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Irrigation water quality evaluation from Renapur Tahsil of Latur district

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Abstract

Quality parameters of irrigation water from Renapur Tahsil of Latur district were studied during the year 2021. Total 100 irrigation water samples were collected from 20 villages of Renapur Tahsil. The water samples were analyzed for its quality parameters viz., pH, EC, TDS, TH, cations and anions. The results obtained from investigation revealed that all irrigation water samples from Renapur Tahsil were slightly alkaline in nature with pH of 7.66. The average EC of these irrigation waters was 0.70 dSm-1. Among 100 irrigation water samples 70 and 29 per cent water samples were categorized as C₂ (medium salinity) and C₃ (high salinity) classes, respectively. The TDS of irrigation water samples were varied from 243.20 to 966.41 mgL⁻¹ with an average value of 451.46 mgL⁻¹ and the average hardness (TH) of irrigation water was 263.6 mgL⁻¹. Among all the cations sodium (Na⁺) was dominant in water with an average value of 7.3 meL⁻¹ and in higher concentration as compared to other cations. The relative proportion of cations in irrigation water were Na⁺ > Mg²⁺ > Ca²⁺ > K⁺. The concentration of anions indicated that sulphate was dominant in irrigation water followed by Cl⁻ > HCO₃⁻ > CO₃²⁻. The correlation study pH and EC showed positive and significant correlation with all the cations and anions present in the water.

Keywords: pH, EC, TDS, TH cations, anions

Introduction

Irrigation plays an important role to increase agriculture production. The availability of water for irrigation purpose is the main constraint in the state of Maharashtra, Rajasthan, Karnataka, and Gujarat due to limited resources of water as compare to the other states. Maharashtra is the third largest state in the country with total geographical area of 30.8 M ha and cultivable area of 24.6 M ha of which hardly 17 per cent presently irrigated by canal, lift or wells (Anonymous, 2011) [1]. Irrigation is the boon to agriculture as it increases the productivity of crop. The quality of irrigation water is crucial factor for long-term soil productivity. Poor quality water if used for a long time can make the soil less productive or even barren, depending on the amount and type of constituents present in it and the texture of the soil. Low or marginally saline water sometimes appear to stimulate crop growth because of the higher amounts of nutrients ions present. However, excess of the soluble salts in water leads to their accumulation in the surface layer particularly in fine textured or poorly drained soils. Use of saline water for irrigation purpose decrease the uptake of nutrients (Patil *et al.*, 1995) [12] and continuous use of sodic water for irrigation decrease soil productivity (Yadav *et al.*, 2007) [16]. In India 54% of irrigation is given through well, out of the total irrigation potential. In Maharashtra irrigation by well is about 63%, canal is about 29% and other is 8%. Maharashtra is the third largest state in the country with total geographical area of 30.8 M ha and cultivable area of 24.6 M ha of which hardly 16.2% is presently irrigated by canal, lifts or wells. States like Rajasthan, Karnataka, Gujarat and Maharashtra have limited water resources in comparison with other states (Ghodke *et al.* 2016) [6].

Material Methods

Collection of water samples: Irrigation water samples were collected from 20 villages of Renapur Tahsil in summer season. From each village five irrigation water samples were collected by following standard procedure (Richards, 1954) [14]. These water samples were collected in clean plastic bottles of one liter capacity and tightly screwed and brought to the laboratory for further analysis.

Examination of Water Samples: The pH and EC of water samples were determined by using pH and EC meter. The TDS computed by formula, $TDS = EC \times 640$. The cations like Ca^{2+} and Mg^{2+} were determined by Versenate (EDTA) titration method given by Richard, 1954 and Na^+ and K^+ were determined by using flame photometer, (Jackson, 1973) [7]. The soluble anion like CO_3^{2-} and HCO_3^- were determined by titrimetric method while Cl^- and SO_4^{2-} were determined by Mohr's titration method and turbidity method, respectively (Richards, 1954) [14].

Results and Discussion

The data regarding pH, EC, TDS and TH of irrigation water are presented in (Table- 1)

Table 1: Quality parameters Ranges of irrigation water samples from Renapur Tahsil

Parameter/Ranges	pH	EC (dSm-1)	TDS (mgL ⁻¹)	TH (mgL ⁻¹)
Minimum	7.14	0.38	243.2	155
Maximum	8.41	1.51	966.4	440
Mean	7.66	0.70	451.46	263.6
S.D	0.25	0.20	129.19	62.25
C.V%	3.35	28.61	28.61	23.61

Water pH: The pH of irrigation water was ranged from 7.14 to 8.41 with an average of 7.66. Overall data indicated that pH of water was slightly alkaline in nature. Similar results were also reported by Chauhan (2012) [3], Patil *et al* (2012) [3] and Patel *et al* (2017) [11].

Electrical conductivity (EC) of water

The EC of irrigation water from Renapur Tahsil was ranged from 0.25 to 1.51 dSm⁻¹ with the average of 0.70 dSm⁻¹. Out of 100 irrigation water samples 29 were categorized as high salinity and grouped under C3 class, while 70 and 1 water samples were under medium (C2) and low salinity (C1) class. The data revealed that 70 per cent water samples were safe for irrigation but needs moderate leaching and 29 per cent water samples have high salinity and cannot be used on soil with restricted drainage. Similar finding were also recorded by Jadhav *et al.* (2012) [8].

Total Dissolved solids (TDS)

The TDS of irrigation water samples were varied from 243.20 to 966.41 mgL⁻¹ with an average value of 451.46 mgL⁻¹. According to Davis and DeWiest (1966) [5] classifications, 71 per cent samples were less than 500 TDS mgL⁻¹ which desirable for irrigation and 29 per cent samples were in permissible limit for irrigation.

Total Hardness (TH)

The TH these water ranged from 155 to 440 mg L⁻¹ with an average 263.6 (mg L⁻¹). Classification of irrigation water from study area based on total hardness (TH) as suggested by Sawyer and McCarty, 1967) [15] maximum water samples (76%) falls under hard water category (150 to 300 mg L⁻¹) and 24% samples falls under very hard water (>300 mg L⁻¹).

Total Cations concentration

The results on concentration of cations are presented (Table-2). The Na⁺ content in water ranged from 4.1 to 14.2 me L⁻¹ with an average value of 7.3 me L⁻¹. The K⁺ content in irrigation water samples of Renapur Tahsil was ranged from 0.1 to 2.1 me L⁻¹ with an average of 0.77 me L⁻¹. The Ca²⁺

content in irrigation water ranged from 0.9 to 3.2 me L⁻¹ with an average of 1.74 me L⁻¹ and (Mg²⁺) content in water ranged from 2.00 to 5.8 me L⁻¹ with an average of 3.52 me L⁻¹. Further data revealed that among the cations sodium (Na⁺) was most dominant in irrigation water as compared to Ca²⁺, Mg²⁺ and K⁺. The relative proportion of cations in irrigation water were Na⁺ > Mg²⁺ > Ca²⁺ > K⁺. Similar finding were also reported by Rathi *et al.* (2018) [13] and Pal *et al.* (2018) [10].

Table 2: Cations ranges in irrigation water samples of Renapur Tahsil

Parameter/Ranges	Concentration of soluble cations (me L ⁻¹)			
	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺
Minimum	4.1	0.1	0.9	2
Maximum	14.2	2.1	3.2	5.8
Mean	7.3	0.77	1.74	3.52
S.D.	1.70	0.43	0.51	0.82
C.V (%)	23.19	55.61	29.30	23.49

Total Anions concentration

The data on anions in water are presented in (Table-3). The CO₃²⁻ content in irrigation water ranged from 0.1 to 2.2 me L⁻¹ with average value 0.91 me L⁻¹. The concentration of bicarbonates (HCO₃⁻) in irrigation water ranged from 3.4 to 9.1 me L⁻¹ with an average of 5.65 me L⁻¹. The chloride (Cl⁻) content in irrigation water samples of Renapur Tahsil were ranged from 4.9 to 10.1 me L⁻¹ with an average 6.8 me L⁻¹ and sulphate were ranged from 5 to 12.4 me L⁻¹ with an average of 7.67 me L⁻¹. The suitability of irrigation water on the basis of sulphate content was specified by BIS limits (1998) indicated that the 99 per cent samples were in C₂ class (Good to injurious) and 1 per cent was in C₃ class (Injurious to unsuitable) The overall data indicated that, among the anions sulphate (SO₄²⁻) was the most dominant anion in water of Renapur Tahsil as compared to other anion. The relative proportion of anions in water were SO₄²⁻ > Cl⁻ > HCO₃⁻ > CO₃²⁻. Similar results were also reported by Chourasia (2018) [4], Bhat *et al.* (2016) [2], and Kumar *et al.* (2015) [9].

Table 3: Anions Ranged in irrigation water samples from Renapur Tahsil

Parameter / Ranges	Concentration of anions (me L-1)			
	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻
Minimum	0.1	3.4	4.9	5
Maximum	2.2	9.1	10.1	12.4
Mean	0.91	5.65	6.83	7.67
S.D.	0.45	1.24	1.15	1.36
C.V (%)	49.69	21.94	16.93	17.71

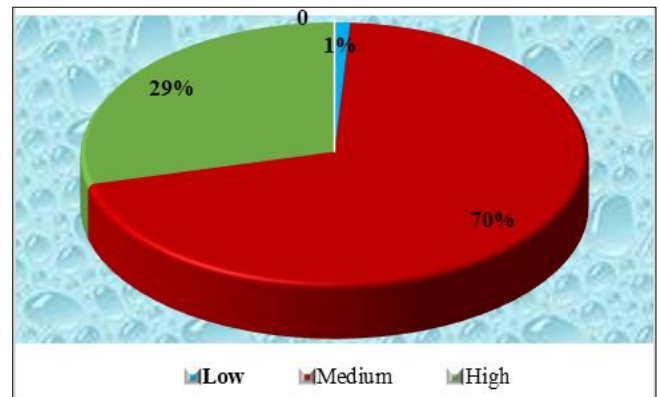


Fig 1: Categorization of irrigation water samples based on salinity classes

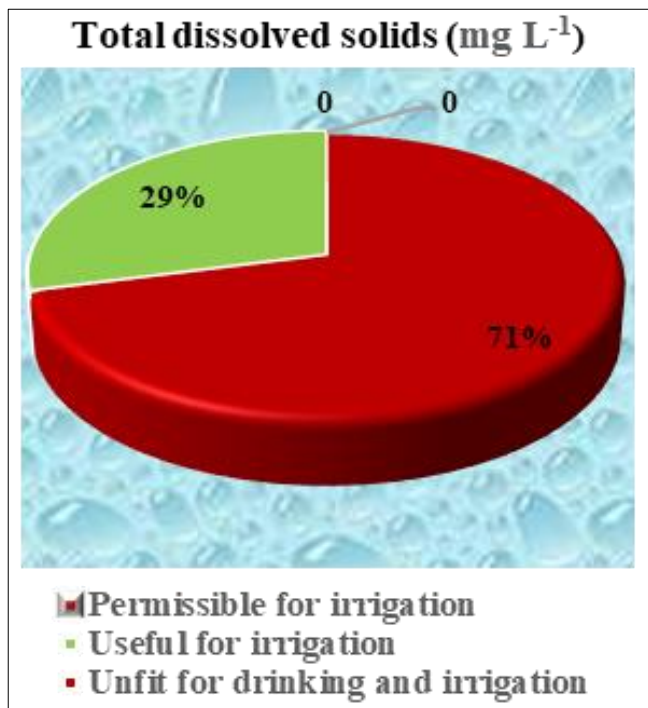


Fig 2: Classification of irrigation water based on total dissolved solids

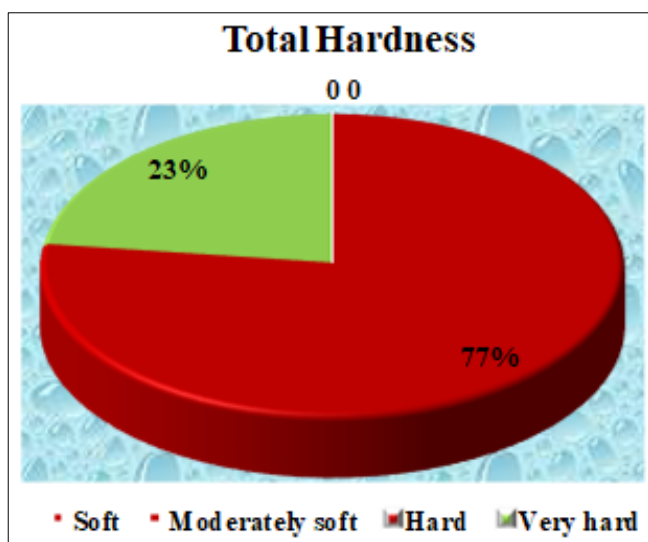


Fig 3: Classification of irrigation water based on total hardness

Correlation Study

The pH and EC of irrigation water showed positive and significant correlation with all the cations and anions present in the water. TDS of irrigation water showed positive and significant correlation with pH, EC, cations, anions. EC and TDS (1.000**) of irrigation water showed perfect positive and significant correlation with each other.

Conclusion

The irrigation water samples collected from Renapur Tahsil were slightly alkaline in nature. On the basis of salinity, 70 % irrigation water samples were having medium salinity (C_2) and safe for irrigation but needs moderate leaching, whereas 29 % samples were having high salinity (C_3) and these were not used on soil with restricted drainage. According to TDS content 29 and 71% samples were permissible and desirable for irrigation purpose. On the basis of total hardness (TH) 76% water samples were categorized as hard water and

remaining and 24% samples were very hard. Among the cations in irrigation water sodium, (Na^+) was most dominant cation followed by Ca^{+2} , Mg^{+2} and K^+ . The sulphate (SO_4^{-2}) was most dominant anion in water followed by Cl^- , HCO_3^- and CO_3^{-2} .

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