Quality of drinking water from different water sources of Thiruverumbur, Tiruchirappalli, India

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Abstract

Examination of the physico-chemical profiles of the bore well, open well and corporation water samples of Thiruverumbur area of Tiruchirappalli District, Tamil Nadu, India showed that the open wells were highly polluted with very high levels of total dissolved solids, total alkalinity and total hardness, and the bore wells with fluoride content higher than the permissible limit of the World Health Organisation. The deep aquifers had higher fluoride levels than the open well aquifers. Microbial pollution was recorded in 12.0% of bore wells, 11.1% of open wells and 6.3% of corporation water samples

Keywords : aquifers, drinking water quality, fluoride, microbial contamination, pollution

INTRODUCTION

Excessive groundwater exploitation has resulted in lowering of water table in rural and urban areas of India. The water quality parameters decide the potability of water (WHO, 2004). The presence of every inorganic constituent in water is vital up to a limit but on exceeding the limit, makes the water polluted. The status of fresh water sources are becoming deteriorated due to various industrial and anthropogenic activities. This paper evaluates the quality of drinking water from three different sources *viz.*, open wells, bore wells and Corporate water supply in the Thiruverambur area of Tiruchirappalli, Tamil Nadu, India.

MATERIALS AND METHODS

Fifty water samples were collected, 25 samples from the bore wells, 9 from the open wells and 16 from the corporation water of the present study area. All the samples collected were stored in polythene containers of 11 capacity with necessary precautions (Brown *et al.*, 1974). The samples for microbiological studies were collected in sterilized bottles. The pH, total hardness, total alkalinity, total dissolved solids and fluoride content in the water samples were analysed by following standard analytical methods (APHA 1998). Microbial studies were carried out by MPN method (Papen and von Berg, 1998).

RESULTS AND DISCUSSION

The physico-chemical characterization of the water samples from different sources are given in Tables 1-3.

рΗ

The pH of bore well, open well and corporation water samples ranged from 5.72 to 8.54, 5.72 to 7.92 and 6.61

and 8.39, respectively (Tables 1-3). The alkaline nature of bore well samples was greater than that of open well samples. Earlier report by Madhnure *et al.* (2007) have also reported higher alkalinity in the bore well water of Pandharkawada area, Yavakmal district, Maharashtra, India.

Total Dissolved Solids (TDS)

The TDS content for the bore well, open well and corporation samples ranged between 327 and 2910 mg/l, 403 and 4030 mg/l and 324 and 2110 mg/l, respectively (Tables 1-3). Fifty two percent of samples from bore wells, 22% from open wells and 87% from corporation water samples fell within the permissible limit (1500 mg/l) of World Health Organization (WHO, 2004) with regard to TDS. The higher TDS in open well sources may be attributed to the percolation of effluents into these aquifers from various automobile and small scale industries located in the study area.

Total Hardness (TH)

The total hardness (TH) of bore well, open well and corporation water samples ranged from 210 to 1518 mg/ I (56% within the maximum allowable limit), 266 to 815 mg/I (22% within the maximum allowable limit) and 224 to 1292 mg/I (75% within the maximum allowable limit of 300 mg/I), respectively. The high hardness of groundwater in the study area may be attributed to its hard carbonate rich rocks.

Total Alkalinity (TA)

The total alkalinity (TA) content of bore well, open well aquifers and corporation water samples ranged from 114 to 496 mg/l, 164 to 326 mg/l and 82 to 164 mg/l, respectively. All the samples except an open well source at Kalkandarkottai (114 mg/l) and two samples from corporation water supply at Thiruverumbur (82 mg/l)

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Table 1. Physico-Chemical profile of bore well water samples collected from Thiruverumbur area, Tiruchirappalli, South India

		Physio-chemical variable ^a									
S.No.	Place	Depth		EC	Salinity	ТА	TH	ΤS	TDS	TSS	F
		(feet)	рп	(m S)	(mg/l)	(mg/I)	(mg/l)	(mg/l)	(mg/l)	(mg/I)	(mg/l)
1	Ellakudi	130	6.77	1.08	510	246	395	600	553	47	0.94
2	Priyanka Nagar	80	7.12	1.36	650	328	480	800	690	110	2.04
3	Manjathidal	90	7.18	1.71	830	213	551	900	870	30	2.21
4	Kailash Nagar	110	6.20	1.34	680	262	535	700	690	10	1.36
5	Anna Nagar	100	6.75	4.97	2410	164	1249	2700	2550	150	1.75
6	Geethapuram	130	6.64	5.56	2710	180	1427	2900	2850	50	1.44
7	Paappakurichi	110	7.72	1.06	510	147	373	600	542	58	1.75
8	Kattur	120	7.35	2.48	1210	246	610	1300	1270	30	1.04
9	Thuvakudi	150	7.65	1.89	910	246	522	1000	970	30	1.11
10	Kokkarasampettal	120	7.05	4.45	2150	295	1070	2300	2280	20	0.63
11	Ganapathy Nagar	150	6.61	5.34	2540	328	934	2700	2680	20	1.24
12	Kondayam Pettai	60	7.70	0.86	410	197	353	500	436	64	0.10
13	Kalkandarkottai	200	5.72	2.52	1220	114	584	1400	1280	120	0.94
14	Chettarpettai	60	7.18	1.36	660	311	486	1400	700	70	1.75
15	Naval Pattu	75	7.56	1.85	900	279	421	1000	950	50	1.22
16	Solaimadevi	60	7.28	1.35	660	262	371	780	690	90	1.04
17	Natarajapuram	60	7.59	2.14	1040	262	486	1140	1090	50	1.61
18	Puthur	100	7.61	0.65	310	131	210	400	327	73	2.04
19	Vengore	65	7.07	1.00	480	213	256	600	502	98	1.44
20	Murukkore	70	7.55	1.84	900	295	382	1000	920	80	1.75
21	Kumerasapuram	85	8.54	4.62	2200	492	181	2400	2310	90	2.49
22	Nochivayal Puthur	60	7.45	4.51	2130	476	230	2300	2270	30	1.81
23	Kaveri Nagar	200	7.20	5.88	2820	197	1518	3000	2910	90	1.94
24	Koothaipar	120	7.84	2.32	1120	246	486	1200	1150	50	0.42
25	Vengore	110	7.97	2.62	1250	197	1434	1400	1310	90	1.44
	Mean	104.6	7.25	2.59	1248.4	253.1	621.8	1400.8	1311.6	64.0	1.42
	S.D.	40.44	0.59	1.67	799.79	90.69	403.11	832.22	840.32	35.00	0.57

^aEC- Electrical Condutivity; TA-Total Alkalinity; TH-Total Hardness; TS- Total Solids; TDS-Total Dissolved Solids; TSS- Total Suspended Solids

Table 2. Physico-Chemical profile of open well water samples collected from Thiruverumbur area, Tiruchirappalli, South India

		Physio-chemical variable ^a									
S.No.	Place	Depth (feet)	рН	EC (mS)	Salinity (mg/l)	TA (mg/l)	TH (mg/l)	TS (mg/l)	TDS (mg/l)	TSS (mg/l)	F (mg/l)
1	Manjathidal	90	6.94	2.51	1220	197	665	1300	1290	10	1.22
2	Vallavanthankottai	60	7.92	0.79	380	213	402	600	403	197	1.44
3	Rajappa Nagar	30	7.28	2.46	1220	295	525	1400	1260	140	1.74
4	Ariyamangalm	35	5.72	0.98	480	164	266	600	480	120	1.75
5	Ambikapuram	65	6.98	3.56	1770	246	814	2000	1800	200	1.44
6	Koothaipar	40	6.75	8.10	3860	328	519	4400	4036	370	1.44
7	Vengore	45	6.97	2.82	1350	311	616	1600	1430	170	1.11
8	Natarajapuram	60	6.70	2.47	920	290	815	1240	1080	160	1.42
9	Neikunam	40	7.22	2.21	478	195	517	1550	1450	100	1.12
	Mean	51.7	6.94	2.88	1297.6	248.8	571.0	1632.2	1469.9	163.0	1.41
	S.D.	18.87	0.59	2.14	1068.21	59.19	179.85	1132.08	1063.16	96.95	0.23

^aEC- Electrical Condutivity; TA-Total Alkalinity; TH-Total Hardness; TS- Total Solids; TDS-Total Dissolved Solids; TSS- Total Suspended Solids

Table 3. Physico-Chemical profile of corporation water samples collected from Thiruverumbur area, Tiruchirappalli, South India

	_	Physio-chemical variable ^a								
S.No.	Place	рН	EC (mS)	Salinity (mg/l)	TA (mg/l)	TH (mg/l)	TS (mg/l)	TDS (mg/l)	TSS (mg/l)	F (mg/l)
1	Manjathidal	7.47	0.64	310	164	321	400	324	76	0.42
2	Ellakudi	6.84	1.07	520	213	454	600	549	51	1.22
3	Malaikovil	8.19	0.96	460	180	340	600	490	110	0.63
4	BHEL Quaters	7.77	1.03	500	180	360	600	524	76	1.24
5	BHEL Factory	7.83	4.07	1970	164	1292	3200	2090	110	1.44
6	Thiruverumbur	6.98	4.12	1990	82	1080	2200	2110	90	1.92
7	Neikunam	6.82	1.53	750	213	577	820	780	40	1.50
8	Kattur	7.76	0.80	390	147	366	600	411	189	0.75
9	Oil mill	7.75	0.72	350	90	197	400	367	33	2.49
10	Rail Nagar	8.14	0.69	330	164	321	400	353	47	1.50
11	Ariyamangalam	7.29	0.69	340	131	227	400	354	46	0.94
12	Ambikapuram	7.83	0.72	350	147	282	400	366	34	1.36
13	Kalkandarkottai	6.61	0.71	340	164	240	410	362	48	1.36
14	Vengopal Nagar	7.70	0.78	380	164	506	440	395	45	0.81
15	Palpannai	7.83	0.79	380	131	412	480	400	80	1.94
16	Pappakurichi	8.39	0.71	340	147	421	400	361	39	1.36
	Mean	7.6	1.3	606.3	155.1	462.3	771.9	639.8	69.6	1.36
	S.D.	0.53	1.13	547.27	35.85	302.39	783.66	581.15	40.85	0.53

^aEC- Electrical Condutivity; TA-Total Alkalinity; TH-Total Hardness; TS- Total Solids; TDS-Total Dissolved Solids; TSS- Total Suspended Solids

Table 4. Microbial analysis of the water samples collected from Thiruverumbur area, Tiruchirappalli, South India

			M P N b
S.	Sampling	Sourcoa	Index
No.	Place	Sourcea	Per
			100 m l
1	Manjathidal	CW	34
2	Ellakudi	BW	< 2
3	Ellakudi	CW	< 2
4	Priyanka Nagar	BW	< 2
5	Kailash Nagar	BW	< 2
6	Anna Nagar	BW	< 2
7	Neikunam	CW	< 2
8	Thuvakudi	BW	< 2
9	Valavanthan kottai	ΟW	9
10	Kattur	BW	< 2
11	Rail Nagar	CW	< 2
12	Kondayampettai	BW	< 2
13	Ariyamangalam	ΟW	< 2
14	Ambikapuram	ΟW	< 2
15	Palpannai	CW	< 2
16	Pappakurichi	CW	< 2
17	Solaimadevi	BW	< 2
18	Chettiar pettai	BW	17
19	Murukkore	BW	13
20	Nochivayal puthur	BW	< 2
21	Geethapuram	BW	< 2
22	KaveriNagar	BW	< 2
23	Vengore	BW	1600
24	Kumaresapuram	BW	< 2
25	Koothaipar	BW	< 2

^aCW = Corporation water; BW = Bore well water OW = Open well water ^bMost Probable Number

and Oil mill (90 mg/l) have exceeded the permissible limit of 120 mg/l (WHO, 2004).

Fluoride

The Fluoride level was within the allowable limit of 1.6 mg/l in 56% of the bore well samples, in 77% of the open well samples and 75% of the corporation water samples. The fluoride level in the deeper aquifers was more than the shallow aquifers. Similar findings were reported by Wodeyar and Srinivasan (1996), Bhoskar (2004) Madhnure *et al.* (2007) in other parts of India.

Fluoride is level from 0.7 to 1.2 mg/l is essential in drinking water (Anon, 1977) and its excess presence will be toxic resulting in dental fluorosis, skeletal fluorosis and non-vertebral fractures, especially hip fractures. Apart from fluorosis, high intake of fluorides may also cause gastrointestinal complaints such as loss of appetite, nausea, vomiting, pain in the stomach, constipation and intermittent diarrhoea and flatulence (WHO, 1970; Susheela *et al.*, 1992; Teotia *et al.*, 1998; Pillai and Stanley, 2002). The adolescent age group is most vulnerable to fluoride pollution and it is a world

wide problem (Dinesh, 1999). The samples exceeding the fluoride level greater than 1.5 mg/l are need to be defluoridated with immediate attention in order to prevent the negative impacts of high fluoride levels on human populations at the study area.

Electrical Conductivity (EC)

The higher the ionisable solids the greater will be the Electrical Conductivity (EC). In the present study area electrical conductivity ranged from 648 to 5880 mS in the bore well waters, 790 to 8100 mS in the open well waters and 635 to 4120 mS in the corporation waters.

Salinity

Salinity ranged from 310 to 2820 mg/l in the bore well samples, 380 to 3860 mg/l in open well sources and from 310 to 1990 mg/l in the corporation water sources in the present study area, which are within the permissible limit of WHO (2004) for potable waters.

Microbial Study

The microbial study was performed on randomly selected 25 samples. Of the 25 samples, 20 samples were found to have microbial numbers within the maximum permissible limit of 1 coliform per 100 ml as per the safe drinking water act (George and Schroeder, 1985). An open well sample at Valavanthan Kottai (MPN: 9/100 ml), a sample of corporation supply at Manjathidal (MPN: 34/100 ml) and samples from three bore well sources at Murukkore, Chettarpettai and Vengore (MPN: 13, 17 and 1600/100 ml, respectively) have registered positive presumptive test results. Immediate action is needed to circumvent this problem and necessary antimicrobial disinfectants should be employed in the water sources.

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