

# Evaluation of Ground Water Quality Index in Coastal region of Karaikkal Town, Pondicherry, India

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*Abstract - Groundwater samples are collected from different locations in and around Karaikal region and their physicochemical characteristics. The present investigation is focused on the determination of physicochemical parameters such as pH, Electrical Conductivity (EC), Total Hardness (TH), Total Dissolved Solids (TDS), Calcium (Ca), Chlorides (Cl), Sulphate ( $SO_4^{2-}$ ) and Nitrate ( $NO_3$ ) for Groundwater suitability for domestic and irrigation purposes to be examined by WHO and BIS standards. Thus, the main objective of this study is to evaluate the water quality index of groundwater especially in and around Karaikal region where groundwater is used for drinking and domestic purposes.*

**Keywords:** Analysis, BIS, Physio - chemical parameters

## I. INTRODUCTION

One of the most important inputs of intensive agriculture is water. The cropping pattern of Karaikal is Rice and it is mainly based on the water availability from the river Cauvery and monsoon rains. The suitability of the community bore wells are to be analyzed for sustainable cropping program in this region. Hence, the underground water quality of in and around Karaikal region where most of the agricultural activity is undertaken is analyzed to test its suitability for irrigation. The chemical character of any groundwater determines its quality and utilization. The sources for groundwater supply mostly depend upon the rainfall and the resulting percolation of the water into the earth. Another important factor is quality of the soil. A total of twenty ground water samples were analyzed for pH, electrical conductivity (EC), Total Hardness (TH), Total Dissolved Solids (TDS), Calcium (Ca), Nitrate, Chloride, Sulphate. The quality of ground water was interpreted in terms of Water Quality Index (WQI).

## II. STUDY AREA

About 150km further south from Puducherry on the east coast lies the Karaikal region between 10°49' and 11°01' N latitudes and 79°37' and 79°53' E longitudes with an area of 161 sq.km. The town is small with a total of 161 sq. km with marine time climate and located on the Koramandel coast of the Bay of Bengal. The total geographical rural area of the district is 140355-56 hectares; the percentage of cultivable area to total area and percentage of irrigated area to total cultivable area are 84.92 and 82.81 respectively. This shows that Karaikal is predominantly an agricultural area.

## III. DATA ANALYSIS AND INTERPRETATION

### • GIS Mapping

Thematic maps pertaining to pH, EC, TDS, TH, Calcium, Magnesium, Sodium, Potassium, Nitrate, Sulphate and Total Alkalinity were interpolated in 1:50,000 scale from the analyzed data. The physicochemical analysis for the ground water samples were performed during Monsoon and Post-monsoon seasons. The areas in and around karaikal were taken for our study Bore well water samples were collected in twenty various location of Karaikal district. Various field visits are conducted for the collection of primary data. The ground water quality resources have been computed jointly by central ground water board and state and surface water resources data centre (PWD, WRO, Govt. of Tamilnadu).

### • Physical and Chemical Parameters of Water Quality

Bore well water samples taken in the study area are studied in order to establish the quality of the study area. The physical properties of all samples are colorless, odorless and tasteless in Table 1.

Table 1: Methods adopted for chemical analysis of water samples

Sl.No	ANALYSIS	METHODS
1.	pH ( mg/L)	pH meter
2.	EC (millimho)	Conductivity meter
3.	TDS ( mg/L)	Titration
4.	Total Hardness ( mg/L)	Titration
5.	Calcium ( mg/L)	Flame Photometric
6.	Nitrate ( mg/L)	Titration
7.	Chloride ( mg/L)	Mohr's Titration
8.	Sulphate ( mg/L)	Spectrometer

•Water Quality Index

Spectrometer WQI is commonly used for the detection and evaluation of water pollution and may be defined as a reflection of composite influence of different quality parameters on the overall quality of water. The physicochemical indices are based on that value of various physicochemical parameters in a water sample of Table 2. Here attempt has been made to calculate the water quality index of the study area based on the hydro-chemical data.

•WQI calculation

Calculation of WQI was carried out in this work by Horton's method. Th WQI is calculated by using the expression given in equation (1)

$$WQI = \sum q_n W_n / \sum W_n \dots\dots\dots (1)$$

Where,

qn = Quality rating of n<sup>th</sup> water quality parameter.

Wn= Unit weight of n<sup>th</sup> water quality parameter.

•Quality Rating (QN)

The quality rating (qn) is calculated using the expression given in Equation (2).

$$qn = [ ( V_n - Vid) / ( S_n- Vid) ] \times 100 \dots\dots\dots(2)$$

Where,

Vn = Estimated value of n<sup>th</sup> water quality parameter at a given sample location.

Vid = Ideal value for n<sup>th</sup> parameter in pure water. (Vid for pH = 7 and 0 for all other parameters)

Sn = Standard permissible value of n<sup>th</sup> water quality parameter.

•Unit weight

The unit weight (Wn) is calculated using the expression given in Equation (3).

$$W_n = k / S_n \dots\dots\dots(3)$$

Where,

Sn = Standard permissible value of n<sup>th</sup> water quality parameter.

k = Constant of proportionality and it is calculated by using the expression given in Equation (4).

$$k = [1 / (\sum 1/ S_n=1, 2, n)] \dots\dots\dots (4)$$

Table 2: WQI and corresponding water quality status

S. No	WQI	Status	Possible usages
1	0 – 25	Excellent	Drinking, irrigation and industrial
2	26 – 50	Good	Domestic , irrigation and industrial
3	51 – 75	Fair	Irrigation and industrial
4	76 - 100	Poor	Irrigation
6	101 - 150	Very poor	Restricted use for irrigation

•WQI of pre monsoon ground water samples

The WQI values of the pre monsoon samples are summarized in Table 3. Here, 4 samples of the study area are excellent and 12 are good in quality during pre monsoon season in Table 4.

Table 3: WQI values of pre monsoon samples

Sample ID	WQI	Sample D	WQI
1	56.93	11	38.29
2	51.53	12	44.65
3	36.32	13	43.53

4	37.90	14	38.87
5	23.41	15	43.59
6	6.74	16	34.04
7	9.88	17	48.01
8	43.15	18	35.26
9	13.34	19	66.82
10	17.60	20	77.90

Table 4: Water Quality Parameters (Pre Monsoon)

Sl	Well Location Name	PH	EC	TDS	Total Hardne	Calciu m	Sodiu m	Potassiu m	Nitrat e	Chlori de	Sulpha te	Total Alkal
1	Keezhavanjur	7.0	1.6	1040.	68.00	5.20	42.91	0.43	2.20	500.00	8.00	0.00
2	Padidharkollai	7.8	1.1	801.1	54.00	3.20	32.84	0.49	1.40	342.00	13.00	0.00
3	Neravy	6.8	1.5	986.0	389.00	6.12	28.22	0.16	1.20	292.00	42.00	0.00
4	Pettai	6.9	1.6	1040.	262.00	10.10	28.05	2.99	0.00	318.00	22.00	0.00
5	Thennangudy	6.6	1.0	715.0	223.00	68.12	292.4	10.96	2.00	216.00	28.00	0.00
6	Madhur	6.6	0.5	321.0	118.00	12.48	86.49	4.32	1.20	88.00	2.40	0.00
7	V.Kottapadi	6.5	0.4	420.0	191.00	21.26	102.9	2.95	1.10	100.00	3.80	0.00
8	Thenbidagai	6.6	1.0	1015.	346.00	38.10	501.4	4.10	0.80	226.00	39.60	0.00
9	Pandaravadai	6.4	0.8	541.0	230.00	25.24	112.8	9.89	0.00	148.00	18.00	0.00
10	Sethur	6.5	0.7	556.0	260.00	31.81	92.00	4.96	1.80	158.00	27.00	0.00
11	Vadthakudi	6.4	1.6	928.0	241.00	62.44	412.7	17.00	0.00	498.00	96.50	0.00
12	Vadapathi	7.8	0.8	652.0	68.00	30.96	301.9	3.96	1.60	28.64	62.00	0.00
13	Thamanangudy	7.5	0.9	722.5	122.00	0.88	356.2	10.89	1.20	310.00	48.00	0.00
14	Kannappur	6.3	1.2	991.5	391.00	110.25	432.4	5.46	1.30	418.00	102.00	0.00
15	Ambagarathur	7.4	1.0	701.0	79.00	64.92	430.8	7.49	1.10	120.00	26.00	0.00
16	Ambagarathur	6.5	1.4	1000.	316.00	98.86	408.9	210.80	1.00	288.00	44.00	0.00
17	Melassubbarayapur	6.9	1.6	1101.	173.00	98.95	552.7	22.92	0.92	366.00	82.00	0.00
18	Kottucherry	6.8	1.1	864.0	146.00	65.82	419.2	15.50	0.80	246.00	58.00	0.00
19	Vadamattam	7.0	2.0	1321.	217.00	116.95	722.2	22.40	0.40	480.00	68.00	0.00
20	Kottucherry	6.9	2.9	2033.	220.00	126.80	751.4	31.74	0.00	520.00	78.00	0.00

Table 5 Water Quality Parameters (Post Monsoon)

Sl. No	Well Location Name	PH	EC	TDS	Total Hardness	Calcium	Sodium	Potassium	Nitrate	Chloride	Sulphate	Total Alkalinity
1	Keezhavanjur	7.82	1.90	1235.00	72.00	5.60	46.22	0.59	2.40	560.00	12.00	290.00
2	Padidharkollai	8.12	1.31	851.5	60.00	3.86	37.70	0.59	2.00	440.00	15.00	248.00
3	Neravy	6.97	1.74	1131.00	412.00	6.42	34.98	0.40	2.00	360.00	48.00	0.00
4	Pettai	7.03	1.80	1170.00	280.00	11.15	34.50	3.41	0.00	320.00	30.00	0.00
5	Thennangudy	6.77	1.16	754.00	232.00	74.15	310.30	12.30	2.20	264.00	48.00	0.00
6	Madhur	6.71	0.58	377.00	128.00	17.59	92.56	6.18	2.00	96.00	3.00	0.00
7	V.Kottapadi	6.65	0.77	500.50	200.00	28.67	113.82	3.11	2.00	112.00	3.00	0.00
8	Thenbidagai	6.98	1.87	1215.50	360.00	92.90	522.50	4.80	2.00	388.00	45.00	0.00
9	Pandaravadai	6.68	0.90	585.00	232.00	29.32	115.73	11.94	0.00	156.00	27.00	0.00
10	Sethur	6.82	0.92	598.00	268.00	34.97	110.32	6.22	2.40	160.00	39.00	0.00
11	Vadthakudi	6.87	1.76	1144.00	360.00	73.0	431.40	20.50	0.00	404.00	105.00	0.00
12	Vadapathi	7.99	1.06	689.00	80.00	36.70	334.30	4.70	2.00	24.80	78.00	0.00
13	Thamanangudy	7.85	1.19	773.50	136.00	0.00	371.20	12.90	1.80	320.00	60.00	0.00
14	Kannappur	6.75	1.77	1150.50	404.00	119.60	479.30	6.90	1.80	440.00	120.00	0.00
15	Ambagarathur North	7.76	1.16	754.00	84.00	76.80	451.20	9.20	1.80	160.00	30.00	0.00
16	Ambagarathur	6.79	1.60	1040.00	324.00	102.00	433.90	230.00	1.80	328.00	50.00	0.00
17	Melassubbarayapuram	7.17	1.90	1235.00	196.00	97.60	571.60	28.00	1.80	400.00	88.00	0.00
18	Kottucherry (Ayyanar	7.13	1.39	903.50	164.00	72.20	439.50	17.60	1.60	252.00	66.00	0.00
19	Vadamattam	7.40	2.50	1625.00	256.00	124.60	743.30	26.20	1.60	660.00	88.00	0.00
20	Kottucherry	7.22	3.20	2080.00	296.00	134.20	786.40	38.10	0.00	912.00	100.00	0.00

•WQI of Post Monsoon Ground Water Samples

The WQI values of the post monsoon samples are summarized in Table 6 .Here, 10 samples of the study area are excellent and 9 are good in quality during post monsoon season in Table 5.

Table 6: WQI values of post monsoon samples

Sample ID	WQI	Sample ID	WQI
1	33.71	11	26.71
2	41.91	12	37.32
3	28.16	13	31.46
4	3.50	14	20.21
5	19.35	15	34.07
6	3.04	16	24.59
7	0.99	17	37.84
8	15.93	18	24.35
9	8.49	19	47.59

Table 7: WQI of the pre-monsoon and post-monsoon samples

S. No	WQI	Status	Representing pre-monsoon Samples	Representing post-monsoon samples
1	0 - 25	Excellent	6, 7, 9, 10	4,5,6,7,8,9, 10, 4,16,18
2	26 - 50	Good	3,4,5,8,11,12, 13,14, 15,16,17,18	1,2,3,11,12, 13, 15,17,19
3	51 - 75	Fair	1, 2, 19	20
4	75 - 100	Poor	20	-

REFERENCES

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10	7.47	20	65.12

IV. RESULTS AND DISCUSSION

The WQI is commonly used for the detection and evaluation of water pollution and it may be defined as the reflection of composite influence of different parameters on the overall quality of the water. The overall water qualities during pre monsoon and post monsoon seasons with representing samples are analyzed here and presented in Table 7.

The WQI of pre monsoon samples state that 20 % of the total groundwater samples are excellent, 60 % are good , 15 % are fair and 5% are poor quality. The WQI of post monsoon samples state that 50 % of the total groundwater samples are excellent, 45 % are good , 5 % are fair in quality ground water quality is better during post monsoon season than during pre monsoon season.

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