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QUALITY OF DRINKING WATER IN AND AROUND THIRUVALLUR DISTRICT, TAMIL NADU

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ABSTRACT

Water has pivotal role for the survivality of the making in the biosphere. For evolving policies to the best use of water resources, it is important to make an assessment of their magnitude, distribution and scope of utilization. It becomes necessary to have an idea of the present and future demands of water for various purposes. The present study is aimed to establish the water quality of bore wells in and around some parts of Tiruvalluvar district.

INTRODUCTION

Water is basic need of life and every living organism needs water to sustain. To obtain pure and clean water for drinking is a fundamental human right. The quality of groundwater in some parts of the country, particularly shallow groundwaters is changing as a result of human activities. The quality of groundwater is of great importance for human beings. To further improve the quality of groundwater, groundwater quality monitoring is important for safeguarding the water quality for future. The groundwater gets polluted and reclamation of groundwater pollution due to any cause is very important. However, a survey of literature reveals that there is no systematic study on potability of groundwater in India; hence, the present work has been undertaken for the studies. The structural and functional attributes of water have to be analysed, both qualitatively and quantitatively, in order to have a widespread evaluation of the water quality necessary for judging its suitability for drinking purpose.

MATERIALS AND METHODS

There were about 20 water samples collected from four different stations in and around Thiruvalluvar district (Table 1). The water samples were collected from bore wells. Care was taken so that the water sample is representative sample of the catchment. The water samples were analysed for physical and chemical parameters by using standard methods (APHA 2000).

RESULTS AND DISCUSSION

The results of the physico-chemical analysis of water samples are given in Tables 1, 2 and 3. Temperature of the groundwater samples in the study varies from 24 to 32ºC. WHO (1992) did not recommend any definite temperature value for drinking water. A temperature of about 15ºC is desirable for drinking.

All the water samples were colourless and odourless. The taste and odour are mainly due to the dissolved impurities often organic in nature. Water containing taste and odour may not be toxic, but are rejected on the aesthetic grounds, and in some stations the water is slightly yellowish in colour with earthy odour.

The turbidity of the collected water samples ranged from 0.4 to 25.2 NTU. The minimum variation was observed at Station-3 in the month of March, and the maximum at Station-2 in the month of June. The reported values were above the prescribed limits (IS: 10500, BIS 1991). Clear water is more appealing to drink. It is important to look for cause of the turbidity when trying to treat the water.

The TDS values vary between 1146 and 7202 mg/L. High TDS greater than 20000 mg/L is commonly objectionable. The minimum variation was found in the month of March at Station-2, and the maximum in the month of March at Station-1. TDS signifies the inorganic pollution load of any water body. The higher values indicated the effect of overland flow. Sangeetha et al. (2000) observed greater values of TDS than that of ISI standard; the reason may be the entry of pollutants.

Electrical conductivity is useful parameter for indicating salinity hazards. The electrical conductivity values in the present study vary from 1401 to 10769 µS/cm. The minimum variation was seen in the month of March at Station-1, and maximum in the month of March at Station-1 (Soundra Pandian et al. 1995).

The pH value of water is an important indicator of its quality, which depends on the carbon dioxide-carbonate-bicarbonate equilibrium. The results of the present study show clearly the dominance of bicarbonate, which range approximately between pH 6.11 and 7.91. The carbonate ion is dominant when pH is above 8.5. However, carbonate in most of the samples is absent, but where the pH is above 8.5, quantity of carbonate is comparatively high. Jain et al. (1998) observed that the groundwater pH varied from 6.8-8.3 with a mean value of 7.4 which was a safe range for drinking as well as for the growth of plants.

Total alkalinity of the water samples ranged from 100 mg/L to 450 mg/L, which was within the prescribed limit of 600 mg/L (IS:10500-1991). Most of the alkalinity in natural water is formed due to dissolution of CO_2 in water. Alkalinity in itself is not harmful to human beings; still the water samples with less than 100 mg/L are desirable for domestic use.

Calcium, magnesium and total hardness in waters are interrelated. In the present study calcium and magnesium vary from 50 to 983 mg/L and 25 to 857 mg/L respectively. The minimum variation was seen in the month of February at Station-2, and the maximum in the month of June at Station-1. An important source of calcium is the dissolution of small quantities of carbonate minerals. Jain (1998) reported that, high concentration of hardness 150-300 mg/L and above may cause kidney problems.

Sodium and potassium are naturally occurring elements and are found in large quantities in brines and in sewage. Potassium ranks seventh among the elements in the order of abundance. The concentration of sodium in the present study was 156 to 1400 mg/L, whereas, the concentration of potassium was in the range of 10 to 150 mg/L. High concentration of sodium and potassium gives a salty taste and limit the use of water for irrigation. The maximum variation of both sodium and

Table 1: Details of sampling stations.

Station No.	Sampling Station	Source	Depth in Feet
1	Tiruvottiyur, Chennai - 19 Domestic area	Bore well	160
2	Ernavoor, Chennai - 57 Domestic area	Bore well	170
3	Tolgate, Chennai - 19 Domestic area	Bore well	150
4	Minjur, Chennai 601 203 Domestic area	Bore well	200

Table 2: Results of physico-chemical analysis of groundwater at sampling Stations-1 and 2.

S. No	Parameters	Unit	Feb	Mar	Apr	May	June	Permissible Limit
Station-1								
	Physical							
1	Temperature(air)	°C	26	27	29	34	37	-
2	Temperature (Water)	°C	24	25	27	32	29	-
3	Appearance	ITCU	C & C	C & C	C & C	C & C	C & C	-
4	Odour	Agreeable	None	None	None	None	Soil smell	-
5	Turbidity	NTU	2.4	2.7	5.6	7.1	8.8	2.5
6	TDS	mg/L	7192	7202	7148	1558	2184	500
7	Electrical conductivity	µS/cm	10586	10769	10700	2288	3115	250
	Chemical							
8	pH	-	7.1	7.3	7.16	7.15	7.80	6.5-85
9	Alkalinity tot	mg/L	100	166	178	280	450	600
10	Total Hardness	mg/L	2150	2350	2500	2500	2696	
11	Calcium	mg/L	520	600	480	918	983	5
12	Magnesium	mg/L	208	216	196	849	857	75
13	Sodium	mg/L	1200	1320	1400	575	450	30
14	Potassium	mg/L	75	150	150	40	30	-
15	Iron	mg/L	0.16	0.33	0.40	0.55	1.13	-
16	Free Ammonia	mg/L	1.54	1.74	2.22	1.08	2.28	0.1
17	Nitrite	mg/L	0.02	0.06	0.38	0.01	0.05	-
18	Nitrate	mg/L	4	5	6	9	19	45
19	Fluoride	mg/L	0.62	0.57	0.82	0.77	0.71	1.0
20	Chloride	mg/L	2762	2550	2181	1837	716	200
21	Sulphate	mg/L	493	406	440	186	240	200
22	Phosphate	mg/L	0.06	0.1	0.6	0.2	0.07	-
23	Silica	mg/L	59.41	69.2	73.29	88.9	99.41	-
Station-2								
	Physical							
1	Temperature(air)	°C	26	27	29	34	37	-
2	Temperature (Water)	°C	24	25	27	32	29	-
3	Appearance	ITCU	C & C	C & C	C & C	C & C	C & C	-
4	Odour	Agreeable	None	None	None	None	Soil smell	-
5	Turbidity	NTU	4.5	3.1	5.2	11.3	25.2	2.5
6	TDS	mg/L	1240	1146	1202	1986	2640	500
7	Electrical Conductivity	µS/cm	1755	1697	1773	2656	3735	250
	Chemical							
8	pH	-	7.3	7.2	7.4	7.35	7.9	6.5-85
9	Alkalinity tot	mg/L	212	250	280	290	360	600
10	Total Hardness	mg/L	300	316	330	650	360	
11	Calcium	mg/L	50	62	74	200	441	5
12	Magnesium	mg/L	25	37	40	60	130	75
13	Sodium	mg/L	255	270	305	345	395	30
14	Potassium	mg/L	10	25	30	45	80	-
15	Iron	mg/L	0.09	0.12	0.16	0.22	1.35	-
16	Free Ammonia	mg/L	0.11	2.49	3.23	1.24	1.81	0.1
17	Nitrite	mg/L	0.34	0.23	0.48	0.43	0.64	-
18	Nitrate	mg/L	28	38	42	32	45	45
19	Fluoride	mg/L	0.27	0.16	0.52	0.67	0.68	1.0
20	Chloride	mg/L	311	293	353	692	995	200
21	Sulphate	mg/L	179	154	163	178	316	200
22	Phosphate	mg/L	0.4	0.9	2.85	0.8	0.71	-
23	Silica	mg/L	45.81	43.03	65.45	74.9	83.32	-

potassium was observed in the month of April at Station-1. The minimum variation for sodium was observed in the month of March at Station-3 and potassium was observed in the month of February at Station-2.

Iron was in the concentration range of 0.09 mg/L to 1.35 mg/L which was above the prescribed limit (IS: 10500-1991). Iron (Fe^{+2} and Fe^{+3}) in many groundwaters provides the tropical well water rust and taste (Doctor et al. 1998). Not only the taste and unpleasant, iron can stain plumbing fixtures, clothes and dishes. Treatment for the reduction of iron can be done by several methods depending upon the concentration and pH of the water. The Environment Protection Agency (EPA) recommends that the concentration of iron in domestic water not exceed 0.3 mg/L.

The concentration of free ammonia ranged from 0.11 mg/L to 3.23 mg/L. Presence of free ammonia in waters can be accepted as the chemical evidence of organic pollution. If only ammonia is present, pollution by sewage must be very recent. Presence of even small quantity of nitrite will indicate the organic pollution and the availability of partially oxidized nitrogenous matter. The concentration of nitrite was in the range of 0.01 mg/L to 0.64 mg/L. Nitrate is of natural as well as anthropogenic origin. The excess amount of nitrate in water causes a disease in children called blue baby syndrome. The permissible limit of nitrate in underground water is 45 mg/L. The reverse osmosis system with a softener can remove as much as 95% of nitrate.

Fluoride is known to contaminate groundwaters globally. In India, its occurrence in top aquifer system is endemic in many places of Andhra Pradesh, Rajasthan, Tamilnadu, Karnataka, Goa and Kerala. The concentration of fluoride in the water samples ranged from 0.16 mg/L to 0.82 mg/L. Fluorosis was reported by Isaiah et al. (2003). They studied fluoride content in groundwater; bore well and dental fluorosis in Salem district. The study reveals that the fluoride ion concentration seems to accumulate over a period and shows stronger sign of symptoms in children. Fluoride concentration less than 0.5 mg/L may be harmful and may cause dental caries. Higher fluoride concentration greater than 1.5 mg/L may cause dental and skeletal fluorosis and other non skeletal manifestations. Fluoride showed maximum concentration in the month of April at Station-1.

The concentration of chloride in the water samples ranged from 186 to 2762 mg/L. All chloride values are above the permissible (IS: 10500-1991) limits. Chloride was maximum in the month of March at Station-3. People who are not accustomed to high chloride in water are subjected to laxative effect. Its concentration is high in groundwater where the temperature is high with less rainfall. Chloride concentration is also an indicator of pollution by sewage. Industries are also important source of chlorides. It is harmless up to 1000 mg/L concentration but produces a salty taste above 250 mg/L.

Most of the sulphate ions are probably derived from the solution of calcium and magnesium ions. Sulphate is a naturally occurring ion found almost in all types of water and its concentration occur in wide ranges in nature. Treatment for the removal of sulphate in water can be done by many methods. Aeration is very effective in removing as H_2S. In the present study concentration of sulphate varied from 90 mg/L to 493 mg/L. The higher concentration of sulphate was observed in the month of February at Station-1, and lower concentration in the month of April at Station-3.

Phosphate was in the range of 0.06 mg/L to 2.85 mg/L, which was above the permissible limit. Excessive amount of phosphate is actually caused by pollution usually by infiltration of wastewater from domestic and industrial sources and agriculture run off. Phosphate values of the samples are varying in the study area indicating possible organic contamination. Phosphate content in

Table 3. Results of Physico-chemical analysis of groundwater at Stations-3 and 4.

S. No	Parameters	Unit	Feb	Mar	Apr	May	June	Permissible Limit
Station-3								
	Physical							
1	Temperature(air)	℃	26	27	29	34	37	-
2	Temperature (Water)	℃	24	25	27	32	29	-
3	Appearance	ITCU	C & C	C & C	C & C	C & C	C & C	-
4	Odour	Agreeable	None	None	None	None	Soil smell	-
5	Turbidity	NTU	0.7	2.3	2.8	2.6	15	2.5
6	TDS	mg/L	1366	1242	1994	2018	2408	500
7	Electrical Conductivity	µS/cm	1991	1401	2750	2855	3675	250
	Chemical							
8	pH	-	6.11	7.0	7.19	7.46	7.91	
9	Tot. Alkalinity	mg/L	152	175	154	320	429	600
10	Total Hardness	mg/L	398	330	430	460	520	
11	Calcium	mg/L	76	82	42	104	145	5
12	Magnesium	mg/L	30	14	40	43	60	75
13	Sodium	mg/L	274	156	302	370	385	30
14	Potassium	mg/L	18	20	25	45	55	-
15	Iron	mg/L	0	0.12	0.22	0.28	1.6	-
16	Free Ammonia	mg/L	0.41	1.70	0.67	0.81	1.82	0.1
17	Nitrite	mg/L	0.10	0.14	0.13	0.28	0.39	-
18	Nitrate	mg/L	19	24	51	40	60	45
19	Fluoride	mg/L	0.23	0.31	0.34	0.45	0.61	1.0
20	Chloride	mg/L	340	186	621	463	530	200
21	Sulphate	mg/L	151	162	90	196	222	200
22	Phosphate	mg/L	0.18	1.14	0.62	0.42	0.23	-
23	Silica	mg/L	51.02	52.03	54.93	62.10	63.47	-
Station-4								
	Physical							
1	Temperature°(air)	℃	26	27	29	34	37	-
2	Temperature (Water)	℃	24	25	27	32	29	-
3	Appearance	ITCU	C & C	C & C	C & C	C & C	C & C	-
4	Odour	Agreeable	None	None	None	None	Soil smell	-
5	Turbidity	NTU	0.4	3.1	1.6	1.3	8.9	2.5
6	TDS	mg/L	3004	3206	3310	3698	4200	500
7	Electrical Conductivity	µS/cm	4624	4860	4918	5236	5691	250
	Chemical							
8	pH	-	7.15	7.2	7.35	7.46	7.75	6.5-85
9	Alkalinity tot	mg/L	156	100	165	190	207	600
10	Total Hardness	mg/L	1560	1630	1570	1950	2170	
11	Calcium	mg/L	285	324	308	359	586	5
12	Magnesium	mg/L	102	101	174	199	204	75
13	Sodium	mg/L	385	392	452	560	529	30
14	Potassium	mg/L	30	28	39	43	45	-
15	Iron	mg/L	0.16	0.17	0.23	0.34	0.62	-
16	Free Ammonia	mg/L	1.50	1.63	0.41	0.68	0.93	0.1
17	Nitrite	mg/L	0.01	0.03	0.05	0.04	0.02	-
18	Nitrate	mg/L	0.33	0.41	0.85	0.90	1.28	45
19	Fluoride	mg/L	0.40	0.50	0.45	0.68	0.39	1.0
20	Chloride	mg/L	1583	1516	1660	1790	1928	200
21	Sulphate	mg/L	218	214	196	329	480	200
22	Phosphate	mg/L	0.12	0.16	0.32	0.23	0.50	-
23	Silica	mg/L	40.61	52.46	61.25	68.10	98.32	-

groundwater samples, in general, was due to leaching from minerals or ores, agricultural run off and a major element of municipal sewage (Trivedy & Goel 1986).

The concentration of silica was in the range of 40.61 mg/L to 99.41 mg/L. The lower concentration was observed in the month of February at Station-4, and higher concentration in the month of June at Station-1. High concentrations of silica indicate the formation of hard scale in pipes and boilers. During summer months, when the water level is low, sudden increase in silicate content was noticed.

CONCLUSION

The present study reveals most of the water samples were above the permissible limit of drinking water standards. In general, the consumers should be trained and created awareness regarding different water polluting sources and their effects. Providing adequate drainage system with proper treatment before disposal and the removal of faulty constructed septic tanks and cesspools may restrict the deterioration of water quality.

The situation is aggravated by the problem of water pollution. India is heading towards a front water crisis mainly due to improper management of water resources and environmental degradation has lead to a lack of access of safe water supply to millions of people. The freshwater crisis is already evidenced in many parts of India particularly Tamilnadu.

REFERENCES

APHA 2000. Standard Methods for Examination of Water and Wastewater, 21th edition, American Public Health Association, Washington DC., U.S.A.

BIS 1992. Drinking Water Specification (First Revision), First Reprint, Bureau of Indian Standards, Oct. 1992, IS: 10500-1991.

Deshpande, S.M., Kaplay, R.D. and Kulkarni, S.C. 1999. Nitrate contamination in ground water of Paithan, Aurangabad District. Poll. Res., 18(2): 191-192.

Doctor, P.B., Raiyani, C.V., Verma Yougendra, Desai, N.M., Kulkarni, P.K., Ruparelia, S.G. and Ghosh, S.K. 1998. Physical and microbial analysis of dye contaminated river water. Ind. J. Environ. Hlth., 40: 7-14.

Isaiah, S., Edison Raja and B. Kavitha 2003. Study of fluoride content in groundwater, Survey of dental fluorosis in Salem District. Ecology Environment & Conservation, 9(3): 297-300.

Jain, C.K., Bhatia, K.K.S. and Vijay, T. 1998. Groundwater quality in a coastal region of Andhra Pradesh. Indian J. Environ. Health, 39(3): 182-192.

Sangeetha, V. Ebanasar and Freoda Ganga Rani, D. 2000. Water quality of groundwater of seven village around Udayarpalayam, Tamil Nadu. J. Ecotoxicol. Environ, Monit., 10(2): 147-155.

Soundara Pandian, V., Revathy, V., Sheela, V. and Shyamala, S. 1995. Quality of river and reservoir water of Tamilnadu. Proc. Seminar on Water Quality and Its Management. Central Board of Irrigation Power, New Delhi. pp. 91-95.

Trivedy, R.K. and Goel, P.K. 1986. Chemical and Biological Methods for Pollution Studies. Environmental Publications, Karad, India.

WHO 1984. Environmental Health Criteria 36. Fluoride and Fluorosis. World Health Organization, Geneva.