



Research Article

ISSN : 0975-7384  
CODEN(USA) : JCPRC5

## Studies on the quality of groundwater in Madurai, Tamilnadu, India

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### ABSTRACT

Water sources available for drinking and other domestic purposes must possess high degree of purity, free from chemical contamination and microorganisms. The rapid growth of urban areas has further affected the water quality due to over exploitation of resources and improper waste disposal practices. A piece of investigation was carried out to study the ground water quality, nutrient status and physicochemical characteristics of ground water in Madurai, India. Various samples of ground water were collected in ten different places and the physicochemical analysis of the collected samples were carried out for the parameters, such as temperature, pH, total dissolved solids (TDS), electrical conductivity (EC), total hardness (TH), alkalinity, calcium, magnesium, sodium, potassium, chloride, sulphate, nitrate, fluoride, chemical oxygen demand, dissolved oxygen, etc.,. In most of the places, the quality of water was not found suitable for domestic and industrial purposes, because of high concentration of total dissolved solids, total alkalinity, total hardness etc.,.

**Keywords:** Physicochemical parameter, Ground water quality, Water quality standards.

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### INTRODUCTION

Ground water was considered to be very clear and safe in past but now a days it is getting polluted with rapid growth of urban and industrial activities, particularly in the developing countries proper waste disposal measure are not followed [1-2]. Since the quality of public health depends to a greater extend on the quality of drinking water, it is incumbent that detailed information about the quality of water be systematically collected and monitored [3]. During last decade, it is observed that the ground water gets polluted drastically because of the increased human activities. Consequently number of cases of water borne diseases has been seen which a cause of health hazards[4]. Therefore, the pollution of water resources need a serious and immediate attention through periodical check up of water quality. The purpose of the study is to evaluate the composition and the quality of ground water in Madurai, India.

### EXPERIMENTAL SECTION

The exact location of the study area lies between 09° 10" to 09° 50" N latitude and 78° 10" to 78° 20" E longitude. Altitude of the city is 101 M above the Mean Sea Level; the study area receives rainfall by Southwest Monsoon during the period of June to September and followed by the Northeast Monsoon in the month of October to November. The city extends to an area of 51.85 sqkm. All the samples were collected in the month of November 2011, the location selected for the investigation are Thuvariman (S1), Kochadai (S2), West Ponnagaram (S3), Sellur (S4), AV Bridge (S5), Madhichiyam (S6), Theppakulam (S7), Vandiyur (S8), Viraganur (S9), Silaiman (S10). The samples were collected in sterilized, phosphate free bottle and the collected samples were analyzed on various physicochemical parameters. The procedure for analysis followed as in , " Standard methods of analysis of water and waste water" (APHA)[5] . The various parameters included in the analysis are temperature, colour, odour, turbidity, pH, total dissolved solids (TDS), electrical conductivity (EC), total hardness (TH), alkalinity, calcium,

magnesium, sodium, potassium, chloride, sulphate, nitrate, fluoride, chemical oxygen demand and dissolved oxygen(DO).

### RESULTS AND DISCUSSION

The results of the physicochemical analysis of the ground water samples in stations S1 to S10 were collected in Madurai and presented in the Table 1 and the Table 2.

The colour and odour of the water samples found to be clear and odourless during the study period. The temperature was found to be in the range between 24.3 °C to 26.3 °C, the lower value of the water temperature observed in the present study could be attributed due to the winter season.

**Table 1. Physical parameters of water samples collected in Madurai**

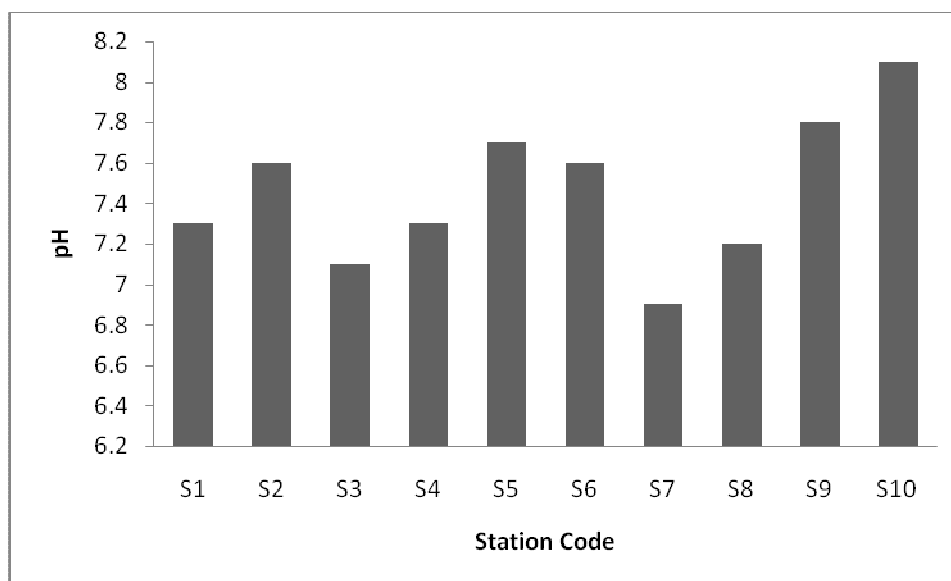
S. NO	Name of the Station	Thuvariman	Kochadai	West Ponnagaram	Sellur	AV Bridge	Madhichiyam	Theppakulam	Vandiyur	Viraganur	Silaiman	WHO Standard
	Station Code	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
1	Water Temperature °C	24.4	24.8	24.4	26.3	25.1	24.9	24.9	25.3	25.1	25.6	25
2	Appearance	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	-
3	Odour	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	-
4	Turbidity (NTU)	1	0	1	1	2	2	3	4	7	9	5
5	pH	7.3	7.6	7.1	7.3	7.7	7.6	6.9	7.2	7.8	8.1	6.5-8.5
6	EC (µmhos/cm)	417	498	693	377	648	602	719	1132	1052	1484	500
7	DO (mg / litre)	1.63	1.99	1.49	1.28	2.34	1.85	2.13	2.27	1.85	2.13	8

CL – Clear OL – Odourless

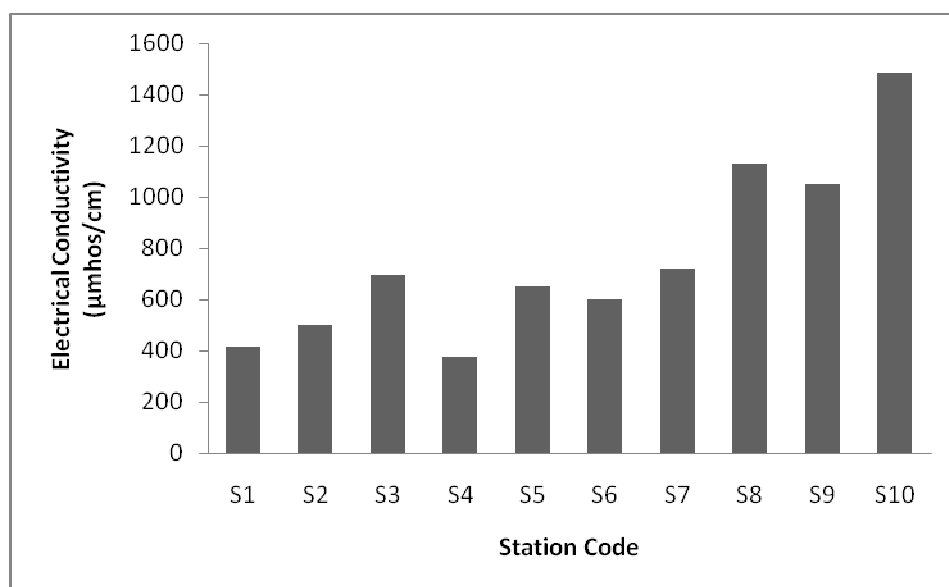
**Table 2. Chemical parameters of water samples collected in Madurai**

Sl. No	Name of the Station	Thuvariman	Kochadai	West Ponnagaram	Sellur	AV Bridge	Madhichiyam	Theppakulam	Vandiyur	Viraganur	Silaiman	WHO Standard
	Station Code	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
1	TDS	696	831	1051	639	987	1010	1122	1691	1575	2215	500
2	Alkalinity	155	293	453	163	293	412	444	417	346	459	250
3	TH	298	447	373	278	283	435	463	483	456	629	500
4	Ca <sup>2+</sup>	219	220	243	175	162	219	204	309	304	389	75
5	Mg <sup>2+</sup>	41	99	104	57	56	91	99	135	136	172	30
6	Na <sup>+</sup>	189	227	200	200	119	162	197	261	293	301	100
7	K <sup>+</sup>	20	31	51	34	31	49	58	62	54	100	10
8	NO <sub>3</sub> <sup>-</sup>	62	65	79	47	62	55	53	58	51	115	5
9	SO <sub>4</sub> <sup>2-</sup>	229	131	219	134	242	199	163	212	204	293	250
10	Cl <sup>-</sup>	413	277	412	220	446	596	364	515	483	659	250
11	F <sup>-</sup>	0.62	0.59	0.63	0.48	0.8	1.22	0.53	0.91	1.15	1.59	1
12	COD	58	85	70	68	48	33	45	62	48	116	-

Unit –mg/litre



**Figure 1. pH of water samples collected from Madurai (S1 to S10).**

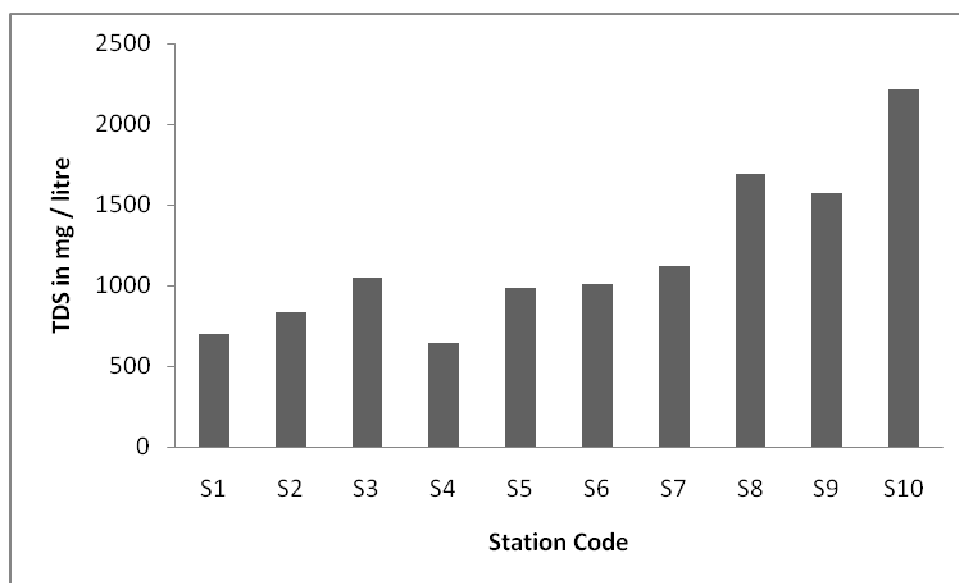


**Figure 2. Electrical conductivity of the water samples collected from Madurai (S1 to S10).**

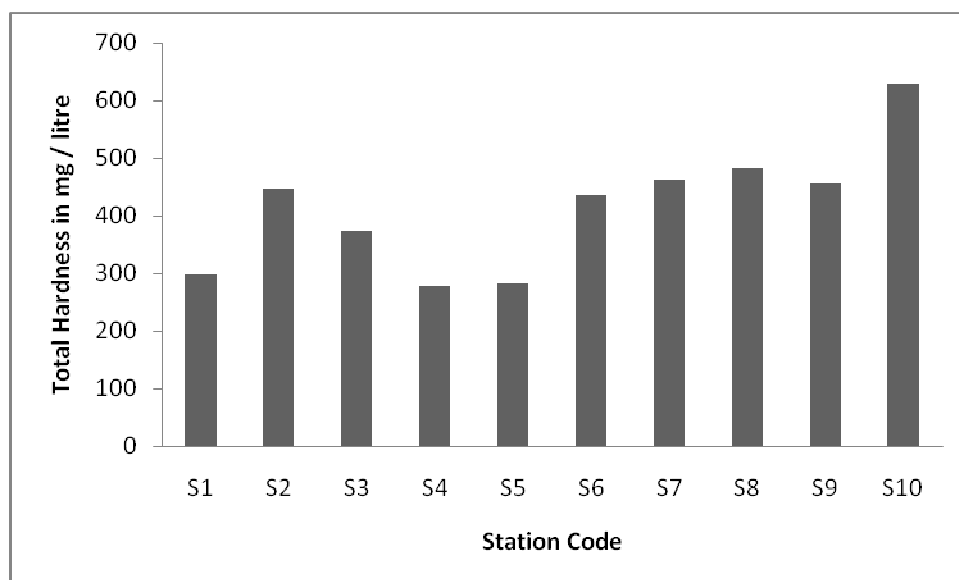
The value of pH range of the collected water samples lie between 6.9 to 8.1. It is in the prescribed limit of ICMR, the pH shows slightly alkaline trend. Generally pH of water is influenced by geology of catchment area and buffering capacity of water [6]. The electrical conductivity values also found to be 377 to 1484 ( $\mu\text{mhos/cm}$ ) higher in S8 and S10, the total hardness values ranged from 278 to 629 mg/litre.

During the period of investigation the value of total dissolved solids ranged from 639 to 2215 mg/litre. The TDS value observed except in S3, S7, S8, S9 and S10 were within the desirable limit. High TDS in ground water may be due to the ground water pollution where waste water from various field are discharged into pits, bonds and lagoons enabling the waste migrate down to the water table [7-8].

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]. Calcium hardness ranged from 162 to 389 mg/litre and magnesium hardness ranged from 41 to 172 mg/litre. Fluoride was found within the permissible limit for all samples and ranging from 0.48 to 1.59 mg/litre.



**Figure 3. Total dissolved solids (mg/litre) of the water samples collected from Madurai (S1to S10).**



**Figure 4. Total Hardness (mg/litre) of the waters samples collected from Madurai (S1 to S10)**

The chloride concentration ranged from 220 to 659 mg/litre. Except S4 all the sampling stations the chloride values exceeded the maximum permissible value. If the value with high chloride is used for construction purpose, it may corrode the concrete. Sulphate was found in the range from 131 to 293 mg/litre. Higher concentration of Sulphate in water can cause malfunctioning of alimentary canal and shows cathartic effect on human being [10].

Sodium and potassium of water samples collected lies in the range of 119 to 301 mg/litre and 20 to 100 mg/litre respectively. These values are exceeding the permissible limit proposed by WHO [11]. The excess amount of potassium present in the water sample may lead nervous and digestive disorder [12]. Dissolved oxygen in drinking water adds taste and it is highly fluctuating factor in water in the study area and the dissolved oxygen content varied in a limited range 1.28 to 2.27 mg/litre. The Chemical Oxygen Demand ranged from 33 to 116 mg/litre and these values are present within the prescribed desirable limit.

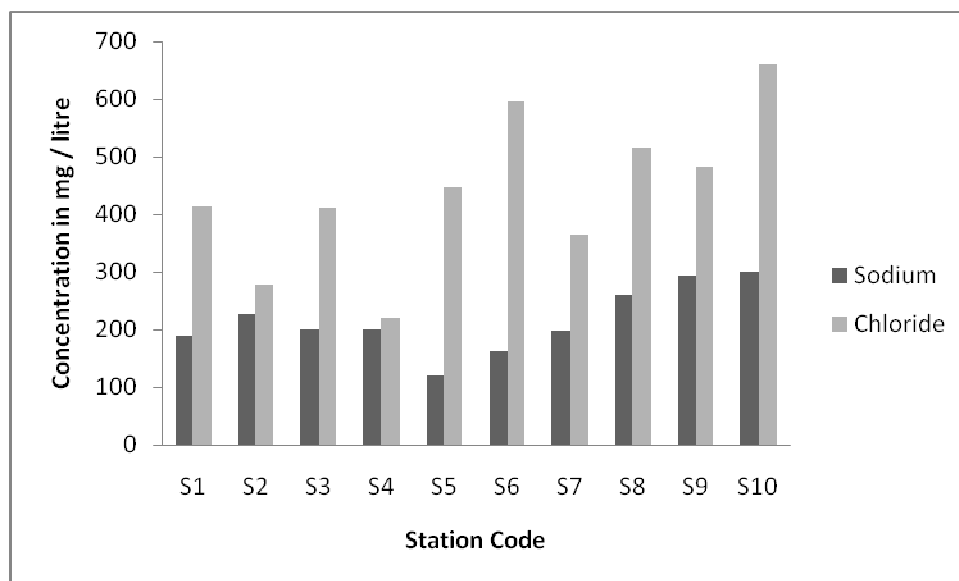


Figure 5. Concentration of Sodium and Chloride ion (mg/litre) of the water samples collected from Madurai (S1 to S10)

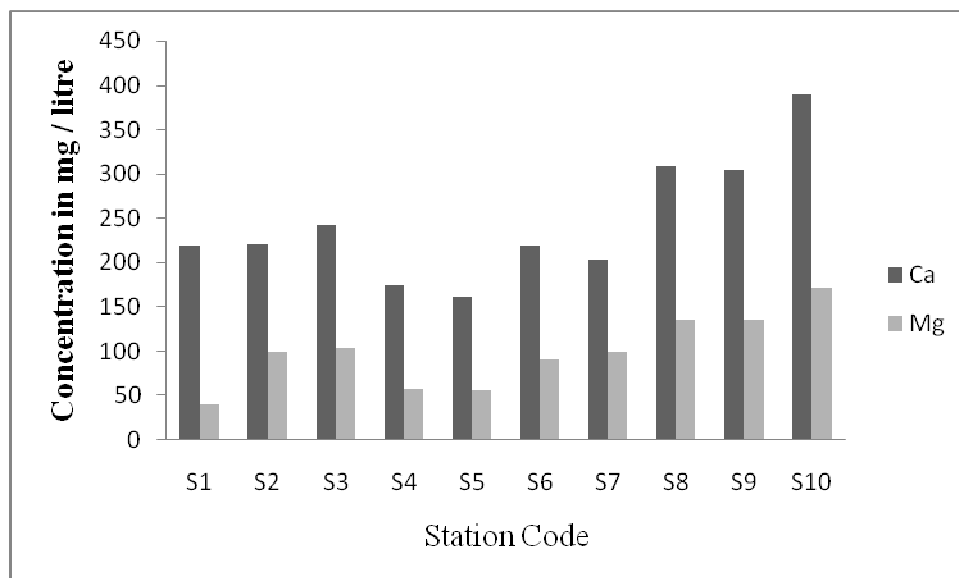


Figure 5. Concentration of Calcium and Magnesium ion (mg/litre) of the water samples collected from Madurai (S1 to S10)

### CONCLUSION

The analysis of water quality parameters of ground water from the 10 different stations in Madurai, India shows that the pH, electrical conductivity, total hardness, alkalinity, calcium, fluoride, DO and COD values are well within the permissible limit. The TDS of S3, S7, S8, S9 and S10 are well above the desirable limit. The values of potassium, chloride, sulphate are also above the prescribed desirable limit. Hence it is suggested to exercise all the necessary precaution before the water is used for drinking and irrigation, otherwise, it may lead to much adverse health effect. People from the study area should drink only the treated water.

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