Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences
Volume 1 Number 6: 681-682, 2002

Characterization of Tubewell Water in Tehsils of District Gujrat

[1]Zahid Pervaiz, [1]S. S. H. Kazmi, [2]K. H. Gill and [3]M. Mukhtar
[1]Soil and Water Testing Laboratory, Gujrat, Pakistan
[2]Soil Fertility Survey and Soil Testing Institute Punjab, Lahore, Pakistan
[3]Soil Fertility Survey and Soil Testing Institute, Rawalpindi, Pakistan

Abstract: Water samples from tubewells of two tehsils (Gujrat and Kharian) of district Gujrat during the years 1986 to 1999 were evaluated for irrigation quality characteristics. The data depicted that maximum number of samples (53 %) of tehsil Gujrat were found fit followed by unfit and marginally fit on the basis of electrical conductivity (EC) whereas 53 percent samples of tehsil Kharian were found unfit followed by fit and marginally fit. Sodium adsorption ratio (SAR) of 83 and 75 percent samples of tehsil Gujrat and Kharian respectively were with in the safe limits followed by marginally fit and unfit. From the residual sodium carbonate (RSC) point of view, maximum number of samples (46 and 56 percent) of tehsil Gujrat and Kharian respectively were found fit followed by unfit and marginally fit. Unfit water samples of all parameters (EC, SAR, RSC) could not be used safely for crop production. It was also found that in greater number of samples (53 %), EC was more hazardous than RSC and SAR in tehsil Kharian whereas RSC was more hazardous in tehsil Gujrat. Correlation among EC and SAR and RSC&SAR in both tehsils was observed.

Key words: Fit, marginally fit, unfit, EC, SAR, RSC

Introduction

In arid and semiarid region where rains are erratic and scarce, one has to rely upon irrigation through canals and tube wells. Forced by the canal water shortage and increasing cropping intensity to feed the ever-growing population, farmers have been tapping ground water resource on a very large scale (Kijne and Velde, 1990; Javaid *et al*., 1998). On the other hand, it is reported that about 70 percent tubewell discharge is used in agriculture sector (Anonymous, 1995) and about 75 percent of discharge of existing wells is saltish (Malik *et al*., 1984b). The use of groundwater of marginal and poor quality without proper mixing may degrade soils, especially at tail end of the system (Mohtadullah, 1997). This practice may also give rise to some apparent and hidden soil problems, directly or indirectly associated with the tubewell irrigations (Javaid *et al*., 1997).

The canal water supplies are being supplemented with ground water. Out of 16.49 million hectares (m ha) canal commanded area (CCA), 10.07 m ha contain useable and 6.42 m ha saline groundwater. The Punjab gross area in CCA is 10.86 m ha of which 9.19 m ha contain useable and 1.67 m ha contain saline groundwater (Ahmed and Chaudhry, 1968).

Quality of water is of immense importance because poor quality of both surface and groundwater is not only a limiting factor in crop production but also its constant and indiscriminate use cause secondary salinization. The extent and nature of salt accumulation and the degree of soil alkalinity depends on the quality of irrigation water. To avoid indiscriminate use of ground water, proper management practices are deemed necessary, keeping in view the crops to be grown and the soil to be used. The water quality research is also needed to develop management practices.

In Gujrat district underground water is being used for irrigation regularly alone or along with canal water. Thus it is very important to ascertain the quality of underground water used for irrigation. Voluminous work has been done for Punjab but very little information is available at district and tehsil level. In this study an attempt has been made to determine the ground water quality characteristics and relationship for two tehsils of Gujrat district.

Materials and Methods

The study area was two tehsils (Gujrat and Kharian) of district Gujrat during the years July 1986 to June 1999. Groundwater samples from running tubewells were collected from 160 locations in tehsil Gujrat and 135 locations in tehsils Kharian. These water samples were collected/received in polythene bottles after ½ hour of tubewell operations. The water samples were analyzed within three days for EC, CO_3^{-2}, HCO_3^{-}, Cl^{-}, SO_4^{-2}, Na^{+} and $Ca^{++}+Mg^{++}$ and then the sodium adsorption ratio (SAR) and residual sodium carbonate (RSC) were calculated (Anonymous, 1954). Based on the values of EC, SAR and RSC, the water samples were categorized using the standards as described by the Soil Fertility Organization (Malik *et al*., 1984a), which are as under:

	Water status		
Parameters	Fit	Marginally fit	Unfit
EC (dS m^{-1})	0–1.0	1.001–1.25	> 1.25
SAR	< 6	6 - 10	> 10
RSC (me L^{-1})	< 1.25	1.25–2.5	> 2.5

The data were grouped for relative frequency distribution. Simple statistical analysis was done and correlations between different water quality parameters were worked out (Steel and Torrie, 1980).

Results and Discussion

Data (Table 1) indicates that electrical conductivity (EC) ranged from 0.40 to 9.05 dS m^{-1} for tehsil Gujrat and from 0.54 to 6.44 dS m^{-1} for tehsil Kharian, with an average value of 1.34 and 1.83 dS m^{-1} respectively. The coefficient of variation was higher in tehsil Gujrat (88 %) than tehsil Kharian (84 %). It was further observed (Table 2) that 53 percent water of tehsil Gujrat and only 32 percent of tehsil Kharian fall with in safe limits i.e. EC up to 1 dS m^{-1} which is below the limits described for marginally (1.1 to 1.25) or unfit water (>1.25). These water could be used with out any salinity hazardous. Only 16 and 15 percent water of tehsil Gujrat and Kharian respectively fall under marginally fit category and could be considered manageable while the rest of 31 and 53 percent are unfit water of tehsil Gujrat and Kharian respectively which will cause salinization (Table 2).

The sodium adsorption ratio (SAR) ranged from 0.1 to 21.13 in tehsil Gujrat and 0.1 to 31.52 in tehsil Kharian with an average value of 3.58 and 4.50 respectively (Table 1). The coefficient of variation was higher in tehsil Kharian (102 %) than tehsil Gujrat (93 %). As regard their distribution (Table 2) 83 percent water of tehsil Gujrat and 75 percent of tehsil Kharian fall with in safe limits i.e. SAR < 6 which is below the limits described for marginally (6 – 10) or unfit water (>10). These waters could be used safely. Only 12 percent of tehsil Gujrat and 18 percent water of tehsil Kharian fall in the range of marginally fit which could be managed without any serious loss to farm production. The rest only few water will promote sodication and could not be used for good crop production.

The residual sodium carbonate (RSC) of tubewell waters ranged from 0 to 11.65 with an average of 2.83 me L^{-1} in tehsil Gujrat

Table 1: Water quality characteristics of tubewells in tehsils of district Gujrat

Parameters	Tehsil Gujrat	Tehsil Kharian
Electrical conductivity (EC) (dS m^{-1})		
Minimum	0.40	0.54
Maximum	9.05	6.44
Average	1.34	1.83
Coefficient of variation (%)	88.00	84.00
Sodium adsorption ratio (SAR)		
Minimum	0.10	0.1
Maximum	21.13	31.52
Average	3.58	4.50
Coefficient of variation (%)	93.00	102.00
Residual sodium carbonate (RSC) (me q^{-1})		
Minimum	0.00	0.00
Maximum	11.65	20.50
Average	2.83	3.17
Coefficient of variation (%)	83.00	112.00

Table 2: Relative frequency distribution (%) of tubewell waters for different quality characteristics in tehsils of district Gujrat

Parameters	Class interval	Tehsil Gujrat	Tehsil Kharian
Electrical conductivity (EC) (dS m^{-1})			
	0 -1.0	53	32
	1.1 -1.25	16	15
	> 1.25	31	53
Sodium adsorption ratio (SAR)			
	< 6	83	75
	6 - 10	12	18
	> 10	5	7
Residual sodium carbonate (RSC) (me q^{-1})			
	< 1.25	46	56
	1.25-2.50	19	19
	> 2.50	35	25

Table 3: Regression equations for water quality characteristics of tubewell waters in tehsils of district Gujrat

Regression equations	Correlation coefficient	t values
Tehsil Gujrat		
SAR = 1.2675 + 1.7210 EC	0.5956**	9.3198
RSC = 2.3005-0.0345 EC	-0.0170	
RSC = 0.8964 + 0.3819SAR	0.5283**	7.8208
Tehsil Kharian		
SAR = 1.5627 + 1.6410 EC	0.5266**	7.1440
RSC = 2.4247-0.1881 EC	-0.0892	
RSC = 0.9127 + 0.5600SAR	0.3786**	4.7172

**:$P < 0.01$

and 0 to 20.50 with an average of 3.17 me L^{-1} in tehsil Kharian. The coefficient of variation was higher in tehsil Kharian (112 %) than tehsil Gujrat (83 %). Considering the relative distribution (Table 2), it was observed that 46% water samples of tehsil Gujrat and 56 percent of tehsil Kharian fall with in safe limits which is far below the limits described for unfit water (> 2.5). The uses of these waters will not create any problem. Only 19 percent water samples of each tehsil are in the range of marginally fit and require some special management practices like use of gypsum and flushing with good quality of water (Idris and Shafiq, 1999). The rest of 35 percent of tehsil Gujrat and 25 percent of tehsil Kharian were unfit and could not be used for crop production.

It was observed that correlation among EC, SAR and RSC, SAR is highly significant for both the tehsils (Table 3). In all the parameters marginally fit waters could be manageable with some special management practices, like use of gypsum, flushing with good quality of water, alternate supply of canal water etc. However, unfit waters due to high electrical conductivity will cause salinization (Ghafoor *et al.*, 1990, 1993). To avoid salinization, it was proposed to increase/decrease the depth of bore or change the place of bore to find good quality of water due to variation in water status at different depth (Ahmed and Chaudhry, 1968 and Youns, 1977). The sodium adsorption ratio (SAR) indicates the relative proportion of sodium to calcium + magnesium whereas residual sodium carbonate is an index, which indicates the sodium hazards (sodication of soil). The unfit water samples (containing excess of carbonate and bicarbonate) for irrigation will precipitate soil solution calcium and increase solution sodium, resulting in soil dispersion (Emerson and Bakker, 1973) as well as impaired nutrient uptake by plants (Kanwar and Chaudhry, 1968.).

It is therefore, recommended that unfit water samples may need special management practices if to be used for irrigation but preferably should be avoided because all these factors will combine to lower down the farm production. However, the extent of deteriorating effect of these factors will vary with soil type and management practices.

References

Ahmed, N. and G.R. Chaudhry, 1968. Irrigated Agricultural of Pakistan. Publisher, M. Shahzad. 61-8/2 Gulberg 3, Lahore, Pakistan.

Anonymous, 1954. U.S. Salinity Lab. Staff. Diagnosis and Improvement of Saline and Alkali Soil. USDA HandBook 60. Washington, USA.

Anonymous, 1995. Effect of groundwater use on soil properties and agricultural development in SCARP in Pakistan. IWASRI Pub. No. 156, pp: 290.

Emerson, W.W. and A.C. Bakker, 1973. The comparative effect of exchangeable Ca: Mg and Na on some soil physical properties of red brown earth soils. 2. The spontaneous dispersion of aggregates in water. Aus. J. Soil Res., 11: 151-152.

Ghafoor, A., F. Ullah and M. Abdullah, 1990. Use of high Mg brackish water for reclamation of saline sodic soil. 1. Soil improvement. Pak. J. Agric. Sci., 27: 29 4-298.

Ghafoor, A.M. Azam and M. Shoaib, 1993. Characterization of tubewell and hand pump waters in the Faisalabad tehsil. Pak. J. Soil Sci., 8: 1-2.

Idris, M. and M. Shafiq, 1999.Irrigation quality of groundwater in Quetta division of Balochistan. Pak. J. Soil Sci., 16: 119-122.

Javaid, M.A., C.K. Ali and M.I. Khan, 1997. Groundwater quality assessment for monitoring sodium hazard of SCARP and private tubewell irrigation. Proc. Int. Symp. Water for the 21st Century, June 17-19, pp: 387-396, Lahore, Pakistan.

Javaid, M.A., C.K. Ali, J.I. Anjum and T.R. Khan, 1998. Soil characteristics and wheat yield the irrigation command of Gajargola distributary. Pak. J. Soil Sci., 14: 43-49.

Kanwar, J.S. and M.L. Chaudhry, 1968. Effect of Mg on the uptake of nutrients from the soil. J. Res. Pb. Agric. Uni., 3: 309-319.

Kijne, J.W. and E. Velde, 1990. Salinity in Punjab Watercourse Commands and Irrigation System Operation: The imperative case for improving irrigation management in Pakistan. IIMI. Res. Paper, 1990.

Malik, D.M., M.A. Khan and B. Ahmed, 1984a. Gypsum and fertilizer use efficiency of crop under different irrigation system in Punjab. Presented in Seminar, Optimum Crop Production through Management of Soil Resources, May 12-13, 1984, Pakistan.

Malik, D.M., M.A. Khan and T.A. Chaudhry, 1984b. Analysis manuals for soil, plant and water. Soil Fertility Survey and Soil Testing Institute Punjab, Lahore, Pakistan

Mohtadullah, K., 1997. Water resources development and utilization in Pakistan. Potential and Challenges, Intl. Symp. Water for the 21st century, June 17 –19, Lahore, pp: 1-12.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics, 2nd. Ed. McGraw Hill Book Company Inc, New York.

Youns, M.M., 1977. Water quality in Indus Plain. Keynote paper. pp: 283-292. In proc. Seminar Water Management for Agricultural, Nov. 15-17,1977, Lahore, Pakistan.