SUSTAINABLE WATER MANAGEMENT: A STUDY ON WATER CRISIS IN MADURAI CITY

DR S JEYARANI

Abstract: "There will be constant competition over water, between farming families and urban dwellers, environmental conservationists and industrialists, minorities living off natural resources and entrepreneurs seeking to commodify the resources base for commercial gain" -UNICEF report on Indian water

Water is the most essential natural resources for the well-being of the human society. Water resources have strong relation with urban development, commercial, industrial sector growth and agricultural development. Water is needed to ensure food security, feed livestock, maintain organic life, and take up industrial production and to conserve the biodiversity and environment. Average water consumption around the world is about 53 liters per head per day. India expects to soon have only about 20 liters available per head per day. Population growth is going to accelerate the water crisis in India, especially as more and more people move into the cities and become part of the middle class. Migration has made water scarcity more accurate and made drinking water more costly in urban areas.Because the rivers are too polluted to drink and the government is unable to consistently deliver freshwater to the cities, many urban dwellers are turning to groundwater, which is greatly contributing to the depletion of underground aquifers. Rural citizens face a similar crisis. Currently 30% of the rural population lack access to drinking water and of the 35 states in India, only 7 have full availability of drinking water for rural inhabitants. Most people who live in rural areas demand less water for day-to-day living than people living in cities.

Introduction: "There will be constant competition over water, between farming families and urban dwellers, environmental conservationists and industrialists, minorities living off natural resources and entrepreneurs seeking to commodify the resources base for commercial gain" -UNICEF report on Indian water

Water is the most essential natural resources for the well-being of the human society. Water resources have strong relation with urban development, commercial, industrial sector growth and agricultural development. Water is needed to ensure food security, feed livestock, maintain organic life, and take up industrial production and to conserve the biodiversity and environment. Average water consumption around the world is about 53 liters per head per day. India expects to soon have only about 20 liters available per head per day.

Water Crisis in India: India's 1.1 billion people need access to clean drinking water. The demand for drinking water comprises about 4-6% of total water demand. Due to the amenities of typical urban life, such as flush toilets and washing machines, people living in cities tend to lead more water intensive life style. The urban population has doubled over the past 30 years, now representing 30% of India's total population and is expected to reach 50% of the total population by 2025.Population growth is going to accelerate the water crisis in India, especially as more and more people move into the cities and become part of the middle class. Migration has made water scarcity more accurate and made drinking water more costly in urban areas.

Because the rivers are too polluted to drink and the government is unable to consistently deliver freshwater to the cities, many urban dwellers are turning to groundwater, which is greatly contributing to the depletion of underground aquifers. Rural citizens face a similar crisis. Currently 30% of the rural population lack access to drinking water and of the 35 states in India, only 7 have full availability of drinking water for rural inhabitants. Most people who live in rural areas demand less water for day-to-day living than people living in cities, and the majority of their water demand.

Table 1 Per capita water availability in India		
Year	**Population (Million)**	**Per capita water availability (m3/year)**
1951	361	5177
1955	395	4732
1991	846	2209
2001	1027	1820
2025	1394	1341
2050	1640	1140

Source: Government of India, 2009.

As can be seen in Table 1, the per capita water availability in 1951 was 5177 m^3 per year when the total population was only 361 million. In 2001, as the population increased to 1027 million, the per capita water availability reduced drastically to 1820 m^3 per year. By 2025, the per capita water availability will further drop down to 1341 m^3 and to 1140 m^3 in 2050. Based on the average requirement of water for various purposes, the situation is considered as water stress condition when the per capita water availability ranges from 1000 to 1700 m^3 per year and it is considered water scarcity when the availability reduces to 1000 m^3 per year. As the water available within the country varies widely as a result of rainfall, ground water reserve and proximity to river basins, most of the Indian States will have reached the water stress condition by 2020 and water scarcity condition by 2025. This would further hamper the food security, as the scarcity of water will directly suppress agricultural production.

Presently, in spite of good rainfall distribution, the country is unable to make good use of rain water, because of lack of awareness and poor infrastructure to construct dams and reservoirs. As a result, only about 35-40% of the cropping area receives irrigation to take 1-2 crops in a year. Out of the total cultivable area of 182 m ha, only 140 m ha are under net cultivation and of this, 62 m ha are under irrigation. There is further potential to increase the area under irrigation to 140 m ha, 76 m ha through surface water and 64 m ha by using ground water. So far, the irrigation potentials have already been created to cover 107 m ha, although they are not utilized effectively. It is estimated that effective area under irrigation by 2025 will be 76 million ha, although the Government of India is estimating to cover 104 million ha. Ground water is the major source of irrigation and this trend will continue. By 2025, 60 million ha will be irrigated by using ground water and by 2050; the area underground water will increase to 70 million ha. In 2000, the area under canal irrigation was 17 million ha, which will increase to 27 million ha by 2050. There is further scope to increase the potential by 35 million ha, by inter-linking the rivers and harnessing 36 billion m^3 through artificial recharging of ground water (Government of India, 2009).

Apart from irrigation, many rivers in India are also used for generating hydro power. Out of the estimated hydro power potential of 1,50,000 mw, only 21% has been developed so far and additional 10% power generation projects are under implementation. Presently, the country is facing many difficulties in further tapping the potential, due to difficult sites, forest conservation concerns; inter State issues, poor implementation and lack of commitment. It is also possible to develop multipurpose projects for power generation and irrigation which can improve the project viability, while increasing water supply.

Pollution of water resources is another major concern which is affecting the water supply as well as human health conditions. Although, 5% of the total water is used for domestic use, 27% of the villages and 4 to 6% urban population in India do not have access to drinking water. Apart from inadequate supply of water, there is a serious concern about the quality of water, which is severely affecting the health. It is reported that over 70% of the water consumed by rural population in India does not meet the WHO standards. It has been reported that 80% of rural illnesses, 21% of transmissible diseases and 20% of deaths among children in the age group of 5 years, are directly linked to consumption of unsafe water.

The major causes of water pollution are discharge of untreated sewage and industrial effluent into rivers, excessive use of fertilizers in agriculture and

contamination of ground water with salts and minerals present in the lower soil profiles. It is estimated that in New Delhi alone, 36 million tons of sewage is generated everyday of which only 50% is treated and the rest is let out in to the Yamuna river directly. Same is the situation in other cities. Only 31% of the sewage water generated in 23 major cities is treated and the rest is polluting 18 major rivers in the country. Most of the rivers in the country are also contaminated by fluorides, nitrites and several toxic metals. Presently, over 66 million people are suffering from fluorosis after consuming water containing more than 1.5 ppm fluoride. Poor sanitation both in rural and urban areas, is another reason for pollution of drinking water sources. Only 30% rural population has access to toilet facilities while 65% urban people use toilets. Nitrates and harmful germs from human excreta flow and percolate down to contaminate the water tanks and open wells.

There is no precise estimate available about the extent of ground water polluted by excessive application of chemical fertilizers and pesticides. The problem is not only that of application of higher doses of fertilizers but also excessive use of water for irrigation. As a result, most of the well water used for drinking in irrigated areas is polluted. Excessive irrigation has also been causing further damage to soil productivity, as the water reaching lower layers of soil and the salts present in this region are dissolved in water. Subsequently, these salts come to the top soil through capillary action. Such soils with high concentrations turn into sodic wastelands unfit for agricultural production. Presently, over 9 million ha fertile irrigated lands have turned into sodic wastelands and the water in these areas will have high salt concentration, unfit for human consumption as well as for agricultural production. As the people living in these villages are helplessly consuming such hard water, the incidences of illnesses are high.

Water mismanagement in Tamil Nadu: The Tamil Nadu Government statistics stated that in Tamil Nadu there are 570000 public rivers, ponds, lakes and wellsare situated in various districts but the 60% of water resources are get hold of by private people which is 342000 are destroyed and the balance of 228000 rivers, lakes, ponds and wells are utilized properly today by public and farmers in Tamil Nadu. In Tamil Nadu 60% populations are engaging in the field of agriculture and agriculture allied industries where water is the life blood for agriculture. In Tamil Nadu 1800000 well waterand bore well water are located for irrigation and agriculture purpose and 44% of irrigation are based on well water and bore well water. At present situation 300000 of well water and bore well water sources are destroyed which is exactly 16.66% because of improper storage of rainwater and over extraction of soil from river beds. After use of electric motor for irrigation and for domestic purpose by farmers and other people in Tamil Nadu the ground water level reaches at more than 300 feet as per TWAD report in 2004 and makes the fertile lands in to uncultivated lands and causes water scarcity.

The over extraction of ground water also leads to be a huge problem to people who are living near coastal zones the ground water level at coastal areas are soon going to convert into salt water which is not useful for drinking and for agriculture purpose. There are list of district which are hugely under water scarcity as per the Government of Tamil Nadu Report. They are Cuddalore, gapattinam, Tanjore, Tiruvarur, Chennai, Vellore, Salem, Namakkal, Tiruvannamalai, Trichy,Dindugal and Madurai.

Average TDS andaverage Bore feet in Madurai

S.No	Area	Average TDS	Average Bore feet
1.	Iravathanallur	973	275
2.	Anupanadi	631	200
3.	Iyerbungalow	635	288
4.	K.K Nagar/Melamadai	405	359
5.	Pudur	855	364

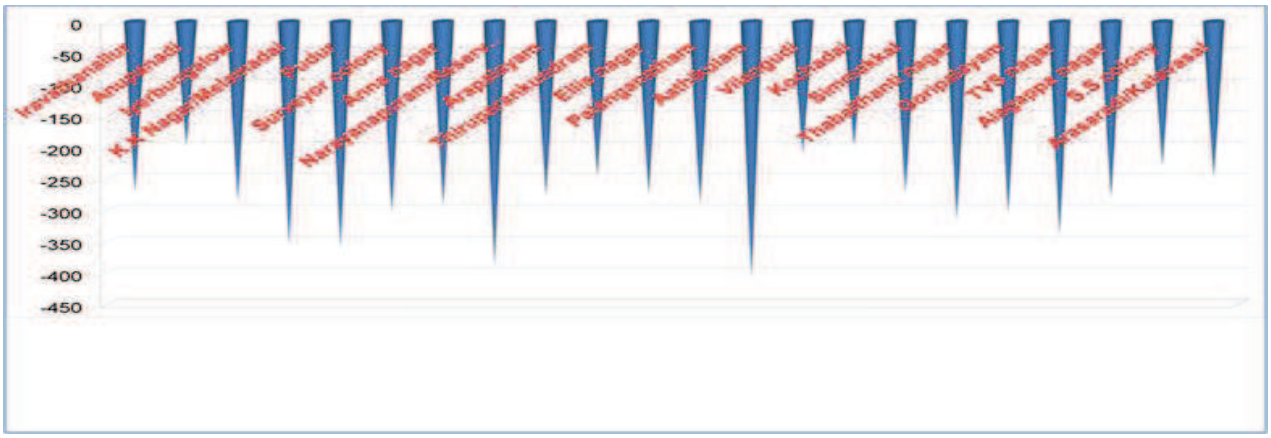
6.	Surveyor colony	719	307
7.	Anna nagar	590	296
8.	Narayanapuram/Reserve lines	408	390
9.	Arapalayam	697	280
10.	Thiruparankundram	717	249
11.	Ellis nagar	708	277
12.	Palanganatham	666	292
13.	Aathikulam	544	411
14.	Vilangudi	987	213
15.	Kochadai	380	202
16.	Simmakkal	635	276
17.	Thabalthantinagar	665	318
18.	Goripalayam	762	308
19.	TVS nagar	779	342
).	Alagappanagar	559	283
21.	S.S colony	729	231
22.	Arasaradi/Kalavasal	581	250

Water Scarcity in Madurai: Tamil Nadu is one of the states in Indiawhich is rich in all the type of resources and in the same way the water is also one of the most important resources. Madurai has a great history known as a district fully surrounded by Vaigai River of water. Madurai is the highest in density of population next to Mumbai and is situated on the bank of the river Vaigai. Madurai Municipal corporation covers 51,96 sq. km area with a total inhabitants of 10,16,885 people (2011 census) while the Madurai Urban Agglomeration encompassing the city and surrounding settlements accommodates a population of 11,94,665 persons. The existing water supply system and schemes are designed to supply 174 MLD of water to the city, but due for vagaries of monsoon and growth in urban areas, the city has a shortage of 59-70 of water. After introducing second Vaigai water supply scheme the deficit has reduced considerable amount. But still the city has lacked in water supply quantity. From the urbanization effect and industrialization in and around Madurai city the population grows rapidly and it poses biggest challenges to meet the potable water needs of the public. The main objective is to study the quantity and quality of ground water level and the problem of water scarcity among Madurai city residents.

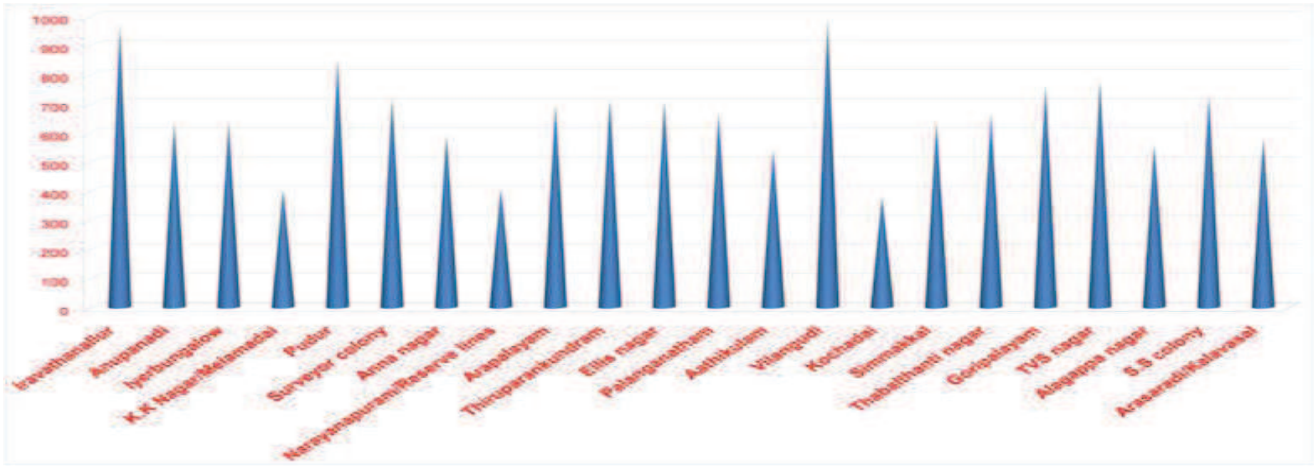
It is observed that the average TDS and average Bore feet in Madurai is found to be very high ranging from 400 to 1000. Vilangudiand Iravathanallur had 987 and 973 highest average TDS respectively. The least average TDS is found in Kochadaiwith 380, K.K Nagar/Melamadai with 405and Narayanapuram/Reserve lines with 408.The average bore depth ranges from 200 to 450. In Aathikulam the bore depth is the highest with 411 and the least in Anupanadiwith 200 and in Kochadai with 202. It is observed that the drainage and drinking water is fixed nearby and hence the water is contaminated very often in many of the areas of Madurai districts. Due to industrialization, improper sewage system, artificial fertilizer, improper rain water harvesting and climate change there is acute problems of water scarcity. All environmental issues affect the water quality like soil contamination. More over thelove of money by industrialized in comodifying water has not helped Madurai to reduce water crisis.

In general the water scarcity is one of the most jarring problems inMadurai Districts. Because of the water scarcity most of the things are affected in Madurai Districts. The main thing that gets affected because of the water scarcity is the agriculture. For the agriculture we need water to be sent to the lands and the fields. If there is no water to be sent the crops die gradually. People cannot rely on the rain for all the time. As we all know the water is one of the main sources of substance that is occurringnaturally and it is more helpful for the survival of the human being. It is very much necessary to go for the rain water harvesting since rain is the first and best source to bring water to the underground. There are also many

aspects related to water because the water has become one of the day to day commodities which we are in search for. There is a situation in which we will not get necessary water for day to day life and even for the drinking purpose. This particular situation is known as the water scarcity in Madurai Districts. Tamil Nadu is one of the states in India that is rich in all the type of resources and in the same way the water is also one of the most important resources that are available to all the people to great extent. But in some areas because of many reasons the water is not available. There will also be scarcity in such a manner that the agricultural fields will be spoiled because of the water scarcity.



Average Underground Bore Depth: (Feet)



Average Total dissolved solids (TDS) in PPM:

This water scarcity condition can easily be overcome by the procedure of rain water harvesting in Madurai Districts.We can also call our earth as the Blue planet because of the presence of water in it. Three by fourth of the earth's crust is fully surrounded with the water. Even then there is some water scarcity occurring in Madurai Districts. The water scarcity is nothing but the missing of the water at the right time. It is not that there is no water available in the ground level, but the ground level of water gets lowered down due to the usage of the water by the people.

There are also many other external reason for the water scarcity in Madurai Districts. The water that is collected in the ground level is not sufficient for the usage of the people. This can be told in the other sense that the water that is collected under the ground is not sufficient for the water users. It gets drained fully before the next rainy season comes. This will ultimately lead to the water scarcity.

The reason for the water loss in Madurai Districts is because of the elevations occurring in Madurai Districts. The land is moving above the ground level easily and because of that the rains that pour on the floor are not taken underground and they are ultimately sent to the areas that are low lying. Because of this the water is not available in the underground in the high level areas. Like the soil erosion we can also tell that the rain water flows from the high level areas to the low lying areas so that no water is contained underground or no water is sent to

underground. The lack in trees and the soil is also one of the major reasons for water scarcity in Madurai Districts. The trees will help in absorbing the water that is necessary for its survival and sends the rest water to the underground. But the water is eroded automatically from the upper surface because of the lack in trees and the sands.

Conclusion: The freshwater scarcity and water stress is in many areas of arid / semi arid zones in India, there are an urgent need for conservation and better management of water resources in Madurai. Consistently increasing demand-supply gap, growing competition, conflicts over water use in Madurai have to be checked.

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Dr. S. Jeyarani./ MA/ M.Phil./ MBA./ Ph.D/Assistant Professor in Economics/
The American College/ Madurai/ Tamil Nadu