

Research Article

Assessment of quality of ground water for irrigation in Ahmedpur tehsil of Latur district, Maharashtra

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Summary

To study the quality of irrigation water from Ahmedpur tehsil, the present investigation was carried out during the year 2010-2011. Total three hundred ground water samples were collected from 30 villages of Ahmedpur tehsil periodically in two seasons i.e. summer season (May, 2010) and winter season (October, 2010). The ground water samples were analyzed for its composition and parameters like pH, EC, cations (Na^+ and K^+), anions (Cl^- , SO_4^{2-} and boron). Soil samples were also collected from the same places of Ahmedpur tehsil, with a view to studying the changes in chemical properties of soil viz., pH and EC. The water samples were alkaline in nature with dominance of sodium and sulphates. Majority of the well waters were higher in salinity class, indicating moderate suitability for irrigation. Among the cations Na^+ was dominant in water followed by K^+ . The relative proportion of anions were in the sequence of $\text{SO}_4^{2-} \rightarrow \text{Cl}^-$. The boron concentration of irrigation water ranged from 0.90 (winter) to 1.07 (summer) ppm which was moderately safe (C_2) for irrigation. Irrigating the soils with such water, average pH and EC of soils were changed accordingly in summer and winter season.

Key words : Cations, Anions, Ground water samples

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Introduction

Irrigation is a key factor that boosts agricultural production. In arid and semi-arid region of India, availability of water for irrigation has been always a constraint in crop production. States like Rajasthan, Karnataka, Gujarat and Maharashtra have limited water resources in comparison to other states. 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. Ahmedpur tehsil is situated in East of Latur district, having 122 villages. The geographical area of the Ahmedpur tehsil is 783 sq. km with annual rainfall 808 mm, net sown area of tehsil is 80100 ha. In Ahmedpur tehsil total open wells are 7391 and tube wells are 279. Total irrigated area of Ahmedpur tehsil is 53993 ha and major crop grown in this region are soybean, pigeonpea, gram, groundnut, sorghum, bajra, sunflower and some horticultural crops.

(Anonymous, 2009).

In India 51 per cent of irrigation is by well out of the total irrigation potential. In Maharashtra irrigation by well is about 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). 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). 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).

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 necessary to assess the well water quality with the objectives to determine the salinity of irrigation water used in Ahmedpur tehsil, to find out concentration of cations and anions in water and to judge the suitability of water for irrigation purpose.

Resource and Research Methods

The water samples were collected for two times, *i.e.* in the month of May 2010 and in the month of October, 2010. The total thirty villages were selected from Ahmedpur tehsil and five underground water samples were collected from each village. Total three hundred water samples were collected in two seasons by using standard procedure (Richards, 1954), water samples were collected in clean plastic bottles of one litre capacity and tightly screwed and brought to the laboratory for further analysis. Similarly, along with water samples, total three hundred representative soil samples were also collected in two seasons from the farmers' fields from 0-15 cm depth.

Water analysis :

The pH of water sample was determined by using glass electrode pH meter and electrical conductivity was determined by using EC meter (Jackson, 1973), sodium and potassium (Na^+ and K^+) content in water samples were determined by using flame photometer (Jackson, 1973) carbonates, chlorides

and sulphate (Cl^- and SO_4^{2-}) were determined by the Mohr's titration method (Richards, 1954). Boron was estimated calorimetrically by using curcumin solution at 420 nm (Berger and Truog, 1939), as per boron concentration ground water samples were categorized as C_1 , C_2 and C_3 (Ayer and Westcott, 1985).

Soil analysis :

The total three hundred soil samples were brought to the laboratory and processed for further analysis. The samples were properly dried and grinded carefully with wooden pestle and mortar. They were passed through 2 mm sieve and stored in plastic bags with proper labeling. The soil pH was measured by using pH meter and electrical conductivity was measured by using conductivity meter as given by Jackson (1973).

Research Findings and Discussion

The findings of the present study as well as relevant discussion have been presented under following heads :

pH and electrical conductivity (EC) :

The data regarding pH of ground water samples collected from Ahmedpur tehsil is presented in Table 1. It was observed during summer season that the pH of ground water samples ranged from 7.18 to 8.81 with an average 7.93, while during winter season, it ranged from 7.12 to 8.68 with the average value 7.58. This increase in pH of summer season water samples might be due to increase in concentration of sodium dominated with carbonates and bicarbonates in summer season samples as compare to winter season samples. Lal *et al.* (1998) reported that the pH of irrigation water samples collected from Bikaner district of Rajasthan ranged from 7.10 to 8.8. Similar results were also reported by Khodapanah *et al.*

	Summer season (May-2010)		Winter season (Oct-2010)	
	pH	EC	pH	EC
Maximum	8.81	1.310	8.68	1.012
Minimum	7.18	0.478	7.12	0.236
Mean	7.93	0.812	7.58	0.575
S.D.	0.42	0.18	0.30	0.20
C.V. (%)	18.57	4.41	24.80	2.83

Parameters	Value	Salinity classes (EC dSm^{-1})				
		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 3.00)
Number of sample	300	4	173	123	Nil	Nil
Percent distribution	100	1%	58%	41%	Nil	Nil
Suitability of irrigation water		Safe for irrigation	Safe for irrigation but need moderate leaching	Cannot be used on soils with restricted drainage	Unsuitable under ordinary condition	Unsuitable for irrigation

(2009).

The data presented in Table 1 indicate that EC values of ground water samples were 0.478 to 1.310 dSm⁻¹ with the average value 0.812 dSm⁻¹ in summer season and 0.236 to 1.012 dSm⁻¹ with the average value 0.575 dSm⁻¹ in winter season.

Out of 300 water samples, 123 samples were categorized as permissible salinity (Table 2) and grouped under C₃ class while 173 and 4 water samples were having good quality (C₂) and excellent quality (C₁) salinity, respectively. Thus, 1.33 per cent water samples were excellent for irrigation while 57.66 per cent water samples were safe for irrigation but needs moderate leaching and 41 per cent water samples were fairly suitable and cannot be used on soils with restricted drainage. The increases in EC of winter season samples might be due to accumulation of more soluble salts in ground water. Mahmud *et al.* (2007) reported that the EC value of water samples ranged from 0.19 to 0.48 dSm⁻¹ which indicates low (C₁) to medium (C₂) salinity classes. Shahid *et al.* (2008) also got the same results.

Cations concentration:

The results on concentration of sodium and potassium in ground water samples of Ahmedpur tehsil are presented in Table 3. The data revealed that the Na⁺ content of ground water samples ranged from 7.92 to 24.10 me L⁻¹ with an average value of 16.95 me L⁻¹ during summer season, while during winter season it ranged from 7.10 to 21.73 me L⁻¹ with an average value of 15.24 me L⁻¹. Shahid *et al.* (2008) observed that the sodium concentration in the water samples from Julana block of Jind district, Haryana had a wider range of Na⁺ from 0.55 to 63.30 me L⁻¹ with mean value of 17.01 me L⁻¹. Similar results were also found by Khodapanah *et al.* (2009). The K⁺ content in ground water samples of Ahmedpur tehsil (Table 3) ranged from 0.05 to 0.19 me L⁻¹ with an average value of 0.115 me L⁻¹ during summer season (May, 2010), while in winter season (Oct, 2010) K⁺ content in water samples ranged from 0.033 to 0.124 me L⁻¹ with an average value of 0.069 me L⁻¹. Singh and Bishnoi (2004) studied that the potassium content

	Summer season (May-2010)		Winter season (Oct-2010)	
	Na ⁺	K ⁺	Na ⁺	K ⁺
Maximum	24.10	0.19	21.73	0.124
Minimum	7.92	0.05	7.10	0.033
Mean	16.95	0.115	15.24	0.069
S.D.	3.44	0.026	3.06	0.019
C.V. (%)	4.92	4.33	4.96	3.50

	Summer season (May-2010)			Winter season (Oct-2010)		
	Cl ⁻	SO ₄ ²⁻	Boron (ppm)	Cl ⁻	SO ₄ ²⁻	Boron (ppm)
Maximum	11.5	24.8	1.90	8.9	22	1.90
Minimum	5.2	12.9	0.50	5.0	10.7	0.50
Mean	7.42	19.24	1.07	6.69	16.36	1.07
S.D.	1.14	3.13	0.26	0.91	3.08	0.26
C.V. (%)	6.48	6.14	4.07	7.29	5.29	4.07

Sr. No.	Class	Boron concentration (ppm)	No. of irrigation water samples	Percentage irrigation water samples
1.	C ₁	<0.5	17	5.66%
2.	C ₂	0.5 to 2.0	283	94.33%
3.	C ₃	>2.0	Nil	Nil

	Summer season (May-2010)		Winter season (October-2010)	
	pH	EC	pH	EC
Maximum	8.96	1.577	8.91	1.311
Minimum	7.35	0.557	7.20	0.378
Mean	8.18	0.985	7.90	0.764
S.D.	0.42	0.17	0.40	0.21
C.V. (%)	19.16	5.56	19.28	3.58

in underground water of Muktsar district of Punjab ranged from 0.07 to 2.95 me L⁻¹.

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

Anions concentration :

The data on contents of different anions *viz.*, chloride and sulphate in ground water samples of Ahmedpur tehsil are presented in Table 4. The data showed that the Cl⁻ content in water samples of Ahmedpur tehsil ranged from 5.2 to 11.5 me L⁻¹ with an average value of 7.42 me L⁻¹ during the summer season, while during winter season it was 5.0 to 8.9 me L⁻¹ with an average value of 6.69 me L⁻¹. Singh and Bishnoi (2004) studied the chloride content in underground water samples of Malout Block of Muktsar district of Punjab ranged from 0.8 to 42.7 me L⁻¹. Similar results were also found by Bharadwaj *et al.* (2010). The SO₄⁻ content in water samples of Ahmedpur tehsil ranged from 12.9 to 24.8 me L⁻¹ with an average value of 19.24 me L⁻¹ during summer season, while during winter season samples, it ranged from 10.7 to 22 me L⁻¹ with an average value of 16.36 me L⁻¹. Lal *et al.* (1998) reported that sulphate content in underground water sample of Bikaner tehsil, Dist. Bikaner ranged from Nil to 31.9 me L⁻¹. The data in Table 4 indicates that boron value of ground water samples ranged from 0.50 to 1.90 ppm with an average value of 1.07 ppm during summer season (May, 2010), while during winter season (Oct., 2010), it ranged from 0.50 to 1.90 ppm with an average value of 1.07 ppm. In Khuian Sarvar Block of Ferozpur district of Punjab boron content ranged from 0.19 to 3.63 ppm (Singh and Bishnoi, 2005).

The data regarding categorization of ground water samples based on boron concentration are presented in Table 5. Out of 300 water samples collected from Ahmedpur tehsil, 17 and 283 water samples were categorized in C₁ and C₂ class, respectively, indicating that majority of ground water samples (94.33 %) were moderately safe for irrigation and categorized in C₂ class, while none samples was found unsafe for irrigation.

The results showed that the Cl⁻, SO₄⁻ and boron concentration of summer season samples was higher than the winter season samples. The reason for low concentration of anions in waters of winter season (Oct., 2010) might be due to increased rain water volume of water and by dilution effect, anions concentration in winter season decreased as compared to summer season. Such results were also given by Gupta and Abichandana (1967).

Chemical properties of soil :

pH and electrical conductivity (EC):

The data regarding pH of soil samples collected from Ahmedpur tehsil are presented in Table 6. It was observed

that pH of soils in Ahmedpur tehsil ranged from 7.35 to 8.96 with an average value of 8.18 during summer season, while during winter season, it ranged from 7.20 to 8.91 with an average value of 7.90. pH of summer season samples were higher as compared to winter season samples. The increase in pH of soil collected in summer season samples might be due to increase in carbonates and bicarbonates of sodium in waters of summer season and accumulation of alkali salts in soil. Bhalerao and Pharande (2003) studied the pH of salt-affected swell-shrink soils of central research farm, Mahatma Phule Krishi Vidyapeeth, Rahuri (Ahmednagar district) which varied from 7.7 to 8.9.

The data regarding EC of soil samples collected from Ahmedpur tehsil showed that EC of soils in Ahmedpur tehsil ranged from 0.557 to 1.577 dSm⁻¹ with an average value of 0.985 dSm⁻¹ during summer season, while during winter season, it ranged from 0.378 to 1.311 dSm⁻¹ with an average value of 0.764 dSm⁻¹ (Table 6). Further data revealed that the EC of summer season soil was higher as compared to winter season soil. This increase in EC of summer season, soil samples might be due to accumulation salts on the surface of soil. Similar findings were also reported by Padole and Mahajan (2003) and Waikar *et al.* (2004).

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