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Assessment of Physico-Chemical status of ground water samples in Tirunelveli District, Tamil Nadu

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Abstract
Fresh water resource is becoming day by day at the faster rate of deterioration of the water quality is now a global problem. The physico-chemical status of ground water samples at different sites were determined, which is mainly used for drinking purpose. The physico-chemical parameter like temperature, pH, electrical conductivity[EC], total dissolved solids(TDS), turbidity, dissolved oxygen(DO), total alkalinity(TA), total hardness(TH), calcium(Ca^{++}), magnesium(Mg^{++}), sodium(Na^+), potassium(K^+), Chloride(Cl^-), fluoride(F^-), nitrate(No_3^-), sulphate(So_4^{2-}) and phosphate(Po_4^{3-}) of bore well was determined by adopting the standard method. The results were compared with standards prescribed by WHO and ISI. It was found that the ground water was contaminated at few sampling sites S1, S5, S6, S7, S8 and S14. The sampling sites S2, S3, S4, S10 and S13 showed physico-chemical parameters within the water quality standards and the quality of water quality is good and it is fit for drinking purpose.

Keywords: Ground water, Physico-chemical parameter, ISI, WHO.

1. Introduction
Natural resources are the important wealth of our country, water is one of them. Good quality water is very necessary for good and healthy life. It is essential part of protoplasm and creates a state for metabolic activities to occur smoothly; therefore no life can exist without water (Dubey and Maheshwari, 2006) [6]. Fresh water resource is becoming day by day at the faster rate of deterioration of the water quality is now a global problem (Mahanand *et al.,* 2005) [9]. About 95% of rural population living in India depends on ground water for domestic use (Moharir *et al.,* 2002) [12]. The ground water is believed to be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the ground water to become polluted and created health problems (Raja *et al.,* 2002) [15]. Hence, there is always a need for and concern over the protection and management of ground water quality (Patil, 2001; Agarwal, 2010) [1]. Considering the above aspects of ground water contamination, the present study was undertaken to investigate the impact of the ground water quality of bore well water sample in Tirunelveli district, Tamil Nadu. Physico-chemical parameters like temperature, pH, electrical conductivity(EC), total dissolved solids(TDS), turbidity, dissolved oxygen(DO), total alkalinity(TA), total hardness(TH), calcium(Ca^{++}), magnesium(Mg^{++}), sodium(Na^+), potassium(Na^+), fluoride(F^-), nitrate (No_3^-), sulphate(So_4^{2-}), and phosphate(Po_4^{3-}) of bore well was determined. The analysed data were compared with standard values recommended by WHO (1973) and ISI (10500-91).

2. Materials and Methods
The present investigation was carried out by selecting fifteen borewells in Tirunelveli district during the period of five months (June-2014 to October-2014). The samples were collected from all the stations at 10.00 am to 12.00 noon for physic-chemical analysis and different methods of collection and handling were adopted based on the standard procedures (APHA 1998) [2]. The water samples were collected in 2 litre plastic cans. The temperature was measured by thermometer at the sampling sites and the samples were taken to the laboratory. The pH of the water samples were measured by using the digital pH meter and other Physico-chemical parameters were analysed by standard methods given in APHA (1989) [3].

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The sampling locations in Tirunelveli district for assessment of Physico-chemical parameter status of ground water are given in Table-1.

Table 1: Sampling locations of bore well in Tirunelveli District

Sl. No.	Sample locations	Sample number
1	M. K. P Nagar	S1
2	K.T.C Nagar	S2
3	Sankar Nagar	S3
4	Vannar pettai	S4
5	Venthankulam	S5
6	Palayamkottai Market	S6
7	Nanguneri	S7
8	Mela Karungulam	S8
9	Thiagaraja Nagar	S9
10	Maharaja Nagar	S10
11	Rajagopalapuram	S11
12	IOB Colony	S12
13	Anbu Nagar	S13
14	Perumalpuram	S14
15	TVS Nagar	S15

2.1 Physico-chemical Analysis
Analysis was carried out for various water quality parameters such as temperature, pH, electrical conductivity(EC), total dissolved solids(TDS), turbidity, dissolved oxygen(DO), total alkalinity(TA), total hardness(TH), calcium(Ca^{++}), magnesium(Mg^{++}), sodium(Na^+), potassium(K^+), Chloride(Cl^-), fluoride(F^-), nitrate(No_3^-), sulphate(So_4^{2-}), and phosphate(Po_4^{3-}) using standard method (Trivedy R.K. and Goel P.K. (1986) [19], Manivaskam N (2005) [11].

3. Results and Discussion
The Physico-chemical parameters of the sampling sites in Tirunelveli district can be calculated and it is described as below.

Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. The temperature was ranging from 28 ºC to 30 ºC. According to Zajic (1971) water with temperature above 30 ºC is unfit for public use. Lowest water temperature was observed in Site 4 was 27 ºC. Highest temperature was noticed in S1, S5, S6, S7 and S8 were 30 ºC. This might be due to the presence of the effluents. Our property of water is that the temperature changes then its density also varies and it becomes less with warming up and more with cooling. The value of pH was within maximum permissible limit in all samples. It was ranging from 6.9 to 8.1 and were found within the limit prescribed by WHO. The higher range of pH indicates higher productivity of water (Khan and Khan 1985) [7]. Electrical conductivity is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts (Sudhir Dahiya and Amarjeet Kaur 1999) [18]. EC values were in the range of 135 micro.mho/cm to 1829 micro. mho/cm. High EC values were observed in six sampling points namely S1, S6, S7, S8, S14 and S15 indicating the presence of high amount of dissolved inorganic substances in ionized form Fig.1).

Water containing more than 500mg/l of Total dissolved solids (TDS) is not considered desirable for drinking water supplies (Trivedy and Goel 1986) [19]. Total dissolved solids values were ranging from 95 mg/l to 1244 mg/l. The sampling points S1, S6, S7, S8 and S14 showed higher TDS values than the prescribed limit given by WHO. Turbidity in water is the degradation in the clarity in water due to the presence of particles such as silt, clay and other forms of living micro organisms and non-living materials found in water (Rputheti *et al.,* 2008) [16]. The turbidity values varied between 0.00 to 4 NTU and found within the limits prescribed by ISI (10500-91).Sampling sites S4 and S15 found above the limits prescribed by WHO. The dissolved oxygen is a regulator of metabolic activities of organisms. (Sahu *et al.,* 2000) [19]. The DO values indicate the degree of pollution in water bodies. DO values varied from 0.16 to 0.72. The sampling points S7 and S15 showed high DO values (Fig.1).

High amount of alkalinity in water is harmful for irrigation which leads to soil damage and reduce crop yields (Lenin Sundar and Saseedaran, 2008) [8]. Alkalinity was ranging from 42 to 400, which is within permissible limit. The sampling points S7, S8, S14 and S15 showed high TA values than the prescribed limit given by WHO. Hardness of water causes disadvantages in domestic uses by producing poor lathering with soap, deterioration of cloths, scale forming skin irritation, boiled meat and food becomes poor in quality (Pragathiswaran *et al.,* 2008) [14]. Total Hardness (TH) was ranging from 52mg/l to 660mg/l. The values for sample from point S5 andS6 were higher than the prescribed limit. The sampling points S1, S5, S6, S7, S12 and S14 showed (Fig.1) higher TH values than the prescribed limits given by WHO.
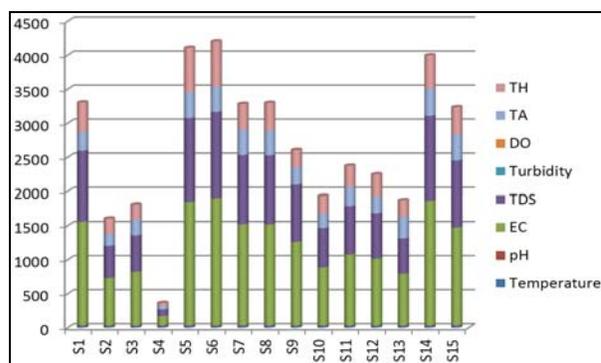
Fig 1: Graphical representation of Average values of the Physico-chemical parameters (Temperature, pH, EC, TDS, Turbidity, DO, TA and TH) of different sites in Tirunelveli district.

Calcium is directly related to hardness. Calcium may dissolve readily from carbonate rocks and lime stones or be leached from soils Chari and Lavanya, 1994) [5]. Calcium concentration ranged between 12 mg/l to 172 mg/l and found below permissible limit of ISI. The sampling points S5, S6, S7, S8, S11, S12, S14 and S15 showed high Ca values than the prescribed limits of WHO. Magnesium generally occurs in lesser concentration than calcium because of dissolution of magnesium rich minerals is slow process and calcium is more abundant in earth crust (Varadarajan *et al.,* 2011) [20]. Magnesium content in the investigated water samples were ranging from 5mg/l to 58mg/l which were found below (Fig.2) the permissible limit of ISI.

High concentration of Sodium ion in drinking water may cause heart problems and high sodium ion in irrigation water may cause salinity problems (Chadrik Rout and Arabinda Sharma, 2011) [4]. Sodium concentrations were found in between 7mg/l to163 mg/l. All the sampling sites showed lower sodium concentration than the prescribed limit by WHO and ISI. Potassium content in the water samples varied from 2mg/l to 40 mg/l. High amount of Potassium in the ground water sample is due to the presence of silicate

minerals from igneous and metamorphic rocks (Zahir Hussain and Abdul Jameel, 2011) [23] People accustomed to higher chloride in water are subjected to laxative effects (Sudhir Dahiya and Amarjeet Kaur 1999) [18]. In the present analysis, chloride concentration was found in the range of 14 mg/l to 275 mg/l. All the sampling sites showed lower chloride concentration except Site 14 (Fig.2).

Fluoride content in the water samples varied from 0.0mg/l to 1.2 mg/l, which were found within the permissible limit prescribed by ISI. The high concentration of fluoride can cause dental and skeletal fluorosis (Maiti, 2004) [10]. Ground water contains nitrate due to leaching of nitrate with the percolating water. Ground water can also be contaminated by sewage and other wastes rich in nitrates (Venkateswara Rao, 2011) [21]. The nitrate content in the study area varied in the range 0 mg/l to 8 mg/l and found within the prescribed limit. Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals (Manivaskam, 2005) [11]. The sulphate concentration varied between 4 mg/l to 235 mg/l and found within the prescribed limit. The phosphate concentration varied between 0.02 mg/l to 0.45 mg/l (Fig.2).
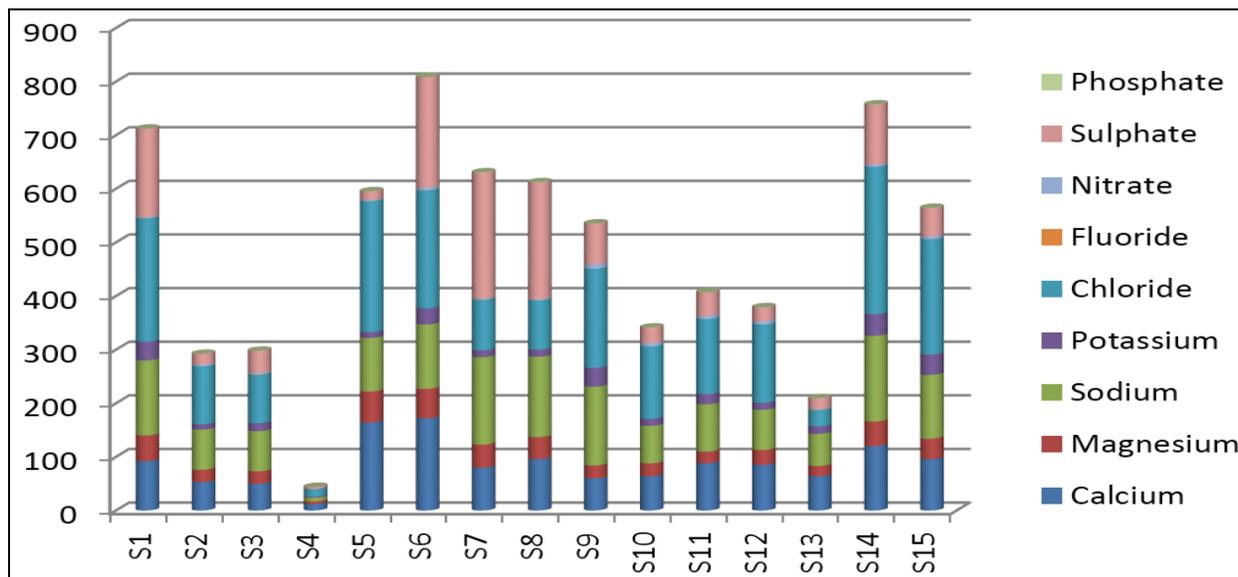

Fig 2: Graphical representation of Average values of the Physico-chemical parameters (Ca, Mg, Sodium, Potassium, Chloride, Fluoride, Nitrate, Sulphate and Phosphate) of different sites in Tirunelveli district.

All the data can be summarized in Table-2 Deviations were observed by some ground water samples in Tirunelveli district. The water samples from sites S1, S5, S6, S7, S8 and S14 showed poor water quality as compared to other water samples. The water samples from these sites are unfit for drinking purpose. Because these sites showed high TDS, Total Alkalinity, Total Hardness and Calcium content indicating the need of some treatment for minimization of the parameters. The sampling sites S2, S3, S4, S10 and S13 showed physico-chemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose. The sampling sites S9, S11, S12, S14 and S15 showed physico-chemical parameters near the border line of the water quality standards. So these sampling sites also need some treatment for minimizing the parameters.

Table 2: Average results of the Physico-chemical parameters of bore-well sites in Tirunelveli district.

Sl. No	Parameter	WHO	ISI (10500-91)	Sampling points in Tirunelveli district														
				S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
1.	Temperature			30	28	28	27	30	30	30	30	29	28	29	29	28	29	29
2.	pH	6.5-8.5	6.5-8.5	7.16	7.71	7.68	8.14	7.1	7.37	7.50	7.23	6.99	6.93	7.05	7.56	7.51	7.01	7.43
3.	EC micro.mho/cm		1400	1523	696	789	135	1811	1863	1485	1483	1229	852	1042	980	761	1829	1438
4.	TDS mg/l	500	2000	1036	474	536	95	1231	1267	1010	1009	836	580	708	667	517	1244	978
5.	Turbidity	1	5	0	0	0	4	0	0	0	0	0	0	0	0	0	0	3
6.	DO mg/l	-	-	0.60	0.36	0.36	0.16	0.60	0.60	0.72	0.72	0.56	0.48	0.48	0.48	0.36	0.60	0.72
7.	TA mg/l	200	600	280	172	232	42	380	376	372	360	256	208	280	240	320	400	380
8.	TH mg/l	300	600	430	228	220	52	650	660	380	410	250	260	310	328	240	490	400
9.	Ca^{++} mg/l	75	200	92	53	50	12	164	172	80	96	60	64	88	85	64	120	96
10.	Mg^{2+} mg/l	30	100	48	23	23	5	58	55	43	41	24	24	22	28	19	46	38
11.	Na$^+$ mg/l	200	-	140	75	75	7	100	120	163	150	147	70	88	75	60	160	119
12.	K$^+$ mg/l	-	-	35	10	15	2	11	30	13	13	35	13	19	13	14	40	38
13.	Cl$^-$ mg/l	250	1000	230	108	90	14	244	220	94	92	185	135	140	146	30	275	215
14.	F$^-$ mg/l	1	1.5	0.4	0.1	0.8	0.1	0.3	0.4	0.3	0.0	0.0	0.1	0.1	0.0	1.2	0.0	0.1
15.	No$_3$$^-$mg/l	45	45	2	3	3	0	2	5	2	2	8	6	6	6	2	4	5
16.	So$_4$$^{2-}$ mg/l	200	400	165	20	41	4	16	206	235	218	76	29	44	26	19	112	53
17.	Po$_4$$^{3-}$ mg/l	-	-	0.08	0.18	0.21	0.02	0.13	0.26	0.48	0.32	0.31	0.18	0.27	0.16	0.42	0.45	0.35

4. References

1. Agrawal R. Physico-Chemical Analysis of Some Groundwater Samples of Kotputli Town Jaipur, Rajasthan. International Journal of Chemical, Environmental and Pharmaceutical Research. 2010; (2), 111-113.
2. APHA, AWWA, WEF, Standard methods for the examination of water and waste water, 20th Ed., Washington DC, 1998.
3. APHA. Standard methods for examination of water and waste water, 16th Edn. American public health association, Washington DC, 1989.
4. Chadrik Rout, Arabinda Sharma. Assessment of drinking water quality, a case study of Ambala cantonment area, Hariyana, India, International Journal of Environmental Sciences. 2011; 2(2):933-945.
5. Chari KVR, Lavanya MG. Ground water contamination in Cuddapah urban area, Andhra Pradesh, in proceedings on regional workshop of Environmental aspects of ground water development. KU, Kurukshetra Oct. 17-19, Kurukshetra, India, 1994, 130-134.
6. Dubey RC, Maheshwari DK. Practical Microbiology. S. Chand & Co. Ltd, Ram Nagar, New Delhi, India. 2006; 413.
7. Khan IA, Khan AA. Physical and chemical condition in Seika Jheelat, Aligarh, Ecol 1985; 3:269-274.
8. Lenin Sundar, Saseetharan. Ground water quality in Coimbatore, Tamilnadu along Noyyal River, Journal of Environmental Science and Engineering. 2008; 50(3):187-190.
9. Mahanand HB, Mahanand MR, Mohanty BP. Studies on the Physico-chemical and Biological Parameters of a Fresh water Pond Eco System as an Indicator of water pollution. Ecol. Env. & Cons 2005; 11(3-4):537-541.
10. Maiti SK. Hand book of Methods in Environmental studies. ABD Publishers, Jaipur, India, 2004.
11. Manivaskam N. Physico-chemical examination of water sewage and industrial effluent, 5th Ed. Pragati Prakashan Meerut, 2005.
12. Moharir A, Rameteke DS, Moghe CA, Wate SR, Sarin R. Surface and ground water quality assessment in Bin a region. Ind J Environ. Prote. 2002; 22(9):961-969.
13. Patil P, Badgujar SR, Warke AM. Oriental J Chem 2001; 17(2):283.
14. Pragathiswaran C, Paruthiral G, Prakash P, Jeya P, Suganandam K. Status of Ground Water Quality in Hosur During summer. Ecol Envir Conserv. 2008; 14(4):605-608.
15. Raja RE, Lydia Sharmila, Princy Merlin, Christopher G, Physico-chemical Analysis of some Ground water samples of Kotuputli Town Jaipur, Rajasthan, Indian J Environ Prot. 2002; 22(2):137.
16. Rputheti RN, Okigbo MS, Advanapu RL. Ground water pollution due to aquaculture in east coast region of nelore district, Andhrapradesh, India. *AJEST.* 2008; 2(3):046-050.
17. Sahu BK, Rao RJ, Behara SK, Pandit RK. Effect of pollutants on the dissolved oxygen concentration of the River Ganga at Kanpur, in pollution and biomonitoring of Indian rivers, ABD publication, Jaipur, India, 2000, 168-170.
18. Sudhir Dahiya, Amarjeet Kaur. Physico chemical characteristics of underground water in rural areas of Tosham subdivisions, Bhiwani district, Haryana, J Environ Poll. 1999; 6(4):281.
19. Trivedy RK, Goel PK. Chemical and Biological methods for water pollution studies Environmental publication, Karad, 1986.
20. Varadarajan N, Purandara BK, Bhism Kumar. Assessment of ground water quality in Ghataprabha command area, Karnataka India, J Environ Science and Engg. 2011; 53(3):341-348.
21. Venkateswara Rao B. Physico-chemical Analysis of selected ground water samples of Vijayawada rural and urban in Krishna district, Andhra Pradesh, India, International Journal Environmental Sciences. 2011; 2(2):710-714.
22. World Health Organization, Guidelines for drinking water quality–1, Recommendations. 2nd Ed. Geneva WHO, 1993.
23. Zahir Hussain A, Nd Abdul Jameel. M. Monitoring the Quality of ground water on the bank of Uyyankondan channel of river Cauvery at Tiruchirappalli, Tamilnadu, India, Environmental Monitoring and Assessment, 10.10007/S 10661 2011; 011:1910-14.