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Demand and Supply of Water and Health Effects of Polluted Water in Madurai Corporation in Tamilnadu, India

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Abstract

Domestic water use includes for drinking, food, preparation, sanitation, cleaning, watering gardens and service industry. Although the quantity of water required for domestic need is not large, the quality must be high. Therefore, water shed management and conservation are often more economical and environmentally sound ways to prevent water scarcity and store water for future use than building house dams and reservoirs. The average water consumption of sample households in different wards in Madurai is lower than the actual demand for water. Lower consumption is mainly due to supply constrains

Keywords: *Water provision, Potable water, Ground water, Water quality*

INTRODUCTION

India as a country with abundance of natural resources is blessed with large resources in terms of water. However, the availability of fresh water varies from place to place based on its geo-physical set-up and natural resources in the country. At present, irrational and unsustainable water withdrawal from ground, tank and reservoirs is on increase. Water is mainly being used for Agriculture and industrial purposes causing drinking water scarcity to the human being. Moreover, water use for drinking and domestic purposes is estimated around 7 to 9 per cent of the total fresh water in India. As per the estimates of national water commission, the total water requirement of India in the year 2050 will be about 973 billion cubic

meters depending on its population growth. (Sivaram.P, 2006)

Water is important for human life; safe drinking water influences the quality of health and productivity. India's fortunes in this century will be dictated by how well it can manage its water resources.1 Water is called "indrajal" in mythology the natures gift through rainfall. It not only satisfies the thirst of human beings but also gives food and sustains life of human beings, plants and animals. In fact, great civilizations settled and flourished around water sources and societies evolved their entire cultures and livelihoods based on it.

RESEARCH PROBLEM

Water is a major limiting factor of the environment, both for biological systems and human societies. Water shortages in many parts of Madurai city result from rising demand, unequal distribution and increased contamination. The extension areas of Madurai city are especially vulnerable to the effects of water scarcity. Domestic water use includes for drinking, food, preparation, sanitation, cleaning, watering gardens and service industry.

Although the quantity of water required for domestic need is not large, the quality must be high. Therefore, water shed management and conservation are often more economical and environmentally sound ways to prevent water scarcity and store water for future use than building house dams and reservoirs. The issue of equity and fairness in water distribution by Madurai Corporation is also important. The concerted research on water management in Madurai Corporation is conducted in this backdrop.

OBJECTIVES OF THE STUDY

To assess the domestic water use pattern and household water resource management practices of sample households;

1. To assess the domestic water use pattern and household water resource management practices of sample households;

2. To find out the factors affecting nutrient loss and contamination of ground water and water related diseases in the study area.

RESEARCH DESIGN

Data Base

This study utilized both primary and secondary data. The secondary data derived from the official sources and other publications, and primary data. The duration of the study relates to three

calendar years i.e., 2012-2015 in respect of primary data.

The study covered Madurai Corporation. The corporation has four zones namely, Zone-I (Madurai West), Zone-II (Madurai North), Zone-III (Madurai East), Zone-IV (Madurai South).

Total Water Demand in Madurai Corporation

The total water demand and net surplus or resultant deficit for the Madurai Corporation in the year 2013 has been estimated on standard water consumption rate of 90, 110 and 135 Ipcd and the results are given in Table 1.

Table: 1 Total Water Demand on Madurai City

Season	*Availability*	*Annual Requirement (MM/litre) at*			*Average Total*
		90 Ipcd	*110 Ipcd*	*135 Ipcd*	
Normal	Water demand Water availability	107.90 91.00	131.87 91.00	161.85 91.00	133.87 91.00
	Deficit (MM Litre)	16.9	40.87	70.85	42.87
Summer	Water Demand Water Availability	104.81 68.00	128.11 68.00	157.22 68.00	130.05 68.00
	Deficit	36.81	60.11	89.22	62.05
Over all	Water Demand Water Availability	106.35 79.50	12.99 79.50	159.53 79.50	131.96 79.50
	Deficit	26.85	50.49	80.03	52.46

Source: Secondary Data

MM Ltrs – Million Litres

Ipcd – Infection prevention and Control Development

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The water demand is normal season and summer season in respect of Madurai Corporation is estimated with the water consumption standards of 90 IPCD, 110 IPCD and 135 IPCD norms. It is estimated that water availability in normal season reflects the same in respect of various IPCD consumption standards whereas the water demand varies with each standard. The water deficiency in 90 IPCD standard lies in 16.01 (MM Litres), 110 IPCD in 40.87(MM Litres) and 135 IPCD 70.05 (MM Litres) in revealed from the analysis. The average total deficiencies of water in the normal season accounted for 42.87(MM Litres) is derived from the analysis.

With regard to summer season, the water deficiency goes on increasing with 90 IPCD, 110 IPCD and 135 IPCD, which share accounted for 36.81, 60.11 and 89.22 respectively to the total. The water deficiency during summer season accounted for the average total of 62.05 MM Ltr. The pooled data for both normal season and summer season accounted to the total of 52.46 (MM Ltr) water deficiencies are pertinent all through the year in Madurai city is inferred from the analysis.

Water Supply in Madurai City

The water supply particulars in respect of Madurai City are detailed in Table 2

Table: 2 Details of Water Supply Sources in Madurai City

Sl.No.	***Particulars***	***Quantity (in Nos.)***
1.	Over-Head Tanks	23
2.	Hand Pumps	634
3.	Wells	412
4.	Bore wells	2,850
5.	Public Fountains	3,863
6.	Pumping Stations	7
7.	House service Connection: Domestic/Commercial/Industries	1,32,647

Source: Office Records, Madurai Corporation, Madurai, March, 2012.

It is evidenced that a total of 23 OHTs, 634 hand pumps, 412 wells, and 2850 bore wells. 3,863 public fountains and 7 pumping stations are presently working to cater to the needs of 15 lakhs population of Madurai City. With these sources of water stations 1, 32,647 are domestic, 3,190 are commercial and 203 are industries connections available to the people to meet out the water requirements every day.

DETERMINANTS OF WATER SUPPLY CONNECTIVITY IN MADURAI CORPORATION

An attempt is made to determine the major factors which determine the water supply connectivity in the study area. The factors which are significant in determining the water supply connectivity in Madurai Corporation are: Number of households, total population and total ward area. In order to examine this, the following form of log linear regression model is employed.

$$\text{Log } y = \beta_0+\beta_1 \log X_1+\beta_2 \log X_2+\beta_3 \log X_3+\beta_4 \log X_4+ U$$

Where

Y – represents Quantity of solid waste generated per day (in Tonnes)

X_1 – Total number of households

X_2 – Total Population

X_3 – Total ward area

X_4 – Total number of houses

U – Disturbance term

β_0, β_1, β_2, β_3, and β_4 are parameters estimated. The above Log Linear Regression Model is estimated with the help of the Method of Least Squares. The estimated results are presented in Table 3

Table: 3 Regression Results of Determinants of Water Supply Connectivity

Variables Employed	*Parameters Estimates*			
	(Madurai East) Zone-I	*(Madurai West) Zone-II*	*(Madurai North) Zone-III*	*(Madurai South) Zone-IV*
Intercept (β_0)	1.6312	3..0103	2.8624	3.21190
Log X_1 (β_1)	0.2036 (1.1123)	0.2027 (0.9567)	0.1246 (1.5217)	0.0465 (0.9367)
Log X_2 (β_2)	0.6274 (3.13123)	0.7612 (4.1874)	0.6184 (3.6171)	0.5838 (3.6463)

Log X_3 (β_3)	0.3212 (3.1036)	0.3676 (2.9874)	0.1322 (2.8762)	0.1543 (3.1432)
Log X_4 (β_4)	0.1894 (2.9876)	0.0841 (0.0573)	0.1732 (4.6341)	0.1483 (2.1651)
R^2	0.5226	0.5187	0.5265	0.5634
'F' Value	28.1385	31.1465	33.1456	29.1564

Indicates that the co-efficients are statically significant at 5 per cent level.

Figures in brackets indicate't' values.

The results of the regression analysis of determinants of water supply connectivity have shown more than 52 per cent of variation across the four Zones of Madurai City. With regard to Zone-I the Co-efficient of Multiple Determinants $(R)^2$ indicates 52.26 per cent of variation in the provision of water connectivity. The regression Co-efficients of variables namely total population and total number of houses are statistically significant at 5 per cent level. This indicates that even one per cent increase in these variables would result in an increase of 0.6274 and 0.1894 per cent increase in water connectivity in the study area. Among the variables, total number of population had a greater influence on provision of water connectivity in Zone-I (Madurai East).

All the four variables are responsible (51.87 per cent) for the generation of solid waste. The co-efficient of variables such as total population and total number of houses are significant at 5 per cent level. This indicates that Zone-I has positive determinants on provision of water connectivity. It is highlighted that one per cent increase in the two variables would result in 0.7612 and 0.3676 per cent increase in water connectivity of Zone-II (Madurai West). The variables of total population and total number of houses are statistically significant at 5 per cent level.

The co-efficient of Multiple Determination $(R)^2$ exhibits 52.65 per cent variation of provision of water connectivity in Zone-III of Madurai City. The total population has significant influence (0.6184%) on provision of water connectivity in Zone-III.

It is inferred from the above table that in Zone-IV has shown 0.5634 per cent of variation in the dependent

variables. The co-efficients in respect of total population, total number of streets and length of the streets are statistically significant at 5 per cent level. It shows that one per cent increase in the relevant variables would result in 0.5838, 0.1543 and 0.1483 per cent increase respectively in provisions of water connectivity with regard to Zone-IV of Madurai City.

It is evident from the above Table that, among the four determinant factors of water supply connectivity, population variable is found to be the most important determinant to influence the water supply connectivity irrespective of the four zones in Madurai City.

Health Effects of Polluted Water

Table: 3 Impact of Ground Water Pollution on Human Health

Sl. No.	*Health Impacts*	*Number of Household Members*			*Total*
		Men	*Women*	*Children*	
1.	Typhoid	8	12	24	44
2.	Jaundice	3	8	7	18
3.	Dysentery	3	5	17	25
4.	Diarrhea	4	4	11	19
5.	Tuberculosis	2	1	1	4
6.	Hebatitis	3	3	6	12
7.	Cold	14	21	43	78
8.	Cover	10	9	21	40
9.	Headache	14	16	8	38
10.	Allergie	14	14	11	39
11.	Osteoporosis	12	18	2	32
12.	Stone formation	18	17	1	35
13.	Hair removal	26	21	1	48
	Total	131 (30.32)	149 (34.49)	152 (35.19)	432 (100.0)

It is a fact that all the sample households witnessed the spread of health impact due to the intake of polluted ground water. Among the sample households the most vulnerable group are children and women family members. They accounted for 152 and 149 family members of the sample households in the study area. Men are to less prone to some kind of health disorder. Illness rates range from typhoid fever to hair removal in the study area.

Among the health illness or sickness or disorder, it is found that hair removal (26) and stone forming is the most prevalent rate of illness or disorder seen in male members of the family. In the case of women, cold and hair removal are the top two health problems opined by the sample households of their family members. With regard of children of the sample households' family, cold and typhoid are the major illness perceived through the intake of poor quality of water.

SUGGESTIONS

Keeping the study objectives, the following suggestions are given to ensure effective reclamation, procurement, distribution and management of water resources in Madurai Corporation

1. The issues of rising demand for water accompanied by increasing water pollution like the discharge of domestic sewage from household sector is enormous in the study area.

2. Government has to establish and introduce sustainability in the context of growing population and the need for an indigenous way of harmonizing the water resources needs to be profounded.

3. Transparent water resource distribution, regulation on private entry in water markets and increased awareness level of urban people are a three legged stool to ensure accession, inclusion and excellence principle in water.

CONCLUSION

The average water consumption of sample households in different wards in Madurai is lower than the actual demand for water. Lower consumption is mainly due to supply constrains in the study area. Interestingly, in spite of such shortage most of the households expressed satisfaction over the water supply by Madurai Corporation. Water markets have helped in reducing the inequalities in the accessibility of ground water resources, but in water scarce wards, principle of profit maximization is being followed by

the sellers. Different strategies are adopted by state and local government to prevent looming water problem and restore sufficient provision of safe drinking water. It is essential to redefine and advocate the nationalization of ground water resource to achieve water rights for sustainable use of water. A community based action is required for the efficient use of ground water. There is a need to shift from top-down delivery mode to demand-driven approach in the water sector as it is vital for sustainable provision and promotion of assured quality of water to the households of Madurai Corporation.

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