Chemical Analysis of Irrigation Water and its Effects on Soil of Dera Ghazi Khan

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Abstract

Irrigated water brings some dissolved salts from sources. The quality and quantity of these dissolved salts depend on the source. Usually most water dissolved substance include sodium (Na^{+1}), magnesium (Mg^{+2}), calcium (Ca^{+2}), chloride (Cl^{-1}), carbonate (CO_3^{-2}) and bicarbonates (HCO_3^{-1}). The amount and concentration of these dissolved ions determine the fitness of water for irrigation. The common quality parameters are Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC). Unfortunately, canal water is inadequate to meet the requirement of crops under severe harvesting system in Punjab. In Dera Ghazi Khan there is many ways are used to irrigate the cultivated soils other than canal systems like tube wells. In which more than 70% water are of poor quality. The study area is either canal irrigated or irrigated through tube wells. This research was conducted in 25 km area from Qasba Samina Sadat to Taunsa canal west of the D.G.Khan city in 2018. To achieve the goal of this research, the study was revealed in the Soil and Water Testing Laboratory for Research Dera Ghazi Khan. The 40 water samples were collected from different sites which are irrigated through both canal and tube well system. The samples were collected in plastic bottles after the 30 minutes operation of tube wells. Similarly 22 soil samples were collected in plastic bags to test the effect of irrigated water on soil of the study area. Table.4 Shows that approximately 40% irrigated water is unfit and 20% is marginally fit for irrigation. This is indication of soil is towards salinity pattern.

The water and soil samples were analyzed at Soil and Water Testing Laboratory for Research, Dera Ghazi Khan for electrical conductivity, cations (Ca^{+2}+ Mg^{+2}, Na^{+1}) and anions (CO_3^{-2}, HCO_3^{-1} and Cl^{-1}) by the methods described by Page et al.,(1982)[10]. Residual sodium carbonates (RSC) and Sodium Adsorption Ratio (SAR) were calculated through international standard.

Key words. Irrigation water, EC, SAR, RSC, Salinity.

Introduction

Water is essential component of all forms of life and it is mainly obtained from two sources, i.e. surface water which includes rivers, canals, fresh water lakes, streams etc. and ground water like well water and borehole water [1]. Because of unique chemical properties of water due to its polarity and hydrogen bonding, it has ability to suspend, dissolve, absorb and adsorb many different compounds. Thus water is not pure in nature, as it acquires contaminants from its surrounding as well as other biological activities [2]. However Irrigated water brings some dissolved salts from sources [3]. The quality and quantity of these dissolved salts depend on the source. Usually most water dissolved substance include sodium (Na^{+1}), magnesium (Mg^{+2}), calcium (Ca^{+2}), chloride (Cl^{-1}), carbonate (CO_3^{-2}) and bicarbonates (HCO_3^{-1}). The amount and concentration of these dissolved ions determine the fitness of water for irrigation [4].The common quality parameters are Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC). Chemically irrigated water affect the soil by changing the nutrients composition in the soil [5]. Salts are originated from weathering of rocks and soil, including dissolution of lime, gypsum and other slowly dissolved soil minerals. These substances are transferred from water resource to wherever it is used [6]. Lower quality of irrigated water adversely affects the production rate of crops. But unfortunately quality of irrigated water should be deserted [7]. Unfortunately, canal water is inadequate to meet the requirement of crops under severe harvesting system in Punjab [8]. In Dera Ghazi Khan there is many ways are used to irrigate the cultivated soils other than canal systems like tube wells. In which more than 70% water are of poor quality [9]. Keeping in view the importance of irrigation water quality, the present study was contemplated with the following objectives

i) To ensure the quality of tube wells water for irrigation and

ii) Suggest the different option to protct the soil of district Dera Ghazi Khan from salination.

Materials and Methods

Description of study area

Dera Ghazi Khan District is situated between river Indus and Suleiman range and lies between 20.40 North and 70.75 East. The study area is either canal irrigated or irrigated through tube wells. This research was conducted in 25 km area from Qasba Samina Sadat to Taunsa canal west of the D.G.Khan city in 2018.

Water and soil sampling

To achieve the goal of this research, the study was revealed in the Soil and Water Testing Laboratory for Research Dera Ghazi Khan. The 40 water samples were collected from different sites which are irrigated through both canal and tube well system. The samples were collected in plastic bottles after the 30 minutes operation of tube wells. Similarly 22 soil samples were collected in plastic bags to test the effect of irrigated water on soil of the study area.

Sample analysis

The water and soil samples were analyzed at Soil and Water Testing Laboratory for Research, Dera Ghazi Khan for electrical conductivity, cations (Ca^{+2}+ Mg^{+2}, Na^{+1}) and anions (CO_3^{-2}, HCO_3^{-1} and Cl^{-1}) by the methods described by Page et al.,(1982)[10]. Residual sodium carbonates (RSC) and Sodium Adsorption Ratio (SAR) were calculated through international standard. The collected water samples were analyzed on the basis of following criteria regarding their suitability for irrigation and effect of this water on salinization of soils irrigated by such water.

Results

Table.1 Criteria used for water analysis

Parameters	Fit	Marginally Fit	Unfit
EC us/cm	0-100	100-1250	>1250
SAR	0-6	6-10	>10
RSC meq/l	0-1.25	1.25-2.50	>2.50

Table.2 Chemical Analysis of Water samples

Total 40 irrigated water samples were analysed and their different parameters are as under

Sample. No.	EC us/cm	Ca^{+}+Mg^{++} meq/l	Na^{+1} meq/l	CO_3^{-2} meq/l	HCO_3^{-} ^{1} meq/l	Cl^{-} meq/l	SAR	RSC meq/l	Fit/unfit for irrigation
1	616	5.78	0.38	3.21	3.97	1.5	0.22	1-23	Fit
2	2930	23.95	5.35	13.4	24.9	7	1.55	3.21	Unfit
3	1443	13.20	1.23	10.03	11.1	3	0.48	2.68	Unfit
4	948	7.37	2.11	6.43	7.3	2	1.1	1.21	Fit

5	418	3.84	0.34	3.1	2.9	1	0.25	1.04	Fit
6	1436	12.17	2.19	11.4	10.8	3	0.87	2.52	Unfit
7	1294	10.40	2.54	8.5	9.7	3	1.11	2.72	Unfit
8	647	6.05	0.42	4,21	5.03	1	0.24	1.16	Fit
9	1839	12.77	5.62	12.4	13.6	4	2.22	4.51	Unfit
10	272	2.65	0.07	1.2	1.5	1	0.06	0.28	Fit
11	276	2.37	0.39	1.4	1.5	1	0.36	0.25	Fit
12	2070	19.09	1.61	13.7	15.4	4.5	0.52	3.24	Unfit
13	588	4.81	1.07	3.5	4.6	1	0.69	1.20	Fit
14	1250	8.78	3.72	8.9	9.8	2.5	1.77	2.12	Marginally Fit
15	1145	6.87	4.58	7.6	8.7	2.5	2.48	2.04	Marginally Fit
16	4370	23.28	20.42	33.4	35.2	7	5.98	3.08	Unfit
17	504	3.89	1.15	2.5	3.3	1.5	0.83	0.37	Fit
18	1122	10.27	0.95	6.8	8.9	2	0.42	2.23	Marginally Fit
19	2480	23.91	0.89	12.86	18.7	5	0.26	2.85	Unfit
20	783	6.60	1.23	5.4	5.2	2	0.68	1.04	Fit
21	463	4.08	0.55	2.9	3.3	1	0.38	0.89	Fit
22	1754	11.57	5.97	11.9	13.5	3.5	2.48	2.25	Fit
23	2050	19.17	1.33	14.5	15.3	6	0.43	2.64	Unfit
24	960	8.51	1.09	4.5	6.7	3	0.53	0.85	Fit
25	2320	21.87	1.33	12.4	15.8	7	0.4	2.67	Unfit
26	1130	10.59	0.71	6.4	8.5	2.5	0.31	2.42	Marginally Fit
27	2080	19.49	1.31	14.5	16.1	4.5	0.42	2.82	Unfit
28	2090	19.41	1.49	14.2	15.4	5	0.48	2.92	Unfit
29	1016	9.29	0.87	5.4	7.2	2.5	0.40	1.48	Marginally Fit
30	990	9.12	0.78	6.2	7.1	2.5	0.36	0.89	Fit
31	2110	19.03	2.07	12.8	15.4	5.5	0.67	3.04	Unfit
32	1167	10.07	1.6	5.2	7.7	3.5	0.71	2.94	Marginally

									Fit
33	1146	10.02	1.44	6.8	7.18	3	0.64	2.23	Marginally Fit
34	998	9.03	0.95	6.03	7.05	2.5	0.45	1.04	Fit
35	1011	9.32	0.79	6.2	7.2	2.5	0.37	2.28	Marginally Fit
36	841	7.66	0.75	5.2	6.1	2	0.38	1.22	Fit
37	288	1.98	0.9	0.24	1.45	1	0.91	0.54	Fit
38	462	3.87	0.75	2.5	3.4	1	0.54	0.68	Fit
39	2050	19.01	1.49	12.5	14.8	5.5	0.48	2.21	Unfit
40	2060	20.01	1.79	14.5	15.6	5.7	0.60	2.68	Unfit

Table. 3 Ranges. Means and Standard Deviation of different Parameters

	EC us/cm	$Ca^{+}+Mg^{++}$ meq/l	Na^{+1} meq/l	CO_3^{-2} meq/l	HCO_3^{-1} meq/l	Cl^{-} meq/l	SAR	RSC meq/l
Range	70.99	0.19-9.92	0.0-9.90	0.02-11.3	0.04-9.90	0-9.69	0.02-9.57	0.01-10.3
Mean	1230.4	8.78	4.89	2.8	7.06	4.42	3.063	2.8
Standard Deviation	825.8	15.47	4.67	2.24	9.56	5.26	2.28	2.12

Table 4 Classification of water samples

Total Samples	Fit for Irrigation		Marginally fit for irrigation		Unfit for irrigation	
	Samples	%age	Samples	%age	samples	%age
40	16	40	08	20	16	40

Table 4. Shows that approximately 40% irrigated water is unfit and 20% is marginally fit for irrigation. This is indication of soil is towards salinity pattern.

Table 5 :Classification of water sample on the basis of EC(µS/m)

Total Samples	Fit for Irrigation		Marginally fit for irrigation		Unfit for irrigation	
	Samples	%age	Samples	%age	samples	%age
40	00	0.0	25	62.5	15	37.5

Table 6 :Classification of water sample on the basis of SAR

Total Samples	Fit for Irrigation		Marginally fit for irrigation		Unfit for irrigation	
	Samples	%age	Samples	%age	samples	%age
40	16	40	08	20	16	40

Table 7:Classification of water sample on the basis of RSC meq/l

Total Samples	Fit for Irrigation		Marginally fit for irrigation		Unfit for irrigation	
	Samples	%age	Samples	%age	samples	%age
40	20	50	07	17.5	13	32.5

Soil samples Analysis

During the current Study 22 soil samples were collected from the different sites which are irrigated with canal as well as tube well water. The analysis indicates that due to different salts in irrigation water all the selected soils were saline. The time will come very soon that these soils which are irrigated by canal as well as tube well water will be saline.

Table.1 Results of analysed soil samples

Sample No.	EC ms/cm	Soil pH	Saturation %	Texture	Soil condition
1	4.22	8.13	50	Clay loam	Saline
2	11.70	7.48	52	Clay loam	Saline
3	11.18	7.57	18	Sandy	Saline
4	9.67	7.70	50	Clay loam	Saline

5	28.80	7.50	36	Loam	Saline
6	5.04	8.07	52	Clay loam	Saline
7	14.50	7.46	56	Clay loam	Saline
8	7.93	7.98	54	Clay loam	Saline
9	15.92	7.11	50	Clay loam	Saline
10	14.79	7.54	48	Clay loam	Saline
11	25.90	7.96	56	Clay loam	Saline
12	15.98	7.98	28	Sandy loam	Saline
13	6.56	8.12	54	Clay loam	Saline
14	4.70	8.12	56	Clay loam	Saline
15	4.06	7.83	50	Clay loam	Saline
16	6.78	7.86	52	Clay loam	Saline
17	10.15	7.66	58	Clay loam	Saline
18	8.29	7.72	26	Sandy loam	Saline
19	9.76	7.62	48	Clay loam	Saline
20	13.75	7.42	52	Clay loam	Saline
21	8.41	7.83	54	Clay loam	Saline
22	7.42	7.4	26	Sandy loam	Saline

Table.1 of the soil samples indicates that due to high EC and pH values of the collected samples from the sites which are irrigated by canal water and tube wells are saline soils.

Discussion

In present study it is clearly indicated that in D.G.Khan the irrigation water is not fit for crop production in soils. The irrigated water from canals is no pure instead contains such substances which play main contribution in making the soil saline. Similarly tube well water is basically ground water, which is basically heavy water having many dissolved salts contribute in salinity.

Suggestions

Keeping in view the above results the farmers of this area are advised, before utilizing the water for irrigation, should be properly analysed from agriculture department. This is the only way to protect the soils from salinity.

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