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Short Communication

Assessment of ground water contamination in Erode District, Tamilnadu

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A systematic study has been carried out to assess the water contamination and the effect of the tanneries and dyeing industries effluents on Erode District, Tamil Nadu. Ten (10) sampling locations were selected in and around industries. The water samples were collected from the selected sampling points. The samples were analyzed for major chemical water quality parameters like pH, EC, Ca, Mg, Cl, SO_4, Na, CO_3 and HCO_3. The present investigation shows a constant variation in different parameters in different locations. So it is highly important to take periodical monitoring of the ground water quality in this region for future sustainability.

Key words: Erode district, Tamilnadu, contamination assessment, tanneries and dyeing industries.

INTRODUCTION

Erode District lies between 10.36' and 11.58' degrees of northern latitude and between 76.49' and 77.58' degrees of the Eastern longitude and 171.91 m above mean sea level. It has an area of 8,162 square kilometres accounting for 6.3% of the total area of the state. Agriculture is the most important income source of the district. Total cultivated area is 37.89% of the total area. The main irrigation source is Bhavani River. The river of Bhavani, the second largest river in Tamil Nadu begins in the upper regions of Nilgiris of the Western Ghats. In the way of Bhavani River, there are many large scale industries such as chemical manufacturers, sugar mills, textile units, tanneries etc., are located in the riverbank and they are using the water from the river and discharging the treated and untreated effluents into the river. The villagers living in the downstream are using the water for their irrigation, drinking and other domestic activities. It crosses the districts of Coimbatore, Nilgiri and Erode and finally merging with the river Cauvery. As per the survey conducted, about 150 dyeing units and 20 tanneries are in operation in catchment area and expected to discharge the trade effluent (both treated and untreated) either directly or indirectly through drain (Sivakumar et al., 2010). This has resulted in poor quality and low yield of crops which were irrigated ground water. In addition, health status of people using the ground water for domestic purposes has been reported deteriorated. The increase in the concentration of the dissolved solids in the ground water indicates the mixing of untreated effluent.

This aim of the present study was to assess the quality of the ground water and the impacts of the effluents from the industries. This study will be very helpful to understand the impact/evaluation of the rate of dumping of effluent water in ground water and impact on the quality of water in terms of irrigation and the impacts onto the environment.

MATERIALS AND METHODS

Totally, 22 samples of ground waters were collected from open wells / bore-wells in 1 L polyethylene containers. The sampling sites were near the dyeing and tannery industries. The samples were kept in an ice box and brought to the laboratory. The pH and the EC

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Table 1. Physico-chemical characteristics of groundwater collected from villages in Erode District.

Village name	pH	EC (dS m^{-1})	NH_4-N mg L^{-1}	NO_3-N mg L^{-1}	P mg L^{-1}	K mg L^{-1}	Ca mg L^{-1}	Mg mg L^{-1}	Na mg L^{-1}	SO_4 mg L^{-1}	Cl mg L^{-1}	CO_3^- mg L^{-1}	$H CO_3^-$ mg L^{-1}
Periyasemur	7.94	6.07	14	32	0.19	37	456	418	50	44	3124	270	110
Periya Agragaram	7.75	4.36	4	8	0.16	28	280	245	35	13	2414	240	171
Maravapalaiyam	8.22	3.53	3	18	0.16	20	220	173	136	83	1172	120	85
Sooriyampalaiyam	8.86	1.06	3	10	0.19	7	92	110	145	26	497	240	146
Sollayampalaiyam	8.50	2.96	8	85	0.11	27	208	161	2190	32	1740	150	122
Veerapanneriyur	8.45	6.13	8	22	0.08	20	580	113	215	52	2201	120	110
Kothukattupudhar	8.40	5.34	6	13	0.22	29	44	379	2240	76	3089	150	12
Palakattupudhur	8.70	1.59	4	17	0.79	10	100	120	1125	29	1385	180	110
Chithode	8.88	0.52	7	13	0.12	0	116	24	119	17	462	120	146
Sunnambu oodai	8.75	1.88	10	24	0.09	148	96	113	1380	31	994	90	293
Manarathipalaliyam	8.92	2.63	14	10	0.12	108	52	180	1470	14	1562	300	61
Maravapalaiyam	8.53	1.88	7	15	0.19	22	144	130	788	23	1172	240	244
Vettukattupudhur	8.38	1.54	4	21	0.07	241	120	144	486	82	1278	210	232
Sengulathupirivu	8.25	2.17	13	4	0.04	17	100	106	932	14	1136	60	220
Sengulam	8.56	1.63	6	11	0.04	13	72	132	1086	14	710	60	164
Sennimalai	8.17	3.40	7	24	0.24	7	192	70	2280	24	1207	240	317
Kumarapalaiyam	7.96	3.12	4	13	0.31	23	228	293	1654	2	1385	120	354
Oodaikattur	8.60	0.62	7	20	0.13	0	80	53	120	33	533	60	183
Kondaiyampalaiyam	8.32	5.00	13	34	0.07	60	148	154	3800	37	3160	180	122
Thulakampalaiyam	8.30	1.83	8	4	0.16	151	76	88	887	6	1207	270	159
Velayuthampalaiyam	9.45	1.20	42	11	0.11	10	116	55	8730	110	746	150	85
Engur	7.75	21.5	63	13	0.12	450	512	204	6100	45	8840	180	500

of water samples were measured using a combined electrode pH meter and conductivity bridge, respectively (Jackson, 1973). The NO_3-N content of the samples was determined by following Bremner method (Jackson, 1973). The concentration of Na was determined by using a Flame Photometer (Jackson, 1973). Ca and Mg content of the samples were determined by a complex-metric method (Jackson, 1973). Chloride and SO_4 were determined by Mohr's method and turbidimetric methods, respectively (Jackson, 1973). Sodium Adsorption Ratio (SAR) is calculated by using the following formula:

$$SAR = Na / \frac{Ca + Mg}{\sqrt{\ }/2}$$

RESULTS AND DISCUSSION

The important characteristics of water samples in the Erode district are presented in Table 1. The pH and EC of water samples collected from Erode district (Figure 1) ranged from 7.75 to 9.45 and from 0.52 to 21.5 dS m^{-1}, respectively. The lowest pH value (7.75) was recorded in Periya Agragaram region and highest (8.66) was observed in sample collected from Velayuthampalaiyam. Similarly, the lowest EC (0.52 dS m^{-1}) was recorded in the water from Chithode and the highest (21.5 dS m^{-1}) in Engur. About 25% of the samples had the EC more than 4 dS m^{-1}. Electrical conductivity (EC) of water is a direct function of its total dissolved salts (Purandara et al., 2003). Hence, it is an index to represent the total concentration of soluble salts in water (Varadarajan and Purandara, 2003). The Na and Cl content of water samples ranged from 35 to 6100 ppm and from 462 to 8840 ppm, respectively. The lowest Na and Cl values were recorded in samples collected from Periya Agragaram and Chithode areas respectively;

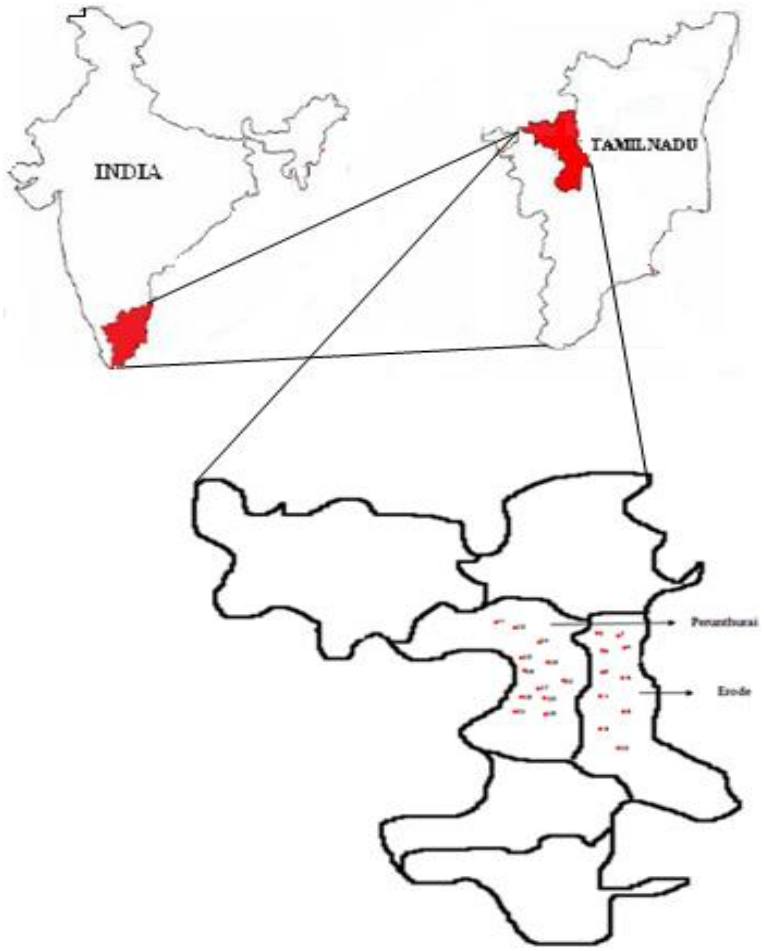

Figure 1. Study area: Erode district.

whereas, the highest value was recorded in Engur. It may have the chance of mixing from the discharge of dyeing industries during their bleaching process with sodium chloride salt.

Sodium content adversely affects the soils nutrients up taking capacity (Palanisamy et al., 2007). Excess chloride concentration indicates the contamination from the sewage; it requires the engineering controls to be adopted on the stream. The Ca and Mg varied from 52 to 580 ppm and 24 to 418 ppm, respectively. The highest calcium content was recorded in Veerapanneriyur water; whereas, the lowest in Manarathupalaiyam village. Similarly, the Mg content was high in Periyasemur and low in Chothode waters. Magnesium usually occurs in lesser concentration than calcium due to the fact that the dissolution of magnesium rich minerals is slow process and that of calcium is more abundant in the earth's crust (Geetha et al., 2008). The SO_4 content ranged from 2.0 to 110 ppm. The lowest SO_4 content (2 ppm) was found in Kumarapalaiyam and the highest (110 ppm) in Velayuthampalaiyam area. The values of carbonates ranged from 60 to 270 ppm; whereas, bicarbonates ranged from 12 to 500 ppm. The value of carbonates was high in sample collected from Thulakkampalaiyam and Engur village and the lowest value was observed in Sengulathupirivu and Kothukattupudhur for carbonate, bicarbonate, respectively.

Concentration of basic cations namely, Na, Ca and Mg ultimately influences the SAR values (sodium adsorption ratio) in soil. The SAR values of different water samples are presented in Figure 2. The sodium hazard is also increased if the water contains a high concentration of bicarbonate ions; for as the soil solution becomes more concentrated, there is tendency for Ca and Mg to precipitate as carbonate and for the relative proportion of sodium. The presence of nitrate in water indicates that the organic pollution of the biological decomposition of nitrogenous organic matter such as sewage and animal wastes contribute nitrite. Nitrite may also enter into a water supply through the discharge of nitrite treated cooling waters. Their presence indicates that the nitrogenous organic matter is undergoing oxidation or nitrification and that the process is not complete. In some cases, nitrates are also reduced to nitrites.

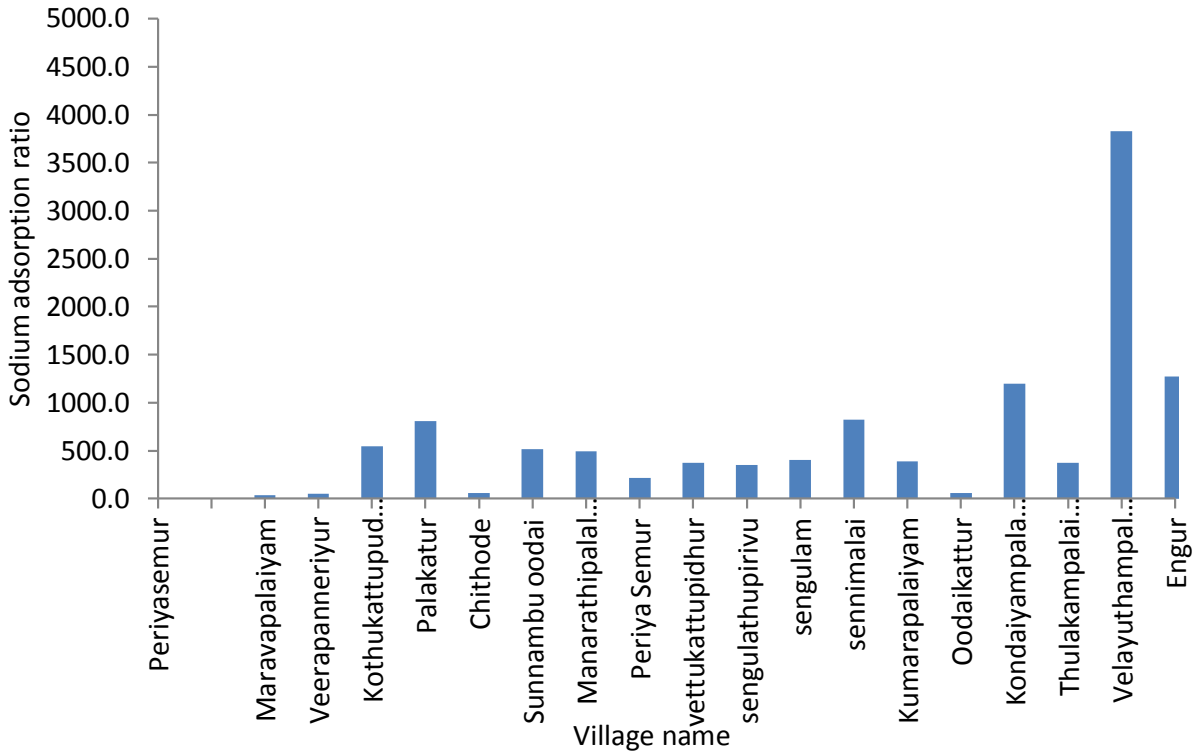

Figure 2. Sodium absorption ratio of groundwater collected from Erode District.

When this polluted water is irrigated, it is evaporated and leaves salts caked on the surface; and it finally spoil the texture of soil. Salts with poor internal drainage facilities are mainly responsible for accumulation of salt in the root zone. Between different sampled locations, there were considerable variations in the concentrations of these basic cations.

Conclusions

The ground water which was taken from the various places in Erode District was analyzed for the various water quality parameters like pH, EC, K, Ca, Mg, Na, Cl, H CO_3^-, CO_3^- and SO_4. The content of the element lies above the maximum permissible limit prescribed by World Health Organization (WHO). Especially the analysis report shows that the contamination highly takes place in Engur, where the most of the dyeing/leather industries are located. From the aforementioned results, it is known that there are the contaminations in Erode district which will affect the agriculture soils in its way.

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