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PR Salunke
Department of Soil Science and Agricultural Chemistry, Collage of Agriculture, Latur, Maharashtra, India

Dr. PB Adsul
Department of Soil Science and Agricultural Chemistry, Collage of Agriculture, Latur, Maharashtra, India

BS More
Department of Soil Science and Agricultural Chemistry, Collage of Agriculture, Latur, Maharashtra, India

US Mutkule
Department of Soil Science and Agricultural Chemistry, Collage of Agriculture, Latur, Maharashtra, India

NR Lingayat
Department of Soil Science and Agricultural Chemistry, Collage of Agriculture, Latur, Maharashtra, India

Corresponding Author
Kaushal Kusum
Department of Veterinary Gynaecology and Obstetrics, MJF College of Veterinary and Animal Science, Jaipur, India

Studies on irrigation water quality of Chakur Tahsil of Latur district

PR Salunke, Dr. PB Adsul, BS More, US Mutkule and NR Lingayat

Abstract
To study the irrigation water quality of Chakur tahsil of Latur district, the present investigation was carried out during the year 2021-2022. Total one hundred ground water Samples were collected from 20 villages of Chakur tahsil of Latur district periodically in winter season (Jan and Feb 2021). The ground water samples were analyzed for its composition and parameters like pH, EC, cations (Na^+, K^+, Ca^{++}, and Mg^{++}), anions (CO3-, HCO3-, and Cl^-) and parameters like sodium absorption ratio (SAR), residual sodium carbonate (RSC), have also been determined for irrigation purpose. The study reveals that ground water samples are slightly alkaline in nature with dominance of sodium and bicarbonate. Majority of the water samples were higher in salinity class, indicating moderate suitability for irrigation. Among the cations Na^+ was dominant in water followed by Mg^{++}, Ca^{++} and K^+. The relative proportion of anions were in the sequence of HCO3-, Cl^- and CO3-.

Keywords: Crossbred cows, microbial isolates, antibiogram, endometrial

Introduction
Irrigation is a critical aspect in increasing agricultural production. Water for irrigation has always been a restriction in agricultural production in India's arid and semi-arid regions. In comparison to other states, Rajasthan, Karnataka, Gujarat, and Maharashtra have inadequate water resources. In the future, water will be a critical limiting resource for farm output, particularly in Maharashtra. Maharashtra is the third largest state in the country with total geographic area of 30.8 Million ha having cultivable area of 17.64 Million ha, of which net irrigation area is 2.96 Million ha which is hardly 16.78 per cent presently irrigated by canal, lifts or wells. Chakur tehsil is situated in East of Latur District, having 85 villages. The Chakur tahsil's geographical area is 67985 ha with annual rainfall of 880.40 mm, net sown area of Chakur tahsil is 54757 ha. In Chakur tahsil total open wells are 497 and tube wells are 2000. Total irrigated area of Chakur tahsil is 2330 ha and major crop grown in this region are soybean, pigeon pea, gram, groundnut, sorghum, sunflower, bajra and some horticulture crops. (Anonymous, 2009) [3].
In India 51 per cent of irrigation is by well out of the total irrigation potential. In Maharashtra irrigation by well is 56 per cent and canal is about 23 per cent. Government of India encourages for use of ground water through well and bore well but approximately 32.84 per cent of total ground water used for irrigation in India is of poor quality. This poor quality is available mainly in canal region or in command of big irrigation projects (Bhakare and Nikam, 2012) [5]. The well quality is also affected predominantly by canal, seepage leaching of rain water and excess use of irrigation water etc. (Sugirtharan *et al*., 2008) [24]. However, the assured supply of good quality irrigation water is one of the important factors for increasing agricultural production. The quality of water is an important consideration in an irrigated area. Mismanagement of land at all levels, particularly in agriculture, has led to the problem of rising water table, soil salinization and pollution of surface and ground water resources (Manjunatha *et al*., 2011) [13].
The concentration and composition of dissolved constituents in water determines its quality for irrigation. The quality of irrigation water is an important consideration in any appraisal of salinity and alkali conditions in an irrigated area. Assessment of the quality of irrigation water is necessary for judicious use of irrigation water and to obtain a sustainable crop yield. However, only few studies have been carried out in determining the quality of well water. In view of this, it was felt nessesary to assess the well water quality with the objectives to determine the salinity of irrigation water used in Chakur tahsil, to find out concentration of cations and anions in water and to judge the suitability of water for irrigation purpose.

Materials and Method

The Latur district is located between 180 05' to 180 75' North altitude and 760 25’ to 770 25’ East latitude. The geographical area of the district is 7166 sq. km with annual rainfall 787mm. Maximum and minimum temperatures of this tahsil are 41.20C and 8.70C, respectively. The elevation is 725-750 m from mean sea level which comes under Central Marathwada Plateau Agro-Climatic Zone and semi arid region. The rainfall during monsoon will occur during the month of June to September and maximum precipitation occurs in the month of July and August. The total rainfall occurred during present study was 856 mm in 28 rainy days. Total randomly selected twenty villages of Chakur tahsil and five underground water samples (three from open well and two from tube well i.e. total 60 open well and 40 tube well) were collected from each village. Total hundred were collected in winter season by using standard method procedure (Richard,1954)], water samples were collected in clean plastic bottles of one liter capacity and tightly screwed and brought to the laboratory for further analysis. The collected water samples were brought to the laboratory on same day and proper labeling were carried out for each sample and stored in refrigerator and analysis was carried out on the next day. The pH and EC of water were determined by using glass electrode pH and EC meter given by Jackson, 1973 [12]. The cations like calcium and magnesium were determined by versenate (EDTA) titration method given by APHA, 1995 [4] and sodium and potassium were determined by using flame photometer APHA, 1995 [4]. The soluble anions like carbonates, bicarbonates, were determined by titrimetric method given by APHA, 1995 [4] and chlorides were determined by the Mohrs titration method Richards, 1954 [20]. The Residual Sodium Carbonate was calculated by formula given by Eton, 1950 as RSC (me L^{-1}) = (CO_3^{--} +HCO_3^{-}) - (Ca^{++}, Mg^{++}) and Sodium Adsorption Ratio was computed by using formula Richards, 1954 [20] as

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

Result and Discussion

pH and Electrical Conductivity:

The data regarding the pH of the irrigation water samples collected from Chakur tahsil are presented in table-1. The ground water samples collected at the end of the winter season in January and February, 2021. The data indicated that the value of pH ranged from 7.05 to 8.61 with an average value of 7.66. The overall data indicate that the pH of these water samples were slightly alkaline in reaction. Among all 100 irrigation water samples 96 percent water samples found in normal range of pH (6.5 to 8.4) for irrigation water. Where 04 percent of samples was shown the pH values above the permissible level i.e. (> 8.4 pH). Increase in pH of winter season water samples might be due to increased concentration of sodium in winter season samples. Ranjith *et al.* (2017) [18] reported that the pH of irrigation water sample collected from Mahebubnagar district of Telangana ranged from 7.62 to 8.66 and represent that the 82% of the water samples had shown pH with in the recommended level (6.5 to 8.4) as given by FAO, while 18% of samples had shown the pH values above the permissible level. Patil *et al*. (2014) [15] found that the pH of irrigation water samples collected from Ahmedpur tahsil of Latur district ranged from 7.12 to 8.68 with an average value 7.58 during winter season.

The data presented in table - 1, indicates that EC values of ground water samples were ranged from 0.25 to 1.31 dSm^{-1} with an average value 0.66 dSm^{-1} in winter season.

Out of 100 water samples 22 per cent samples were categorized having high salinity (table-2) and grouped under C3 class while 77 per cent and 1per cent water samples were categorized under medium salinity water (C2) and low salinity water (C1), respectively. Further data revealed that, 22% water samples fairly suitable for irrigation cannot be used on soil with restricted drainage, while 77% water safe for irrigation but need moderate leaching and 1% ground water samples were safe suitable for irrigation purpose. Further, it was observed that water samples collected from bore well showed higher EC as compared to open well water, this might be due to bore well water were at higher depth and accumulation of more soluble salt. The ncrease in EC of winter season sample might to be due to accumulation more soluble salt in ground water. Patil *et al*. (2014) [15] reported that the EC of irrigation water samples collected from Ahemadpur tahsil, Latur district ranged from 0.23 to 1.01 dSm^{-1} during winter season and EC value ranges from 0.478 to 1.310 dSm^{-1}. These results are in conformity with those of Ranjith *et al.* (2017) [18].

Table 1: pH and (dSm-1) of irrigation water samples from Chakur tahsil.

	pH	EC
Maximum	8.61	1.31
Minimum	7.05	0.25
Mean	7.66	0.66
S.D	0.34	0.21
C.V. (%)	4.53	31.83

Table 2: Categorization of water samples of Chakur tahsil according to salinity classes

Salinity Classes ($ECdS^{-1}$)						
Parameters	**Value**	**Excellent (C_1) (Less than 0.250)**	**Good (C_2) (0.25 to 0.75)**	**Permissible (C_3) (0.75 to 2.25)**	**Doubtful (C_4) (2.25 to 3.0)**	**Unsuitable (C_5) (More than 3.0)**
Number of stele	100	1	77	22	Nil	Nil
Percent distribution	100	1%	77%	22%	Nil	Nil
Suitability of Irrigation water Leaching		Safe for irrigation	Safe for irrigation but need moderate	Cannot be used on soil with restricted drainage	Unsuitable under ordinary condition	Unsuitable for irrigation

Cation concentration

Table 3: Concentration of soluble cations (ml^{-1}) in irrigation water samples from Chakur tahsil

	Na^+	K^+	Ca^{++}	Mg^{++}
'Maximum	24.96	4.21	6.6	7.6
Minimum	8.22	1.19	3	4
Mean	17.39	2.94	4.36	5.50
S.D	4.25	0.75	0.68	0.73
C.V. (%)	24.45	25.99	15.74	13.30

The revealed that the Na^+ content of irrigation ground water samples were ranged from 8.22 to 24.96 me L^{-1} with an average value of 17.39 me L^{-1} in winter season. . Patil *et al.* (2014) [15] observed that sodium concentration in water samples from Ahemadpur tahsil of Latur district ranged from 7.92 to 24.10 me L^{-1} with an average of 16.95 meL^{-1}. Shahid *et al.* (2008) [21] observed that the sodium concentration in the water samples from Julana block of Jind district, Haryana was ranged from 0.55 to 63.30 me L^{-1} with an average value 17.01 me L^{-1}. These results are in line with finding of Gaikwad *et al.* (2019) [10]. The K content in ground water samples of Chakur tahsil (Table – 3) ranged from 1.19 to 4.21 me L^{-1} with an average value of 2.92 me L^{-1} in winter season. Ahmed *et al.* (2013) [2] reported that the concentration of cation K^+ content in ground water quality in Alathur Block, Perambalur district, Tamilnadu, were ranged from 4.00 to 59 me L^{-1}. Rathi *et al*. (2018) [19] observed that the K^+ content in ground water from Kaithal district, Haryana were ranged from 0.08 to 3.20 me L^{-1}. These result are in close agreement with those reported by Adhikary and Biswas (2011) [1].

The data regarding calcium content in irrigation ground water samples of Chakur tahsil of Latur district presented in table-3. The data indicated that the concentration of Ca^{++} in irrigation ground water samples in Chakur tahsil, were ranged from 3.0 to 6.6 me L^{-1} with an average value of 4.36 me L^{-1}. Ranjith *et al*. (2017) [18] observed that the calcium content in irrigation water samples from Mahabubnagar district, Telangana, were varied from 3.0 to 6.8 me L^{-1} and 5.1 to 7.6 me L^{-1} during kharif and rabi season with an average of 5.6 me L^{-1} and 6.6 me L^{-1} , respectively. Rathi *et al*. (2018) [19] studied the quality of calcium content in irrigation water sample from Kalayat block of Kaithal district, Haryana and found that it was ranged from 0.40 to 5.10 me L^{-1} with an average value of 2.52 me L^{-1}. Similar results were noted by Islam *et al*. (2003) [11].

The magnesium content in irrigation water samples of Chakur tahsil are presented in table-3. The magnesium content of irrigation water samples of Chakur tahsil were ranged from 4.0 to 7.6 me L^{-1} with an average value of 5.50 me $^{L-1}$. Chilkar (2011) [6] studied irrigation water quality from Udgir tahsil of Latur district and reported 4.97 me L^{-1} magnesium content of in water samples. Gaikwad *et al.* (2014) [9] collected water samples from Jalkot tehsil of Latur district and noted that Mg^{++} content in water samples ranged from 0.2 to 7.0 me L^{-1} during May. These result are in close agreement with those reported by Ranjith *et al.* (2017) [18].

The increase in cations concentration might be due to pumping of water for irrigation and domestic uses are more in summer season as compare to winter season. This decrease the quality of water and increased concentration of cations in irrigation water.

Anion concentration

Table 4: Concentration of soluble anions (ml^{-1}) in irrigation water samples from Chakur tahsil

	CO_3	HCO_3	Cl
Maximum	3.6	11.6	11
Minimum	08	5.2	6.2
Mean	2.34	8.25	8.08
S.D	0.63	1.19	0.9
C.V. (%)	27.03	14.47	12.08

The data on content of different anion *VIZ.*, Carbonate, Bicarbonate and Chloride in ground water samples of Chakur tahsil are presented in table - 5. The data regarding carbonate content in irrigation ground water samples are presented in table-5. The revealed that the CO3- content of irrigation ground water samples ranged from 0.8 to 3.6 me L^{-1} with an average value of 2.34 me L^{-1}. Dahiphale (2010) [7] reported that the carbonate content of irrigation ground water samples ranged from to 3.4 me L^{-1} with an average value of 2.04 me L^{-1} during monsoon season while during winter season ground water ranged from 1.6 to 3.9 me L^{-1} with an average value of 2.79 me L^{-1}. Singh and Bishnoi (2005) [22, 23] reported that the carbonate content of ground water in Ferozepur district of Punjab was ranged from 0 to 5.6 me L^{-1}. Similar results were also reported by Chilkar (2011) [6]. The data regarding bocarbonates concentrations in irrigation groundwater samples of Chakur tahsil presented in table-5. Indicated that the bicarbonate (HCO3-) concentration in irrigation water samples ranged grom 5.2 to 11.6 me L^{-1} with an average value 8.25 me L^{-1}. Dahiphale (2010) [7] reported that the carbonate content of ground water samples ranged from 4.5 to 8.8 me L^{-1}. Chilkar (2011) [6] observed that the carbonate content of ground water in Udgir tahsil of Latur district with average value of 2.59 me L^{-1} in summer season, while during winter season average value of 1.91 me L^{-1}. Similar result were reported by Kaur and Singh (2011) and Ranjith *et al.* (2017) [18]. The chloride content in ground water samples of Chakur tahsil presented in table-5. The data revealed that the Cl^- content of irrigation ground water samples ranged from 6.2 to 11 me L^{-1} with an average value of 8.08 me L^{-1}. Mehta *et al.* (2005) [14] reported that the chloride content of ground water in Rupnagar district of Punjab was ranged from 5.2 to 11.5 me L^{-1}. Patil *et al*. (2014) [15] reported that the chloride content of ground water in Ahmedpur tahsil area was ranged from 3.00 to 9.00 me L^{-1}. These results are in line with findings of Chilkar (2011) [6].

The increase in concentration of anion in winter season might be due to increased rain water volume of ground water.

Sodium Adsorption Ratio (SAR)

Table 5: SAR and RSC (mel^{-1}) in irrigation water samples from Chakur tahsil

	SAR	RSC
Maximum	10.98	2.4
Minimum	4.26	0.0
Mean	7.71	0.72
S.D	1.72	0.57
C.V. (%)	22.38	78.99

Table 6: Categorization of irrigation water samples based on SAR values (Sodicity).

Water classes				
S_1 (w sodium) (<10)		**S_2 (Medium sodium) (10 to 18)**	**S_3 (High Sodium) (18 to 26)**	**S_4 (Very high sodium) (>26)**
Number of sample (100)	87	13	Nil	Nil
Percent distribution (100)	87%	13%	Nil	Nil
Suitability for irrigation	Safe for irrigation	May be used on course textured soil	Ordinary unsuitable	Unsuitable

Table 7: Categorization of irrigation water samples based on RSC values

Water classes			
I (<1.25)		**II 1.25 to 2.25**	**III >2.25**
Number of sample (100)	87	13	Nil
Percent distribution (100)	87%	13%	Nil
Suitable for irrigation	Suitable	Marginal	Unsuitable

The result obtained from this investigation regarding SAR of irrigation ground water sample are presented in table 6. From the data, it was observed that SAR of irrigation water samples in Chakur tahsil were ranged from 4.26 to 10.98 me L^{-1} with an average value of 7.71 me L^{-1}. Patil (2010) [16] reported that the Sodium adsorption ratio of ground water in Renapur tahsil of Latur district was ranged from 5.1 to 11.00 me L^{-1}. Pawar *et al*. (2016) [17] observed that the SAR content of ground water in Shirur Anantpal tahsil of Latur district was ranged from 0.51 to 10.36 me L^{-1}. These results are in conformity with those of Chilkar (2011) [6]. The data regarding RSC values of irrigation ground water samples collected from Chakur tahsil are presented in table 6. It was revealed that the RSC in the irrigation water samples ranged from 0.0 to 2.4 me L^{-1} with an average value of 0.72 me L^{-1}. Chikar (2011) reported that the RSC content of ground water in Udgir tahsil was ranged from 0.0 to 3.20 me L-**1**. These results are in agreement with those reported by Patil (2014) [15].

The irrigation water samples categorized by USSL (Richards, 1954) [20] on the basis of SAR are presented in table- 7. According to these categorization all the water samples were falls under S1 (Low sodium) and S2 (Medium sodium). Further data revealed that the all water samples 100% good for irrigation and categorized in S1 (SAR < 10) and S2 (SAR 10 to 18) class.

The result regarding categorization of irrigation water samples based on RSC (Eaton, 1950) [8] are presented in table -8. Overall data observed that out of 100 water samples 87 samples were categorized in class I (suitable), 13 water samples were falls under class II (marginal) and 0 samples were falls under class III (unsuitable). Further data revealed that 87 per cent water sample were suitable for irrigation, 13 per cent samples marginally suitable for irrigation.

Conclusion

Ground water of Chakur tehsil were alkaline in reaction and with respect to salinity most of ground water was fairly suitable for irrigation purpose. Among the different cations and anions sodium and sulphate were predominant. According to sodicity and RSC most ground water safe and suitable for irrigation. Overall indicated that most of ground water of Chakur tahsil of Latur district was suitable for irrigation purpose.

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