*International Research Journal of Environment Sciences*________________________________ ISSN 2319–1414
Vol. **4(1),** 33-41, January **(2015)** *Int. Res. J. Environment Sci.*

Groundwater Quality Monitoring in Walajah Block, in Palar river basin at Vellore District, Tamilnadu, India

Tamilarasi V.[1], Murugesan S[1] and Vishwanathan B[2]
[1]PG and Research Department of Botany, Pachaiyappa's College, Chennai, Tamilnadu, INDIA
[2]Department of Joint Director of Economics and Statistic, Chennai, Tamilnadu, INDIA

Available online at: www.isca.in, www.isca.me
Received 25th November 2014, revised 17th December 2014, accepted 20th January 2015

Abstract

The hydro chemical quality of groundwater in Walajah block in Palar river basin at Vellore District has been studied. Totally 48 water samples were collected, out of four sampling location during the month of January, April, July and October for three years of 2009, 2010 and 2011. The samples were analysed for various parameters such as turbidity, pH, electrical conductivity, alkalinity, hardness, iron, manganese, nitrate, chloride, fluoride, sulphate and chromium. Based on the analysis, water quality Index (WQI) was calculated. According to the WQI, the water quality rating is done and it reveals that 60.42% are excellent, 25% are good, 6.25% are moderately polluted, 2.08% are severely polluted and 6.25% are unfit for drinking use. This study reveals that the groundwater in Walajah block, situated at Palar basin in Vellore district is deteriorated by the parameters such as total dissolved solids, total alkalinity, total hardness, nitrate and chromium.

Keywords: Groundwater quality, hydro chemical parameters, water quality index, water quality rating.

Introduction

The hydro chemical quality of groundwater in the Tamilnadu State varies depending on the lithology, climatic conditions, rainfall and topology. The major part of the state, comprising of hard rock terrain. The quality of groundwater varies from place to place. In the sedimentary formation, the quality varies in vertical extension[1]. There are 32 types of industries that are termed as 'RED' industries by Tamilnadu Pollution Control Board (TNPSC). It is noted that among 2477 units, 76.8% industries are located in Chennai (28.9%), Palar (19.8%) and in Cauvery (28.1%) basins[2]. It is apparent that the Chennai basin receives the largest load of various pollutants generated from industrial effluents. The Cauvery, Vellar and Palar rivers also receive a substantial pollution load from the industries. In Vellore district, in a stretch of 120 km from Vaniambadi to Walajah about 570 tanneries are functioning. The impact of tannery effluent pollution in Palar is in alarming proportion. The tannery effluent having high BOD, sodium, chloride and chromium is let into the Palar river.

The quality of drinking water is deteriorated in the Palar river bed owing to the discharge of industrial effluent into the river and thus polluting nearly 35,000 hectares of cultivable lands. The widespread use of fertiliser is also found to influence the quality of water to a greater extent. It is noted that the use of nitrogen fertilisers has caused irreparable damage to the groundwater in the north-western parts of Tamilnadu. Apart from industrial discharges, inland rivers are polluted by indiscriminate disposal of sewage and other domestic waste also.

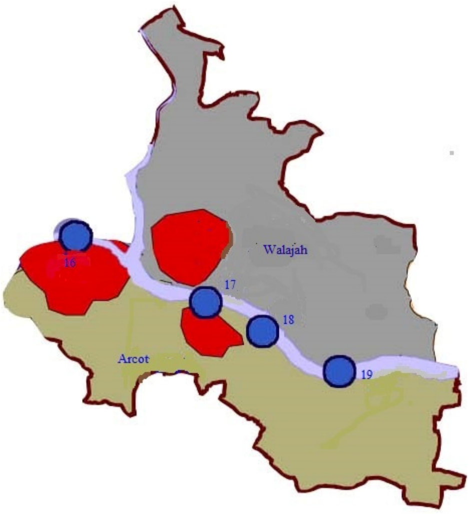
Meterial and Methods

Study Area: Walajah block, Palar river basin. Vellore district, Tamilnadu. Four number of groundwater sources are selected in Palar river basin at Walajah block for water sample collection. They are Vannimedu Mathur-Kangaiamman Koil street, Gudimallur, Ranipet head works, and Sathampakkam village and are shown in table-1 and figure-1.

Water samples are collected from the above said locations at walajah block during the month of January, April, July and October for three years of 2009, 2010, and 2011. Totally forty eight samples were collected from groundwater sources. Proper preservation was carried out before reporting to the laboratory. The samples were analysed for drinking water quality parameters as referred in the Standard Methods[3]. The water quality data were compared with the Drinking Water Specifications- BIS-10500-2012 and are shown in table-2[4].

Table -1
Sample Locations

Station Code	Location Code	Location of sampling	Block
1	16	Vannivedu Mathur, Kangaiamman koil st	Walajah
2	17	Gudimalloor	Walajah
3	18	Ranipet head works	Walajah
4	19	Sathambakkam village	Walajah



●Sampling location ●Tannery location

Figure-1
Sampling location with Tannery location

Water Quality Index: Water quality of four sources has been presented, on the basis of calculated water quality indices[5]. The estimated quantitative values of water quality parameters and their standards as per the Drinking Water Specifications-IS-10500-2012 have been used for WQI calculation.

Water quality index (WQI) has been computed using the formula[6] = n

$\sum w_i q_i$

i = 1

Where, w_i= weightage factor of i^{th} parameter, qi = quality rating of i^{th} parameter, w_i is calculated from the following equation:

$w_i = (k/S_n)$

Where k = constant = $1 / (1/v_{s1}+ 1/v_{s2}\text{------}+1/v_{sn})$, Sn = standard value of i^{th} parameter,

q_i is calculated from the following equation:
$q_i= (v_a-v_i/ v_s-v_i) \times 100$

Where v_a = actual value obtained from analysis of i^{th} parameter, v_s = standard value of i^{th} parameter, v_i = ideal value (pH= 7 and 0 for all other parameters)

Results and Discussion

Water Quality Index (WQI) is one of the meaningful approach for groundwater and all other type of water like river, lake and surface water quality analysis[7]. Water quality is the condition of the water body or water resource in relation to its designated uses. The hydro-chemical data analyses of the present study for each parameter for the year 2009, 2010 and for 2011 are tabulated in table-3. For quality assessment, all the parameters were compared with the guidelines suggested by the Bureau of Indian Standards in which there are two levels *i.e.* acceptable limit and permissible limit in the absence of alternate source.

Table-2
Mean Value and Drinking Water Specifications - BIS-10500:2012

Sl. No.	Parameters	S1	S2	S3	S4	Requirement (Acceptable limit-BIS)	Permissible limit (BIS)in absence of alternate source
		Mean Value In mg/l					
1	Turbidity	2.0	1.4	1.0	1.3	1	5
2	Total dissolved solids	1547	970	781	1110	500	2000
3	pH	7.68	7.70	7.83	7.72	6.5 – 8.5	No relaxation
4	Total alkalinity	387	310	256	312	200	600
5	Total hardness	613	453	428	470	200	600
6	Calcium hardness	155	110	102	116	75	200
7	Magnesium hardness	56	40	36	42	30	100
8	Sodium	203	127	91	153	Not suggested	
9	Potassium	19	11	9	15	Not suggested	
10	Iron	0.09	0.07	0.08	0.08	0.3	No relaxation
11	Ammonia	0.26	0.08	0.09	0.16	Not suggested	
12	Nitrate	66	28	24	31	45	No relaxation
13	Chloride	360	217	176	252	250	1000
14	Fluoride	0.82	0.70	0.64	0.70	1.0	1.5
15	Sulphate	157	84	51	104	200	400
16	Phosphate	0.10	0.06	0.08	0.08	Not suggested	
17	Chromium	0.0065	0.0043	0.0026	0.0025	0.05	No relaxation

Note :Values are mentioned in mg/l except for pH and Turbidity

Table -3
Water Quality Parameter Analysis

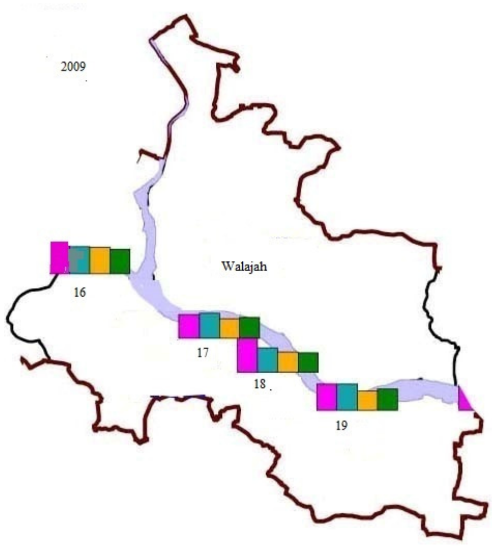
S.No.	Parameter	Minimum Mean		Maximum Mean		Counts within Acceptable Limit (BIS)		Counts within Permissible Limit (BIS)		Counts greater than Permissible Limit (BIS)	
		Value in mg/l	Station No.	Value in mg/l	Statio n No.	No.	%	No.	%	No.	%
1	Total dissolved solids	781	S3	1547	S1	5	10.4	41	85.4	2	4.2
2	pH	7.68	S1	7.83	S3	48	100.0	0	0.0	0	0.0
3	Total alkalinity	256	S3	387	S1	6	12.5	42	87.5	0	0.0
4	Total hardness	428	S3	613	S1	2	4.2	31	64.6	15	31.3
5	Calcium	102	S3	155	S1	9	18.8	37	77.1	2	4.2
6	Magnesium	36	S3	56	S1	11	22.9	37	77.1	0	0.0
7	Sodium	91	S3	203	S1	Limits not suggested					
8	Potassium	9	S3	19	S1	Limits not suggested					
9	Iron	0.07	S2	0.09	S1	45	93.8	0	0.0	3	6.3
10	Ammonia	0.08	S2	0.26	S1	45	93.8	3	6.3	0	0.0
11	Nitrite	0.014	S2	0.035	S1	0	0.0	0	0.0	0	0.0
12	Nitrate	24	S3	66	S1	32	66.7	16	33.3	0	0.0
13	Chloride	176	S3	360	S1	28	58.3	20	41.7	0	0.0
14	Fluoride	0.64	S3	0.82	S1	45	93.8	3	6.3	0	0.0
15	Suphate	51	S3	157	S1	44	91.7	4	8.3	0	0.0
16	Phosphate	0.06	S2	0.1	S1	Limits not suggested					
17	COD	4.4	S3	7.8	S1	Limits not suggested					
18	Chromium	0.0025	S4	0.0065	S1	48	100.0	0	0.0	0	0.0

Based on the hydro chemical analytical data of the present study, the calculated WQI for the year 2009, 2010 and for 2011 is represented in the form of bar chart in figure-2, figure-3 and figure-4. It is also tabulated in table- 4, table-5, table- 6, table-7, table- 8, table-9 and table-10, respectively.

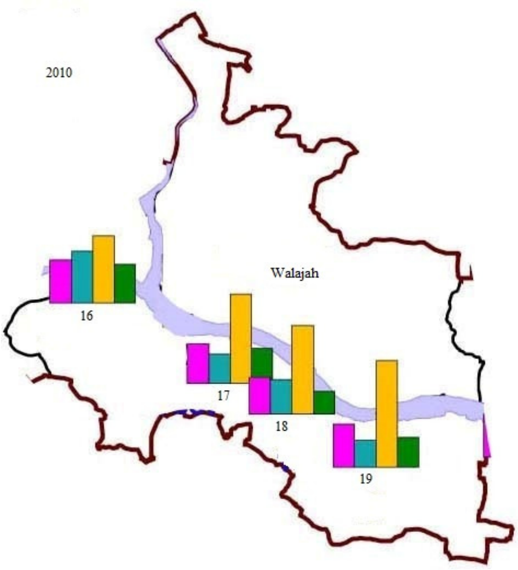
According to the water quality index, the analysed samples were grouped into five classes as excellent (0-25), good (26-50), moderately polluted (51-75), severely polluted (76-100), and unfit for drinking (above 100). In this study, the water quality index rating is found as follows.

Excellent – 60.42%; Good – 25%; Moderate – 6, 25%; Severe – 2.08%; Unfit – 6.25. The rating and WQI are tabulated in table-7.

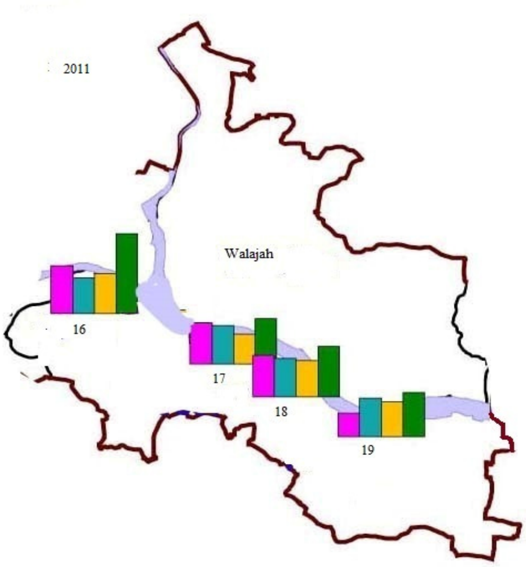
Total dissolved solids (TDS) are an important parameter for deciding the water quality and it is contributed by industrial waste. It is the sum of all dissolved chemicals present in water. Local lithology imparts high concentration of TDS. Hence, the water losses its potability and reduces the solubility of oxygen in water. In the present study, the minimum TDS value of 781 mg/l is recorded in S3 and the maximum value of 1547 mg/l is recorded in S1. The counts within acceptable limit (500 mg/l) are 5 (10.4%), counts within permissible limit (2000 mg/l) are 41 (85.4%) and counts greater than permissible limit are 2 (4.2%). Water with high residue is normally less palatable reaction in the transient consumer and even may cause gastrointestinal irritation. Water containing high solid concentration may cause constipation effects[8]. TDS causes undesirable taste, gastro intestinal irritation, and corrosion. It can be removed by distillation, solar evaporation and by reverse osmosis.



(•January•April•July •October)
Figure-2
Water quality index -2009



(●January●April●July ●October)
Figure-3
Water quality index-2010



(●January●April●July ●October)
Figure-4
Water quality index -2011

The pH value of drinking water is an important index of acidity or alkalinity. pH value represents the hydrogen ion concentration and it is contributed by industrial waste. A number of minerals and organic matter interact with one another to give the resultant pH value of the sample. It ranges from minimum value of 7.68 in S1 and maximum value of 7.83 in S3 and it is 100% well within the acceptable limit (8.5) for drinking and other domestic uses. It can be treated by neutralisation.

Total alkalinity is generally imported by the salts of carbonates and bicarbonates with hydroxyl ions in free state[9]. In the present study, the minimum alkalinity value of 256 mg/l is recorded in S3 and the maximum value of 387 mg/l is recorded in S1. The counts within acceptable limit (200 mg/l) are 6 (12.5%) and counts within permissible limit (600 mg/l) are 42 (87.5%). High alkalinity water turns the cooking rice to yellow and dhal to rubbery. Alkalinity values providing guidance in applying proper doses of chemicals in water and wastewater treatment process particularly in coagulation, softening and operation control of anaerobic digestion process. It can be removed by distillation, solar evaporation and by reverse osmosis.

The hardness is due to dissolution of alkaline earth metal salts from geological matter. Total hardness is caused by calcium and magnesium ions present in water. Total hardness is caused by calcium and magnesium ions present in water. In the present study,the minimum hardness value of 428 mg/l is recorded in S3 and the maximum value of 613 mg/l is recorded in S1. The counts within acceptable limit (200 mg/l) are 2 (4.2%), counts within permissible limit (600 mg/l) are 31 (64.6%) and counts greater than permissible limit are 15 (31.3%). Hardness has no adverse effect on human health. However, some evidence has attribute about its role in heart disease.It causes scale formation, skin irritation, consume more time and fuel for cooking. It can be removed by distillation, solar evaporation and by reverse osmosis.

High content of calcium is contributed from the soil. In the present study, the minimum calcium value of 102 mg/l is recorded in S3 and the maximum value of 155 mg/l is recorded in S1. The counts within acceptable limit (75 mg/l) are 9 (18.8%), counts within permissible limit (200 mg/l) are 37 (77.1%) and counts greater than permissible limit are 2 (4.2%). Excessive calcium causes concretions in human body and may cause gastro- intestinal problem. It can be removed by distillation, solar evaporation and by reverse osmosis.

Magnesium contributes to hardness in water. In the present study, the minimum magnesium value of 36 mg/l is recorded in S3 and the maximum value of 56 mg/l is recorded in S1.The counts within acceptable limit (30 mg/l) are 11 (22.9%); counts within permissible limit (100 mg/l) are 37 (77.1%). It can be removed by distillation, solar evaporation and by reverse osmosis.

Iron content is contributed by soil and rocks. In the present study,the minimum iron value of 0.07 mg/l is recorded in S2 and the maximum value of 0.09 mg/l is recorded in S1. The counts within acceptable limit (0.3 mg/l) are 45 (99.8%), and counts greater than permissible limit (0.3mg/l) are 3 (6.3%). Such water stains cloths and utensils during washing and consumes more fuel and time for cooking. Iron can be removed by precipitation by aeration and filtration through activated charcoal is suggested for water having higher concentration of iron.
Sodium concentrations in the present study were observed

minimum value of 91 mg/l in S3 and maximum value of 203 mg/l in S1 and potassium as minimum value of 9 mg/l in S3 and maximum value of 19 mg/l in S1. Excess sodium combining with carbonate will lead to the formation of alkaline soil, while with chloride and sulphate will form saline soils which are not suitable for irrigation[10].

Ammonia is formed as a result of the decomposition of nitrogenous organic materials. In the present study, the minimum ammonia value of 0.08 mg/l is recorded in S2 and the maximum value of 0.26 mg/l is recorded in S1. Ammonia is toxic to aquatic life and itcan be removed by biological oxidation method.

Nitrate content is due to increased agricultural activities and application of fertilisers. In the present study, the minimum nitrate value of 24 mg/l is recorded in S3 and the maximum value of 66 mg/l is recorded in S1. The counts within acceptable limit (45 mg/l) are 32 (66.7%), and counts greater than permissible limit (45 mg/l) are 16 (33.3%). This will cause methaemoglobinemia (Blue baby disease) and it influences the growth of algae[11]. The removal of nitrate is not an easy process but it can be possible by reverse osmosis method.

Chloride might be derived from natural processes in the earth, industrial effluent of soda ash, refineries and tanneries. In the present study, the minimum chloride value of 176 mg/l is recorded in S3 and the maximum value of 360 mg/l is recorded in S1. The counts within acceptable limit (250 mg/l) are 28 (58.3%), and counts within permissible limit (1000 mg/l) are 20 (41.7%). Chloride content affects the taste of water and corrosive nature. Chloride can be removed by installing chloride removal unit in the sources by local functionaries. We need to arrest the toxic effect of other chemical contents so as to improve the chloride effect.

Fluoride content is contributed from the soil and rocks. It is also derived from fertiliser effluent and fluoride based industries. In the present study, the minimum fluoride value of 0.64 mg/l is recorded in S3 and the maximum value of 0.82 mg/l is recorded in S1. The counts within acceptable limit (1.0 mg/l) are 45 (93.8%) and counts within permissible limit (1.5 mg/l) are 3 (6.3%). This causes both dental and skeletal fluorosis diseases. Removal of fluoride from drinking water is suggested through various de-fluoridation techniques are available including quick reverse osmosis, electro-dialysis and hit and trial method, precipitation and filtration method by using alum and lime and also by adsorption method by using activated alumina based on ion exchange resin. The Nalgonda technique is an economical way of de-fluoridation.

Sulphate is contributed from sewage, sulphate based industry.In the present study, the minimum sulphate value of 51 mg/l is recorded in S3 and the maximum value of 157 mg/l is recorded in S1. The counts within acceptable limit (200 mg/l) are 44 (91.7%) and counts within permissible limit (400 mg/l) are 4 (8.3%). Sulphate content affects the taste of water. It can be removed by solar evaporation method and by reverse osmosis method.

Phosphate is present as soluble phosphate and organic phosphate and it is contributed from sewage and fertiliser effluent. In the present study, the minimum phosphate value of 0.06 mg/l is recorded in S2 and the maximum value of 0.10 mg/l is recorded in S3. Agricultural runoff containing phosphate fertiliser as well as the waste water containing the detergents tends to increase pollution in water[12]. It can be removed by precipitation method by using poly aluminium chloride.

Chromium content indicates the impact of effluent discharge from tannery industries and extends of pollution.In the present study, the minimum chromium value of 0.0025 mg/l is recorded in S4 and the maximum value of 0.0065 mg/l is recorded in S1. The counts within acceptable limit (0.05 mg/l) are 48(100%). The minimum value of chromium is recorded in this study but on accumulation in soil is affecting the cultivation land. Chromium is toxic in nature and it can cause respiratory problem and skin complaints. It can be removed by chemical reduction method by using sodium bisulphate and also by chemical precipitation by using lime and caustic soda.

In technical report for “District Groundwater Brochure, Vellore District, Tamil Nadu”, it is stated that the quality of groundwater and soil in Vellore district is polluted by effluent from tanneries. Based on all water quality parameters, the excess value of total hardness, chloride, and nitrate are deteriorating the quality of ground water but in respect of all other parameters, the ground water is fit for drinking and domestic purposes. Nitrate values are observed more than 100 mg/l in 42% of samples and this pollution is caused by usage of fertilisers and other inadequate waste disposal. The high value of total hardness has also caused the composition of litho unit which establish the aquifers in the district. In this situation, prevention of groundwater and soil from quality deterioration can be attained by providing common effluent treatment plant (CETP) for safe disposal of waste and by adopting user friendly technologies for tanning[13].

Conclusion

The water quality and its pollution status in the Palar river are very important because it is related to human health directly.Almost 90% of the diseases are caused by direct consumption of water.The rivers are the main source for water. The Tamil Nadu Government is using 80% of ground water for water supply.

In the present study, the WQI reveal that out of 48 counts for the year 2009, 2010, and 2011, 60.42% are excellent, 25% are good, 6.25% are moderately polluted, 2.08% are severely polluted and 6.25% are unfit for drinking use.This study reveals that the water quality in Walajah block area situated at Palar river basin in Vellore district is affected by the parameters total dissolved solids, total alkalinity, total hardness, nitrate and chromium and needs some degree of treatment before consumption. It also needs an integrated approach of public and private sector, to protect the groundwater from contamination.

It is also observed that the maximum value for TDS, total alkalinity, total hardness, calcium, magnesium, sodium, potassium, ammonia, chloride, nitrate, fluoride, sulphate and chromium is recorded in S1 which is located very much nearer to the tannery industries. This confirms that deterioration of groundwater in Walajah block is mainly due to the seepage of industrial effluent. The data base will be highly useful for analysing the key reason for deterioration of groundwater quality, for water supply and for water supply management.

Table-4
Water Quality Index for January and April, 2009

Station code				1	2	3	4	1	2	3	4
Location Code				16	17	18	19	16	17	18	19
Season				Jan	Jan	Jan	Jan	Apr	Apr	Apr	Apr
Year				2009	2009	2009	2009	2009	2009	2009	2009
Parameter	Sn	Weightage (Wi)	Vi	Wiqi							
Total Dissolved Solids	500	0.000442	0	0.13	0.07	0.06	0.07	0.13	0.08	0.08	0.07
pH	8.5	0.026	7	0.59	0.71	1.06	1.07	0.78	0.55	1.66	1.58
Total Hardness	200	0.001105	0	0.36	0.20	0.22	0.21	0.38	0.21	0.22	0.22
Calcium	75	0.00294667	0	0.62	0.35	0.37	0.37	0.65	0.36	0.38	0.38
Magnesium	30	0.00736667	0	1.55	0.88	0.91	0.91	1.63	0.91	0.96	0.95
Iron	0.3	0.73666667	0	31.92	14.73	51.57	27.01	27.20	18.13	18.13	27.20
Nitrate	45	0.00491111	0	0.77	0.45	0.23	0.28	0.88	0.50	0.29	0.34
Chloride	250	0.000884	0	0.08	0.05	0.04	0.03	0.08	0.05	0.06	0.03
Fluoride	1	0.221	0	13.26	17.68	13.26	13.26	13.26	17.68	13.26	13.26
Sulphate	200	0.001105	0	0.14	0.04	0.03	0.06	0.14	0.04	0.03	0.07
WQI				49.41	35.17	67.74	43.28	45.15	38.53	35.08	44.10

Table-5
Water quality index for July and October, 2009

Station code				1	2	3	4	1	2	3	4
Location Code				16	17	18	19	16	17	18	19
Season				July	July	July	July	Oct	Oct	Oct	Oct
Year				2009	2009	2009	2009	2009	2009	2009	2009
Parameter	Sn	Weightage (Wi)	Vi	Wiqi							
Total Dissolved Solids	500	0.000442	0	0.26	0.02	0.02	0.02	0.15	0.11	0.05	0.15
pH	8.5	0.026	7	0.95	1.20	1.16	1.25	1.46	1.11	1.77	1.21
Total Hardness	200	0.001105	0	0.36	0.25	0.32	0.21	0.35	0.27	0.12	0.40
Calcium	75	0.00294667	0	0.62	0.35	0.37	0.37	0.73	0.42	0.20	0.75
Magnesium	30	0.00736667	0	2.14	0.27	0.25	0.27	0.98	1.35	0.59	1.47
Iron	0.3	0.73666667	0	19.64	0.00	0.00	0.00	4.91	12.28	7.37	14.73
Nitrate	45	0.00491111	0	1.24	0.05	0.05	0.05	0.62	0.53	0.29	0.64
Chloride	250	0.000884	0	0.33	0.01	0.01	0.01	0.15	0.11	0.05	0.14
Fluoride	1	0.221	0	17.68	17.68	17.68	17.68	26.52	8.84	8.84	8.84
Sulphate	200	0.001105	0	0.09	0.01	0.01	0.01	0.08	0.04	0.00	0.07
WQI				43.31	19.84	19.87	19.86	35.95	25.07	19.29	28.40

Table-6
Water Quality Index for January and April, 2010

Station code				1	2	3	4	1	2	3	4
Location Code				16	17	18	19	16	17	18	19
Season				Jan	Jan	Jan	Jan	Apr	Apr	Apr	Apr
Year				2010	2010	2010	2010	2010	2010	2010	2010
Parameter	Sn	Weightage (Wi)	Vi	Wiqi							
Total Dissolved Solids	500	0.000442	0	0.13	0.08	0.08	0.07	0.12	0.07	0.08	0.08
pH	8.5	0.026	7	0.95	0.73	1.84	1.75	1.20	0.85	2.11	1.28
Total Hardness	200	0.001105	0	0.20	0.21	0.22	0.20	0.29	0.17	0.26	0.18
Calcium	75	0.00294667	0	0.34	0.36	0.38	0.34	0.39	0.29	0.46	0.27
Magnesium	30	0.00736667	0	0.84	0.91	0.96	0.86	1.60	0.81	1.08	0.88
Iron	0.3	0.73666667	0	27.20	18.13	18.13	27.20	29.47	4.91	9.82	9.82
Nitrate	45	0.00491111	0	0.88	0.50	0.29	0.34	1.00	0.07	0.28	0.04
Chloride	250	0.000884	0	0.11	0.05	0.06	0.03	0.13	0.08	0.08	0.09
Fluoride	1	0.221	0	13.26	17.68	13.26	13.26	22.10	17.68	17.68	8.84
Sulphate	200	0.001105	0	0.06	0.04	0.03	0.07	0.06	0.04	0.02	0.04
WQI				43.96	38.7	35.25	44.13	56.35	24.96	31.88	21.53

Table-7
Water Quality Index for July and October, 2010

Station code				1	2	3	4	1	2	3	4
Location Code				16	17	18	19	16	17	18	19
Season				July	July	July	July	Oct	Oct	Oct	Oct
Year				2010	2010	2010	2010	2010	2010	2010	2010
Parameter	Sn	Weightage (Wi)	Vi	Wiqi							
Total Dissolved Solids	500	0.000442	0	0.13	0.12	0.12	0.16	0.12	0.07	0.04	0.06
pH	8.5	0.026	7	1.70	1.70	0.42	2.01	1.84	1.49	1.53	0.66
Total Hardness	200	0.001105	0	0.49	0.43	0.43	0.40	0.43	0.21	0.12	0.10
Calcium	75	0.00294667	0	1.05	0.79	0.79	0.66	0.78	0.46	0.22	0.15
gnesium	30	0.00736667	0	1.30	1.65	1.65	1.77	1.69	0.52	0.49	0.47
Iron	0.3	0.73666667	0	54.02	83.49	83.49	108.04	9.82	12.28	4.91	2.46
Nitrate	45	0.00491111	0	0.10	0.16	0.15	0.24	1.36	0.13	0.08	0.37
Chloride	250	0.000884	0	0.15	0.16	0.18	0.16	0.08	0.05	0.03	0.04
Fluoride	1	0.221	0	17.68	17.68	17.68	17.68	22.10	17.68	8.84	22.10
Sulphate	200	0.001105	0	0.08	0.07	0.06	0.06	0.04	0.05	0.01	0.01
WQI				76.70	106.24	104.96	131.18	38.26	32.94	16.27	26.41

Table-8
Water Quality Index for January and April, 2011

Station code				1	2	3	4	1	2	3	4
Location Code				16	17	18	19	16	17	18	19
Season				Jan	Jan	Jan	Jan	Apr	Apr	Apr	Apr
Year				2011	2011	2011	2011	2011	2011	2011	2011
Parameter	Sn	Weightage(Wi)	Vi	Wiqi							
Total Dissolved Solids	500	0.000442	0	0.09	0.09	0.02	0.20	0.11	0.13	0.13	0.15
pH	8.5	0.026	7	1.87	1.92	1.85	0.71	1.14	1.84	2.06	1.49
Total Hardness	200	0.001105	0	0.15	0.15	0.05	0.39	0.32	0.38	0.38	0.44
Calcium	75	0.002946667	0	0.25	0.25	0.09	0.68	0.59	0.68	0.68	0.82
Magnesium	30	0.007366667	0	0.64	0.64	0.25	1.65	1.25	1.47	1.47	1.67
Iron	0.3	0.736666667	0	19.64	14.73	18.42	14.73	2.46	2.46	2.46	2.46
Nitrate	45	0.004911111	0	0.13	0.12	0.10	0.12	0.51	0.75	0.76	0.89
Chloride	250	0.000884	0	0.10	0.09	0.01	0.30	0.08	0.09	0.09	0.13
Fluoride	1	0.221	0	10.17	9.72	7.29	7.74	17.68	17.68	17.68	17.68
Sulphate	200	0.001105	0	0.07	0.07	0.01	0.13	0.05	0.07	0.07	0.08
WQI				33.105	27.79	28.087	26.64	24.202	25.548	25.779	25.819

Table-9
Water Quality Index for July and October, 2011

Station code				1	2	3	4	1	2	3	4
Location Code				16	17	18	19	16	17	18	19
Season				July	July	July	July	Oct	Oct	Oct	Oct
Year				2011	2011	2011	2011	2011	2011	2011	2011
Parameter	Sn	Weightage (Wi)	Vi	Wiqi							
Total Dissolved Solids	500	0.000442	0	0.16	0.08	0.08	0.06	0.13	0.12	0.08	0.09
pH	8.5	0.026	7	0.19	1.46	1.47	1.07	1.42	1.02	0.28	0.85
Total Hardness	200	0.001105	0	0.41	0.24	0.23	0.13	0.33	0.28	0.25	0.24
Calcium	75	0.002946667	0	0.65	0.40	0.40	0.22	0.65	0.45	0.46	0.46
Magnesium	30	0.007366667	0	1.89	1.01	0.98	0.59	1.11	1.30	0.96	0.86
Iron	0.3	0.736666667	0	4.91	2.46	2.46	2.46	27.01	14.73	14.73	0.00
Nitrate	45	0.004911111	0	0.93	0.28	0.27	0.26	0.24	0.11	0.29	0.39
Chloride	250	0.000884	0	0.12	0.06	0.06	0.04	0.12	0.12	0.08	0.07
Fluoride	1	0.221	0	17.68	13.26	17.68	17.68	26.52	13.26	17.68	26.52
Sulphate	200	0.001105	0	0.14	0.04	0.04	0.02	0.09	0.05	0.02	0.08
WQI				27.07	19.27	23.67	22.53	57.62	31.44	34.83	29.55

Table-10
Water Quality Index And Rating

Station code		1		2		3		4	
Location Code		16		17		18		19	
Location of Sampling		Vannivedumathur, Kangaiaammankoilst.		Gudimalloor		Ranipet head works		Sathambakkam village	
		WQI	Rating	WQI	Rating	WQI	Rating	WQI	Rating
2009	January	49	Good	35	Good	68	Good	43	Good
	April	45	Good	39	Good	35	Good	44	Good
	July	43	Good	20	Excellent	20	Excellent	20	Excellent
	October	36	Good	25	Excellent	19	Excellent	28	Good
2010	January	44	Good	39	Good	35	Good	44	Good
	April	56	Moderately Polluted	25	Excellent	32	Excellent	22	Excellent
	July	77	Severely Polluted	106	Unfit	105	Unfit	131	Unfit
	October	38	Good	33	Good	16	Good	26	Good
2011	January	33	Good	28	Good	28	Good	27	Good
	April	24	Excellent	26	Good	26	Good	26	Good
	July	27	Good	19	Excellent	24	Excellent	23	Excellent
	October	58	Moderately Polluted	31	Good	35	Good	30	Good

Note: 0 to 25 - Excellent; 26 to 50 - Good; 51 to 75 - Moderately Polluted;76 to 100 - Severely Polluted; > 100 - Unfit.

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