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Characterization of ground water quality of Rania block in Sirsa District in Haryana

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Abstract

Ground water quality plays a key role in sustainable crop production. It is the quality of ground water that decides possibility and choice of crops for a particular area. So characterisation of ground water is necessary to use for agricultural purposes. So ground water quality parameters of Rania block in Sirsa district in Haryana were assessed to have an idea of suitability of tubewell water for irrigation purpose. A total of 180 samples received in soil testing laboratory of Krishi Vigyan Kendra, Sirsa were analysed for pH, EC, cations, anions. Subsequently RSC and SAR were calculated by standard procedures. EC ranged from 0.3 dSm⁻¹ to 16.0 dSm⁻¹ with mean values of 3.88 dSm⁻¹ whereas pH ranged from 4 to 8.6 with a mean value of 7.7. Among the cations Na⁺ was dominant with mean value 27.83 meL⁻¹ whereas Cl⁻ was dominant anion. Of all the samples, 31 per cent water samples were in the good category in which almost all the crops could be grown. 36 percent water is saline which should be used in combination with canal water in cyclic mode. 19 per cent water samples were marginally saline, 4 percent water was alkali and there is need to neutralise it with gypsum application. 10 percent of the water samples were marginally alkali which can cause problem in the soils where silt and loam content are more.

Keywords: Rania, Sirsa, ground water quality, sustainable use, salinity, sodicity, cations, anions

Introduction

Agriculture is a leading sector in the economic growth of India and contributes 46% of the entire national product (Rehman & Hussain, 2016) ^[14]. Freshwater resources are extremely scarce (Qadir *et al.* 2007) ^[13] with less than 1 percent of the water on Earth suitable for human consumption (Gleick, 1996 and Alotaibi, *et al.*, 2023) ^[6, 2]. (Asadi *et al.* 2020 and Hashmi *et al.* 2009) ^[3, 8]. Therefore, managing and preserving freshwater resources is crucial (FAO, 1994) ^[5]. In Sirsa district, agriculture largely depends upon tube wells for irrigation as the canal or seasonal rivers are as a source of water are not sufficient to meet the water requirements of crops particularly Paddy. Under these circumstances, Groundwater plays a crucial role in Indian agriculture, particularly in semi-arid regions due to the lack of surface water resources. Fifty per cent of the irrigated area is dependent on groundwater and 60% of irrigated food production is from groundwater wells (Shah *et al.* 2000; FAO 2003; Vasantha Vigar *et al.* 2012) ^[15, 4, 12].

The suitability of irrigation water depends on many factors, including the quality of water, soil type, climate, drainage characteristics of the soil, and salt tolerance characteristics of the plants (Venkateswaran and VEDIAPPAN, 2013) ^[19].

Groundwater always contains certain amounts of soluble salts which are dissolved in it. The solubility of these salts depend on the source of the recharge and the geological strata through which it percolates. If the salt concentration in the groundwater increases, the quality of water will deteriorate (Kumar *et al.* 2014) ^[11].

The excess quantity of soluble salts may be harmful to many crops. They can limit plant growth by restricting water uptake through modified osmotic processes and may damage plant growth through metabolic processes. Sodicity, salinity and toxicity are important factors to consider when assessing the suitability of groundwater quality for irrigation (Khodapanah *et al.* 2009) ^[10].

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The present study aimed to analyse and evaluate chemical and physical parameters, including different cations, anions, water quality index, Sodium Adsorption Ratio (SAR), and heavy metals speciation for the Rania block of Sirsa district (Haryana). The study also attempted to focus on assessing the suitability of groundwater for agricultural purposes.

Materials and Methods

Sirsa is located in North West region of India sharing borders with Rajasthan and Punjab. The climate of the

district may be defined as semi-arid with an annual rainfall of 300 mm. Major source of irrigation in the district is groundwater which is not very good at all the locations in the district. The topography of the area is almost flat with a gentle slope towards southwest direction. Rania is a block situated in the western side of the district. A seasonal river, Ghaggar passes through the block from eastern to western side. The soil type is sandy-loam and source of irrigation are tube-wells and rivers.

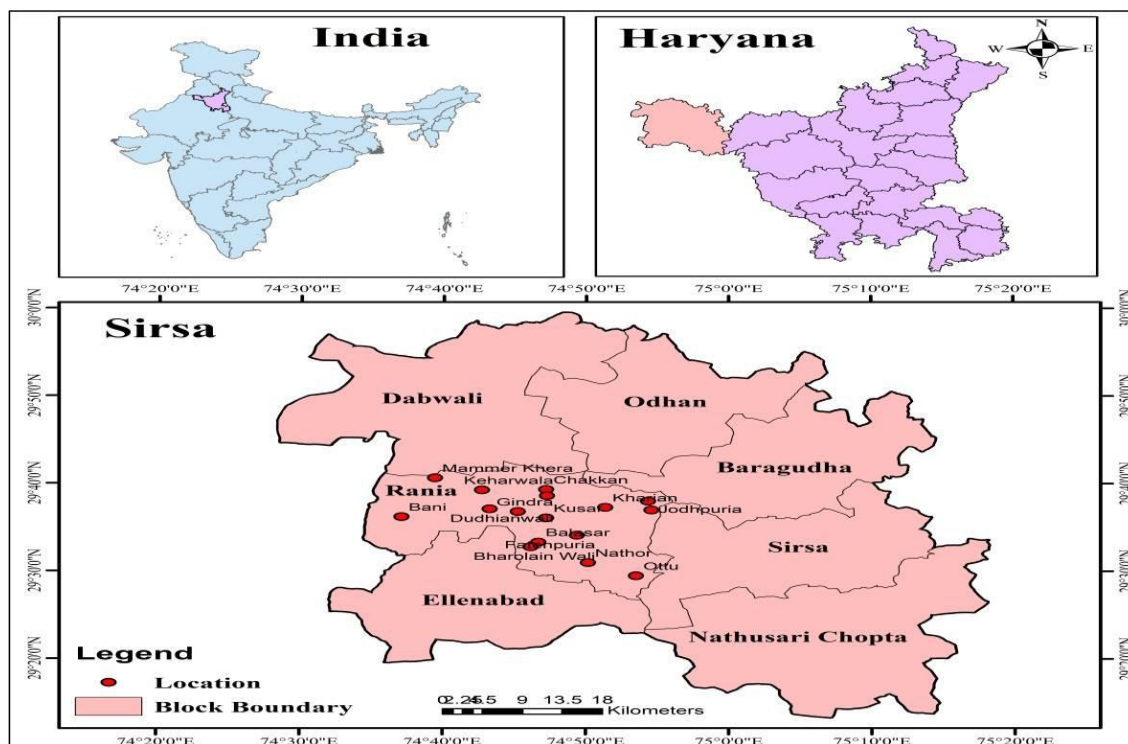


Fig 1: Show map

Krishi Vigyan Kendra has a soil and water testing laboratory where a large number of samples are received throughout the year. The record of farmer name village name block and depth of tube well is maintained. Out of these samples, about 180 samples received during three consecutive years 2020-21, 2021-22 and 2022-23 of various villages of Rania block were picked and analysed for various physiochemical properties *viz.* EC, pH, anions (CO_3^{2-} , HCO_3^- , Cl^- and SO_4^{2-}) and cations (Ca^{2+} , Mg^{2+} , Na^+ and K^+). To categorise quality of ground water, SAR and RSC were calculated using following formulae. The formula for calculating the sodium adsorption ratio (SAR) is:

$$SAR = \frac{[Na^+]}{\left\{ \frac{([Ca^{2+}] + [Mg^{2+}])}{2} \right\}^{1/2}}$$

Likewise,

$$RSC (\text{meL}^{-1}) = (\text{CO}_3^{2-} + \text{HCO}_3^-) - (\text{Ca}^{2+} + \text{Mg}^{2+})$$

Based on EC, SAR and RSC, water samples were classified in to different categories as per the classification of All India Coordinated Research Project on Management of Salt-affected Soils and Use of saline Water in Agriculture. (AICRP, 1989) [1].

Results and Discussion

Water samples were analysed for pH, EC, anions, cations and subsequently RSC and SAR were calculated.

Table 1: Range and mean of water quality parameters of Rania block of Sirsa district

Quality parameter	Range	Mean
EC (dS m^{-1})	0.3-16.0	3.88
pH	7.4-8.6	7.7
HCO_3^- (me l^{-1})	1-8.3	4.38
Cl^- (me l^{-1})	1-75.2	17.75
$\text{Ca}^{2+} + \text{Mg}^{2+}$ (me l^{-1})	0.6-39.9	11.55
RSC (me l^{-1})	0.01-4.6	2.39
Ca^{2+} (me l^{-1})	0.20-13.30	3.85
Na^+ (me l^{-1})	0.90-160	27.83
SAR (mmol l^{-1}) ^{1/2}	0.75-49.27	9.93

- Electrical Conductivity:** In the block Rania, the values of EC at different locations ranged from 0.3 dS m^{-1} to 16.0 dS m^{-1} with mean values of 3.88 dS m^{-1} . The lowest EC was noted in the village Kharian whereas higher EC values were found in the village Mehna Khera. Lowest EC in the village Kharia is due to location of tubewell on the river side and higher EC in the village Mehna Khera is due to location of the sampling site away from tubewell or seasonal river. Observed that electrical

conductivity in the parts of block Badagudha was comparatively lower in the parts which were lying adjoining to Ghaggar River. Out of all the samples, 44.62 per cent of the samples were in the range of 0 to 2 dSm⁻¹, 20.66 per cent were in the range 2-4 dSm⁻¹, 19 per cent samples in the range 4-8 dSm⁻¹, 14.87 per cent samples were observed in between the range 8-12 dSm⁻¹ where as in 10 per cent samples EC was more than 12 dSm⁻¹. Jakhar *et al.* (2017) [9] while characterising ground water samples of district Sirsa, found that 38, 28 and 25% water samples had an EC of 0.2-2.0, 2.1-4.0 and 4.1-8.0 dSm⁻¹, respectively and only 0.82 per cent samples during different years showed very high EC above 12 dSm⁻¹.

- **pH:** pH of the water samples collected ranged from 7.4 to 8.6 with a mean value of 7.7. The highest pH was found in the village Abholi whereas lowest pH was found in the village Dudhyainwali. Recorded lowest pH (6.48) in the village Gagli Panchanki and highest pH (9.5) in the village Agwanpur while accessing ground water quality in Palwal block of Palwal district in Haryana.
- **Cations and Anions:** Among the cations, among all the cations Na⁺ was the dominant cation, mean values ranging from 0.90-160 (me l⁻¹) under different EC ranges. Na⁺ was found lowest in the village Atth burji and highest in the village Gobind pura. The values of Ca²⁺ ranged from 0.3-43.0 (me l⁻¹) with a mean value of 3.23 (me l⁻¹). Ca²⁺ was found lowest in the village Kharian and highest in the village Mehna khera. Similar trend was observed in case of Mg²⁺ and the lowest and highest values were found in the villages Jhorarnali and Madhosinghana respectively. Among the anions

HCO₃²⁻, Cl⁻ and CO₃⁻ were prominent in all the samples. HCO₃²⁻ ranged 0.5 to 14.2 (me l⁻¹) with a mean value of 4.42 (me l⁻¹). The highest value of HCO₃²⁻ was noticed in the village Bhuna whereas lowest value was noticed in the village Sainpal. The mean values of CO₃²⁻ and Cl⁻ were 17.75 (me l⁻¹) respectively. These results are in line with finding of Kumar *et al.* (2020) who characterised ground water quality of Badagudha block in Sirsa district and based on Cations and Anions concentration in Badagudha Blocka of Sirsa district in Haryana.

- **RSC:** RSC of the samples received ranged from 0.01 to 4.6 (me l⁻¹) with a mean value of 2.3 (me l⁻¹). The RSC levels lower than 1.25 (me l⁻¹) are considered as safe but as the level increases it needs good irrigation management practices. Table 2 shows that mean RSC in the samples having EC range of 0-2 dSm⁻¹ was 1.82 (me l⁻¹) and in the EC range 2-4 dSm⁻¹, the respective RSC is 0.56 (me l⁻¹). However, no RSC was noticed in EC range above 2-4 dSm⁻¹. Lowest RSC values were recorded in the village Bahia 0.01 (me l⁻¹) and highest value was recorded in the village Abholi.
- **SAR:** SAR is a measure of suitability of water for use in agricultural purposes. In the present study, as evident in the table 2, SAR values ranged 0.75 (m mol l⁻¹)^{1/2} in the EC range 0-2 dSm⁻¹ to 49.27 (m mol l⁻¹)^{1/2} in the EC range more than 12 dSm⁻¹. The lowest SAR was found in the village Kharia and highest in the village Ghoranwali. Singh and Kumar (2023) [17] while assessing quality of underground irrigation water in western Rajasthan found that SAR of underground irrigation water was recorded from Nagaur district, 8.5 minimum and 22.7 maximum with an average value of 15.05.

Table 2: Chemical composition of ground water samples of Rania block

EC (dSm ⁻¹)	Percentage of Samples	HCO ₃ (me l ⁻¹)	Cl ⁻ (me l ⁻¹)	Ca ²⁺ +Mg ⁺⁺ (me l ⁻¹)	RSC (me l ⁻¹)	Ca ²⁺ (me l ⁻¹)	Na ⁺ (me l ⁻¹)	SAR (mmol l ⁻¹) ^{1/2}
0-2	44.62	4.22	4.41	2.94	1.82	0.98	3.26	2.65
2-4	20.66	4.78	13.71	7.52	0.56	2.51	13.0	6.73
4-8	19	4.27	29.42	17.93	0.00	5.98	44.19	14.77
8-12	14.87	4.39	43.72	32.41	0.00	10.65	91.73	22.60
>12	0.82	5.00	64.60	37.40	0.00	12.74	160	36.78

The mean chemical composition related to different values of quality parameters have been presented in Table 2. Of all the samples analysed, highest samples were found in the EC range 0-2 d Sm⁻¹ whereas lowest no of samples were found where EC was more than 12.0 dSm⁻¹. More number of

samples in the range of 0-2 dSm⁻¹ suggests that half of samples received were suitable for all the crops depending on soil types and rainfall received. The per cent of samples in the range 2-4, 4-8 and 8-12 were 23, 20 and 5.91 per cent respectively.

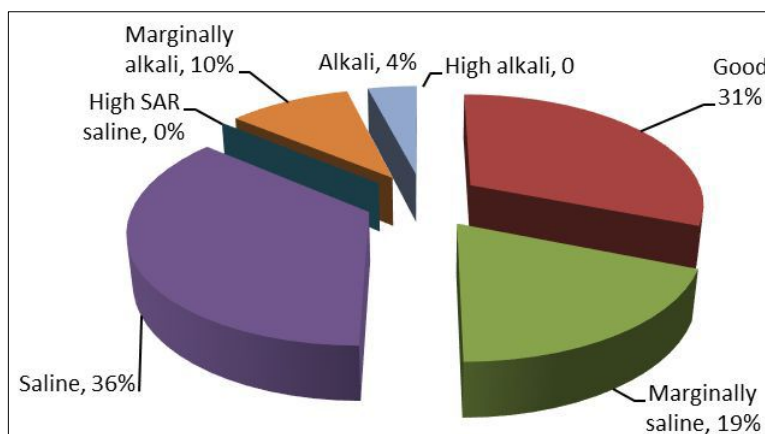


Fig 2: Water quality: mostly saline, good, and marginally saline.

Conclusion

From the study, it may be concluded that in Rania block of Sirsa district 31 per cent water was in the good category in which almost all the crops can be grown. 36 per cent water is saline which should be used in combination with canal water in cyclic mode. 19 per cent water is saline, 4 per cent water is alkali and there is need to neutralise it with gypsum application. 10 per cent of the water is marginally alkali which can cause problem in the soils where silt and loam content are more. No water was found in high alkali and high SAR saline class.

References

1. AICRP. Progress Report (1988-1991). All India Coordinated Research Project on Management of Salt Affected Soils and Use of Saline Water in Agriculture. Central Soil Salinity Research Institute, 1989.
2. Alotaibi BA, Baig MB, Najim MM, Shah AA, Alamri YA. Water scarcity management to ensure food security through sustainable water resources management in Saudi Arabia. *Sustainability*. 2023;15(13):10648.
3. Asadi SS, Jafari A, Rahnemaei M. Freshwater resources management: A review of current practices and challenges. *J Water Resour Manag*. 2020;34(1):45-67.
4. FAO. The irrigation challenge: Increasing irrigation contribution to food security through higher water productivity from canal irrigation system. IPTRID Issue Paper 4. Rome: Food and Agriculture Organization of the United Nations, 2003.
5. FAO. Water quality for agriculture. Rome: Food and Agriculture Organization of the United Nations, 1994.
6. Gleick PH. Basic water requirements for human activities: meeting basic needs. *Water Int*. 1996;21(2):83-92.
7. Ground water quality assessment for irrigation in Palwal block of Palwal district, Haryana, India. *J Appl Nat Sci*. 2019;9(1):34-38.
8. Hashmi S, Ahmed J, Siddiqui FI. Analysis of the contribution of agriculture sector in the economic growth of India. *Asian J Agric Econ*. 2009;2(1):1-14.
9. Jakhar DS, Lathwal OP, Kumar D, Lohan SC. An overview of ground water quality of Sirsa District in Haryana. *Annal of Agric Bio Res*. 2017;22:39-42.
10. Khodapanah L, Sulaiman WNA, Khodapanah N. Groundwater quality assessment for different purposes in Eshtehard District, Tehran, Iran. *Eur J Sci Res*. 2009;36(4):543-553.
11. Krishnakumar K, Lakshmanan E, Kannan R, Senthilkumar M. Hydrogeochemistry and groundwater quality assessment in lower part of Ponnaiyar River basin, Cuddalore district, Tamil Nadu, India. *Appl Water Sci*. 2014;4(1):31-47.
12. Kumar A, Tripathi RM, Rout S, Mishra MK, Ravi PM, Ghosh AK. Characterization of groundwater composition in Punjab state with special emphasis on uranium content, speciation and mobility. *Radiochim Acta*. 2014;102(3):239-254.
13. Qadir M, Sharma BR, Bruggeman A, Choukr-Allah R, Karajeh F. Non-conventional water resources and opportunities for water augmentation to achieve food security in water scarce countries. *Agric Water Manag*. 2007;87(1):2-22.
14. Rehman A, Hussain I. Agricultural and economic development in Pakistan and its comparison with China, India, Japan, Russia and Bangladesh. *Andamios*. 2016;12(1):180-188.
15. Shah T, Molden D, Sakthivadivel R, Seckler D. The global groundwater situation: Overview of opportunity and challenges. IWMI, 2000. Available from: <http://publications.iwmi.org/pdf/H025885.pdf>. Accessed 20 Jun 2016.
16. Shah T, Scott CA, Kishore A, Sharma A, Singh O. Groundwater overdraft reduction through agricultural energy policy: Insights from India and Mexico. *Nat Resour Forum*. 2000;24(1):45-53.
17. Singh P, Sharma KK. Poor quality of underground irrigation water: In western Rajasthan, India. *Farma Innov J*. 2023;12(2):1629-1634.
18. Vasanthavigar M, Srinivasamoorthy K, Rajiv RG, Vijayaraghavan K, Sarma VS. Characterisation and quality assessment of groundwater with a special emphasis on irrigation utility: Thirumanimuttar sub-basin, Tamil Nadu, India. *Arab J Geosci*. 2012;5:245-258.
19. Venkateswaran S, VEDIAPPAN S. Assessment of groundwater quality for irrigation use and evaluation of feasible zones through geospatial technology in lower Bhavani sub-basin, Cauvery river, Tamil Nadu, India. *Int J Innov Technol Explor Eng*. 2013;3(2):180-187.