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Irrigational Quality of Under Ground Water in Kasur District

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Abstract: New tubewell bores's water samples were collected from various locations of District Kasur for chemical analysis. The aim was to check the quality of under ground water for irrigation purposes. Electrical conductivity (EC) of the water samples collected from 64 locations varied from 524 to 5700. Sodium adsorption ratio (SAR) of the samples ranged from 0.49 to 26.00 while residual sodium carbonate (RSC) from zero to 17.00. Twenty- six samples out of 64 have EC, SAR and RSC < 1000, 6 and 1.25, respectively. These are considered desirable characters for irrigation water. Only 8 samples's EC, SAR and RSC ranges are as 1000-1250, 6-10 and 1.25 to 2.50. Thirty samples have EC, SAR and RSC > 1250, 10 and 2.50, respectively.

Key words: Irrigational quality, under ground water, Kasur

Introduction

Our progressively increasing population's food and fibre requirements, Agriculture in arid and semi-arid regions depends primarily on irrigation. Irrigation water has the advantages over rainfall of being under control with respect to time and amount of application. In Pakistan, the canal water is not sufficient to exploit the potential of soil and crop cultivars under intensive cropping pattern. The scarcity of good quality irrigation water is becoming more acute day by day.

Out of 79.61 million hectares (mha) total geographical area of the country, only 20.54 mha are cultivated. Due to limited supply of irrigation water and lack of improved management practices, 11.19 mha are lying as culturable waste-land. Total irrigated area is 15.62 mha and area irrigated by canals and tube wells is 11.34 and 3.59 mha, respectively (Anonymous, 1987).

It is reported that 106 million acre-foot water is required for optimum growth of crops while only 60 million acre-feet water is available at present. Hence, the balance water has to be made available from the under-ground water. It has been reported by Malik *et al*. (1984) that out of 40 MAF of ground water resources in Indus plains, only 25% is fit for irrigation and other 25% is marginally fit. Thus 50% ground water if used blindly can be a serious threat to crops and soil health. Out of 16.49 mha canal commanded area (CCA), 10.07 mha contains useable and 6.42 mha, saline ground water (Ahmad and Chaudhary, 1988). Classification of Punjab under-ground water revealed that two third of it is unfit for irrigation and required prior amendment/scientific management (Hussain *et al*., 1991).

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 its indiscriminate and constant use causes salinity/alkalinity. Keeping in view the severity of these problems, the quality of water from new wells should be checked prior to their use for irrigation. Therefore, water samples were collected for their quality test.

Materials and Methods

Water samples from 64 new tube well bores were collected from district Kasur during the year 1999-2000 and 2000-2001. These samples were analyzed for anions (CO_3^{-2}, HCO^-_3, Cl^{-1}), cations (Ca^{2+} + Mg^{2+}, Na^+) and electrical conductivity. Sodium adsorption ratio (SAR) and residual sodium carbonate (RSC) were calculated by using the analytical methods given by United States Salinity Laboratory Staff (1954). The equations used to determine SAR, RSC are given as under:

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

when ionic concentrations are expressed in meq L^{-1} or $mmol_c$ L.

$$RSC = (CO_3^{2-} + HCO_3^-) - (Ca^{2+} + Mg^{2+})$$

Based on the value of EC, SAR and RSC thus obtained, the water samples were categorized. As described by U.S. Salinity Laboratory Staff (1954), limits of various parameters are presented in Table 1.

Results and Discussion

Irrigational water related quality parameters are given in Table 1. These parameters (TSS, SAR and RSC) are calculated from the primary data i.e., EC, $Ca^{2+}+Mg^{2+}$, CO_3^{2-}, HCO_3^- and Na^+ (data not given). Electrical conductivity (EC) of water samples collected from 64 ranges from 524 to 5700. Twenty-six samples out of 64 have EC < 1000, i.e., below the upper limit (1000 μS) described for fit irrigation water. Only 8 water samples have EC between 1000-1250, which is range for marginally fit irrigation water. Whereas all other water samples/sites have EC > 1250.

Table 1: Suitability criteria of water for irrigation purpose

Water quality	$EC_{(\mu S)}$	SAR	RSC (meq L^{-1})
Fit	< 1000	< 6	< 1.25
Marginally fit	1000-1250	6 10	1.25 – 2.5
Unfit	> 1250	> 10	> 2.5

EC = Electrical conductivity
SAR = Sodium adsorption ratio
RSC = Residual Sodium carbonate

The sodium adsorption ratio (SAR) represents the relative proportion of Na^+ to $Ca^{2+}+Mg^{2+}$. The SAR data of all of the sites ranges from 0.49 to 26.00. The data shows that 26.00 sites have fit irrigation water (SAR < 6), 8 sites have marginally fit (SAR 6-10) and 30 sites have unfit (SAR > 10) irrigation water. These 30 sites (46.87% sites) will sodicate the soils. Ghafoor *et al*. (1993) reported that about 60% sites of Faisalabad Tahsil have manageable SAR value, while 40% sites will soidcate the soils. However, the fitness of water of different sites depends upon the average conditions of soil texture, quantity of irrigation water applied, soil drainage, infiltration rate etc. along with other variable like climate and tolerance of the crops to salts. Sodium adsorption is stimulated when Na proportion increases than Ca:Mg resulting in soil dispersion (Emerson and Bakker, 1973).

The residual sodium carbonate (RSC) reflects the sodium hazard. The irrigational water containing excess of CO_3^{2-} and HCO_3^- will precipitate soil solution calcium and increase the sodium solution. It leads to saturation of clay complex and consequently decreases in infiltration rate. The RSC values of all the sites range from zero to 17.00. Thirty sites have RSC values > 2.50 (Table 2). So, these sites

Table 2: Analysis of water samples of new tube well bores collected during 1999-2000 and 2000-2001

Location	($EC_{\mu S}$)	SAR	RSC (meq L^{-1})
Shamshabad	14000	4.11	4.00
Tolowala	4500	11.00	3.50
Thathi Hithar	1700	4.89	1.50
Rao Khanwala	1500	6.15	5.50
Kot Hakim Ali	750	2.02	2.40
Olakh Hithar	1400	4.30	4.50
Bahamni wala	900	1.23	0.50
Chunian	1500	7.40	6.50
Pattoki	1350	2.74	0.70
Sherpur	679	2.13	0.67
Rosa Tiba	1230	1.37	0.30
Sarhali Khurd	837	1.67	0.23
Fatehpur	941	1.51	1.13
Kotli Abu Bakar	847	1.17	0.60
Phool Nagar	1189	2.61	2.16
Kasur	1850	10.31	6.64
Syedan Wala Farm	900	1.33	1.20
Khara	2337	23.45	14.37
Naol	1980	7.12	7.80
Patto Kalan	744	1.21	0.17
Buken Key	790	1.60	0.51
Jamat Pura	965	2.59	1.80
Khudian Khas	820	1.46	0.70
Rakh Chunian	5700	16.80	17.50
Kawin Blaka Singh	3864	19.40	22.00
Khoday	2560	7.40	7.50
Sahjra	1230	5.37	2.00
Sarjali	1095	5.55	7.21
Sada	735	3.89	2.40
Blaka Singh	4529	20.90	20.10
Hindal	1255	5.49	3.00
Raja Jang	2800	26.00	14.00
Mustafabad	837	3.00	3.44
Nazampura	811	2.42	0.60
Changa Manga	776	1.69	1.21
Chak 33	795	1.33	2.16
Ola Key	524	0.50	Nil
Mobokey	760	2.13	0.24
Bhadian usman	678	1.48	0.14
Pakho Key	799	2.79	1.10
Chunian Sugar Mills Farm	2933	24.21	15.90
Mokal	667	1.57	0.42
Kali	679	0.49	0.27
Kangun pur	847	2.87	0.88
Dolay Wala	2771	13.46	7.00
Noshera	3043	18.36	7.82
Natha Khalsa	913	2.83	0.81
Lambay Jageer	1213	3.64	1.22
Bath Kalan	846	2.42	1.11
Noorpur	861	4.40	2.21
Munde Key	3747	13.87	4.66
Bhoay Aasal	849	3.23	0.80
Blandi	1813	14.30	11.80
Daftu	2362	13.67	9.80
Kot Rahda Kishan	2899	13.37	4.10
Mian Wala	991	1.85	0.30
Bhela Hithar	1575	3.55	0.70
Sanda	863	1.77	0.55
Katcha Paka	637	1.80	0.20
Bado Juena	3176	11.78	3.30
Joara	767	2.72	1.14
Wadana	1603	11.19	9.40
Ganja Kalan	711	0.59	0.40
Bhala	1373	5.70	5.82

will promote the sodium accumulation in soils. While only 8 sites have RSC from 1.25 to 2.50. However, the remaining 26 sites have RSC < 1.25 which indicates the suitability of water for irrigation purpose. The results show that 40.63% sites have fit underground water, 12.50% sites marginally fit while 46.87% sites have unfit under ground water for irrigation.

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