Reforming water sector governance and institutions for improving efficiency: the case of Mumbai

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Abstract

In India, the progress of the urban water supply sector has been very slow because of improper focus and inadequate reforms in the urban local bodies. Even large cities like Mumbai are yet to undertake reforms for improving the efficiency of water service provision. Mumbai's future requirements of water resources were to be largely met through an expansion of the water supply system in an incremental manner. However, such a course of action has now come under question due to a rapid rise in water demand (on account of the increasing population) on one hand and snags in supply on the other. As such, there has hardly been any strategic focus on 'demand management' and on improving the efficiency in service delivery. In spite of these lacunae, no reforms have been undertaken in urban water resources management as the concerned authorities refuse to acknowledge the water deficit situation in Mumbai. This paper argues against such a stance. It first provides a quantitative and analytical overview of the water resource status in Mumbai and then outlines the need for reforms on several fronts, particularly in water institutions and governance, while elaborating on some of them. It is hoped that the institutions and agencies responsible for water resource management will soon embark upon such a reform agenda and provide improved service delivery as well as adopt a pragmatic and balanced approach towards water management through a choice of policy instruments and institutional changes.

Introduction

Water is critical to human survival and fresh water is even more precious, given its limited availability and erratic distribution over space and time. It is imperative that water does not get wasted in the process of its use, and water institutions should ensure this through a variety of arrangements, as identified in the Rio conference (1992). Following it, the Dublin conference (1993) laid down two guiding principles for water resource management (Nickson and Franceys 2003).

- *Institutional principle* Water management should be based on a participatory principle involving users, planners, and policymakers at all levels, with the decision taken at the lowest appropriate level according to the concept of subsidiarity.
- *Instrument principle* Water has an economic value in all its uses and should thus be recognized as an economic good. Managing water as an economic good is an important way of achieving efficient and equitable use and encouraging the conservation of water resources.

In acknowledging the importance of the water sector, the World Bank, an important partner in world development (through development loan assistance), prepared a strategy paper in 1993. It explicitly stated that for improving the sector performance in meeting water requirements, the borrowing countries would have to reform their water management institutions, policies, and planning systems (World Bank 2002). The strategy paper emphasized the following initiatives for improving the overall management of the water sector.

- Building institutional regulatory capacity and taking a comprehensive approach to water sector planning and management
- Promoting cooperative arrangements/agreements for water management
- Involving all stakeholders and ensuring participation, decentralization, and partnerships as instruments for achieving effective water management.
- Adopting water rights, pricing, and incentives to encourage efficient allocation of water amongst competing uses; discouraging waste; and ensuring adequate water services
- Ensuring that water operations enhance human and natural environments, with special attention to different social groups, genders, and the poor

However, with an increase in the importance of institutions and the policy environment, the World Bank undertook a reassessment of its earlier strategy in 2002. This resulted in a revised strategy, focusing on the following transitional movements in water management (World Bank 2004): (1) from development to development and management, (2) from local to regional/international management, (3) from conflict to cooperation, and (4) towards public–private partnerships. The World Bank thus gave strategic priority to addressing the institutional framework, management instruments, development and management of infrastructure, and the political economy of water management and reform. This was implied in its strategies for individual countries as well.[1]

Almost at the same time, FAO (Food and Agriculture Organization) undertook a comprehensive overview of the water sector in terms of the principles, objectives, and the agenda for water sector reforms (FAO 1995). This general focus on water sector reform also matched public sector reform in developing countries that led to NPM (new public management) and the reform of public institutions and policies (Nickson and Franceys 2003). While a changing policy environment set the background for reforms in the water sector, its actual progress depended on the institutional structure, dynamics, and environment. These changes in institutional arrangements and process of change have been well documented with varying details, contexts, and perspectives (Le Moigne *et al.* (1992), Saleth (1996), Vermillion (1998), cited in Saleth and Dinar (2005). The importance of reforms in water institutions can be gauged by the impact they have had in a cross-section of countries, particularly in the Latin American and African continents, including those in the Middle-East (Ahmad 2000).

While these changes were underway, the urban water sector began to assume greater importance across the world, and primarily in developing countries, due to an increase in the urban population. Dynamic economic growth began to place greater pressure of production and consumption demands on the existing water resources. In order to meet these challenges it became imperative for India's urban water sector also to embark upon

[1] J Briscoe, Senior Water Advisor to the World Bank, in his inaugural keynote address at the Fourth Annual International Water Management Institute–Tata Water Research Partners' meet 2005 on 'India's Water Economy: Bracing Up for a Turbulent Future' at the Institute of Rural Management, Anand on 24–26 February 2005.

the path to reform. A consensus on the need for reform among political institutions set the stage for reforms (Mathur and Thakur 2003). Nevertheless, the eventual success of reforms depends upon several key factors. These factors include the political environment, external support agencies' activities, engagement of the 'elite', socio-economic environment, crisis, output-performance gap, approach to reform, and likely impacts on the society (Mosley 2004).

Indian cities are not yet fully geared-up for reforms. They follow the old guiding principle of limited supply expansion, use irrational water pricing methods, persist with inadequate organizations and systems, and are yet to formulate their agenda in implementable terms. There are a few comprehensive cross-sectional water sector studies that elaborate on the status of the urban water sector and reforms therein. Some of these studies are reviewed as follows.

- The World Bank (1999) study is the first comprehensive review of the urban water sector in India. It identifies the following reasons for an unhealthy urban water supply: the tariffs are not adequately reflective of the cost of services; there has been poor cost recovery in the case of urban water supply projects; subsidies are neither well-designed nor appropriately targeted at the needy groups; and the investments in water supply projects are inadequate to meet the growing needs. This study emphasizes the need for taking bold steps towards reform on several fronts. It posits reform as necessary to break the vicious circle created in the form of lower-level equilibrium trap and to create virtuous circles in the urban water supply sector (Figure 1).
- The TCG International (2001) study provides an overview of the rising importance of the urban sector in India and the need for reforming urban service delivery in order to meet new challenges. It deals primarily with issues concerning urban service delivery and the interventions to be made at local, state, and central levels. It advocates improved urban governance through interventions in finance, management, regulation, and project development at the level of ULBs (urban local bodies). An analytical study, it identifies potential interventions that can be made and the results achieved within the scope of FIRE(D) (Financial Institutions Reform and Expansion-Debt Market Component) project.
- The Ruët, Saravanan, and Zérah (2002) study critically evalu-

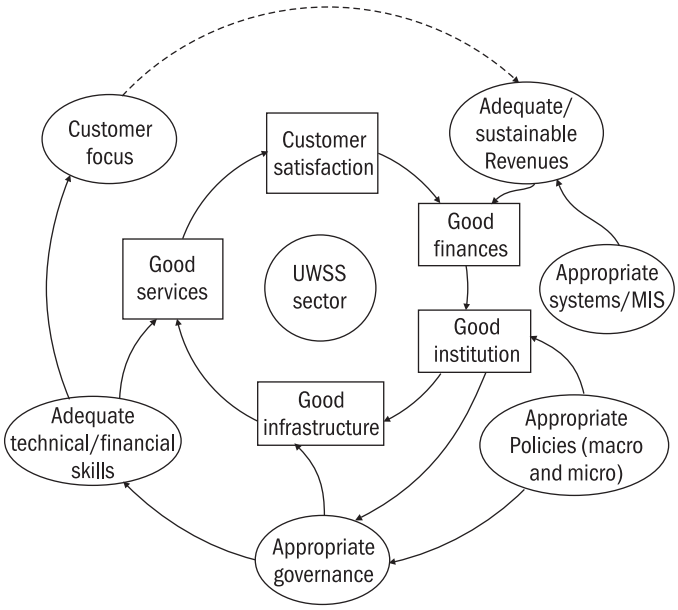

Figure 1 Creating virtuous circles in water management in cities
Source Adapted from the World Bank (1999)

ated the water supply and sewerage systems in four major Indian metros – Delhi, Mumbai, Chennai, and Kolkata – in terms of: (1) physical supply; (2) financial position, including tariffs and cost recovery; (3) institutional coordination and arrangements; and (4) alternative services for the poor. Its findings indicate that water supply arrangements and their management differ widely among the four major metros. It advocates improving the water situation through conservation-based water planning, efficient tariff design for cost recovery, more effective participation of the public in the delivery of services, and addressing the needs of the urban poor.

- The Mathur and Thakur (2003) study focuses on an important aspect of water sector reform – urban water pricing. This issue was given particular importance in the reform agenda of the ULBs of the Tenth Five-year Plan. It examines this aspect in detail by reviewing the instruments of water charging, the existing pricing structures, and the price-cost linkages through a diagnostic review of five Indian cities – Agra, Allahabad, Bangalore, Pune, and Vadodara – which display diverse institutional arrangements for operating water supply systems. In the study, these cities (and the ULBs) were evaluated in terms of adequacy/pitfalls in water charging methods, the

unit cost of water provision, the extent of recoveries on water sales, and the extent of cost recovery through pricing. This study was the first of its kind and it outlined the need for bringing about reforms not only at the sector level but at the individual city/ULB-level by restructuring the pricing structure, particularly the water tariff structure.

While cross-sectional studies emphasize the need for reforming the urban water sector, contextual studies in the specific cities or states serve to direct policy makers, who operated at that level. A few studies were undertaken at the state level in India recently (Pangare, Kulkarni, and Pangare 2004) that provided a regional/state-level overview of water. However, these studies were bogged down with the details of macro-institutional reform and concentrated on a few cities/ULBs and generalized their findings to the entire state/region.

City/ULB-level studies that can evaluate and provide relevant context to reform appear to be in short supply at present.[2] However, there has been an attempt to fill in this gap through a case study of Mumbai. This study was motivated by the media's reports of water scarcity in Mumbai during the period of the delayed monsoon (Nallathiga and Sabale 2002). However, as media's attention focused on the fluctuating water levels in the reservoirs, the lack of a holistic view of water resources prompted an evaluation of Mumbai's water resources and a review of the past study (MCGM 1994). A discussion paper that emerged from the findings was presented in a seminar (Nallathiga 2002) and published (Nallathiga 2003) as well. Later, the scope for reforms in the urban water sector was critically examined in order to suggest an alternate course of action to the policy-makers and decision-makers concerned with water resource management in Mumbai.[3]

This section has provided the background and motivation for the study, while the next section explains the approach and methods. Subsequently, the status of water resources in Mumbai is presented and following that, a situation analysis raising im-

[2] An exception to this is the study by Smitha (2004), which evaluates the performance of the service provider–BWSSB (Bangalore Water Supply and Sewerage Board)– in terms of the trends in the adequacy of water coverage, distribution, and consumption, and reforms at the ULB in governance, infrastructure, citizen empowerment, and corporatization.

[3] The study report of FAO (1995) served as a valuable reference document.

portant issues concerning water management. Finally, the reforms in water institutions and governance are articulated.

Approach and methodology

The study evaluates the state of the water resources, as a first step, by reviewing the current as well as the expected, future state of water resources. In other words, it analyses water supply *vis-à-vis* its demand, which provides a quantitative overview. The study then analyses existing water management institutions.[4] Subsequently, the shortcomings of the current approach to water management are discussed in the situation analysis, particularly with reference to the relevant experiences of other cities. Finally, a reform agenda is drawn up based on the situation analysis and citation of relevant literature. The paper, therefore, argues for the need for reforms in institutions and governance of urban water supply in Mumbai, which primarily concerns the main water supply entity – MCGM (Municipal Corporation of Greater Mumbai).

This study employed a combination of research methods in order to meet its objectives. Secondary data from various sources was collected and analysed in an effort to gauge the status of water resources. Desktop research was undertaken to review the provisions laid down by MCGM (MCGM 1994) and to review the relevant literature as well as case studies. Stakeholder meetings were organized to understand the lacunae in the current water supply system. The workshop approach was used, in which the current water resources status facts and figures were presented to the stakeholders[5] and their observations/responses were noted down and discussed. Finally, a reform agenda was drawn up based on the findings of the situation analysis, stakeholder feedback, and desktop research. An operational framework for its implementation was also prepared.

[4] By water institutions, a narrow concept of institutional arrangements for water management is implied, and, within it, the primary concerns with the main water supply organization in order to perform a meaningful evaluation and identify the reform areas. For a broader and deeper discussion of water institutions, Saleth and Dinar (2004 and 2005) are useful references, as they have built upon wider literature featuring deeper aspects of institutions *per se*.

[5] The main stakeholders consulted here include: the major service provider–Municipal Corporation of Greater Mumbai (the chiefs of the concerned departments), the key officials at Mumbai Metropolitan Region Development Authority, the civil society groups/NGOs, as well as the general public (through an open seminar on the topic).

Water resource status in Mumbai

Mumbai has been deprived of appropriate water resource management largely due to a perception among decision makers that there is adequate water inspite of rapid population growth. The city, which was originally formed as a cluster of seven uninhabited islands about four centuries ago, emerged as the trade and commerce capital of the country with the largest concentration of human beings. The city grew steadily to become a peninsular city by joining mainland India and today it is 432 km^2 (MCGM 2003a) within the jurisdiction of MCGM. MMA (Mumbai Metropolitan Area), which comprises 16 small and medium municipal corporations (including Mumbai city), is spread over 4500 km^2.

Along with the city's growth, the nature and availability of water resources has been changing, from an initial dependence on wells and tanks within the city to water impoundments made 100 km away from the city, on the mainland. This latest system involves using the existing gradient and gravity to bring water down into the city using water pipelines. However, by and large, the water supply infrastructure was laid down during colonial rule, when large land reclamations took place to create the Bombay island city.

Water supply

Mumbai city primarily draws water from the nearby reservoir impoundments created in the catchments to the north of its location. The total water resources available for utilization in the BHA (Bombay Hydraulic Area) have been estimated at 7869 MCM (million cubic metres)/year at 95% dependability and 10439 MCM/year at 75% dependability (MCGM 1994). However, only a fraction of this is available for consumption due to the limited potential for tapping into natural and artificial reservoirs. This fact is reflected in the limited number of reservoirs in the BHA. Currently, the water harnessed amounts to 2969 MCM/year. With an additional 292 MCM/year earmarked for utilization, the sum total of water harnessed would go up to 3261 MCM/year (MCGM 1994). Table 1 shows the source-wise water supply.

The water harnessed in the impoundments is brought down to the levelling reservoirs in the city through a conveyance pipeline and distributed through a network of major and minor pipelines.

Table 1 Source-wise water supply in Mumbai

Catchment area/ lake	*Daily water supply* (MLD)
Vaitarana catchment Area	
Modak Sagar, Upper Vaitarana	1160
Tansa	455
Bhatsa Catchment Area	1450
Other Catchment Areas	
Vihar	110
Tulsi	18
Total	3193

Source MCGM (2002)
MLD - million litres per day

MCGM has an installed water supply capacity of 3193 MLD (million litres per day) from these reservoirs. Of this, 100 MLD is delivered to the Thane Municipal Corporation, leaving a balance of 3093 MLD for Mumbai (Table 2).

Water quality is currently monitored by MCGM, only at the sources, in order to ensure that the water being supplied meets with the potable drinking water standards of MPCB (Maharashtra Pollution Control Board), which is the regulatory authority for water quality. At the receiving end, water quality is monitored by the ward offices of MCGM. This is periodically reported in terms of the proportion of the samples with contamination (MCGM 2003a). The current water quality at the sources shown in Table 3 broadly meets the criteria of water supply laid down under BIS:10500-1991 in terms of physical parameters, but

Table 2 Source-wise yield of water for Mumbai

Year of operation	*Source*	*Yield* (MLD)	*Distance from city* (km)
1860	Vihar	70	20
1872	Tulsi	18	30
1892–1945	Tansa	410	110
1954	Vaitarana	490	130
1972	Upper Vaitarana	560	180
1980	Bhatsa - I	455	130
1989	Bhatsa - II	455	130
1998	Bhatsa - III	455	130
	Total	2913	

Source MCGM (2003a)
MLD - million litres per day

Table 3 Water quality status at source in Mumbai

Parameter	*Unit of measurement*	*Water Source*		
		Tulsi Lake	*Vihar Lake*	*Panjrapur Lake*
Turbidity	NTU	2.7–20.0	6.3–12.0	1.9–>1000
PH	mg/l	7.1–8.6	7.7–8.8	6.5–7.7
Alkalinity	mg/l	38–50	45–56	20–77
Chlorides	mg/l	13–16	13–15	7–14
Total hardness	mg/l	44–60	56–62	26–82
Total coliform	MPN/100 ml	0–275	80–900	220–1600
E-coli	MPN/100 ml	0–140	9–140	49–170

Source MCGM (2003a)

NTU - Nelson's Turbidity Unit; mg/l - milligram per litre; MPN - most probable number

does not conform to the same in terms of bacteriological parameters, such as coliform counts, indicating poor water quality.

Water demand

The water demand in Mumbai consists primarily of a domestic and industrial component. Although industrial use accounts for a substantial amount of water, most of the water intensive heavy manufacturing industries have moved outside the city, paving the way for low-water consuming, light manufacturing units and service industries. However, as the population of Mumbai city continues to grow, so does its water demand, though the growth rate has gone down slightly in the recent past (Table 4).

Table 4 Population and its growth in Mumbai (1901–2001)

Year	*Population* (in millions)	*Growth* (%)
1901	0.93	–
1911	1.15	23.7
1921	1.38	20.0
1931	1.40	11.5
1941	1.80	28.6
1951	2.99	66.1
1961	4.15	38.8
1971	5.97	43.8
1981	8.22	38.0
1991	9.92	21.1
2001	11.91	20.1

Source MCGM (2003a)

Table 5 Water demand projections for Mumbai by the Water Resources Expert Committee

Description	*2001*	*2011*	*2021*
Domestic use	2841	3310	3747
Non-domestic use	700	700	700
Sub-total	**3541**	**4010**	**4447**
Other uses (@2%)	71	80	89
En-route supply	90	90	90
Leakages	740	669	555
Losses through plants	178	194	207
Total	**4620**	**5043**	**5388**

Source MCGM (1994)

Water for domestic use accounts for the largest share of water supply to the city. In 1991, for example, domestic use accounted for 3093 MLD of the total 3930 MLD utilized on a whole. In its 1994 report, the Water Resources Expert Committee (MCGM 1994) had projected the population for the years 2001, 2011, and 2021 in order to assess the demand of water. These estimates appear to be far more realistic, in view of the fact that the population projection for the year 2001 came very close to the actual recorded figures of the census survey. Attempts are being made to reduce leakages from 20% in 2001 to 16% in 2011 and 12% in 2021 as is shown in Table 5.

Future requirements

To meet the future water requirements of the city, MCGM has apparently made provisions through planned water projects. These projects involve the construction of water intake structures at rivers and natural lakes and impoundment of reservoirs in the upstream catchment areas of BHA. While the Bhatsa project was yet to be completed, even by 2005, the Middle Vaitarana project did not even commence for the want of environmental clearance, as it involved loss of forest cover due to reservoir impoundment (Table 6).

Table 6 Water resource projects for meeting demands in future

Project	*Capacity* (in MLD)	*Expected year of completion*
Bhatsa - IIIA	355	2003
Middle Vaitarana	455	2011
Kalu	590	2025
Gargai	455	2017
Shai	1067	2030
Pinjai	865	2025
Total	3787	

Source MCGM (1994)
MLD - million litres per day

Institutional arrangements for water management

The institutional arrangements for water management are as follows.

- MCGM is the main institution responsible for overall water management within the jurisdiction of Mumbai. It acts as a water resource developer and supplier, an owner of the distribution network and the water works, a service provider, and an agency for fixing tariffs and collecting water charges.
- CIDCO (City and Industrial Development Corporation) assumes a similar function in Navi Mumbai, a satellite township of Mumbai.
- In other areas within the MMR (Mumbai Metropolitan Region), water supply is primarily undertaken by the corresponding municipality, that either purchases water from MCGM (which is minimal) or uses groundwater.
- Water procurement is facilitated by MJP (Maharashtra Jeevan Pradhikaran), which acts as a state water agency.
- MMRDA (Mumbai Metropolitan Region Development Authority) prepares regional-level strategic plans for ensuring adequate water supply during the plan time horizon.
- Water quality monitoring is carried out by MCGM through its ward offices and MPCB is responsible for setting standards and ensuring compliance in terms of meeting the water quality norms.

MCGM has a separate water supply division that takes care of a wide range of its operations–service delivery, maintenance, water

works, meter reading, billing, and procuring municipal appurtenances. Its hydraulic engineering division is responsible for the construction, operation, and maintenance of reservoirs, intake structures, treatment plant as well as all hydraulic instruments, including large pipelines. It also lays down regulations on the use of material for water storage. It oversees everything, from the distribution systems to water supply to the meters that can be used for water consumption measurement (MCGM 1976). Yet, water supply is intermittent, with an average supply of two hours per day in the city and three and a half hours in the suburbs.

The common coping strategy to deal with this irregularity is the construction of underground storage structures for drawing water from municipal water pipelines. The water stored herein is then pumped up to overhead tanks, from where it is supplied to individual housing units/flats through building pipelines. Furthermore, most of the population (almost 50%–60%),[6] which lives in slums and squatter settlements, resorts to collecting water from the public taps (or community standposts) during the limited hours of water supply and storing it in their own storage tanks.

Water pricing

Water pricing is an important component of urban water supply, particularly in relation to its costs and objectives. Whereas the cost of water supply provision (of old assets and conveyance) is roughly around Rs 4/1000 l(litres), the price charged for water supply ranges from Rs 2.25/1000 l in residential slums (or chawls), to Rs 3.50/1000 l in high rise buildings, while commercial/industrial units are charged in the range of Rs 10.50–Rs 38/1000 l, depending upon the consumption level (MCGM 2002). The water tariff structure of metered connections in Mumbai is essentially a uniform rate structure that distinguishes between users on the basis of their usage requirements and, to some extent, their socio-economic status. There are about 246000 metered water connections and about 75 000 un-metered water connections in Mumbai (Padwal 2003). In the case of un-metered connections, water tariffs are levied at 65% of the annual ratable value of the property under residential use and at 130% of the annual ratable value of the property under commercial/industrial use (MCGM 2002).

[6] Slum population figures are widely disputed–official estimates are at 50% whereas the activists and other sources estimate it at 60% (Dadich 2002).

In addition to the consumption charges, consumers are also required to pay a water benefit tax that has been fixed at a flat rate of 12.5% of the ratable value for residential premises, and 25% for non-residential premises. Moreover, as 70%–80% of the water supplied exits as sewage, and its management is an essential service of the municipal corporation, sewage collection is charged at a rate of 60% in the case of metered and 39% in the case of non-metered connections. For commercial/industrial units, it has been fixed at 78%. The sewerage benefit tax, like with the water benefit tax, has been fixed at 7.5% and 15% of the ratable value for residential and non-residential premises, respectively.

So far an overview of the water sector in Mumbai has been taken both quantitatively, in terms of the demand and supply status, as well as qualitatively, in terms of institutions and pricing. The next section provides a critical analysis of the features of the current system and evaluates its performance in terms of various parameters.

Situation analysis of water

The status of water resources in Mumbai needs to be analysed in terms of its inadequacies, relative position, and the scope for reforms, which is what is attempted in this section. The expert committee of MCGM (MCGM 1994) made a comprehensive analysis of Mumbai's water supply system and identified some areas in which reforms are required. It did not, however, look into many aspects of water supply, such as water demand management, tariffs, service delivery, and staffing norms Instead, it focused on supply-side improvements.

Adequacy of water supply

The average gross per capita water supply in Mumbai city is 260 lpcd (litres per capita per day) and the net water available for domestic use is about 155 lpcd. The net available water supply exceeds the BIS (Bureau of Indian Standards) norm for planning an urban water supply system, which has been set at 135 lpcd. This points to a satisfactory water supply status. However, the fact that there are a good number of private water suppliers (such as mobile tankers) and there exists a conspicuously large market for bottled water, it is clear that the deficits in water supply are not so obvious from the aggregates. Moreover, these

aggregates should not make the municipal authorities complacent. Spatial, temporal, and sectoral coverage of water supply is still inadequate. In other words, some parts of the city do not receive water at all, other parts receive an intermittent supply, and some sectors enjoy greater privileges in terms of access to water than the others. For example, slum dwellers receive highly inadequate levels of water supply (about 40–50 Lpcd) as compared to apartment dwellers. Furthermore, water supply is unreliable in remote areas, at a distance from the main trunk line of the distribution system. Water markets are emerging in the peripheral areas due to the unreliability of water supply and the people favour supplementing the municipal water supply with tanker water supply, in order to ensure the availability of adequate water. At the same time, water transfers are also taking place at an exchange price between the locations without a municipal water connection and those with water connections, primarily for drinking purposes. Moreover, bottled water supply is very much in vogue in various parts of the city, which offsets the unreliability of the municipal water supply, due to the demand for good, reliable water and people's willingness to pay for it. In fact, the economic importance attached to water is reflected in the price people pay for bottled water in the city, which is exorbitantly high at Rs 10 per litre. This has implications for water tariffs, which are discussed subsequently. Yet, MCGM indicated that it was planning to implement measures to reduce water loss by using a host of technical tools to identify the sources and plug them (MCGM 2003b). While this is a positive step, it is not clear whether leakage can be fully stopped, given that, as per the officials, part of it is in the form of pilferage in slum areas.

Water resource development

Water resource management in India, in general, and in urban areas, in particular, has focused heavily on expanding the supply, whereas there is scope for improved demand management. This means that water management requires a balanced approach (Maheshwari and Pillai 2001). In Mumbai city as well, water resource management has focused on supply expansion alone. Even though there is scope for the development of water resources in Mumbai, its costs might rise sharply in future. This could make it difficult to tap into the remaining water potential. Moreover, the burgeoning of urban areas in the metropolitan

region may make it difficult to obtain land in future for laying down pipelines for conveyance and distribution. Also, even when land is acquired, the cost of laying down pipes will increase. The expansion of the city poses a threat to some of the existing water sources, as is evident in the extinction of Lake Powai as a water supply source. In contrast, the demand for domestic water use has been constantly increasing over time, and there will be more demand for water from the surrounding urban areas as well as other cities within MMR having rapidly increasing populations. Evidently, water availability is likely to assume a critical state where demands will far exceed overall supply, even after augmenting the water supply. In particular, the completion of the Middle Vaitarana and Bhatsa projects is considered to be critical for enhancing water supply in the near future (private communication, 2003).[7] The fact that there was a delay in the construction of the Middle Vaitarana dam due to the failure to get environmental clearance resulted in a huge cost escalation for that project. This should act as an eye-opener for decision-makers. Likewise, a linear projection of costs would be inaccurate if the service levels of MCGM were targeted at improving, or even coping-up with, future demand.

Water supply distribution efficiency

Of the gross available water supply of 3193 MLD, the losses through leakages and other sources make the net available water supply 2320 MLD, which includes 600 MLD of water for the non-domestic purposes of industry and commerce. The water supply in Mumbai falls short of actual demand by about 900 MLD. The losses arising from leakages in the water supply distribution system amount to a high of 25% and above, despite MCGM's attempts to reduce it to 15%. Incidentally, the causes of water leakage include pilferage and losses from pipelines (which are about 50–100 years old). Moreover, though adequate water is brought down to the city, its supply is intermittent. In contrast, some of the cities in western countries, inspite of having a per capita water supply less than that of Mumbai, have

[7] It is estimated that there are about 35 employees per 1000 meter connections, which is very high figure as compared to the 1–2 persons per 1000 meter connections estimate for Singapore (ADB, cited in Padwal 2003). While, the estimates might be inflated, given the large number of un-metered connections and community tap connections, yet they reflect the high staffing levels prevalent for the service.

attained the service levels of continuous water supply made available to their citizens.

In Mumbai, the distribution efficiency, as per the service level norms, is also not being met. While the municipal norms of water supply have been fixed at 45 lpcd in slums, 90 lpcd in chawls, and 135 lpcd in high-rise buildings, the actual water supply varies between wards and within a ward. For example, it varies from 50 lpcd in slums to 250 lpcd in high-rise buildings. Erratic water supply is a marked feature in summers. These factors illustrate inadequate service delivery, a fact MCGM refuses to acknowledge.

Current practices in water management

The complete range of water supply and sewerage functions is entrusted a single entity–MCGM. This concentration of all services in the hands of one large organization (or monopoly) has resulted in inefficient service delivery and rampant corruption at various levels. This is exacerbated by the fact that operations are neither automated nor well-defined, which is not so in the case of professionally-run organizations. The current budgeting/fiscal practices do not fully reflect the value of the fixed assets created. Rather, they provide scope for departments working without coordination. Water supply is carried out by various departments of MCGM–the hydraulic engineering department deals with the engineering aspects of water development and distribution works, water bills are prepared by the bills division, and meter readings are recorded and water charges are collected by two separate departments. Internal coordination is established through ledgers and files, rather than systems that make use of electronic information, databases, and dispatch methods. The staffing ratio is high against the service provided[8] and duty specification has not been achieved yet, in order to foster an environment of employee accountability. The inefficiencies in the service levels of BMC, coupled with frequent pressure from the employees' unions for better wages, are responsible for the public antipathy towards it. Yet, little has been done to improve the water supply or even the organization providing this service. The

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importance of data generation, storage, processing, and retrieval at various levels and its use in policy-making as well as public interface are somehow completely ignored, whereas FAO (1995) clearly expects the city authorities to plan and design information systems for effective water resource management. Moreover, although the 74th Indian constitutional amendment provided urban local bodies with more autonomy in decision-making and encouraged financial self-sufficiency, the attainment of these through organizational capacity-building and improved citizen interface has not been adequately thought out.

Inefficient water tariff structure

Water tariffs in Mumbai were designed to recover costs and to cross-subsidize the residential use. Unfortunately, these are not being used as a demand management tool yet. Water tariffs have not been able to match the cost of water supply. They have sufficiently funded about 40% of capital works as well as managed to meet operation and maintenance charges. Ideally, the urban water tariff system should attempt to recover (1) cost of consumption, (2) cost of access to service (network), and (3) cost of making the option available (Bagchi 2003). However, the fact remains that the full cost of the water supply service is not recovered through the current system. This can have a long-term impact on consumption patterns, leaving consumers with little incentive for directing efforts towards water conservation. Moreover, the environmental value of conserving water is also not well realized due to such a 'consumption-friendly' tariff structure. Although water is a public good, the necessity and luxury aspects of it need to be distinguished through water pricing. Instead of levying a uniform charge tariff for domestic as well as other uses, MCGM should identify the threshold point of necessity (in order not to burden the poor) and levy higher water tariffs for greater amount of unit water consumption.[9] Given the fact that a reasonable level of metering has been achieved, it should make attempts to move towards introducing volumetric pricing of water supply for consumption in the long run. It has been reported that a good amount of meters are faulty (Padwal

[9] It is also known as 'lifeline' block, under which the consumption can be provided at low prices to ensure their affordability. In Johannesburg, it is even provided free of cost, which needs to be followed here. The local government needs to specify the size of the lifeline block contingent based upon the state of finances and the objectives of the tariff structure reform, rather than taking risks with the politically determined, rigid lifeline block.

2003), which is a different issue that requires solutions in the form of improving the existing water metering department or inviting private parties to take care of this function. Moreover, the domestic water tariffs are pegged to property rental, which not only is an inefficient method but also exposes it to the same distortions that exist in land and housing markets. For example, the annual ratable values in some locations are very low due to the operation of the rent control act, and they are already adversely affecting the property tax (Nallathiga 2003). These distortions are difficult to correct. Basing the water tariffs on such distortions will also result in the same difficulties. Furthermore, while the domestic to non-domestic water consumption ratio is 90:10, the water revenue ratio for the same is 50:50 (MCGM 2003b). This reflects the disproportionate burden shared by the industrial sector. Also, the increase in water charges for industrial use has been higher than that of the water tariff increase for domestic use. High water charges for industrial use have affected industries and employment in the past. Tariff needs to be restructured in order to reduce consumption below the threshold level in the domestic sector, preferably based on IBT (increasing block tariffs).[10] In addition, attempts should be made to minimize the cross-subsidy between the industrial and domestic sector initially, leading to its eventual abolition, as discussed in the reform agenda in the next section.

The need for reforms

The situation analysis clearly outlines the need for bringing about reforms in water resources management in Mumbai (as well as other urban local bodies in MMR). This requires bringing about changes in the current institutional arrangements and in the mode of service delivery, which did not come to the attention of the decision and policy makers.[11] In particular, some systemic changes in water supply, tariffs, service, and accountability are

[10] However, IBTs need to be designed well such that they meet with the principles of efficiency, equity, and fairness; ill-designed IBTs can at the same time cause much damage to the poor residents or fail to recover the costs (Boland and Whittington 2000).

[11] This is in stark contrast with the experience of reforming the water sector for improving service delivery in Johannesburg, another developing city, which rightly recognizes the need for improving the key infrastructure (including water) for transforming the city (Moloi 2005). In fact, Johannesburg demonstrates how service delivery improvement can be comprehensively achieved through the use of institutional, policy, and politico-legal instruments.

required for efficient and effective service delivery. Moreover, good urban water management is also necessary to avoid any possible conflicts among the cities within the metropolitan region, including Mumbai, Thane, and Navi Mumbai. Some structural improvements to water resource management have already been highlighted in MCGM (1994). MCGM (2003b) also plans to reduce leakages from the water supply system through a range of technical measures. While these changes are required on the technical and organizational front of MCGM, institutional and governance reforms are much needed in order to attain a better, more responsive water resource management system.

Institutional reforms

Good water management requires putting in place good institutional arrangements. In particular, as countries (and cities) move from a state of plenty to water scarcity, institutions, which define the rules of water development, allocation, and utilization, have to be concurrently reoriented to reflect the realities of the changing supply-demand and quantity-quality balance (Saleth and Dinar 2004). This necessitates transformations in current institutions and the creation of new ones to meet management objectives and create institutional capacity.

Unbundling of institutions

The unbundling of service delivery (design, operation, and maintenance of water supply system) and the policy and regulation functions of the water supply system in Mumbai should be the first step of the reform process. It is almost a necessary step in any urban infrastructure reform, which has been undertaken by several states in India, including Maharashtra, in the case of the power sector (MEDC 2002). Cities like Bangalore, Hyderabad, and Chennai have implemented it by setting up autonomous corporations/boards for water supply and sewerage functions (which are also known as parastatals) and have successfully transformed the management of their water supply systems. However, it is also important to group water supply and sewerage functions together so that the returns from beneficial operation of water supply can be utilized for improving the sewerage system.[12] On the one hand, there is generally a low

[12] Most of the poor do not have access to a sewerage system. Alternatively, decentralized sanitation solutions, particularly for poor people in slums, could be provided through specific capital expenditure of the Board or through donor assistance. This opinion was

willingness-to-pay for sewerage service among the urban households, which cannot fully cover the huge costs associated with the maintenance of sewerage systems. Water supply, on the other hand, has a high willingness-to-pay. Historically, Indian cities have clubbed water supply and sewerage functions. However, charges were levied separately, but some implicit subsidy has prevailed. Moreover, since sewerage is largely related to household water consumption, the apportionment of its charges would be easier. Separating sewerage from water supply can potentially lead to its neglect, which can result in huge costs in terms of reduced public health.

Corporatizing the function of water supply

The water supply unit has to function like a professional body with meticulous planning and control of its finances and operations. It has to shift from its dependence on public grants to undertake borrowings for financing the development of the water system. The borrowings can be made in the form of debt from private parties, with transparent and market-based obligations, or the form of bonds. Such measures are designed to bring about a degree of professionalism in the water supply service delivery by making the administrators accountable for fiscal discipline through the obligation of financial performance. Another alternative could be taking loans from development financial institutions and banks. Essentially, the return on investment obligations, made through debt and bond market borrowings, compels them to perform well in order to attain the targets.[13] Such accountability becomes necessary when complacency prevails over service delivery, which usually happens in publicly administered services, such as the city water supply. However, this does not mean devolving the function to the private sector. Rather, in a sector like water supply, where there exist natural monopolies in the case of a public good, public service can keep costs low, so long as it does so without compromising services. Public service delivery improvement, by changing its orientation, will lead to better distribution benefits of a public good like water. This accountability will prevent the occurrence of debacles like the

voiced by the civil society groups/ NGOs, given the poor levels of sanitation in cities (less than 50%).

[13] See Mohanty (2003) for further discussion on the financial resource mobilization strategies for municipal corporations, based on the experience of Hyderabad city.

huge amount of water loss (almost a third of the total) incurred through the current water supply network. Such a loss is a wastage of natural resources, money spent tapping the water, and the expense of bringing it down to the city. A professionally managed corporation would not have allowed such wastage to take place.

Outsourcing of non-essential services

MCGM needs to concentrate on the delivery of core services, rather than in the provision of non-core services. The same applies to its water supply function. This would enable it to identify areas of expertise and of strategic importance. Many peripheral activities, such as organizational services, billing and metering, and service provision components, (pipe laying and data and information systems support) can be outsourced to private sector players through efficient use of management contracts, joint implementation contracts, and similar instruments. This reduces the burden of monitoring and executing all functions by the authority, on the one hand, and provides scope for system improvements and concentration on core services, on the other. It also gives these agencies an opportunity to innovate incentive structures and new practices that will lead to better service delivery. The advantages of long-term contracting and its variants are discussed in Johnson, McCormally, and Moore (2002). Furthermore, private participation can also come in the form of cooperative institutions involving themselves in service management (Swaminathan 2002).[14] However, some municipal officials cite the problem of labour union resistance, which needs to be solved if the reform were to improve the overall performance.

Formation of institutions

Institutional reforms need to be supplemented by the formation of an (1) autonomous CWSE (City Water Supply Entity) for discharging administrative functions, and (2) autonomous financial entity, along the lines of IDF (Initiative Development Fund) suggested by the GoM (Government of Maharashtra) 2001, for taking care of the funding of large projects and system improvements, including capacity building exercises, which are akin to the Project Development Fund mechanism suggested by The

[14] Rosenthal and Alexander (2003), for example, list the major types of contract arrangements available for private sector participation in water resource management.

World Bank (1999). The main features of such autonomous CWSEs as well as IDFs are defined, for instance, in GoM (2001) (Box 1). In such re-organization, the municipal corporation shall specify the appropriate service standards to be achieved, covering the aspects related to service delivery, reliability, continuity, and norms for the redressal of consumer grievances. Moreover, there is a need for the creation of an independent regional water authority, such as MMRWA (Mumbai Metropolitan Region Water

Box 1 Institutional structure for city water supply management

City Water Supply Entity

The main features of CWSE (City Water Supply Entity) will be as follows.

- It shall be set up independently as a municipal enterprise/undertaking or a company under the Companies Act or a water cooperative society under the Cooperative Societies Act.
- It shall take the form of long-term concessions (25–30 years) with private firms, selected on a competitive basis.
- The ownership structure is to range from fully owned by the urban local authority, to joint public-private ownership or even fully privately owned.
- It will serve either one urban local body, such as MCGM, or several ULBs.
- CWSE has to mobilize its own investment resources from the market on a proposed commercial basis through capital market, domestic financial institutions, or the proposed IDF (Initiative Development Fund).
- Outsourcing of services to the restructured MJP, private sector, NGOs, or community groups, needs to be done as appropriate.

Initiative Development Fund

IDF (Initiative Development Fund) has to be set up for capacity building and for organizing finance for infrastructural needs. It shall have the following features.

- It will provide support in the implementation of efficiency improvements (such as leakage detection and energy conservation), tariff reforms, accounting reforms, project development for private sector participation, and institutional restructuring.
- It will provide process management support as well as funding support.
- It will have two entities/windows: one for capacity building and another for organizing finance.
- It should be set up as a company under the Companies Act with a minor stake from government and major stake from infrastructure finance institutions in order to ensure professional management and fiscal discipline.
- It should be funded by state governments, Indian financial institutions, multilateral agencies, and donor agencies. Additional resources from other programmes and market sources can also be pooled.

Source GoM (2001)

Authority), which can perform the regional water planning function as well as coordinate water distribution between various municipalities in the region through various partnership agreements. This can also be facilitated through the restructuring of MJP, which was has been on the cards for a while now. Water quality is currently monitored by MCGM, both at the source as well as at the delivery end. It needs to seriously think about transferring the delivery-end function to local NGOs (non-governmental organizations) and citizens groups. For this, it will have to impart training and provide equipment to them for monitoring rather than deploy its own staff for the same function. MPCB has to step up its efforts in water quality regulation by monitoring and ensuring the compliance of water quality at the water supply sources and service reservoirs. It should also coordinate with citizens groups in end-user level monitoring (including providing them with training and resources).

Integration of institutions

The integration of institutions will have to begin with the urban local authority, MCGM, and other such municipalities, entering into an agreement with the regional water agency, MMRWA, for appropriating its share in regional water resources. Yet, during this process, the involved parties must be careful so as to avoid conflict with other municipalities to ensure a smooth transfer of water resources. The MMRWA, in turn, has to be integrated into the current system of state water management. Integrating the institutional reforms into the wider framework of regional institutions, sectoral reforms of the state government, and wider capacity-building programmes of multilateral agencies like the World Bank, DfID (Department for International Development), and ODC (Overseas Development Corporation) is a necessary step at the city-/region-level in order to institute reforms by attracting funds for their implementation. The reforms in the institutional structure, information flows, and integration with the water sector institutions and policy framework are delineated in Figure 2.

Governance Reforms

The concept of water governance has wider meanings in wider contexts, but it essentially refers to the way water supply services are delivered. In other words, it involves ensuring the efficiency

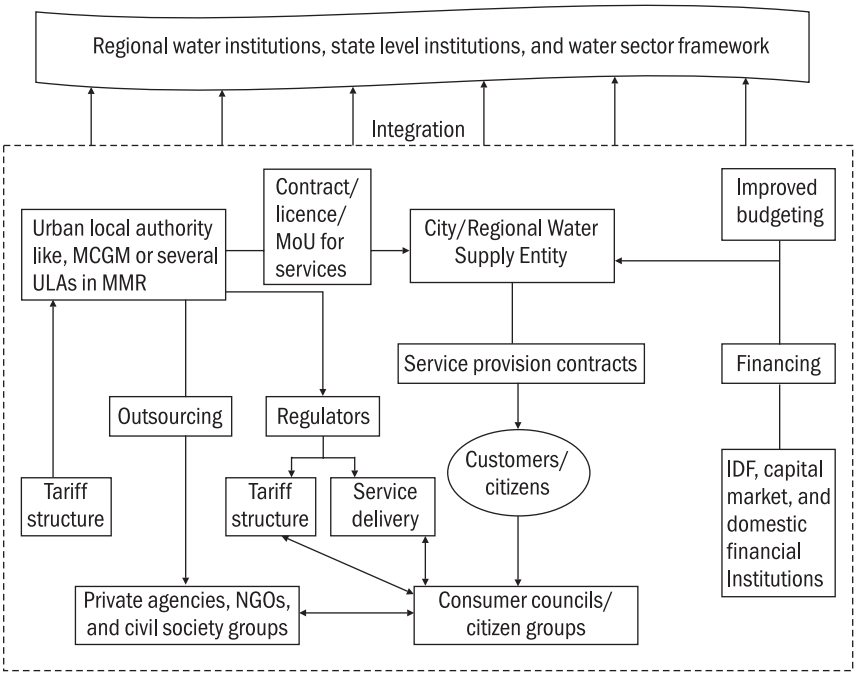

Figure 2 Preferred institutional arrangements—water supply and sewerage services
Source Adapted from GoM (2001)
ULA - urban local authority; MOU - memorandum of understanding; IDF - Initiative Development Fund; NGO - non-governmental organization; MCGM - Municipal Corporation of Greater Mumbai; MMR - Mumbai Metropolitan Region; MJP - Maharashtra Jeevan Pradhikaran

and equity of distribution, transparency of the delivery process, accountability, participation, responsiveness, and the empowerment of citizens (Ballabh 2002). Good water governance is based on the foundation of good institutions, sound policies, and effective practices, all of which need to be inculcated into the water supply system. However, achieving good governance is a long-term process, unless it is enforced through technologies (e-governance) and power structures (administrative or structural reforms). Some of the governance improvements in the water sector in Mumbai are discussed hereafter.

Budgeting reforms

There is a lot of scope for improving the municipal budgeting and accounting practices in the water supply sector. Ideally, this should start from changes in the design of the records/observations to a

shift in the nature of accounting system. An example of this is the switch from cash-based accounting to fund-based accounting, which has already been done successfully in the case of Bangalore (Karnik 2002). Although double-entry book-keeping of accounts is in place in Mumbai, designing it in line with fund-based accounting systems has not been done. Such systemic changes will lead to better control over assets and increase the accountability of employees against the spending on the water supply operations. Ideally, this should lead to the development of a better MIS (management information system), which would also help in regular/routine decision-making of the operations and systems. These changes will have to take place irrespective of whether corporatization takes place or not. Even though a separate budget is prepared for water supply, its accounting methods need to be changed in order to get improved accounting of costs and better evaluation of assets on the one hand and to make the information more useful to decision-making on the other. This might also require a good amount of changes in current practices. As a result, training needs to be imparted to the staff after the necessary changes have been incorporated. Capacity building is also required at the data entry levels of accounts in order to avoid wrong entries and to make data logs error free. This, in turn, helps in dealing with consumer grievances.

Accounting reforms

Water resource accounting has not been well conceived – it is only thought of in terms of water drawal and supply, and to some extent the costs of the waterworks. Resource accounting comprises preparation of physical accounts and financial accounts, both of which need to be prepared properly in order to take decisions and set targets. By setting up such resource accounting systems, information on water availability, use, and wastewater accounts as well as defensive expenditures on capital and operations can be obtained. Economic valuation can be performed from time to time, which will aid the water resource development and management policy. It has been argued (Nallathiga, Rao, and Rambabu 2005) that this will help the agency identify the current consumption patterns of various sectors and their shifts, and also aid in drawing up water tariffs. Such rationalization will lead to well-informed decision-making and guide policy-making in terms of allocation priorities and

tariffs (Ramakrishna 2005). Ideally, this will also help in attaining both economic and environmental goals through guided strategic policy and decision-making, which has also been suggested by the United Nations (UN–Habitat 2002).

Tariff structure reforms

MCGM should take up water tariff structure reforms on a priority basis. The current tariff structure is insensitive to demand characteristics and the service does not have a well-laid priority for low-income groups or any target sections explicitly. The tariff structure needs to move away from the uniform rate tariff, as it is not efficient in promoting water conservation. The marginal cost of water needs to guide the pricing, given there are a good number of metered connections in place.[15] However, designing an IBT tariff structure with a well-targeted lifeline block will provide some relief to low-income sections of the society and penalize the high-consuming sections, but the designing has to be done carefully. Even though uniform rate tariffs are considered to be efficient in expanding the network (Rosenthal and Alexander 2003), they do not encourage resource conservation and are misused for cross-subsidizing between sectors, rather than the users of different economic groups. Moreover, several experts (Whittington 2003) now argue that the subsidy in tariff to lower-income sections is inefficient and prone to populist policies.[16] Hence, subsidies should target access to the water supply system (tap connections and meters), and the tariff structure should encourage water conservation while avoiding transfers between consumers. Based on the survey of the urban water supply system in South Asian cities, Whittington (2003) recommended a set of three tariff reforms: (1) expanding the customer base and ensuring connections are metered so that pricing policies can be implemented, (2) changing the way the bills are calculated for households, industrial and commercial consumers, and (3) putting in place policies to protect poor households during the reform

[15] The advantages of marginal cost pricing, achieved through uniform volumetric charge, are well discussed in Dinar, Rosegrant, and Meinzen-Dick (1994).

[16] In fact, the UNDP - World Bank water supply and sanitation (1999) paper mentions that such populist politics have gone against the welfare of the poor. Although the poor were willing to pay more for the services, they were not provided with adequate water, making them pay even more to the exploiters. The subsidies also tended to provide huge benefits to the rich as compared to the poor.

process. Moreover, as mentioned earlier, water charges should not be pegged to property markets, which is an inefficient method of measuring the value of the resource and its service.

Service and staffing reforms

The municipal water supply department regards water supply as a necessary obligation and provides it with all its technical expertise. However, it has not given thought to the levels of service and staffing, and their capacities to deliver the service. Poor interface with the public in the case of grievance handling comes out as an obvious reference, but the staff members also lack several professional skills and appropriate orientation for providing such a service. For example, the data collection, logging, and recording methods deployed are quite outdated and are not easily understood or cannot easily be logged in by any third party. As a result, information retrieval is difficult and the interface with customers is not smooth. An important aspect of service provision is streamlining the staff at various levels and broadbasing the tasks to which they can be assigned individually. This means less number of dedicated and accountable staff for each task and more tasks (but can have more shifts). However, MCGM has to strive to achieve it. For example, MCGM has a very high staffing ratio of 35 persons for 1000 water connections against that of one per 1000 connections in Singapore (ADB 1994 cited in Padwal 2003). An important element of the service effectiveness is the use of information gathering and processing techniques as well as the levels of automation. As mentioned earlier, data logs from customer water meters, observations of water devices, and water supply system information are not fed to a centralized information unit; information is in disarray and the retrieval of a file takes much time and labour. MCGM should automate several departments, including the water supply department dealing with data generation, data collection, data processing, and data analysis, so that the database is kept at a central place and is available for easy retrieval. The staff should be trained to make use of the systems. Indeed, some employees could find gainful employ in the data analysis and processing functions, rather than being relegated to data collection. It will also provide scope for the upward mobility of employees within the organization. This will facilitate service delivery, improve customer interface, help deal with grievances faster and more effectively, and enhance the image of the corporation.[17]

Decentralization and public participation

The current approach towards the provision of water supply is top-down, with virtually no public participation. Bureaucracies based on the top-down model and their inefficiencies are well known and have been illustrated in the discussion earlier. The need for decentralization and effective public participation has already been identified in the 74th Constitutional Amendment, which sought the creation of ward committees and the establishing of an effective interface between them and the public. Although the ward offices of MCGM act as interfaces between the corporation and the general public; they, nevertheless, act as truly decentralized power-delegated centres. Their role needs to be enhanced, something which is not possible without delegating some of their current duties to third parties like private agencies, NGOs, and citizen groups. Moreover, this will also increase their participation in the service delivery function. These groups, apart from the consumer councils, can also act as decentralized monitoring agencies of water supply quantity and quality at the neighbourhood level. Empowering these groups and entrusting them with responsibilities leads to improved accountability and service delivery, and enhances public participation in the city water resource management. This initiative would not only promote public participation but also achieve the decentralization referred to in the 74th Constitutional Amendment.

Conclusion

The paper began with an overview of the status of water supply and demand *vis-à-vis* availability in Mumbai and found that a simplistic approach in terms of supply expansion is inadequate on several grounds. The city water supply needs to be reformed not only to meet future water demands, expanding regional structure, and lags in water supply responses but also to overcome the rigidities built into the institutions and governance and to make it responsive to the expectations of its citizenry as enshrined in the 74th Constitutional Amendment. Based on the situation analysis, it is clear that the concerned authorities need to undertake various institutional and governance reforms in the water sector for improving resource management and service

[17] Caseley (2003), for example, has documented the case of how organizational restructuring towards better services, coupled with training and change management towards customer orientation, led to the improvement of services by Metro Water in Hyderabad.

delivery in Mumbai. The municipal water supply authorities are concerned about technical delivery (overall per capita supply) and citizen satisfaction, both of which have limited potential in gauging the overall performance. This paper exposes the flip side of this argument by undertaking a thorough analysis and featuring the reform areas. It is now imperative for the decision-and-policy makers to embark on a reform agenda and provide improved water supply services to all.

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