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EQUITABLE DISTRIBUTION OF DRINKING WATER SUPPLY IN MUNICIPAL CORPORATIONS IN THANE DISTRICT

Sanjay RODE
University of Mumbai, Mumbai, India, sanjayjrode@gmail.com

Abstract
Due to higher urbanization, water demand in six Municipal Corporations of Thane district is continuously increasing. The growth of the population, small and large industries, health and educational institutions, commercial units are the responsible factors. The demand of drinking water is continuously increasing but supply is not matching with increasing demand. Municipal Corporations have not made the provision of drinking water to the growing population on 24*7 basis. The alternative policies of rainwater harvesting, reducing leakages and wastage, more provision of funds for water supply projects, revision of tariff structure and private sector participation in distribution of drinking water supply will yield the better results in terms of growing demand of water supply.
Keywords: water supply, water demand.

1. Introduction

Drinking water is a basic requirement of the human being. The water scarcity in urban areas of developing countries is a major concern. In future population in urban areas will face acute water problems. The daily supply of water in developing countries is very low compared to the industrial world. (Khatri and Vairavamorthy, 2007). Despite higher economic growth, the full access of drinking water to population is a major challenge in India (Shaw, 2007; Gujja and Shaik, 2005). Drinking water is a basic human right and the state has the responsibility to provide safe drinking water. (Panickar, 2007). Rising urbanization does not guarantee the reliable access to safe and sustainable drinking water supply. It often causes inequality of drinking water supply. Lower water supply leads to morbidity and mortality among population. In six municipal corporations of Thane district, the population, industries and commercial units are continuously increasing. In Brihan Mumbai Corporation (BMC) area, due to the real estate prices and physical limitation of growth of the city, population and industrial units are shifting in the Thane district. It further caused an increase in the new residential, commercial complexes, educational and health institutions etc. The migrants from rural India are another cause of the growth of the population in the district. The small industries, trade and commerce, banking, construction and manufacturing activities have made the tremendous employment opportunities. In Thane district,

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industrial zones are getting converted into the residential complexes. New township and affordable housing is developed for the middle, business class and professionals. Due to proximity and well connectivity to financial capital through rail and roads, the population is growing faster in all the municipal corporations. All the factors have continuously put the pressure on the civic amenities in the six municipal corporations of Thane district. An Inadequate and unreliable drinking water supply is observed in all municipal corporations. The policy of the 24*7 drinking water supply is beyond the limit of all municipal corporations. Few hours of regular drinking water supply is required but it is not provided to all households. Most of the times, there is disruption in the drinking water supply due to the leakages, repairing, joining new pipeline etc.

In some areas water pressure is very low due to the topography. It further causes the inequality of the drinking water supply. The richer households are getting more drinking water supply whereas the poor households struggle for the basic necessary water supply. Drinking water shortage is forcing the women and children to carry water from the longer distance. Most of the women's are working in various industrial and service sectors units and children are studying in city schools. They do not have time to stand in a long queue and carry drinking water. It is further affecting on their day today activities. Better and easier access to water make more time available for economic activities and keep children in school thus improving human capital. It also helps to for income generation. (Mehta et al., 2007) The quality of drinking water supply affecting on health of the women and children. The cost of the water borne and water washed diseases are higher for the poor households. It is beyond the limit of poor household to purchase the daily required drinking water. Most of the water supply schemes to Mumbai city are located in the Thane district. Brihan Mumbai Municipal Corporation is getting the adequate drinking water supply (Rode, 2008). But all the municipal corporations are facing the shortage of drinking water supply except New Mumbai Municipal Corporation.

The first section of the paper explains the history of the drinking water supply system of each municipal corporation. Second section explains the water demand according to Municipal Corporation and type of the water use. Third section explains the water distribution system and mismanagement of water supply. The last section explains the regression result and the policy implication.

2. History of Drinking water supply

In Thane district, each Municipal corporation has its source of drinking water supply. All the Municipal Corporations have developed the water supply system including the ESR, Piped distribution system, meter fitting, bill collection system in the respective area. Under the JNNURM, each municipal corporation has received funds for the provision of drinking water supply. The TMC used to get water

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from state owned organizations such as the MJP, MIDC. The BMC as well as the Shahad-Temghar water supply authority under the MJP. The purchase of the water from the public bodies used to be a costly affair and yet the suppliers were at liberty to deny some portion of the promised waters to the city during summer months. The change took place since early 2002. The municipal commissioner of TMC took up the first step of setting up of a 100 MLD water supply project on Bhatsa dam in the district. The project was self funded by the Thane Municipal Corporation and water from it began to flow into the city from 2003. The cost of the water from the project was much cheaper as compared to the cost charged by the water suppliers. The second big step in this direction took place in 2003 when the state government proposed to turn STEM in to a joint stock company between the TMC and two other civic bodies as well as the Zilla Parishad Thane. The TMC has the biggest share of assets in the first joint stock water firm of the country. The corporation effectively took up the responsibility and made STEM turn round the corner. Thane is getting around 127mld from the firm. The third major step towards making the city self reliant in water supply took place in late 2007 when commissioner decided to launch the 110mld water project. Other than this scheme the Brihan-Mumbai Municipal Corporation (BMC) Supplying 30mld as a raw and 30mld as pure drinking water supply. Maharashtra Industrial Development Corporation (MIDC) is also supplying 75mld drinking water to the Thane Municipal Corporation. The MIDC water is supplied to the whole of Mumbra, Kausa, Kalwa as well as the industrial belt of Wagale estate. Some MIDC water is also provided to Ghodbunder Road. From all and its own independent source, Thane Municipal Corporation gets 362 MLD drinking water supply on a regular basis. The new drinking water supply project has added 110 MLD drinking water supply. TMC began to make the city independent of state owned water supplier.

In New Mumbai, the water supply system is old. In 1998, Government of Maharashtra transferred the drinking water supply system to New Mumbai Municipal Corporation (NMMC, 2006). Such water supply was inadequate and insufficient for growing population. In 2005, NMMC decided to purchase the water of Morbe dam. The official ownership of the Morbe dam is transferred from the Government of Maharashtra to NMMC. Kalyan-Dombivali Municipal Corporation (KDMC) is depending on Ulhas and Kalu rivers. Around 255mld water is supplied from such schemes. The resident of the Mira Bhaynder get only 91 MLD drinking water supply. Before two years, MIDC promised 30mld drinking water supply but Mira-Bhaynder Municipal Corporation has received 5-8 MLD drinking water supply. In Ulhasnagar, the water supply system is very old. In 1948, the drinking water was supplied to military camp from Badlapur Barrage head works. It was 18 diameters tapping from 24CI line. Total water supply was 1.59 MLD through Balkan ji Bari GSR. Total nine distribution mainlines were laid from supplying water to camp 1 to 5. Total water supply was inadequate to the rising population. Therefore in 1967, a special

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pipeline of 15mld was developed at Shanti nagar. Similarly pump house of 0.9ml capacity was constructed for supplying water to camp number four. In 1978, the water demand was higher for growing population. The old system was not yielding adequate water. Therefore water from the Badlapur barrage system was stopped. Total water is supplied from the Shahad water works and Barvi dam. The population growth for the year 1991 was forecasted as 3.66 lakhs. The water supply for the growing population was designed as 55mld. In 1995, M/S Kirloskar prepared a 51 crores water supply scheme to the Ulhasnagar Municipal Corporation from Barvi and Shahad reservoirs. Such water supply is managed by Maharashtra Jeevan Pradhikaran (MJP) and MIDC. Total 112mld water is supplied to the whole Ulhasnagar Municipal Corporation area. Thane district get the water from the Andhra dam. Barvi dam is located in the Ambernath tahasil. Water from the both the dam is send in Ulhas river. Such water is provided to Kalyan-Dombivali, Thane, Mira-Bhaynder, Ulhasnagar and New Mumbai Municipal Corporation.

Current water demand

Water supplied to the various municipal corporations is depending on the daily total available water stock, leakages and repairing of pipeline. Water supply and pressure is more if there is less density of the population, commercial and industrial units. The water demand in the six Municipal Corporations is classified as follows.

TABLE 1 - CURRENT DRINKING WATER DEMAND IN MUNICIPAL CORPORATIONS

Municipal Corporation	Water Demand (MLD)	Percent
Thane	378.77	31.40
Kalyan–Dombivali	238.16	19.74
Ulhasnagar	121.31	10.06
New Mumbai	228.53	18.94
Mira-Bhaynder	121.87	10.10
Bhiwandi-Nizampur	117.69	9.76
Total	**1206.33**	**100**

The demand of drinking water is 378.77 MLD in Thane Municipal Corporation. The growth of population and industrial units are demanding higher drinking water as compared to the other municipal corporations. The industrial zones such as Wagle estate, Raila Devi and newly residential complexes in Ghodbander road are demanding more drinking water. In Kalyan-Dombivali, the industrial units and population is rising and it is second largest demand of drinking water among the six municipal corporations. In KDMC health care and educational facilities are also good (NIUB, 2008a) .In New Mumbai, the water demands is 228.53 MLD which is 18.94 percent of the total demand of all municipal

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corporations. The demand of the water in Mira Bhaynder Municipal Corporation is more than 122 mild. It is also more than hundred MLD in city development report (NIUB, 2008b). In Bhiwandi-Nizampur Municipal Corporation water demand is 117.69 MLD. It is 9.76 per cent of the total water demand of six municipal corporations. In Bhiwandi-Nizampur Municipal Corporation, population growth is less. Similarly the textile and garment industry requires less water. Drinking water is supplied for few hours and it is not on 24*7 basis. Total demand in all the municipal corporations is 1206.36 MLD. The water demand is also classified according to the type of use. It is as follows.

TABLE 2 - WATER DEMAND ACCORDING TO TYPE OF USE

No.	Type of demand	Water demand (MLD)	Percent
1	Population	859.90	71.28
2	Shops	0.89	0.07
3	Hotels and restaurant	5.20	0.43
4	Theaters and malls	3.49	0.29
5	Public toilets	3.02	0.25
6	Public hospitals	2.49	0.21
7	Educational institutions	1.66	0.14
8	Small and large industries	329.66	27.33
9	**Total**	**1206.33**	**100**

In all the municipal corporations nearly 71.28 per cent of the water is demanded by the population. The demand of water by shops is only 0.07mld. Shops do not required drinking water. Only for cleaning and drinking purposes, water is used. The demand of water by hotels and restaurant is 5.20mld. In Thane district, due to the growth of population, the numbers of hotels and restaurants have grown fast. In New Mumbai, Thane, Mira-Bhaynder Municipal Corporation, the new restaurants and hotels requires water for cleaning, washing, food preparation etc. In all the Municipal corporations, the number of theaters and malls are also increasing. Total 3.49 MLD water is demanded for various activities such as cleaning, washing, food preparation etc. Due to growth of shopping malls, the water is used for cleaning, hygiene etc. There are no restrictions on the use of the drinking water in all the municipal corporations. All the shopping malls and theaters are using the drinking water for different purposes. Public toilets are the integral part of the municipal corporation area. They are important for the public health and hygiene. Total 3.02 MLD water is demanded by the public toilets in all the municipal corporations.

Public hospitals are demanding water for cleaning, operations, gardening etc. The demand of water by various hospitals in all the municipal corporations is estimated as 1.66 MLD. It is only 0.14 percent of the total demand. In Thane district, most of the small and large industries are shifted from Mumbai city. They get the advantage in terms of location, cheap labor, land and roads etc. Most of the industrial units

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are using the drinking water for various purposes. The demand of such small and large industries is 27.37 percent. Water is demanded for cleaning, drinking for worker, toilets, gardening, own production etc.

Water supply network

In all the Municipal corporations, drinking water is supplied through network system. The demand of water is fixed but the supply is depending on the number of factors. All the municipal corporations are subjected to supply water on regular basis to all types of units in their respective area. In Thane Municipal Corporation, the length of the water supply system is 42 k.m. The distribution network is spread on 369 k.m. The entire Thane Municipal Corporation is divided into three major zones and 44 water districts. Each zone has provided the water by separate source. It is further supplied to the ESR in respective area. The central zone has 13 water districts. It gets 100mld water from STEM. The northern zone get 100mld water from STEM and it has 14 water districts. Eastern part of the Thane city gets water from MIDC source. It has 17 water districts. All the zones are regularly supply water to different water districts (TMC, 2006). In NMMC, the water is supplied from Morbe dam. The supply system network is spread in CBD Belapur, Nerul, Sanpada and Vashi. Water is regularly supplied to all the households in the municipal area (NMMC, 2006). In Ulhasnagar Municipal Corporation, due to the topography the water supply system is divided into 16 water zones. Out of these zones, the southern and northern part of the municipal area is further divided into 7 zones.

Water supply connections

The water supply connections are mainly classified as residential, hotels, industries and shops etc. In the Thane Municipal Corporation, the residential connections include water supply connections to the buildings and Chawls. Total 72524 connections are residential connection to the buildings. The chawls have the different types of connections. Total 3489 connections are in slums of different size. Shops have 3221 connections. There are 8029 families which are not connected to the water supply pipe. They get drinking water through stand posts bore wells or wells. Nearly 98 percent of the households have municipal tap water. In the year 2005-06, NMMC had 10673 as metered and 92245 non metered domestic connections. There are 257 institutional and 3352 commercial connections. In NMMC installation of meters is faster as compare to the other municipal corporations. In Ulhasnagar Municipal Corporation, total numbers of connections are 54532. The domestic connections are 52087 and non domestic connections are 2312. The other utility connections are 137 only.

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Water tariff

Water tariff is different in the different municipal corporations. Water tariff is depending on the price of purchased water, population, industrial units etc. In Thane Municipal Corporation, the STEM and raw water received from BMC is charged as Rs.4 per 1000 liters. The water received from the MIDC is Rs. 7.50 and pure water received from BMC has Rs8 per 1000 liters. The water received from the PISE is cheap and the rate is Rs.2.50 per 1000 liter. In NMMC, tariff for water is based on consumption categories, ranging from Rs.3.75 to Rs. 4.65 for domestic metered connections. Water tariff for the non metered connection is Rs.60 to Rs.100 per month. The rate of tariff for the commercial consumers is Rs.30 per cum. The average monthly water bills due to installation of meters are increasing in New Mumbai. In the past drinking water was charged at flat rate. But due to installation of meters, the average bills are increasing more than hundred rupees per months for a family. The water use by the richer household is increasing where as the poor households are using the less drinking water. It is a conflicting factor in the New Mumbai. NMMC does not supply water to industries in MIDC area. NMMC supply water to slums through public stand posts. NMMC has provided tub wells in slum pockets of Airoli, Digha, TTC and Dahisar ward.

Water supply mismanagement

In UMC, TMC, Bhivandi-Nizampur Municipal Corporation, the water supply system is old. In UMC, TMC the water supply schemes have collaborations with MIDC and MJP. They cannot design implement maintain their own water supply system. The water supply storage capacity is low. The system often causes the leakages and waste of water. Different housing and construction work also causes the damage to underground water supply networks. The topography in municipal corporation area causes an inequality of drinking water supply. The lower slope areas receive more water than required. The settlements in higher slopes do not receive minimum required water supply. The Population in all the municipal corporations is increasing but the required ESR's are not developed according to water demand. The cost of provision of water through tanker is higher in the high topography areas. There are several illegal kuttcha slums in each municipal corporation area. The meters are not installed for slums, chawls, multi-storied buildings, industrial, commercial consumers, HIG colonies and in the end to slum areas. Uninstalled and non working meters leads to more use of drinking water by the richer households. There is no survey conducted of the consumers in the different municipal corporations. Daily account of the water is not kept. Consumers are not given the information about the water cuts due to repairing, joining new pipelines, present water stock in dams etc. There is no computerized water supply and bill collection system. Water tariff is charged at flat rate to all type of consumers. The richer

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consumers are using more water and pay low bills. The poor consumers in high topography area do not get the required drinking water supply. Such poor consumers often depend on the tankers water supply. If the tankers water supply is not regular then they need to purchase the drinking water. The purchase of the water supply is depending on the number of household members, distance from the municipal tap, topography etc. In Thane city, around 98 percent of the households are connected to the municipal water supply. There are large inequalities of drinking water in the Thane Municipal Corporation area. Ghodbunder road and Wagle estate are suffering heavily due to the acute water shortage. The population coverage in Diva, Mumbra, Kausa and Kalwa is very thick. Therefore daily drinking water supply pressure is very low. Similarly the broken pipe lines, interconnecting the water supply pipelines are the major causes of acute water shortage in the city. In NMMC, the existing water supply coverage is 227 lpcd. But there is variation in the supply of water in various Gaothan and wards. In Airoli, Koparkhairane, Nerul and CBD Belapur, nearly 40 percent of the households have 24*7 water supply coverage. In Vashi and Ghansoli, 25 percent of the households have 24*7 drinking water supply. In Sanpada, only 10 percent of the households have 24*7 water supply coverage.

Residents of the Mira-Bhaynder get water supply after a gap of every 30-40 hours. Water problem has gone from bad to worse. Housing societies have to depend on water tankers to meet the shortfall. There is always a water scarcity and households are depending on the tanker water supply. Some areas in the Ulhasnagar city get unregulated water access. The users are not charged for the water usage. Due to this, the tail end consumers receive less than 40lpcd drinking water. On 29th September 2009, the water stock in the Barvi dam was 162.94 TMC and in the Andhra dam it was 211.82 TMC. In Thane city every Friday, the water from MIDC will be subjected to total denial due to low stock of water in dam. From MIDC, Mumbra, Kalwa, Diva, Wagle estate and parts of the Ghodbunder road gets water. There is 20 per cent of water cut in all municipal corporations due to low rainfall in dam catchment area. Thane Municipal Corporation will get around less 80mld drinking water. It will further reduction in the distribution of drinking water supply.

3. Regression Results

We have used the 2 sls regression method (Greene, 2005) to examine the factors co-related to the positive demand of drinking water. The result is shown as follows.

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TABLE 3 - 2SLS REGRESSION RESULT

Variable	Co-efficient	Std. errors	T test
Population	0.96	0.00	160.82
Hotels and restaurants	1.92	0.02	108.66
Educational institutions	16.0	2.68	5.96
Small and large industries	1.00	0.00	7117.67
Constants	9.61	0.61	15.76
	R-square:1.00 Adjusted R square =1.00 Root MSE =0.05		

The water demand of the population is significant and positively co-related. Population growth is responsible for the growth of water supply. The demand of the water by small and large industries is positively significant. Industries are shifted from the Mumbai city due to cheap land, labor and electricity, low taxes etc. They require drinking water for workers, gardening, production etc. The ground water is saline and it cannot be used for drinking purposes. The demand of water by the hotels and restaurants is positive and significant. Due to the growth of industries, residential complexes hotels and restaurants have increased. The demand of drinking water to educational institutions is also positively significant. In all the municipal corporations, due to population growth, the numbers of schools, colleges have also grown fast. Such school colleges require water for the drinking, washing, cleaning, toilets, gardening etc.

4. Drinking water supply projection

We have estimated the drinking water supply in the six municipal corporations till 2031. We assumed that the population, schools will increase in all the municipal corporations.

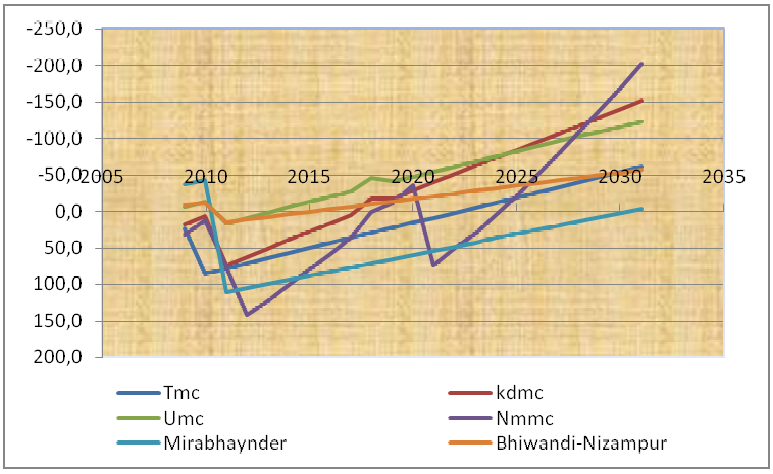

FIGURE 1 - DEFICIT OF DRINKING WATER SUPPLY IN MUNICIPAL CORPORATIONS (MLD)

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There are number of water supply schemes which are planned by the Government of Maharashtra and six Municipal corporations. The TMC has planned to build its own dam. The civic administration proposed to set up the dam at Shai River in Murbad taluka of the district. The dam will generate around 800mld of water for the city which will totally end the civic dependence upon state owned water suppliers to meet the city's demands. The dam will also take care of the water needs of the city till 2021 if the present rate of rise in the population is taken into consideration till then. The TMC will also be able to provide surplus waters from the dam to other civic bodies in the district. The state government has assured 200 MLD drinking water to the residents of the Mira Bhaynder. Such water will be added after two years from the Shahad Temghar project of Ulhas River. In the year 2011, Ulhasnagar Municipal Corporation will get 36 MLD water from the river Ulhas and 58 MLD water will be added from the Shadhad water supply scheme (UMC, 2006). In NMMC, 26 MLD water from Ransai and 61 MLD from Patalganga will get added. For Bhiwandi- Nizampur municipal corporation 31 MLD water will get added from Barvi dam.

5. Policy Implication

Each municipal water supply system requires more water related investment. In Pune Municipal Corporation number of water supply projects is announced with the growing population. (Rode, 2009).The water supply distribution system is old in different municipal corporations and it must get replace. The distribution system needs to develop with growing population demand and 24*7 drinking water supply system. New distribution pipeline and new ESR's should get developed with growing population. The cost of water through tanker will get declined. All the municipal corporations need to install the meters to each type of consumers. It will reduce the inequality of drinking water supply. Water tariff needs to replace with current flat rate system. Different rates of water tariffs are required for water use. Small and large industrial units and commercial units should have the higher water tariff. Higher tariff for the higher water use especially for the richer consumers will yield more revenue. Consumers should be made aware of the water cuts due to the repairing, storage levels in dams etc. The revision of tariff and billing system, billing centers etc. information should be given to the citizens through mass media. All the consumers should be made aware of the proper use of the water. Each municipal corporation must prepare advertisement of the proper water use. It will create awareness of the scarcity of the drinking water. The water demand can be managed through increase in water use efficiency, recyclining and promotion of water saving technologies (Reddy, 2001).All the citizens must be made aware of the rain water harvesting method. All the buildings of residential, industrial, commercial use must be made compulsory of roof rain water harvesting method. New constructions should not give the

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permission unless; they show the roof rain water harvesting plan. Other alternative sources of water supply such as wells, ponds need to search in each municipal corporation. Such water can be used for the toilets and gardening. There is need to prepare the detail plan of the distribution of drinking water supply in each municipal corporation. It will reduce the inequality of drinking water supply. Progressive and sustained expansion of access to safe water supplies among disadvantages urban dwellers will contribute greatly to reducing under five mortality (Fotso et al., 2008). There is need of private sector participation in water related investment. Such investment can be converted as technological investment in water supply system (Thomas, 2007). Private sector companies can help for water bill collection, water supply distribution, installing meters, computerized water supply management, prevention of leakages and wastages etc. There is need to see the entire water supply system in terms of the modern water supply distribution system. It will help households to improve health through reduction of diseases burden.

6. Conclusion

The demand of the drinking water is increasing with increase in urbanization in six Municipal Corporation of Thane district. The demand is increasing due to the growth of population, commercial units and small and large industrial units etc. The deficit in the drinking water supply is observed in municipal corporations because water supply is not planned with water demand. The policy of 24*7 drinking water supply is a dream for all Municipal Corporations. All the municipal corporations will get twenty percent less drinking water supply except New Mumbai Municipal Corporation due to the drought like situation in the dam catchment area. The policies of rain water harvesting, reducing water wastage through mass media awareness and private participation in water supply system will reduce the water waste. The water supply system requires more funds for construction of dam, storage of water, replacement of the old pipelines, water supply meters, bill collection etc. Private sector participation will certainly provide some relief to water shortage. The Government of Maharashtra (GoM) must take immediate steps to resolve the issue of drinking water supply in different municipal corporations.

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