International Journal of Research in Engineering, Science and Management
Volume-2, Issue-4, April-2019
www.ijresm.com | ISSN (Online): 2581-5792

Assessment of Ground Water Quality by using Water Quality Index in Karaikal

T. Senthamizhselvan
Assistant Professor, Dept. of Civil Engg., Bharathiyar College of Engineering and Technology, Karaikal. India

***Abstract*: Groundwater is one of the most important resources for domestic and irrigation use in Karaikal. Groundwater sample was randomly collected from the eighteen bore wells in and around Karaikal during pre-monsoon and post-monsoon. Collected sample were tested for ten physic-chemical parameters such as pH, EC, Turbidity, Alkalinity, Cl, Mg, Na, TDS, Hardness and SO4. Water Quality Index was calculated by using seven parameters for PRM and POM, to assess the quality of groundwater. Seawater intrusion causes major effect in groundwater quality. Seawater Mixing Index was calculated to assess the effect of seawater intrusion in the study area. Analyzed parameters were feed into MS Excel and the results were presented in the form of tables and graphs.**

***Keywords*: Groundwater, pre-monsoon, post-monsoon, physic-chemical parameter, water quality index, seawater mixing index.**

1. Introduction

In India nowadays groundwater is the major source for all our day by day activity. Due to over exploitation of groundwater, the water table drawn down and sea water intrusion is major problem in sea shore areas. Karaikal is situated in tail end of Arasalar basin.

2. Study area

Karaikal district is situated in Puducherry U.T. Its total area is 160 km square. It has a population of 200222 as per the 2011 censes. The location of the town is 11° 23' N latitude and 79° 73' E longitude. Famous holly places such as Thirunallar temple, Vellankanni church and Nagour Dharka are located around Karaikal.

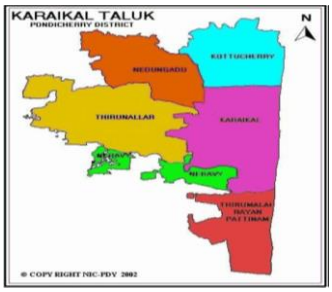

Fig. 1. Karaikal, Puducherry U.T

3. Methodology

The main focus of the study is to analysis the ground water and assesses the ground water quality by using WQI and SMI.

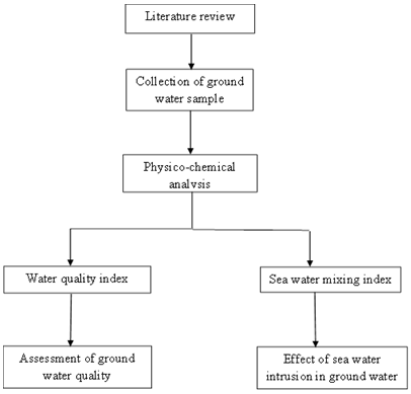

Fig. 2. Methodology

4. Material and methods

In this study 18 water samples were collected in a 1000ml plastic bottle from bore wells randomly around the study area PRM (Pre-monsoon) August 2018 and POM (Post-monsoon) March 2019.

A. Physico-chemical parameters

Thirteen physic-chemical parameters such as pH, turbidity, alkalinity, electrical conductivity, chloride, TDS, sodium, magnesium, sulphate were analyzed by using standard procedure of APHA for pre-monsoon and post-monsoon. Analyzed parameters are compared with BIS 10500:2012.

B. Water quality index

Water quality index is used to quantitate the overall quality of water. It is calculated from the equation.

$$\frac{(Wi)i}{\sum(Wi)i}, \quad \sum Wi = 1$$

The value for the parameter have been divided into four stages viz, normal, slight, stress and famine for which quality rating (qi) ranges from 100 to 0. Average values of hysic-chemical parameter to assign WQI value for different sample have been used in the present study depicted. The sub index (SI) has been calculated for each parameter by applying multiplication of weight value and the rating scale of individual and therefore the formula of WQI is

WQI=$\sum(SI)i \div \sum Wi$

So WQI = $\sum(qi\ wi)$ as w_i=1

Table 1
Details of groundwater sample

Sample No.	Latitude & Longitude	Village
A1	10.594N, 79.494E	POOVAM
A2	10.591N, 79.4924E	VARICHEKUDY
A3	10.585N, 79.501E	THIRUVATTAKUDI
A4	10.575N, 79.493E	KOTTUCHERRY
B1	10.9733N, 79.774E	VADANATTAM
B2	10.5827N, 79.416E	NEDUNGADU
B3	10.5850N, 79.461E	KULUMBAGARAM
C1	10.4672N, 79.434E	AMBAGATHUR
C2	10.5827N, 79.416E	SETHUR
C3	10.5850N, 79.461E	THIRUNALAR
D1	10.934N, 79.831E	KOVILPATHU
D2	10.897N, 79.838E	AKKARAVATTAM
D3	10.915N, 79.83E	PUTHUTHURAI
E1	10.331N, 79.485E	NERAVY
E2	10.541N, 79.468	VIZHIDUR
F1	10.515N, 79.501E	KILAIYUR
F2	10.862N, 79.824E	POLOGAM
F3	10.865N, 79.833E	VANJOOR

C. Seawater mixing index

The concentrations of Na+, Mg+, cl, SO42 were used to calculate the sea water mixing index. It had been calculate using the following equation.

Where , constants a, b, c, and d denotes a relative proportion of Na+, Mg+, Cl-SO4- respectively, there values are (a=0.31, b=0.04, c=0.57, d=0.08), T is the regional threshold value and C is the calculated concentration of groundwater sample.

$$SMI = a\times\frac{Cna}{Tna} + b\times\frac{Cmg}{Tma} + c\times\frac{Ccl}{Tcl} + d\times\frac{Cso4}{Tso4}$$

5. Results and Discussion

Water Quality Index has been computed to assess the suitability of groundwater of seven different parameters for drinking purposes in and around Karaikal region.

Table 2
Physicochemical parameter of sample for PRM

Sample	PH	Turbidity	TDS	Hd.	Cl	EC	Alk.
A1	7.03	12.3	2720	430	72.6	2.2	14
A2	7.17	11.9	160	290	5.2	1.02	9
A3	7.1	13.2	3480	160	0	0.63	18
A4	6.85	16.3	1960	140	0	0.38	10
B1	7.57	11.9	520	70	6.7	1.25	18
B2	8.21	11.6	440	210	11.0	1.15	15
B3	8.07	11.2	260	70	15.2	0.99	16
C1	7.28	12.3	520	255	25.2	2.19	32
C2	7.25	8.6	810	260	5.9	1.16	19
C3	7.35	9	1680	170	5.9	1.78	21
D1	7.37	16	890	140	6.7	1.64	24
D2	7.27	17.2	6870	995	180.6	5.8	22
D3	8.16	14.2	530	80	6.6	1.42	16
E1	7	11	12290	390	35.6	1.59	19
E2	8.13	14.2	790	625	6.7	1.2	21
F1	7.3	10.3	910	290	6.7	1.22	24
F2	8.26	13.9	550	180	26.9	1.72	21
F3	7.61	14.4	1080	35	6.7	1.23	28

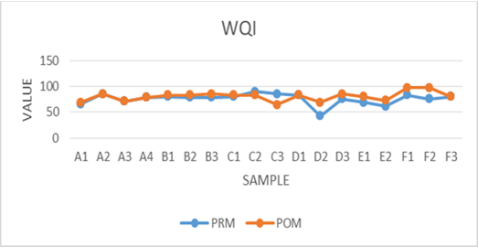

Fig. 3. Variation of WQI for PRM and POM

The value of WQI in PRM for eighteen samples is given in table 5. The results observed that the maximum and minimum value of WQI has been found to be 90 and 42.85 delineated as C2 and D2 respectively. The present study is observed that nearly nine samples are having poor status. None of them fallen under excellent category as highlighted in table 6.

In POM the value of WQI for eighteen samples are slightly increasing. Number of samples reduced from four to two in very poor status. Two samples F1 and F2 fallen under excellent category.

Table 3
Physicochemical parameter of sample for POM

Sample	pH	Tur.	TDS	H	Cl	EC	Alk.	SO_4	Mg	Na
A1	6.6	11.8	2620	385	64.9	1.96	11	195	187	183
A2	6.24	11.6	140	250	4.9	0.93	7	250	264	283
A3	6.2	12.5	3400	150	0	0.54	15	200	156	133
A4	5.9	15.5	1840	120	0	0.33	7	14	165	150
B1	7.64	11.3	480	40	5.9	1.14	16	154	173	200
B2	7.52	11.1	400	195	9.9	1.09	11	218	235	250
B3	7.34	10.9	200	45	14.9	0.92	10	23	275	300
C1	6.56	11.7	460	240	24.9	2.11	29	250	253	266
C2	6.74	7.8	780	255	4.9	1.06	15	250	312	350
C3	6.58	8.3	1660	155	4.9	1.64	19	259	288	333
D1	6.36	15	860	125	5.9	1.46	20	250	271	283
D2	6.54	16.7	6800	980	174.9	5.2	17	259	343	400
D3	7.46	13.1	480	65	5.9	1.24	12	250	334	383
E1	6.35	9	12240	375	34.9	1.52	16	294	412	500
E2	7.6	13.6	720	600	5.9	1.14	17	422	483	466
F1	6.56	9	840	260	5.9	1.16	20	250	398	416
F2	6.98	13.6	480	160	24.9	1.64	17	254	432	466
F3	7.84	13.7	1000	20	5.9	1.16	23	245	381	400

Table 4
Quality rating scale for water quality parameters (qi)

S. No.	Degree of pollution Rating(q_i)	Normal (100)	Slight (80)	Stress (50)	Famine (0)
1	Ph	6.5 – 7.5	7.51 – 8.0	8.01 – 8.5	>8.5
2	Turbidity	0 – 5.0	5.1 – 7.5	7.5 – 10.0	>10
3	TDS	0 – 500	501 – 1250	1251 – 2000	>2000
4	Hardness	0 – 300	301 – 450	451 – 600	>600
5	Ec	0 – 2	2 – 4	4 – 5	>5
6	Chloride	0 – 250	251 – 600	601 – 1000	>1000
7	Alkalinity	0-200	201 – 400	401 – 600	>600

Sea water mixing index was used to determine the ill effect of sea water intrusion into groundwater. By using cl, Mg, So4, and Na, SMI was calculated. The SMI of the groundwater is calculated for POM and the values are given in the table 7. All the eighteen samples are fallen under the category of "pure".

Table 5
Water Quality Index for PRM and POM

Sample No.	WQI PRM	WQI POM
A1	65.71	68.57
A2	85.71	85.71
A3	71.42	71.42
A4	78.57	78.51
B1	80	82.85
B2	78.57	82.857
B3	78.57	85.714
C1	80	82.857
C2	90	82.857
C3	85.71	64.285
D1	82.85	82.857
D2	42.85	68.571
D3	75.71	85.714
E1	68.57	80
E2	61.42	72.85
F1	82.85	97.14
F2	75.71	97.14
F3	80	80

Table 6
Status of WQI in PRM

WQI	Status	Sampling source number under the status	Number of sample
0-70	Very poor	A1,D2,E1,E2	Four
71-80	Poor	A3,A4,B1,B2,B3,C1,D3,F2,F3	Nine
81-90	Good	A2,C2,C3,D1,F1	Five
>90	Excellent	None	None

Table 7
Status of WQI in POM

WQI	Status	Sampling source number under the status	Number of sample
0-70	Very poor	A1,D2	Two
71-80	Poor	A3,A4,E1,E2,F3,B1	Six
81-90	Good	A2,B2,B3,C1,C2,C3,D1,D3	Eight
>90	Excellent	F1,F2	Two

6. Conclusion

Groundwater samples were collected from eighteen different locations in Karaikal during Pre-monsoon and Post-monsoon. Ten parameters were analyzed and compared with BIS105000-2012 and also each parameters were compared between PRM and POM. Seven physic-chemical parameters such as pH, turidity, EC, Alkalinity, Cl, TDS and hardness were used to calculate the WQI during PRM and POM and the results were compared.

Table 8
Status of SMI in POM

Sample	SMI	Nature of water	Depth of water (Ft)
A1	0.385	PURE	25
A2	0.273	PURE	30
A3	0.139	PURE	28-30
A4	0.139	PURE	28
B1	0.193	PURE	1000-1200
B2	0.238	PURE	1700
B3	0.306	PURE	1000
C1	0.318	PURE	30
C2	0.319	PURE	35
C3	0.308	PURE	35
D1	0.275	PURE	30
D2	0.852	PURE	1500
D3	0.348	PURE	1200
E1	0.523	PURE	20
E2	0.447	PURE	1000
F1	0.406	PURE	20
F2	0.431	PURE	30
F3	0.359	PURE	1200-1500

Four parameters such as Na, Cl, Mg and SO4 were used to calculate the SMI in POM. The result shows that all the samples were within the limit. The study revealed the current stats of groundwater quality in Karaikal. From the above discussion it is clear that quality of groundwater is slightly better in POM when compared to PRM. WQI also concluded the same result. The samples were collected from the deep bore wells. The SMI result shows that all samples are in the "pure" state. So we concluded that there is no seawater intrusion into groundwater in that depth at which the samples were collected.

References

[1] Durgadevagi S, Annadurai. R and Mohan Meenu., Spatial and Temporal Mapping of Groundwater Quality using GIS based Water Quality Index (A Case Study of SIPCOT-Perundurai, Erode, TamilNadu, India, Indian Journal of Science and Technology, 2016, Vol 9.

[2] Francis Andrade, H. B. Aravinda and E. T. Puttaiah., Studies on Mangalore coastal water pollution and its sources, Indian Journal of Science and Technology, 2011, Vol. 4, No. 5.

[3] Funda Dökmen., Salinity and Seawater Intrusion into the Ground Water, Indian Journal of Science and Technology, 2012, Vol. 5.

[4] Kayode Olusola.T, Aizebeokhai Azegbobor.P, Adewoyin Olusegun. O, Joel Emmanuel. J and Omeje Maxwell., Geochemical Analysis of Domestic Groundwater Sources in a Suburb of Ota, Southwestern Nigeria, Indian Journal of Science and Technology, 2016, Vol 9.

[5] Lathaamani R, Janardhana. M.R, Suresha. S, Application of Water Quality Index Method to Access Groundwater Quality in Mysore city, Karnataka, India, International Conference on Innovations & Advances in Science, Engineering and Technology, 2014, Volume 3.

[6] Padmini. T. K and Parameswari. K, Spatial Variation of Groundwater Quality from Porur to Poonamallee: A Case Study in Tamil Nadu, India. Indian Journal of Science and Technology, 2015, Vol 8.
[7] Pavithra. B, Renganathan. M, Assessment of Sea Water Intrusion in Muthupettai Block, IRA-International Journal of Technology and Engineering, 2016, Vol.3.
[8] Saravana Kumar. K. B and Ranjith Kumar., Analysis of water quality parameters of groundwater near Ambattur industrial area, Tamilnadu, India, Indian Journal of Science and Technology, 2011, Vol. 4 No. 5.
[9] Sudarshan. M. R, Jayapradha. A, Lavanya and Joshua Amarnath.D., Evaluation of Groundwater Quality at Oragadam – A GIS Approach, Indian Journal of Science and Technology, 2016, Vol 9.
[10] Sunita Kumari, Jyoti Rani, Assessment of Water Quality Index of Ground Water in Smalkhan, Haryana, International Journal of Latest Research in Science and Technology, 2014, Volume 3.
[11] Sundara Kumar. K, Satish Kumar.CH, Hari Prrasad. K, Rajesh. R, Sivaram Prasad. R Venkatesh. T, Assessment of Ground Water Quality Using Water Quality Index, International Journal of Innovative Research in Advanced Engineering, Vol 2., 2015.