Biological Forum – An International Journal **14(4): 217-224(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Assessment of Irrigation (ground) Water Quality and Creation of Thematic Mapping in the Coastal Soils of R S Mangalam Block, Ramanathapuram District, Tamil Nadu, India

V. Arulkumar[1*], J. Prabhaharan[2], R. Shanmugasundaram[3], A. Gurusamy[4] and M.L. Mini[5]

[1]Ph.D. Scholar, Department of Soils and Environment, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai (Tamil Nadu), India.

[2]Assistant Professor, Coastal Saline Research Centre, Ramanathapuram (Tamil Nadu), India.

[3]Professor, Department of Soil Science & Agrl. Chemistry, Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), India.

[4]Professor & Head, Dry land Agriculture Research Station, Chettinad, Karaikudi (Tamil Nadu), India.

[5]Associate Professor (Biochemistry), Department of Biotechnology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai (Tamil Nadu), India.

(Corresponding author: V. Arulkumar)*

(Received 07 August 2022, Accepted 27 September, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: To developments in urbanisation and industrialization, which overuse groundwater, the quality of irrigation water is becoming more and more important. In July 2019 at various intervals, ground water samples were collected from 17 revenue villages in the R S Mangalam block of the Ramanathapuram district of Tamil Nadu. The samples were then processed and analyzed for various physico-chemical parameters including cationic and anionic characteristics to determine the quality and there by estimating the parameters such as SAR (Sodium Adsorption Ratio), RSC (Residual Sodium Carbonate), TDS (Total Dissolved Solids) (Soluble Sodium Percentage). The results revealed that even-though the cumulative mean values lie well within the range of safe limit for water quality, 37 percent of the water samples were reported with high salinity levels, the other37 percent of the samples were slightly saline and the rest 26 percent as non-saline. The highest value of pH (8.69), EC (47.93 dSm^{-1}), SAR (37.46 meq/l), RSC (7.11meq/l), TDS (30675.20 meq/l) and SSP (80.57 %) were noted in the analyzed samples. The water quality parameters data along with GPS readings were used for the preparation of thematic maps of R S Mangalam block, Ramanathapuram district.

Keywords: Anions, Cations, Derived parameters, GPS and GIS techniques, Water quality.

INTRODUCTION

To attain sustainability in agriculture, it is essential to monitor and assess the quality of the soil and also water. Irrigated agriculture has been widely blamed for the development of salinity and sodicity around the world (Verwey and Vermeulan 2011), and it has been observed in the Indian states of Punjab and Haryana. According to Munn's (2005) estimates, around 900 million hectares of agricultural land or about 6 percent of the total world's total land area were affected either by salinity and sodicity and out of the total world's irrigated land about 20 percent of irrigated land is salt-affected. Irrigation water quality and quantity have an impact on the physical, biological, and chemical characteristics of soil both directly and indirectly. A better understanding regarding the potential temporal fluctuations in the quality of ground water can be achieved by geochemical studies of groundwater. To check whether groundwater is appropriate or not for irrigation purposes depends mainly on its geochemistry. For the survival of humans and all other forms of life on earth, ground water quality is a must and needs to be at excellent level. For crops cultivated in fields, modest amounts of growth media, or hydroponically, water quality is most crucial With the demand on industries and agriculture increasing along with the level of living rising, it is observed that greenhouse farming and good quality water are becoming more and more important. According to FAO statistics, 20% of the land is irrigated but produces 40% of the crops (Tiri *et al*., 2018). Although irrigation can considerably boost output, there are certain environmental drawbacks, namely water stagnation and increased salinity. The

processes and interactions that affect the water that is condensed in the atmosphere up until the point that it is released by a well or spring determine the quality of groundwater (Kesavan and Parameswari 2005). Fresh water supply is essential for drinking, farming, and ensuring a sustained improvement in agricultural productivity (Jeyaraj *et al*., 2019). In this investigation, an effort was made to evaluate the irrigation appropriateness and ground water quality of farms owned by Horticultural College and Research Institute, Periyakulam.

Though most of the area is covered under the seasonal rivers namely Sarugani, Vaigai, Manimutharand Vaippar in Ramanathapuram district, there are also large areas which are solely dependent on ground water for irrigation. Paddy (*Oryza sativa*) is main food crop cultivated in more than 63% of net area sown (Balachandran, 2009). Other major crops grown are Cotton (*Gossypium hirsutum*) and Chillies (*Capsicum annuum*). The paradigm shift about the quality of the soil and water is the vital part of this of research. In order to create a reliable database for research and information transfer, it is required to assess and monitor the features of soil fertility and ground water quality due to their dynamic nature. Therefore, the core objective of this study is to evaluate the irrigation water quality of R S Mangalam block, Ramanathapuram, Tamil Nadu.

MATERIALS AND METHODS

To assess the quality of irrigation water, the pre-monsoon irrigation water samples were collected from the seventeen revenue villages in the RS Mangalam block of the Ramanathapuram district of Tamil Nadu (Ground water). RS Mangalam block is the southernmost block of Ramanathapuram district of Tamil Nadu. It lies between 9.05°N to 9.50°N latitudes and 78.10°E to 79.27°E longitudes, at an elevation of 121 mover the mean sea level (MSL). The Geographical area of this Ramanathapuram district has an area is 4,123 km^2 of rural and urban area. In the month of July 2019, 100 irrigation water samples were collected for pre-monsoon analysis in order to define the irrigation water quality. The samples were drawn from the R S Mangalam block's overall irrigation water quality as well as the irrigation water quality of all the revenue villages. Using GPS coordinates, irrigation water was randomly gathered from wells or tube-wells. Each revenue village had a minimum of one and a maximum of six water samples collected. Random selections of flowing tube-wells within each hamlet were made to gather water samples in that field. After each selected tube-well had run for 20 minutes, the samples were collected in painstakingly cleaned plastic bottles, appropriately labelled, and brought to the lab. Several parameters were investigated in the collected water and soil samples using the recognized techniques, including pH by potentiometry (Jackson, 1958), EC by conductometry (Wilcox, 1950), Ca and Mg by versonate titration (Cheng & Bray 1951; Diehl *et al*., 1950), Na and K by flame photometry (Toth *et al*., 1948), Cl^-, CO_{32}^- & HCO_3^- by volume Based on the values recommended by the Central Soil Salinity Research Institute (CSSRI), Karnal, Haryana, utilised in the categorization, irrigation water samples from the pre-monsoon season were divided into several quality categories. Arc GIS 10.1 was used to create thematic maps related to ground water.

Classification of groundwater samples for irrigation purpose in study area pH. The pH of water samples was measure by using glass electrode pH meter (Jackson, 1958).

Electrical Conductivity (EC). EC of water sample was measured by using ELICO Conductivity Bridge as given by (Anderson & Jackson 1967).

Computation of groundwater quality parameters. The quality parameters were calculated by using the results of ionic constituents of groundwater. This was enumerated as under

Sodium Adsorption Ratio (SAR) (Richards, 1954). It is commonly used as an index for evaluating the sodium hazard associated with irrigation water supply. The formula for SAR is

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$$

Where, all cations are expressed in meq L^{-1}.

Residual Sodium Carbonate (RSC)

This index is important for carbonate and bicarbonate rich irrigation water. It indicates that tendency to precipitate Ca^{2+} as $CaCO_3$

$RSC\ (meL^{-1}) = (CO_3^{2-} + HCO_3^-) - (Ca^{2+} + Mg^{2+})$

Where concentration of both cations and anions is in meq L^{-1}. Sodicity hazard in terms of RSC is categorized as under (Eaton, 1950).

Total dissolved solids (TDS)

The following equation provides an approximation for the link between groundwater's specific conductance and TDS:

$TDS = k_eEC$

Where EC is the electrical conductivity in microsiemens per centimetre at 25 °C and TDS is given in mg/L. The correlation coefficient, ke, ranges from 0.55 to 0.8. This electrical conductivity measurement is used by some TDS metres to calculate the parts per million (ppm); 1 ppm equals 1 mg of dissolved solids per kilogramme of water.

Soluble sodium percentage (SSP)

Soluble sodium percentage (SSP) was enumerated by employing the equation given by Todd, the ionic concentration was presented in meq L^{-1}:

$$SSP = \frac{(Na^+ + K^+)}{(Ca^{2+} + Mg^{2-} + Na^+ + K^+)} \times 100$$

Groundwater Classification by pH, EC, SAR, RSC and SSP.

Parameter	Range	Water Class
pH	6.5 – 7.5	Neutral
	7.5 – 8.0	Slightly alkaline
	8.0 – 8.5	Moderately alkaline
	8.5- 9.0	Strongly alkaline
EC (dSm^{-1})	<2	Good non- saline
	2-4	Marginally slightly saline
	>4	Saline
	>4	High saline
Sodium Adsorption Ratio (SAR)	<10	Low
	10 – 18	Medium
	18 – 26	High
	>26	Very High
Residual Sodium Carbonate (RSC)	<1.25	Low
	1.25 – 2.5	Medium
	>2.50	High
	>2.50	Very High
Total Dissolved salts (TDS)	<150	Low
	150 - 500	Medium
	>500	High
Soluble Sodium Percentage (SSP)	<50	Suitable
	>50	Unsuitable

RESULTS AND DISCUSSION

Physio chemical properties of irrigation water quality, R S Mangalam block. The pH values of the various irrigation water samples ranged from 7.60 to 8.69, with a mean value of 8.24. The pH value with the highest reading was 8.69 at the Setheedal, Varavani, Thiruppalaikkudi Revenue Village, followed by 8.66 at Chitturvadi, and the pH value with the lowest reading was 7.60 at Parannur revenue village respectively. The pH (6.5 to 7.5) neutral (0%) range, (7.5 to 8.0) slightly alkaline (16%) range, (8.0 to 8.5) moderately alkaline (67%) range, and (8.5 to 9.0) strongly alkaline (17%) range of the 100 irrigation water samples All seventeen revenue villages were found to fall within the moderately alkaline category after analysis. Positive correlations exist between the pH and the salt and carbonate concentrations in ground water. Singh and Bajwa (1991). It has been found that irrigation water's pH rises as its salt level rises, especially where carbonates and bicarbonates are the associated anions (Table1), (Fig. 1).

The parameter electrical conductivity (EC) of the ground water quality was ranged from 1.12to 47.93dSm^{-1} with an overall mean value of 4.92dSm^{-1} which showed that majority of the water turned to be slightly saline. The highest value of EC *i.e.*, 47.93 $dSm^{-1}$was recorded at Uppur village, followed by 14.61dSm^{-1} at Pullamadai village and the lowest of 1.12dSm^{-1} was recorded at Thiruppalaikkudi village. Twenty-three samples (26%) of the 100 ground water samples analysed were non-salty, thirty- seven samples (37%) were mildly saline, and thirty- seven samples (37%) were salinic in nature (Fig. 2). The obtained mean values reflected that nine of the revenue villages have fallen in the saline category (Varavani, Sengudi, Thumbadaikkakottai, Parannur, Chitturvadi, R S mangalam, Pullamadai, Rathanur and Uppur) among the seventeen revenue villages. According to (Sajil *et al.*, 2014), electrical conductivity of water is increased in close proximity to coastlines due to seawater intrusion. The electrical conductivity of irrigation water was found to be connected with soluble salts, i.e., chloride and sulphate content. Prabhaharan *et al.* (2020) noticed a rise in the electrical conductivity of irrigation water, especially where chlorides and sulphates are present as coupled anions. According to Sree Ramulu (1962), the order of contribution various cations and anions towards conductivity declined in the following order *i.e.*, $Cl^- > SO_4^{2-} > HCO_3^{2-}$ for anions and $K^+ > Na^+ > Mg^{2+} > Ca^{2+}$ for cations (Table 1).

Cationic and Anionic parameters of ground quality, R S Mangalam block. The cations (Ca^{2+}, Mg^{2+}, Na^+& K^+) present in the samples have been depicted in the (Table 2). The cationic concentration ranged from 1.26 to 22.14me L^{-1}, 1.50 to 126.74 $meqL^{-1}$, 2.26 to 321.25 $meqL^{-1}$ and 0.03 to 10.91 $meqL^{-1}$ for Ca, Mg, Na & K respectively. The average values were 6.17, 10.71, 31.38 and 0.84 $meqL^{-1}$ for Ca, Mg, Na & K respectively. The highest calcium of 22.14 $meqL^{-1}$ recorded at Varavani, magnesium of 126.74 $meqL^{-1}$ recorded at Uppur, Sodium of 321.25 $meqL^{-1}$ recorded at Uppur and potassium of 10.91 $meqL^{-1}$ recorded at Uppur. More than 10 $meqL^{-1}$ of sodium was measured at its peak in many of the settlements. According to Gajbhiye *et al.* (1973), the magnesium concentration of the irrigation waters of Western Rajasthan was higher than the calcium content in the samples of water showing excessive salinity. When irrigation water's sodium level rose, Singh and Bajwa (1991) noticed a rise in pH. The Carbonates and bicarbonates were the related anions. Calcium becomes unavailable in high pH soils when bicarbonate reacts with calcium to form calcium carbonate. Since, the amounts of free calcium

and magnesium is decreased in soil, the negative exchangeable sites of clay particles get occupied by sodium. It was reported by Kahimba *et al.* (2016) that sodium would compete with the calcium and magnesium ions for occupying the negatively charged exchangeable sites on the clay particles. The coastal belt of Radhapuram taluk, Tirunelveli District was documented for the dominance of sodium in irrigation water as per the reports submitted by Mahendran and Arunachalam (2002) (Table 2).

The particulars of anions (CO_3^{2-}, HCO_3^-, Cl^- and SO_4^{2-}) in the samples ofirrigation water were presented in the (Table 3). The carbonates were within the range of 1.60 $meqL^{-1}$ (Parannur, Gudaloor, Thiruppalaikkudi village) to 16.40 $meqL^{-1}$ (Rathanur) whereas the bicarbonates reached low at Chitturvadi (1.60 $meqL^{-1}$) and high at Rathanur (25.20 $meqL^{-1}$). The chlorine content was in the range of 4.21 $meqL^{-1}$ (Thiruppalaikkudi village) to 461.25 $meqL^{-1}$ (Uppur) where as the sulphates reached low at Pullamadai (0.03 $meqL^{-1}$) and high at Thiruppalaikkudi (3.16 $meqL^{-1}$). The means values of 5.58, 7.71, 35.49 and 0.31 $meqL^{-1}$ of CO_3^{2-}, HCO_3^-, Cl^- and SO_4^{2-} respectively (Table 4). The toxic nature of bicarbonate to roots and shoots was observed by Hajiboland *et al.* (2003) who reported the reduction of root and shoot growth thereby reducing uptake of phosphorus and many other micronutrients. The Chloride and the Sulphate ions were reported as the major or dominant anions by Rathi *et al*. (2018). The presence of sulphate ions in groundwater samples may be caused by the use of sulphate-rich fertilizers, the application of gypsum and sulphide-bearing minerals and industrial wastes (Sridharan and Nathan 2017). Furthermore, a high sulphate content in the groundwater is anticipated to be caused by the use of soil additives like gypsum (Pal *et al*., 2018). It may be able to enrich irrigation water with more chloride by allowing natural processes like weathering and salt deposit dissolving to take place. Cl content may also be influenced by non-lithological elements of the environment, such as unsanitary conditions, irrigation, and return flows, as well as chemical fertilisers.

Water quality – parameter. The RSC in irrigation water samples exhibited a range from-29.30 to 7.11 withan average value of 2.84 indicating a high problematic water in this particular zone. RSC mean values are calculated only for the positive values. The highest RSC of 7.11 was documented at Parannur village and the lowest of -29.30 was documented at Uppur village. Among the analyzed ground water samples, low (33 percent), medium (22 percent) and high (45 percent) values were recorded. Sodium carbonate and pH levels are favourably correlated with the RSC values. The majority of the irrigation and tube well samples from Punjab have high RSC values, according to Bajwa & Singh (1973). According to Gupta (1986), high salinity waters will be found to be dominant in sodium chloride, while low salinity waters may be found to be dominant in sodium bicarbonate. Ramprakash *et al.* (2013) found that irrigation with enhanced RSC water caused the progressive development of sodium hazard in soils and crops (Fig. 3). However, the maximum RSC values were greater than 2.5 respectively which are detrimental in sight of the alkalinity/sodicity development in soil upon irrigation (Table 4) (Kumar *et al.,* 2019).

The SAR in the irrigation water samples ranged from 0.89 to 37.46 with an average SAR value of 10.36. The highest SAR of 37.46 was recorded at Uppur village while the lowest of 0.89 was recorded at Manakudi village (Fig. 4). The irrigation water with enhanced SAR led to the detrimental effects on the growth of crops due to the sodium hazard (Ramprakash *et al*., 2013). However the mean SAR values were greater than 10(R S mangalam, Uppur, Parannur, Rathanur, Govindhamangalam, Pullamadai, Thumbadaikkakottai, Karunkudi and Kavanoor) respectively which are harmful in view of the alkalinity/sodicity development in soil upon irrigation.

The TDS in the irrigation water samples ranged from 716.80 to 30675.20 with mean TDS value of 3150.19. The highest TDS of 30675.20 was noted at Uppur village and the lowest of 716.80 was noted at Thiruppalaikkudi village. The Irrigation water with enhanced TDS led to development of sodium hazard in soils and crops (Kuttimani *et al.,* 2017), (Fig. 5). However, the mean TDS values were greater than 500 respectively which are considered as harmful in view of the alkalinity/sodicity development in soil upon irrigation.

The SSP in the irrigation water samples ranged from 13.95 to 80.57% with mean SSP value of 63.61%. The highest SSP of 80.57% was documented at Parannur village while the lowest of 13.95% was documented at Manakudi village. The Irrigation water with enhanced SSP led to development of sodium hazard in the soils and crops (Kuttimani *et al.,* 2017), (Fig. 6). However, the mean SSP values were greater than 50% respectively which are harmful in the context of development in alkalinity/sodicity of the soil upon irrigation. The percentage of soluble salt is a crucial factor in determining how permeable the soil is to irrigation water, according to (Nagaraju *et al.,* 2006). Clay particles' Mg^{2+} and Ca^{2+} ions have a tendency to replace the sodium ions found in irrigation water. The exchange process reduces the soil's permeability and also causes poor internal drainage and soil hardening, both of which are detrimental to the soil's quality and seedling emergence. Additionally, high sodium concentrations encourage the synthesis of soil salinity and alkalinity by promoting the mixing of sodium with carbonates and chloride. Excessive soil salinity and alkalinity have a negative effect on plant growth and agricultural yield.

Table 1: Physico – chemical properties of irrigation water quality, R S Mangalam block Ramanathapuram district.

Sr. No.	Village name	No. of samples	pH			EC(dSm^{-1})		
			Min	Max	Avg	Min	Max	Avg
1.	R S mangalam	5	8.09	8.55	8.40	2.43	7.91	5.82
2.	Uppur	5	8.11	8.56	8.28	1.96	47.93	16.04
3.	Chitturvadi	5	7.84	8.66	8.24	1.52	10.11	5.25
4.	Parannur	7	7.60	8.39	8.09	2.61	6.97	4.82
5.	Rathanur	3	8.16	8.45	8.27	6.51	11.05	9.19
6.	Govindhamangalam	6	7.89	8.39	8.11	2.13	6.42	3.74
7.	Sengudi	5	8.16	8.46	8.33	1.23	13.42	4.44
8.	Setheedal	11	7.93	8.69	8.32	1.36	4.79	2.94
9.	Manakudi	6	7.91	8.50	8.22	1.26	2.71	1.78
10.	Aanandhur	4	8.30	8.49	8.39	1.32	2.31	1.80
11.	Pullamadai	6	7.71	8.13	7.90	3.31	14.61	8.43
12.	Varavani	6	7.61	8.69	8.25	1.62	11.91	4.44
13.	Thumbadaikkakottai	6	7.91	8.40	8.17	2.91	6.91	4.57
14.	Karunkudi	3	7.91	8.61	8.32	1.94	4.56	2.90
15.	Kavanoor	2	8.30	8.45	8.38	1.75	1.95	1.85
16.	Gudaloor	6	7.91	8.36	8.15	1.63	2.73	2.14
17.	Thiruppalaikkudi	14	8.06	8.69	8.35	1.12	7.71	3.54
	Total/ Avg	**100**	**7.60**	**8.69**	**8.24**	**1.12**	**47.93**	**4.92**

Table 2: Cationic parameters of irrigation water quality, R S Mangalam block Ramanathapuram district.

S. No.	Village Name	No. of samples	Ca(me L^{-1})			Mg(me L^{-1})			Na (me L^{-1})			K(me L^{-1})		
			Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1.	R S mangalam	5	2.66	13.71	8.97	6.73	16.36	12.27	14.56	47.31	36.11	0.17	1.13	0.48
2.	Uppur	5	3.88	20.36	11.85	2.61	126.74	44.50	11.93	321.25	100.90	0.11	10.91	3.01
3.	Chitturvadi	5	3.36	12.08	6.81	5.24	18.14	11.10	4.95	70.12	33.43	1.01	1.05	1.03
4.	Parannur	7	1.68	10.23	5.80	3.21	14.21	9.18	18.53	48.03	32.33	0.17	1.09	0.71
5.	Rathanur	3	8.32	15.13	10.95	11.19	22.91	16.08	45.12	74.32	63.43	0.13	1.27	0.89
6.	Govindhamangalam	6	2.62	6.12	4.12	4.52	12.80	7.79	10.16	46.59	25.05	0.12	1.23	0.50
7.	Sengudi	5	1.26	14.32	6.66	2.12	21.93	8.86	7.11	96.23	28.27	0.03	2.11	0.70
8.	Setheedal	11	1.36	9.54	4.23	1.50	8.76	5.94	9.09	29.76	18.46	0.05	3.16	0.61
9.	Manakudi	6	1.31	8.70	3.32	1.62	5.90	3.52	2.26	16.41	10.21	0.13	1.03	0.44
10.	Aanandhur	4	2.11	2.39	2.21	3.01	3.29	3.09	7.59	17.54	12.35	0.11	0.52	0.26
11.	Pullamadai	6	6.21	15.23	10.29	10.22	39.73	19.08	15.46	91.11	53.86	0.17	4.31	1.19
12.	Varavani	6	3.11	22.14	8.38	4.11	38.26	11.97	9.45	56.23	22.95	0.12	2.36	1.13
13.	Thumbadaikkakottai	6	4.21	12.45	7.51	3.49	16.43	9.40	19.88	40.11	27.60	0.19	3.10	1.14
14.	Karunkudi	3	2.06	3.12	2.75	2.01	11.96	5.39	14.99	28.14	19.96	0.16	2.01	0.79
15.	Kavanoor	2	1.61	2.06	1.84	1.93	2.21	2.07	13.59	15.03	14.31	0.14	0.17	0.16
16.	Gudaloor	6	1.81	9.40	3.91	1.96	6.11	3.56	11.46	17.12	13.58	0.11	1.19	0.41
17.	Thiruppalaikkudi	14	2.08	16.32	5.36	2.21	25.39	8.37	5.21	45.79	20.64	0.11	4.75	0.91
	Total	**100**	**1.26**	**22.14**	**6.17**	**1.50**	**126.74**	**10.71**	**2.26**	**321.25**	**31.38**	**0.03**	**10.91**	**0.84**

Table 3: Anionic parameters of irrigation water quality, R S Mangalam block Ramanathapuram district.

S. No.	Village Name	No. of samples	CO_3 (me L^{-1})			HCO_3 (me L^{-1})			Cl (me L^{-1})			SO_4 (me L^{-1})		
			Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1	R S mangalam	5	3.47	15.20	10.25	7.76	18.90	13.45	12.73	45.89	33.92	0.13	0.36	0.24
2	Uppur	5	4.50	13.60	7.21	3.60	10.60	7.64	12.11	461.25	145.55	0.11	0.93	0.31
3	Chitturvadi	5	2.90	12.92	7.82	1.60	19.20	9.88	9.71	68.23	34.37	0.13	0.36	0.25
4	Parannur	7	1.60	8.20	5.71	4.30	15.30	9.88	14.40	46.04	32.23	0.16	0.63	0.27
5	Rathanur	3	9.20	16.40	11.80	10.40	25.20	17.31	43.56	74.43	61.75	0.11	1.03	0.46
6	Govindhamangalam	6	3.20	6.40	4.54	5.60	10.20	7.42	11.60	46.41	25.03	0.11	1.01	0.29
7	Sengudi	5	2.40	7.20	4.34	2.40	7.92	4.42	5.01	117.33	35.13	0.11	1.91	0.49
8	Setheedal	11	4.40	10.40	6.19	2.40	11.56	6.71	6.40	26.98	16.05	0.11	0.65	0.25
9	Manakudi	6	2.10	8.20	4.22	2.50	4.80	3.68	6.12	14.92	9.72	0.06	0.30	0.15
10	Aanandhur	4	3.10	5.20	4.33	2.40	4.30	3.50	5.11	14.53	9.89	0.16	0.31	0.21
11	Pullamadai	6	3.20	6.90	5.04	3.60	21.90	8.34	26.41	117.21	71.22	0.03	0.41	0.16
12	Varavani	6	2.40	10.40	6.23	6.12	19.10	10.10	6.80	90.19	28.68	0.14	1.09	0.34
13	Thumbadaikkakottai	6	3.56	7.10	5.66	4.40	13.20	7.02	17.56	60.41	32.70	0.11	1.06	0.30
14	Karunkudi	3	2.90	7.21	5.24	4.60	5.64	5.28	9.11	31.19	17.87	0.17	1.06	0.47
15	Kavanoor	2	3.20	4.45	3.83	3.91	6.80	5.36	7.60	14.23	10.92	0.11	0.13	0.12
16	Gudaloor	6	1.60	4.00	2.96	4.00	7.60	5.31	9.15	19.60	13.02	0.09	0.93	0.31
17	Thiruppalaikkudi	14	1.60	7.20	3.73	2.65	10.30	5.86	4.21	60.74	25.28	0.11	3.16	0.58
	Total	**100**	**1.60**	**16.40**	**5.83**	**1.60**	**25.20**	**7.71**	**4.21**	**461.25**	**35.49**	**0.03**	**3.16**	**0.31**

Table 4: Derived parameters of irrigation water quality, R S Mangalam block Ramanathapuram district.

S. No.	Village Name	No. of samples	RSC (me L^{-1})			SAR (me L^{-1})			TDS (me L^{-1})			SSP (me L^{-1})		
			Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1.	R S mangalam	5 (5)	1.84	2.96	2.46	6.72	12.63	10.90	1555.20	5062.40	3722.24	60.07	65.45	62.25
2.	Uppur	5 (2)	-129.30	4.59	3.10	6.62	37.46	16.14	1254.40	30675.20	10263.04	52.70	67.03	60.81
3.	Chitturvadi	5 (3)	-6.29	3.48	2.81	2.31	18.04	9.94	972.80	6470.40	3357.44	32.72	69.46	54.81
4.	Parannur	7 (5)	-6.25	7.11	3.28	9.86	14.73	12.12	1670.40	4460.80	3084.80	60.21	80.57	68.50
5.	Rathanur	3 (3)	0.69	3.56	2.08	14.45	21.66	17.45	4166.40	7072.00	5881.60	64.32	74.97	69.65
6.	Govindhamangalam	6 (4)	-5.84	2.89	1.85	4.30	17.81	10.29	1363.20	4108.80	2390.40	44.91	76.89	63.47
7.	Sengudi	5 (3)	-21.51	3.44	2.94	3.40	22.60	9.41	787.20	8588.80	2842.88	31.75	73.09	59.89
8.	Setheedal	11(11)	1.23	5.08	2.74	4.48	11.26	8.25	870.40	3065.60	1880.44	40.49	74.90	62.58
9.	Manakudi	6(5)	-7.01	3.67	2.67	0.89	8.19	6.09	806.40	1734.40	1137.07	13.95	76.41	58.19
10.	Aanandhur	4 (4)	2.00	3.08	2.53	4.62	10.85	7.60	844.80	1478.40	1150.40	57.85	76.66	67.64
11.	Pullamadai	6 (0)	-26.16	-3.36	0.00	5.18	20.93	14.13	2118.40	9350.40	5395.20	45.83	74.15	61.19
12.	Varavani	6 (4)	-31.90	4.24	3.43	4.94	10.23	7.39	1036.80	7622.40	2843.73	45.28	64.04	56.00
13.	Thumbadaikkakottai	6 (4)	-18.57	4.17	2.91	5.42	13.18	10.08	1862.40	4422.40	2926.93	41.19	72.72	61.82
14.	Karunkudi	3 (2)	-2.23	5.93	4.68	10.25	10.53	10.34	1241.60	2918.40	1858.13	62.22	77.19	71.84
15.	Kavanoor	2 (2)	4.09	6.46	5.28	10.21	10.29	10.25	1120.00	1248.00	1184.00	77.20	78.69	77.94
16.	Gudaloor	6 (5)	-7.91	4.05	2.54	4.39	10.22	7.65	1043.20	1747.20	1370.67	43.82	76.18	64.91
17.	Thiruppalaikkudi	14 (9)	-19.89	6.75	3.06	3.29	13.21	8.00	716.80	4934.40	2264.23	46.36	71.96	59.86
	Total	**100**	**-129.30**	**7.11**	**2.84**	**0.89**	**37.46**	**10.36**	**716.80**	**30675.20**	**3150.19**	**13.95**	**80.57**	**63.61**

* The (RSC) value nos in brockets indicated the positive no. of values

Spatial distribution of different quality parameters of irrigation (ground) water in R S Mangalam block of Ramanathapuram district

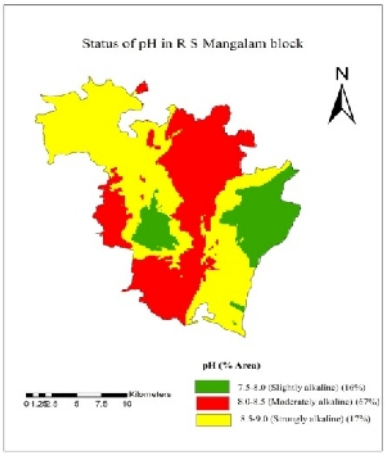

Fig. 1. Spatial Distribution of (pH) (%).

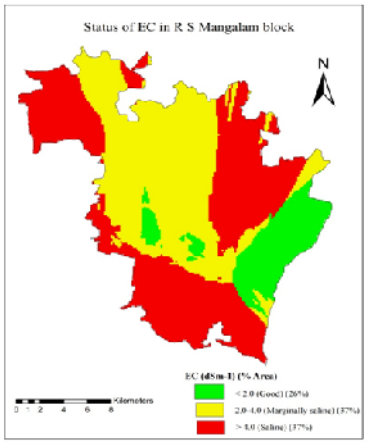

Fig. 2. Spatial Distribution of Electrical Conductivity (EC) (%).

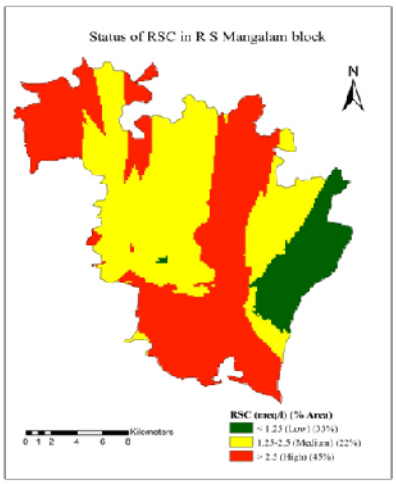

Fig. 3. Spatial Distribution of Residual Sodium Carbonate (RSC) (%).

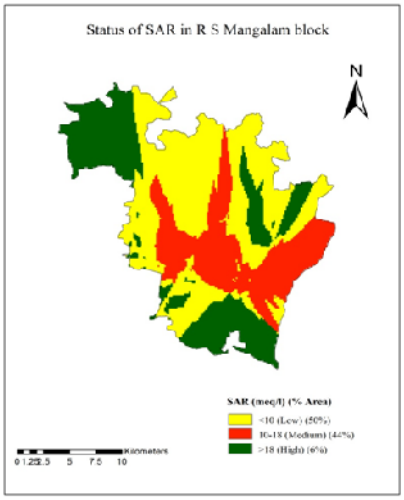

Fig. 4. Spatial Distribution of Sodium Adsorption Ratio (SAR) (%).

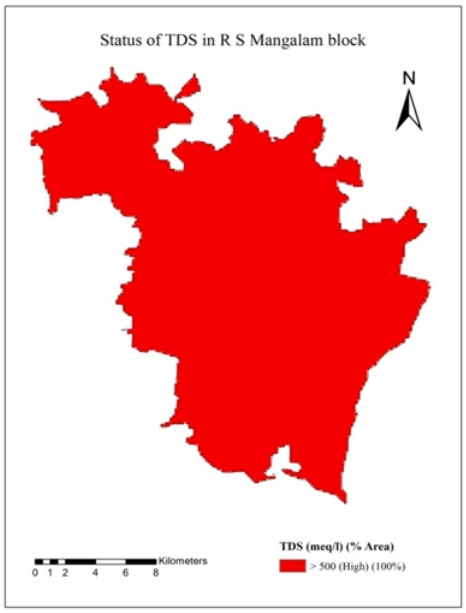

Fig. 5. Spatial Distribution of Total Dissolved Salts (TDS) (%).

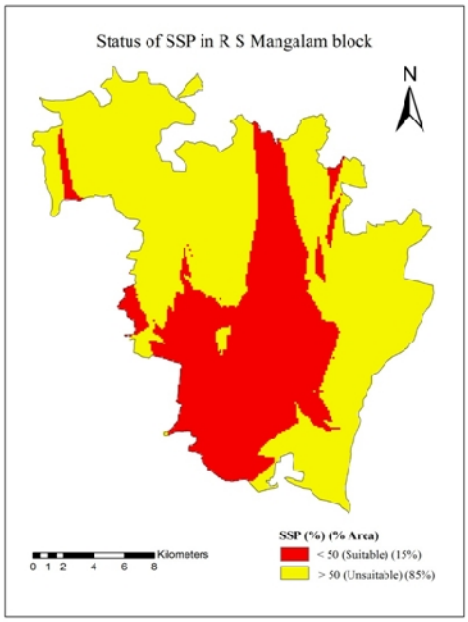

Fig. 6. Spatial Distribution of Soluble Sodium Percentage (SSP) (%).

CONCLUSION

The information generated from the current study regarding the quality of irrigation water will be resourceful in the development of agricultural and environmental policies of sustainable irrigation. This will also serve as warning bell for taking up the water conservation measures. Georeferenced maps also help in monitoring changes in nutrient status over a period of time by revisiting with the help of GPS. It was discovered from the study that analysis of underground irrigation water samples of the Ramanathapuram block that majority of the water became alkaline in nature. The EC parameter of the tested samples ranged from 0.95 to 9.73 dSm^{-1} with a cumulative mean value of 3.88 dSm^{-1} which therein indicates that most of the water tends to be saline. The parameters RSC (Residual Sodium Carbonate) and SAR (Sodium Absorption Ratio) values indicated that there is a moderate level of problematic water in this zone. The SSP values indicated high soluble sodium percentage (> 50 %) in the Ramnad block. The effective management practices can be made in specific problematic areas.

Acknowledgement. The Present study was supported by the Department of Soils and Environment, Agricultural College and Research Institute-Madurai, Tamil Nadu Agricultural University, Tamil Nadu, India.
Conflict of Interest. None.

REFERENCES

Anderson, T. B., & Jackson, R. (1967). Fluid mechanical description of fluidized beds. Equations of motion. *Industrial & Engineering Chemistry Fundamentals*, *6*(4), 527-539.

Balachandran, A. (2009). District Groundwater Brochure, Ramanathapuram District, Tamil Nadu. *Central Ground Water Board, South Eastern Coastal Region, Chennai*, 1-20.

Bajwa, M., & Singh, N. T. (1973). Chemical Composition of Underground Waters of the Punjab State.

Cheng, K. L., & Bray, R. H. (1951). Determination of calcium and magnesium in soil and plant material. *Soil science*, *72*(6), 449-458.

Chesnin, L., & Yien, C. H. (1951). Turbidimetric determination of available sulfates. *Soil Science Society of America Journal*, *15*(C), 149-151.

Diehl, H., Goetz, C. A., & Hach, C. C. (1950). The versenate titration for total hardness. *Journal (American Water Works Association)*, *42*(1), 40-48.

Eaton, F. M. (1950). Significance of carbonates in irrigation waters. *Soil science*, *69*(2), 123-134.

Gajbhiye, K. S., Kolarkar, A. S., & Bhatia, O. P. (1973). Quality of Ground Waters in Bikaner District of Western Rajasthan. *Annals of Arid Zone*, *12*(1 & 2).

Hajiboland, R., Yang, X. E., & Römheld, V. (2003). Effects of bicarbonate and high pH on growth of Zn-efficient and Zn-inefficient genotypes of rice, wheat and rye. *Plant and soil*, *250*(2), 349-357.

Jackson, M. L. (1958). Soil chemical analysis prentice Hall. *Inc., Englewood Cliffs, NJ*, *498*, 183-204.

Jeyaraj, M., Indhuleka, A., & Arunpaul, C. (2019). Investigation of water quality index of river Noyyal and its connected ponds Coimbatore Tamilnadu India. *Oriental Journal of Chemistry*, *35*(3), 1125.

Kahimba, F. C., Ali, R. M., & Mahoo, H. F. (2016). Research note: evaluation of irrigation water quality for paddy production at Bumbwisudi Rice Irrigation Scheme, Zanzibar. *Tanzania Journal of Agricultural Sciences*, *15*(2).

Kesavan, K. G., & Parameswari, R. (2005). Evaluation of ground water quality in Kancheepuram. *Indian Journal of Environmental Protection*, *25*(3), 235.

Kumar, M. M., Balasubramaniam, P., Gomadhi, G., Ramesh, T., & Jagadeeswaran, R. (2019). Groundwater quality assessment and mapping in coastal blocks of Ramanathapuram district, Tamil Nadu. *IJCS*, *7*(3), 3185-3188.

Kuttimani, R., Raviraj, A., Pandian, B. J., & Kar, G. (2017). Determination of water quality index in coastal area (Nagapattinam) of Tamil Nadu, India. *Chem Sci Rev Lett.*, *6*(24), 2208-2221.

Mahendran, P. P., & Arunachalam, G. (2002). An assessment of chemical parameters of well waters in the coastal belt of Radhapuram taluk, Tirnunelveli district, Tamil Nadu. *Journal of the Indian Society of Soil Science*, *50*(2), 230-231.

Munns, R. (2005). Genes and salt tolerance: bringing them together. *New phytologist*, *167*(3), 645-663.

Nagaraju, A., Suresh, S., Killham, K., & Hudson-Edwards, K. (2006). Hydrogeochemistry of waters of mangampeta barite mining area, Cuddapah Basin, Andhra Pradesh, India. *Turkish Journal of Engineering and Environmental Sciences*, *30*(4), 203-219.

Pal, S. K., Rajpaul, R., Bhat, M. A., & Yadav, S. S. (2018). Assessment of groundwater quality for irrigation use in Firozpur-Jhirka block in Mewat district of Haryana, North India. *J. of Soil Salin and Water Qual*, *10*(2), 157-167.

Prabhaharan, J., Kalaichelvi, K., Sathyamoorthy, N. K., Ragavan, T. & Valliammai, A. (2020). Assessment of irrigation water quality (Ground water) of Melur block, Madurai district, Tamil Nadu. *IJCS*, *8*(4), 979-982.

Rathi, P., Ramprakash, S. K., & Satyavan, N. R. (2018). Characterization and mapping of groundwater quality in Siwan block of Kaithal district in Haryana. *International Journal of Chemical Studies*, *6*(1), 986-990.

Sajil Kumar, P. J., Elango, L., & James, E. J. (2014). Assessment of hydrochemistry and groundwater quality in the coastal area of South Chennai, India. *Arabian Journal of Geosciences*, *7*(7), 2641-2653.

Singh, H., & Bajwa, M. S. (1991). Effect of sodic irrigation and gypsum on the reclamation of sodic soil and growth of rice and wheat plants. *Agricultural water management*, *20*(2), 163-171.

Sree Ramulu, U. S. (1962). Influence of cations and anions on the electrical conductivity measurements of ground waters. *Madras Agric. J.*, *49*, 101-109.

Sridharan, M., & Senthil Nathan, D. (2017). Groundwater quality assessment for domestic and agriculture purposes in Puducherry region. *Applied water science*, *7*(7), 4037-4053.

Tiri, A., Belkhiri, L., & Mouni, L. (2018). Evaluation of surface water quality for drinking purposes using fuzzy inference system. *Groundwater for Sustainable Development*, *6*, 235-244.

Toth, S. J., Prince, A. L., Wallace, A., & Mikkelsen, D. S. (1948). Rapid quantitative determination of eight mineral elements in plant tissue by a systematic procedure involving use of a flame photometer. *Soil Science*, *66*(6), 459-466.

Verwey, P. M. J., & Vermeulen, P. D. (2011). Influence of irrigation on the level, salinity and flow of groundwater at Vaalharts Irrigation Scheme. *Water SA*, *37*(2).

Wilcox, R.R. (1950). STDs: Definition. A Textbook of STDs.

How to cite this article: V. Arulkumar, J. Prabhaharan, R. Shanmugasundaram, A. Gurusamy and M.L. Mini (2022). Assessment of Irrigation (ground) Water Quality and Creation of Thematic Mapping in the Coastal Soils of R S Mangalam Block, Ramanathapuram District, Tamil Nadu, India. *Biological Forum – An International Journal*, *14*(4): 217-224.