



Groundwater Quality Assessment of Some Blocks in Tannery Belt of Dindigul District, Tamilnadu

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ABSTRACT

Industrialization is responsible not only for economic development but also for environmental pollution. Among the polluting industries, tanneries come under one of the most polluting industrial categories. There are more than 2500 tanneries in the country and nearly 1000 tanneries are located in Tamilnadu state alone. Out of these more than 80 tanneries are located in Dindigul district in Tamilnadu. The untreated effluents contaminate water and soil resources. At present both surface water and groundwater resources get depleted and polluted due to unscientific management and utilization. In the present study, the groundwater quality survey was carried out in Dindigul. The sampling points (wells) are located using GPS. The samples of groundwater were collected and analysed for 10 physicochemical parameters and the status of water quality is suggested using water quality index (WQI).

INTRODUCTION

Water is a renewable natural resource of earth and is essential for all living organisms for their existence and metabolic processes. Water is not only the most important essential constituent of all animals, plants and other organisms but also the pivotal for the survivability of mankind in the biosphere. The wholesome resources of water for villages nearby Dindigul are surface water and groundwater sources. Groundwater in the ancient times was considered to be fresh, but its pollution now receives attention since the groundwater quality is in decline. Out of 1000 tanneries units in the state of Tamilnadu about 80 tannery units are located in Dindigul alone. The groundwater, surface water resources and vast agricultural land were irreversibly damaged in the villages sounded by Dindigul (Mondal & Singh 2003, 2004 and 2005). Hence, in the present study an effort has been made to study the physicochemical characteristics in tannery polluted groundwater of villages namely, R.N Patti, Kanavai patti, Kombai patti, Ayyampalayam, Parapatti, Pillaiyarntham, Wisdomcity and Pallapatti and some others villages in Dindigul district.

STUDY AREA

In Tamilnadu, several leather tanneries are located in Dindigul, Chromepet, Pallavaram and Vellore. Although various government departments take effective steps to control the groundwater pollution, its contamination is seen in all these areas. In this research, an attempt has been made to evaluate the groundwater contamination in Dindigul, because the area has many tanneries, and therefore, effluents from leather tanneries will cause contamination.

Study area of Dindigul is located in part of toposheet No: 58/F/15/SE lying between longitude 77°52'-78°0'E and latitude 10°15'-10°22' N. Dindigul is located about 399 km southwest of Chennai.

About 50 leather tanneries have been located and operated for more than 30 years for manufacturing of leather goods. Groundwater is one of the most important sources of water for domestic, agricultural and industrial purpose in Dindigul. Effluents from leather tanneries contaminate the groundwater due to disposal on land (Kumar & Vanni 2008).

MATERIALS AND METHODS

1. Location of sampling stations using GPS: Latitude and longitude values were obtained.
2. Monitoring of depth of water table: Depth of water table from dug wells (gravity wells) was measured with a tape attached with a weight at the end.
3. Collection of groundwater samples: Clean plastic bottles were used for collection and a volume of 2 L was collected from each sampling point.
4. Analysis: The water samples were analysed for 10 physicochemical parameters: pH, alkalinity, chlorides, sulphates, total hardness, conductivity, calcium, magnesium, sodium and potassium.
5. Water quality index calculation: Weighted arithmetic index method has been used.

RESULTS AND DISCUSSION

The results of physicochemical characteristics of groundwater are presented in Tables 1, 2 and 3. The water quality index of 31 locations of the study area is presented in Table 4. It was revealed that there were considerable deviations in the water quality parameters from the water quality standards. Also the variation in the concentration for each parameter was wider.

pH: The pH of all the samples was found to be in the range of 7.2 to 8.2. All the samples fall in the range prescribed by the IS for the pH (i.e., 6.5 to 8.5).

Electrical conductivity (EC): The average value for the electrical conductivity was ranging from 600-45000 $\mu\text{mho/cm}$. Maximum electrical conductivity was noted for the sample collected at the location of tannery industrial area at Pallapatti. Minimum electrical conductivity was observed for the sample collected at Kappiliyapatti. The standard value for the electrical conductivity is only 1400 $\mu\text{mho/cm}$. The drinking water quality standard for electrical conductivity was satisfactory in 12 samples only. Those samples were collected from the location of Kottaiyoor, Siluvathoor, Kannapadi, Kosavapatti, K. Sukkappatti, Idaiyakottai, Margampatti, Verripur, Kappiliyapatti, Veiladichanpatti, Malayapuram and Kombaipatti. In the remaining 19 samples, the observed electrical conductivity value exceeded the standard value.

Total dissolved solids (TDS): The total dissolved solids range from 215-18091 mg/L with maximum concentration noted for the sample collected from Pallapatti, and minimum value from the sample collected at Kapiliyapatti. The standard recommended for TDS is 1000 mg/L. Only 23 samples have TDS below 1000 mg/L, while in the remaining 8 samples, the TDS value was exceeding the standard value.

Total hardness (TH): The values for the total hardness were observed in the range of 110-7300 mg/L. Maximum hardness was noted for the sample collected from Pallapatti, and minimum for the sample collected from Veiladichanpatti. The standard recommendation for the total hardness is only 300 mg/L as desirable value. Five locations were found to be satisfying standard recommendations and 26 locations have total hardness values greater than 300mg/L. Standards recommend that 600 mg/L is maximum permissible concentration and if total hardness value in water sample exceeds this, that sample source is unsuitable for domestic purpose. Sixteen locations have hardness values lesser than 600 mg/L, while 10 locations have hardness value greater than 600 mg/L.

Table 1: Chemical analysis of water of various blocks in Dindugal.

S. No.	Param-eters	Locations										
		Pappa patti (B.W)	Nadu vannor (B.W)	Kottai yoor (B.W)	Siluva thoor (BW)	Kaana padi (B.W)	S. Kuru mbapatti (D.W)	Kosav apatti (B.W)	Puliya mpatti (B.W)	D. God alur (B.W)	K.V. Palayam (B.W)	Kasipa layam (B.W)
1	pH	7.3	7.6	7.5	7.8	7.8	7.7	7.9	7.8	7.7	7.6	7.7
2	EC	2940	1600	1250	1150	720	1780	1260	1720	2480	2000	1650
3	CO ₃	-	264.09	-	-	-	-	-	-	-	-	-
4	HCO ₃	610	536.8	500.2	463.6	366	652.7	427	652.7	597.8	658.8	274.5
5	Cl	543.15	255.6	152.65	138.45	42.6	252.05	198.8	230.75	422.45	287.55	315.95
6	SO ₄	192.4	-	-	-	-	-	-	-	151.93	67.01	151.93
7	Ca	200	78	68	124	80	80	106	42	152	60	142
8	Mg	156	106.8	86.4	6	20.4	108	31.2	57.6	75.6	84	62.4
9	Na	139.78	54.99	39.99	109.99	30.49	189.99	99.99	239.99	222.29	189.98	96.41
10	K	9.33	57.99	4.235	6.78	8.48	10.45	16.95	8.48	28.82	14.41	11.02
11	Acidity	20	20	40	20	20	30	20	10	30	50	60
12	Alkalinity	372	316	260	316	112.5	225	182.5	465	355	390	260
13	Hardness	1140	597.5	600	360	307	630	410	440	530	540	620
14	TDS	1192	720	582	443	282	795	568	778	1130	920	774
15	NO ₃	4	5	4	4	8	8	7	60	17	32	8
16	F	0.6	0.43	0.3	0.56	1	1	1	0.6	0.59	0.56	0.95

Table 2: Chemical analysis of water of various blocks in Dindugal.

S. No.	Param-eters	Locations										
		K. Sukk ampatti (B.W)	Idaiya kottai (B.W)	Marga mpatti (D.W)	Verri pur (BW)	Kethai yerembu (B.W)	Puduka lanjipatti (B.W)	Kakppil iyapatti (B.W)	Kenniv adi (B.W)	Veiladic hanpatti (B.W)	Kesava napatti (B.W)	Malyap uram (B.W)
1	pH	7.6	8	8	7.9	7.8	7.7	8.1	7.2	7.8	7.5	8.2
2	EC	880	650	850	1380	1620	1780	600	1540	820	3700	800
3	CO ₃	-	9.003	15.00	18.01	18.01	21.20	12	-	9	-	12
4	HCO ₃	305	250.1	305	372.1	408.7	463.6	274.5	603.9	341.6	750.3	390.4
5	Cl	134.9	74.55	106.5	101.7	315.95	337.25	39.05	195.25	81.65	763.25	56.8
6	SO ₄	-	-	-	85.24	-	-	-	-	-	162.00	-
7	Ca	46	30	78	68	90	90	78	78	26	120	2
8	Mg	66	36	28.8	78	91.2	105.6	14.4	100.8	32.4	186	33.6
9	Na	23.99	35.99	52.99	69.99	89.99	96.19	18.98	74.99	94.99	269.99	129.99
10	K	4.24	5.93	3.38	8.48	11.87	11.02	5.09	3.39	70	152.69	1.69
11	Acidity	40	20	30	30	20	30	20	70	80	20	80
12	Alkalinity	210	230	360	310	297.5	312.5	280	350	280	340	415
13	Hardness	370	370	300	380	530	510	240	560	110	1090	290
14	TDS	444	290	372	645	725	832	215	711	408	1696	387
15	NO ₃	7	27	35	4	19	12	58	32	12	19	1
16	F	0.95	0.5	0.39	0.33	0.45	0.25	0.27	0.7	0.55	0.24	0.46

Chlorides: The chloride concentration ranged from 39.05-12570.55 mg/L. Minimum chloride concentration was noted in the sample collected from Kappikliyapatti, and maximum from Pallapatti. The standard recommendation for chlorides is only 250mg/L as desirable value. Fifteen locations were found to be satisfying standards recommendations, while 16 locations have chloride value greater

Table 3: Chemical analysis results in Tannery industrial area around Dindigul.

S. No.	Parameters	Locations								
		Villages around Tannery industrial area								
		R.N. Patti (B.W)	Kanvaipatti (B.W)	Kombaipatti (D.W)	Ayyampalayam (BW)	Parapatti (B.W)	Parapatti (B.W)	Pillaiyarnatham (B.W)	Wisdomcity (B.W)	Pallapatti (B.W)
1	pH	7.2	7.7	8.1	7.8	7.9	7.7	7.4	7.2	6.6
2	EC	2800	1500	1200	1460	7300	3320	1920	2440	45000
3	CO ₃	-	-	-	-	9	-	-	-	-
4	HCO ₃	433.1	573.4	427	616.1	762.5	628.3	469.7	427	1030.9
5	Cl	550.25	198.8	177.5	159.75	2005.75	717.1	408.35	468.6	12570.55
6	SO ₄	280.76	-	-	-	182.34	132.37	-	203.22	3798.55
7	Ca	78	76	64	52	64	160	80	258	5080
8	Mg	195.6	100.8	73.2	87.6	181.2	121.2	135.6	82.8	2198.4
9	Na	159.99	69.41	69.41	107.99	1229.99	329.98	79.99	99.98	279.99
10	K	40.69	59.32	5.09	5.93	57.64	28.82	17.8	10.17	61.04
11	Acidity	70	50	100	70	70	50	90	150	700
12	Alkalinity	285	390	302.5	427.5	520	420	370	620	300
13	Hardness	850	590	352	507.5	290	680	770	870	-
14	TDS	1278	693	573	680	3400	1572	905	1001	18091
15	NO ₃	7	19	6	17	12	4	13	24	35
16	F	1.1	0.75	0.81	0.53	0.79	0.78	0.95	1.1	1.1

than 250mg/L. 1000mg/L is maximum permissible concentration of chloride and if chlorides exceed this, the sample source is unsuitable for domestic purpose. Fourteen locations have chloride value less than 1000 mg/L, and 2 locations have chloride value greater than this.

Sulphates (SO₄): The sulphate concentration ranged from 67.01-3798.55 mg/L. Minimum sulphate concentration was noted for the sample collected at the location of K. V. Palayam, and maximum for the Pallapatti. The standard recommendation for sulphates is only 200 as desirable value, and 400 mg/L as maximum permissible concentration. Twenty eight locations were found to be satisfying standard recommendation, and 3 samples have sulphates greater than 200 mg/L. One sample has more than 400 mg/L.

Calcium (Ca): The calcium concentration was in the range of 2-5080 mg/L. Minimum calcium concentration was noted for the sample at Malayapuram, while maximum calcium was observed at Pallapatti. The standard recommendation for calcium is only 75 mg/L as desirable value. Nine locations were found to be satisfying standard recommendations, while 22 locations have calcium values greater than 75 mg/L. The standards recommend that 200 mg/L is maximum permissible concentration, and if calcium value in water exceeds 1000 mg/L, the sample source is unsuitable for domestic purpose. Twenty locations were found to be with calcium values less than 200 mg/L, and 2 locations with calcium values greater than 200 mg/L.

Sodium (Na): The sodium concentration ranged from 18.98-1229 mg/L. Minimum sodium concentration of 18.98 mg/L was noted for the sample from Kappiliyapatti, and maximum from Parapatti. The standard recommendation for sodium is 200 mg/L as permissible value. Twenty five locations were found to be within the standard recommendation, and six with greater than 200 mg/L which are the locations unsuitable for domestic purpose.

Potassium (K): The potassium concentration ranged from 1.693-153mg/L. Minimum potassium

Table 4: Water quality index rating.

Sl No.	Location	Longitude	Latitude	WQI	Character
1	Pappapatti B.W	78°14'52.68947"E	10°13'57.52730"N	41.58	GOOD
2	Naduvanoor B.W	78°16'46.63535"E	10°15'04.39318"N	33.154	GOOD
3	Kottaiyoor B.W	78°20'11.16099"E	10°19'06.61612"N	24.467	EXCELLENT
4	Siluvattor B.W	78°05'29.06337"E	10°21'07.71890"N	41.438	GOOD
5	Kanapadi B.W	78°05'59.92549"E	10°24'19.34649"N	63.348	POOR
6	S. Kurumbapatti D.W	78°06'55.86514"E	10°24'21.05973"N	64.237	POOR
7	Kosavapatti B.W	78°02'57.61794"E	10°27'22.12099"N	65.403	POOR
8	Puliyampatti B.W	78°05'57.40971"E	10°38'15.84006"N	47.881	GOOD
9	D. Godalur B.W	78°07'26.69535"E	10°47'21.96648"N	44.206	GOOD
10	K. Vasanthakathir palaym B.W	78°04'15.68098"E	10°46'25.10511"N	42.223	GOOD
11	Kasipalaym B.W	77°56'24.3858"E	10°36'55.6501"N	62.238	POOR
12	K. Sukkampatti B.W	77°54'04.02954"E	10°31'08.52299"N	59.804	POOR
13	Edaya kottai B.W	77°50'37.08179"E	10°37'05.61309"N	40.371	GOOD
14	Margampatti D.W	77°48'32.17726"E	10°40'24.82580"N	35.062	GOOD
15	Verippur B.W	77°47'37.23521"E	10°31'25.58126"N	30.492	GOOD
16	Kethaiyerembu B.W	77°49'30.01236"E	10°30'20.57213"N	36.684	GOOD
17	Pudhukalajipatti B.W	77°46'44.55906"E	10°30'06.06813"N	24.771	EXCELLENT
18	Kapliya patti B.W	77°43'29.78412"E	10°31'20.85967"N	30.603	GOOD
19	Kennivadi B.W	77°49'54.42743"E	10°22'50.63361"N	45.317	GOOD
20	Veiladichan patti B.W	77°54'04.16742"E	10°23'52.47264"N	40.537	GOOD
21	Kesavanapatti B.W	77°52'08.61389"E	10°22'08.73367"N	24.808	EXCELLENT
22	Malayapuram B.W	77°49'59.81919"E	10°19'01.41789"N	40.289	GOOD
23	R.N. Patti B.W	77°41'32.65392"E	10°09'17.16951"N	66.783	VERY POOR
24	Kanavai patti B.W	77°44'07.35465"E	10°11'08.10116"N	52.524	GOOD
25	Kombai patti B.W	77°47'01.17903"E	10°09'23.24400"N	57.824	POOR
26	Ayyampalayam B.W	77°44'59.75435"E	10°13'29.16383"N	41.656	GOOD
27	Parapatti B.W	77°57'36.96287"E	10°21'15.41491"N	61.082	GOOD
28	Parapatti B.W	77°57'49.76956"E	10°21'20.07982"N	55.141	GOOD
29	Pillaiyarnatham B.W	77°56'56.84105"E	10°19'33.51056"N	60.651	POOR
30	Wisdomcity B.W	77°57'08.97857"E	10°19'26.60807"N	69.996	VERY POOR
31	Palla patti B.W	77°57'25.87917"E	10°20'03.75579"N	103	UNFIT

concentration of 1.693mg/L was noted for the samples from Malayapuram, and maximum for the sample collected at Kesavanapatti.

Nitrate (NO₃): The maximum permissible limit of NO₃ in drinking water as per WHO standard is 50 mg/L. The concentration of nitrate ranged from 1 to 60 mg/L. Most part of the district has the concentration ranging from 0 to 20 mg/L. The maximum concentration of 60 mg/L was found in one well at Puliyampatti in the Guziliam Parai block, and the minimum concentration of 1 mg/L in one well at Authur block.

Fluoride (F): Fluorides in water can be detrimental or beneficial depending on the concentration. Usually well waters have excess amount of fluorides. The maximum permissible limit for F in drinking water as per WHO standard is 1.5 mg/L. The concentration of fluoride ranged from 0.24 to 1.1 mg/L. Most part of the district has the concentration of F ranging from 0.5 to 0.75 mg/L. The maximum concentration was found to be 1.1 mg/L at Pallapatti, Wisdomsity, R.N. Patti and Tannery industrial area. The minimum concentration was 0.24 mg/L in the Reddiyarchatram block.

Water quality index (WQI): WQI is poor in Vadamadurai, Vedachantur and Tannery industrial

area. It ranges from 24.467 to 103. Minimum WQI was found in Natham block, and maximum in Tannery industrial area.

CONCLUSION

Water Quality Index out of 31 wells, shows that only 3 wells are excellent, 14 wells good, 13 wells poor and one well unfit for drinking. The groundwater of tannery industrial area has very poor WQI. The physicochemical properties of the groundwater highly varied in locations. The area having poor water quality requires treatment before supplying for public consumption.

RECOMMENDATIONS

- To increase the groundwater quality by rain water harvesting.
- The Industrial wastes, domestic effluents and sewage should be treated before disposal.
- To spread awareness about groundwater quality to the public.
- To monitoring the groundwater quality.

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