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Quality of irrigation water in Rajkot District of Gujarat

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Abstract

An investigation was undertaken to study the quality of irrigation waters by analyzing 200 samples from ten talukas of Rajkot district. In general, the underground well/tube well water was neutral to alkaline in reaction. The overall pH values ranged from 7.01 to 8.42 with mean value of 7.59. The water was saline in nature and overall EC values ranged from 0.70 to 9.24 with mean value of 2.07 dSm⁻¹. On the basis of EC, 68.5 and 28.5 per cent samples were found in C₃ and C₄ classes, respectively. Whereas on the basis of SAR, 97.0, 3.0 per cent samples falls under S₁ and S₂ classes, respectively. Highly significant positive relations were observed between EC_{iw} with SSP_{iw} and SAR_{iw}. The pH_{iw} was significantly and positively correlated with RSC_{iw}.

Keywords: quality of irrigation water, EC, pH, SAR, alkaline and saline.

Introduction

Quality of irrigation water is one of the main factor to be understood in irrigated agriculture. "Injudicious irrigations" even with good quality waters, turn many a good soils into saline or alkali conditions. In majority of arid, semi-arid and coastal regions groundwater is either the major or the only source of irrigation to supplement the scanty rainfall. The majority of groundwaters in these regions are of poor quality due to excessive salt concentration and high values of SAR and RSC because deep borewell (up to 300Meter). Scarcity of good quality of waters forces the farmers to use available saline or sodic water for irrigation (Girdhar, 1996) [2]. Such waters are being used in Rajkot district of Gujarat knowing full well that quality and yield of the crops are continuously decreased or stagnant. Therefore, the present investigation was undertaken to study the quality of irrigation water in Rajkot district of Gujarat.

Materials and Methods

Rajkot district is falls in North and South Saurashtra Agro Climatic Zone, located at 22 °18' N–70 °46' E, 22 °3' N–70 °78' E. It has an average elevation of 128 meters (420 ft). It occupies area of 170 km². The length from North to South of this territory is about 105.4 kms and from east to west about 102.6 kms. It is bounded in the north by Morbi district and in north-west by Jamnagar and in the west by Porbandar and Junagadh districts and in the south by Amreli and east by Surendranagar and Botad districts. The area covered by the district is 7,570 Sq. kms. Two hundred underground water samples were collected from the ten talukas of Rajkot district viz., Paddhari, Rajkot, Lodhika, Kotda Sangani, Upleta, jetpur, Gondal, Dhoraji, Jam Kandorna, and Jasdán. The water samples were collected in plastic bottle of 500ml capacity with all necessary precautions. These water samples were analyzed for the parameters viz., electrical conductivity, pH, calcium, magnesium, sodium, potassium, carbonate and bicarbonate content as per the standard methods outlined by Richards (1954) [6]. Sodium adsorption ratio, residual sodium carbonate and soluble sodium percentage were computed using standard equations available. The water qualities were determined as per USSS classification. Rating of water quality appraisal EC, SAR, RSC and SSP are given below.

Electrical conductivity (Richards, 1954) [6]

EC (dSm ⁻¹ at 25 °C)	Symbol	Salinity class
0-0.25	C ₁	Low
0.25-0.75	C ₂	Medium
0.75-2.25	C ₃	High
2.25-5.00	C ₄	Very high

Sodium Adsorption Ratio (Richards, 1954) [6]

SAR value	Symbol	Class
0-10	S ₁	Low Na water
10-18	S ₂	Medium Na water
18-26	S ₃	High Na water
>26	S ₄	Very high Na water

Residual Sodium Carbonate (Eaton, 1950)

RSC (me/l) value	Class
<1.25	Safe
1.25-2.50	Marginal
>2.50	Unsafe

Soluble Sodium Percentage (Richards, 1954) [6]

Sr. No.	SSP	Class
1.	<60	Good
2.	>60	Fair

Results and Discussion

The data presented in Table.1 indicated that in general, underground well waters were slightly neutral to alkaline in reaction. The overall pH values of irrigation water ranged from 7.01 to 8.56 with mean value of 7.68 indicating waters of the region were alkaline in nature. The water samples of region were found saline and overall EC values ranged from 0.70 to 9.24 with mean value of 2.04 dSm⁻¹. The overall mean value of SAR was 4.58 and it was varied from 1.36-10.91. The lowest (1.36) and highest (10.91) SAR values were reported in samples collected from Jam Kandorna and Upleta talukas, respectively. The RSC values ranged from 0.0 to 1.70 with mean value of 0.15 me l⁻¹. The highest mean RSC value (0.40 meL⁻¹) was recorded in Jam Kandorna taluka, whereas the lowest (0.03 me l⁻¹) in Rajkot taluka. The overall mean value of SSP was 51.66, which varied from 23.28 to 79.21. These results are in conformity with those reported by Maliwal and Timbadia (2000) [3], Polara and Kabaria (2006) [4] and Rajput and Polara (2013) [5].

Among the cations, overall highest proportion of Na⁺ (9.80 me l⁻¹) was observed, which was followed by Ca⁺⁺ (5.55 me l⁻¹), Mg⁺⁺ (3.76 me l⁻¹) and K⁺ (0.05 me l⁻¹). The presence of large proportion of Na⁺ in most of the area under investigation is indicative of a potential danger for the alkalinity hazards. The overall concentration of Ca⁺⁺, Mg⁺⁺, Na⁺ and K⁺ varied from 1.10 to 22.50, 0.90 to 17.20, 2.32 to 43.5 and 0.00 to 0.69 me l⁻¹, respectively (Table 2). The highest mean value for Na⁺ (18.55 me l⁻¹) was found in Upleta taluka followed by Paddhari (12.20 me l⁻¹), while the lowest mean value for Na⁺ (5.58 me l⁻¹) was reported in Jasdan taluka (Table 2). Similar results were also found by Timbadia (1988) [7] for Jafrabad and Rajula talukas of Amreli district and Rajput and Polara (2013) [5] for Bhavnagar district.

In case of anions, the highest overall mean value of 12.34 me l⁻¹ was recorded for Cl⁻ and it was followed by HCO₃⁻ (4.99 me l⁻¹), SO₄⁻ (0.90 me l⁻¹) and CO₃⁻ (0.05 me l⁻¹). The highest mean value of Cl⁻ (25.10 me l⁻¹) and SO₄⁻ (1.43 me l⁻¹) was observed in Upleta and Jetpur talukas, respectively, whereas CO₃⁻ (0.20 me l⁻¹) and HCO₃⁻ (7.20 me l⁻¹) in Jetpur and Upleta talukas. The overall range values for CO₃⁻, HCO₃⁻, Cl⁻ and SO₄⁻ were 0.0 to 1.40, 1.10 to 11.50, 1.70 to 67.90 and 0.10 to 4.06 me l⁻¹, respectively (Table 2). Similar results were also found by Timbadia (1988) [7] for Jafrabad and Rajula talukas of Amreli district and Rajput and Polara (2013) [5] for Bhavnagar district.

The percentage distribution of water samples into different quality indices viz., EC and SAR are presented in Table 3. The data showed that overall 1.0, 2.0, 68.5 and 28.5 per cent samples were found under C₁, C₂, C₃ and C₄ classes of EC, respectively. Overall 83.0 and 17.0 per cent samples were found under safe and unsafe classes of SSP, respectively. Overall 95.5, 4.5 and 0.0 per cent samples were found under safe, marginal and unsafe classes of RSC, respectively. The overall 97.0, 3.0, 0.0 and 0.0 per cent samples were found under S₁, S₂, S₃ and S₄ classes of SAR, respectively.

Highly significant positive relations were observed (Table 4) between EC_{iw} with SSP_{iw} and SAR_{iw}. These indicate that SSP and SAR increase with increasing EC. The pH_{iw} was significantly and positively correlated with RSC_{iw}. The SSP_{iw} was significantly and positively correlated with SAR_{iw}. This studied shows that there is a need to use underground water with caution.

Table 1: Talukawise range and mean values of EC, pH and different indices of irrigation water samples of Rajkot district

Name of Taluka	EC (dS m ⁻¹)	pH	RSC (me l ⁻¹)	SSP	SAR
Paddhari	1.31-5.50 (2.20)	7.18-8.29 (7.68)	0.00-1.10 (0.23)	45.29-68.61 (55.85)	3.52-10.90 (5.59)
Rajkot	1.12-4.71 (2.16)	7.05-7.98 (7.62)	0.00-0.60 (0.03)	29.58-63.60 (47.80)	2.17-7.91 (4.22)
Lodhika	0.89-2.31 (1.36)	7.06-8.31 (7.71)	0.00-1.40 (0.27)	37.19-70.18 (53.50)	2.62-6.72 (3.97)
Kotda Sangani	0.70-2.95 (1.60)	7.06-7.96 (7.59)	0.00-0.80 (0.15)	37.04-68.77 (54.54)	2.27-7.47 (4.36)
Upleta	1.71-9.24 (3.68)	7.04-8.22 (7.74)	0.00-1.00 (0.19)	23.28-60.31 (44.33)	2.12-10.91 (5.07)
Dhoraji	1.05-6.22 (2.43)	7.12-8.07 (7.69)	0.00-1.40 (0.15)	38.16-66.78 (53.38)	2.71-8.42 (5.17)
Jam Kandorna	0.81-3.06 (1.40)	7.03-8.56 (7.76)	0.00-1.70 (0.40)	27.65-77.79 (56.81)	1.36-9.24 (4.68)
Gondal	1.01-4.33 (1.69)	7.01-8.24 (7.81)	0.00-1.00 (0.13)	41.57-68.31 (51.47)	2.74-6.29 (4.18)
Jetpur	0.51-3.95 (2.20)	7.07-8.42 (7.58)	0.00-1.00 (0.08)	38.56-79.21 (54.56)	2.31-7.99 (5.20)
Jasdan	1.12-2.61 (1.70)	7.04-7.95 (7.61)	0.00-0.90 (0.05)	27.11-67.81 (44.39)	1.61-6.15 (3.45)
Overall	0.70-9.24 (2.04)	7.01-8.56 (7.68)	0.00-1.70 (0.15)	23.28-79.21 (51.66)	1.36-10.91 (4.58)

Table 2: Talukawise range and mean values of cations and anions of well/ tube well water samples of Rajkot district.

Name of Taluka	Cations in me l ⁻¹				Anions in me l ⁻¹			
	Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	CO ₃ ⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻
Paddhari	3.10-10.80 (5.50)	1.90-7.80 (3.80)	6.87-33.40 (12.20)	0.02-0.05 (0.03)	0.00-0.80 (0.00)	4.00-8.50 (6.10)	6.70-42.80 (13.40)	0.10-2.96 (1.23)

Rajkot	2.40-19.70 (6.60)	1.80-11.70 (4.40)	4.94-25.20 (9.66)	0.00-0.47 (0.06)	0.00-0.00 (0.00)	2.30-9.40 (5.10)	5.50-40.50 (14.10)	0.13-2.69 (0.77)
Lodhika	1.20-6.80 (3.50)	1.10-4.40 (2.30)	4.58-10.77 (6.56)	0.00-0.08 (0.04)	0.00-0.40 (0.00)	3.00-6.10 (4.40)	2.50-15.20 (6.90)	0.10-1.38 (0.42)
Kotda Sangani	1.10-8.40 (3.70)	0.90-5.90 (2.60)	3.17-14.68 (7.67)	0.01-0.28 (0.06)	0.00-0.60 (0.10)	2.60-6.60 (4.10)	1.70-20.10 (8.40)	0.10-1.46 (0.70)
Upleta	3.90-22.50 (11.60)	1.90-17.20 (7.30)	5.29-43.5 (18.55)	0.01-0.69 (0.11)	0.00-0.80 (0.10)	3.10-11.30 (7.20)	8.90-67.90 (25.10)	0.27-2.92 (1.25)
Dhoraji	2.50-18.20 (6.00)	1.90-9.50 (4.40)	5.24-29.5 (11.71)	0.01-0.09 (0.03)	0.00-0.00 (0.00)	2.90-8.90 (5.50)	4.30-52.30 (15.10)	0.10-1.56 (0.64)
Jam Kandorna	1.20-6.80 (3.40)	0.90-4.20 (2.00)	2.32-18.37 (7.49)	0.01-0.27 (0.07)	0.00-0.20 (0.00)	1.80-7.30 (4.50)	2.60-18.30 (6.90)	0.24-1.96 (0.42)
Gondal	1.40-12.90 (4.50)	1.10-6.20 (3.20)	4.61-19.33 (8.18)	0.01-0.24 (0.06)	0.00-0.80 (0.10)	1.60-6.80 (4.60)	2.60-35.40 (9.60)	0.17-2.24 (0.80)
Jetpur	1.20-10.40 (5.50)	0.90-7.40 (4.00)	2.86-19.28 (11.13)	0.00-0.10 (0.03)	0.00-1.40 (0.20)	1.10-6.90 (4.20)	3.20-30.60 (14.10)	0.38-3.44 (1.43)
Jasdan	2.30-8.40 (5.20)	1.90-5.80 (3.60)	3.50-10.4 (5.58)	0.01-0.07 (0.02)	0.00-0.00 (0.00)	2.10-5.90 (4.20)	4.60-15.90 (9.80)	0.39-4.06 (1.34)
Overall	1.10-22.50 (5.55)	0.90-17.20 (3.76)	2.32-43.5 (9.80)	0.00-0.69 (0.05)	0.00-1.40 (0.05)	1.10-11.50 (4.99)	1.70-67.90 (12.34)	0.10-4.06 (0.90)

Table 3: Percentage distribution of well/tube well water samples into different EC and SAR, RSC and SSP classes.

Name of Taluka	EC (dS m ⁻¹)				SAR classes				RSC classes			SSP classes	
	C ₁	C ₂	C ₃	C ₄	S ₁	S ₂	S ₃	S ₄	Safe	Marginal	Unsafe	Safe	Unsafe
Paddhari	0 (0)	5 (1)	65 (13)	30 (6)	95 (19)	5 (1)	0 (0)	0 (0)	90 (18)	10 (2)	0 (0)	65 (13)	35 (7)
Rajkot	0 (0)*	0 (0)	70 (14)	30 (6)	100 (20)	0 (0)	0 (0)	0 (0)	100 (20)	0 (0)	0 (0)	100 (20)	0 (0)
Lodhika	0 (0)	10 (2)	95 (19)	5 (1)	100 (20)	0 (0)	0 (0)	0 (0)	90 (18)	10 (2)	0 (0)	75 (15)	25 (5)
Kotda Sangani	5 (1)	5 (1)	70 (14)	20 (4)	100 (20)	0 (0)	0 (0)	0 (0)	95 (19)	5 (1)	0 (0)	75 (15)	25 (5)
Upleta	0 (0)	0 (0)	25 (5)	75 (15)	75 (15)	25 (5)	0 (0)	0 (0)	100 (20)	0 (0)	0 (0)	90 (18)	10 (0)
Dhoraji	0 (0)	0 (0)	55 (11)	45 (9)	100 (20)	0 (0)	0 (0)	0 (0)	95 (19)	5 (1)	0 (0)	85 (17)	15 (3)
Jam Kandorna	0 (0)	0 (0)	80 (16)	20 (4)	100 (20)	0 (0)	0 (0)	0 (0)	85 (17)	15 (3)	0 (0)	70 (14)	30 (6)
Gondal	0 (0)	0 (0)	95 (19)	5 (1)	100 (20)	0 (0)	0 (0)	0 (0)	100 (20)	0 (0)	0 (0)	95 (19)	5 (1)
Jetpur	5 (1)	0 (0)	50 (10)	45 (9)	100 (20)	0 (0)	0 (0)	0 (0)	100 (20)	0 (0)	0 (0)	80 (16)	20 (4)
Jasdan	0 (0)	0 (0)	90 (18)	10 (2)	100 (20)	0 (0)	0 (0)	0 (0)	100 (20)	0 (0)	0 (0)	95 (19)	5 (1)
Overall	1.0 (2)	2.0 (4)	68.5 (137)	28.5 (57)	97.0 (194)	3.0 (6)	0.0 (0)	0.0 (0)	95.5 (191)	4.5 (9)	0.0 (0)	83.0 (166)	17.0 (34)

Table 4: Correlation coefficients among different properties of irrigation water and irrigated soils of Rajkot district.

	EC _{iw}	pH _{iw}	RSC _{iw}	SSP _{iw}	SAR _{iw}	EC _{2.5}	pH _{2.5}	SSP _{2.5}	SAR _{2.5}	RSC _{2.5}	ESP
EC _{iw}	1.000	--	--	--	--	--	--	--	--	--	--
pH _{iw}	0.282	1.000	--	--	--	--	--	--	--	--	--
RSC _{iw}	0.044	0.531*	1.000	--	--	--	--	--	--	--	--
SSP _{iw}	0.696**	0.028	0.354	1.000	--	--	--	--	--	--	--
SAR _{iw}	0.657**	0.322	0.284	0.415*	1.000	--	--	--	--	--	--
EC _{2.5}	0.927**	0.446*	-0.006	-0.488	0.457*	1.000	--	--	--	--	--
pH _{2.5}	0.214	0.652**	0.642**	0.238	0.355	0.112	1.000	--	--	--	--
SSP _{2.5}	0.599**	0.333	-0.082	0.642**	0.482*	0.628**	0.427	1.000	--	--	--
SAR _{2.5}	0.870**	0.441*	-0.031	0.532*	0.451*	0.948**	0.248	0.826**	1.000	--	--
RSC _{2.5}	-0.456	0.404*	0.170	0.364	-0.239	-0.398	0.599*	0.260	-0.146	1.000	--
ESP	0.715**	0.329	0.026	-0.541	0.133	0.856**	0.101	0.741**	0.882**	-0.023	1.000

* Significant at 5 per cent level

** Significant at 1 per cent level

Reference

- Eaton FM. Significance of carbonates in irrigation water. Soil Science. 1950; 69:23-133.
- Girdhar IK. Effect of different RSC waters of varying salinity and SAR on soil properties of Haplustalfs. Journal of the Indian Society of Coastal Agricultural Research, 1996; 14(1&2): 69-71.
- Maliwal GL, Timbadia NK. Nutrient status of coastal salt affected soil and their relationship with soil properties. Journal of Indian Society of the Coastal Agricultural Research. 2000; 18:58-60.
- Polara JV, Kabaria BD. Fertility status of irrigated soils of coastal Amreli district of Gujarat. Journal of the Indian Society of Coastal Agricultural Research. 2006; 24(1):50-51.
- Rajput SG, Polara KB. Evaluation of quality of irrigation water in coastal Bhavnagar district of Saurashtra region of Gujarat. Journal of the Indian Society of Soil Science. 2013; 61(1):317-320.
- Richards LA. Diagnosis and Improvement of Saline and Alkali Soils. Hand Book No. 60, Oxford and IBH pub. Co., Calcutta, 1954, 16.
- Timbadia NK. Survey of the quality of underground well waters and their effects on soil properties of Jafarabad, Kodinar, and Rajula talukas of Amreli district. M.Sc. thesis, GAU, Sardar Krushinagar, 1988.