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Physico-chemical characteristics of ground water of Manachanallur Block Trichy, Tamilnadu, India

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ABSTRACT

Trichy has located in centre of Tamilnadu (India). Manachanallur is one of the main taulk which is called as "green valley of trichy". It also has a historical importance and is blessed with fertile lands, having and various types of rice mills. It has an area of 36383.85 hectare of land in which 35236 hectare is under cultivation. Manachanallur taulk is located in northern part of the trichy district. Its border populated upto perambalur district. The people in the 40 villagers use kollidam river water and the ground water for drinking. Lot of work has been done and published already on the ground water quality of many village in other taulk of trichy district. But in the manachanallur taulk, there is a need to undertake the study to assess the drinking water quality. Hence water samples of ten villages were subjected to physico-chemical parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), Calcium (Ca^{2+}), magnesium (Mg^{2+}), Sodium (Na^{+}), Potassium (K^{+}), Chloride (Cl^{-}), Nitrate (NO^{3-}), Sulphate (SO_4^{2-}) were analyzed (APHA, 1998) The results were compared with standards prescribed by ISI 10500-91/ICMR/WHO and suitable suggestion were made.. The correlation coefficients were calculated for water quality assessment.

Key Words Physicochemical characteristics**,** Ground water, water quality, Manachanallur Block, Water quality.

INTRODUCTION

Groundwater is used for agricultural, industrial, household, recreational and environmental activities all over the world. In India, most of the population is dependent on groundwater as the only source of drinking water supply. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization [1]. Potable water is the water that is free from disease producing microorganisms and chemical substances. About 10% of the rural and urban populations do not have access to regular safe drinking water and many more are threatened. Most of them depend on unsafe water sources to meet their daily needs. The story of each city may be different, but the main reasons for the water crisis are common, such as, increasing demand, zonal disparity in distribution of water supply, lack of ethical framework, inadequate knowledge and resources, major land-use changes, long term water level declines, increase in salinity and pollution [2]. The reason for elucidation of important parameters in water quality assessment may be attributed to the fact that in the overall potability of water. The present study deals with the physico-chemical characteristics of groundwater samples of selected bore wells in Manachanallur area. A systematic analysis of correlation and regression coefficients of the quality parameters not only helps to assess the overall water quality but also to quantify relative concentration of various pollutants in water and provide necessary cue for implementation of rapid water quality management programmes [3-5].

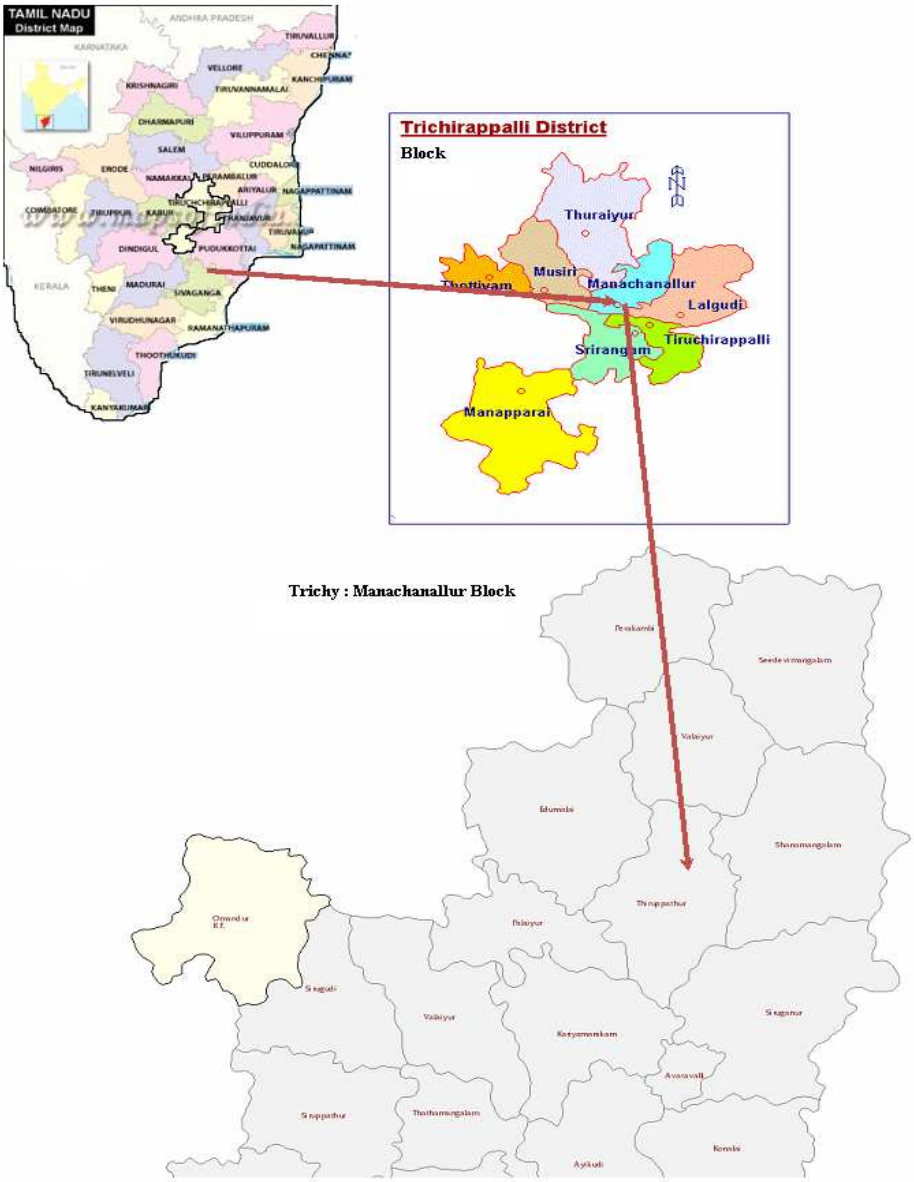

Fig.1 Sampling locations and map of study area

Study area

Geographically trichy lies with latitude of 10°81′ N and longitude 78°69′ E. The district lies in the Southern plateau & hill zone of Agro-climate regional planning with characteristics of semi-arid climate. The soil is predominantly red loamy and black. The major crops grown in the district are paddy, groundnut, sugarcane and millets. paddy is the major plantation crop. Bore well water is generally using for drinking and irrigation purposes in this district.

MATERIALS AND METHODS

Ten villages at manachanallur taulk in trichy district, Tamilnadu, India were selected (Fig.1) for testing Potability of drinking water sources. The sampling sites are rural places and the samples are major sources of drinking for the villagers, which are obtained from bore wells. The details of the sampling stations are given in Table (1). Grab samples were collected in the polythene bottles which were previously cleaned. The analysis was carried out

systematically both volumetrically and by instrumental techniques. The Procedures were followed from standard books and manuals [6-8]. The analysis was carried out immediately for pH, EC Odour and for all other parameters within three hours of sampling time. In the present investigation the samples were collected during the month of December 2011 - February 2012.

Table 1 Details of the sampling locations

Sample No	Sampling Location	Taulk	Population		
			Male	Female	Total
S1	EDUMALAI	Manachanallur	1,768	1,853	3,621
S2	KARIYAMANIKAM	Manachanallur	3,424	3,540	6,964
S3	PALAIYUR	Manachanallur	995	943	1,938
S4	PERAKAMBI	Manachanallur	1,165	1,339	2,504
S5	SHANAMANGALAM	Manachanallur	1,849	1,752	3,601
S6	SIRUGUDI	Manachanallur	943	728	1,385
S7	SRIDEVIMANGALAM	Manachanallur	553	570	1,123
S8	THATHAMANGALAM	Manachanallur	1,416	1,486	2,902
S9	THIRUPPATTUR	Manachanallur	1,277	1,258	2,535
S10	VAZHAIYUR	Manachanallur	795	753	1,548

Table 2 Values obtained for physical parameters in the study area

S. No	Parameters	WHO standard	BIS standard	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	Appearance	Clear & Colourless	Clear & Colourless	Clear & Colourless									
2	Colour	Colourless	Colourless	Colourless									
3	Taste	Not objectional	Not objectional	Agreeable									
4	Odour	Odourless	Odourless	Odourless									
5	Turbidity(NTU)	5	10	1	1	1	1	1	1	1	1	1	1
6	EC microsiemens cm-1	1000-2000	750-2250	1448	1620	1002	1958	4122	1750	1836	1582	1465	2017
	TDS, mg/L	500	500	1130	1119	998	1450	3275	1280	1545	860	1150	1350

Table 3 Values obtained for chemical parameters in the study area

S. No	Parameters	WHO standard	BIS standard	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	pH	7-8.5	6.5-8.5	7.3	6.9	7.3	7.6	7.8	7.2	7.3	7.1	7.2	7.4
2	Alkalinity	100	200	264	320	280	356	512	330	298	239	318	394
3	Total Hardness	300	300	398	295	259	498	658	428	587	435	398	460
4	Calcium	75	75	127	85	97	68	108	48	80	60	119	144
5	Magnesium	50	50	68	42	58	31	56	80	48	28	69	26
6	Sodium	200	200	126	187	216	98	230	196	188	215	193	647
7	Potassium	12	12	28	35	26	19	59	44	57	59	41	158
8	Iron	-	0.321	0	0	0	0	0	0	0	0	0	0
9	Manganese	-	-	0	0	0	0	0	0	0	0	0	0
10	Ammonia	-	-	0	0	0	0	0	0	0	0	0	0
11	Nitrate	100	100	12	19	11	17	38	20	24	18	16	26
12	Chloride	200	250	178	210	256	98	250	253	192	206	190	798
13	Fluoride	1	1	0	1	1	0	1.2	1	1	0	1	1.1
14	Sulphate	200	200	190	20	140	110	970	60	165	155	142	370
15	Phosphate	1	1	0.03	0.07	0.1	0.02	0.08	0.1	0.09	0.1	0.06	0.62
16	Tidy's	1	1	0.35	0.42	0.24	0.16	0.68	0.76	0.30	0.27	0.24	0.54

Except pH, all values are given in mg/L

Table 4 Correlation matrix for different quality parameters

Parameters	EC	TDS	P^H	Tot. alk	TH	Ca	Mg	Na	K	NO_2	NO_3	Cl	F	SO_4	PO_4
EC	1														
TDS	1.032	1													
P^H	-0.420	-0.419	1												
Tot. alk	0.756	0.756	-0.430	1											
TH	0.625	0.626	-0.468	0.530	1										
Ca	0.682	0.683	-0.506	0.578	0.992	1									
Mg	0.635	0.635	-0.420	0.469	0.992	0.968	1								
Na	0.982	0.982	-0.298	0.840	0.604	0.612	0.570	1							
K	0.956	0.956	-0.252	0.892	0.542	0.550	0.501	0.981	1						
NO_2	-0.168	-0.167	0.88	-0.350	-0.105	-0.152	-0.062	-0.189	-0.234	1					
NO_3	0.868	0.868	-0.520	0.846	0.465	0.530	0.425	0.850	0.866	-0.116	1				
Cl	0.992	0.992	-0.412	0.852	0.740	0.755	0.720	0.970	0.938	-0.192	0.850	1			
F	0.365	0.365	0.158	0.408	-0.068	-0.057	-0.073	0.425	0.365	-0.250	0.285	0.278	1		
SO_4	0.918	0.918	-0.127	0.720	0.512	0.502	0.520	0.932	0.954	-0.098	0.710	0.888	0.258	1	
PO_4	0.625	0.625	-0.402	0.722	0.420	0.433	0.398	0.644	0.632	0.158	0.786	0.648	0.450	0.466	1

RESULTS AND DISCUSSION

The results of the analysis are presented in the Table 2 & 3. The pH value of all samples falls within the permissible limit (ie) minimum of 6.9 and maximum of 7.8 [9]. Electrical conductivity (EC) of water is direct function of its total dissolved salts. EC range varies between 1002 to 4122 in the study area [10]. The total dissolved solids indicate the salinity behavior of ground water. The minimum and maximum recorded were 860 and 3275.

The total hardness is the measure of the capacity of water to precipitate soap. The hardness is more than 50mg/L will causes the Renal Calculi formation of kidney stone [11]. The minimum and maximum values recorded were 259 and 658 mg/l respectively. The maximum level of total hardness is due to presence of carbonate and non carbonate hardness.

Total Alkalinity ranges from 239 to 512 in the study area. Alkalinity of water is the capacity to neutralize acidic nature and is characterized by the presence of hydroxyl ions. Alkalinity around 150 mg/L has been found conductive to higher productivity of water bodies[12]. The chloride ions are ranged from 98 to 798 mg/L. It may be due to the presence of domestic sewage disposal and the presence of soluble chlorides from rocks [13]. Sulphate in most of the samples found lower than highest desirable level, that is 200 mg/L except S5 and S10. In the study area, minimum and maximum recorded value of sulphate was 20 to 970 mg/L.

Sodium plays an important role in human body. Regulatory action is exercised by sodium, potassium, calcium and magnesium. The flux of these ions through cell membranes and other boundary layers sends signals that turn metabolic reactions on and off. The maximum permissible limit of sodium in water is 230 mg/L. From table 3 it is seen that the concentration ranges of sodium for sample vary from 98 to 647 mg/L, except S6 and S7 all the other stations are all below the permissible limit.
Potassium has properties similar to sodium. In this study, the minimum and maximum recorded values of potassium were 19 to 158 mg/L. In order of abundance, calcium is the fifth element which is commonly present in all water bodies where it usually comes from the leaching of rocks. Calcium is very essential for nervous system and for formation of bones and teeth. The concentration of calcium in potable water ranges from 75 to 200 mg/L. The maximum and minimum values recorded 48 to 144 mg/L. All the values of study area are within the permissible limit. Magnesium is a beneficial metal, but it is toxic at high concentration. Higher the concentration of magnesium in drinking water gives unpleasant taste to the water. The concentration of magnesium in potable water ranges from 30-100 mg/L. The minimum and maximum recorded values of magnesium were 28 to 80 mg/l.

Iron is biologically important element which is essential to all organism and present in hemoglobin system [14]. High concentration of iron causes slight toxicity. The result showed that the concentration of iron is almost zero for all the stations. Fluoride is essential for human beings as a trace element and higher concentration of this element causes toxic effects.

Concentration of fluoride between 0.6 to 1.0 mg/L in potable water protects tooth decay and enhances bone development. BIS has suggested permissible limit of fluoride in drinking water as 1.0 mg/L and tolerance range up to 1.5 mg/L. If fluoride concentration is more than 1.5 mg/L it may cause fluoride dental motling and bone diseases [15]. In the study area, all the water sample fall within the permissible limit of BIS.

The desirable nitrate value for drinking water prescribed by BIS is 100 mg/L. The values of nitrate for all water samples fall within the limit. The minimum and maximum value lies between 11 and 38 mg/L.

Phosphorous, an essential nutrient for living organisms occurs in water as both dissolved and particulate species. It controls primary productivity [16]. In the study area phosphate is varied from 0.02 to 0.62 mg/L.

Statistical analysis

Interrelationship studies between different variables are very helpful tools in promoting research and opening new frontiers of knowledge. The study of correlation reduces the range of uncertainty associated with decision making. The correlation co-efficient 'r' was calculated using the equation[17].

$$r = \frac{N\sum(X_i Y_i) - \left(\sum[X_i].(\sum[Y_i]\right]}{\sqrt{\left[N\sum X_i^2 - (\sum[X_i])^2\right]\left[N\sum Y_i^2 - (\sum[Y_i])^2\right]}}$$

Where,

Xi and Yi represents two different parameters.

N = Number of total observations. The numerical values of correlation coefficient (r) for 16 parameters are tabulated in Table 4. Out of the 120 correlation coefficients 26 correlation coefficients studies are found to be highly significant level(0.8< r <1.0) [18]

CONCLUSION

Among the 10 bore well water samples analyzed all the stations are having excess of TDS, Tot.Alk, TH, Ca, Mg, Na, K, Cl. Particularly S5 and S10 have high values of all the important parameters when compared to standards prescribed by BIS/ICMR/WHO. The values of the water quality parameters and the correlation coefficient will help in selecting proper treatment to minimize ground water pollution.

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