Biological Forum – An International Journal **15(8): 478-481(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Hydro-chemical Assessment of Groundwater Quality in Part of Jodhpur District, Rajasthan India

Shankar Lal Bijarnia[1]*, Ranjeet Singh[2], A.S. Godara[3], R.K. Jakhar[4], Harish Kumar Bijarnia[5] and Arun Pratap Singh[5]

[1]Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, SKRAU (Rajasthan), India.
[2]Associate Professor, Department of Soil Science and Agricultural Chemistry, SKRAU (Rajasthan), India.
[3]Associate Professor, Department of Agronomy, SKRAU, Bikaner (Rajasthan), India.
[4]Assistant Professor, Department of Soil Science and Agricultural Chemistry, SKRAU (Rajasthan), India.
[5]Ph.D. Scholar, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan), India.

(Corresponding author: Shankar Lal Bijarnia)*
(Received: 09 June 2023; Revised: 24 June 2023; Accepted: 28 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: Underground water is one of the most important resources for plant growth and development. Determination underground water quality is important tool observe the suitability of water for use a particular area. An investigation was carried out to assessment of hydro-chemical properties of underground water quality in part of Jodhpur district, Rajasthan and 182 sites from 88 villages of 6 tehsils of south eastern part of district were collected during December 2021 and analysed for hydro chemical behavior. Among different cations, the order of dominance of different cations was Na^+, Mg^{2+}, Ca^{2+} and K^+ and average content of these cations was 27.89, 9.05, 5.45 and 0.31 me L^{-1}, respectively. The mean anion content of south part of Jodhpur was 24.51, 12.14, 5.28 and 1.26 for Cl^-, HCO_3^-, SO_4^{-2} and CO_3^{-2}, respectively. Mostly water quality parameter like good, marginally saline and high SAR saline depends on theses cation and anion ion.

Keywords: Underground water, Cations, Anions, Jodhpur region.

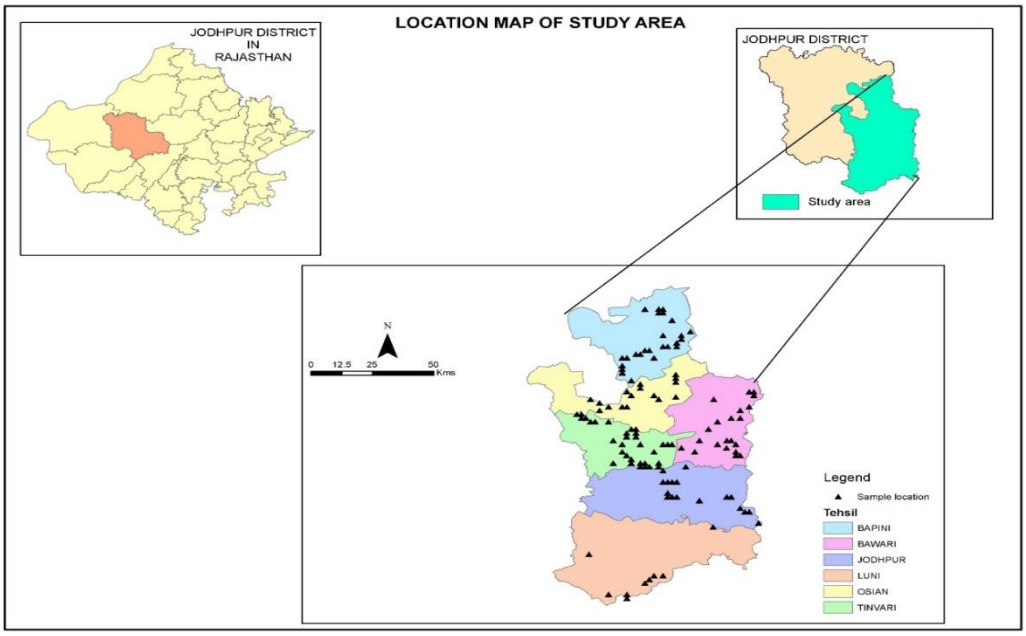
INTRODUCTION

The nature and concentration of salts in irrigation water determine its quality. The nature of the salts in irrigation water may be more important than the total amount of salts in some cases; for example, if the proportion of sodium in irrigation water is excessive, the soils may eventually become unproductive. Water with a high concentration of soluble salts is inappropriate for irrigation. If sodium is the dominant ion, the physical characteristics of the soil worsen, causing soil deflocculation, reduced infiltration rate and poor aeration. On the other hand, the presence of excess ions (cations and anions) raises the osmotic pressure of soil solution, thereby causing a disturbance in the mechanism of water and nutrient uptake of plants. Based on chemical analysis, if required safe guards in water and soil management are implemented, even water of questionable quality can be used without causing major damage to soils and crops (Thorne and Thorne 1954). A chemical analysis of water is required to make an appropriate decision about the irrigation water quality.

At global level, out of the total 810 mha salt affected soils, 376 mha area comes under salinity and 434 mha area comes under sodicity. In India, 6.73 mha and in Rajasthan, 1.18 mha of land is affected by salinity and sodicity (Sharma *et al.*, 2014). The main contributing factors for soil salinization are the highly impregnated salty layer in the soil profile, saline ground water coupled with high water table, seepage from canals and other water bodies causing a rise in water table, restricted surface and subsurface drainage, irrigation with poor quality water and intrusion of sea- water into main land.

MATERIALS AND METHODS

Geo-reference done hundred eighty two water samples were collected from eighty eight villages of Bapini, Osian, Bawari, Tinvari, Jodhpur and Luni tehsils of south eastern part of Jodhpur district of Rajasthan during December, 2021 from the tube wells/open wells which were used for irrigating the fields. The collected samples for analysis were stored in clean, rinsed and properly labelled plastic bottles. Few drops of toluene were also be added to check the microbial growth. The water samples of the study area were analyzed for cation (Ca^{2+}, Mg^{2+}, Na^+, and K^+) and anion (CO_3^{2-}, HCO_3^-, Cl^- and SO_4^{2-}) content. Statistical analysis was carried out with standard methods as given by Snedecor and Cochran (1967).



Map 1. Showing soil samples collected areas.

RESULT AND DISCUSSION

A. Cation composition of underground water

The data presented in Table 1 revealed that the tehsil wise cations - Ca^{2+}, Mg^{2+}, Na^{+} and K^{+} of underground water for irrigation ranged between 0.41 to 4.80, 0.67 to 7.32, 1.85 to 20.99 and 0.01 to 0.21 with the average values of 2.21, 3.47, 10.41 and 0.09 in Bapini, 0.45 to 13.10, 0.70 to 20.05, 2.15 to 64.35 and 0.01 to 0.72 with the mean values of 4.94, 7.95, 24.28 and 0.21 in Bawari, 0.35 to 21.05, 0.63 to 34.21, 1.63 to 112.63 and 0.02 to 0.56 with the mean values of 8.06, 12.17, 38.86 and 0.23 in Jodhpur, 5.18 to 64.61 , 9.63 to 81.67, 31.43 to 256.87 and 0.30 to 7.61 with the average values of 19.17, 27.80, 84.99 and 1.31 in Luni, 1.45 to 7.20,2.35 to 11.8, 7.18 to 35.37 and 0.08-2.00 with the average values of 3.08, 5.18, 15.77 and 0.22 in Osian, 0.35 to 8.75, 0.60 to 11.64, 2.00 to 39.94 and 0.02 to 0.31 with the average values of 2.60, 3.93, 12.02 and 0.13 me L^{-1} in Tinvari tehsils, respectively. The cations in underground water for irrigation of south-eastern part of Jodhpur district as a whole was varied from 0.35 to 64.61, 0.60 to 81.67, 1.63 to 256.87 and 0.01 to 7.61 with the average values of 5.95, 9.05, 27.89, 0.31 me L^{-1}, respectively.

Among tehsils, the average values of calcium were observed in order of 2.21 < 2.60 < 3.08 < 4.94 < 8.06 < 19.17 me L^{-1} in Bapini, Tinvari, Osian, Bawari, Jodhpur and Luni tehsils, respectively. The mean values of magnesium were recorded in the order of 3.47< 3.93< 5.18<7.95< 12.17<27.80 me L^{-1} in Bapini followed by Tinvari, Osian, Bawari, Jodhpur and Luni tehsils, respectively.

In case of sodium, the mean values were recorded in order of 10.41< 12.02 < 15.77< 24.28< 38.86< 84.99 me L^{-1} in underground water for irrigation of Bapini, Tinvari, Osian, Bawari, Jodhpur and Luni tehsils, respectively. The mean values of potassium were observed in order of 0.09 < 0.13 < 0.21 < 0.22 < 0.23 < 1.31 me L^{-1} in Bapini, Tinvari, Bawari, Osian, Jodhpur and Luni tehsils, respectively.

In general, sodium was found dominant cation followed by magnesium, calcium and potassium. The results of present investigation were in close conformity with the findings of Singh (2006); Kumar *et al.* (2016); Serawat (2021); Choudhary *et al.* (2022).

B. Anion composition of underground water

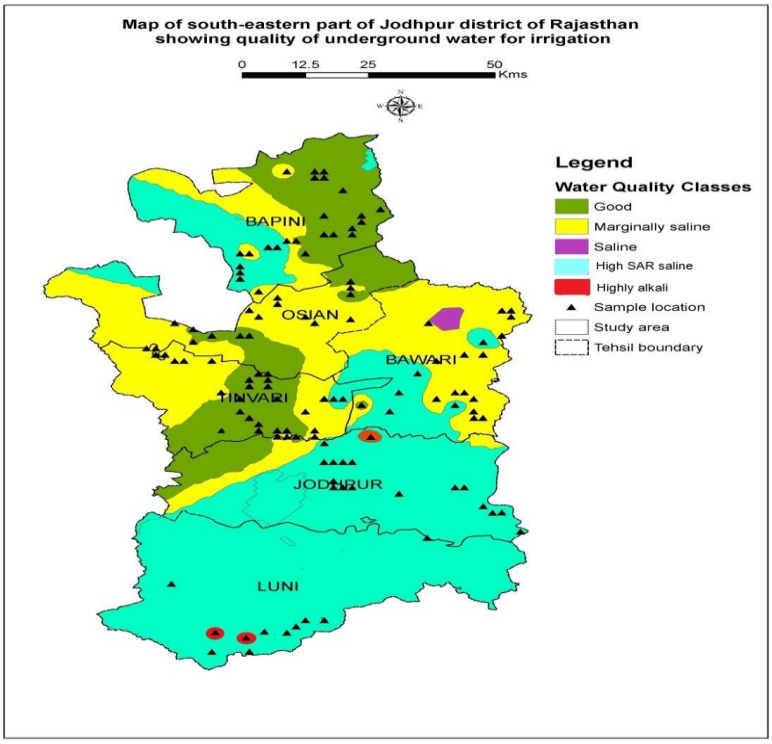
Further, on the visualization of data (Table 1) revealed that the anions CO_3^{2-}, HCO_3^{-}, Cl^{-} and SO_4^{2-} in these underground water for irrigation were ranged between trace to 1.80, 0.72 to 10.25, 1.68 to17.63 and 0.05 to 3.61 with the mean values of 0.32, 4.67, 9.30 and 1.90 in Bapini, trace to 10.00, 0.75 to 30.00, 1.75 to 53.65 and 0.71 to 8.20 with the average values of 1.27, 11.25, 21.50 and 3.30 in Bawari, trace to 3.56, 0.88 to 46.03, 1.50 to 98.00 and 0.20 to 22.00 with the average values of 0.50, 16.91, 33.57 and 8.32 in Jodhpur, 1.10 to 24.60, 16.75 to 137.00, 22.50 to 240.60 and 6.21 to 54.63 with the mean values of 5.89, 34.20, 75.06 and 18.11 in Luni, trace to 3.00, 3.95 to 16.35, 6.44 to 30.65 and 0.68 to 6.95 with the mean values of 0.63, 7.46, 13.68 and 2.47 in Osian, trace to 2.00, 0.75 to 19.10, 1.70 to 36.37 and 0.32 to 3.72 with the mean values of 0.47, 5.81, 10.76 and 1.66 me L^{-1} in Tinvari tehsils, respectively. The anions in underground water of south-eastern part of Jodhpur district as a whole were ranged between trace to 24.60, 0.72 to 137.00, 1.50 to 240.60, 0.05 to 54.63 with the average values of 1.27, 12.14, 24.51 and 5.28 me L^{-1}, respectively.

Tehsil wise, the average values of carbonate were recorded in order of 5.89 > 1.27> 0.63 > 0.50 > 0.47 > 0.32 me L^{-1} in Luni, Bawari, Osian, Jodhpur, Tinvari and Bapini tehsils, respectively. The mean values of bicarbonate were observed in order of 34.20 > 16.91 > 11.25 > 7.46 > 5.81 > 4.67 me L^{-1} in Luni, Jodhpur, Bawari, Osian, Tinvari and Bapini tehsils, respectively.

The mean values of chloride were noted in order of 75.06 > 33.57 > 21.50 > 13.68 >10.76 > 9.30 me L^{-1} in Luni, Jodhpur, Bawari, Osian, Tinvari and Bapini tehsils, respectively. In case of sulphate, average values

were found in order of 18.11 > 8.32 > 3.30 > 2.47 > 1.90 > 1.66 me L^{-1} in Luni, Jodhpur, Bawari, Osian, Bapini and Tinvari tehsils, respectively.

Chloride was observed as dominant anion in underground water for irrigation in south-eastern part of Jodhpur district followed by bicarbonate, sulphate and carbonate. Similar results were also reported by Narsimha *et al.* (2013); Kumar *et al.* (2017); Dhaka *et al.* (2022).



Map 2: Showing quality of underground water for irrigation.

Table 1: Cation composition of underground water for irrigation of south-eastern part of Jodhpur district of Rajasthan.

Tehsils/District	Ions (me L^{-1})			
	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}
Bapini				
Range	0.41-4.80	0.67-7.32	1.85-20.99	0.01-0.21
Mean	2.21	3.47	10.41	0.09
C.V.	53.66	55.57	53.21	57.58
Bawari				
Range	0.45-13.10	0.70-20.05	2.15-64.35	0.01-0.72
Mean	4.94	7.95	24.28	0.21
C.V.	66.92	62.68	61.75	85.30
Jodhpur				
Range	0.35-21.05	0.63-34.21	1.63-112.63	0.02-0.56
Mean	8.06	12.17	38.86	0.23
C.V.	77.11	74.19	78.55	65.23
Luni				
Range	5.18-64.61	9.63-81.67	31.43-256.87	0.30-7.61
Mean	19.17	27.80	84.99	1.31
C.V.	81.55	70.27	68.64	146.99
Osian				
Range	1.45-7.20	2.35-11.8	7.18-35.37	0.08-2.00
Mean	3.08	5.18	15.77	0.22
C.V.	45.17	45.61	43.34	152.22
Tinvari				
Range	0.35-8.75	0.60-11.64	2.00-39.94	0.02-0.31
Mean	2.60	3.93	12.02	0.13
C.V.	71.75	66.15	68.11	63.35
South-eastern part of Jodhpur district as a whole				
Range	0.35-64.61	0.60-81.67	1.63-256.87	0.01-7.61
Mean	5.95	9.05	27.89	0.31
C.V.	138.10	123.58	123.35	253.54

Table 2: Anion composition of underground water for irrigation of south-eastern part of Jodhpur district of Rajasthan.

Tehsils/District	Ions (me L^{-1})			
	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}
Bapini				
Range	Trace -1.80	0.72-10.25	1.68-17.63	0.05-3.61
Mean	0.32	4.67	9.30	1.90
C.V.	137.67	55.20	53.44	54.15
Bawari				
Range	Trace-10.00	0.75-30.00	1.75-53.65	0.71-8.20
Mean	1.27	11.25	21.50	3.30
C.V.	152.64	62.83	61.36	63.23
Jodhpur				
Range	Trace-3.56	0.88-46.03	1.50-98.00	0.20-22.00
Mean	0.50	16.91	33.57	8.32
C.V.	161.71	78.07	76.37	80.59
Luni				
Range	1.10-24.60	16.75-137.00	22.50-240.60	6.21-54.63
Mean	5.89	34.20	75.06	18.11
C.V.	78.30	84.43	68.89	71.96
Osian				
Range	Trace-3.00	3.95-16.35	6.44-30.65	0.68-6.95
Mean	0.63	7.46	13.68	2.47
C.V.	128.44	36.43	43.88	56.57
Tinvari				
Range	Trace-2.00	0.75-19.1	1.70-36.37	0.32-3.72
Mean	0.47	5.81	10.76	1.66
C.V.	113.10	70.91	69.29	50.70
South-eastern part of Jodhpur district as a whole				
Range	Trace-24.60	0.72-137.00	1.50-240.60	0.05-54.63
Mean	1.26	12.14	24.51	5.28
C.V.	202.87	124.85	123.11	144.06

CONCLUSIONS

In various degrees, all of the water contains dissolved salts. When salts dissolve in water, they are divided into ions (cations and anions). In irrigation water, the main cations are calcium, magnesium, sodium, and potassium, and its anions are carbonate, bicarbonate, chloride, and sulphate. In general, sodium was found to be the most abundant cation in all irrigation water samples in the south-eastern parts of Jodhpur, followed by magnesium, calcium, and potassium. Chloride was shown to be the leading anion among anions, followed by bicarbonate, sulphate, and carbonate.

Acknowledgement. The specially thankful to my Advisor Committee of Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan for providing funding to carry out during Ph. D, Research.

Conflict of Interest. None.

REFERENCES

Choudhary, K., Sharma, Y. and Singh, R. (2022). Delineate the quality of underground water for irrigation of north-western part of Pali district of Rajasthan. *Annals of Agricultural Research*, *43*(3), 353-358.

Dhaka, S., Singh, R., Chanwla, C., Serawat, A. and Kant, R. (2022). Characterization and Quality Assessment of Ground Waters of Marwar Junction and Rani tehsils of Pali, Rajasthan. *Journal of Soil Salinity and Water Quality*, *14*(1), 1-5.

Kumar, S. K., Babu, S. H., Rao, P. E., Selvakumar, S., Thivya, C., Muralidharan, S. and Jeyabal, G. (2016). Evaluation of water quality and hydrogeochemistry of surface and ground water, Tiruvallur district, Tamil Nadu, India. *Applied Water Science*, *7*, 2533-2544.

Kumar, V., Yadav, P. K., Tikkoo, A., Jat, M. K. and Yadav, S. S. (2017). Survey and characterization of ground water quality in Rewari block of district Rewari, Haryana. *International Journal of Chemical Studies*, *5*(5), 2070-2074.

Narsimha, A., Sudarshan, V. and Swathi, P. (2013). Ground water and its assessment for irrigation purpose in Hanma konda area, Warangal district, Andhra Pradesh, India. *International Journal of Research in Chemistry and Environment*, *3*, 196-200.

Serawat, A. (2021). Evaluation of ground water quality and its effect on soil properties of north-western part of Jodhpur district of Rajasthan. *Ph.D. Thesis*, Swami Keshwanand Rajasthan Agricultural University, Bikaner.

Sharma, D.A., Rishi, M.S. and Keesari, T. (2017). Evaluation of ground water quality and suitability for irrigation and drinking purposes in southwest Punjab, India using hydrochemical approach. Applied Water Science, *7*, 3137–3150.

Singh, R. (2006). Appraisal of salinity, sodicity and fertility indices of soils in relation to irrigation water quality of Bikaner district of Rajasthan. *Ph.D. Thesis*, Rajasthan Agricultural University, Bikaner.

Snedecor, G. W. and Cochran, W. G. (1967). *Statistical methods applied to experiments in agriculture and biology*. 5th ed. Ames: Lowa State University Press.

Thorne, D. and Thorne, J. P. (1954). Change in composition of irrigated soils as related to the quality of irrigation water. *Proceedings of Soil Science Society of America*, *18*, 92-97.

How to cite this article: Shankar Lal Bijarnia, Ranjeet Singh, A.S. Godara, R.K. Jakhar, Harish Kumar Bijarnia and Arun Pratap Singh (2023). Hydro-chemical Assessment of Groundwater Quality in Part of Jodhpur District, Rajasthan India. *Biological Forum – An International Journal*, *15*(8): 478-481.