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Analysis of ground water quality based on WQI and SAR in and around Salem district, Tamil Nadu, India

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ABSTRACT
Ground water quality was evaluated using the physico-chemical parameters in the city and rural locations of Salem district, Tamil Nadu, India after North-East monsoon. Water samples were collected from city and rural locations of Salem district. In this study, different parameters like pH, EC, TDS, alkalinity, hardness, dissolve oxygen, chloride, sulphate, BOD were analysed. The water quality index is greater than 100. The analysis showed that the quality of the groundwater is not suitable for drinking purpose, but suitable for irrigation purposes.
Key words: Water quality index,SAR , Seasonal variation, Groundwater

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INTRODUCTION

Water plays vital role for human life**.** Ground water has an essential role in human life. The consequences of urbanization and industrialization lead to ruin the water for agricultural purposes. Ground water is explored in rural especially in those areas where other sources of water like dam and river or a canal is not considerable [1]. During last decade, this is observed that ground water get polluted drastically because of increased human activities. According to an estimate about 70% of all the available water in our country is polluted due to the discharge of effluents from the industries, domestic waste, land and agricultural [2].

A polluted environment has a detrimental effect on the health of people, animal life and vegetation [3] Consequently number of cases of water borne diseases has been seen which a cause of health hazards [4]. The quality of water is of vital concern for the mankind since it is directly linked with human welfare. It is a matter of history that facial pollution of drinking water caused water-borne diseases which wiped out entire population of the studied. Water quality assessment is essential for pollution control and protection of surface and ground waters. Hence, there is a need for proper planning, development and management of the greatest assets of the country like water [5]

There are different ways for accessing water quality, one of which is the Water quality Index [6]. WQI is an efficient tool on communicating the overall quality of water [7]. The present study was aimed to obtain a decision support system for the study area by integrating WQI and ArcGIS. [8], [9], [10] WQI implies that the water under consideration is fit for human consumption if its WQI is less than 100 and is unfit for drinking without treatment if its WQI is greater than or equal to 100 [11]. Water quality index is a very useful tool for communicating the information on overall quality of water [12]. So in the present study WQI was used to assess the quality of groundwater in Salem district.

The objective of the present work is an attempt to measure the groundwater water quality and to know the suitability of ground water as a potable water at fifteen city locations such as New bus stand, Ammapet, Kannakurichi, Old bus stand, Ponnamapet, Hasthampatty, Ramakrishna road, Four road, Gorimedu and Korangusavadi and at ten rural locations such as Puthu road, Poosaripatty, Nalikalpatty, Theivettipatty, Pottaneri, Muthunaikanpatti, Mettupatty,Deviyakurichi, Kattukottai and Panchukalipatty of Salem district, Tamil Nadu, India.

STUDY AREA

Salem district lies in the western part of Tamil Nadu, located between 11°15'-12°00' north latitudes and 77°35'78°50' east longitudes. The total geographical area is about 5207 sq.km out of which the Stanley reservoir covers an area of about 164.5 sq.km. The study area is bounded by the districts Dharmapuri in the north, Namakkal in the south, Erode in the west and South Arcot in the east.

The district has a maximum and minimum temperature of 40°C and 13°C. The rivers Cauvery, Vashista Nadhi, Swedha Nadhi, Sarabhanga Nadhi and Thirumanimuthar flow in the district. The topography of this district is hilly terrain with undulating plain terrain. The western, central and southern parts of the district is covered by undulated plains, and eastern and northern parts with hills. Important hills in the district are Shevaroys, Kalrayan, Pachamalai, Palamalai and Chitteri hills. The highest peak of this district is Solaikarudu in Shevaroys hills. The mean sea level of this place is 1649m.

The climatic condition of this district has been sub-tropical with a moderate humidity and temperature. The district experiences hot climate from March to June but it would be pleasant from November to February. The district receives rainfall from both northeast and southwest monsoon. The maximum rainfall was received from northeast monsoon (October-December). The average annual rainfall of the district is 979.65mm.

Figure 1. Location of study area

Table: 1 The ground water samples were collected from the Salem district during the month of October 2020–April 2021

S.No	Sampling Stations	S.No	Sampling Stations	S.No	Sampling Stations
S1	Kannakurichi	S11	Omalur	S21	Muthunaikanpatti
S2	Ponnamapet	S12	Taramangalam	S22	Mettupatty
S3	New bus stand	S13	Attayampatti	S23	Panchukalipatty
S4	Ammapet	S14	Kottamettupatti		
S5	Old bus stand	S15	Salem junction		
S6	Hasthampatty	S16	Puthu road		
S7	Ramakrishna road,	S17	Poosaripatty		
S8	Four road	S18	Nalikalpatty		
S9	Gorimedu	S19	Theivettipatty		
S10	Korangusavadi	S20	Pottaneri		

MATERIAL AND METHODS

Twenty-three samples were collected in the study area spread over Salem districts of Tamilnadu. The parameters analysis for the groundwater samples were performed during Rainy, winter and summer seasons. Analysis of physicochemical parameters such as pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Hardness (TH), Carbonate (CO3), Bicarbonate (HCO3), Chloride (Cl), Fluoride (F), Nitrate (NO3), Phosphate (PO4), Sulphate (SO4), Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were carried out to assess the groundwater quality.

Sample Collection

The samples were collected in polyethylene bottles (2.0 litres capacity) which have been thoroughly washed, filled with distilled water and then taken to the sampling site. The bottles were emptied and rinsed several times with the water to be collected. Also, the sample bottles were partially filled with the collected water and vigorously shaken to note the odour. The sample bottles were tightly covered immediately after collection and the temperature taken. They were then stored in a refrigerator at $4^{o}C$ to slow down bacterial and chemical reaction rates. All the parameters were analyzed using standard procedure of APHA [13].

RESULT AND DISCUSSION

Table: 2 Mean values of Physico-Chemical and Heavy metal concentrations of groundwatercol0lected in the Rainy Season (November 2020)

S no	pH	EC	TDS	DO	BOD	COD	SO4	CO3	HCO3	NO3	PO4	TH	Ca	M g	Na	K	Cl	F
1	8	1003	665	10	8	41	602	ND	239	32	0.22	500	297.3	181.3	153.7	160	707	1.96
2	8.2	1373	866	10	9	44	591	ND	331	33	0.18	567	208.3	151.7	141.7	153	856	1.83
3	8	1536	881	10	6	39	592	ND	150	42	0.18	502	214.7	165.7	145	163	193	1.93
4	8.3	1926	772	9	10	48	608	ND	168	37	0.19	507	201	176.7	134	153	137	2.8
5	8.7	1096	626	9	9	41	616	ND	305	40	0.17	484	215	157	146.3	130	157	1.81
6	8.4	1456	617	6	12	38	571	ND	307	41	0.19	485	193.7	165	133.7	153	115	1.65
7	8.4	1580	826	6	6	45	581	ND	205	43	0.2	485	189.3	160	151	170	476	1.82
8	8.1	1353	663	9	8	46	612	ND	457	41	0.21	486	191.3	154	150	157	167	1.62
9	8.3	1073	816	9	8	32	595	ND	372	46	0.18	489	203	153	134.3	150	308	2.4
10	8.1	1100	617	7	10	33	616	ND	353	57	0.2	534	202.3	169.3	161.7	147	213	1.97
11	6.6	1573	770	9	8	42	586	ND	329	44	0.19	519	202.7	166.3	152	158	226	1.5
12	8	924	762	8	10	38	600	ND	246	49	0.19	480	202.7	157	135	130	168	2.4
13	8.7	1640	894	8	15	45	591	ND	646	32	0.23	486	207	149	148.7	133	213	1.75
14	8.3	1216	693	6	9	45	610	ND	302	38	0.8	487	189	151.7	162	153	406	1.39
15	7.9	1496	603	8	10	39	573	ND	435	42	0.24	457	198.7	150.7	135.7	150	115	2.32
16	8	1603	839	8	9	41	597	ND	896	49	0.18	480	203.3	161.7	146	167	99	2.41
17	8	1430	909	7	11	49	570	ND	386	48	0.17	468	190	160	163	140	77	2.12
18	8	2016	724	10	10	44	586	ND	459	45	0.19	474	196	162.3	154.7	147	232	2.39
19	7.9	1100	846	10	13	48	571	ND	225	50	0.18	480	212.7	169.7	166.7	147	106	2.52
20	7.7	1123	726	7	9	39	603	ND	225	32	0.18	501	296	186.7	162.3	147	64	2.62
21	8	1053	930	7	7	43	582	ND	239	48	0.18	503	286	182	145.7	143	172	2.69
22	8.2	1240	693	11	10	44	605	ND	331	35	0.17	518	300	185	156.3	142	347	2.81
23	7.7	1056	603	11	7	47	561	ND	150	49	0.19	490	214.7	156.7	145	163	192	1.93

Table: 3 Mean values of Physico-Chemical and Heavy metal concentrations of groundwater collected in the Winter Season (January 2021)

S No	pH	EC	TDS	DO	BOD	COD	SO4	CO3	HCO3	NO3	PO4	TH	Ca	M g	Na	K	Cl	F
1	8.2	945	2133	7	16	57	585	ND	233	46	0.08	528	267	154.7	151.3	257	607	2.22
2	8.1	1246	968	7	20	49	571	ND	274	49	0.27	541	261	145.7	187	233	159	2.18
3	7.9	1176	886	6	18	53	584	ND	263	49	0.22	539	249.7	146	157.7	167	158	2.68
4	7.8	1046	800	8	18	48	600	ND	242	63	0.21	533	246	152	174.7	163	124	2.36
5	7.8	1060	766	8	18	41	577	ND	208	48	0.19	536	254.3	147	157.3	210	135	2.32
6	7.7	1650	936	6	16	38	616	ND	146	66	0.09	543	302	183	137.1	223	91	2.7
7	7.7	1663	1054	7	15	41	612	ND	157	48	0.1	522	258.7	171	160	167	161	2.8
8	7.9	1586	1063	7	15	42	600	ND	258	43	0.11	533	286.7	174.4	172.7	227	207	1.93
9	7.9	623	1092	6	16	48	574	ND	178	63	0.25	523	287	158	165.7	214	531	1.97
10	7.6	1210	824	6	14	48	577	ND	131	59	0.14	522	274	173.7	173	230	132	1.89
11	7.9	1100	724	10	11	39	573	ND	225	42	0.24	457	198.7	150.7	135.7	150	115	2.32
12	8	1123	846	10	10	46	597	ND	225	49	0.18	480	203.3	161.7	146	167	99	2.4
13	8	1053	726	10	13	50	570	ND	239	48	0.17	462	190	160	163	140	77	2.12
14	8	1245	930	9	9	41	586	ND	331	45	0.19	475	196	162.3	154.7	147	232	2.39
15	7.9	1056	693	9	7	44	571	ND	150	50	0.18	482	211.7	169.7	166.7	147	106	2.52
16	7.9	1296	1400	7	19	55	601	ND	318	39	0.24	542	243.3	141.3	168.3	230	368	1.97
17	8	1456	1011	7	18	45	600	ND	156	59	0.15	545	248	144.3	153	187	147	2.11
18	7.9	1456	1090	7	22	50	596	ND	336	55	0.2	539	260.3	141	214.7	197	370	1.91
19	7.7	1954	1333	8	22	47	592	ND	337	56	0.24	539	254	139.3	144.7	186	913	1.72
20	7.9	1656	1003	6	21	53	583	ND	251	38	0.17	546	243.3	135.3	148.3	230	141	1.88
21	7.9	1546	888	7	19	46	580	ND	264	51	0.13	547	262	148	215.7	170	101	1.81
22	7.8	1015	1715	6	20	55	596	ND	409	46	0.19	540	264	148.3	158	183	187	1.81
23	7.9	1173	1631	7	20	46	562	ND	272	49	0.15	553	243	154	341	250	279	1.75

Table: 4 Mean values of Physico-Chemical and Heavy metal concentrations of groundwater collected in the Summer Season April 2021

S s.no	pH	EC	TDS	DO	BOD	COD	SO4	CO3	HCO3	NO3	PO4	TH	Ca	M g	Na	K	Cl	F
1	7.6	933	768	4	4	23	582	ND	419	41	0.15	506	215.7	167	181.7	153	335	2.52
2	7.8	1320	755	5	10	33	602	ND	325	21	0.17	483	256.3	175	219.3	143	120	2.42
3	7.9	2440	1128	4	17	35	584	ND	658	33	0.21	498	301	188	140.7	124	311	3.15
4	7.7	1146	714	6	6	18	597	ND	619	52	0.15	491	213.3	156.7	312.4	147	532	2.57
5	7.6	1493	750	5	4	20	588	ND	375	37	0.19	490	240	186	191.3	147	132	2.57
6	7.9	1410	787	5	4	27	583	ND	348	37	0.14	492	197.3	167	199	150	133	2.42
7	8.3	1573	826	8	8	38	581	ND	646	43	0.2	485	189.3	160	151	170	476	1.82
8	8.1	924	663	7	10	45	612	ND	302	41	0.21	486	191.3	154.7	150	157	167	1.6
9	6.6	1640	816	10	8	45	595	ND	435	46	0.18	489	203	153	134.3	150	308	2.4
10	7.9	1260	737	4	7	20	597	ND	480	43	0.16	506	207.3	168	245.6	147	526	1.58
11	8.6	1476	713	5	6	25	610	ND	494	25	0.17	502	197.7	156.3	345.3	160	182	1.6
12	7.8	1526	788	5	6	19	596	ND	551	44	0.15	512	204.7	140	337.3	147	200	1.98
13	7.7	1410	1235	6	4	11	610	ND	990	22	0.16	513	211.3	172.2	177.3	153	604	1.99
14	8.3	1790	749	5	5	19	597	ND	399	39	0.16	532	213.3	170.7	358.3	187	337	1.93
15	8.2	1383	912	7	6	17	593	ND	357	46	0.27	533	288.3	187.6	178.7	137	179	2.68
16	8.1	1576	963	6	10	28	589	ND	481	32	0.23	508	304.7	189	169.3	173	242	2.97
17	7.9	1393	1224	6	10	31	588	ND	621	38	0.23	488	217.7	172	174.7	160	438	2.89
18	8.1	1580	1020	6	17	38	603	ND	550	33	0.15	498	298	172.3	189	177	202	2.71
19	7.6	3460	770	5	14	25	596	ND	363	41	0.16	482	224	167.3	201.3	213	856	2.3
20	8.3	1096	665	7	6	38	602	ND	205	32	0.22	500	297.3	181.3	153.7	160	70	1.96
21	8.6	1456	866	9	10	45	591	ND	457	33	0.16	467	208.3	155.7	141.7	153	856	1.83
22	8.7	1586	881	8	9	46	581	ND	372	42	0.18	502	214.7	165.7	145	163	195	1.93
23	8.4	1353	772	8	12	32	608	ND	353	37	0.19	507	201	176.7	134	153	137	2.8

Estimation of Water Quality Index (WQI)

Water Quality index (WQI) is defined as a technique of rating that provides the composite influence of individual water quality parameter on the overall quality of water. It is calculated from the point of view of human consumption. The average means concentration of the ten physico-chemical parameters such as pH, TDS, HCO_3, Ca, Mg, TH, SO_4, NO_3, Cl, Na and F was used for the calculation of WQI. The critical pollution index considered unacceptable is 100 [14].

The calculation involves the following steps

First, the calculation of weightage of i^{th} parameter.

Second, the calculation of the quality rating for each of the water quality parameters. Third, the summation of these sub-indices in the overall index.

The Weightage of i^{th} Parameter

$$W_i = k/S_i \qquad (1)$$

where W_i is the unit of weightage, S_i the recommended standard for i^{th} parameter (I = 1-6) and k is the constant of proportionality. Individual quality rating is given by the expression,

$$Qi = 100V/Si \qquad (2)$$

where Qi is the sub index of i^{th} parameter, V is the monitored value of the i^{th} parameter in mg/l and S_i the standard or permissible limit for the i^{th} parameter.

The Water Quality Index (WQI) is then calculated as follows [15].

$$WQI = \sum_{i=1}^{n}(QiWi) / \sum_{i=1}^{n} Wi \qquad (3)$$

where, Q_i is the sub index of i^{th} parameter,

W_i is the unit weightage for i^{th} parameter and n is the number of parameters considered.

Table: 5 The mean values of physico-chemical parameters collected from different stations during Rainy season

Parameters	Mean value in ppm (v_i)	Highest permitted value (WHO) (s_i)	Unit weightage (W_i)	Wi × Qi
pH	8.1	8.5	0.1176	9.729
TDS	752	500	0.002	0.248957
TH	494	500	0.002	0.163
Cl	241	250	0.004	0.3196
SO_4	592	500	0.002	0.196
HCO_3	329	240	0.0041	0.472
NO_3	42.12	50	0.02	1.393
Ca	217.2	100	0.01	1.796
Mg	223.8	150	0.0066	0.8225
Na	148.19	200	0.005	0.3059
F	2.13	1.5	0.66	93.24

WQI = $\sum_{i=1}^{n}(QiWi)/\sum_{i=1}^{n}Wi$ **WQI = 111.4**

Table: 6 The mean values of physico-chemical parameters collected from different stations during Winter season

Parameters	Mean value in ppm (v_i)	Highest permitted value (WHO) (s_i)	Unit weightage (W_i)	Wi X Qi
pH	7.9	8.5	0.1176	9.542
TDS	1114.3	500	0.002	0.3686
TH	524.8	500	0.002	0.1736
Cl	236.2	250	0.004	0.3125
SO_4	586.3	500	0.002	0.1939
HCO_3	251.4	240	0.0041	0.3609
NO_3	50.2	50	0.02	1.6605
Ca	248.4	100	0.01	2.0542
Mg	154.5	150	0.0066	0.5678
Na	177.8	200	0.005	0.7281
F	2.1	1.5	0.66	93.24

WQI = $\sum_{i=1}^{n}(QiWi)/\sum_{i=1}^{n}Wi$ **WQI = 109.22**

Table: 7 The mean values of physico-chemical parameters collected from different stations during Summer season

Parameters	Mean value in ppm (v_i)	Highest permitted value (WHO) (s_i)	Unit weightage (W_i)	Wi X Qi
pH	8	8.5	0.1176	9.411
TDS	829.8	500	0.002	0.2744
TH	497.6	500	0.002	0.1646
Cl	312.4	250	0.004	0.4133
SO_4	594.9	500	0.002	0.1967
HCO_3	455.0	240	0.0041	0.6532
NO_3	37.6	50	0.02	1.6538
Ca	228.2	100	0.01	1.8871
Mg	157	150	0.0066	0.5513
Na	149.2	200	0.005	0.4134
F	2.1	1.5	0.66	93.24

WQI = $\sum_{i=1}^{n}(QiWi)/\sum_{i=1}^{n}Wi$ **WQI = 123.8**

Table: 8 Status Categories of WQI

WQI	Quality of Water
0-25	Very Good
26-50	Good
51-75	Poor
Above 75	Very Poor (Unsuitable for Drinking)

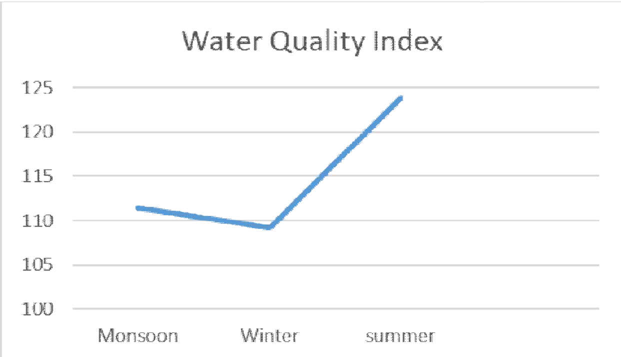
In our study, the Water Quality Index obtained for monsoon season has been tabulated (Table: 4). The computed WQI value of rainy season is 111.4.This value is found to be above 75 as per WQI (Table: 7) which shows the nature of the water quality of the areas during three monsoon seasons seems to be very poor. The overall high value of WQI of all the stations of our study has been found to be mainly due to the higher potent of iron, nitrate, total dissolved solids, hardness, fluorides, bicarbonate, chloride and manganese in the groundwater samples. It is clearly understood that the groundwater of our study area is not recommended for civic purposes as per the WQI standard values.

The parameters given in table (Table: 5) and the manipulation of WQI value for the groundwater samples of our area collected in the winter seasons of consecutive three years period indicates 109.22 which exceeds the normal value of 75. The cause of high potent of dissolved ions and solids in the groundwater of these areas may be due to hardness of the surface soil. The study area is adjacent closely to the coastal regions. The WQI value 123.8 as per the table (Table: 6) of the groundwater samples collected during three successive summer seasons (2020-2021) suggests that the water reserves at the surface tend to reach at the lower level, thus accumulating the excess dissolved solids of the soil and to become unsuitable for common needs as that of seawater

Sodium adsorption ratio

Sodium adsorption ratio is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca , Mg ions concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity (Ksat) and aeration, and a general degradation of soil structure

Fig.2 : **The graphical representation shows water quality index for different season**



Sodium absorption ration (SAR)12 Sodium absorption ratio is an important parameter to determine the suitability of irrigation water and is calculated by the following formula.

SAR= Na + /√[(Ca 2+ + Mg 2+) /2]

Table:8 Sodium Adsorption Ratio for various sample stations in three seasons

Sample stations	Rainy season	Winter season	Summer season
1	1.285	1.435	1.899
2	1.574	1.839	2.034
3	1.525	1.594	1.151
4	1.419	1.756	3.377
5	1.573	1.568	14.796
6	1.491	1.131	2.185
7	1.729	1.489	1.729
8	5.738	15.498	1.734
9	1.509	1.489	1.509
10	1.741	1.546	2.618
11	1.648	13.554	3.902
12	11.501	1.600	13.914
13	10.671	1.863	1.849
14	1.902	1.727	3.732
15	1.554	16.748	1.502
16	1.600	1.750	1.372
17	1.863	1.560	1.793
18	1.727	2.140	1.607
19	1.744	1.472	2.058
20	1.345	1.567	1.285
21	1.245	2.104	17.557
22	1.289	1.533	1.525
23	1.562	3.436	1.419

Sodium absorption ratio Sodium hazard is a tendency of water to replace absorbed Ca^{2+}, Mg^{2+} with Na^{+}, which is expressed in terms ofSAR. The sodium forms alkaline water with a combination of carbonates and with chloride forms salinity. Exchangeable Ca^{2+}, Mg^{2+} ions are replaced by Na^{+}, which cause deflocculation and lose permeability of water [16-17]. The SAR value in the study area ranges from 1.285 to 1.744 meq/L for Rainy,1.131–3.436 meq/L in Winter season, while in Summer season it ranges from 1.151 to 3.914 meq/L (Table 8).At the same level of salinity and SAR, adsorption of sodium by soils and clay minerals is more at higher Mg: Ca ratios. This is because the bonding energy of magnesium is less than that of calcium, allowing more sodium adsorption and it happens when the ratio exceeds more than 4 [18]. It was also reported that water containing high levels of exchangeable magnesium causes infiltration problem [19]. Seventy five percent samples in Rainy and 66.70 %samples in Summer and winter seasons fall in 0–6 meq/L with no problems (Table 7) on SAR and remaining in the other two categories 6–9 and 9 meq/L having alkalinity problems.

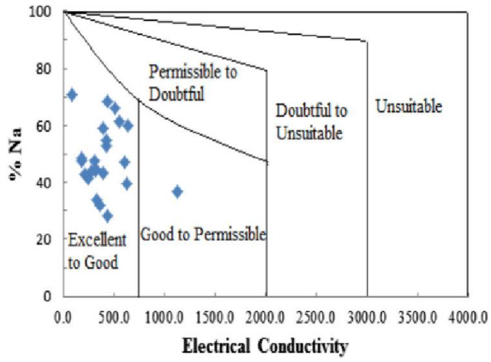


Fig. 3 Wilcox diagram showing the suitability of groundwater for irrigation

Irrigation water containing large amounts of sodium is of special concern due to sodium's effects on the soil and poses a sodium hazard. Continued use of water having a high SAR leads to a breakdown in the physical structure of the soil. Sodium is adsorbed and becomes attached to soil particles. The soil then becomes hard and compact when dry and increasingly impervious to water penetration. Fine textured soils, especially those high in clay, are most subject to this action. Certain amendments may be required to maintain soils under high SARs. Calcium and magnesium, if present in the soil in large enough quantities, will counter the effects of the sodium and help maintain good soil properties [20]. Groundwater for irrigation with a SAR value less than 10 meq/L (SAR\ 10 meq/L) are classified as ''Excellent'', those with SAR values between 10 and 18 meq/L are termed ''Good'' and ''Doubtful'' if the SAR value is between 18 and 26 meq/L. ''Unsuitable'' refers to groundwater with a SAR value greater than 26 meq/L (SAR[26 meq/L) [21]. Based on SAR values for the study area, all the ground waters could be classified as excellent and would be suitable for irrigation. A plot of groundwater data on the US salinity diagram [22], in which the EC is taken as salinity hazard and SAR as alkalinity hazard (Fig. 4), shows 13.04 % of the samples fall within the low salinity-low sodium type of water (C1-S1) and 82.61 % fall under medium salinity-low sodium class (C2-S1). Only 4.35 % (representing only one sample) of the samples fall within the high-salinity hazard-low sodium hazard class (C3-S1). This groundwater sample (C3-S1) is from a well in the Tharamangalam of the Salem district. Groundwater's that fall within the C1-S1 and C2-S1 can be used for irrigation on all types of soil with little danger of the development of harmful levels of exchangeable sodium. However, C3S1 types of water could only be used to irrigate certain semi-tolerant crops.

CONCLUSION

The suitability of groundwater for irrigation in some selected areas of intensive farming in five areas of Salem district has been assessed with reference to internationally accepted standards. EC values in the study area show that the groundwater in the study area is excellent and good as such suitable for irrigation purpose.The WQI map prepared for the study area can be used as a tool for decision making, regarding the usage of water for drinking and other domestic purposes. With the help of Sodium absorption ratio a distinct zoning could be established with regard to the changes in major chemical compositions of their groundwater. Proper sewerage system followed by an effluent treatment plant, collection, treatment and disposal of solid waste by the municipality, usage of biofertilizers are some of the methods to be developed to safeguard the quality of surface and ground water of study areas. The method adopted can be implemented in other areas having similar water related problems so that water pollution can be prevented, thereby opening a way to face the water crisis of the whole world.

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