International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No. (01), January 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN ERODE DISTRICT, TAMILNADU, INDIA

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ABSTRACT

The groundwater quality is a major problem in different parts of our country. In Tamilnadu the groundwater is the only alternative source when surface water becomes scarce in pre-monsoon seasons. Higher concentrations in excess of the permissible limit in drinking water have been linked to health problems, especially in infants. In this study 38 groundwater samples were collected from different locations in Erode district. Water quality assessment was carried out for the parameters like pH, Electrical Conductivity, Total Dissolved Solids, Hardness, Calcium, Magnesium, Chlorides, Nitrates, Sulphates and Fluorides. The chemical characteristics of groundwater have been studied to evaluate the suitability of groundwater for domestic and irrigational purposes.

Keywords: Groundwater, Parameters, Permissible limit, Suitability, Water quality assessment.

I. INTRODUCTION

Water is an important limiting factor for the human health. Water plays an important role in human life. The earth is the only planet where water exists in substantial quantity. Major water sources on the earth are saline water sources (Seas and Oceans). They are about 99% of the total water available. Remaining 1% of water source includes the fresh water bodies on the earth and the groundwater sources. The groundwater is an important source of water for agriculture, domestic and industrial purpose.

The groundwater scenario in India, which receives a substantial amount of annual rain fall, is not encouraging primarily due to the imbalance between recharge and groundwater exploitation. A large amount of rain water is lost through runoff, a problem compounded by the lack of rain water harvesting practices.

Groundwater is the only alternative option for even the urban centre having well planned, designed and executed water supply systems like Erode, during the period of water scarcity due to shortfall of rain or its non occurrence. Nowadays, the groundwater potential and its quality level in major cities and urban centre is getting deteriorated due to population explosion, urbanization, industrialization, and also the failure of monsoon and improper management of rain water. The groundwater quality is normally characterized by different physico – chemical characteristics [1]. These parameters change widely due to the type of pollution, seasonal fluctuations, groundwater extraction, etc., A continuous monitoring of groundwater becomes mandatory to minimize the

groundwater pollution, to have control over pollution causing agents and to give corrective measures. Since the groundwater quality in different parts of the city is widely deviating from the prescribed standards, it also becomes necessary to identify locations and categorize them according to pollution levels.

II.STUDY AREA

The study area is located between 10^0 35' and 12^0 0' North latitude and 76^0 50' and 77^0 50' East longitude. It is positioned North Western part of Tamilnadu. The total area of Erode district is 8209 Sq. KM and average rain fall is 700 mm. The study area and sampling stations are shown in Fig. 1.

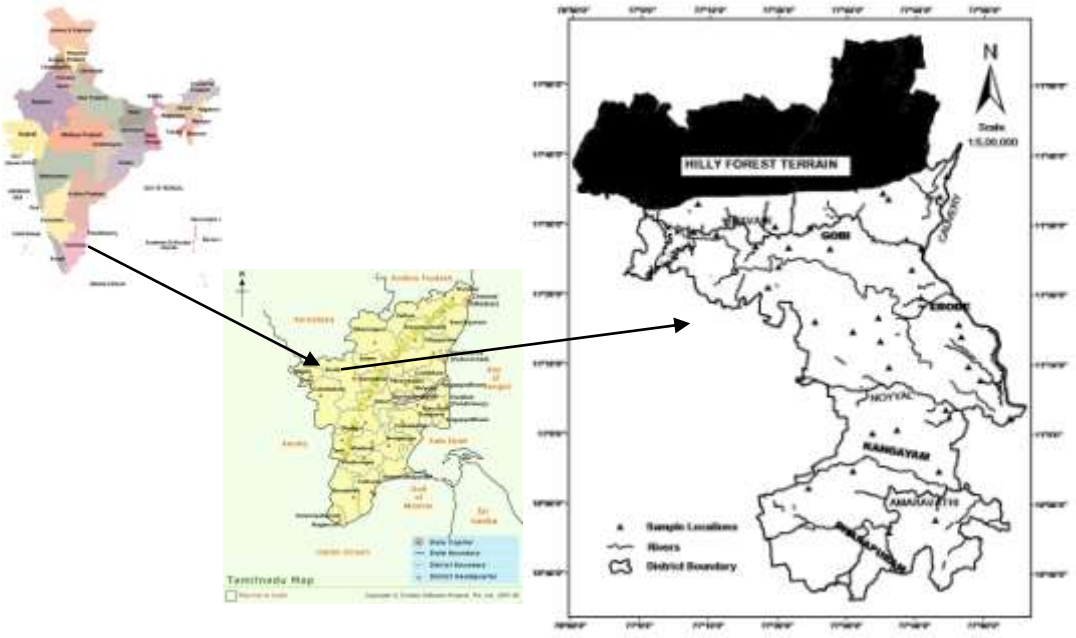

Fig. 1: Study area and sampling locations

2.1. GEOLOGY OF THE AREA

The topography of the region is an undulating terrain with an altitude ranging from 160 to 1760 metres above sea level. Cauvery with its tributaries Amaravathi, Noyyal and Bhavani are the main drainages in the study area. With regard to geology, the area lies in the hard rock strata with semi confined aquifer.

III. SAMPLING LOCATIONS AND METHODOLOGY

The sampling stations and corresponding parameters are given in table 1. For the present study, groundwater samples from bore wells in the sampling locations were taken after operating the hand pump or motor pumps for about 10 to 15 minutes. Each sample is collected in a pre-cleaned polypropylene bottle with necessary

precautions. The collected samples were analyzed for chemical constituents to assess the quality of groundwater as per the standard methods [2]

Table 1: Sampling stations and physio-chemical parameters

Sl. No.	Sampling stations	pH	EC	TDS	TH	Ca	Mg	Cl	F	No_3	So_4
1.	Moongil palayam	7.74	610	427	300	73	32	36	0.2	24	28
2.	Uthukuli	7.83	1092	764	392	80	41	72	0.6	60	43
3.	Orukkam palayam	7.72	2400	1680	344	68	32	320	0.2	298	80
4.	Perundurai	7.81	1396	977	340	49	28	60	0.2	60	51
5.	Pacha palayam	7.85	1072	750	420	85	43	72	0.2	44	42
6.	Kangayem	8.0	1920	1344	320	72	34	336	0.6	62	33
7.	Chennimalai	7.67	530	371	220	47	17	32	0.2	16	11
8.	Ingur	7.58	883	618	240	57	23	72	0.4	88	47
9.	Muthur	7.9	439	307	172	37	20	24	0.2	24	12
10.	Karattu palayam	7.74	896	627	296	64	36	54	0.6	59	60
11.	Mulanur	7.86	2320	1624	690	275	80	572	0.2	99	102
12.	Kolathu palayam	7.57	1194	835	520	98	50	72	0.8	36	40
13.	Dharapuram	7.92	906	634	420	100	41	64	0.2	58	56
14.	Thottam patty	7.92	1857	1299	520	139	91	172	0.4	180	179
15.	Ruthravathi	7.86	2322	1624	700	278	82	573	0.4	102	96
16.	Sengodam palayam	7.54	749	524	196	62	30	56	0.4	64	64
17.	Chittode	7.85	1222	860	160	106	58	136	0.4	52	43
18.	Thindal	7.85	1221	854	456	105	57	136	1.0	50	40
19.	Bhavani	8.0	549	384	200	54	18	40	1.4	23	32
20.	Jambai	7.39	828	579	240	53	23	56	0.4	41	44
21.	Anthiyur	7.84	462	323	196	39	23	20	0.2	61	12
22.	Kandam palayam	7.85	1516	1066	473	111	69	185	0.4	52	133
23.	Ammapet	7.9	1120	784	448	79	53	70	0.2	57	56
24.	Barrage III	7.83	676	473	232	38	26	40	1.0	19	48

25.	Elathur	7.79	1336	2085	396	98	48	220	0.7	13	41
26.	Pola palayam	7.87	1582	1107	464	93	51	196	0.5	42	92
27.	Alukuli	7.90	1124	787	420	85	51	112	0.8	21	40
28.	Gobi	7.87	489	342	248	71	23	40	0.7	12	22
29.	Arakkan kottai	7.85	1515	1060	472	110	68	184	0.8	48	132
30.	Nanjai puliampatty	8.0	499	349	224	59	23	36	0.6	12	18
31.	Konthalam	7.93	779	545	272	55	31	64	0.5	15	22
32.	Chenna samudram	7.87	917	642	388	104	49	112	0.4	21	40
33.	Chikkarasam palayam	7.85	1127	788	336	71	29	132	0.7	76	22
34.	Kotha mangalam	7.92	1104	772	324	76	36	120	0.5	88	27
35.	Uthandiyur	7.87	744	520	184	40	20	112	0.2	18	15
36.	Makinan kombai	7.95	1327	929	332	36	30	172	0.4	54	21
37.	Modakurichi	7.54	1024	716	336	67	51	152	0.8	32	17
38.	Kulavilaku	7.8	854	597	360	84	40	64	0.5	44	23

Note : EC - µs/cm, except pH all other parameters are in mg/l.

IV.RESULTS AND DISCUSSION

Analysis is made for Physico-chemical characteristic for the groundwater collected from the 38 locations in Erode district. The values of such parameters like pH, TDS (Total Dissolved Solids), Total Hardness (TH), Ca, Mg, Cl ,F, NO_3 and So_4 concentrations were compared with the standard values prescribed by the World Health Organization [3].The results are given in table 2.

The groundwater quality is determined by Classification of Electrical Conductivity and TDS [4] and are given in table 3 and 4 respectively. Excess concentrations of TDS cause undesirable taste, gastrointestinal irritations and corrosion or incrustation. Higher levels of TH, Ca and Mg cause [5] poor lathering with soap, deterioration of the quality of cloths, scale forming, skin irritation, boiled meat and food become poor in quality. Higher concentrations of No_3 cause blue baby disease (Methemoglobimemia) and algal growth [6].

Pipers trilinear diagram [7] was used to evaluate and understand the problems about the geochemistry. This diagram consists of two triangular describing the dominance of cations and anions on lower left and right side of the field. The diamond shape field combines the composition of cations and anions.

The data plotted in the Piper's diagram (Fig.2) shows that the 70% of the groundwater samples in the study area were saline in nature due to heavy concentration of sulphates and chlorides.

Table 2: Comparison of physio-chemical parameters with WHO standards.

Parameters	No. of samples exceeding the desirable limits	Percentage of Samples exceeding the limits	WHO international standards, 1993		Undesirable effect outside the desirable limit
			Most Desirable Limits	Maximum Allowable Limits	
pH	Nil	Nil	6.5-8.5	6.5-9.2	Beyond this range the water will affect the mucous membrane and/or water supply system
TDS, mg/l	30	79	500	1500	Beyond this palatability decreases and may cause gastro intestinal irritation
TH, mg/l	38	100	100	500	Encrustation in water supply structure and adverse effects on domestic use.
Ca, mg/l	18	47	75	200	Encrustation in water supply structure and adverse effects on domestic use.
Mg, mg/l	11	29	50	150	Encrustation in water supply structure and adverse effects on domestic use.
Cl, mg/l	5	13	200	600	Beyond this limit, taste, corrosion and palatability are affected.
F, mg/l	1	3	1.0	1.5	High fluoride may cause fluoriosis
No_3, mg/l	20	53	45	--	Beyond this methemoglobinemia takes place.

So_4 ,mg/l	Nil	Nil	200	400	Beyond this causes gastro intestinal irritation when Mg or Na are present.

Table 3: Groundwater Quality Classification based on EC (µs/cm)

Quality of water	Electrical Conductivity µs/cm	No. of samples exceeding the limit	Percentage of Samples
Excellent	Up to 250	Nil	Nil
Good	250 – 750	10	26
Fair	750 – 2250	25	66
Poor	Greater than 2250	3	8

Table 4: Groundwater Quality Classification based on TDS (Davis and Dewiest 1966)

Category	TDS (mg/lit)	Number of Samples	Percentage of Samples
Desirable for drinking	<500	8	21
Permissible for drinking	500-1000	21	55
Useful for irrigation	1000-3000	9	24
Unfit for drinking and irrigation	>3000	Nil	Nil

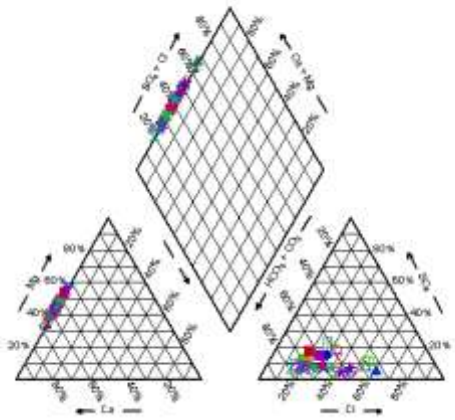

Fig. 2: Piper Trilinear diagram

Schoeller's method [8] was used to relate the evolution of groundwater with respect to chemistry. The Schoeller's digram (Fig. 3) shows that the groundwater in the study areas is predominant in chloride and calcium in most of the areas which reflects greater residence time of groundwater.

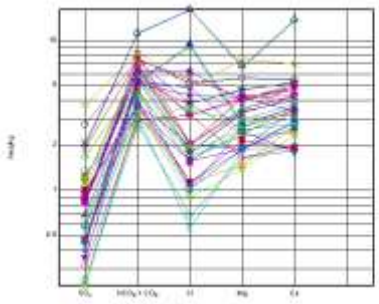

Fig. 3: Schoeller's Diagram

V.CONCLUSIONS

Based on the results observed, following are the conclusions made in this study.

1. 21% of groundwater samples are desirable for drinking purposes, 55% is permissible for drinking and remaining 24% is useful only for irrigation.
2. From the charts it can be easily identified which location is most polluted and which is least polluted. This will help in assigning priority to the samples for its treatment.
3. The influence of individual parameter on the pollution effect in a particular location can be identified. This will help in selection of water treatment which are needed and which is most essential.
4. Water quality monitoring can be considered as reliable method for monitoring groundwater quality.
5. Development that meets the need of the present without compromising the ability of the future generations to meet their own needs.

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