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Study on ground water quality and its suitability or drinking purpose in Alathur block - Perambalur district

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ABSTRACT

The study was conducted over ten villages in Perambalur district, Tamilnadu. It covers more than 60 sq.km, assessing the suitability of ground water quality for drinking purpose through water quality index investigation of the different bore wells. This was done by subjecting the ten bore well waters in the fertile area. For calculating WQI, ten parameters such as pH, TDS, EC, TH, Total alkalinity, Sulphate, Chloride, Nitrate, Calcium and Magnesium have been considered. The study spread over three seasons namely pre monsoon, monsoon and post monsoon.

Key words: Ground water, Perambalur, Water quality index.

INTRODUCTION

Owing to rapid urbanization, growing population and speedy industrialization have lead to the pressure on demand for water. Ground water is used for domestic, industrial and irrigational purposes all over the world. In the last few decades there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization [1]. Water is an universal solvent and it dissolves the minerals from rocks in which it is stored and then chemical and physical attributes of ground water depend on geology of particular area, rapid urbanization especially in developing countries like India has affected the availability and quality of ground water [2]. The quality of ground water may also vary with depth of water table, seasonal changes and composition of dissolved salts depending upon sources of the salt and sub surface environment [3].

Intensively irrigated agricultural discharges into the ground water bring about considerable change in the ground water quality [4]. These anthropogenic activities contaminated the quality[5]. The socioeconomic growth of a region is severely affected by unavailability of safe drinking water [6].

Assessment of ground water quality and its suitability for drinking is the objective of the present study by comparing the results against drinking water quality standards laid down by world Health organization and Indian council of medical research (I.C.M.R). The suitability of ground water for domestic use has been based on WQI. This was derived by weightage arithmetic method. It is one of the most effective ways to communicate information on water quality trends to policy makers to shape strong public policy and implement the water quality programs[7].

Study area

The study area is Alathur Block of Perambalur District of Tamilnadu. Most of the People in this area depend upon agricultural activity. In some places mining activity is also going on. Nowadays industrialization is also taking place in and around the study area.

MATERIALS AND METHODS

Ten water samples in three different seasons collected in poly ethelyene bottles from various bore wells covering the study area. Utmost care was taken during the collection of samples to avoid any kind of contamination. Volumetri and instrumental techniques were adopted for systematic analysis of the water samples using Standard procedures [8-12]. The analysis was carried out immediately for pH, EC and for all other parameters within three hours of sampling time.

Water quality index

Water quality Index (WQI) is defined as a technique of rating that provides the composite influence of individual water quality parameters on the overall quality of water. It reduces the large amount of water quality data to a single numerical value. It is calculated from the point of view of human consumption. Water quality and its suitability for drinking purpose have been considered for calculation of WQI [13]. In this method the weightage for various water quality parameters is assigned to be inversely proportional to the recommended standards for the corresponding parameters [14].

Calculation of Water Quality Index

Water quality index [WQI] = QiWi
Where, Qi is water quality rating
Qi = 100*[Va-Vi]/[Vs-Vi]
Va = Actual value of the parameters present in water sample
Vs = Standard value
Vi = ideal value
Wi = K/Sn , Where Wi = Unit weightage
K[constant] = 1/[(1/S1) + (1/S2) + (1/S3) + ….. + (1/Sn)]

$$WQI = \sum_{i=1}^{n}(QiWi)/ \sum_{i=1}^{n} Wi$$

Table 1 : Sampling location along with their Latitude and Longitude

Code	LOCATIONS	LATITUDE	LONGITUDE
S1	PADALUR	11° 5'43.86"N	78°49'44.04"E
S2	IRUR	11° 7'46.25"N	78°49'52.27"E
S3	NATTARMANGALAM	11° 8'24.28"N	78°47'52.84"E
S4	CHETTIKULAM	11° 8'9.28"N	78°46'28.16"E
S5	KARAI	11° 7'54.23"N	78°52'23.79"E
S6	KOLAKANATHAM	11° 7'9.76"N	78°57'7.77"E
S7	SIRUGANBUR	11° 9'37.74"N	78°55'42.15"E
S8	VARAGUPADI	11° 9'25.39"N	78°54'5.55"E
S9	NARANAMANGALAM	11° 8'58.30"N	78°51'57.23"E
S10	THERANI	11° 6'12.61"N	78°52'3.01"E

Table 2 : Water quality scale with reference to WQI

WQI	Quality of water
0-24	EXCELLENT
25-49	GOOD
50-74	POOR
75-100	VERY POOR
>100	UNFIT FOR DRINKING

Table 3 : Unit Weightage of parameters based on WHO International standards for drinking water. All values are in mg/L, expect pH and EC.

Parameters	Standard Value, Vs	Ideal Value, Vi	Assigned Weightage factor, Wi
pH	8.5	7.0	0.024
EC	1400	0	0.000
TDS	500	0	0.000
T.H	300	0	0.001
Cl	250	0	0.001
NO_3	45	0	0.004
SO_4	200	0	0.001
T.Alk	120	0	0.002
Mg	30	0	0.007
Ca	75	0	0.003

Table 4 : Physico- chemical characteristics and WQI of ground water-Pre Monsoon season

Code	Place	pH	EC	TDS	TH	Cl	NO_3	SO_4	T.Al.	Mg	Ca	WQI
S1	PADALUR	7.84	1343	940	498	158	7	180	239	61	97	91.45
S2	IRUR	7.3	1824	1277	398	222	21	18	318	44	86	65.83
S3	NATTARMANGALAM	7.2	1679	1176	478	253	16	139	299	59	92	70.96
S4	CHETTIKULAM	7.2	1078	1176	295	97	10	103	275	35	60	49.93
S5	KARAI	7.3	1593	1115	498	232	13	67	414	58	102	76.70
S6	KOLAKANATHAM	7.6	1801	1260	259	202	18	365	330	33	48	72.25
S7	SIRUGANBUR	7.1	5110	3577	697	838	38	976	553	81	144	124.23
S8	VARAGUPADI	7.1	1904	1333	418	253	24	156	358	47	88	65.25
S9	NARANAMANGALAM	7.6	1687	1181	259	192	21	142	394	28	56	69.21
S10	THERANI	6.9	1978	1385	587	323	24	139	386	69	120	74.02

Table 5 : Physico-chemical characteristics and WQI of ground-Monsoon season

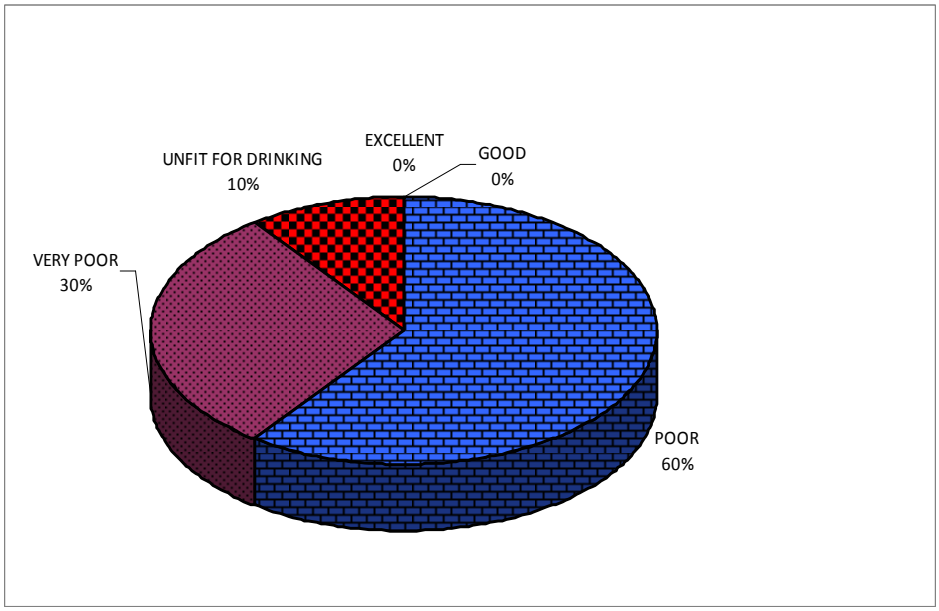
Code	Place	pH	EC	TDS	TH	Cl	NO_3	SO_4	T.Al.	Mg	Ca	WQI
S1	PADALUR	8.13	972	680	223	97	14	49	251	24	49	75.77
S2	IRUR	7.68	1914	1340	430	311	19	126	394	53	83	89.37
S3	NATTARMANGALAM	8.05	1214	849	398	125	9	64	390	45	84	92.25
S4	CHETTIKULAM	7.65	1277	894	302	125	13	68	430	39	56	73.74
S5	KARAI	8.07	1224	856	267	73	16	26	470	30	57	85.40
S6	KOLAKANATHAM	8.19	1513	1059	195	178	7	179	267	22	41	79.02
S7	SIRUGANBUR	7.78	4874	3412	597	959	29	494	728	67	127	136.61
S8	VARAGUPADI	7.9	1952	1366	406	230	22	96	470	46	86	96.23
S9	NARANAMANGALAM	7.43	1905	1333	287	246	15	53	462	32	60	65.83
S10	THERANI	7.58	1817	1272	366	315	20	47	426	42	76	78.71

Table 6 : Physico-chemical characteristics and WQI of ground-Post Monsoon season

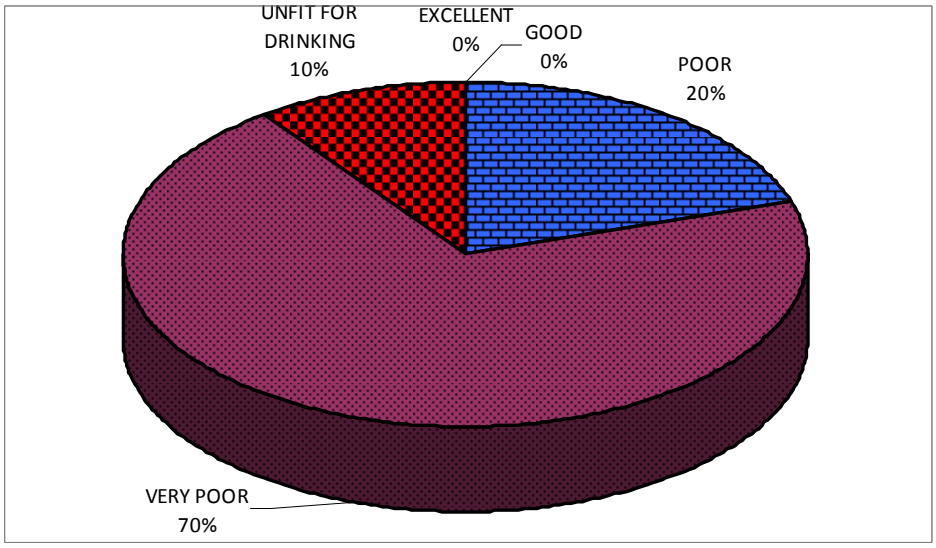
Code	Place	pH	EC	TDS	T.H.	Cl	NO_3	SO_4	T.Al.	Mg	Ca	WQI
S1	PADALUR	7.22	1247	873	466	154	14	71	313	54	97	66.51
S2	IRUR	7.38	1964	1375	346	319	20	140	341	39	73	68.34
S3	NATTARMANGALAM	7.36	1534	1074	573	145	10	88	444	67	117	85.19
S4	CHETTIKULAM	7.42	1170	819	410	141	14	94	309	46	87	68.55
S5	KARAI	7.24	1388	971	426	113	17	64	432	54	81	70.26
S6	KOLAKANATHAM	7.14	1907	1335	310	315	20	53	432	31	73	56.41
S7	SIRUGANBUR	7.11	4995	3497	2687	960	29	519	539	303	570	279.53
S8	VARAGUPADI	7.3	1380	966	322	85	9	50	487	37	68	61.33
S9	NARANAMANGALAM	7.79	1709	1196	334	238	16	91	372	38	70	80.87
S10	THERANI	7.21	1856	1300	151	255	23	140	380	17	32	47.08

RESULTS AND DISCUSSION

The Physico-Chemical Parameters with their WHO Standards/ ICMR standards, ideal value and assigned weightage factors, Wi are listed in the table 3. A location wise calculated value of WQI for the pre monsoon period, monsoon period and post monsoon period is presented in the following tables 4,5 and 6 respectively. pH of all locations in three seasons falls within the permissible limit of standards.



Water Quality Index for Pre monsoon



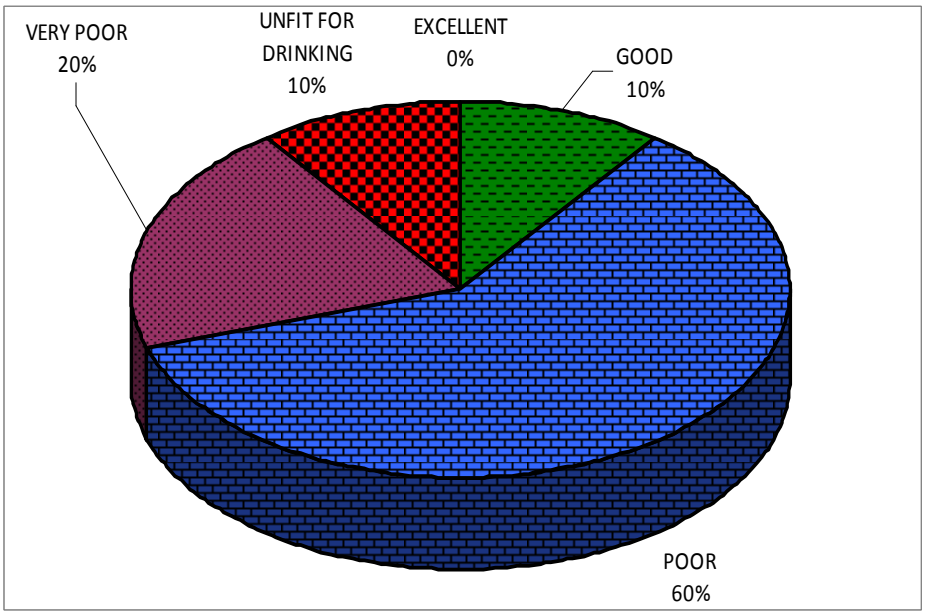
Water Quality Index for Monsoon

Electrical conductivity of all stations falls within the desirable limits of standards except Siruganbur during all the three seasons. Electrical conductivity depends on the function of dissolved mineral matter content. If the TDS is high then EC will be high [15].

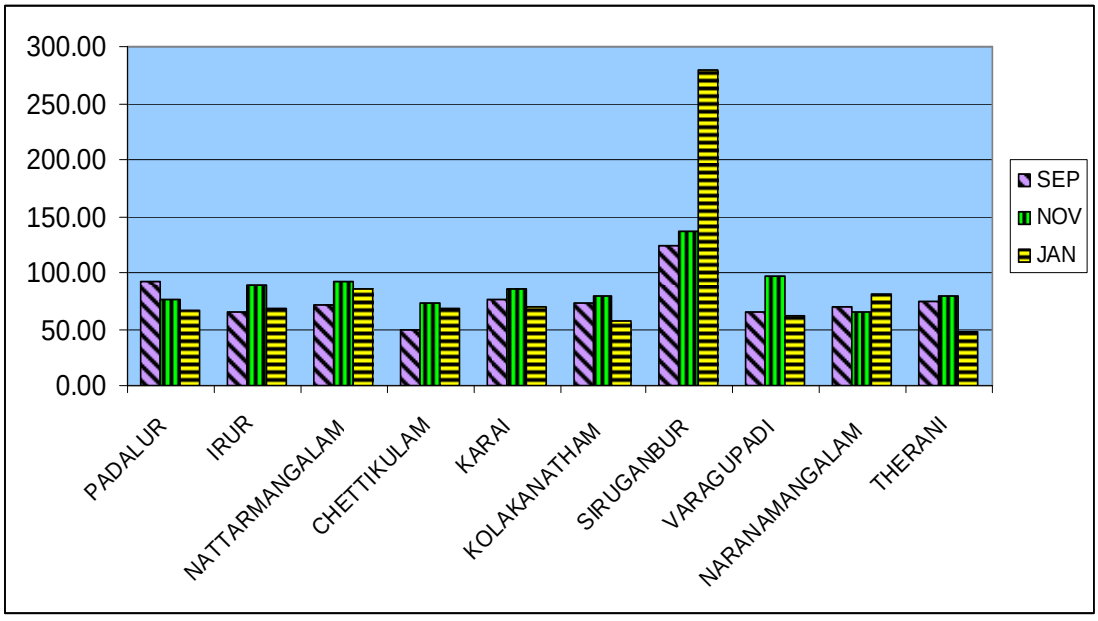
The range of total dissolved solid is from 940 to 3577 mg/L during pre monsoon, it is 680 to 3412 mg/L in the monsoon season and 819 to 3497 mg/L. This shows that almost all the stations fall above the standard level this shows that anthropogenic impact which can be due to agricultural activity leading to local spatial and temporal variability of runoff [16].

The determined total hardness in all stations is from 259 to 697 mg/L during pre monsoon, 195 to 597 mg/L in monsoon season and post monsoon season shows that 151 to 2687 mg/L. The hardness of the many of the stations in

all three seasons was shown well above the standard level. The hardness in the water is due to dissolved minerals from sedimentary rocks seepage and runoff [17]. Detergents and soaps also aggravate the situations.



Water Quality Index for Post monsoon



Comparison of Water Quality Index for Three Seasons

The range of alkalinity in the sampling stations is from 239 to 553 mg/L in pre monsoon season, it ranges from 251 to 728 mg/L during monsoon season and post monsoon season is from 309 to 539 mg/L. The hydroxide, carbonates and bicarbonate probably released from limestone sedimentary rocks, carbonate rich soils, cleaning agents contributes to the alkalinity [18].

The chloride value is from 97 to 838 mg/L in pre monsoon season, 73 to 959 mg/L during monsoon season and 85 to 960 mg/L in post monsoon season. Excess of chloride is due to anthropogenic activity like septic tanks effluents,

usage of bleaching agents by people nearby bore well [19]. In Present study the determined sulphate values in all sampling stations is from 18 to 976 mg/L in pre monsoon season, in monsoon season it range is from 26 to 494 mg/L and post monsoon season ranges from 50 to 519 mg/L. In most of the stations sulphate value exceeds the standard value in all the three seasons. Domestic and agricultural seepage responsible for the higher level of sulphate in the ground water [20].

The values of nitrates in the study stations were well within the desirable limit of 45 mg/L. If the nitrates are higher concentration than 45 mg/L will cause a disease called blue baby disease or methaemoglobinaemia in infants [21].

Calcium in the sampling station range from 56 to 144 mg/L during pre monsoon season 41 to 127 mg/L during monsoon and 32 to 570 mg/L. In most of the stations it falls above the standards of 75 mg/L. The higher value is mainly attributed due to the abundant availability of lime stone in the area. Consequently more solubility of calcium ions is present [22]. Magnisum in the sampling stations ranges from 28 to 81 mg/L in the pre monsoon season, 22 to 67 mg/L in monsoon season and 17 to 303 mg/L in post monsoon season. In most of the sampling stations magnesium falls above the standard desirable limit in all three seasons. The concentration of magnesium may be due the dissolution of magnesium calcite, gypsum and dolomite [23-24].

All the major parameters in all the three seasons were in excesses of the desirable limit given by WHO / ICMR standards, so that WQI value of all stations falls in poor and very poor quality range as shown in the figure 1,2 and 3. Further the comparative of Water Quality Index value is shown in the figure 4 by the Bar chart.

CONCLUSION

The above observations in the present study indicate the higher values of most of the parameters of the samples. They minimize the suitability of drinking purpose without treatment. When WQI is greater than 100, it implies that the pollutants are above the standard limits. Similarly 0 < WQI> 100 reflects in unsuitability for human use. The one station like Siruganbur has WQI greater than 100 in all three seasons and shows the nature of unsuitability of water quality for drinking and domestic purpose.

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