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Suitability of Ground Water for Irrigation near Mula Canal Command Area of Rahuri Tahsil in the Ahmednagar District

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Abstract

Chemical analysis of ground water samples of Mula right bank canal command area in Rahuri tahsil of Ahmednagar district, Maharashtra State of India was carried out to determine the suitability of groundwater for irrigation. Sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) concentrations in the water samples were analyzed and Electrical conductivity (EC) was measured periodically during December 2006 to March 2007. The results indicated that the groundwater can be used for irrigation with the suitable management practices.

Key words: Command area, ground water, seepage, sodicity

Introduction

Ahmednagar district is located at the Western part of the Maharashtra state in India, receiving average annual rainfall of 520mm . Main water resources of the district are the rivers, dam and groundwater. Rahuri is one of the tahsils in this district and major portion of the population is encaged in Agriculture. Water from Mula dam and groundwater resources are utilized by the farmers for the irrigation purpose (Dhonde *et al.,* 2003). The catchment area of this dam is about 2274km^2. The command area was fully developed in 1975-76. Water from the Mula dam is diverted to the farmers' field by two canals called Mula Right Bank Canal (MRBC) and Mula Left Bank Canal (MLBC). Depends on these canals the command area also divided into MRBC and MLBC command areas. Mula command area caters the irrigation needs of Rahuri, Newasa, Shavgaon and Pathardi Tahsils of the Ahmednagar district.

MRBC command area of Rahuri tahsil has several shallow and deep wells which supplement the canal water irrigation. In some part of the season, the quality of this well waters changed by the canal seepage during canal rotation as well as changes occurs due to the climatic variations (Anonymous, 2001;Sugirtharan *et al*, 2008). In this view, this study was carried out in *Rabi* season to determine the variation in the quality of well waters and it's suitability for irrigation.

Material and Methods

Five wells were selected from the Mula right bank canal command area of Rahuri Tahsil to study the variation in its quality. Distance between each well was about 1500 meters. Three water samples in different points were collected from each well in separate plastic bottles and sampling was done at monthly intervals from December 2006 to March 2007. The methods for analysis were followed according to the USDA Handbook 60 (Richards 1954). Sodium (Na) was determined using flame photometer; calcium and magnesium were determined by Versante titration method. Electrical conductivity (EC) was measured by the digital conductivity meter. The relative proportions of sodium to other cations were determined by the Sodium Adsorption Ratio (SAR) and Soluble Sodium Percentage (SSP) using following equations Richards (1954).

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

$$SSP = \frac{Na^+}{Na^+ + Ca^{2+} + Mg^{2+} + K^+} X100$$

Where the concentrations of each ion is expressed in meqL^{-1}

Results and Discussion

Figure 01 shows the monthly variation of SAR values of the well water samples in four months period of study. Water samples from sampling location No 02 showed higher values compared to other 4 locations. Likewise lower values of SAR were observed at the location No 05 during the whole study period.

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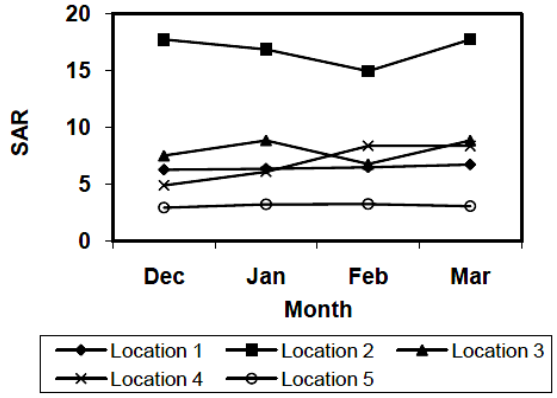

Fig 01: Monthly variation of SAR of the well water in MRBC command area

The highest SAR value of 17.75 was observed at location No 02 during the month of March which location is closer (100m) to the MRBC compared with the other 4 sampling location. The lowest SAR (2.97) was found at location No. 05 during December 2006 which is located nearly about 300m away from MRBC. Among the 5 sample locations proper lining of canal was only observed in the area near to the location No.05. This may be the cause for the lower value of SAR in well water sample due to the restricted seepage from the canal.

Table 01: Classification of irrigation water based on the SAR (Richards, 1954).

Water class	**SAR value**	**Suitability**
Low Sodium hazard	Below 10	Can be used for all types of soil
Medium sodium hazard	10 – 18	Used for coarse textured soil
High sodium hazard	18 – 26	Unsatisfactory for most of the crops
Very high sodium hazard	above 26	Unsuitable for irrigation

According to the classification of irrigation water based on SAR values (Table 01), groundwater from the selected wells can be used for irrigation with the suitable management practices in order to improve the infiltration capacity because of the accumulation of exchangeable sodium in the soil.

The following Table 02 shows the variation in the mean values of SSP at 5 locations.

Table 02 The variation in the mean values of SSP

Sampling Location	**Soluble Sodium Percentage (%)**			
	Month			
	Dec 2006	**Jan 2007**	**Feb 2007**	**Mar 2007**
01	67.7	66.6	66.2	66.6
02	87.3	87.2	84.0	86.6
03	64.1	68.6	61.8	66.6
04	63.8	64.8	71.3	68.5
05	53.2	53.5	52.2	48.1

Water samples collected from location No.02 showed higher values than the others. Seepage from the canal may be the reason for these higher observed values. Lowest value was observed in Location No. 05. There are some reductions in the SSP values in the month of February except the location No.04. Break in canal rotation and lower level of water in the canal was observed during the sample collection, this might be the reason for the reduction of SSP in that particular month. Introducing proper management techniques in order to improve the soil structure in respect of increasing the infiltration rate can be a solution to overcome this problem.

According to the Wilcox's classification of irrigation water based on the SSP values (Table 03), showed that the water samples collected from the location No.05 is suitable for the irrigation purpose. Groundwater from location 01, 03 and 04 were showed that the sodium hazard was slightly injurious. And unsatisfactory levels were found in the water samples collected from location No.02.

Table 03: Suitability of Irrigation water based on SSP values (Wilcox, 1948).

Class	**SSP (%)**	**Suitability for irrigation**
I	Less than 20	Excellent
II	20 – 40	Good
III	40 – 60	Suitable
IV	60 – 80	Doubtful
V	Above 80	Unsuitable

Figure 02 illustrates the monthly variations of Electrical Conductivity (EC) of groundwater samples. The EC values ranged between 0.63 dSm^{-1} to 2.70 dSm^{-1} with an average value of 1.79 dSm^{-1}. EC of ground water collected from location No. 02

and 03 showed higher values i.e under the doubtful class (Table 04) according to the classification made by the Bauder *et al.*, (2004). The lowest values were observed in the location No. 05.

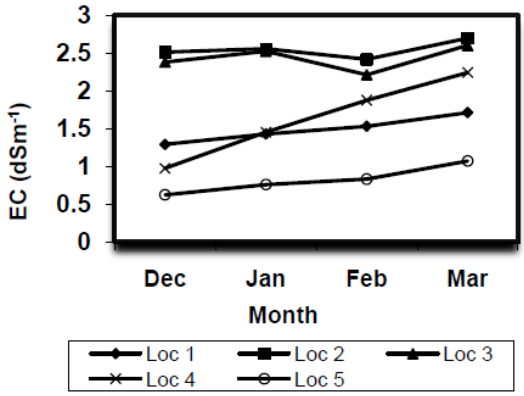

Fig 02: Monthly variation of EC (dSm^{-1}) of well water in MRBC command area

Table 04: Classification of irrigation water based on the EC (Bauder *et al.*, 2004)

Water class	**EC (dSm^{-1})**
Excellent	< 0.25
Good	0.25 - 0.75
Permissible	0.76 - 2.00
Doubtful	2.01 - 3.00
Unsuitable	>3.00

Increasing values of EC indicates a gradual buildup of salinity in the groundwater..Shallow ground water table with high EC of soils leads to secondary salinzation by the process of capillary fringe (Hillel, 1997). Ashraf (1994), also revealed that the salinity is a major factor limiting the crop productivity in the arid and semi-arid areas of the world. Similar effect will be expected in this study area too Therefore, suitable management practices and proper drainage is essential in those areas to control salinity.

Conclusion

There is an increasing concentration of Sodium and salinity in water samples from December to March. Over pumping of water from the well is the major cause for the water intrusion from the canal. Higher concentrations of Soluble Sodium Percentage (SSP), Electrical conductivity (EC) and Sodium Adsorption Ratio (SAR) values of ground water samples will cause detrimental effects on soil properties as well as to the plant growth. Most of the water samples showed higher SSP values. It will cause permeability problem in the soil. Therefore, careful management practices including drainage facilities are vital for these areas while applying this water for irrigation purpose.

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