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Water Quality Index Study around Compost Yard Using GIS

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Abstract
The study has demonstrated the utility of GIS technology combined with laboratory analysis in evaluation and mapping of groundwater quality in Thanjavur region.in this study. Water samples are collected in different places in and around the compost yard. Then the samples are analysed in laboratory of various physio chemical characteristics like pH, TDS, EC, TH, Cl, HCO_3, SO_4, NO_3, Ca, Mg, Na, and K.Based on the sodium concentration the water quality index is achieved. By using ARGGIS software Water quality index map has been prepared the thematic layers by overlay method.

I. Introduction

Water is the natural resources providing a backbone for agricultural and industrial development. Thanjavur city and the adjacent areas facing an acute shortage of good drinking water except good potable water supplied by the municipality. Generally, the concentrations of dissolved ions in ground water are governed by litho logy, Interpretations of chemical data for ground water, groundwater flow, nature of geochemical reactions, residence time, solubility of salts and human activities. More ever, the groundwater quality is mostly affected by either natural geochemical process such as rock weathering, dissolution/precipitation reactions, ion exchange or various man-made activities and industrial wastages etc.low ph values can cause gasintrointestinal disorder and this water cannot be used for drinking purpose. The present study was carried out to evaluate the water quality and its suitability for domestic and agriculture activities in Thanjavur town. The ground water is the only major source of water for agricultural purpose and domestic purposes due to lack of water in Cauvery River which is the major river in this area.

The study has demonstrated the utility of GIS technology combined with laboratory analysis in evaluation and mapping of groundwater quality in urban region. About 83% of the area under study comes under moderately polluted to severely polluted category revealed by the WQI studies. The two numbers of sampling locations in premonsoon season and six locations in postmonsoon season are only suitable for drinking purpose in the study. The spatial distribution maps generated for various physicochemical parameters using GIS techniques could be useful for planners and decision makers for initiating groundwater quality development in the area. Swarna Latha.P 1 , Nageswara Rao.K (2010)

II. Material And Methods

Study Area

The study area Thanjavur town is located 300 km southeast of Chennai and area extends from 10° 45’ 00” to 10 °50’ 00” N latitude and 79° 05’ 00” to 79° 10’00” E. longitude, (Toposheet No 58 N/1 scale 1:50,000.) .Thanjavur is located on east coast between Nagapatinam district in north and Pudukkottai district in south as shown in fig 1.

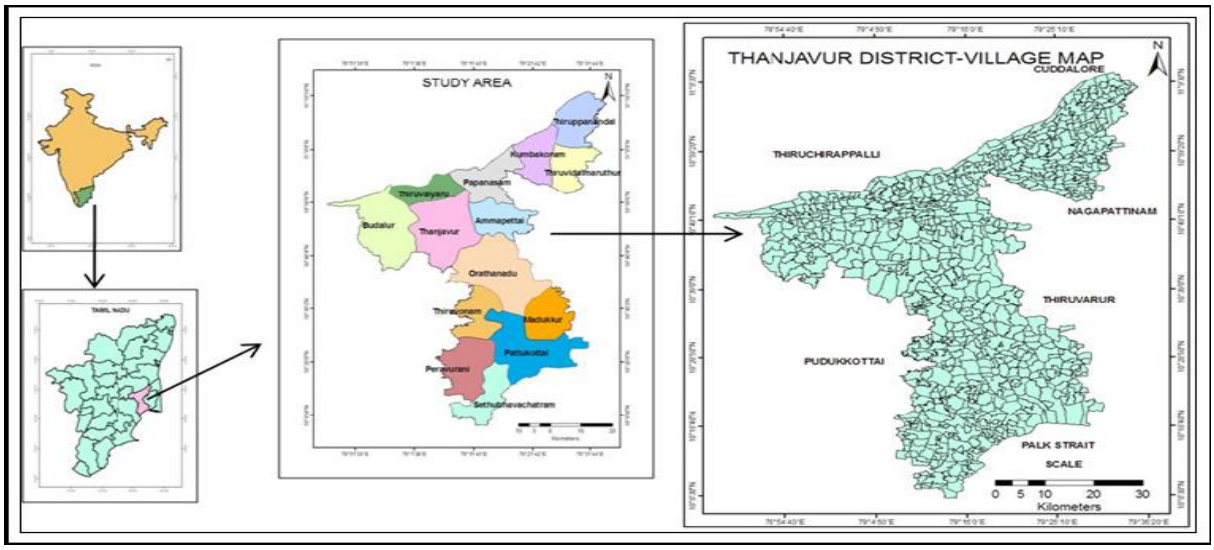


Fig 1. Location map of the study area

SAMPLE COLLECTION

Municipal solid waste like household waste , vegetable waste, industrial waste , street cleanings, abounded waste, sewage and garbage waster are collected by municipality and NGO'S. The compost yard is extended to an area of 20 acres. Daily waste generation of the compost is 114 MT (CCP). In this yard a certain length of compost yard is well lined and leach ate water is collected separately. Here samples are segregated and compost for 45 days by spreading the sewage water, composting the waste as manure and sale as fertilizer for crops. The outer section and some portion of the compost yard is not lined. The water squeezed out from the waste is seepage through the ground water. That water is taken for analysis.

Fig 4.Compost yard (outside)

Fig 5.compost yard (inside)

The samples collected in various areas are shown in Table 1. by spatial and non spatial data.

Table 1. Location details of the study area

Sample no	Spatial data		Non spatial data
	latitude	longitude	
1	10˚ 47'25.596" N	79˚07' 38.77" E	Srinivasapuram,Sekkadi st
2	10˚47' 30.585" N	79˚07' 23.320" E	Sai Baba temple
3	10˚ 47' 31.94" N	79˚07' 06.942" E	Angel Nagar
4	10˚47' 14.160" N	79˚07' 12.450" E	Melavali panchayat
5	10˚47' 56.802" N	79˚07' 32.862" E	Kali medu
6	10˚47' 07.52" N	79˚07' 28.59" E	Srinivasapuram Classic Mahal
7	10˚47' 00" N	79˚07' 38.77" E	Mangalapuram
8	10˚45' 43.71" N	79˚07' 40.356" E	Housing board
9	10˚47' 39.58" N	79˚08' 26.124" E	Town police station,kilavasal
10	10˚46'59.076" N	79˚09' 03.756" E	Manambujavadi

11	10˚48' 02.502" N	79˚08' 16.908" E	Ghandhi salai
12	10˚48' 53.292" N	79˚08' 21.324" E	Vennaru river street
13	10˚49' 02.022" N	79˚08' 07.248" E	Old thiruvaiyaru salai
14	10˚49' 40.104" N	79˚08' 29.280" E	Karpagam nagar
15	10˚51' 06.71" N	79˚09' 29.446" E	Nedar
16	10˚51' 55.980" N	79˚09' 46.878" E	Mangorai
17	10˚47' 07.542" N	79˚13' 57.834" E	Mathur

The physio chemical analysis of various parameter such as pH, TDS, EC, TH, Cl, HCO_3, SO_4, NO_3, Ca, Mg, Na, and K of water sample are analyzed by standard procedure.

III. Result And Discussion

Total dissolved solids (TDS) values are also considered as an important parameter in determining the usage of water, and groundwater with high TDS values is not suitable for both irrigation and drinking purposes (Fetters 1990; Freeze and Cherry 1979).To ascertain the suitability of groundwater for any purposes, it is essential to classify the groundwater depending upon their hydro chemical properties based on their TDS values, which are presented in (Table 2). Data shows 70% of groundwater samples in the study area representing fresh water and the remaining 30% samples representing brackish water as per the WHO international standard. Below 500 mg/l of TDS as shown in Table 4, indicating low content of soluble salts in groundwater which can be used for drinking without any risk.

Table 2. Physio-chemical analysis for water sample

SI.NO	PH	EC (µs/cm)	Turbidity (NTU)	TH (mg/l)	$Ca2^+$ (mg/l)	Mg^{2+} (mg/l)	TDS (mg/l)	CL^- (mg/l)	DO (mg/l)	COD (mg/l)	SO_4^{2-} (mg/l)	Na^+ (mg/l)	K^+ (mg/l)	WQI	SAR
1	7.3	333	2.44	75	52.5	22.5	20	570	6.8	20	677.1	51	2.34	53.77	8.33
2	8	237	0.55	125	105	25	99	1150	7.2	10	196.3	105.87	3.6	57.89	13.13
3	8.1	467	2.85	47.5	37.5	10	130	240	7.5	10	630.4	105	3.47	62.04	21.55
4	8	367	0.87	115	100	15	75	710	7.6	20	490.37	93.7	3.34	53.11	12.36
5	7.9	1003	9.93	162.5	125	37.5	1310	1340	7.2	30	560	87.7	3.22	116.46	9.73
6	7.9	373	2.21	167.5	92.5	75	980	780	7.1	20	583	87.7	3.22	72.59	9.58
7	6.2	282	0.86	62.5	47.5	15	120	400	6	10	723	14.9	1.06	29.78	2.67
8	6.9	325	0.67	12.5	7.5	5	80	200	6.5	30	677	27.3	1.95	33.36	10.92
9	8	296	2.7	62.5	25	37.5	600	520	7.6	10	513	93	3.31	65.51	16.64
10	8.1	974	1.07	60	50	10	600	300	7.5	20	747	105	3.31	54.22	19.17
11	8.1	522	0.5	50	45	5	1400	390	7.5	30	630	102	3.31	49.11	20.40
12	7.9	958	0.66	112.5	72.5	40	1980	490	7.2	20	677	90	3.1	56.19	12.00
13	7.8	664	0.97	100	60	40	1170	1460	7.1	10	537	62	3	58.2	8.77
14	8.2	887	0.42	45	37.5	7.5	1190	320	6.9	20	700	97	3.5	52.3	20.45
15	7.9	824	3.77	87.5	27.5	60	80	300	7.2	30	513	89	3.22	76.81	13.46
16	8.4	1096	0.65	77.5	42.5	35	260	400	7.5	20	510	117.9	3.86	60.8	18.94
17	7.3	2420	0.97	110	97.5	12.5	410	1110	6.8	10	630	51.4	2.46	46.74	6.93

Table 3: Classification of groundwater based on TDS values

TDS (mg/l)	Nature of water	Percentage of Sample	Total no. of sample
<1000	**Fresh water**	**64%**	11
1000-10000	**Brackish water**	**29%**	**5**
10000-100000	**Saline water**	**Nil**	**Nil**
>100000	**Brine water**	**Nil**	**Nil**

The total hardness for drinking water is specified as 300 mg/l. (BIS: 1991). The most desirable limit is 100 mg/l as per the WHO (1993) international standard. The water hardness is primarily due to the result of interaction between water and geological formations (Angino, 1983).Total hardness is varying from 45 to 167.5 mg/l in the study area. The table (4) shows that 47% of water samples fall in the category of soft, 41.3% of water samples fall in the category of moderately hard, 11.7% of water samples fall in the category of hard and in the study area

Table 4: Classification of groundwater based on hardness

Total hardness as CaCo3(mg/l)	Water class	% of samples	Total no. of sample
<75	Soft	47%	8
75-150	Moderately hard	41.3%	7
150-300	Hard	11.7%	2
>300	Very hard	Nil	Nil

The conductivity measurements provide an indication of ionic concentrations. It depends upon temperature, concentration and types of ions present (Hem, 1985). In the study area ,measured EC values ranged from 237 to 2420 microsimens / cm in which 11.76% of water samples are representing Excellent,47% of them are good, 35.29% of the samples fall under permissible and 5.8% samples are classified as doubtful category of water classes(Table 5). The highest EC values which are classified as doubtful category are found in the areas nearer to rice mills, fish market and dumping of wastages which is clearly giving evidence of migration of leach ate

Table 5: Quality of water based on Electrical conductivity

EC (micro mhos/cm)	Water class	% of samples	Total no of Sample
< 250	Excellent	11.76	2
250-750	Good	47	8
750-2250	Permissible	35.29	6
2250-4000	Doubtful	5.8	1
>4000	Unsuitable	Nil	Nil

While a high salt concentration in water leads to formation of saline soil, a high sodium concentration leads to development of an alkaline soil (singh, AK et al.). The sodium adsorption ratio (SAR) parameter evaluates the sodium hazard in relation to calcium and magnesium concentrations

Table .6 Calculation of WQI for the sample 1

Parameters	Actual measured (Wi)	WQ standard value (Si)	Relative weight (Wi)	Quality Rating (Qi)	Weighted Valus (Wi) x (Qi)
PH	7.3	8.5	0.11647	20	4.659
EC(µs/cm)	333	250	0.004	133.2	0.533
DO(mg/l)	6.8	6	0.166667	90.70	15.116
Turbidity (NTU)	2.44	5	0.2	48.8	9.760
TH(mg/l)	22.5	100	0.01	22.5	0.225
Ca^{2+}(mg/l)	52.5	100	0.01	52.5	0.525
Mg^{2+}(mg/l)	22.5	30	0.033333	75	2.500
Na^{+}(mg/l)	51	200	0.005	25.5	0.128
K^{+}(mg/l)	2.34	10	0.1	23.4	2.340
Cl^{-}(mg/l)	570	250	0.004	228	0.912
SO_4^{2-}(mg/l)	516	250	0.004	206.4	0.826
TDS(mg/l)	20	1000	0.001	2	0.002
			Σ Wi 0.65447		Σ Wi.Qi 35.196

Based on USSL Salinity Diagram ,shows that the field of C2S1 indicates medium salinity water to low sodium water which can be moderately suitable for irrigation purposes and C3S2 indicates high salinity to medium sodium water type in which plants with good salt tolerance is suitable and this water may be used on organic soils with good permeability. Some of the samples fall under the category of C3S3 and C4S1 indicating high SAR as shown Table 7 and Salinity hazard.

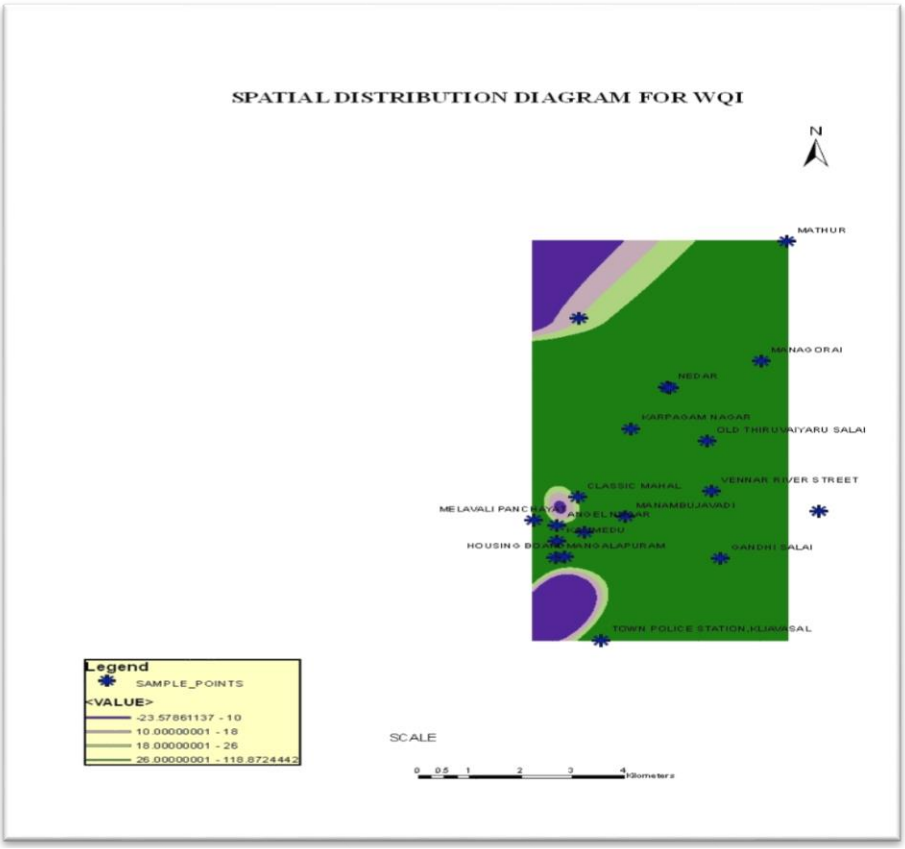
Table 7: Suitability of groundwater for irrigation based on SAR

SAR	Water class	% of samples	Total no of Sample
0-10	Excellent	35	6
10-18	Good	35	6
18-26	Fair	29.41	5
>26	Poor	NIL	NIL

WATER QUALITY INDEX

The interpretation of WQI for ground water of the study area reveals that all places water quality is medium and bad .

Out of 17 observation points water is found to be unsuitable in the following area, namely Srinivasapuram Sekkadi Street, Angel Nagar, Classical Mahal,Gandhi Salai, Old Thiruvaru Salai, Sai Baba Temple, Karpagam Nagar , Manambuchavadi , Kalimedu based on Table 6. The pollution of ground water in the study area is mainly due to the contamination of chemical elements namely chlorides, Sulphates, TDS and sodium by the leachate action of solid waste.



The interpolation of chemical parameters reveals that Chlorides, Sulphates, Total Dissolved Solids are found in excessive above the permissible limit. Using the chemical parameter of the observation points, spatial distribution for all sample points has been prepared by ARCGIS Software.

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