

## Ground Water Quality of Madurai District in Tamil Nadu, India - A Case Study

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**Abstract:-** This case study was carried out to determine the ground water quality of Madurai district, Tamilnadu, India. The results of various samples of water collected from the observation wells/bores at the seven Taluks of the Madurai district during the period of 2001-2011 at periodical intervals by the Ground Water Wing of Public Works Department of Tamil Nadu have been collected by the present authors and analyzed and compared with WHO standards. Some of the parameters like pH value and total hardness (TH) are well within the allowable limit. Some water quality problems have been identified with regard to parameters like Total Dissolved Solids and Chloride. The quality of ground water in Madurai district, Tamil Nadu, India has been analyzed in detail by the present authors and some suggestions have been provided for improvement.

**Keywords:-** Ground water quality, WHO standards, Pollution.

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### I. INTRODUCTION

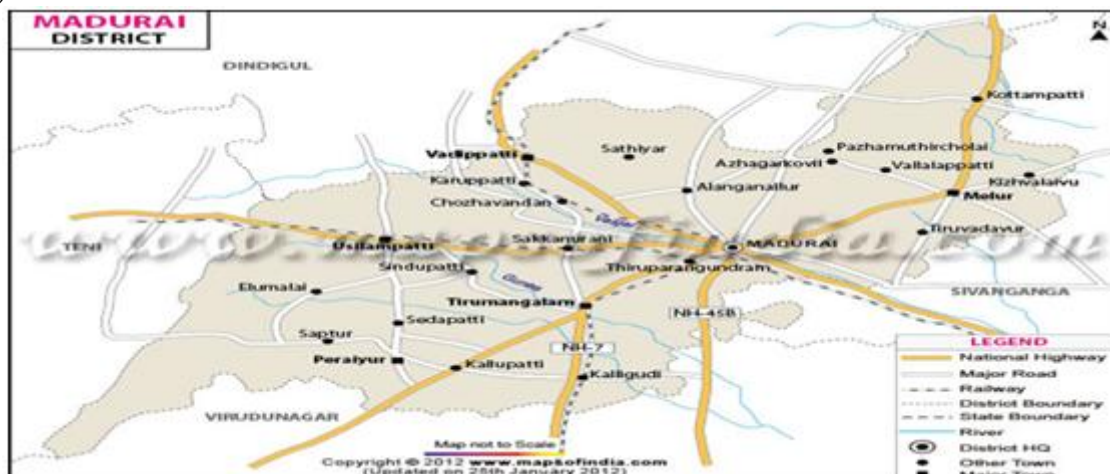
Water is one of the basic needs of man's life, without which he cannot survive. But it is imperative that water should be free from chemical and biological contamination and have a high degree of purity for drinking as well as domestic purposes. But several factors like rapid growth in population, boom in urban and industrial activities [1] and shift of rural population to urban areas, heavy quarrying and mining activities [2]-[3] have resulted in over-use of water and decline in ground water levels. Further, the pollution of water bodies through discharge of industrial waste into fresh water lakes/rivers [6]-[7], and infiltration of polluted surface water into the ground are detrimental to the environment.

In a State like Tamil Nadu in India, particularly during the post-independence period, there has been a phenomenal increase in the use of ground water in several districts including Madurai, which has led to declining levels of water table. In Madurai District, hard rocks are seen in several regions, and once few patches are left with alluvial formation. There is a need for the Government to manage the groundwater resources in an effective and judicious manner, especially in the hard rock regions with limited renewable potential to ensure adequate supplies of dependable quantity and quality. The objective of this study is to conduct a case study to analyse the various water samples collected at observation bore wells in periodical intervals in the seven Taluk regions of the Madurai district by the Ground Water Wing of Public Works Department during the period 2001-2011, and also to compare the results with the WHO standards and suggest suitable measures for improvement.

### II. STUDY SIGNIFICANCE / OBJECTIVES

The study area is Madurai district of Tamilnadu, India. It is of 3742 square kilometers divided in to seven Taluks namely Madurai north (T<sub>1</sub>), Madurai south (T<sub>2</sub>), Melur (T<sub>3</sub>), Vadipatti (T<sub>4</sub>), Usilampatti (T<sub>5</sub>), Peraiyur (T<sub>6</sub>) and Tirumangalam (T<sub>7</sub>). It lies between 09° 32' 00" to 10° 18' 00" (N) latitude and 77° 28' 00" to 78° 27' 00" (E) longitude. The general climate in this district is Tropical and it receives rainfall by both North East monsoon and South West monsoon. The average annual rainfall of this district is 857.63 mm. Due to the heterogeneous nature of hard rock formation in this district, it does not contain potential aquifers to store large quantity of water and transmit to other areas. Water samples are being collected regularly from 58 control wells and 37 piezometers during the months of January and July of every year by the Ground water wing of Public works department of Tamilnadu. They tested the samples at their regional laboratories for the physical, chemical and biological properties immediately to make a study on their quality. The results of the various parameters for different durations are available with the Chief engineer, SG & SWRBC, Tharamani, Chennai 113. We received the results for the period of 2001 to 2011 for some of the parameters towards this case study and reviewed the

results of pH value, total dissolved solids (TDS), electrical conductivity (EC), total hardness (TH) and chloride (Cl)

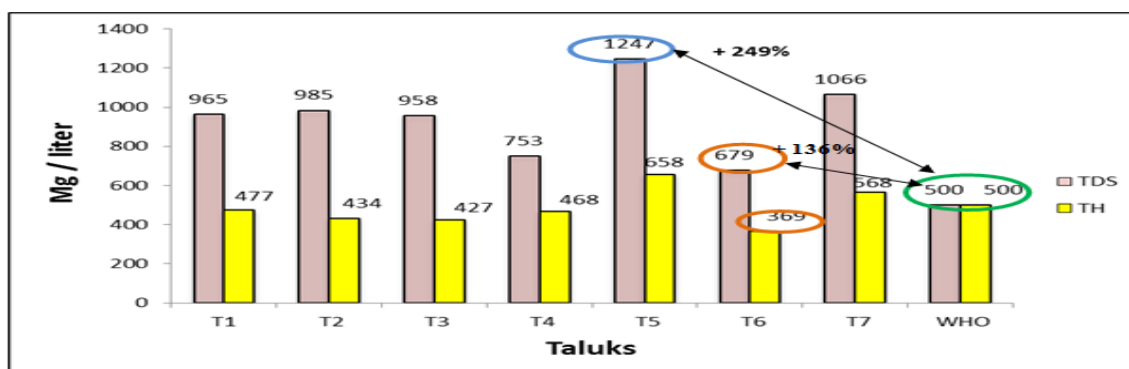


### III. RESULTS AND DISCUSSIONS

The mean values of the results observed during the period 2001 to 2011 for the various physiochemical properties of the groundwater samples from the taluks T<sub>1</sub> to T<sub>7</sub> (Taluk T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub> relate to Madurai north, Madurai south, Melur, Vadipatti, Usilampatti, Peraiyur and Tirumangalam respectively) of Madurai district is given in Table 1.

**Table 1.** Mean Values of Water Quality Parameters during the period 200to 2011

S. No	Quality Parameters	Unit	Taluk (T1)	Taluk (T2)	Taluk (T3)	Taluk (T4)	Taluk (T5)	Taluk (T6)	Taluk (T7)	WHO Standard
1	pH	--	7.81	7.85	7.90	7.80	7.98	7.91	7.92	6.5-8.5
2	TDS	mg /litre	965	985	958	753	1247	679	1066	500
3	EC	µS /cm	1682	1637	1575	1340	2105	1168	1841	500
4	TH	mg /litre	477	434	427	468	658	369	568	500
5	Cl	mg /litre	326	276	322	129	397	159	343	250



**Fig.1** TDS and TH of the Ground water samples collected in various Taluks of Madurai district

From Fig. 1 (marked in light brown colour), the mean values of Total dissolved solids (TDS) is varying from 1247 to 679 mg/litre among all the seven taluks, which is higher than the WHO standards of 500 mg/litre. The highest value is absorbed in Usilampatti taluk (T<sub>5</sub>), which is more than 249% (500 to 1247 mg/litre) above the standard and the lowest is from Peraiyur taluk (T<sub>6</sub>) with 136% (500 to 679 mg/litre) higher than the standard. The TDS levels in other taluks are 151% (500 to 753 mg/litre), 192% (500 to 958 mg/litre), 193% (500 to 965

mg/litre ), 197% (500 to 985 mg/litre ) and 213% (500 to 1066 mg/litre ) higher than the standard in Vadipatti (T<sub>4</sub>), Melur (T<sub>3</sub>), Madurai north (T<sub>1</sub>), Madurai south (T<sub>2</sub>) and Tirumangalam (T<sub>7</sub>) respectively.

Hardness in water is that characteristic which prevents the formation of sufficient lather or foam, when such hard water is mixed with soap. It is usually caused by the presence of Calcium and Magnesium salts present in water, which form scum by reaction with soap. Hard waters are undesirable because they may lead to greater soap consumption, making food taste less, scaling of boilers, causing corrosion and incrustation of pipes. From fig 1(marked in yellow colour), the mean values of Total hardness (TH) in all taluks except Usilampatti (T<sub>5</sub>) 658 mg/litre and Tirumangalam (T<sub>7</sub>) 568 mg/litre, are well within the desirable limits(500 mg/litre) of WHO and hence the ground water quality in this aspect is good. The highest & lowest values of Total hardness (TH) is absorbed in Usilampatti (T<sub>5</sub>) taluk, which is more than 132% (500 to 658 mg/litre ) above the standard and in Peraiyur taluk (T<sub>6</sub>) ,it is less than 26% (500 to 369 mg/litre ) below the standard respectively. In other taluks the hardness results are 427 mg/litre in Melur taluk (T<sub>3</sub>), 434 mg/litre in Madurai south (T<sub>2</sub>) taluk, 468 mg/litre in Vadipatti (T<sub>4</sub>) taluk, 477 mg/litre in Madurai north (T<sub>1</sub>)taluk and 568 mg/litre in Tirumangalam (T<sub>7</sub>) taluk

The pH value is an indicator of the acidity or the alkalinity of water. The higher values of pH means lower hydrogen ion concentrations, thus represent alkaline solutions, whereas the lower value of pH means higher hydrogen ion concentrations representing acidity solutions. From fig.2, the mean pH values of all the seven taluks are ranging from 7.8 to 7.92, thus meeting the basic acceptable standard of 6.5 – 8.5. However, the values are more than seven, which shows the water is of alkaline in nature. The alkalinity may produce incrustation, sediment deposits, difficulties in chlorination and certain psychological effect on human system. Generally, pH of water is influenced by geology of catchment area and buffering capacity of water [6]. The alkalinity imparts a bitter taste to water. Excess alkalinity in water is harmful for irrigation, which leads to soil damage and reduce crop yields [9].The pH value of Madurai north (T<sub>1</sub>), Madurai south (T<sub>2</sub>), Melur (T<sub>3</sub>), Vadipatti (T<sub>4</sub>), Usilampatti (T<sub>5</sub>), Peraiyur (T<sub>6</sub>) and Tirumangalam (T<sub>7</sub>),are 7.81,7.85,7.9,7.8,7.98,7.91,7.92 respectively.

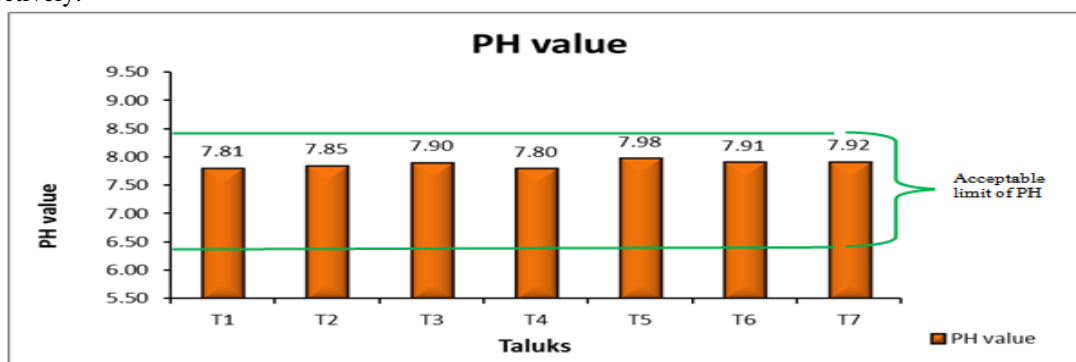
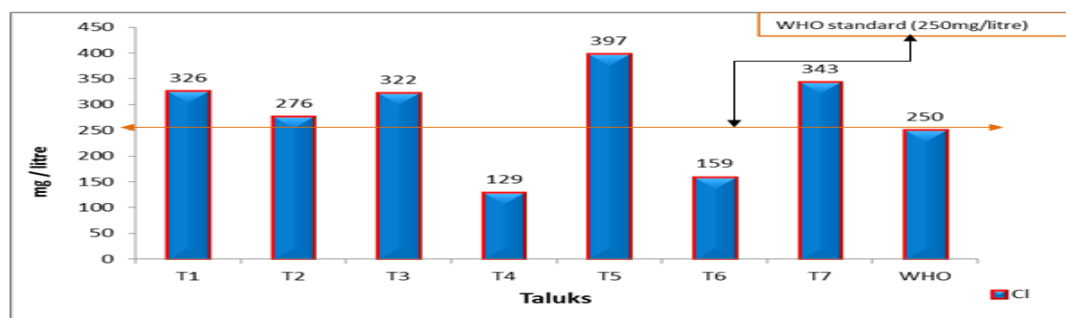


Fig.2 PH values of the Ground water samples collected in various Taluks of Madurai district

Since the electrical conductivity is a measure to the capacity of water to conduct electrical current, it is directly related to the concentration of salts dissolved in water, and therefore to the Total Dissolved Solids (TDS). Salts dissolve into positively charged ions and negatively charged ions, which conduct electricity. The values of electrical conductivity of the ground water of the seven taluks are ranging from 2105 to 1168  $\mu\text{S}/\text{cm}$ .

The higher value is obtained in Usilampatti taluk (T<sub>5</sub>) 2105  $\mu\text{S}/\text{cm}$  and the lower value in Peraiyur taluk (T<sub>6</sub>) 1168  $\mu\text{S}/\text{cm}$ . The values of other taluks are 1682  $\mu\text{S}/\text{cm}$  in Madurai north (T<sub>1</sub>), 1637  $\mu\text{S}/\text{cm}$  in Madurai south (T<sub>2</sub>), 1575  $\mu\text{S}/\text{cm}$  in Melur (T<sub>3</sub>), 1340  $\mu\text{S}/\text{cm}$  in Vadipatti (T<sub>4</sub>) and 1841  $\mu\text{S}/\text{cm}$  in Tirumangalam (T<sub>7</sub>) respectively

Chlorides are generally present in water in the form of sodium chloride and may be due to the leaching of marine sedimentary deposits, pollution from brine or industrial and domestic wastes. Their concentrations above 250 mg/litre produce a noticeable salty taste in drinking water and are objectionable. Water with high chloride is used for construction purpose; it may lead to carbonization of concrete and corrosion the steel reinforcement bars. The mean result of Chloride (Cl) shows the level is exceeded the maximum permissible value of 250 mg/litre as per WHO. But in In Madurai north (T<sub>1</sub>) it is 326 mg/litre, Madurai south (T<sub>2</sub>) 276mg/litre, Melur (T<sub>3</sub>) 322 mg/litre, Usilampatti (T<sub>5</sub>) 397 mg/litre and Tirumangalam (T<sub>7</sub>) 343mg/litre. But in Vadipatti (T<sub>4</sub>) 129 mg/litre and Peraiyur (T<sub>6</sub>) 159 mg/litre, the values are for below the maximum limits. The results are ranging from 129 to 397 mg/litre. The ground water quality in Vadipatti (T<sub>4</sub>) and Peraiyur (T<sub>6</sub>) taluks are satisfying all parameters and the taluks Usilampatti (T<sub>5</sub>) and Tirumangalam (T<sub>7</sub>), where more abnormalities are found. This is due to the depletion of ground water, pollution by industrial and sewerage waste etc.



**Fig.4** Chloride(Cl) values of the Ground water samples collected in various Taluks of Madurai district

#### IV. CONCLUSION

From the above studies, it can be concluded that the ground water quality in Madurai district, Tamilnadu, India is suitable for domestic and agricultural purposes. Even though some of the parameters like pH value and Total Hardness are well within the allowable limit, there are some quality issues noticed with regard to Total Dissolved Solids, Electrical Conductivity and Chloride. Some of the causes for problems in water quality may be organic pollution and insufficient treatment of water before use for drinking purposes. The present authors recommend that excess draining and discharge of ground water by the private parties may be controlled by the government through strict vigil and control. This study suggests that further studies may be conducted with samples collected on shortened intervals that will bring out more insights on quality standards of ground water in Madurai District.

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