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ASSESSMENT OF WQI FOR GROUNDWATER SAMPLES NEAR DYEING INDUSTRY IN AYYAMPETTAI VILLAGE, KANCHIPURAM

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ABSTRACT

Water quality assessment was carried out for the physical and chemical parameters such as Total dissolved solids (TDS), Electrical Conductivity (EC), p^H, Total Alkalinity, Total Hardness, Calcium, Magnesium, Iron, Chloride and Sulphate for ground water samples collected from ten locations near dyeing industries in Ayyampettai village, Kanchipuram. Water quality indices were developed for the results obtained from the analysis. The WQI for these samples ranges from 5.94 to 745.93. The high value of WQI indicates that the high concentration of Total dissolved solids, Electrical Conductivity, Total Hardness and Iron in the groundwater. The results show that the places nearer the treatment plant are more contaminated than the faraway place and that their ranges do not match with the standards given. The analysis shows that the groundwater of those particular locations needs either primary or advanced treatment before consumption, and it also needs to be protected from the evils of contamination.

KEYWORDS: Groundwater Assessment, Water quality standards, dyeing industry, WQI, parameters, Analysis of Water samples

INTRODUCTION:

The significance of groundwater for the existence of human society cannot be ignored. Groundwater is the major source of drinking water in both urban and rural India, Moharir A., et al., (2002). Apart from that it is the main source of water for the agricultural field and the industrial sectors. In the hydrological cycle, the quantity of pure and unpolluted water available is mainly depends upon rainfall and recharge conditions, Nanda Balan I, et al., (2012). In the last few decades, quantity of water required has getting high over the years and this led to scarcity of water in many parts of the world. The situation is greatly increased by the problem of water contamination due to rapid growth of population and enormous growth of industries, Gautam. D.K. and M.R. Sharma,(2011). Our country is facing a problem towards freshwater crisis mainly due to poor management of water resources and environmental degradation, which has led to a lack of access to supply potable water to millions of people, Joshi VA., et al., (2002). Many parts of India are already undergoing this fresh water crisis. Though degree of suffering depending mainly on the season of the year. The quality of underground water is getting severely affected because of the widespread pollution of surface water, Mamadou Samake, et al., (2010). Besides, discharge of untreated effluent through bores and leachate from unscientific disposal of solid wastes also contaminates groundwater, thereby reducing the quality of groundwater, Ashwini.V.Chandekar, (2010). Drinking contaminated water from water wells can cause serious health problems, so everyone should be aware how easily groundwater can become contaminated One source of contamination is from chemicals such as pesticides, dyes and fertilizers that can be carried in rainwater runoff and then mix with the groundwater . Once pollutants make their way down into the aquifers that store groundwater, it is very hard to remove them. From the aquifers, contamination could then be pumped from a well and directly introduced into drinking water, Charmaine Jerome., (2011). The ground water quality is characterized by conducting various physico –chemical and biological analysis, Ibrahim Bathusha M., (2006). Monitoring of water quality levels are much more important to assess the levels of pollution and to find out the potential the eco system .If the groundwater is contaminated once it is very tedious to restore its quality by preventing the entry of pollutants from the source, Rosario Arun Kumar X., et al., (2012). So it is very big task to protect the quality of water by continuous assessment. Water quality index is one of the effective methods of knowing the quality of water to the Environmentalist, Srinivasa Gowd., (2008). A water quality index (WQI) numerically summarizes the information from numerous water quality parameters into a single value that is understandable and usable by the public, Tiwari.R.N, (2011). The objective of the present work is to discuss the suitability of groundwater for drinking purpose based on computed water quality index values.

STUDY AREA:

Kanchipuram town is located at a distance of 76Km from the capital of Tamilnadu, Chennai on the northern bank of the river Vegavathi, a tributary of the river Palar in TamilNadu, India. It is situated at 12°50' north latitude and 79°42' east longitude. Geological condition of Kanchipuram District is with hard rocks and sedimentary formations surrounded by alluvium and laterite. The average rainfall of the district is 1212 mm and occurs mostly due to the north – east monsoon and also not having any perennial rivers.

In Kanchipuram town, dyeing and printing of textile are considered as the traditional industries and is also called as Silk city with large number of textile industries along with dyeing and printing clusters have been increased in the area. The dyeing units in Kanchipuram municipality and the surrounding villages are under constant threat of ground water contamination with chemicals of dyes as shown in figure 1. The present study evaluates the groundwater quality in and around Ayyampettai, Kanchipuram town of Tamil Nadu with reference to drinking purposes by Water Quality Index. Access to safe drinking water supply is one of the basic needs of society and hence a comprehensive plan of action is sought to curb groundwater contamination in the studied region.

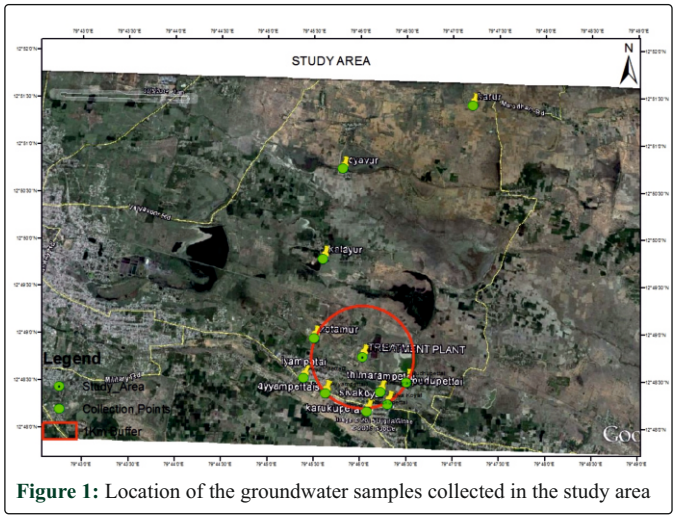

Figure 1: Location of the groundwater samples collected in the study area

METHODOLOGY:

Ten representative groundwater samples were collected in the dyeing industrial areas of Ayyampettai village of Kanchipuram town and carried in pre-cleaned polyethylene bottles; after collection the samples kept in air tight boxes and analyzed within six hours of collection. The locations of the groundwater sample sites were listed in Table 1 and Figure 2 and 3.

Table 1: Groundwater Sample Sites

Sample No.	Source	Location of Well Points
1	Bore Well	Kaliyanur
2	Bore Well	Olaiyur
3	Bore Well	Karur
4	Bore Well	Kuttamur
5	Bore Well	Siva Temple (Ayyampettai)
6	Bore Well	Thimmaiyan Pettai
7	TAP WATER	Rani Amman temple
8	Bore Well	Kurrukkupattai
9	TAP WATER	Pudupettai
10	Bore Well	Satya nagar, Ayyampettai

Figure 2: Location of Bore Well 6

Figure 3: Location of Bore Well 10

In this study, for the calculation of water quality index, nine important parameters such as Total dissolved solids (TDS), Electrical Conductivity (EC), p^H, Total Alkalinity, Total Hardness, Calcium, Magnesium, Iron, Chloride and Sulphate were chosen (Table 2). The WQI has been calculated by using the standard of drinking water quality recommended by WHO, Palanisamy, PN., et al., (2007). To determine the Water Quality Index (WQI) are followed. The relative weight (W_i) is computed by inversely proportional to the permissible limit of each parameter (Table 3).

A quality rating scale (Q_i) for each parameter is assigned by dividing its concentration in each water sample by its respective standard according to the guidelines of WHO (2004) and then multiplied by 100.

$$\mathbf{Q_i = (C_i / S_i) \times 100}$$

Where Q_i is the quality rating, C_i is the concentration of each chemical parameter in each water sample in mg/L, and S_i is the WHO drinking water standard for each chemical parameter in mg/L according to the guidelines of WHO (2004) (Table 3).

The SI_i is first determined for each chemical parameter, which is then used to determine the WQI as per the following equation, Maheswari. J. (2011):

$$\mathbf{Si_i = W_i \times Q_i}$$

Where SI_i is the sub index of ith parameter and Q_i is the rating based on concentration of i^{th} parameter. (Table 4)

The overall water quality index (WQI) was calculated by summation of each sub index values of each groundwater samples to the summation of relative weight as follows, Manjunatha .H, (2011):

$$\mathbf{WQI = \Sigma SI_i / \Sigma W_i}$$

Table 2: Water Quality Parameters from Ten sampling points

PARAMETERS	pH	TDSmg/l	EC µ mho/cm	TA mg/l	TH mg/l	Ca mg/l	Mg mg/l	Fe mg/l	Cl mg/l	SO4 mg/l
Sample No.										
1	7.71	1300	2800	472	280	64	29	0	480	200
2	7.3	1688	4100	736	528	116	57	2.08	600	550
3	7.68	557	1159	336	124	28	13	0.26	106	130
4	7.63	1282	2700	440	272	60	29	0	464	180
5	7.02	940	2000	352	240	52	26	0.65	236	220
6	7.01	2100	4600	720	384	84	42	2.34	744	300
7	8.14	1000	2200	328	296	64	33	0	300	225
8	7.34	1200	2500	408	424	92	47	0.26	368	250
9	7.36	1686	4100	416	736	160	81	0	800	350
10	7.11	1300	2800	424	448	99	48	2.08	388	300

Table 3: Relative weight of chemical parameters

Parameters	Permissible Limit (BIS Standards)	Relative Weight
pH	8.5	0.1176
TDS	500	0.0020
EC	300	0.0033
TA	200	0.0050
TH	300	0.0033
Ca	75	0.0133
Mg	30	0.0333
Fe	0.3	3.3333
Chloride	250	0.0040
Sulphate	200	0.0050
Total		3.5203

Table 4: Water classification of each sample for Quality rating (Q_i), Sub index (SI_i)

Samples No.	pH		TDS		EC		TA		TH		Ca		Mg		Fe		Cl		So_4	
	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i
1	90.71	10.67	260.00	0.52	933.33	3.08	236	1.18	93.33	0.31	85.33	1.13	96.67	3.22	0	0.00	192	0.77	100	0.50
2	85.88	10.10	337.60	0.68	1366.67	4.51	368	1.84	176.00	0.58	154.67	2.06	190.00	6.33	693.33	2311.09	240	0.96	275	1.38
3	90.35	10.63	111.40	0.22	386.33	1.27	168	0.84	41.33	0.14	37.33	0.50	43.33	1.44	86.67	288.89	42.4	0.17	65	0.33
4	89.76	10.56	256.40	0.51	900.00	2.97	220	1.10	90.67	0.30	80.00	1.06	96.67	3.22	0	0.00	185.6	0.74	90	0.45
5	82.59	9.71	188.00	0.38	666.67	2.20	176	0.88	80.00	0.26	69.33	0.92	86.67	2.89	216.67	722.22	94.4	0.38	110	0.55
6	82.47	9.70	420.00	0.84	1533.33	5.06	360	1.80	128.00	0.42	112.00	1.49	140.00	4.66	780	2599.97	297.6	1.19	150	0.75
7	95.76	11.26	200.00	0.40	733.33	2.42	164	0.82	98.67	0.33	85.33	1.13	110.00	3.66	0	0.00	120	0.48	112.5	0.56
8	86.35	10.16	240.00	0.48	833.33	2.75	204	1.02	141.33	0.47	122.67	1.63	156.67	5.22	86.67	288.89	147.2	0.59	125	0.63
9	86.59	10.18	337.20	0.67	1366.67	4.51	208	1.04	245.33	0.81	213.33	2.84	270.00	8.99	0	0.00	320	1.28	175	0.88
10	83.65	9.84	260.00	0.52	933.33	3.08	212	1.06	149.33	0.49	132.00	1.76	160.00	5.33	693.33	2311.09	155.2	0.62	150	0.75

RESULTS AND DISCUSSION:

The average value of physico-chemical parameters and WQI of Ten samples is given in Table 5. The results observed that the maximum and minimum value of WQI has been found to be 745.93 and 5.94 delineated as Sample No. 6 and 4 respectively. In the present study it is observed that nearly 40% and 20% of water samples were Excellent and good. It should be received only primary treatment is given in Table 6. No samples fall within the range of 100-200. Samples collected from the locations 5, 2, 6 and 10 undergoes poor and very poor category due to high concentrations of TDS, EC, TH and Iron as shown in figure 4. Hence, it is advisable to consume the water after the full pledged advanced treatment.

Table 6: Water quality classification based on WQI value

WQI	Status	Samples No.	Total number of sampling locations	Percentage of Sampling Locations
0-50	Excellent	1,4,7,9	4	40
50-100	Good	3,8	2	20
100-200	Satisfactory	-	0	0
200-300	Poor	5	1	10
>300	Very Poor	2,6,10	3	30

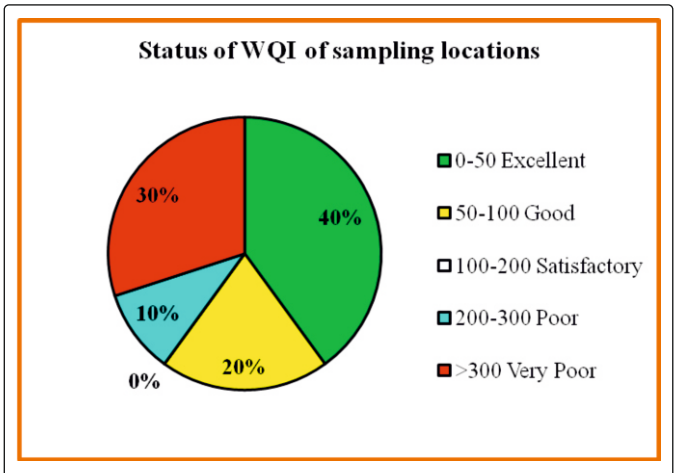

Figure 4: WQI Categories of samples (%)

CONCLUSION:

WQI has been determined to assess the suitability of groundwater of nine parameters for drinking purposes in and around Ayyampettai Village, Kanchipuram. In this work, ten groundwater samples were collected and analyzed. About 60% is under the category of excellent and good, suitable for drinking purpose as per standards. This paper concludes that 10% and 40% in poor and very poor category. It may reflects that four parameters such as TDS, EC, TH and Iron are found to be higher compared to permissible limit owing to improper treatment of dying industries effluent.

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