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DRINKING WATER SUPPLY MANAGEMENT THROUGH PUBLIC PARTICIPATION IN MUNICIPAL COUNCILS OF PUNE DISTRICT

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Abstract
Drinking water demand is rising in Municipal Councils of Pune district. Population is continuously increasing because of industrialization, service sector growth and change in lifestyle. People demand safe drinking water for different purposes such as cooking, cleaning, washing cloth. There is need to provide safe, reliable and consistent drinking water in all municipal councils. Municipal councils must invest more money in storage and distribution of drinking water supply. Water supply connections in each municipal council are less in terms of total households and commercial units. The recovery of water bills is very low in all municipal councils. Therefore there is less revenue generated from water supply system. All municipal councils should have modern water supply system to resolve different issues at different levels. There is need of public participation in drinking water supply in all municipal councils. Public awareness of water use will save more drinking water.
Keywords: Water distribution, Storage, equality

1. INTRODUCTION

Water is a basic necessity of human being. Therefore it is responsibility of government to provide drinking water to whole population. India has undoubtedly made some impressive gains in providing drinking water to its population compared to the situation at independence. However, the fact remains that more people in India lack proper drinking water. Also, more people are vulnerable to water related diseases (Gujja, Biksham, Hajarashaik (2005). Safe drinking water reduces different water borne and water washed diseases. It reduces mortality; improve health and future income earning. Unsafe drinking water creates different kinds of health problems. World Health Organization estimated that the toll from unsafe drinking water is more than five million deaths annually of which about four million children are under the age of five. Besides the use of the water for drinking and cooking purposes, availability of abundant and safe water for other domestic chores and sanitation is no less important for a healthy living (Roy, Jayashree et.al 2004). But in all developing countries, the propriety is given for drinking water supply to population. Insufficient water hinders the ingestion of food. Low ingestion of water keeping the quality of food intake the same, would result in underutilization of nutrients contained in the food consumed. If food intake is maintained and its ingestion is improved with increased water intake, it

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would imply increased energy available for work at no additional real cost. If we are looking for additional sources of economic development at low investment, this could be one such source, if we are able supply water locally (Shah C.H.2005). Therefore it is important to provide safe water to all people at local level. Piped water is supposed to be the most reliable, safest and easiest source of drinking water. Hand pumps and tub wells are more labor and capital intensive respectively, though they are relatively safe after piped water (Reddy V.Ratna 2001). But urbanization and industrialization has increased demand of drinking water and it has put more pressure on existing water resources. Similarly water pollution reduced the chance of ground water availability for drinking purposes. Many industries are continuously polluting water resources through discharge of chemicals. Pune district is growing fast in terms of industries, manufacturing and service sector units. There are many auto components industries are spread across district. Maharashtra Industrial Development Corporation (MIDC) has promoted industrial estates such as Ranjangaon, Hinjewadi, Hadapsar, Talegaon-Chakan and Rajgurunagar. There are many IT, Logistic, BPO, design, wait elite goods industries, automobiles industries are set up in this region. Government of Maharashtra is promoting various industrial developmental programs to initiate the latest technological developments in different sectors in this region. The proliferation of different industries is demanding skilled labors, managerial workforce in this region. The larger numbers of educational institutions of higher learning are increasing in this region. Some technical institutions are supported by the several industrial training institutions in this region. Other than industrial institutions, management, engineering, medical, pharmacy and information technology institutions are emerged in Pune region. It has resulted in migration from outside district and state. Unskilled and skilled labor migration has resulted in population growth and additional requirement of infrastructure facilities. Pune city is eight metropolitan cities in India. Due to affordable housing and adequate transportation facilities, people are staying within and outside of metropolitan region and work in city or municipal councils.

Population density in Pune city and outside of metropolitan region is rising fast. Due to heavy traffic, inadequate water supply, solid waste, sanitation, the health of people gets affected. All Municipal councils of Pune district have recorded high growth of population and other units. But they have inadequate quantity and quality of drinking water supply. Water supply is irregular, unequal and inadequate for growing population in terms of quantity. Due to number of reasons, the safe and regular drinking water is beyond the limit of all municipal councils.

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People are using contaminated water of hand pumps, wells which is unsafe for drinking purposes. It affects on their health, work capacity, nutrition etc. The children are suffering due to different water bore and water washed diseases.

All municipal councils should provide basic amenities such as water supply, solid waste, sewage, housing and health care to population. Successive governments in Maharashtra have continued to pour money into schemes ranging from digging new wells to piped supply, yet the number of habitations threatened by scarcity continues to rise (Kumar Anuradha 2002). Water scarcity is also observed because of lower rainfall and lack of storage capacity in different regions in Maharashtra. Central government has sanctioned funds from time to time for water resource development. But all the schemes are failed to provide water on 24*7 in all municipal councils of Pune district. Lack of access to safe drinking water has continuously affected on the economic productivity of population. It was found that most of the widespread diseases were water borne. Thus provision of safe drinking water reviewed as an urgent requirement (Bharwada Charul, Vinay Mahajan 2002).

Municipal councils do not maintain water resource adequately and properly. Source water contamination poses a risk to public health and increases the cost of drinking water treatment. Source water protection is a proactive approach for the enhancement of drinking water quality and quantity (Folifac F. et.al 2009). But overall water supply protection, storage and distribution in each municipal council is a challenge. First section of the paper deals with water demand in all municipal councils. Second section deals with history of water supply. It explains the development of drinking water source over the period of time in each municipal council.

Third section deals with drinking water supply management. It includes water supply network in each municipal council and its management over the period of time. Fourth section deals with Tobit regression result. The last part of paper deals with conclusion and policy implication.

2. DATA AND STATISTICAL MODEL

We have collected population data of all municipal councils from census 1991, 2001, 2011. We have referred data of different Municipal Corporations in Maharashtra. Study reports on water supply of different cities have been referred too. Similarly water supply system of Pune, Mumbai, Nasik, Solapur, Thane, Navi-Mumbai has been studied. The Economic and financial evaluation of drinking water supply projects of World Bank, Asian Development Bank has been referred too.

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Statistical model

Drinking water demand in each municipal council is function of different types of units. It is explained as follows.

$$\Sigma Wd=\Sigma T*N \quad (1)$$

Where

Wd: It is water demand by all units

T: Number of different units in each municipal council

N: Per capita norms for each unit

We have further defined number of units into different sub categories in each municipal council. It is as follows

$$\Sigma T= P+I+E+R+H \quad (2)$$

P: Population in particular municipal council

I: Industrial units with number of workers in each council

E: Educational institutions such as schools and colleges

R: Restaurants and shops in each municipal council

H: Number of health care institutions in each municipal council

Based on the number of units and per capita norms, we have calculated the water demand of each sub category in each municipal council. We have added the water demand of different sub category into total water demand of each municipal council. We have used Tobit regression to examine the co-relation of variables with drinking water demand of municipal councils in Pune district.

Water demand in municipal council

Each municipal council is supplying drinking water to different units. But the actual supply of water is depending on available water, time of water supply and pressure. The size of water supply pipeline also play and important role. Each municipal council supply drinking water to each unit based on particular norm. We have used the same norms to calculate the water demand in each municipal council of Pune district. In each municipal council, water demand is calculated on the basis of population.

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There are industrial units, hospitals, educational institutions which are also demanding drinking water on daily basis. We have calculated water demand based on the number of units and per capita norm. It is calculated for the year 2013. It is explained in the following table.

TABLE 1 - WATER DEMAND IN MUNICIPAL COUNCILS

Municipal Council	Water demand (MLD)	Percent
Alandi	4.35	4.61
Bhor	3.69	3.91
Junnar	4.01	4.25
Lonawala	20.77	22.00
Shiror	10.69	11.32
Talegaon Dabhade	12.32	13.05
Baramati	12.33	13.06
Daund	9.27	9.82
Indapur	5.19	5.50
Jejuri	4.78	5.06
Saswad	7.01	7.43
Total	94.41	100.00

Source: Computed from data

Daily drinking water demand in Alandi is 4.35 MLD. It is 4.61 percent of demand among all municipal councils in Pune district. The drinking water demand in this council is higher because it is a pilgrim center. Many people different parts of state are visiting regularly to this place. The water is used for drinking, bath cooking and cleaning purposes by residential and floating population. In Bhor municipal council, water demand is 3.69 MLD which is less than 3.91 percent of total water demand in all municipal councils. It is lowest water demand observed as compare to all municipal councils. It is mainly because this municipal council has less industrialization and urbanization. In Junnar municipal council, the daily water demand is 4.01 MLD. It is 4.25 percent of total water demand in all municipal councils. Junnar city is small in terms of area and density of population is very low. In Lonavala, drinking water demand is 20.77 MLD. It is tourist place and many tourists regularly visit Lonavala. They stay at different hotels and use maximum drinking water for different purposes. The water is also abundant in this municipal council therefore demand of water by different hotels is also higher. In Shiror municipal council, drinking water demand is 10.69 MLD. Water demanded by industrial units is very high and it is increasing. At present, the water demand is 8.59 percent of total water demand in all municipal councils of Pune district. In Talegaon Dabhade municipal council, the water demand is 12.32 MLD. In this municipal council, the water demand is increasing because of high residential colonies. Some manufacturing units are also located in this area. They demand drinking water for different purposes. In Baramati municipal council, the water demand is 12.33 MLD. It is almost similar to Talegaon Dabhade

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city. Baramati city is emerging as educational and manufacturing hub in Western Maharashtra. Therefore more drinking water is demanded for different purposes. In Daund municipal council, the demand of drinking water is 9.27MLD. It is less urbanized municipal council; therefore the water demand is only 7.45 percent of total water demand. In Indapur municipal council, the water demand is 5.19 MLD. It is 4.17 percent of the total water demand of all municipal council of Pune district. In Jejuri municipal council, water demand is 4.78MLD. It is less industrialized Municipal Council. But it is religious place and many pilgrims visit this place. It is economically less developed council in this region. In Saswas municipal council, the water demand is 7.01 MLD. It is 7.43 percent of the total water demand of all municipal council of Pune district. The total water demand in all Municipal council of Pune district is calculated as 94.41 MLD. The municipal councils are at different locations and each municipal council has its own independent water supply system.

History of water supply in municipal councils

Alandi municipal council has estabilished in 1867. There are 17 wards in this council. It is c class municipal council in pune district. Total area of Alandi municipal council is 6.84 Sq. km. It is well known prilgrim center in Maharashtra. In Alandi, the great temple of Sant Dnyaeshvar is located. Many pilgrims visit in November and December as a cause of yearly fair. Water supply system is very old. Alandi gets drinking water from Wadwale dam. Such dam is built on Indrayani River. It is situated 2 k.m. away from municipal council. Every day 3.5 mld water is supplied to Alandi from this dam. When prilgrims visit to city, more water is supplied from Vadivale dam. It is located upstream of Wadwale dam. The storage capacity of Wadwale dam is 0.79MCM. The length of this dam is 200 meters and a height is 5.60 m. This water supply scheme is functional since 1981. At present water is not sufficient for the population. There is no any additional source of water supply to this city. At present, population required more drinking water is this municipal council. Junnar municipal council is established in 1861. At that time municipal council borrowed Rs 33 thousand to build a reservoir and supply water to council. Junnar city is spread only on 2.74 sq.km. There are 17 wards in this council. Drinking water is supplied from Kukadi River. This river is 2 km away from municipal council. Every day 2.3 mld water is supplied to council. The drinking water is not sufficient for this council. Therefore other than this drinking water supply, there are hand pumps and tub wells in the city which supply 0.25 mld water. There are 30 hand pumps and tub wells in city. There are 3 wells near Kukadi River which also supply the water to council. One well is called as Barabavdi. It was a private well but government took over this well and ownership is provided to municipal council. Lonavale Municipal Council is forty miles North West of Pune Municipal Corporation (PMC). Municipal council is established in 1881. It is in Maval tahasil of Pune district. It is c

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class of municipal council. The area of the municipal council is 38.84 sq.km. There are 24 wards in city. The source of the drinking water is Valvan dam, Tungarli and Bushi dam. The distance of the Valvam dam and Tungarli is 0.5 km each from city. The quantity of the water supply from Valvan dam is 21 mld. From Tungarli dam, drinking water supply is 1.36 MLD. From Bushi dam, the city gets 0.2 MLD drinking water supply. Total water supply from all the sources is 22.38 MLD. As per 1991 census, the population was 43263. In 2001 census, it has grown and it is observed as 49865 persons. Drinking water is sufficient for population. There is no any other alternative source of drinking water supply and system for this council.

Shiror city is located at forty miles of north east of Pune city. Municipal council is established in 1868 and it is c class municipal council. The area of the council is 6.24 sq km. The source of drinking water to council is river Ghod. It is 2 kilometer away from council. Total water supplied to council is 5.21 mld. Other than this water supply, there are 27 tub wells in city area which supply 0.1 mld water. As per 1991 census, population was 18410. Drinking water was insufficient for population. In 2001, population is reported as 26999 persons. Population is demanding more drinking water in this municipal council. Talegaon Dabhade municipal council is twenty miles North West of Pune city. The municipal council is established in 1866. It is b type of municipal council. It is in Maval tahasil of Pune district. In 1991, the population was 32232. In 2001, population is observed as 40344. The council is spread over an area of 10.27 sq.km. There are 23 wards in this city. The source of the drinking water is Pawana River. Council gets 10 mld drinking water from this source. Second water supply source is Indayani River where city gets 3.15mld. The distance of the source of water supply is 1.5km. There is no any other source of drinking water supply to city. Baramati is located fifty miles from south east of Pune city. The municipality has established in 1865. It is recognized as the b class municipal council in Pune district. Total area of the Municipal council is 4.25 sq, k.m. There are 20 wards in this council. The source of drinking water to council is Nira left bank Cannel and it is 1 km away from council. Total water supplied to council from the source is 6.5 mld. The second water supply source to council is Mankdki Dohveer and it is 20 kilometer away from council. Total water supply from this source is 1.3 mld. There is no any other source of drinking water supply to council. Daund is forty eight miles east of Pune city. It is B class municipal council. In 1991, population of Daund was 33353. In 2001, it is observed as 42204. Total area of this council is 6.02 sq.km. There are 23 wards in the city. This municipal council gets water supply from Khadakwasala Mula right cannel. It is 5 k.m. away from municipal council. Total 5 mld water is supplied to council from above sources. There is no any other alternative source of water supply to council. Indapur city is located eighty miles from south east of Pune city. It is classified as c class municipal council. Total area of council is 3.5 sq.km. There are 17 wards in this council. The source of

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drinking water to council is Tarangwadi M.I. tank. It is 2.4 k.m. away from municipal council. Total water supply from this source is 0.5 MLD. As per 1991, census, population of Indapur Municipal Council was 12003. But drinking water was insufficient for growing population. There is another source of water supply to council which is 4 k.m. away from city. Total 2.15 mld water is supplied to council from this source. In 2001, total population of council is observed as 21592. This water supply is insufficient for growing population. Therefore there are some bore wells which supply 0.1 mld water to population of this council.

Jejuri is a famous place of pilgrim in Western Maharashtra. It is ten miles south east of Saswad city. Jejuri municipal council is estabilished in 1868. The fairs are organized annually in honour of the god Khandoba, who is also called Bahiroba, Malhari, and Martand. Khandoba . This council is of c type of municipal council in Pune district. It is in Purandar tahasil of Pune district. In 1991, population of this council was 7758 but in 2001, it is observed as 12000. The area of this council is only 6.68 sq.km. There are 17 wards in this city. There are two sources of water supply for city. First source is Malhar Sagar Nazare which is located 5 km away from city. It has 1.3 mld capacity to supply drinking water to council. The Mandki Doh Veer is another source of drinking water to council. It supplies 1.3 mld water to council. The distance of this source from the city is 20 k.m. There is no any other source of water to city. Total 2.6mld water is supplied from both dams. Saswad city is located at left bank of the Karha and about sixteen miles south-east of Pune city. The municipal council is established in 1879 and it is c class municipal council. It is located in Purandar tahasil of Pune district. In 1991, population was 14500. In 2001, it is reported as 26689. Total area of this council is 9.56 sq.km. There are 17 wards in city. Municipal council gets water from Garade Dam which is 12 k.m away from the city. Total 2 mld water get supplied to city. The second source is Ghorawadi dam which is 8 k.m. away from city. Total 2 mld drinking water is supplied to city. The third source is Vir dam from which 1 mld water is supplied to city. The distance of this dam from council is 31 k.m. There is no any other source of water supply. Bhor is class c municipal council. It is in Bhor tahasil of Pune district. Total area of this municipal council is 8.36 sq.k.m. Total population as per 1991 census was 15065. In 2001, it is observed as 17882. The source of drinking water to municipal council is Bhatgar Dam. Total water supplied to city is 1.59mld. The distance of dam from city is 7.5k.m. Other than this water supply, there are 27 tub wells/hand pumps in council area. They supply approximately 0.1mld water to population. Each municipal council has its own water supply system and it is developed over the period of time.

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Water demand according to different types

Water is used by population for cooking, drinking, washing cloth, cleaning. Industrial units use water for cleaning, processing raw materials, gardening, drinking etc. It depends on what kind of that industry and production. Educational institutions are using the water for drinking cleaning, gardening etc. Hotels and restaurants are using the water for food preparation, cleaning, washing utensils, drinking etc. The demand of drinking water is higher in hotels restaurants because water is used for different purposes. Shops and theaters are also using the drinking water for cleaning and drinking purposes. Health care institutions are using the water for cleaning, operations, gardening etc. The use of the water is different for different institution. We can calculate the use of water based on norms of water and number of units in each type.

TABLE 2: WATER DEMAND ACCORDING TO DIFFERENT CATEGORIES (MLD)

Municipal Council	Population	Educational institutions	Industry	Hotels	Shops/ theaters	Health care institutions
Alandi	3.84	0.10	0.24	0.14	0.02	0.01
Bhor	2.51	0.02	0.06	0.86	0.02	0.22
Junnar	3.46	0.08	0.12	0.24	0.01	0.10
Lonawala	17.9	0.21	0.54	1.13	0.02	0.97
Shiror	8.40	0.23	0.56	0.75	0.01	0.74
Talegaon Dabhade	10.71	0.30	0.72	0.56	0.01	0.02
Baramati	10.01	0.44	0.53	1.3	0.02	0.03
Daund	7.83	0.21	0.36	0.85	0.01	0.01
Indapur	3.71	0.08	0.17	1.2	0.01	0.02
Jejuri	2.27	0.05	0.13	2.3	0.01	0.02
Saswad	5.43	0.14	0.31	1.1	0.01	0.02
Total	76.07	1.86	3.74	10.43	0.15	2.16

Source: Computed from data

Above table shows that the demand of drinking water by population in Alandi municipal council is 3.84 MLD. Industrial units use 0.24MLD water. The numbers of industrial units are less as compare to population. In Bhor city, water demand by population is only 2.51 MLD. Hotels demand almost 0.86MLD water. In Junnar municipal council, water demand by population is 3.46mld. The demand of hotels is 0.24mld. The number of hotel and restaurants in this city are less. In Lonavala, water demand by population is 17.9 mld. The demand of drinking water by hotels is observed as 1.13mld. The demand of water by tourists is higher therefore hotels demand more drinking water. In Shiror, the demand of drinking water by population is 8.4mld. The industry demands 0.56 MLD water in this council. In

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Talegaon Dabhade city, the demand of drinking water by population is 10.71 MLD. The industrial units demand 0.72mld drinking water. Drinking water demand by population in Baramati is 10.01 MLD. Industrial units demand 0.53 MLD drinking water. In municipal council of Daund, population demands 7.83 MLD drinking water. Demand of water by hotels is observed as 0.85mld. The numbers of hotels are less and they are in smaller size. Therefore water demand is less by hotels. The demand of drinking water by population in Indapur municipal council is observed as 3.71mld. Water demand by hotels is 1.2 MLD. The demand of water by population in Jejuri municipal council is observed as 2.27 MLD. In Saswad municipal council, the water demand by population is observed as 5.43 MLD. Total water demand by population in all municipal councils is observed as 76.07 MLD. Educational institutions demand 1.86mld drinking water. Industry demands 3.74 MLD water. Hotels demand 10.43 MLD drinking water in all eleven municipal councils. Shops and theaters demand only 0.15 MLD drinking water. Water demand by health care institutions is 2.16mld. We can conclude that the water demand by population is higher in all municipal councils.

Water distribution system

In Alandi Municipal Council, every day sixteen hours drinking water is pumped and distributed. The water treatment capacity of council is only 2.4 MLD. It is located at Siddhabet in city. The water supply is varying in each area and from time to time and in each month. There are 2421 domestic consumers with half inch line. The industrial and commercial consumers are 251 with half inch type connection. There are 53 stand posts with meters in city. There are four storage reservoirs in city. The Janabai Dharmashala ESR has 4.5 lakh liters capacity and the height is12 meters. The second Janabai Dharamashala ESR has capacity of 5 lakh liters. The height of this ESR is 12 meters. Third GSR is namely as Kalewadi GSR. The capacity of this GSR is 2 lakh liters. The main transmission is located from Jackwell to WTP. The diameter of main line is 300 mm and total length is 30 meter. Second main is located from sump to ESR Gaothan. The diameter of this transmission line is 300mm and total length is 2 thousand mm. The third main line is from sum to GSR that is Kalewadi. The diameter of this line is 300mm. Total length of this line is 2000m. Water distribution system in Alandi municipal council is divided into eight types of lines. There are different lines with different size. Annual average expenditure on water supply system from 2005 to 2007 is observed as Rs.21.16 lakh. In 2008-09, it is observed as Rs. 42.21 lakh. Maximum expenditure in water supply system is observed for chemical charges. In this municipal council, the billing and recovery rate is observed as 92 percent from 2005 to 2008. In 2008-09, recovery rate is observed as only 88 percent. The raw water pumps are in working condition but the frequent power cut affects the water supply. Water treatment plant is located near the dam. Its capacity

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is 1.68 MLD. An additional settling tank of 1.68 MLD is provided in council. However, it is not used for daily water supply in city. It is not part of the WTP. It is an old treatment plant. The civil structure of this tank is in poor condition. The treatment plant was constructed by Maharashtra Jeevan Pradhikaran (MJP) and it is handed over to the Municipal council in 1993. However, the WTP has not been cleaned since then. At present 1.65 MLD water is being supplied to the town. The supply level during normal period is 80 to 90 Liter Per Capita Daily (LPCD). During summers, it becomes 70 LPCD. At the time of festivals, around 3.5 MLD of water is supplied to the town. The rate of supply for floating population is about 20 LPCD. The town can be broadly divided into two zones for distribution of water. The Gaothan area and other residential areas on the left bank of the river and Kalewadi, Dehu Phata and other newly developed areas on the right bank of the river. The clean water from the WTP is pumped into two ESR of 4.5 lakh litre capacities each. The water from the treatment plant is conveyed to the ESR by a 12" diameter CI pipe of 2 km length. These are located at the Markal Chowk on the Pradakshina Marg. Supply to the town is through gravity from these ESR's. One GSR of thirty eight thousand litre capacity is located at Kalewadi, which takes care of the needs of the areas on the right bank of the town. The water is supplied through piped network of about fifty thousand meters length. Total household are 4383 but connected by pipeline is only 1723 and only 1327 get regular water supply and about 40 public taps which are catering the needs of the devotees and general public. Duration of water supply during normal season is from 6.00am to 9.00am and at evening it is 4.00 pm to 6.00 pm. The Gaothan Area is connected with house-to-house tap connection. The new developed area on the southern bank of the river also receives piped supply from the municipal council. The total length of 50 km of pipeline includes some nearby villages outside the municipal council limits. The municipal council supplies drinking water to the temple. But the water supply of temple is depending on an open well and a bore well. The water from the bore well is hard water and they need a softening plant. Length of distribution network in the municipal council is approximately 25 km. Households served by piped water connection is only 30 percent. Other households are using ground water. Ground water use is 15 to 20 thousand liters in this municipal council. The entire water supply that is storage, treatment and distribution is under the control of municipal council. The MJP provides technical assistance to the Municipal council, whenever required.

In Bhor Municipal Council, the raw water is supplied approximately 16 to 20 hours to WTP through pumping method. At Shankar hill, there is water treatment plant. Water is treated for 16 hours and the capacity of this plant is 1.8 mld. The second Shankar hill treatment plant has capacity of 2 mld which is treating water for 20 hours. Every day total 3200 households receive water from such scheme. Water supply varies from month to month. There are 2770 domestic connections is this council. There are no

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consumer water supply meters in this municipal council. There are 12 stand posts in this council. Storage reservoirs are located at three places in city. The Shankar hill storage reservoir that is GSR has capacity of 4lakh liters. The second Shankar hill GSR has capacity of 1lakh liters. There are four transmission lines. The raw water transmitted from Jackwell to BPT with 250 diameter line. Total length of this line is 2760m. Second raw material main line is from BPT to WTP with diameter 250mm. Total length of line is 2160 meter. The third raw water line is from jack well to BPT. The diameter is 250mm line. Total length of line is 3450m. The transmission line is located from Jackwell to WTP and diameter is 250mm. Total length of this line is 7000m. There are three types of water distribution systems in city. The length varies from 100 to 150 meters. The average annual expenditure on water supply system from 2004 to 2009 was Rs.36.65lakhs. In this period, money spent on salary of staff is exactly half of the total expenses on entire water supply system. In this municipal council, water bill recovery rate is very low. From 2004 to 2009, the average recovery rate was only sixty percent. Due to lower recovery, the arrears are increasing every year. Water supply system is not working efficiently due to number of problems.

In Junnar municipal council, the raw water is pumped up to the 16 hours. It is pumped since 2005. Total 5336 households get benefit of water supply scheme in this municipal council. Water supply varies from 70 lpcd to 90 lpcd subject to normal and winter season. There are 3090 domestic consumers and 152 industrial connections in this council. Total consumers are only 3242. The water is supplied to all consumers through half inch pipe line. There are no water meters in this town. There are two GSR and one ESR is located in council area. The first GSR is located near and the capacity is 3 lakh liters. The second GSR is located at Chatrapati Shivaji College and the capacity of this GSR is 3 lakh liters. The second ESR is located at Shankarro Butte high school. The total capacity of this ESR is 6 lakh liters. The height of this ESR is 12 meters. The water supply distribution line varies from 80 meters to 250 meters. The average expenditure on water supply system from 2004 to 2009 was Rs 30.33 lakh. Total expenditure on salary of staff was 25 percent of total water supply expenditure. Billing and recovery in this municipal council is very poor. From 2004 to 2009, the recovery was only 89 percent. The average arrears are observed as Rs.3 lakh per year. But recovery is increasing now in this municipal council.

In Lonawale municipal council, water treatment plant is located at Nagargaon area. It is conventional type of water treatment plant. Water is treated on 24 hours basis. The capacity of water treatment plant is 12 mld. Water supply varies according to season. Some households get higher and some are getting lower per capita water supply. There are different types of consumers in municipal council. Domestic consumers are only 5460. Private bungalows are 828 and industrial and commercial connections are

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388 in number. There are government bungalows and estates. Therefore total government connections are 58 in terms of number. There are no meters for water supply to government bungalows. Tungarli ESR has 8 lakh liter storage capacities. The staging height is 12 meters. Prichly hill ESR has capacity of 5 lakhs liters. The staging height has capacity of 12 meters. Nagargaon ESR has capacity of 8 lakh liters and hights is 12 meter. The Bangarwadi ESR has capacity of 1.5 lakh liter and the height is 12 meter. Raiwood ESR has 12 lakh storage capacities and height is 12 meter. Hudco colony ESR has capacity of 15 lakh and height is 12 meters. The Hanuman Estate GSR has capacity of 26.6 thousand liters. The Bhusi ESR has ten thousand liters capacity. The Ramma ESR has one lakh liter capacity and the height is 8 meter. Rammanagar ESR has capacity of two lakh liter. The Sardar colony ESR has capacity of fifty thousand liter. The Rustic highlam GSR has capacity of 15 lakh liter. The Atre GSR has capacity of 45 lakh liter. The Batary hill khandala GSR has capacity of 75 thousand liter. The Hill top colony ESR has capacity of 80 thousand liter. The Pangolin ESR has capacity of one lakh liter and height is 12 meter. The Nagargaon transmission line has 100 meter length. Raiwood rising has 3020 meter length. Tugarli rising has 1970 meter length. Prichly hill gravity has 1950 meter transmission line. Hudco has 3220 meter length line. The Bhusigaon rising has 50 meter length. The Pangolin gravity has 600 meter length with 100 diameters. The average expenditure occurred from 2004 to 2009 was Rs.1.25 lakh. The wage of staff was 25.05 percent of total water supply expenditure. Recovery rate from 2004 to 2009 was only 72 percent. The bill recovery rate is very low in this municipal council.

In Shiror municipal council, there are 3893 domestic consumers where as 298 are the group connections for water supply. There are five different storage reservoirs in council. The Joshi wadi GSR storage reservoir has capacity of 4.5 lakh liters. The Kacheali ESR has capacity of 5.5 lakh. The other three storage reservoirs have capacity of 1.6 lakh, l lakh and fourty thousand liter each. The distribution of water supply is carried out by 50 to 450 meter pipe lines. In each area, further distribution of water is done through different size of pipes. From 2004 to 2009, the average annual expenditure was Rs.40 lakh in this council. The average recovery rate of water bills is observed as 75 percent in this municipal council. Therefore it is a challenge for municipal council to increase the recovery rate and number of connections.

Talegaon Dabhade Municipal Council has old water supply system. At Somatane phata, the conventional water treatment plant is located. The capacity of this plant is 10.05 mld. Near Talegaon railway station, there is unconventional water treatment plant is located. The capacity of this plant is 5 mld. Water supply gets vary from 70 lpcd to 90lpcd in this municipal council. There are 8 storage reservoirs and they are located at different parts of city. The Water Treatment Plant (WTP) storage

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reservoir has capacity of 1.10 lakh liter. Panchwati Elevated Storage Reservoir (ESR) has the capacity of 8 lakh liter. The Harnyes ESR has storage capacity of 2.5 thousand liters. Milind ESR has capacity of 3.50 thousand liter. The Tapodham ESR has capacity 10.50 thousand liters. From 2004-05, total expenditure on water supply system was 151.88 lakh. But in 2009-10, total expenditure was Rs1.68 lakh. There is sudden rise in amount spend on water supply system. This is mainly because population in this area has grown fast. Addition population and growth of industrial units demand more water supplies. Billing recovery in 2004-05 was 71.16 percent. In 2009-10, the recovery was only 57.71 percent. It means more dues are observed in this council. It is a major challenge in front of this municipal council.

Baramati Municipal Council has three water treatment plants in city. First treatment plant is located near NLBC canal which is unconventional type of water treatment plant with 6.5 mld capacity. The second water treatment plant is located at Kumbhargaon and it is conventional type of water treatment plant. It has capacity of 5.5 mld. The third water treatment plant is located near NLBC cannel. It is totally computerized type of unit. It has capacity of 6.5mld. Per capita water supply does not very much in different seasons. There are 2188 residential consumers and 112 are commercial consumers. There are no meters for water supply in this municipal council. The storage reservoirs are located at different part of city. The storage reservoir of ESR near T.C.College has capacity of 16 lakh liter. The height of this reservoir is 12 meters. Near WTP, the ESR has capacity of 16 lakh liters and the height is 16 meters. The Remand home ESR has 5 lakh liter capacities. The Kasba peth ESR has 7 lakh liter water treatment capacities. The height of this ESR is 12 meters. There is Ujiani main transmission line which has 405 meter length. The pure water main one line has 3100 meter length. The pure water two has a capacity of 2000 meter length. All lines have diameter of 300 mm line. In 2008-09, total expenditure on the water supply system was Rs.44.9 lakhs. There is need of more expenditure for water supply system.

Daund Municipal Council has old water supply system. There is only one treatment plant located in city. It is in front of SRP group office. It is unconventional type of water treatment unit. The capacity of this treatment plant is 5 MLD. Water supply gets vary from season to season and time to time. There are 5634 domestic connections in city. There are only 6 meters of water supply in city. Total 376 are the stand-posts. There are 3 storage reservoirs in city. First GSR is near Kurkumb ghat and the capacity is 7.56 lakh liters. The height of this GSR is 12 meters. Second ESR is located near Goal road and it has capacity of 11.37 lakh liters. The height of this ESR is 15 meters. The near filter tank GSR has capacity of 50 thousand liter and the height is 12 meter. The near filter two GSR has capacity of 45 thousand liter. Near filter three GSR has capacity of 1.70 lakh liter. The last ESR is located near mission hospital

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and the capacity is 2 lakh liters. Near Nehru chawak, ESR has capacity of 2 lakh liters. The Navgiri ESR has a capacity of 3 lakh liters. All ESR/GSR have height of 12 meters. Water bill recovery in this municipal council is low.

In Indapur Municipal Council, the water treatment plant is located in the Saraswati Nagar, which is unconventional type of unit with capacity of 1.5 MLD. The second water treatment plant is located near rest house Malwadi. It is unconventional water treatment plant. Total capacity of this treatment plant is 2.2 mld. Water supply gets vary from time to time. There are 2665 domestic consumers. Total non domestic consumers are only 35. All consumers get water supply through half inch line. There are no meters for water supply in this council. Total stand posts are 45 in this council. There are four storage reservoirs in city. In Saraswati Nagar, the GSR has 2.70 thousand liter capacities. The reservoir near rest house has the capacity of 10 thousand liter. The Datta Nagar ESR has the capacity of 5 lakh liters. This reservoir has the capacity of 12 meters. In 2008-09, total expenditure on water supply is 44.9 lakh. The salary of the staff was Rs.18 lakhs. This water supply system requires more resources.

In Jejuri Municipal Council, first water treatment plant is located at Anand Nagar which is unconventional type with capacity of 2.14mld. The second water treatment is also located at Anand Nagar and it is unconventional type with capacity of 3 mld. In Jejuri municipal council, the water supply get vary from 135 to 100 lpcd. There are 2010 domestic consumers and 80 are commercial consumers. There are 11 stand posts in council and 6 are the group connections. The storage reservoirs are located at different places. The GSR is located near Jejuri temple which has 4 mld, 1.75mld and 2.5 mld water treatment capacity. Near petrol pump, the ESR has 5 mld treatment capacity. Near petrol pump, another GSR has 9 mld water treatment capacity. There are 80 and 100 meters length line for water supply. In 2008-09 total 44.9 lakh rupees are spent on water supply system. It was not enough for rising population and water supply requirement. In Saswad Municipal Council, water treatment plant is located at Sopan Nagar. It is unconventional type of WTP and it has 3 mld water treatment capacity. The second Sopan Nagar water treatment plant has capacity of 5 mld. Water supply gets vary from 100 to 135 lpcd in this municipal council. The residential consumers are 4639 where as the commercial consumers are only 224. There are only 40 meters for water supply in which only 30 are in working condition. Number of group connections are 8 in this council. The Ambedkar Nagar GSR and Sopan Nagar ESR located in city with different water storage capacities. In 2008-09, total expenditure occurred on water supply system was Rs.1.29 lakh. On salary of staff, total expenditure was 13.48 lakh. This is the only council where recovery rate is observed as hundred percent in 2008-09. Each municipal council

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has its own water distribution system. But the numbers of connections are less and the recovery of water bills is low.

Regression result

In order to understand the different co-related factors with drinking water supply, we have used Tobit regression (Greene W.H. 2003). Such regression model is used to examine the correlation between total water supply and different selected factors. The dependent variable is used as the total water supply of the different categories. We have regressed total water demand on the water demand by different type of units. The model is defined as follows

$$Y^*i=\beta1+\beta2pop+ \beta3I + \beta4hos + ...+\varepsilon i \quad (3)$$

Where

$Y^*i>0$, It is a dependent variable. It consists of total water demand of each municipal council.

The independent variables are explained as follows,

Pop: population in council

I: Industrial units in city

Hos: Hospitals in each council

εi : Constant term

We have already explained that the total water demand consists of water demand of households, industrial units, hospitals, shops and restaurants, schools, colleges etc. The demand of water is calculated till 2050. The total water demand is added of all units for particular year. The results are presented in following table.

TABLE 3 - REGRESSION RESULT

Variable	Co-efficient	Std error	T test
Population	18.51*	0.006	2837.16
Constant	-33.64	0.07	-474.75
Log likelihood=36.02	Pseudo R2 = 1.1922	Prob > chi2 = 0.0000	LR chi2(1) = 447.00

*Significant at 1 percent.

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Above table shows that the water demand is positively co-related to the population. Population demands the water for cooking, drinking, washing, cleaning. As the number of persons increases, the demand of drinking water for different purposes increases. It is observed for all municipal council in Pune district.

Drinking water deficit in future

We have estimated drinking water deficit in all eleven municipal councils of Pune district.

$$Dt = \sum ddt - \sum sst \quad (4)$$

Where

Dt= Deficit of drinking water supply in the t period

dd t=Demand of water in period t.

sst=Supply of water in period t.

In order to calculate the deficit in drinking water supply, we have subtracted the current water supply from the current water demand. The numbers of future water supply schemes are not announced by the municipal councils. Therefore the deficit in drinking water is continuously rising. The deficit of drinking water in each municipal council is presented in following figure.

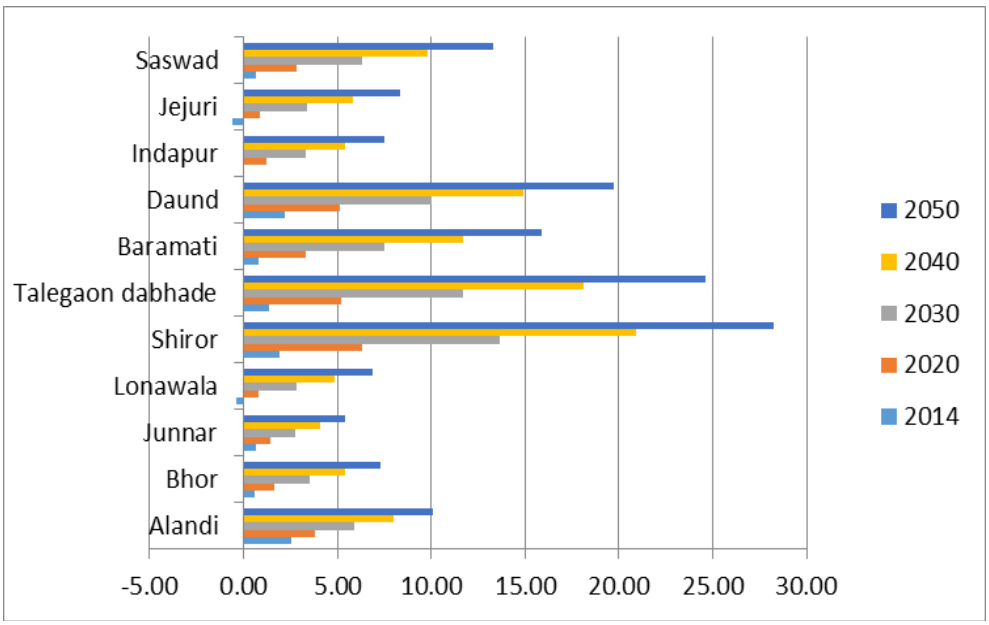

FIGURE 1 - DEFICIT OF DRINKING WATER IN MUNICIPAL COUNCILS

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Water deficit is increasing very fast for Shiror and Talgaon Dabhade municipal council. In Shiror Municipal Council, the water deficit is observed as more than 20MLD in 2040. In 2050, it will be more than 25 MLD. In Talegaon Dabadhe Municipal Council, the water deficit is observed as 5mld in 2020. In 2050, the water deficit will touch to 25MLD. This is because high urbanization in this municipal councils. There is need to prepare comprehensive future plan for drinking water in this municipal council. The lowest water deficit is observed for the Junnar municipal council. Such municipal council does not have industrial units. It is the only agricultural zone of Pune district. Therefore water demand will be lower.

3. CONCLUSION AND POLICY IMPLICATION

Drinking water has always received more attention in all developing countries. Water, sanitation, and hygiene are essential to sustainable development and poverty reduction (Sun Yan et.al 2010). Specifically in case of water, reforms have been proposed in many countries to a way to address diminishing per capita availability, increasing problems in water quality and increasing competition for control access and use of available fresh water. They seek to comprehensively reform governance in the water sector (Sampat P. 2007). It is argued that the government should provide community drinking water supply systems as a matter of policy. At present, all the municipal councils gets inadequate, unequal and irregular water supply. Due to frequent power failure, technical, administrative problem water is not supplied consistently to population. Water supply get vary from time to time and seasons. Sometime there is no water for few days to population. Water demand in Alanadi municipal council is increasing with increase in floating population. It is similar case for the Jejuri municipal council. Water provided in Alandi municipal council is of bore well. It required to process because it is hard water. Operation and maintenance of WTP is in poor condition of all municipal councils. Municipal councils need new water treatment plants. The manpower for each water supply department of municipal council is low. Almost all municipal councils are spending half of resources on payment of salaries. All households and other units are not connected by water supply connection. Therefore few households and units are paying for water supply. The water bills recovery is very low in all municipal councils. The water distribution network is old in all municipal councils. More financial resources are required for water distribution network. Government has to give top priority to provide safe drinking water in all municipal councils. The water supply system must work efficiently to provide water to whole population. There are different industrial units located near the water supply systems. The industry releases highly toxic effluents that are causing irreparable damage to health of citizens (Ramchandraiah C. 2001). Such problem is more persist in Alandi, Talegaon Dhabhade, Shiror, Daund and Indapur municipal council. Government must take action on such water resource polluting units. There is inequality in distribution

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of drinking water in each municipal council. Such inequality of drinking water supply is also observed in Pune Metropolitan Region (Rode S.2009). Generally, drinking water is supplied to higher income groups. Poor people have to depend more on stand posts where the supply level is low or hand pumps where the supply is unreliable and the quality is very poor. (Kanmony J Cyril 2003). The poor need to provide water at lower tariff on consistent basis. But there is no such provision for poor people and they depend on different sources for drinking water. In Pune district, there is frequent power failure is observed. Due to irregular power supply, water supply systems are able to run only for 3-4 hours a day. Additionally, breakdowns are frequent due to voltage fluctuations and or poor maintenance. When water is not available from the tap, people fetch water from tub wells and carry it (Krishnan Rekha et.al. 2003). All the water supply systems at municipal and village level are initiated by Central and State government in India. There is no co-ordination from local level to central government. The water supply systems are not planned properly or there have different technical issues. As the population of that area increases, the water supply does not increase. It results in to decline of per capita drinking water. People have to spend more time for collection of water. Most of the water supply policies are on the lines of constitutional goals and hence there are fewer interfaces between the water supply laws and policies (Panickar, M.2009). There is local demand to increase the water supply in each municipal council but most of the time the funds are not sanctioned for water supply system. Now the community should take initiatives to maintain water supply system and generate revenue for additional water supply. The community should assume the responsibility for the maintenance of such assets. In course of time even the capital costs of expansion of the asset could be decided managed and implemented by the community itself with limited state intervention. This is the best option for sustainability of common assets (Veerashekharappa 2000). There is need of private participation in each water supply system. Government has limitations in order to provide resources to each municipal council. Water supply system is not a revenue generating economic model. There is need of municipal council to take initiatives to sustain water supply system.

They must allow local community to involve more in water supply system. It will help to improve the access to water supply. Such local community will help to make understand the value of water through low wastage and insufficient use (Krishnan R.2003). There are number of interventions are required at different levels. But the aim should be that the people should get clean, reliable, continuous water supply at lower price. The cost of providing clean drinking water is much less than the benefits received from the clean drinking water. This research study will be successful if it helps to solve the water supply issue at some extent in municipal councils.

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REFERENCES

Bharwada, Charul, Vinay Mahajan (2002) 'Drinking water crisis in Kutch: A natural phenomena?' Economic and Political Weekly, November 30, 2002, PP 4859-4866.

Folifac, Fidelis Lydia Lifongo, George Nkeng and Susan Gaskin (2009) 'Municipal drinking water source protection in low income countries: Case of Buea Municipality Cameroon' Journal of Ecology and Natural Environment Vol. 1(4), pp. 073-084, July, 2009

Greene, W.H. (2003) 'Econometric Analysis' fifth edition, Pearson Education Private, Ltd,Indian branch, Delhi, India.

Gujja, Biksham, Hajarashaik (2005) 'A decade for action: water for life,when will india cover the uncovered?' Economic and Political Weekly, March 19, 2005, PP1056-1089.

Krishnan, Rekha (2003) 'Swajaldhara: more empty promises?' Economic and Political Weekly, March 8, 2003, PP937-939.

Kanmony, J. Cyril (2003)'Drinking water in Kanyakumari' Economic and Political Weekly, August 30,3002, pp 3633-3636.

Krishnan, Rekha, Suruch Bhadwal, Akram Javed, Shaleen Singhal S. Sreekesh (2003) 'Water stress in Indian villages' Economic and Political Weekly, September 13, 2003, PP3879-3884.

Kumar Anuradha (2002) 'Water supply schemes in Vidharba' Economic and Political Weekly, November 16, 2002, PP 4603-4605.

Panickar, Meena (2009) 'State responsibility in the drinking water sector an overview of the Indian scenario' IELRC working paper 2009, available at http://www.ielrc.org/content/w0706.pdf

Ramchandraiah, C. (2001) 'Drinking water as a fundamental right' Economic and Political Weekly , February 24, 2001, PP 619-621.

Reddy, V.Ratna (2001) 'Declining social consumption in India' Economic and Political Weekly, July 21, 2001, PP2750-2751.

Rode, S. (2009) ''Sustainable drinking water supply in Pune Metropolitan Region: Alternative policies', Theoretical and Empirical Research in Urban Management, Special number 1 S/April 2009, pp 48-59.

Roy, Joyashree , Subhorup Chattopadhyay, Sabyasachi Mukherjee Manikarnika Kanjilal , Sreejata Samajapti, Sanghamitra Roy (2004) 'An economic analysis of demand for water quality: case of Kokatta' Economic and Political Weekly, January 10, 2004, PP 186-192.

Sampat, Preeti (2007) 'Swajaldhara or pay-jal-dhara: Right to drinking water in Rajasthan' Economic and Political Weekly, December, 29, 2007, PP102-110.

Shah, C.H.(2005) 'Economic analysis of a drinking water project in Andhra Pradesh' , Economic and Political Weekly, January 29, 2005, pp 474-481.

Sun Yan, Felix Asante (2010) 'Opportunities and Challenges of Community-Based Rural Drinking Water Supplies: An Analysis of Water and Sanitation Committees in Ghana', IFPRI Discussion Paper 01026, September 2010.

Upadhyay, Videti (2005) 'Water question in Jharkhand: Present law and policy context' Economic and Political Weekly, October 8, 2005, pp4451-4454.

Veerashekharappa (2000) 'Reforms in rural drinking water supply' Economic and Political Weekly, February 12, 2000, PP 585-584.

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