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Assessment of Groundwater Quality for Irrigation of Adampur Block, Hisar, Haryana

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Abstract

The study was based on 437 ground water samples collected randomly from Adampur block of Hisar district. The study revealed that 35.47% of the samples showed EC values less than 4 dS/m and rest of the samples had EC values above 4 dS/m which falls either in saline or high SAR saline categories. The maximum samples were found in saline (47.6%) category followed by marginally saline (15.1%). Good quality category recorded 11.9% of samples and high SAR saline category accounted for 13.04% of samples. The per cent samples in sodic classes were 2.06, 0.92 and 9.39% in marginally alkali, alkali, and high alkali classes, respectively. The concentration of Na^+, Ca^{+2} and Mg^{+2} ions generally increased with increase in EC of the water samples. Chlorides and HCO_3^- were found in appreciable quantities whereas CO_3^{-2} were in traces. The ground waters of Adampur block are Na-Mg-Ca type dominated by chloride. The brackish waters are saline in nature. Good quality and marginally saline waters can be successfully used for crop production without any hazardous effect on soil and plant.

Key words : Groundwater quality, Irrigation, Saline, Sodic.

One of the main hurdles in boosting the agricultural production in arid and semiarid areas of the world is the inadequate supply of good quality water for irrigation. Agriculture is the major user (89%) of the India's water resources but the estimates show that the growing demands from municipalities, industry and energy generation will claim about 22% (24.3 m ha-m/year) of the total water resources (105 m ha-m/year) by 2025 AD, thereby further reduce the good quality water supply for irrigation (1). In Haryana state, out of the total cultivated area of 3.4 million ha, canal irrigated area is only 66%, whereas the rest of the area is dependent either on rainfall or upon wells/tube wells of doubtful quality. The quality of the ground water plays a key role in judging its suitability for crop production. Indiscriminate use of brackish water deteriorates the productivity of the soil through salinity, sodicity and toxicity effects and sometimes the land eventually go out of cultivation. Therefore, a prior appraisal of ground water quality is important for judicious use of this scarce resource. In the past attempts have been made to establish water quality zones of Haryana state (2), but a sea change has occurred over the years due to exhaustive water use and a shift in the cropping pattern in the western part of the state which has led to change in water quality (3). Therefore, a reappraisal on nature, properties and extent of underground water quality of Adampur block of Hisar district is essential for sound irrigation planning of the area.

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Methods

The study was based on 437 water samples collected from Adampur block of Hisar district, Haryana. Random sampling of the running tube wells of the block was undertaken. The samples were analyzed for pH, EC, CO_3^{-2}, HCO_3^-, Cl^-, Ca^{+2}, Mg^{+2} and Na^+ following standard methods (4). Residual sodium carbonate (RSC) and sodium adsorption ratio (SAR) were also calculated as described by Richards (4). Water samples were categorized on the basis of criteria adopted by All India Coordinated Research Project on management of salt affected soil and use of saline water based on EC, SAR and RSC values (5).

Results and Discussion

The EC values ranged from 0.2—42.4 dS/m in

Table 1. Range of quality parameters and chemical constituents of water samples.

	Parameters (m mol/l)	Range
1	EC (dS/m)	0.2—42.4
2	SAR (m mol/l)$^{1/2}$	0.58—17.8
3	RSC	0—41.2
4	Na	0.5—232.6
5	Ca	0.2—100.0
6	Mg	0.3—241.0
7	CO_3	0—2.5
8	HCO_3	1.2—45.2
9	Cl	0.3—48.8

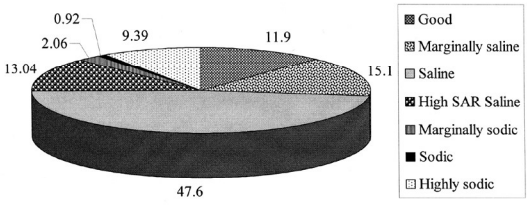

Figure 1. Frequency distribution of water samples in Adampur Block.

the water samples collected from Adampur block (Table 1). The highest EC was recorded in Telanwli village of the block. The RSC values ranged from nil to 41.2 meq/liter. Manchanda (2) also reported water samples dominated by RSC in Hisar district. The SAR ranged from 0.58—17.8 (mmol/liter)$^{1/2}$ in the block. Similar results in respect of SAR (0.36—26.31) were reported by Singh and Bhumbla (6) in the 73 well water samples from Hisar district. The cations, Na^+, Ca^{+2} and Mg^{+2} were present in appreciable amounts, whereas the Cl^- (0.3—48.8 meq/liter) and HCO_3^- (1.2—45.2 meq/liter) were dominant anions in the groundwater samples and CO_3^{-2} (nil—2.5 meq/liter) was recorded in traces except in a few samples. The results indicated that underground irrigation waters of this region are saline dominated by chlorides. Earlier study made by Manchanda (2) also reported chloride dominated waters in this region.

The distribution of water samples of Adampur block in various quality classes is presented in Figure 1. Percentages of samples falling in good and marginally saline category were 11.90 and 15.01%, respectively. Saline category constituted the highest percent of samples i.e. 47.60 and 13.04% samples found their way to high SAR saline category. The samples in alkali classes were 2.06% in marginally alkali, 0.92% in alkali and 9.39% in high alkali category. Minhas et al. (7) reported on the basis of the surveys conducted under the project AICRP on use of saline water that 32—84% of running wells in India are rated to be of poor quality. However, Manchanda (2) reported 60 to 64% of samples of this region belonged to saline and saline sodic quality classes. Singh and Kumar (8) also observed an increase in the magnitude of sodic water in Moga district of Punjab over a period of ten years.

The average concentration of Na ranged from 2.56 to 56.53 meq/liter and that of Cl ranged from 1.14 to 157.71 meq/liter and it increased with increase in EC of the water samples. The concentration of Ca

Table 2. Average chemical composition of ground water samples of Adampur block in different EC classes.

EC classes	No.	Na	Ca	Mg	CO_3 (meq/l)	HCO_3	Cl	RSC	SAR (m mol/l)$^{1/2}$
0—1	20	2.56	1.65	2.38	0.0	3.83	1.14	2.93	2.45
1—2	56	7.04	3.33	4.65	0.07	6.87	3.99	6.13	6.07
2—3	44	9.02	6.55	8.56	0.03	7.28	8.50	6.63	4.57
3—4	35	12.79	11.07	13.21	0.07	7.06	14.04	5.18	5.59
4—5	45	16.43	13.11	17.41	0.0	7.22	36.31	13.25	5.59
5—6	46	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
6—7	34	29.33	14.20	20.36	0.0	8.85	39.56	5.33	8.80
7—8	23	22.39	19.36	28.95	0.0	7.66	44.77	41.20	5.96
8—9	23	24.79	24.65	39.18	0.02	7.93	82.55	9.80	5.30
9—10	15	24.79	24.65	39.18	0.02	7.93	82.55	9.80	5.30
> 10	96	56.53	34.77	67.42	0.01	6.88	157.71	11.93	8.32

and Mg also showed similar pattern as of Na. However, it remained less than Na in all salinity classes. The data showed that highly saline waters are dominated by sodium and chloride ions. Another important feature of these waters is the predominance of magnesium over calcium. In these waters carbonate is either absent or is very little. Paliwal (9) also reported similar results in Rajasthan well waters.

It is concluded from this study that the ground waters of Adampur block are Na-Mg-Ca type dominated by chloride and the brackish waters are generally saline in nature. Good quality and marginally saline waters can be successfully used for crop production without any hazardous effect on soil and plant. The waters rated as saline and high SAR saline is unfit for irrigation. Their indiscriminate use may cause secondary salinization and sodification of soil resulting in serious effect on crop growth. But in emergency these waters can be used with special management practices depending upon the rainfall, crop to be grown and soil type. The continuous use of poor quality irrigation water may not only cause calcium deficiency but also create poor soil physical condition, as both sodium and magnesium damage the soil structure by their highly dispersive action.

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