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Ground water quality characteristics at Erode district, Tamilnadu India

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ABSTRACT

Ground water samples were collected from 60 locations in Erode District during pre-monsoon and post monsoon seasons. Ground water samples were tested for 11 physico-chemical parameters following the standard methods and procedures. World Health Organisation(WHO) standards were adopted for calculation of Water Quality Index (WQI). Comparison of observed and estimated values based on water quality indices revealed that drinking water at almost all the locations were found to be highly contaminated, except a few locations, where it was found to be moderately contaminated for both the monsoons. WQI provides an easy and rapid method of monitoring of water quality. It also becomes easier to compare the quality levels in different locations and to give priority for the required treatment to the location.

Key words: Water Quality Index, Physico-chemical parameter, Pre monsoon and Post monsoon

1. Introduction

It is well known fact that potable safe water is absolutely essential for healthy living. Adequate supply of fresh and safe drinking water is a basic need for all human beings on the earth. The problem of drinking water contamination, water conservation and water quality management has assumed a very complex shape. Attention on water contamination and its management has become a need of the hour because of far reaching impact on human health [1]. Water Quality Index (WQI) is regarded as one of the most effective way to communicate water quality [2-4]. Water quality is assessed on the basis of calculated water quality indices [5-7]. The data obtained through quantitative analysis and WHO water quality standards [8] were used for calculating water quality indices. The purpose of calculating WQI and comparing it with standards is to assess drinking water contamination and variation of drinking water quality in pre monsoon as well as post monsoon on the basics of calculated values of water quality indices.

Erode district having population of about 30,00,000 as per the 2001 census. The total area of the district is 8209 Sq. Km. Erode district 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 average rainfall of Erode region is 700mm. The boundaries of the district are Namakkal and Karur in east, Coimbatore and Nilgiri in the west, Dindigal in the south and Karnataka in the north. Erode is characterized with a scanty rainfall and a dry climate with dry weather throughout except during the monsoon season.

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During the last two decades, Erode has gone through rapid industrialization and population growth, though it is agriculture based area. Some industries are causing pollution, especially water contamination in the area of concern. Therefore, the present study was carriedout to draw attention towards this region for taking necessary steps to minimize the adverse impacts likely to occur due to water pollution.

2. Materials and Methods

Sixty different locations in Erode district were selected in order to study the physico-chemical characteristics of ground water samples in the pre monsoon and post monsoon. The samples were collected following the standard methods described for sampling. The standard methods and procedures were used for quantitative estimation of water quality parameters[12]. The standards prescribed by WHO were used for the calculation of water quality indices. The indices have been calculated for 11 water quality physico-chemical parameters.

WQI of ground waters collected at 60 different locations at Erode district in the pre monsoon as well as post monsoon, were calculated using the methods proposed by Horton[9] and modified by Tiwari and Mishra[10] . According to the role of various parameters on the basis of importance and incidence on the over all quality of ground water, the rating scales were fixed in terms of ideal values (C_{id}) of different physico-chemical parameters. Even if they were present they might not be the ruling factor. Hence they were assigned zero values (except pH). For calculating WQI, the following equations were used.

$$\mathbf{WQI = Antilog\ [\sum_{i=1}^{n} w_i \log_{10} Q_i\ ]} \quad \text{---------- 1}$$

Where $W_i = \frac{K}{S_i}$

$K = \frac{1}{\sum_{i=1}^{n} \frac{1}{S_i}}$

$Q_i = \frac{C_i - C_{id}}{C_s - C_{id}} \times 100$

Let

W_i is the weightage factor
S_i is the standard value for the i^{th} parameter prescribed by the standards
Q_i is the quality rating for i^{th} parameter
C_i is the measured concentration for i^{th} parameter which is estimated value
C_{id} is the ideal concentration/value for i^{th} parameter
C_s is the standard concentration for i^{th} parameter recommended by standards ie, same as S_i

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To include the collective role of various physico-chemical parameters on the over all quality of ground water, quality status is assigned on the basis of calculated values of water quality indices. The following assumptions were made with reference to assess the extent of contamination or the quality of drinking water [11]. The assumptions were: WQI < 50: fit for human consumption; WQI < 80: moderately contaminated; WQI 80 to 100: excessively contaminated and WQI > 100: severely contaminated.

3. Results and Discussion

The physico-chemical parameters with their WHO standards (S_i), ideal value (C_{id}) and assigned weightage factor (W_i) are listed in table 1. A location wise calculated value of WQI for the pre monsoon period as well as post monsoon period is presented in table 2.

Table – 1: Water quality parameters, their standard values, their ideal values and the assigned weightage factor.

Parameter	Standard Value, S_i	Ideal Value, C_{id}	$1/S_i$	Assigned Weightage factor, W_i
pH	8.5	7	0.1176	0.3004
Chlorides	250	0	0.004	0.0102
Sulphate	250	0	0.004	0.0102
Alkalinity	120	0	0.0083	0.0213
Hardness	300	0	0.0033	0.0085
Total Dissolved Solids	500	0	0.0020	0.0051
Sodium	200	0	0.0050	0.0128
Turbidity	5	0	0.2000	0.5106
Calcium	75	0	0.0133	0.0340
Magnesium	30	0	0.0333	0.0851
Electrical Conductivity	1400	0	0.0007	0.0018
Total (ie, K)			0.3917	1.0000

The observed range of water Quality Index in premonsoon is 52 to 256, except at site No.3 where it is 558, at site No.23 where it is 572, at site No. 25 where it is 330, at site No.36 where it is 577, at site No.40 where it is 490, at site No.50 where it is 655, at site No.52 where it is 350 and at site No.58 where it is 411. The above water quality index got raised because of excessive concentration in alkalinity, turbidity and magnesium and also in pre monsoon 50 site samples are severely contaminated. Ground water is found to be moderately contaminated at site No's 1,32 and 35 with WQI values less than 80 for pre monsoon period, where as it is excessively

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contaminated at site No's 9,15,21,29,33,48 and 59 with WQI values more than 80 for the pre monsoon period.

Ground water is observed to be excessively contaminated with WQI values more than 80 at site No's 1, 15 and 48 for the post monsoon period and all other locations are severely contaminated whose WQI is greater than 100 due to excess concentration of alkalinity, turbidity and magnesium. The observed range of water quality index in post monsoon is 90 to 244.

A comparison of the values of WQI for two season's reveals that in general, ground water quality is deteriorated or contamination of ground water is increased which is quite alarming.

Table – 2: Location wise calculated values of Water Quality Index for pre monsoon and post monsoon period

Location No.	Water Quality Index	
	Pre monsoon	Post monsoon
1.	52	97
2.	231	170
3.	558	108
4.	167	244
5.	103	189
6.	134	175
7.	122	190
8.	157	181
9.	93	191
10.	116	221
11.	102	155
12.	157	138
13.	182	131
14.	151	130
15.	99	98
16.	168	147
17.	232	105
18.	215	159
19.	253	146
20.	179	112
21.	87	195
22.	110	128
23.	572	193
24.	234	165
25.	330	193
26.	132	117
27.	256	162

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28.	112	103
29.	98	128
30.	114	163
31.	131	161
32.	72	131
33.	92	112
34.	186	198
35.	77	126
36.	577	190
37.	143	167
38.	110	145
39.	111	164
40.	490	159
41.	183	201
42.	118	105
43.	129	151
44.	116	172
45.	163	220
46.	118	202
47.	107	204
48.	96	90
49.	122	128
50.	655	149
51.	114	109
52.	350	136
53.	116	164
54.	126	130
55.	107	181
56.	219	168
57.	149	108
58.	411	103
59.	96	130
60.	133	172

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4. Conclusion

The above observations in the present study indicate the higher values of some parameters of the samples. They minimize the suitability of these samples for drinking purposes without treatment. But, after the filtration and disinfection, naturally present impurities can be removed in water, which provide its suitability for drinking and domestic purposes. People depend on this water are often prone to health hazards due to polluted drinking water. Therefore, some effective measures are urgently required to enhance the drinking water quality by delineating an effective water quality management plan for the region Erode (Tamilnadu, India).

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