CHARACTERIZATION OF GROUND WATER QUALITY FOR IRRIGATION IN HAFIZABAD DISTRICT

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ABSTRACT

A total of 215 advisory water samples were received from two tehsils of district Hafizabad namely Hafizabad and Pindi Bhattian during the year 2006-07. The water samples were analysed and classified for EC (Electrical Conductivity), SAR (Sodium Adsorption Ratio) and RSC (Residual Sodium Carbonate). At district level among them 20 percent fit, 28 percent marginally fit and the rest of 52 percent were unfit for irrigation purposes. In tehsils, Hafizabad and Pindi Bhattian 22 and 15 percent water samples fit, 31 and 12 percent marginally fit and 47 and 73 percent were unfit respectively. Out of 112 unfit water samples, the RSC of 67% samples were higher followed by EC+RSC (24%), EC (6%) and combined effect of EC+SAR+RSC (3%). The unfit samples in tehsil Hafizabad were due to RSC (75%) followed by EC+RSC (20%) and EC(5%) whereas in Pindi Bhattian 45% due to higher RSc followed by EC+RSC (35%), EC (10%) and EC+SAR+RSC(10%).

Key Words: EC, SAR, RSC, Fit, Marginally fit, unfit.

INTRODUCTION

Crop production in arid and semiarid regions is dependent on irrigated agriculture. About 82 million acre feet canal water [1] is falling short for crops due to increased cropping intensity and non-agriculture demands over the years [2]. Resulatantly the farmers have been tapping about 70% poor quality ground [3-7]. Pervaiz *et al*. [8] reported that out of 680 water samples of District Gujrat, 48 percent were unfit for irrigation. Pervaiz [9] also reported that out of 52 water samples of tubewell having depth 60 $\pm$ 5 feet from 13 villages of union council Gakhra Kalan in district Gujrat, 60 percent were unfit. Ali *et al* [10] reported that out of 60 water samples from 20 villages of Lahore district, 12 percent were fit, 12 percent marginally fit and 76 percent were found unfit for irrigation purposes.

The use of poor quality ground water deteriorate soil quality [11 & 12], hence assessment of Quality of water is of immense importance. Poor quality of water is not only a limiting factor in crop production but also its constant and indiscriminate use causes secondary salinization. The extent and nature of salt accumulation depends on the quality of irrigation water. The proper management practices are deemed necessary keeping in view the crops to be grown and the soil to be used. The water quality assessment is also needed to develop management practices.

In Hafizabad district underground water is being used for irrigation alone or along with canal water. Little information is available regarding the quality of tube well water. The objective of this study was to categorize the quality of tube well water in Hafizabad district and to find out the extent of various parameters contributing individually or collectively to the quality of tube well water.

MATERIALS AND METHODS

The study area was district Hafizabad during the year 2006-07. Ground water samples from running tubewells having depth 100 to 300 feet at random were received from 215 locations of district Hafizabad. These water samples were received in polythen bottles after ½ hour of tubewell running. The collected water samples were analysed with in three days for EC, carbonate, bicarbonate, chloride, sodium and calcium +magnesium. Then the Sodium Adsorption Ratio (SAR) and Residual Sodium carbonate (RSC) were computed (Richards, 1954). Based on the value of EC, SAR and RSC, the water samples were categorized using the standards given by the Soil Fertility Punjab, Pakistan [13 & 14]. Statistical data were analysed for mean, standard deviation and percentage [15].

RESULTS

1. TEHSIL HAFIZABAD

Data on different quality parameters for tubewell water in the Hafizabad tehsil are presented in Table 1. The perusal of data indicated that EC ranged from 0.24 to 10.70 dSm^{-1} with an average value of 1.03 $\pm$ 0.79 and coefficient of variation 77 percent. The SAR ranged from 0 to 7.3 with an average value of 3.04 $\pm$1.62 and coefficient of variation 53 percent. The RSC ranged from 0 to 7 meL^{-1} with an average value 2.55 $\pm$1.66 and coefficient of variation 65 percent. Data in Table 2 showed that, 22 percent samples were fit, 31 marginally fit and 47 percent unfit. The quality wise description of fit, marginally fit and unfit water samples is as under.

(1.1) FIT WATER SAMPLES

Data in Table 3 revealed that fit water samples have an average value of EC 0.68±0.18 dSm^{-1} , SAR 1.03±0.65 and RSC 0.44±0.42 meL^{-1} and out of 38 fit samples 9 had no RSC values.

(1.2) MARGINALLY FIT WATER SAMPLES

Data in Table 4 indicated that out of 54 marginally fit water samples, 7% samples were marginally fit due to higher EC with an average value of 1.08 dSm^{-1}, 71% due to higher RSC with an average value of 1.95 meL^{-1} and 22% due to higher value of EC+RSC with an average value of EC 1.08 dSm^{-1} and RSC 2.1 meL^{-1}.

(1.3) UNFIT WATER SAMPLES

Data in Table 5 indicated that out of 83 un fit water samples, 4 samples (5%) were un fit due to higher EC with an average value of 3.83 dSm^{-1}, 62 (75%) due to higher RSC with an average value of 3.85 meL^{-1} and 17 samples (20%) were due to higher value of EC+RSC with an average value of EC 1.50 dSm^{-1} and RSC 4.85 meL^{-1}.

2. TEHSIL PINDI BHATTIAN

Data on different quality parameters for irrigation purposes are presented in Table 1. The perusal of data indicated that EC ranged from 0.25 to 8.37 dSm^{-1} with an average value of 1.52 ±1.51 and coefficient of variation 99 percent. The SAR ranged from 0.4 to 12.78 with an average value 7.50±14.09 and coefficient of variation 188. The RSC ranged from 0 to 30.60 meL^{-1} with an average value 4.80±6.07 and coefficient of variation 126 percent. Data in Table 2 showed that, 15 percent samples were fit, 12 marginally fit and 73 percent unfit. The quality wise description of fit, marginally fit and unfit water samples is as under.

(2.1) FIT WATER SAMPLES

Data in Table 3 showed that fit water samples have an average value of EC 0.55 ±0.27dSm^{-1} , SAR 0.98±0.52 and RSC 0.34±0.33 meL^{-1} and out of 6 fit samples 1 had no RSC value.

(2.2) MARGINALLY FIT WATER SAMPLES

Data in Table 4 showed that out of 5 marginally fit water samples, 20% samples were marginally fit due to higher EC with an average value of 1.09 dSm^{-1}, 40% due to higher RSC with an average value of 2.05 meL^{-1} and rest of 40% due to higher values of EC+RSC with an average value of EC 1.13 dSm^{-1} and RSC 2.4 meL^{-1}.

(2.3) UNFIT WATER SAMPLES

Data in Table 5 showed that out of 29 un fit water samples, 3 samples (10%) were un fit due to higher EC with an average value of 1.52 dSm^{-1} ,13 (45%)due to higher RSC with an average value of 4.08 meL^{-1}, 10 samples (35%) due to higher values of EC+RSC with an average value of EC 1.62 dSm^{-1} and RSC 5.45 meL^{-1} and 3(10%) sdue to the combine effect of EC+SAR+RSC with an average EC value of 6.01 dSm^{-1} , SAR 47.73 and RSC 22.40 meL^{-1}.

DISCUSSION

In all the parameters marginally fit waters could be manageable with some special management practices, like the use of gypsum, flushing with good quality of water, alternate supply of canal water etc. However, unfit water due to higher EC will cause salinization [16 & 17]. 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 depths [18 & 19]. The SAR indicates the relative proportion of sodium to calcium+ magnesium, whereas RSC is an index, which indicates the sodium hazards (sodication of soil). The unfit waters (containing carbonate and bicarbonate) for irrigation will precipitate soil solution calcium and increase solution sodium, resulting in soil dispersion as well as impaired nutrient uptake by plants [20]. It is therefore, recommended that unfit water 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.

FINDINGS:

1. The most of the tubewell water in the district Hafizabad were unfit for irrigation due to higher RSC (67%) and EC+RSC (24%).
2. SAR was not the problem of the area.

SUGGESTIONS:

1. Before installation of tube wells, the quality of water be got tested from the respective district Soil and Water Testing Laboratory.
2. Unfit water may need special management practices like cyclic irrigation with canal water.
3. Farmers should addressed to get analyzed their soils along with tube well water to suggest management measure.

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Table 1. Range, mean, standard deviation and coefficient of variation values of quality parameters of tube well waters in Hafizabad and Pindi Bhattian tehsils.

Parameters	Tehsil Hafizabad	Tehsil Pindi Bhattians
Electrical conductivity (EC) dSm^{-1}	0.24 – 10.70(1.03±0.79)(CV=77)	0.25-8.37(1.52±1.51)(CV=99)
Sodium Adsorption Ratio (SAR)	0 -7.3 (3.04±1.62)(CV=53)	0.4-12.78(7.5±14.09)(CV=188)
Residual Sodium Carbonate (RSC) meL^{-1}	0-7(2.55±1.66)(CV=65)	0-30.60(4.8±6.07)(CV=126)

Table 2. Classification of tube well water samples of Hafizabad and Pindi Bhattian tehsils.

Parameters	Total (#. Samples)	Tehsil Hafizabad (#. Samples)	Tehsil Pindi Bhattians (#.samples
Fit	44(20)	38(22)	6(15)
Marginally Fit	59(28)	54(31)	5(12)
Unfit	112(52)	83(47)	29(73)
Total	215	175	40

Table 3. Values of fit ground water in respect of EC, SAR and RSC in Hafizabad and Pindi Bhattian tehsils.

Parameters	Tehsil Hafizabad			Tehsil Pindi Bhattian		
	EC (dSm^{-1})	SAR	RSC(meL^{-1})	EC (dSm^{-1})	SAR	RSC(meL^{-1})
No. of samples	38	38	29*	6	6	5*
Average value	0.68± 0.18	1.03±0.65	0.44±0.42	0.55±0.266	0.98±0.52	0.34±0.33

* Out of 38 fit samples of tehsil Hafizabad, 7 samples has no RSC whereas out of 6 samples of tehsil Pindi Bhattian 1 sample has no RSC.

Table 4. Distribution (No. and value) of marginally fit water samples in respect of EC, SAR and RSC in Hafizabad and Pindi Bhattian tehsils.

Parameters	Statistical Characters	Tehsil Hafizabad	Tehsil Pindi Bhattian
EC (dSm^{-1})	n	4	1
	Average	1.08	1.09
	%	7	20
RSC (meL^{-1})	n	38	2
	Average	1.95	2.05
	%	71	40
EC +RSC	n	12	2
	EC average	1.08	1.13
	RSC average	2.1	2.4
	%	22	40
	Total	54	5

Table 5. Distribution (No.and value) of unfit water samples in respect of EC, SAR and RSC in Hafizabad and Pindi Bhattian tehsils.

Parameters	Statistical Characters	Tehsil Hafizabad	Tehsil Pindi Bhattian	Total
EC (dSm^{-1})	n	4	3	7(6)
	Average	3.83	1.52	
	%	5	10	
RSC (meL^{-1})	n	62	13	75(67)
	Average	3.85	4.08	
	%	75	45	
EC +RSC	n	17	10	27(24)
	EC average	1.50	1.62	
	RSC average	4.85	5.45	
	%	20	35	
EC +SAR+RSC	n	-	3	3(3)
	EC average	-	6.01	
	SAR average	-	47.73	
	RSC average	-	22.40	
	%	-	10	
	Total	83	29	112