

Water Sustainability Assessment of Pune City: A Case Study of Selected Wards of Pune Municipal Corporation

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Abstract

This paper surveys the main issues in the literature on residential water demand. Several issues and their objectives are analyzed. Then, the main contributions to the literature on residential water demand estimation, water loss, waste water treatment infrastructure, potential risk in water management are reviewed, with particular attention to variables, specification model, data set, and the most common econometric problems. The paper concludes with comments on future water demands, water wastage and potential risk in water management.

Pune municipal corporation areas are going to experience a continuous exponential built-up expansion in the coming years due to the rapid economic development. This shall lead to an unprecedented growth of the city in terms of population, which in turn shall increase the demand for housing and other civic amenities like water supply. A major chunk of the migrated population shall constitute of lower strata group, which would be forced to live in the slums due to demand-supply gap of housing in the city. Providing water connections to growing population of the slums could pose a challenge for the authorities, as it further adds to the burden of water resources already under pressure and an overall urban infrastructure.

In this study the total sample size is four hundred and twenty (400 citizens and 20 PMC employees) on the basis of the random sampling method. The researcher has taken the information from the respondents wherever they were available. The citizens from the 14 ward offices include mostly housewives, men from the different wards of Pune city.

This present paper attempts to review the total drinking water situation present in PMC with the help of total water supply and utilization, total water loss, and suggest some recommendation for sustainable water management.

Introduction

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Rapid built-up expansion in the coming years could put an enormous pressure on land and water resources, which might change the resource availability and ecology of the area. Water bodies like lakes and rivers could continue to shrink due to encroachments, unauthorized constructions and poor disposal of municipal waste and construction debris into them. The flood intensity during monsoons will keep on increasing in PMC region due to reduction in catchment area with shrinking water bodies and green cover and expansion in built-up land.

Extensive industrialization of Pune district after the 1960s and expansion of IT industry in the last two decades has resulted in rapid increase in population of PMC and PCMC areas. As Pune city nears its urbanization potential and is going to experience massive urban growth in the coming years with increase in water demand for residential, commercial, and industrial projects.

The major sectors of water consumption in the cities over the coming years will be majorly residential housing, commercial, and institutional establishments. Agricultural land area is on a decline due to conversion into built up and would almost become negligible in the near future. As Pune is a rapidly developing industrial center, water demand of the area shall increase manifolds in future. Reclaimed water could provide a strong alternative water source to meet the rising industrial water demand.

The study is focusing on the current scenario of water supply system and the water problems and the general views of the Pune citizens on water conservation. The researcher has used survey and experiment based research methodology to carry out this research. In this research, peripheral wards has been selected because while studying various aspects of the water supply it is observed that the area which are lying to the outskirts are suffering from much problems like, water shortage problems, illegal connections and though they are getting less quantity of water, less water conservation practices are going on.

Objectives of the study

The main objective of the research is

1. To evaluate the total water supply and total water consumption
2. Explore ward-wise water loss in PMC water supply distribution

3. Recommendation for sustainable water management

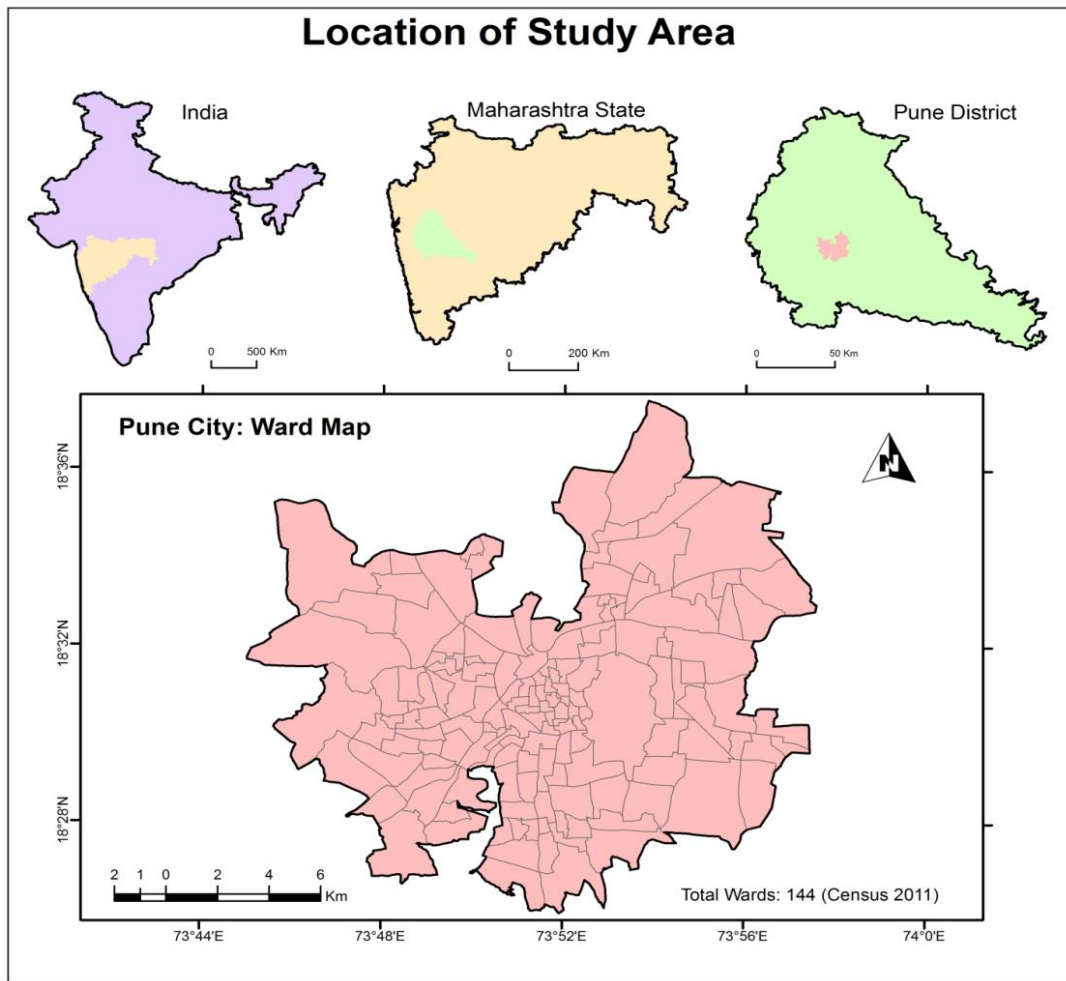
Problem Statement

PMC is facing a serious water problem to meet water demand. The societies lie at the peripheral area of PMC and situated at higher elevation those does not get adequate water. There is great uncertainty regarding the future demand and supply which will result in an unsustainable gap between water supply and water demand for many years.

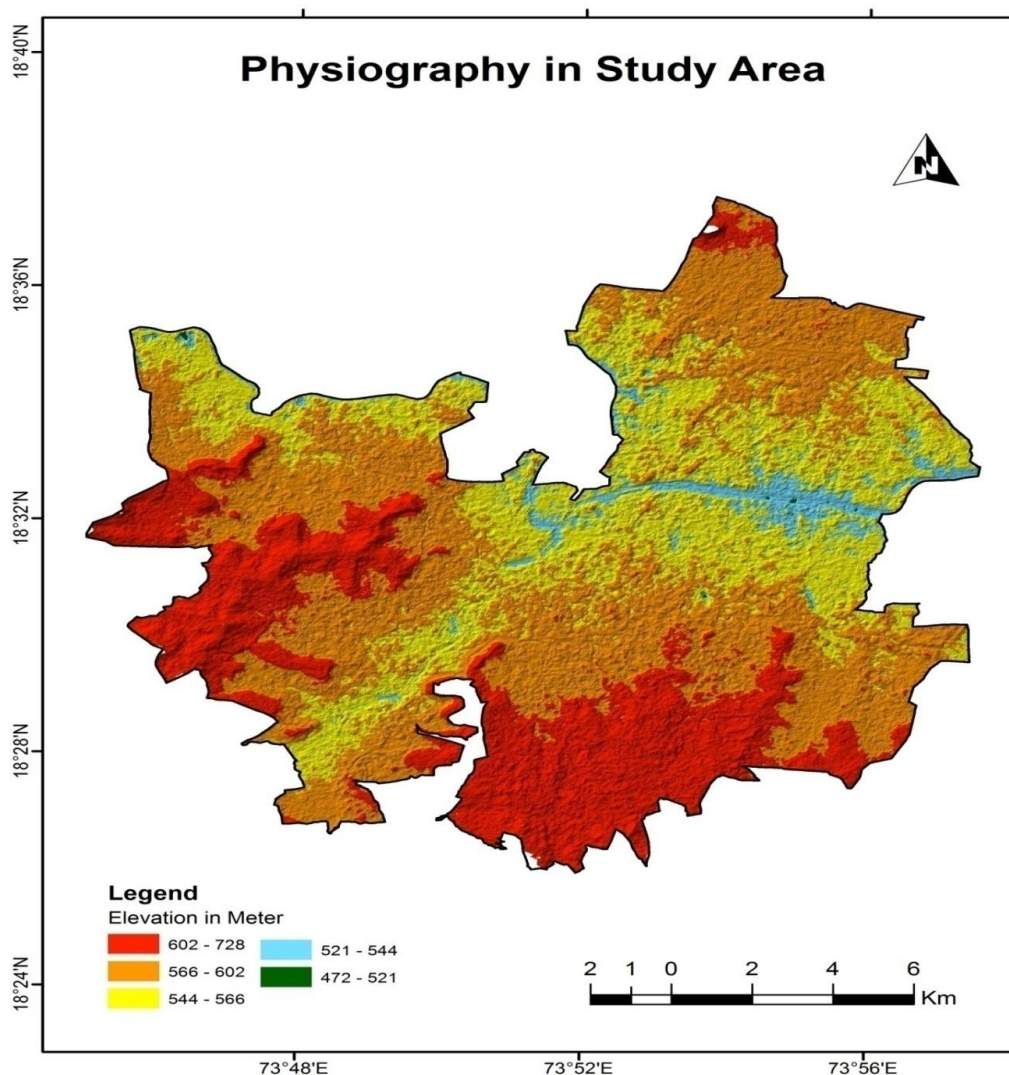
Study area:

The Pune Municipal Corporation (PMC) administers the city. The Pune Municipal Corporation (PMC) was established on 15th February 1950. The PMC controls the whole administration of Pune. For administrative convenience, the Municipal Corporation of Pune city has been divided into four zones which include 14 Ward Offices (144 wards). Each ward office includes more than 9 sub wards. This work measures the demand, supply and problems of drinking water in Pune Municipal Corporation. The demand for drinking water is continuously increasing due to growth of population, industrialization and commercial units. Drinking water is not provided on a sustainable basis in the Pune municipal corporation. The study revealed that, this water supply issues it notice that amount of water is enough and it is sufficient for PMC population, but still we suffer scarcity of water specially in summer season and that is due to water wastage, illegal connections and water improper management of PMC.

Map No. 1. Location of the study area



Map No. 2. Physiography of the Study Area



Data analysis and interpretation

Analysis of domestic water consumption

Problems of the citizens with respect to water supply are studied by checking the parameters as per capita water consumption, activity wise water consumption, and water conservation at different ward. First, water consumption per person is found out at different places. Also, for different uses how much is the consumption per person at different area is found out, to know disparity in the use of water requirement at ward level. To study the above mentioned parameters, first water consumption per person is found out at different wards. Also, water consumption per person for different use at different wards is analyzed, further followed by analysis of water supply at different places. Conclusively, the overall citizens' satisfaction is analyzed through the rated responses. Citizen has rated different problems which are studied in details through tables.

Per capita water consumption at various wards

An attempt is made to measure the per capita water consumption through survey at household level. To find out the consumption, availability, access and methods adopted for conservation of water in households in Pune City. This shows that per capita water supply in the city is less than the Service Level Benchmark (194 litres lpcd) it is 135 lpcd (litre per capita per day)

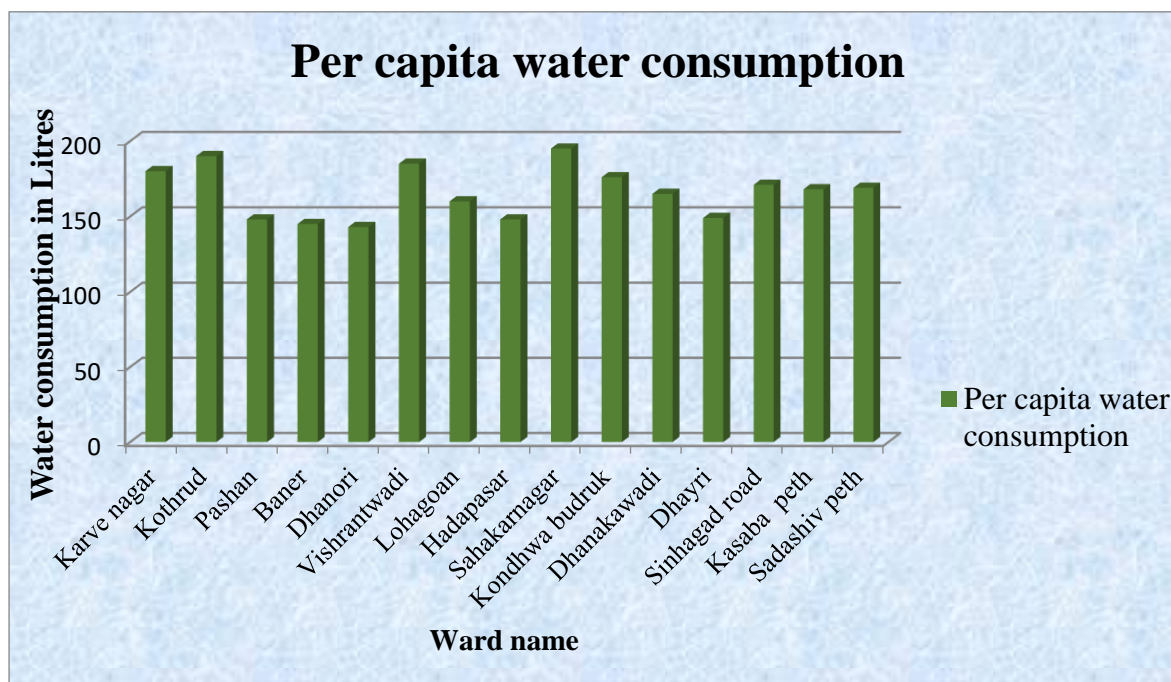
Table No. 1: Ward wise Per Capita Water Consumption

Sr. No.	Ward name	No of Respondents	Water consumption in litres per capita per day (LPCD)
1.	Warje, Karve nagar	50	180
2.	Kothrud	50	190
3.	Pashan	20	148
4.	Baner	10	145
5.	Dhanori	20	143
6.	Vishrantwadi	60	185
7.	Lohagoan	20	160
8.	Hadapasar	60	148
9.	Sahakarnagar	20	195
11.	Kondhwa budruk	10	176
12.	Dhanakawadi	20	165
13.	Dhayri	10	149
14.	Sinhagad road	20	171
15.	Kasaba peth	10	168
16.	Sadashiv peth	10	169
17.	Total =	400	Average = 166. 13

Source: Household Survey Data

Table No. 1. Shows per capita water consumption of water in selected areas of Pune city. It is very obvious from the table that in all the samples, the water consumption (indication of availability of water per capita) is much higher than what is recommended by CPHEEO, 150 lpcd. It is to be concluded that the usage of water is lowest at fringe areas and highest at the core area of Pune City.

Graph No. 1: Ward wise Per Capita Water Consumption



Source: Household Survey Data

The above Graph no. 1 shows Ward-wise per capita (Per person) water consumption in Pune city. This graph shows the highest consumption of water at Ghole road and Hadapsar. It is followed by Dhanakwadi, Yerwada & Bibwewadi etc. and remaining wards having consumption more or less equal.

Projected Drinking Water for Pune City

Table no. 2: Projected Domestic Water Demand and Water Loss of Pune Municipal Corporation

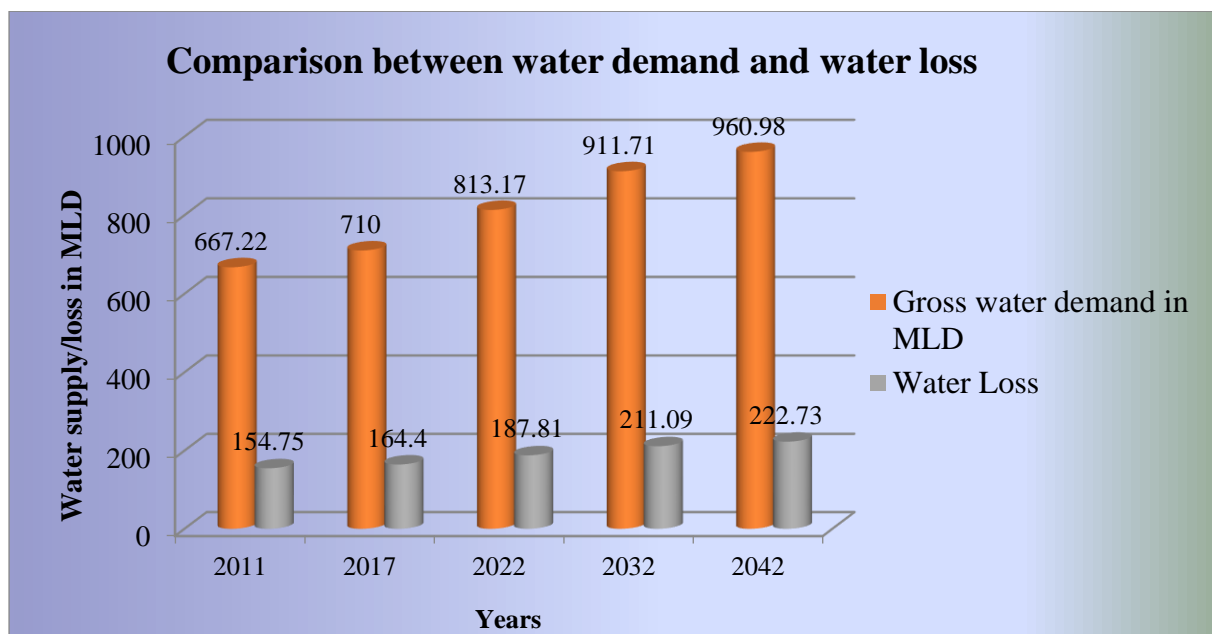
Design Year	Arithmetically projected Population	Net Water demand in MLD (@150 LPCD)	System losses 25 % + 5 % NRW	Gross water demand in MLD	Difference between NET and GROSS water use. (in MLD) <u>Means it is</u>

					<u>water loss as well NRW.</u>
2011	3115433	467.31	30	608.50	141.19
2017	3416470	512.47	30	667.22	154.75
2022	3637335	545.60	30	710	164.4
2032	4169066	625.36	30	813.17	187.81
2042	4670797	700.62	30	911.71	211.09
2047	4921663	738.25	30	960.98	222.73

Source: Compiled by the author

The above table shows projected population and domestic water demand. Here 150 lpcd water consumption has been considered to project water demand (as per the provisions of the CPHEEO). Further, the actual gross water consumption was 667.22 MLD means 195.23 lpcd, in the recent year 2017 which is higher than the suggested norm 150 lpcd.

Graph No. 2: Comparison between Water Demand and Water Loss



Source: Compiled by the author

Sewage Treatment Plants

There are a total of 10 sewage treatment plants in Pune city as can be seen in Table 6.

But instances of discharging untreated sewage directly into waterways is rampant. Due to insufficient capacity of sewage treatment plants and not enough sewage carrying infrastructure covering every household, this is resulting in discharge of untreated waste directly into Mula-Mutha River. The polluted Mula-Mutha rivers combine to form Bhima River, which further meets Krishna River and ultimately flows into the Bay of Bengal. Pune City (PMC limits) covers 92% of sewerage network of 2,200 km. six intermediate pump stations (IPS) have been installed for pumping the sewage.

As per the agreement between the Pune Municipal Corporation and the Water Resources Department (WRD) of the Government of Maharashtra, Pune receives 11.5 TMC of water annually and it is supposed to give back 6.5 TMC of water back to the WRD. This 6.5 TMC of treated water from STPs is used either in agriculture or directly discharged in Mula-Mutha River.

Table no. 3- Sewage Treatment Plants in Pune City Taluka

S. No.	Sewage Treatment Plant	Designed Capacity (MLD)	Main Treatment Process
1	Naidu (New)	115	Activated sludge process
2	Bhairoba	130	Activated sludge process
3	Tanajiwadi	17	Biotech with extended aeration
4	Erandwane	50	Modified activated sludge process
5	Bopodi	18	Extended aeration process
6	Baner	30	Sequential batch reactor process
7	Mundhwa	45	Sequential batch reactor process
8	Kharadi	40	Activated sludge process
9	Naidu (Old)	90	Activated sludge process
10	Vitthalwadi	32	Activated sludge process
Total		567	

Source: Water Sustainability Assessment of Pune

Findings and Conclusion

A) Potential Risks in Water Management

Past scenario in 2011

- In 2011, average per capita water supply in city was 194 lpcd. The per capita water supply varied from 138 lpcd to 358 lpcd, which is more than the suggested standard of National Building Code of 150–200 lpcd. This shows inequitable distribution of water in the city.
- As per the agreement between PMC and state irrigation department, the city has been allocated 900 MLD of water against which the city was found to be consuming around 1123 MLD. This clearly reflects that the population is rapidly increasing in the city as the allocated water is not able to meet the population's water requirement.
- The water transmission losses accounted to 25% of the total water supply against the standard of 20%. The transmission losses were not only due to old and defunct water supply network and poor management rather due to the undulating terrain of the city.
- According to a report by Acwadam, it shows that Pune's groundwater is depleting at an alarming rate due to rapid expansion of the city. The groundwater extraction was around 56.6 MCM in the year 2011.
- The treated water from STPs is taken back by the irrigation department from PMC and used in agriculture and discharged in waterways.
- The water treatment plants were found to have adequate capacity required for the population that is being served by each of the treatment plants, considering average water supply of 194 lpcd
- The quantity of wastewater generated in Pune City was around 586 MLD. Out of this, approximately 567 MLD was treated in the treatment plants. Remaining wastewater was being let into the streams thereby contaminating it. This reflected the scarcity of STPs in the city.

Existing Scenario in 2019

- Due to significant increase in population, the total domestic water demand of the city increased to 745.8 MLD from 605 MLD in 2011.
- The PMC continued to consume more water than it was allocated from the state irrigation department even in 2019. Considering the rapid expansion of the city, PMC has been demanding allocation of 1500 MLD of water, as against its usual quota of 900 MLD approved by the Irrigation department, to meet the increasing water demands. In November 2019, the department pushed back by urging the PMC to restrict its consumption, citing the order of the MWRRA in the matter. The PMC has appealed against the MWRRA order and sought a higher quota of water, and a final decision in the matter has to be taken by the state Water Resources department.
- According to a report by ACWADAM Pune city was found to be roughly using around 113.2 MCM of groundwater as of 2018-19. This exceeds the entire store stock of Khadakwasala as of 2018-19. This exceeds the entire stock of Khadakwasala dam (56 MCM). The groundwater extraction has double since 2011.

- To meet the increasing demand of water, the installed capacity of water treatment plants was increased to 1034.5 MLD. This treatment capacity was found to be adequate for the population, having 745.8 MLD of total domestic water demand..

Future Scenario in 2025

- Pune city is going to experience a rapid rise in population by 2025, which will stand at around 4,267,485. This is going to increase the water demand of the city to 853.5 MLD. Considering the restricted water allocation by the state irrigation department, PMC might have to look at other alternative sources or practice demand side water management.
- The installed capacity of water treatment plants, i.e., 1034.5 MLD (as of 2019), is found to be adequate for the population, having 853.5 MLD of total domestic water demand in 2025.
- The quantity of wastewater generated in Pune city is estimated to increase to 682.8 MLD In 2025. The current STP infrastructure in 2025. The current STP infrastructure (567 MLD installed capacity) would fail to treat the wastewater being generated, thus polluting the natural waterways.

B) Recommendations for sustainable development of water

- **Give attention to improve infrastructure:**

The higher magnitude of the loss is evaluated in consumption of water. Therefore attention should be paid to reduce water loss while additional water sources are planned for the future. Proper management of available water and existing infrastructure and the water network should be given emphasis.

- **Compulsory water meter:**

The other problem observed was, in PMC area only 23 % water meters were installed for industrial and commercial water use. Therefore, for better management of improving billing system and better evaluation of water losses, the billed water consumption 100 % water meters should be installed.

- **Sewage Treatment Plants:**

Capacity of the sewage treatment plants needs to be increases now at present it should be 567 MLD only and the total generation of the sewage is 717 MLD and it will again increase as the population increase and increase in the demand of water. These figure shows that PMC is fail to re-treat the sewage. One good solution over this this STP network has to be increase or give this sewage treatment facility to the local societies. So might this problem will solve.

- **Link water meter data with GIS:**

Updating of the water network which is undertaken by the GIS unit of PMC will become easy after installing water meter for each customer and this needs to be integrated with the land information system (LIS) of the city as well as information on hydraulic flow of the water network. Operation and maintenance data including pressure records need also be integrated spatially with the network. Therefore, introducing geographic information system (GIS) timely may facilitate the updating of the networks and support to perform related spatial analysis. The recently prepared digital elevation model (DEM) of the city may support to divide the network into manageable smaller hydraulic zones or district meter areas.

GPS system also has to be installed for water tankers so as to get the idea about how much water deficit is found in the areas, how much water they need, from where the water tanker is filled, frequency of water tankers, etc. Hence, these tankers come under water audit and help to reduce illegal supply of water.

- **Private sector participation:**

The Pune Water Supply System and Sewerage Project represent a new course for private sector participation in the water supply and sewerage sector in India. In addition, it incorporates new innovations in billing and collections, in leak detection and the reduction of unaccounted-for water. Finally, it has succeeded in bringing new financial institutions into the urban infrastructure sector in Pune city.

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