priced and inefficient municipal systems dampens public support for major reforms that may be needed. Incomplete and difficult-to-find information on groundwater withdrawals makes urban and peri-urban drinking water interventions unsustainable. While efforts are underway to carry out some benchmarking of financial performance of several large utilities, regular and comparable data need to be made available on, *inter alia*, water quality, subsidization, metering, groundwater levels and infrastructure maintenance. The power of benchmarking would be further enhanced if other countries were also to follow such procedures.

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